

DEC.
1925

35
CENTS

RADIO BROADCAST



New Experiments for Home Radio Laboratories
How to Use the New Vacuum Tubes

THE NEW BROWNING
DRAKE RECEIVER

HOW METERS CAN
IMPROVE YOUR SET

Doubleday, Page & Co., Garden City, New York

TYPES C-301-A C-299

C-300 C-11 C-12

In the
ORANGE and
BLUE CARTON
PRICE
\$2.50
EACH



Quality Detected ~ Service Amplified
by

Cunningham RADIO TUBES

Since 1915 Standard for All Sets

PEAK SATISFACTION
in detection, amplification and rugged long life are factors that have marked the radio tubes bearing the Cunningham name.

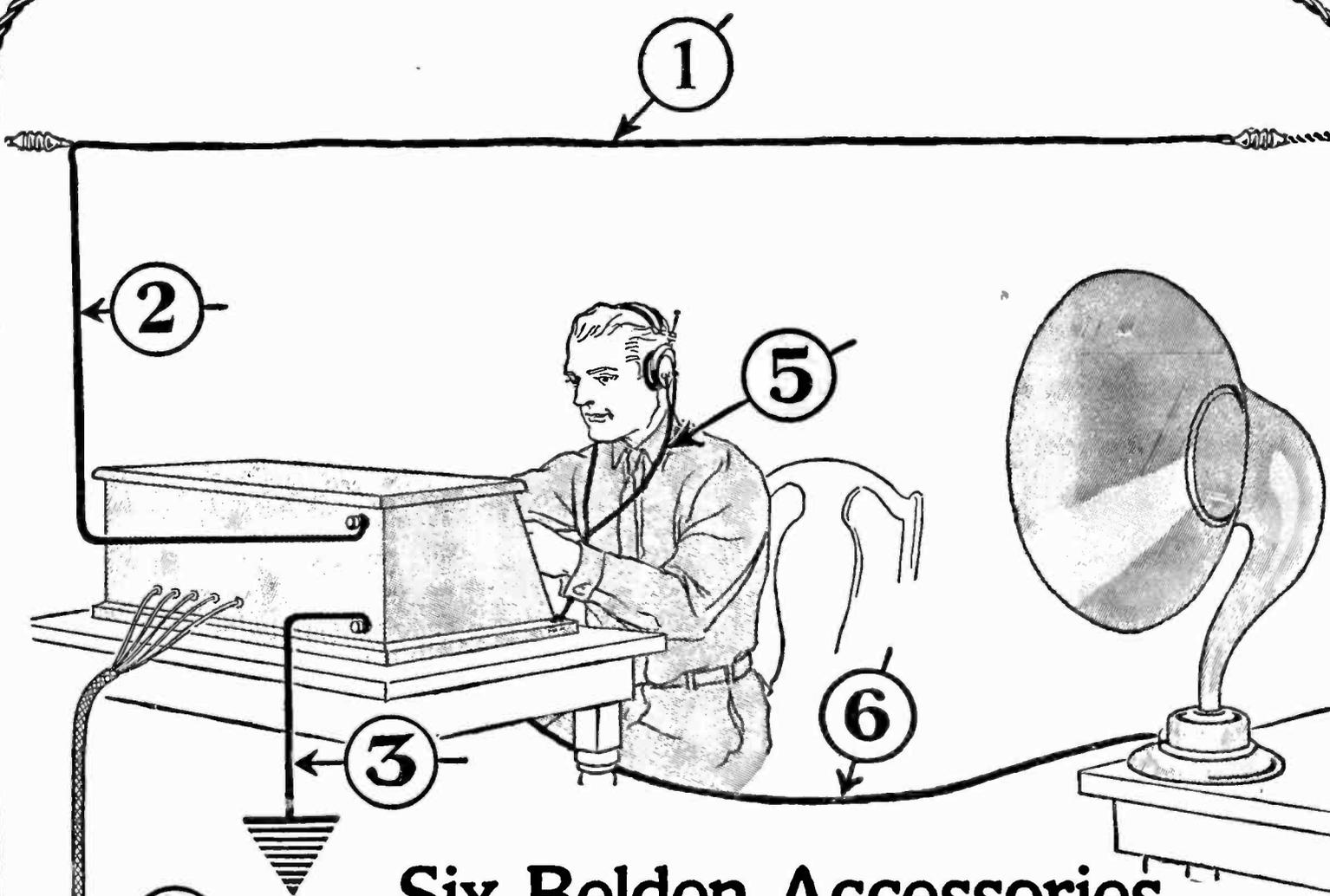
You want real music, true tone clarity and utmost sensitivity from your radio set. Cunningham Radio Tubes—gleaming and glowing in every socket—are the secret in your obtaining the utmost in broadcast reception.

E. J. Cunningham Inc.

Home Office: 182 Second Street
SAN FRANCISCO

CHICAGO
NEW YORK

★ Tested and approved by RADIO BROADCAST ★



Six Belden Accessories that improve every radio set!

TUBES and batteries are not the only accessories that must be selected with care. Think of the aerial! A poor aerial will cripple your entire set, no matter how fine the set is. That's why you should always specify a Beldenamel Aerial, the aerial that lasts indefinitely.

And a Belden Radio Battery Cord makes a neat installation. It takes the place of a tangle of messy wires that frequently short-circuit and blow out tubes. And for ground wires, extension cords, receiver cords, and many other essential items, be sure to specify Belden. Every Belden product is distributed in a distinctive carton for your protection. An illustrated booklet, "Helpful Hints for Radio Fans" describes each product and its application. Send for it!

- 1 Beldenamel Aerial Wire, made of 7 copper strands, each coated with baked Beldenamel.
- 2 A continuation of No. 1 connecting aerial to set without joint.
- 3 Special Belden Ground Wire—Rubber covered.
- 4 The well-known 6-ft. Belden Battery Cord with five conductors enclosed in a brown braid.
- 5 Belden Headphone Cord
- 6 Belden 20-ft. Radio Extension Cord.

Mail the Coupon for Free Illustrated Booklet

★

Belden Radio

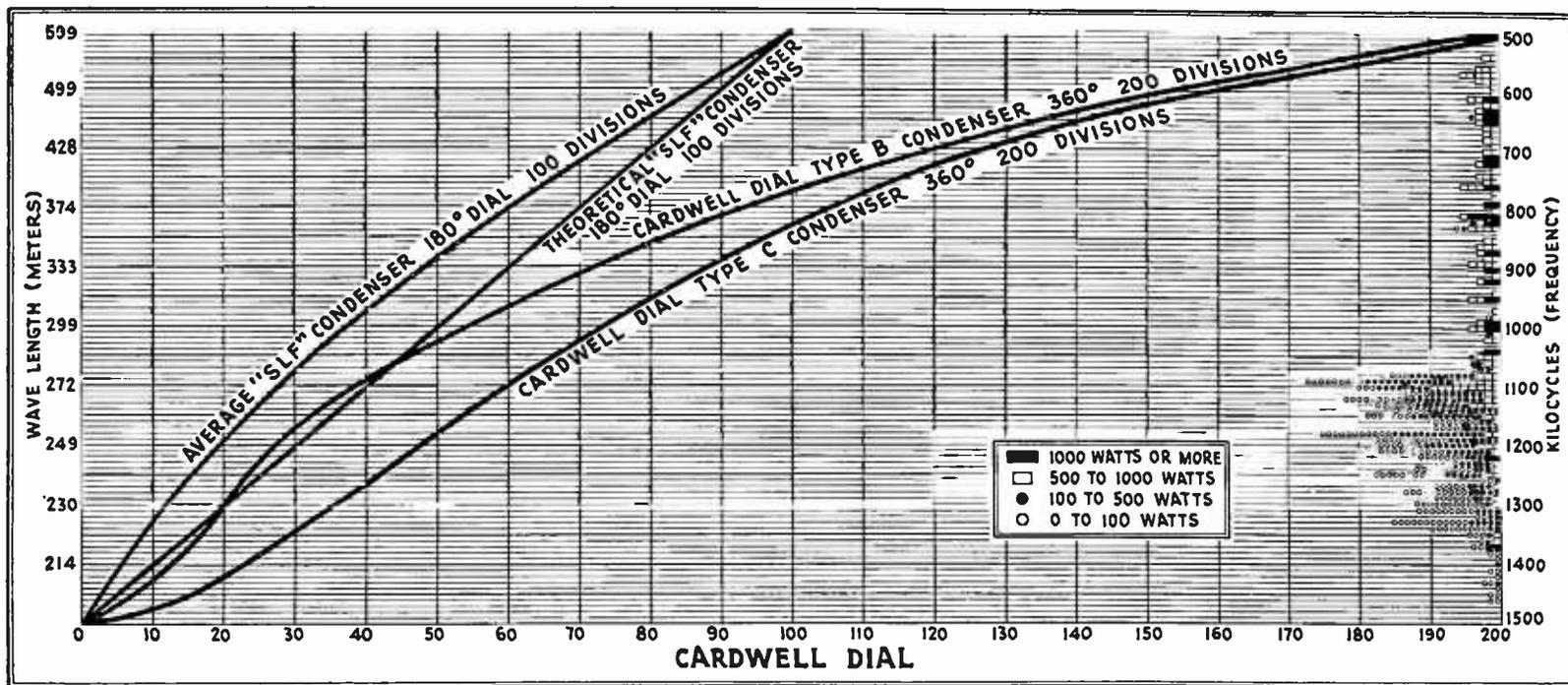
BELDEN MANUFACTURING CO.
2312G South Western Ave., Chicago

Please send me your booklet entitled "Helpful Hints for Radio Fans."

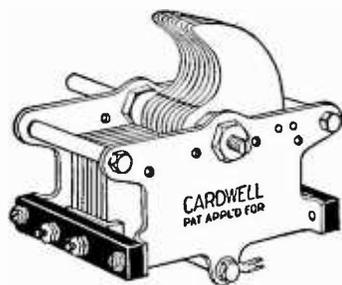
Name.....

Address.....

Belden

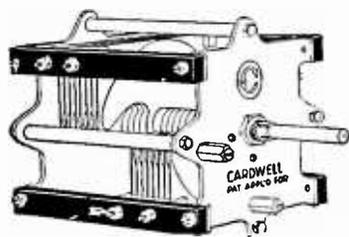


FROM "SLC" TO "SLF"



TYPE C

Max. Ct	Type No.	Plates	List Price
88	167C*	5	\$4.00
131	168C*	7	4.00
218	169C*	11	4.00
260	170C*	13	4.25
350	171C*	17	4.50
429	172C*	21	4.75
517	173C*	25	5.00
750	193C*	35	6.00



TYPE D

Max. Ct	Type No.	Plates	List Price
330†	217D*	34	\$8.00
240°	173D*	25	5.00
320°	174D*	33	5.50
340°	193D*	35	6.00
400°	194D*	41	6.50
440°	175D*	47	7.00

† MMF. *Specify "R" for clockwise, "L" for counter clockwise. (Add "V" to any type number for built-in vernier adding \$1.50 to list price of plain types.) † Dual, °Singles. Over 100 other types not listed.

A CONDENSER to possess real efficiency, must have negligible losses and retain its calibration at all times. These are cardinal virtues of Cardwells. That they were the original "low loss" type, suggests that they must be so excellent in all other respects that they are the final perfection in condenser art.

Because of their inherent efficiency, they are readily adaptable to straight-line design, which affords conveniences at the dial in logging. Thus, without resorting to peculiar looking construction, the Cardwell can be made in SLC, SLW, or SLF types without sacrificing basic advantages: extreme rigidity and constant calibration.

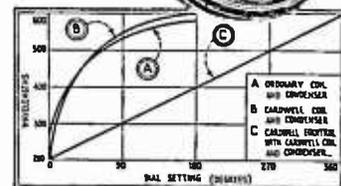
Note that Type B (SLC) is converted into SLW by using the Cardwell Equitrol dial. This is shown in terms of frequency above and in terms of wavelengths in the small graph. Type B is more "selective" than most SLF types. With the Equitrol, you have more dial visibility than with any 180° SLF condenser. Type C gives semi-SLW tuning. Type D is for SLF service—No. 217 being a dual, balanced type recommended for all TRF circuits.

Write for Booklet C-77

**THE ALLEN D. CARDWELL
MANUFACTURING CORPORATION ★**

81 Prospect St.

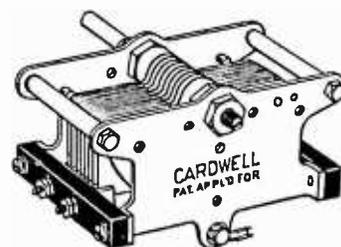
Brooklyn, N. Y.



EQUITROL DIAL

In the above graph note that "A" is the way the standard (SLC) condenser tunes with a 180° dial. "C" shows how this has been converted into SLW by the Equitrol and is spread over 360° of the dial. Space is provided for marking stations in upper window.

Equitrol your set. No need to take out old condensers and put in new ones. Equitrols give your receiver that professional appearance. They turn clockwise. With the Equitrol you have more dial visibility than with 180° "SLF" condensers. Sold singly: \$3.50; in sets of three, \$10.00.



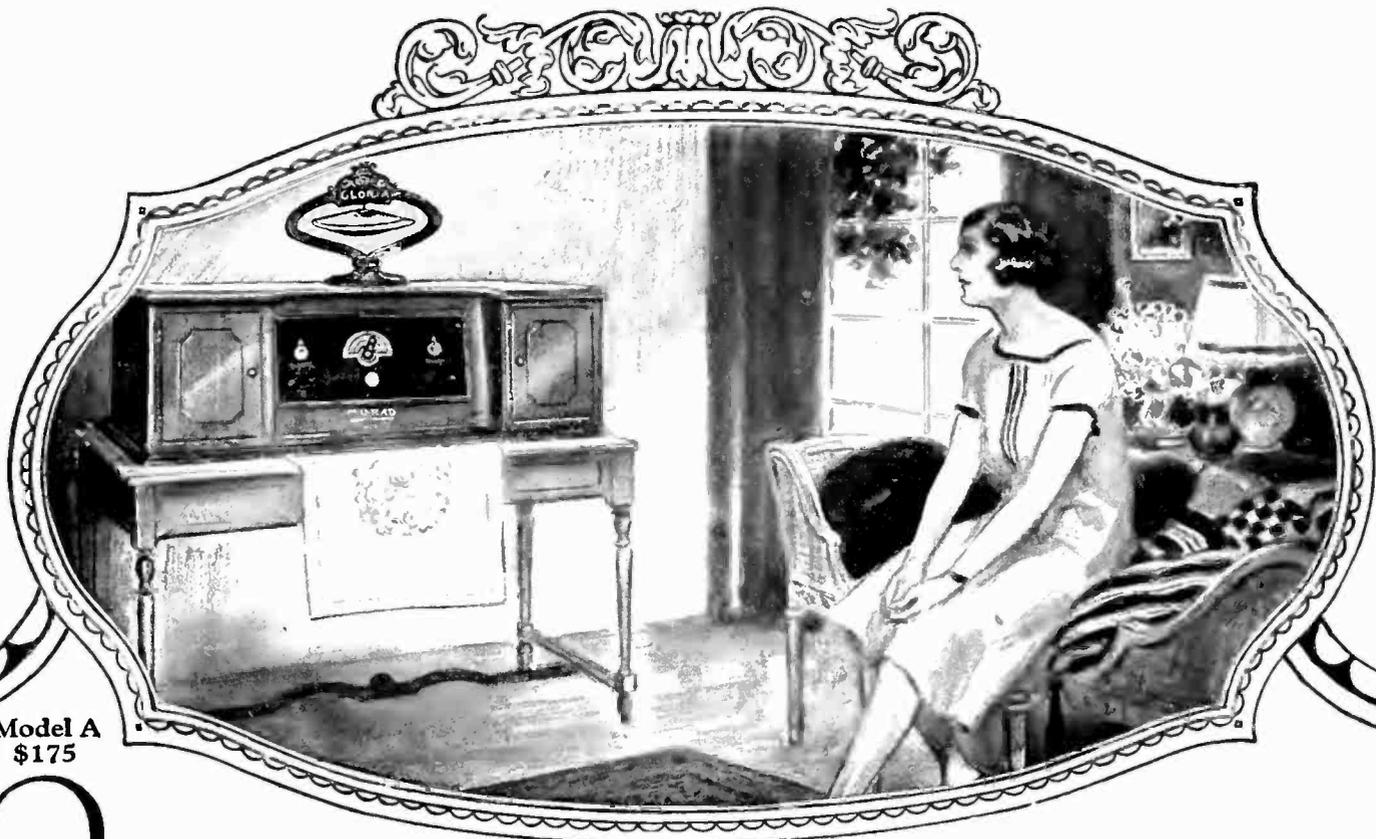
TYPE B

Max. Ct	Type No.	Plates	List Price
47	159B	3	\$4.00
98	188B	5	4.00
142	154B	7	4.00
240	141B	11	4.25
340	153B	15	4.50
380	152B	17	4.75
480	123B	21	5.00
954	137B	41	6.00

CARDWELL QUALITY

© RADIO PARTS ©

★ Tested and approved by RADIO BROADCAST ★



Model A
\$175

You Might as Well Have the Perfect Receiver

WHEN you buy your Radio there are two things you will want to consider; "Am I getting the BEST Radio I can possibly get at the price," and "Is the Radio I am buying of an ADVANCED design that guarantees the PERMANENCY of my investment?" Buy a MU-RAD and you are absolutely assured of getting a satisfactory answer to both of these questions.

One big feature of the MU-RAD, alone, THE ONE DIAL CONTROL, is sufficient reason for you to decide on this great Radio Receiver. Think of being able to bring in any station at will, clear and strong, with the simple turning of one knob! The MU-RAD is calibrated in wave lengths to make logging of stations doubly easy.

MU-RAD is far in advance of the times. It is the Radio you will eventually buy if you want the Best—and the Best is always the cheapest in the long run.

Ask your dealer to show you the MU-RAD Transcontinental Receiver.

The - ONE DIAL CONTROL - **MU-RAD** *Transcontinental Receiver*

5 Tubes
Sockets Fit
All New Tubes



Model B.
Price \$125



MU-RAD RADIO CORPORATION

Sales Office

972 BROAD ST., NEWARK, N. J.

Factory

ASBURY PARK, N. J.

Write Dept. E 4, for literature

Standard Bearers of an Ideal

BACK of every Ferguson Receiver—since the pioneer days of broadcasting—stands the Ferguson Ideal: "Fewer but Better" Receivers. Each is a precision-built Standard Bearer of this Ideal.

The owner of a Ferguson feels that well-founded pride of ownership which comes only with the possession of a true musical instrument of graceful dignity and charm, that will be a welcome addition to any home for years to come.

You can always count on a Ferguson. Hear one in a comparative test with others and you'll learn why it has been acclaimed "The Gold Standard of Radio Receivers."

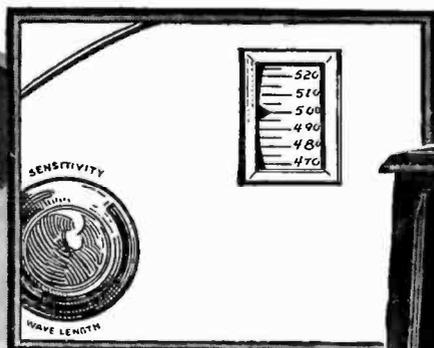
There could be no more fitting testimony of the true worth of Ferguson Receivers than the well-balanced growth of the Ferguson business; the ever-increasing number of Ferguson enthusiasts.

See and hear the Ferguson Model "Eight" at your Authorized Ferguson Dealer's.



J. B. FERGUSON, INC.

41 East 42nd Street • New York, N. Y.



One Tuning Control—
Calibrated in Meters!

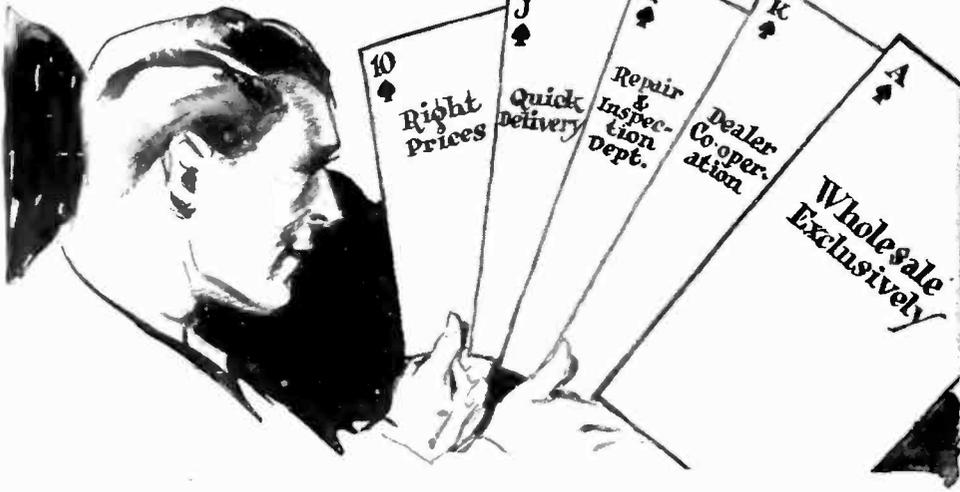


Just choose your program, turn to its wavelength, and in comes your station!

Ferguson

J.B. INCORPORATED
The Gold Standard of Radio Receivers

HOMMEL IS AN ACE-HIGH RADIO JOBBER



HE works shoulder to shoulder with his dealers at all times—he never competes with them. Large stocks of the best and most desirable radio equipment are carried ready for dealer shipment on a moment's notice.

An inspection and repair department is maintained so that apparatus, requiring testing, can be

quickly checked before shipment, and repairs made to returned sets without sending the equipment to the factory.

Hommel dealers further benefit from Hommel's national advertising as all user inquiries and orders resulting are forwarded promptly to the local dealers.

Tie up with Hommel Now—the Helpful Jobber—Our New Encyclopedia on Radio Apparatus—466-B—will help you,—write for your copy to-day.

WHOLESALE

EXCLUSIVELY

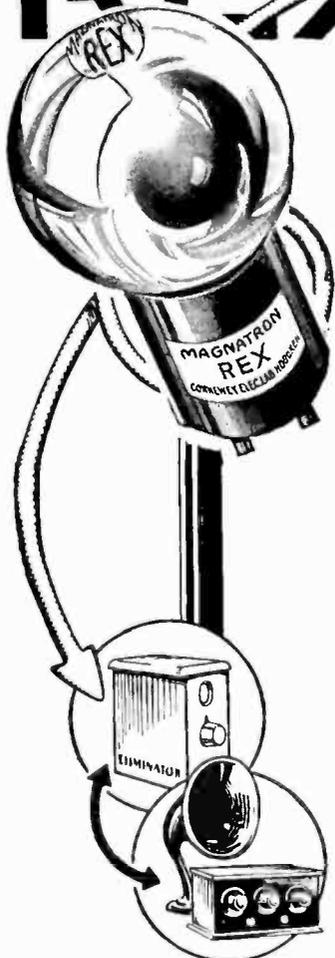
LUDWIG HOMMEL & CO

929 PENN AVENUE



PITTSBURGH, PA.

REX



REX answers the eliminator problem. The B Battery eliminator equipped with Magnatron Rex tubes works day in and day out—silently and economically.

Magnatron Rex is the product of long research by the oldest exclusive manufacturers of thermionic valves in the country. It has been designed primarily and only for eliminator work.

Magnatron and Excellence have come to mean one and the same thing. Impartial laboratories and radio engineers

for your B battery eliminator

throughout the country have certified this. Their reports explain why Magnatrons in your set will make it function better.

Your dealer has the Rex as well as the other Magnatrons. Ask him today!

They list for only \$2.50.

Write for your **FREE** copy of "Pot Pourri—a snappy review of mirth and music", to Dept. R. B.

CONNWEY ELECTRIC LABORATORIES
Magnatron Building, Hoboken
New Jersey

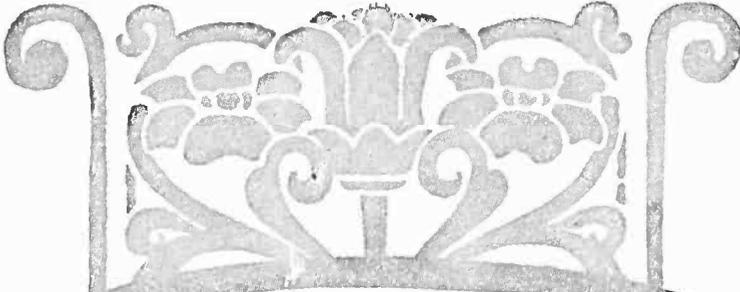
West Coast supplied from complete stocks carried by
Pacific Radio Laboratories, 256 South Los Angeles
Street, Los Angeles, California



MAGNATRONS

★ Tested and approved by RADIO BROADCAST ★

www.americanradiohistory.com



25

MILLION MICADONS *now in use!*

WHEREVER radio is known, Micadons are recognized as the standard fixed condensers. In good receivers, the world over, fixed condenser efficiency is assured—by Micadons.

When you buy your set—be sure you ask if it is equipped with Micadons.

Expert engineers make them—expert manufacturers use them in their sets. It is unwise to buy a receiver that is not *Micadon* equipped.

Guaranteed accurate within 10% of their marked capacity.

Send 10c for 32-page booklet, H-4,
“Applications of Dubilier Condensers in Radio Circuits”

Address: 4377 Bronx Blvd., New York

Dubilier

CONDENSER AND RADIO CORPORATION





CLAROTUNER is best! Radio engineers have said so; radio fans everywhere have said so. And the technical staff of Radio Broadcast proves their belief in Clarotuner by indicating that it can be used in their Aristocrat receivers, for their Roberts reflex, for their Phonograph model and for their Knockout sets. There can be no more conclusive proof!

Clarotuner is the only original tuning device which uses a variable resistance together with a fixed tickler to control regeneration. And because this variable resistance is the famous Clarostat, no other device can tune as accurately as the Clarotuner.

Clarotuner has worthwhile features galore. Low-loss coils, sturdy compactness, true one-hole mounting and an antenna coupler that entirely eliminates drilling holes for extra switchpoints are only a few of them.

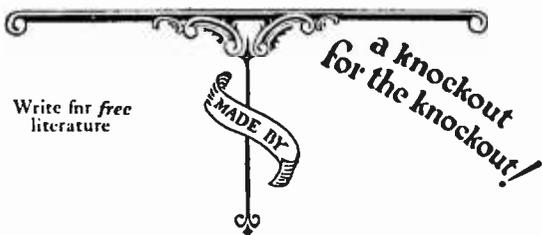
CLAROTUNER, model 2RK
(two units as shown) \$7.50

CLAROTUNER, model TCH,
(for any three-circuit set) \$4.50



The famous CLAROSTAT heart of the CLAROTUNER \$2.25

In case distribution has not reached your dealer send your remittance direct to the address given below.



Write for free literature

American Mechanical Labs., Inc., 285-287 North 6th St. Brooklyn, N. Y.



DOUBLETOROID COILS Price \$2.75

If your set is not satisfactory, Doubletoroids will improve it. Replace ordinary coils with the coils that can be mounted anywhere, that do not form miniature loop aerials, and that have no external fields.

OUTSTANDING FEATURES OF THE DOUBLETOROIDS

Primary and secondary are true toroids. The magnetic path is shortest. They are the most compact. Ask your dealer for booklet showing a "hook-up" and embodying a letter from Professor J. H. Morecroft of Columbia University, a recognized authority on toroid coils.

Price 85 cents

It's Variable

The Nonoise Gridleak improves reception because it can be adjusted for every station. Fits standard brackets. Absolutely noiseless. At all dealers and in the better sets.

NONOISE GRIDLEAK

Radio Foundation, Inc. ★
25 West Broadway New York
Dealers: Some territories still open. Write

THE TUBE WITH A SENSIBLE GUARANTEE **SUPERTRON** A GOOD TUBE



If someone wants to give you something for nothing... hesitate. If someone wants to sell you something too cheap... hesitate. If someone wants to sell you a radio tube—with an unlimited guarantee, and without means of identification... hesitate. SUPERTRON is reasonably guaranteed. Each tube serial numbered—identified by a guarantee certificate, for your protection—for your satisfaction.

BUY SAFE—BUY SUPERTRONS

Avoid Cut Price Stores

Branch Offices in Principal Cities thruout the United States
SUPERTRON MFG. CO., Inc. ★
HOBOKEN, NEW JERSEY

Export Department, 290 Broadway, New York

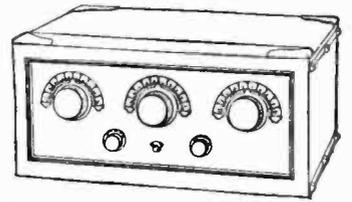


ALL TYPES \$2.00
Canada \$2.75

SUPERTRON
A SERIAL NUMBER GUARANTEE



ABOVE: 5-tube Thorola Islodyne in Burled Walnut with Circassian top . . . \$100
 New Model 51; Genuine Mahogany Cabinet . . . \$85
 Console Model . . . \$225



5-tube Thorola Islodyne in smart Thoroco Finish . . . \$85



Thorola 4 Speaker \$25



Thorola Jr. Speaker \$15



Islodyne action is based on Thorola Low-Loss Doughnut Coils. They bring many Thorola advantages to other receivers

Set of 3 Coils . . . \$12

Per Coil \$4

Thorola Low-Loss Straight Line Frequency Condensers can also be bought separately \$5.50 and \$6

Thorola Golden Audio Reproducing Transformer . . . \$4.50

of Music ★

The Name

Because it so clearly meant *Music* and natural speech, Thorola from the very first was a great name in radio. The loud speakers which established Thorola now lead by an increased margin, with their new technical refinements such as the self-harmonizer; with their new burnished Bakelite horns, the largest forms of this material ever produced; and with still finer beauty, exemplified by the identifying golden throat-band.

Only when it became possible to produce a complete radio receiver of similar artistic perfection, was the 5-tube Thorola Islodyne sponsored. It is the only radio set with Thorola Low-Loss Doughnut

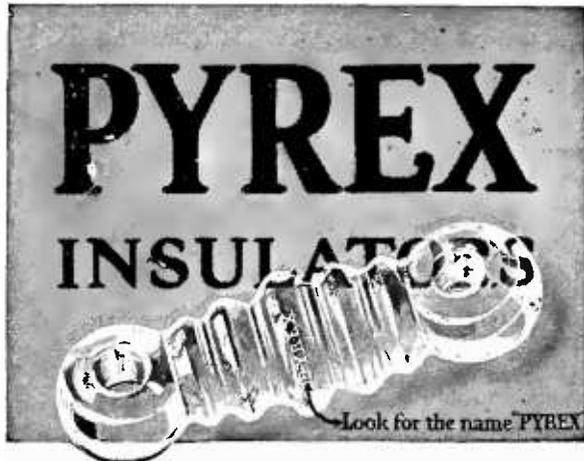
Coils. They *isolate* power, concentrating upon one chosen set of signals only—the crux of selectivity. Full power applied without interference yields the strength that alone pierces distance and rolls up volume. Gone are “pick-up,” intercoupling, excess “feed-back”—but Thorola Islodyne owners do not even know the unstable, temperamental old elements of radio.

For them there is Thorola tone which reflects their high taste; range worthy of pride; uniformity of results that forestalls embarrassment! Have a demonstration—at your dealer’s—and in your home every night.

REICHMANN COMPANY, CHICAGO

Thorola

I S L O D Y N E



Make Your Set Weather-Proof!

BECAUSE Pyrex Insulators are diamond hard and crystal smooth, they are not affected by rain or snow. Little drops of moisture cannot gather on them. They remain leakproof in spite of the weather. They continue to conserve every available bit of energy. Put in Pyrex Antenna Insulators and get more pleasure out of stormy nights. That's when you most want to use your set. They cost only 45c each at good dealers.

Pyrex Insulators are used by the United States Government for the most exacting service. They must not be confused with ordinary glass insulators.



Industrial and Equipment Division

CORNING GLASS WORKS, CORNING, NEW YORK

World's Largest Makers of Technical Glassware



You Cannot Expect Perfect Reception

Unless

Your Battery is Charged Regularly

You can do it *Overnight* right in your own home with the ★



Makes use of full A.C. Current -not half of it.

RADIO BATTERY CHARGER

If you want distance, volume, clarity from your set use a Ful-Wave, charges in almost half the time because it uses the Full electric wave . . . costs less to operate. Uses no acids. Cannot spill or boil over. Needs no expensive bulbs. Here is the last word in charger efficiency—sealed at the factory. Needs no adjustment. Absolutely guaranteed.

Model "A"—for radio "A" and 6 volt automobile batteries. A.C. line, 40 to 60 cycle, 110-120 volts. Battery—6 volts 6-8 amperes. Comes complete **\$18.00** with cords, plug and leaded clips. Price East of the Rockies

Model "A-B"—for charging radio "A" and "B" batteries *simultaneously*. A.C. line, 40 to 60 cycle, 110-120 volts. Battery—"A," 6 volts 3-4 amperes; **\$22.00** "B," 48 to 96 volts in series, 1/10 ampere, up Price East of the Rockies

Pays its cost in a short time by what it saves you

Ask your dealer to show it to you—or write for booklet.

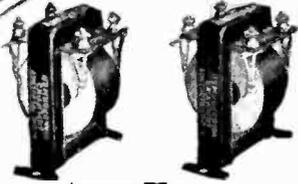
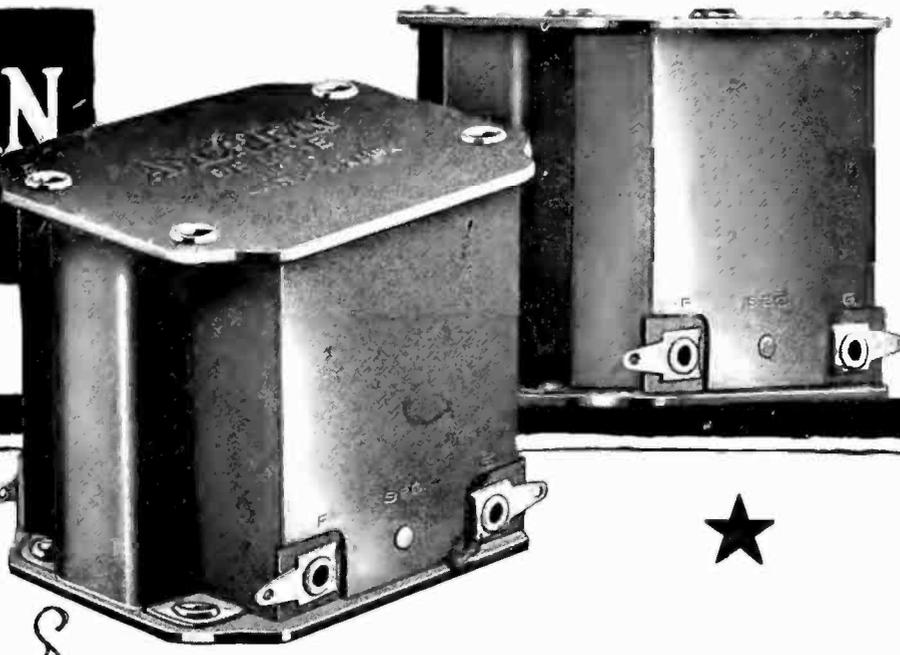
LIBERTY ELECTRIC CORP. of NEW YORK - 342 Madison Ave., New York



AMERTRAN

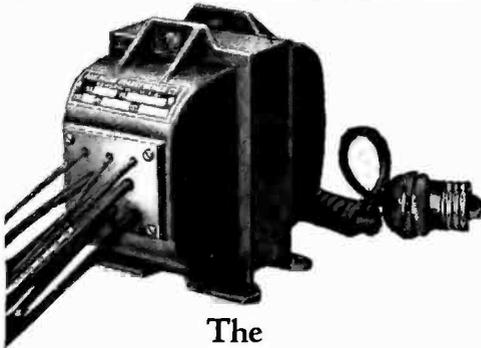
TRADE MARK REG. U.S. PAT. OFF.

DE LUXE



AMERTRAN
Types AF-7 and AF-6

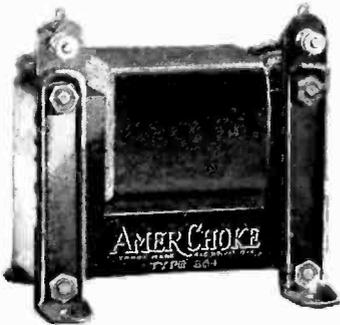
AmerTran audio transformers Types AF-7 and AF-6 have been considered for years among the leaders in audio amplification. These popular and efficient models may now be purchased at a considerable saving in cost. Types AF-7 (ratio 3½:1)—AF-6 (ratio 5:1) . . . \$5.00 each



The AMERTRAN Power Transformer

Type PF-45, 65 Va-60 cycles 110 volts primary, 450-8/4-8/4 secondary

Type PF-45 is intended for use on the standard 110 volt, 60 cycle house lighting circuit. It has three separate well-insulated secondary windings. These are enclosed in a strong metal case provided with mounting feet. The secondary leads are standard code flexible wires left long enough to reach the terminals in the average set without splicing. This transformer is well suited for supplying AC power for filter circuits, and is designed with the usual margin of safety . . . \$15.00 each



The New AMERCHOKE

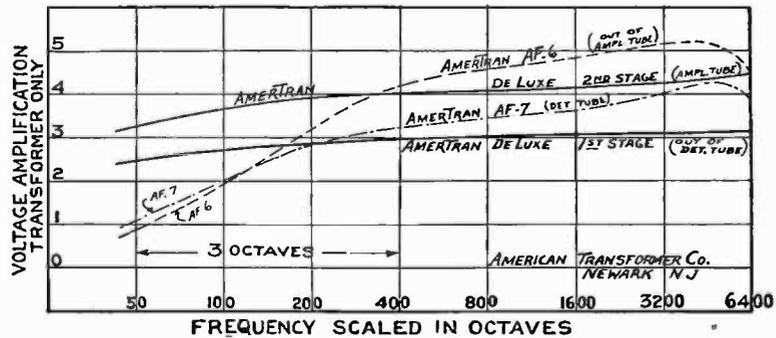
Type 854

Type 854 is a scientifically designed impedance or choke coil of general utility, designed primarily for use in filter circuits. As an output impedance for by-passing direct current from the loudspeaker it is just as efficient and more economical than an output transformer. When used with a 1 mfd. (or greater) fixed condenser, the tone quality equals that of the best output transformer. DC saturation is prevented by two adjustable butt joints in the core. \$6.00 each



A New Standard of Excellence in Audio Amplification

THIS new audio transformer has been developed for those who are satisfied only with the utmost in quality. It possesses an unusually straight line frequency characteristic extending the range below the lowest note now being broadcast, and actually shows a gain of about three octaves below that previously obtained.



The AmerTran De Luxe is a transformer of moderate size and weight, enclosed in a strong metal case with mounting holes at both top and bottom so that it may be inverted, affording simplified connections. While the AmerTran De Luxe will improve any set, appreciation of its uniform amplifying qualities can best be realized when operated in conjunction with straight line frequency loudspeakers, such as the best cone and disc types, and with a tube in the last stage capable of handling the output.

The AmerTran De Luxe is made in two types, one for the first stage and one for the second stage, and plainly marked as such. The chief difference between these two types is that the first stage transformer has approximately 50% greater primary inductance than the second stage transformer, thus more nearly corresponding to the operating impedances of the tubes out of which they work. For this reason it is advisable to purchase and operate these transformers by the pair!

PRICE, EITHER TYPE, \$10.00

Write for descriptive booklet on AMERTRAN Radio Products

American Transformer Company

178 Emmet Street, Newark, N. J.

"Transformer builders for over twenty-four years"

SOLD ONLY AT

AUTHORIZED AMERTRAN DEALERS

On to Success in RADIO!



Mr. R. L. Duncan
Director of the
Radio Institute
of America

RADIO is a profession well worth following. The work is interesting—fascinating. The pay is high. The demand for new men—skilled men—is strong.

You can embark, right now, on a successful career in radio. With a few months study under the expert instruction of the Radio Institute of America you can pass your U. S. Government Commercial or Amateur Radio License Examination and be ready for your first real radio job.

Study in spare time

There's no need to give up your present work. Study at home in spare time. If you really want to make a success in radio, fill in and mail the coupon to the Radio Institute of America for information on the finest theoretical and practical radio courses offered today.

RADIO INSTITUTE OF AMERICA

Formerly Marconi Institute Established in 1909
328 Broadway New York City

CUT HERE

RADIO INSTITUTE OF AMERICA
328 Broadway, New York City
Please send me full information about your Home Study Course of radio instruction.
I am interested in the complete course, including code instruction, which qualifies for the U. S. Government Commercial or Amateur Radio License.

Name.....
Address.....
City..... State.....

If you want the best!



Grecian Model

Pathé sets operate on house current



CONE LOUD SPEAKER

Exquisite in Tone
Exquisite in Design
Exquisite in Workmanship

Some territories for both jobbers and dealers still open. Write

PATHÉ PHONOGRAPH AND RADIO CORP.
Dept. 20 20 Grand Avenue, Brooklyn, N. Y.

FOR— REAL ENJOYMENT



LOUD SPEAKER



Assures remarkable clarity of tone with maximum volume—reaches full range of musical scale and gives a faithfulness of reproduction that equals hearing the original. New Concert unit is of substantial size and is designed along scientific lines.

Burns Horns are of distinctive design and have special amplifying properties which combined with the pleasing tone of the Concert Unit gives most remarkable results.

PRICES

- No. 205B—With black flare..... \$22.50
- No. 205D—Mahogany tinted flare..... 25.00
- No. 205P—Mother-of-pearl flare..... 30.00
- No. 100 —Medium phonograph unit... 10.00
- No. 120 —Concert phonograph unit... 12.00

Manufacturers

American Electric
COMPANY

Chicago, U. S. A.



CONCERT UNIT

FREE LUNCH
 The obsolete, slow 2-ampere battery charger has been put with the other relics of years ago!
 Buy nothing but an up-to-date 5-ampere charger!

The New Improved
5 AMP. A & B
GOLD SEAL
HOMCHARGER
\$19⁵⁰



Over 500,000 already in use

Charges in One-Third the Time!

Better Because:—

- New micrometer adjustment, hinged lid, and carrying handle.
- No bulbs to buy or break.
- Can be used anywhere—contains no acids or other harmful liquids to spill.
- Approved by underwriters—trouble-proof, shock-proof and fireproof.
- Beautiful cabinet in maroon and gold.

It takes only one-third as long to fully charge your battery with the New Improved 5-ampere: **GOLD SEAL HOMCHARGER.**

No more of the long, bothersome waits that were necessary when the slow inefficient 2-ampere charger was the best that radio offered. The New Improved **GOLD SEAL HOMCHARGER** charges 150% faster—fully charges the average battery overnight—and it charges both A and B batteries without additional equipment.

Before you buy any charger be sure it charges at 5-amperes. To be absolutely sure insist on the **GOLD SEAL HOMCHARGER.**

Free Write for new edition of our instructive booklet on radio operation "The Secret of Distance and Volume in Radio."

The Kodel Radio Corporation
 505 East Pearl Street Cincinnati, Ohio



RADIO BROADCAST

ARTHUR H. LYNCH, Editor
 WILLIS K. WING, Associate Editor
 JOHN B. BRENNAN, Technical Editor

DECEMBER, 1925
 Vol. VIII, No. 2

CONTENTS

Cover Design	<i>From a Painting by Fred J. Edgars</i>	
Radio Enters the Club	Frontispiece	
How Radio Grew Up	Robert H. Marriott	159
Tubes: Their Uses and Abuses	Keith Henney	163
The March of Radio	J. H. Morecroft	167
A Five-Tube Receiver of Dual Efficiency	Glenn H. Browning	172
The Listeners' Point of View	Kingsley Welles	177
Short Waves—A New Paradise for the DX Fan	Edgar H. Felix	182
Plans for the Third of the International Radio Broadcast Tests	Arthur H. Lynch	185
An Improved Plate Current Supply Unit	Roland F. Beers	186
As the Broadcaster Sees It	Carl Dreher	191
The "Aristocrat" Receiver: Resistance-Coupled Amplification		196
How to Use Meters in Your Receiver	James Millen	198
New Fields For the Home Constructor	Keith Henney	201
"Now, I Have Found"		206
Tracing Radio Noises A Ratchet Coil Winder A Coupling Device for the Roberts Circuit A File for Ideas Super-Heterodyne Noises Check it up on B-Battery Leakage A Variometer for the Roberts Set		
How to Eliminate Local Interference		212
A List of Australian Broadcasting Stations		224
The Grid—Questions and Answers		226
Coil Placement in an R. F. Amplifier Precautions in Antenna Erection Measuring the Resistance of Coil Units Matching Tubes and R. F. Coils		
A Key to Recent Radio Articles	E. G. Shalkhauser	232
Is Your Set a Blooper?		238
What Our Readers Write Us		244

BEHIND THE EDITORIAL SCENES

THE new and enlarged RADIO BROADCAST has met with almost universal favor and its reception was even more hearty than the publishers had dared hope. In New York City alone, the supply of the November number was exhausted four days after it was placed on sale. Copies of the number are so rare that we haven't more than three copies in the editorial offices for our own use. Letters from readers all over the country have been most generous in praising the appearance and contents of the November number.

ROBERT H. MARRIOTT, whose article, "How Radio Grew Up" leads this issue, is one of the old men of wireless in the United States. He was the first president of the Institute of Radio Engineers, was one of the first radio inspectors to be appointed after the radio law of 1912 was passed. For a long time he was expert radio aide at the Bremerton Navy Yard, Washington, and is now a consulting radio engineer in New York. . . . Edgar Felix, who writes about short waves in this number, was for several years publicity representative of station WEAF in New York. Glenn H. Browning, who with his inseparable technical partner, Mr. F. H. Drake, has become nationally known for the Browning-Drake receiver, describes a great improvement over the early model in this number. Both Mr. Browning and Mr. Drake are familiar figures around the famous Cruft laboratory at Harvard University, where much of their work has been done. The valuable current periodical surveys, made by E. G. Shalkhauser, the first of which appeared in our November issue, are continued in this number. Many readers have written us saying that these condensed surveys of the important articles appearing in this magazine and in our contemporaries are of great value to them.

THE January RADIO BROADCAST will contain an article by Arthur H. Lynch telling how to build "RADIO BROADCAST's Universal Receiver." The set he describes is an unusual and very efficient combination of standard parts and it is doubtful if there is any receiver its superior in point of sensitivity and quality. It is not a "freak" outfit in any sense. Kendall Clough of Chicago will have an article about the principles of audio amplification which is of particular interest. The author weighs and casts aside some of the commonly accepted theories of amplification. We believe the article will attract a great deal of attention. Mr. John Wallace of Evanston, Illinois, will from now on write the "Listeners' Point of View." With his central location, Mr. Wallace is able to hear broadcast offerings in almost every part of the United States and Canada. Our new broadcast critic is an unusually versatile person, for he is a writer of great charm and not a little wit, as well as an artist of considerable ability. In his college days, his drawings and humorous "pieces" appeared in the Cornell Widow.

THE advertising pages of the magazines of the "Quality Group," that is, the Atlantic Monthly, Harpers, Review of Reviews, Scribners, and the World's Work now contain only the announcements of those radio manufacturers whose products have been tested and approved by the Laboratory of RADIO BROADCAST. Readers of those magazines who are not well versed in matters radio have the privilege of calling on the technical staff of this magazine for help and advice.

Doubleday, Page & Co.
 MAGAZINES
 COUNTRY LIFE
 WORLD'S WORK
 GARDEN & HOME BUILDER
 RADIO BROADCAST
 SHORT STORIES
 EDUCATIONAL REVIEW
 LE PETIT JOURNAL
 FLICO
 THE FRONTIER

Doubleday, Page & Co.
 BOOK SHOPS
 NEW YORK: LORD & TAYLOR BOOK SHOP
 PENNSYLVANIA TERMINAL (2 Shops)
 38 WALL ST.
 ST. LOUIS: GRAND CENTRAL TERMINAL
 223 NORTH 8TH STREET
 4014 MARYLAND AVENUE
 KANSAS CITY: 1920 GRAND AVENUE
 306 WEST 47TH STREET
 TOLEDO: LASALLE & KOCH
 CLEVELAND: HIGBEE CO.
 SPRINGFIELD, MASS.: MEEKINS, PACKARD & WHEAT

Doubleday, Page & Co.
 OFFICES
 GARDEN CITY, N. Y.
 NEW YORK: 120 WEST 32ND STREET
 BOSTON: PARK SQUARE BUILDING
 CHICAGO: PEOPLES GAS BUILDING
 SANTA BARBARA, CAL.
 LONDON: WM. HEINEMANN LTD.
 TORONTO: OXFORD UNIVERSITY PRESS

Doubleday, Page & Co.
 OFFICERS
 F. N. DOUBLEDAY, President
 A. W. PAGE, Vice-President
 NELSON DOUBLEDAY, Vice-President
 RUSSELL DOUBLEDAY, Secretary
 S. A. EVERITT, Treasurer
 JOHN J. HESSIAN, Asst. Treasurer

DOUBLEDAY, PAGE & COMPANY, Garden City, New York

Copyright, 1925, in the United States, Newfoundland, Great Britain, Canada, and other countries by Doubleday, Page & Company. All rights reserved.
 TERMS: \$4.00 a year; single copies 35 cents.

Unchanging "B" power at last



RCA Duo-Rectron, Model AP-937, with Radiotron UX-874 and Rectron UX-213 - - - \$65

A Power Amplifier for Loudspeakers

May be connected to the first audio stage of any receiver, and to any loudspeaker—to supply a stage of power amplification for tremendous volume increase and marked improvement in tone. Operated from 60 cycle, 110 volt A.C. source.
RCA Uni-Rectron - \$105

**RCA-
UNI-RECTRON**
\$105.

RCA has held its new power unit in the laboratories for more than a year after the main principles were developed. There were problems to overcome and these the RCA Duo-Rectron solves at last.

FIRST—It supplies correct voltage for any size set up to ten tubes—works equally well on a one-tube set or a ten-tube set—supplies the full necessary voltage at any rate, up to fifty milliamperes.

SECOND—It takes into account the unsteady, changing voltage that comes in from the power house, and automatically adjusts that current by means of a *voltage regulator*—a new tube developed for the purpose. No matter how the current changes at the power house, the RCA Duo-Rectron feeds unchanging current into your set.

THIRD—A newly designed filter system takes out all the A. C. hum.

Therefore, the RCA Duo-Rectron supplies the necessary plate voltages of 22½, 45, 90 and 135 volts for any existing type of radio receiver. Supplies it silently—dependably—unchangingly—from any 60 cycle, 110 volt A.C. lighting circuit. A unique feature of this unit is the furnishing of 135 volts on the plate for the operation of the new Radiotron audio-amplifiers UX-120 and UX-112.



RCA- DUO-RECTRON

RADIO CORPORATION OF AMERICA

NEW YORK

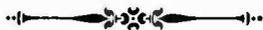
CHICAGO

SAN FRANCISCO

Notice to Set Builders

“ARISTOCRAT” BLUE PRINTS

are NOW READY



The RADIO BROADCAST “Aristocrat” five-tube receiver with resistance coupled amplification described in the November magazine by Arthur H. Lynch has taken the fancy of set builders wherever the receiver has been exhibited. At the Boston Radio Show this receiver aroused considerable curiosity and thousands of fans stopped to get the “dope.” At the Brooklyn Radio Show fully ten thousand fans had this receiver described to them in detail.

Your order for blue prints of this receiver will be filled by your Radio Dealer. If he cannot supply, you write us direct giving his name and address and enclose one dollar.

The blue prints are full size and give complete constructional dimensions for building the receiver on a base board or with a subpanel. Full size schematic diagrams together with hook-up are furnished for both layouts. There are also minor sketches which explain in detail how to mount the resistance coupled amplifier units in their proper positions, and how to neutralize the set. If you did not read the article by Mr. Lynch on the “Aristocrat” beg, borrow or buy a copy of the November magazine and study it. The “Aristocrat” is a five-tube single control receiver with neutralized tuned radio frequency, regenerative detector and resistance coupled audio amplification. The parts will cost from fifty to sixty dollars. Use this order blank to order blue prints direct.



DEALERS WRITE FOR DISCOUNTS

RADIO BROADCAST Booklet Department
Doubleday, Page & Company
Garden City, New York

Gentlemen:

Enclosed please find one dollar for complete set of the RADIO BROADCAST “Aristocrat” five-tube receiver blue-prints with schematic diagram for baseboard and sub panel layouts. It is understood that if these do not come up to my expectations, I am at liberty to return them to you for refund.

.....
(Name)

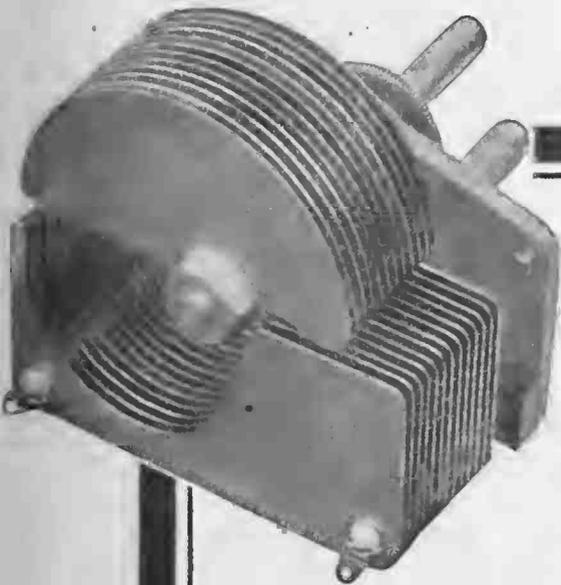
.....
(Address)

My dealer's name and address is:

.....



Parts



EVER since the first Silver-Marshall product was marketed, the S-M reputation for quality apparatus of originally distinctive design has been growing steadily until to-day it is only logical to find Silver-Marshall with apparatus, not designed just for the season of 1925-1926, but with equipment that will be adding to that reputation years hence. For is it not to be expected that the vision of S-M engineers should foresee developments months in advance—be ready for them with parts, not designed in the last minute rush to get business, but as the result of months of careful investigation and development work? The results are such parts as the low-loss all wave interchangeable inductances and their special sockets—the compact SLF condensers, and

the combination UX and UV sockets for both new and old tubes.

When you see—handle—each or all of these or other S-M parts, you feel they are *right*, their sheer perfection delights the soul of the craftsman—and radio authorities the world over have approved and endorsed them.

That's why this year,—next year, and the year after, the finest of fine sets will be built with S-M parts.

S-M condensers are at once the smallest and yet the most efficient available. They are made in SLF and SLW. Several may be simultaneously controlled by a single knob, due to an ingenious coupling arrangement supplied.

S. L. F.

No. 310—.0005	\$6.00
No. 311—.00035	5.75
No. 312—.00025	5.50

S. L. W.

No. 305—.0005	\$5.00
No. 306—.00035	4.75
No. 307—.00025	4.50

All bakelite low loss interchangeable coils for 50 to 550 meters are now available for a variety of purposes. Each coil has an adjustable rotor, except 112 type, and fits in the 515 socket. Type 113 is the unwound form, complete with rotor, springs and contacts.

R. F. TRANSFORMERS

112-A	190-550 M
112-B	90-210 M
112-C	50-110 M

All types, \$2.50 each

ANTENNA ADAPTERS OR OSCILLATORS

110-A	190-550 M
110-B	90-210 M
110-C	50-110 M

Type 113, UNWOUND FORMS, \$1.25 each

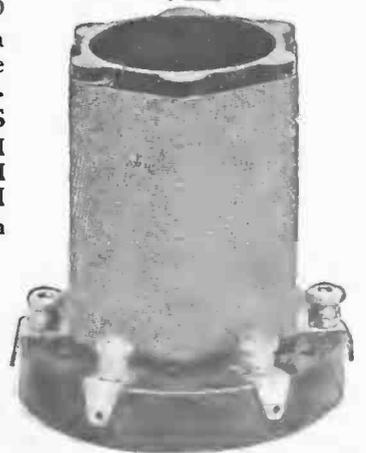
Type 515, BAKELITE SOCKET FOR COILS, \$1.00 each

No. 510 socket is of genuine black bakelite, designed to take all new or old (UX or UV) tubes except the old type UV 199's. Springs are of silver bronze. Price..... 50c.

Complete kit for the "SILVER SIX" including all the necessary parts, with three stage resistance amplifier..... \$53.00

"SILVER SIX" essential kit only, including three condensers, necessary coils and coil sockets..... \$27.75

Instructions for building the "SILVER SIX"..... 50c



See S M Products at Your Dealers

SILVER-MARSHALL, INC.

103 SOUTH WABASH AVENUE

CHICAGO, ILLINOIS

THE DAVEN LEAKANDENSER



EQUALS



SOLVES A DUAL PROBLEM

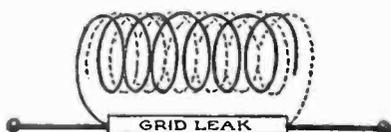
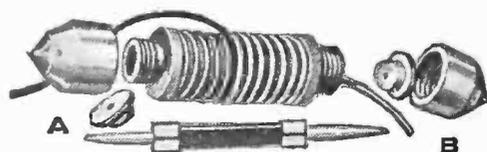


Diagram of the Leakandenser. There are two coils of wire, each forming one of the "plates" of a tiny condenser.



Assembly of the Leakandenser



The cross section above shows construction and assembly of the Leakandenser.

A pair of wires, coated with a special insulating material are wound in parallel, in a single layer, upon the Bakelite bobbin. To distinguish these in the illustration, one is shown dark, and the other light. The dark wire is connected to cap "A" in the illustration, and the light wire to the cap "B". Each wire therefore has one open end and one end connected to the terminal, thus forming two plates of a condenser.

The method of winding insures that the spacing between them can vary only the smallest fraction of a percent. This gives extreme uniformity. This is a great stride forward, as grid condensers in the past have been known to vary in capacity as much as 300 percent.

And now, the Grid Leak. One of permanent and constant value is absolutely essential. Daven's reputation for manufacturing precision Grid Leaks needs no comment here.

The Leak is suspended in the centre of the Bakelite cylinder on which the condenser is wound. The ends of the leak are connected to the caps which are also the terminals of the condenser.

Daven engineers have produced an innovation so simple and effective that you will wonder it was not thought of before.

Leading engineers and radio manufacturers have asked us repeatedly if we could not improve the old-fashioned combination grid leak and grid condenser which is (1) unattractive and cumbersome, (2) often inaccurate.

The Daven Leakandenser Contains No Mica

Grid condensers (particularly those of the mica type) often lack uniformity in capacity, especially in lower values; are susceptible to injury during soldering operations, and change capacity frequently after installation.

The Daven Leakandenser contains no mica and delivers all the efficiency the name Daven implies. It is a great step forward, both electrically and mechanically.

Manufacturers—you will instantly recognize the convenience and practicability of this new device. *Set Builders*—the Leakandenser will make your set more attractive and save you time and trouble. *Jobbers and Dealers*—here is something new. Show it to those of your customers who know radio. The Leakandenser is precision-built, like all other Daven products, moisture proof and rugged. It takes up less space, is better looking. Made with five different values of grid leaks: 2, 3, 4, 5 and 7 megohms. The condenser is known as type "D" and is correct for all makes of detector tubes. The price includes a pair of clips.

.....CLIP THIS COUPON.....



DAVEN RADIO CORPORATION E-12-25
158-160 Summit Street, Newark, New Jersey.

Please send me the following

Check Leakandenser Bulletin
 Resistor Manual. 30c is enclosed.
 Complete Catalog (free).

Name

Address

.....

Get the Handbook of Resistance Coupled Amplification. At Dealer's 25c. By mail 30c.

Manufacturers are invited to send for a sample.

"The Sine of Merit"

DAVEN RADIO CORPORATION

Resistor Specialists

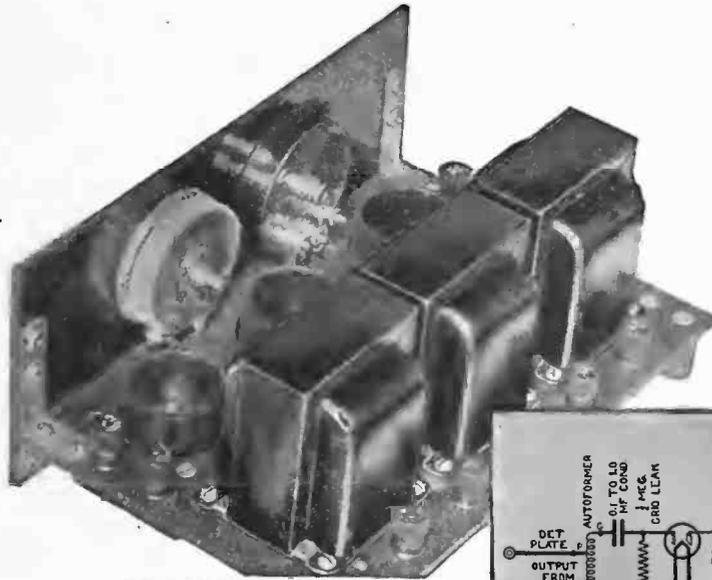
Newark
Reg. U. S. Pat. Off.
New Jersey

THE BIG LITTLE THINGS OF RADIO



No note is too low—no note is too high—to be fully amplified by Thordarson Autoformers. Autoformers are all frequency amplifiers—they amplify with even magnitude ALL notes within range of the human ear. Developed, perfected and built only by Thordarson.

A Thordarson Autoformer Amplifier built in accordance with instructions and diagrams furnished with each instrument.

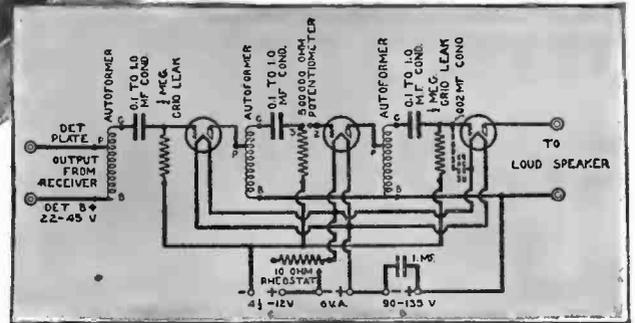


free!

Send for our new interesting bulletins on Autoformer amplification. They contain hook-ups and complete directions.

Autoformer Amplification Amazes Vast Crowds

Used at Radio World's Fair, New York City, to Amplify Programs and Announcements Broadcast by Loud Speakers Throughout the Great Halls



How Autoformer Amplification is praised by its users

Dunkirk, N. Y., August 5, 1925.

This is to congratulate the Thordarson Co. on their achievement in producing such a perfect piece of apparatus as your Autoformer which I embodied in a new hook-up I have just completed tuned regenerative R. F. 2 stages, soft detector and 3 Autoformers. I wish to advise that it is without parallel, exception or any comparison whatsoever, the most perfect performer I have ever seen, heard, tested or built—and I have built some pretty good ones.

Reproduction is absolutely faultless and perfect throughout the entire register—each and every note from the deepest bass to the highest treble is perfect and uniformly amplified. Sunday night I had Godfrey Ludlow on his 225 year old Stradivarius (from WJZ) absolutely perfect although it was a pretty "rotten" night. It was some treat. To-night (one of the poorest for some time) I pulled in everything east of the Rockies, that was on the air and I pulled in enough music to overcome the static to a great extent. Everything on Speaker.

She's a good D.X. getter and as for volume, has all that the windows will stand—and with all this volume does not distort any. It makes a beautiful outdoor program distributor. You can hear it plainly and perfectly for two or three blocks (at night).

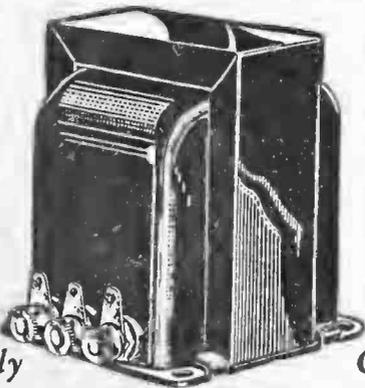
Very truly yours,
John Player.

Tens of thousands of radio enthusiasts were completely won to Autoformer amplification during the Radio World's Fair in New York. The Thordarson Booth was besieged by fans, amazed and delighted over this latest Thordarson achievement. It was hailed on all sides as the outstanding development of the year in amplification. "What is it?" "How may I use it with my set?" Such questions were continually repeated.

Our answer was this: As the world's oldest and largest exclusive makers of transformers, we have led for years in broadening their amplifying range. In the Autoformer

we have finally developed an all-frequency amplifier—a new instrument capable of fully amplifying all notes audible to the human ear. Thus the deepest notes of the grand organ, bass viol, tuba, English horn, etc., at last are brought out as clearly as those in the middle and upper registers of the musical scale. Improved long distance reception and better volume control are further advantages.

Autoformer amplification is expressly for those who seek the finest reproduction of programs to be had. May be used with any set in place of present amplifying transformer hook-up. Autoformers are \$5 each.



Unconditionally

Guaranteed

THORDARSON

Autoformer

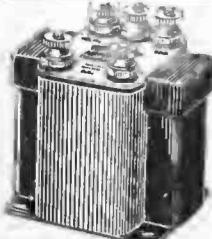
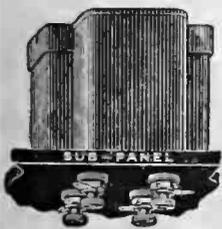
Trade Mark Reg.

All Frequency Amplifier

Other Thordarson Transformers

Thordarson Super Audio Frequency Transformers are to be had in either the sub-panel or top mounting type. Sub-panel type permits neater assembly, shorter leads and concealed wiring—as in factory sets. Three ratios: 2-1, \$5; 3½-1, \$4; 6-1, \$4.50.

Thordarson Power Amplifying Transformers, \$13 the pair. Thordarson Interstage Power Amplifying Transformers, \$8. All Thordarson products are unconditionally guaranteed. Shipped direct upon receipt of price, if dealer cannot supply.

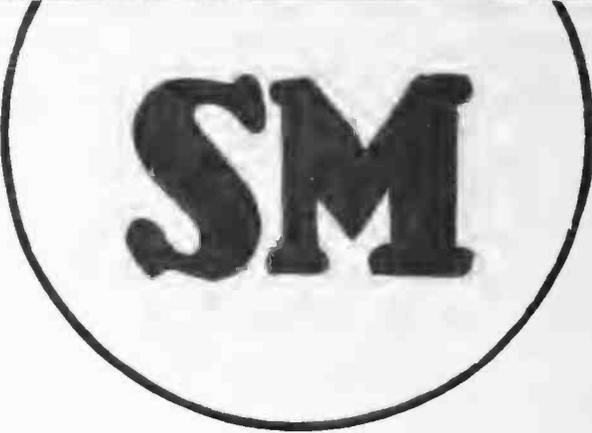


THORDARSON ELECTRIC MANUFACTURING CO.
Transformer specialists since 1895
WORLD'S OLDEST AND LARGEST EXCLUSIVE TRANSFORMER MAKERS
Chicago, U.S.A.

- ZENITH
- KENNEDY
- Radiodyne
- Planstiehl
- Howard
- Thermodyne
- OZARKA
- Deresnadyne
- ADLER-ROYAL
- MURDOCK
- MU-RAD
- Valley
- LEICH
- Silver-Marshall
- GLOBE
- ULTRADYNE
- Newport
- BUCKINGHAM
- NUNN-LANDON
- KUSTOMBILT and many others

Also choice of the MacMillan Arctic Expedition

use Thordarson Super Amplifying Transformers. Leading set builders use more Thordarsons than all competitive transformers combined.



SM

IT is a noteworthy fact that W. M. Silver, in developing the new "Silver Six" set, selected the Centralab Modulator for volume control, after carefully testing other controls available for this same purpose. The Centralab Modulator is assurance of long-lived efficiency.

You'll Want This Modulator in Your Set!—



Centralab Radiohm

The Centralab Radiohm is identical in appearance with the Centralab Modulator, except that it has two terminals instead of three.

Furnished with maximum resistances of 2,000, 5,000, 100,000 or 200,000 ohms. Used by many set manufacturers as an oscillation control in plate or grid circuits.

THE Centralab Modulator is an advanced type of potentiometer with a total resistance of 500,000 ohms, smoothly variable from zero. It takes the "rough spots" out of radio reception—smooths out powerful locals as well as difficult "DX". Gives you perfect control of both *tone* and *volume* from a whisper to a fog-horn blast!



You can use the Centralab Modulator in audio circuits with any ordinary transformer or with the new "Thordarson Autoformer." Does away with interstage jacks and danger of transformer burn-outs."

It is this Centralab Modulator that is recommended for oscillation control in the new Silver Six circuit, described in the November issue of RADIO BROADCAST.

\$2.00 at your radio dealer's—or mailed direct. Write for literature describing this and other Centralab patented controls

Central Radio Laboratories

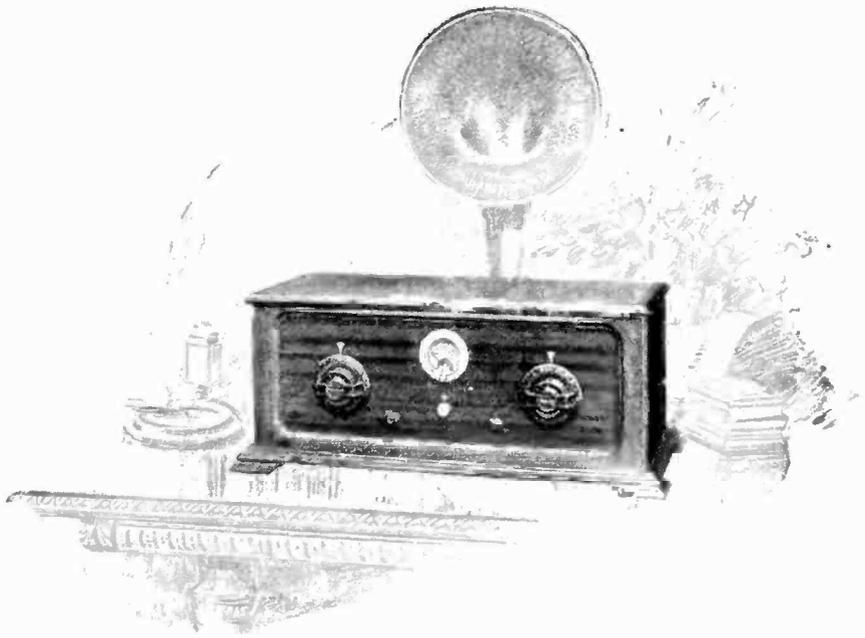
22 Keefe Avenue

Milwaukee, Wis.

Centralab



Real Progress in Radio



Emphatically Yes!

Radio IS marching forward, this season as before. But it is marching in a new direction.

Quality of Reception.

That is the big, new theme. And the new Jewett Receiver is its inspiration.

At last Radio commands a Receiver that is truly a Musical Instrument, by a manufacturer of experience in the musical instrument field.

Mere words cannot describe this new Jewett Quality of Reception. You must *hear* and understand.

So just visit an authorized Jewett Dealer and let him prove to you that here is a new kind of Radio—so different from the old as to create new standards and ideals.

For the first time, B-Battery current and resulting distortion have been completely barred from the speaker circuit.

You should know the story of this epoch-marking Receiver and its birth in the brains of our straight-thinking young engineers who refused to admit that it couldn't be done. Ask us for it.

"There Is No Substitute For The Best"

JEWETT RADIO & PHONOGRAPH CO.

5672 TELEGRAPH ROAD

PONTIAC, MICHIGAN

Factories: Allegan, Michigan—Pontiac, Michigan

In Canada: Jewett Radio-Phonographs, Ltd., Walkerville, Ontario

Export Sales Offices: 116 Broad Street, New York City



The Jewett Receiver

—Three simple controls provide distortionless reception and eliminate all receiver noises—The most richly beautiful Receiver you have ever seen.

The Jewett Superspeaker

—All that the name implies. Recommended by experts everywhere.

The Jewett Superspeaker Console

—A handsome cabinet with Superspeaker performance.

The Jewett Cone

—Faithful in tone and pitch regardless of heat, cold, or dampness. Semi-adjustable.

The Jewett Vemco Unit

—Makes a loud speaker out of your phonograph.

The Jewett Parkay Cabinet

—Puts the amateur on a par with the most exclusive cabinet worker.

The Jewett Micro-Dial

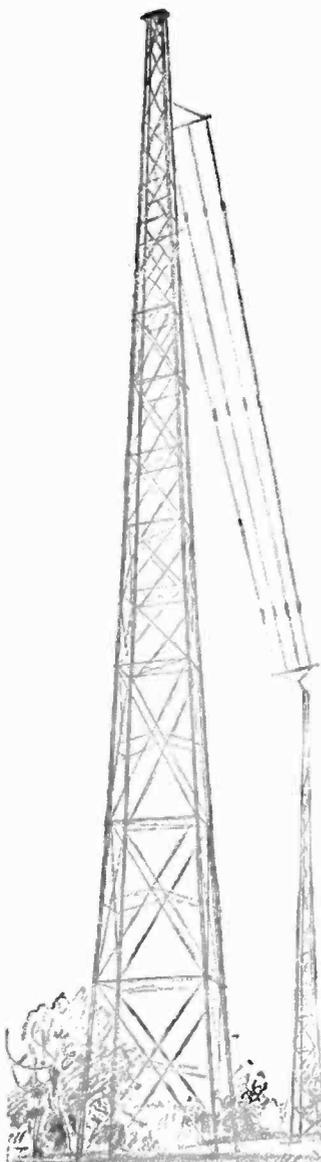
—Makes tuning 50 times as accurate. Fits any standard receiver.

The Jewett Superspeaker Highboy

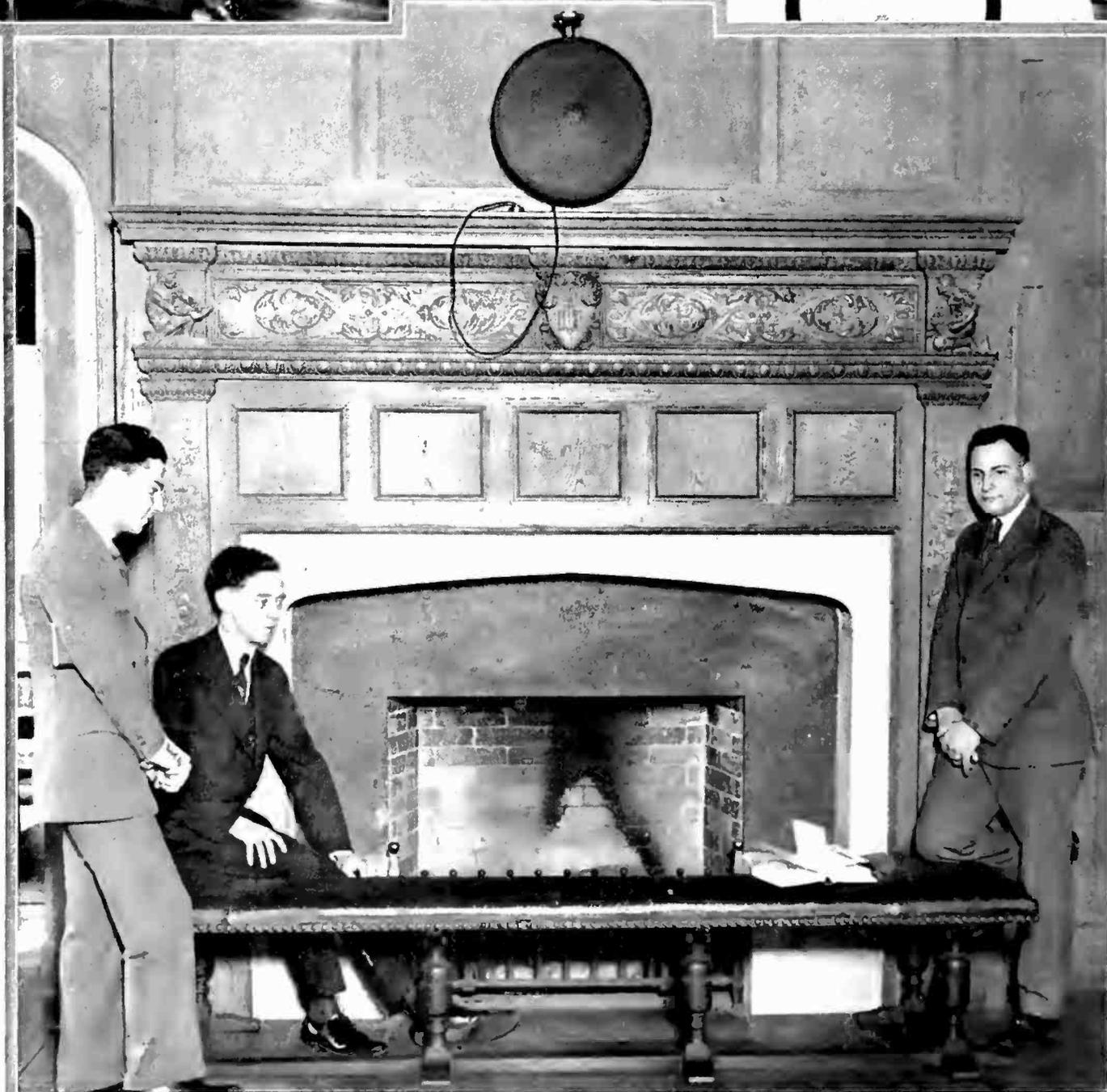
—Houses any standard Radio set and all batteries. Superspeaker built in.

"Quality Broadcasting to Match Quality Products —Station WJR"

Special Wednesday WJR feature—The Burroughs Hour, 9 to 10 p. m.



©1925 Jewett Radio & Phonograph Co.



RADIO ENTERS THE CLUB

The installation at the Cornell Club in New York City. The Western Electric super-heterodyne with peanut tubes is shown in the top view at the left. A four-tube amplifier below intensifies the energy which is supplied to the loud speakers on the panelled walls of the various rooms. Employees of the Club are shown listening to the first test of the equipment. A public address system is also installed. Microphones pick up the speeches which are carried to all parts of the club through the loud speakers

RADIO BROADCAST

VOLUME VIII'



NUMBER 2

DECEMBER, 1925

How Radio Grew Up

Many Little Known Facts About Radio Development are Related—Here Is the First of a Series of Articles on This Subject Written by a Pioneer in Wireless

By ROBERT H. MARRIOTT

First President Institute of Radio Engineers

REPEATEDLY during the last one hundred years, radio has been referred to as new, which has had the result of making people come to the conclusion that it must be new. This is, of course, very confusing, and is due no doubt to the fact that certain inventions and inventors have been overrated while others have been forgotten. Human love of fairy tales makes it easy for a man or a corporation with money to refer to a certain individual as the great one who has done all of the wonderful things that have been done. Money getters, too, take advantage of that love of fairy stories to fill their pockets.

Haywire, halos, and haymakers have characterized many of the early careers in radio. Inventors and would-be inventors built haywire apparatus. Promoters built press agent halos around the alleged inventors and their haywire products. Some of the hay went to develop radio and a lot of it went to whoever received the stock jobber's money. Sometimes promoters became so extravagant in the claims about an invention that the inventor himself would be found to disclaim some of the things that he was purported to have done, and to give the credit to others. Such a procedure was, of course, just what the promoters wanted, and they immediately got their press agents and after-dinner speakers on the job, in order that they might tell how modest and generous the inventor was, and thereby stud his halo with the pearls of modesty and generosity.

Homage is due to many rather than to a few. Many radio develop-

ers have received little compensation for their work in the past and they are not in a position to collect now. The public owes a debt to many people which it cannot

pay. Some of those people need the money, others do not; some are dead while those still alive do not expect to realize anything on their past labors.

The changes in radio development may often be traced to unexpected causes. For example, the United States Prohibition Act seems to have played a somewhat important rôle in the recent stimulation of radio broadcasting. Volstead's unintentional creation of laborious home brewing and the attendant substitution of inconvenient bootleggers for bar tenders, has apparently been an important step in the development of radio, because it suddenly has shut off from the public a very convenient means of spending their money. Now these baffled people are looking for other outlets. Broadcast receiving has supplied that demand, and its problems present a new field in which alcohol-free brains may engage.

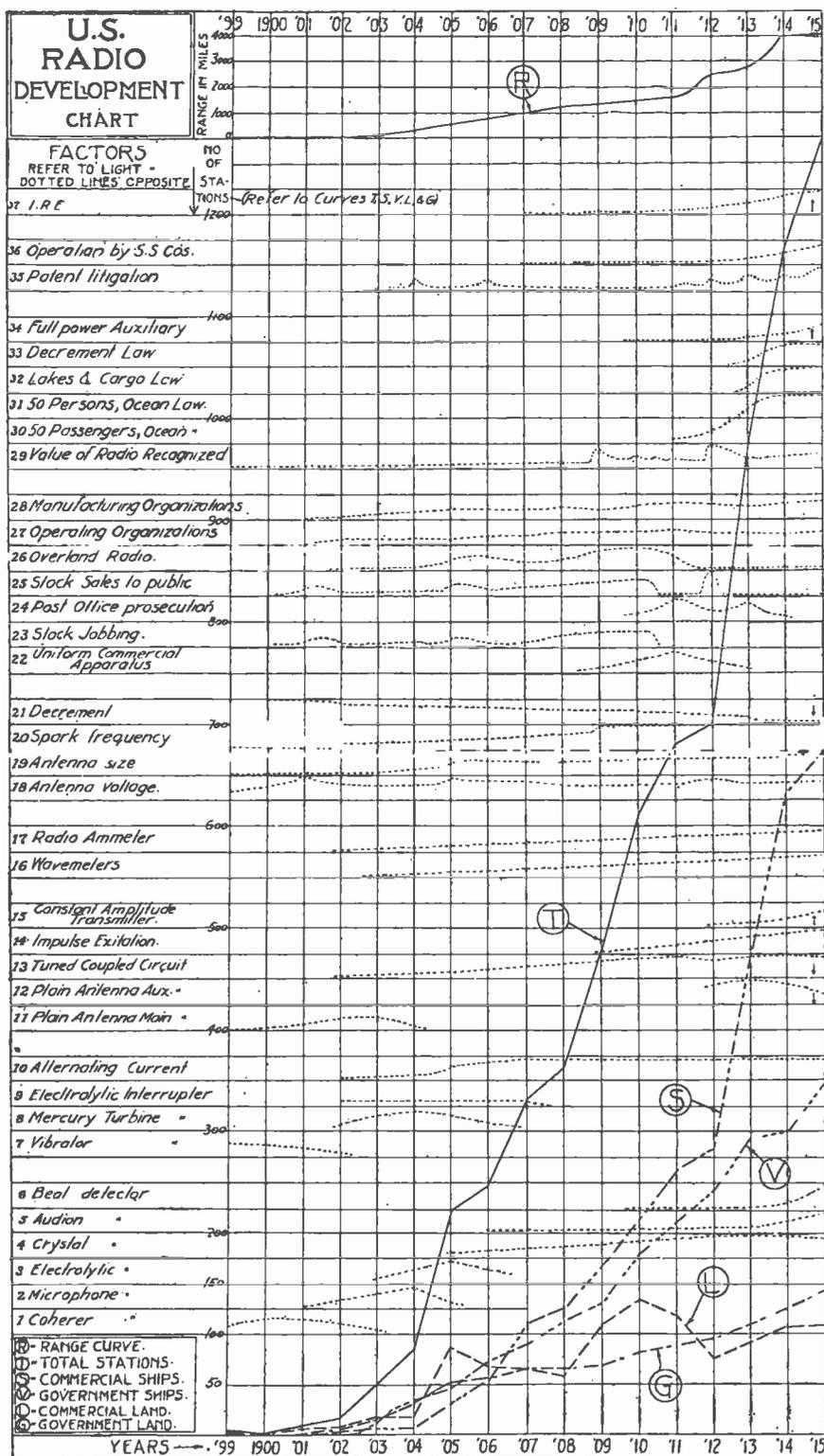
Not only is radio history valuable as a thing of interest, as educational, and as a precedent for use in planning the future, but it is valuable in other ways. I was recently examined and cross-examined for three days about historical radio devices, for evidence in a radio suit. I believe the suit was for several millions of dollars. At any rate the amount was so interesting that two lawyers and an expert traveled across the United States and back to get my testimony.

The lawyers' questions and my answers in that testimony took up more words than I am using in this whole series of articles. The testimony was relative to only a few historical devices which had their origin from 1899 on, while I am striv-



A PORTABLE SET, 1901 MODEL

Mr. Marriott operating a portable transmitting set. Note the ground plate on the floor. With an outfit about the same size as this, using vacuum tubes as the radio generating device, signals are being sent by amateurs using code, for tremendous distances. The Laboratory of RADIO BROADCAST recently communicated with the U. S. S. *Seattle* as she was leaving Tahiti in the Pacific ocean. A five-watt tube was used as a transmitter for this remarkable communication



HOW WIRELESS DEVELOPED

One of a number of charts presented by Mr. Marriott in a paper published in the *Proceedings of the Institute of Radio Engineers* for June, 1917, showing graphically the rise and decline of the various radio factors. For example, the electrolytic detector, No. 3 in the charts, came into use about 1902, was the leading detector about 1905 and then gave way to crystal detectors, No. 4

ing in these articles to outline the more interesting points in the development of radio since about 1790.

Starting on our outline of radio history then, we find that Galvani got a "radio kick" out of frogs' legs even before 1790; De Salva wrote a recipe for a "wireless" in 1795; Morse built a "wireless" which worked across narrow bodies of water in 1842; Maxwell wrote a theory for radio in 1867; Loomis patented a "wireless" in 1872; Hughes made and used a radio in about 1879, but he only let a few friends in on it; Professor Dolbear patented one in 1886; Hertz made a tuned radio system according to Maxwell's recipe in 1886, and

that development led others in our radio of today.

MARCONI EXPLOITS RADIO

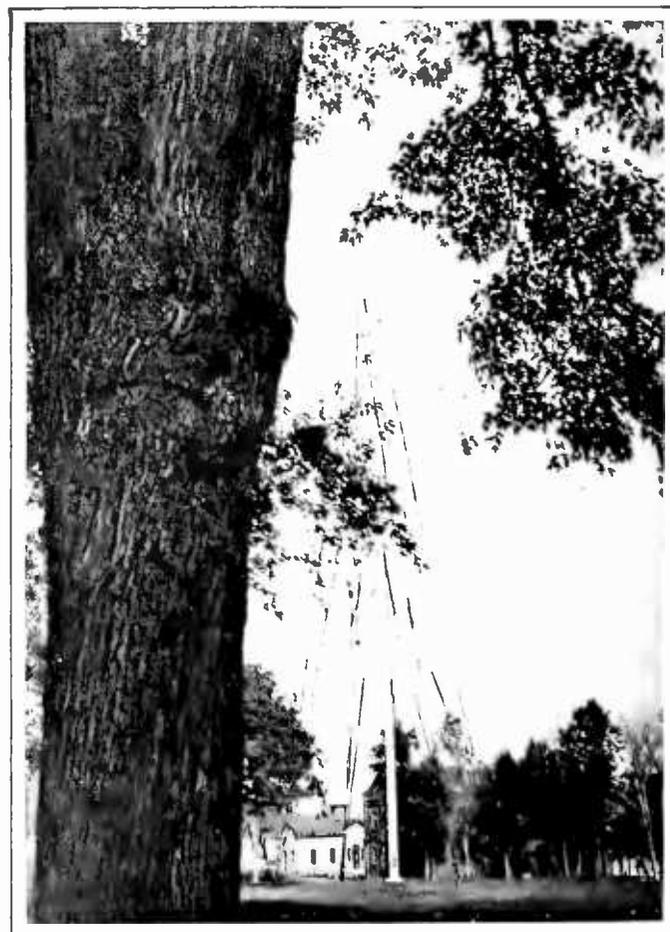
RADIO had been thus brewing since the 18th century. By 1895 it was ready for exploitation, by which I mean that it was ready for sales engineers, exploiters, promoters, advertisers, and others. Marconi demonstrated the more or less academic radio instru-



A VERTICAL ANTENNA

About the year 1900, vertical antennas were quite popular for land stations, but as wireless became more general and the installations more elaborate, the flat top horizontal type was almost universal. It is interesting to note that now, for short wave transmissions, amateurs and others are returning to the vertical antenna

ments to some politicians, army men, and money getters at this time. He played the part of a demonstrator and sales engineer. A money getting company was then formed



AT ANNAPOLIS

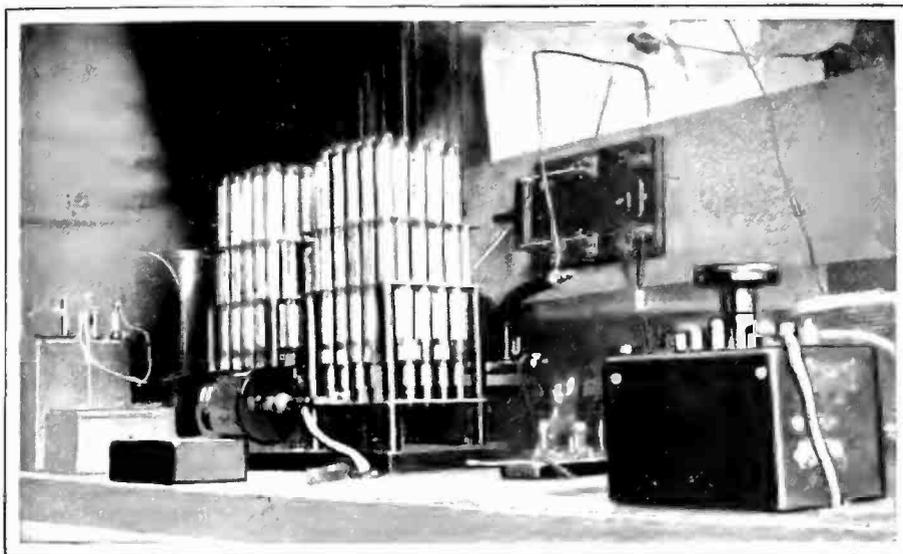
How the wireless towers looked when the picture was taken on October 25, 1902. On this day, some history was made, for, using this equipment, the Navy made its first record of about 50 miles by wireless from this equipment to a ship. Fifty miles, with the equipment known then was an extraordinary distance

which, in attempting to obtain a monopoly, set out to advertise to everybody that Marconi was the inventor and that they owned that patent on wireless which entitled them to a monopoly in America and other places. That was not, of course, true, but he did advertise wireless and to him is due the credit for having started the development of radio in many different parts of the world.

By 1900 radio had edged itself into the market as a mild public service. It continued as a tonic and stimulant for business, for military purposes, and for life saving. To obtain plenty of radio equipment for recent war purposes greater quantities of money and effort were suddenly put forth. In 1921 a radio by-product called broadcasting began to take on. Now it is a principal product, a product that sold for about \$350,000,000.00 last year. That is a very brief outline of some of the more important events in the history of radio.

Luigi Galvani was an Italian anatomist and he got the kicks from frogs' legs when he put them near an electric spark. Nowadays we would call his spark maker a radio transmitter while the detached frogs' legs acted as the radio detector. Therefore he must be credited with having made a genuine radio experiment one hundred and thirty-five years ago. The distance between the spark gap and legs must have been only a few inches or, at most, a few feet, and at that time the whys and wherefores probably were not realized.

On December 16, 1795, De Salva, a Spanish physicist, read a paper before the Academy of Sciences at Barcelona in which he said: "One could, for example, arrange at Mallorca an area of earth charged with electricity, and at Alicante a similar space charged with opposite electricity, with a wire going to, and dipping into, the sea. On lead-



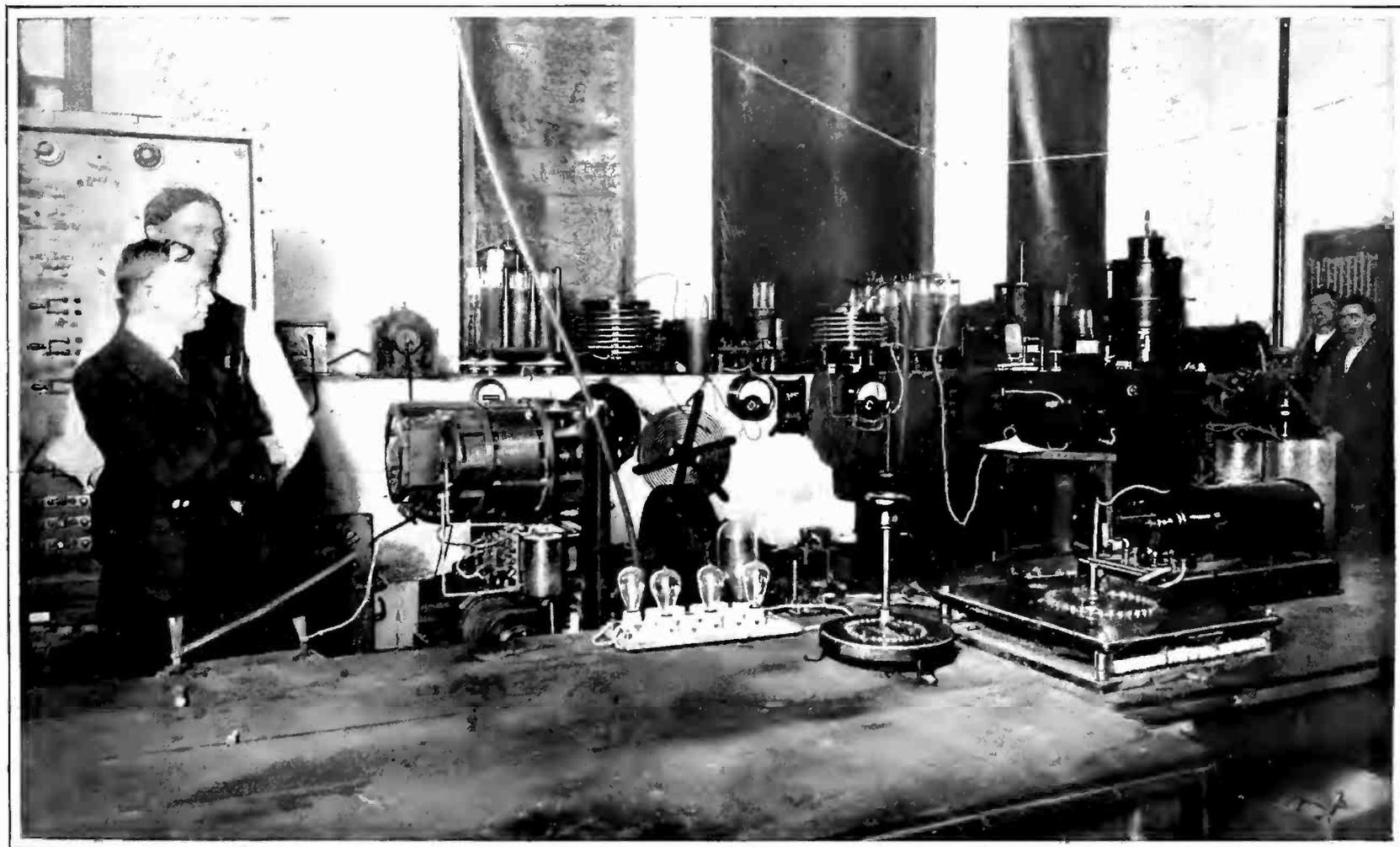
INTERIOR OF THE OLD ANNAPOLIS STATION

ing another wire from the sea shore to the electrified spot at Mallorca, the communication between the two charged surfaces would be complete, for the electric fluid would traverse the sea, which is an excellent conductor, and indicate by the spark the desired signal."

If Salva's scheme had worked as he said, it would

have been wireless, but not radio. He specified for the flow of a direct current from one station to the other, rather than waves composed of combined magnetic fields and condenser fields such as are radiated from one radio station to another. However he had the idea of establishing wireless communication. Therefore the idea of wireless communication by electrical means must be at least one hundred and thirty years old.

In 1831, Faraday demonstrated electro-



A GALLERY OF TRANSMITTING APPARATUS

In use between 1899 and 1915 set up in the Brooklyn Navy Yard. Mr. Marriott, at the left in the photograph, was the expert witness in a case tried before a United States judge in 1915. In the foreground, to the right, is a ten-inch induction coil, with separate vibrator. This was connected directly to the antenna and was popular until about 1906. Various kinds of glass jar transmitting condensers can be seen. The inductances, of large wire, are "oscillation transformers" and coupled the oscillating circuit, consisting of spark gap and condenser, inductively to the secondary circuit which had taps leading to antenna and ground. This is a most unusual historical photograph

magnetic induction. He showed that making current start and stop in one circuit would cause currents to flow in a circuit parallel to it, although there be no connecting wires between the two circuits. That was a kind of wireless, but it is not classed as the kind of wireless we call radio.

Professor Samuel F. B. Morse, of the United States, telegraphed across narrow bodies of water in 1842, by installing a ground return transmitter circuit along one bank and a ground return receiver circuit along the other, without any wires between the sender and receiver. His, again, was not radio communication but it was wireless communication. He not only had the idea of communicating without using wires between the transmitter and receiver, but he did actually telegraph with success that way. The currents between the points at which he connected his transmitter are supposed to have wandered across the stream and through the wire that connected the two points of ground or water contact of his receiver. That was a kind of wireless that worked, and it worked more than eighty years ago.

The electromagnetic theory, which is our present accepted theory of radio wave propagation, is said to have originated with William Clerk Maxwell, a noted Scotch physicist in about 1867, and it was published shortly after that time.

LOOMIS UTILIZES STATIC FOR SENDING

JULY 30th, 1872, patent number 129,971, was issued to Mahlon Loomis, dentist, of Washington, District of Columbia. The following is quoted from the patent.

What I claim as my invention or discovery, and desire to secure by Letters Patent, is—The utilization of natural electricity from elevated points by connecting the opposite polarity of the celestial and terrestrial bodies of electricity at different points by suitable conductors, and, for telegraphic purposes, relying upon the disturbance produced in the two electro-opposite bodies (of the earth and atmosphere) by an interruption of the continuity of one of the conductors from the electrical body being indicated upon its opposite or corresponding terminus, and thus producing a circuit or communication between the two without an artificial battery or further use of wires or cable to connect the cooperating stations.

Stating the Loomis claim briefly and in present day language; if you put up an antenna where it will get atmospheric charges, and interrupt the flow of current from the antenna to ground, you can send messages. If the atmospheric voltage is high enough so that the sparks from antenna to ground will jump a gap of one inch, it would be possible to send messages more than a hundred miles to a present day receiver. However, the atmospheric voltage is not reliable for telegraphing, because conditions vary widely in different locations and at different times. Unless you use a sensitive galvanometer you might be unable to detect any voltage on your antenna, the day you read this. On the other hand, it is not a safe thing to try, carelessly, because you might get too much voltage, especially just before a rain storm.

That arrangement as described by Loomis, has worked for me many times in years past and in fact I am experimenting with such a device at present. I am using the system to find out things about the unidentified noises that interfere with radio receiving, and about fading and static. The one I am working with now is interrupted by a little copper water wheel. When the voltage is low the current only discharges from the antenna through the longest paddle of the wheel. When the voltage is high it jumps to all four. Some of us can hear it click at our receiving stations and get an idea of what is happening in the atmosphere.

An observer might record the area and movement of high voltage atmosphere by setting up numerous Loomis antennas, with clock operated spark gaps having differently timed interruptions, in a

large circle around him and his receiving apparatus. Weather scientists may find this suggestion useful.

From observations made with this kind of an arrangement, it seems that some of the interference one hears on a broadcast receiver is probably due to the atmosphere charging insulated conductors to such a high voltage that the charge jumps over to earth in one spark which produces a click, or many sparks, that produce grinding, buzzing, or sizzling noises. The conductor in question might be a guy wire, fence wire, power wire, or something else. If electric power follows those pilot sparks to earth, you may hear an alternating current or commutator hum. Falling rain may contribute both voltage and moisture, causing a power circuit to leak over insulators.

I am not an inveterate story reader, but so far as I know, fiction writers have overlooked the possibilities of the Loomis antenna. All their hero or heroine needs for wireless salvation are the right weather conditions, an elevated conductor and the radio code. The villain might even grab the conductor and get a static knock-out. Loomis was away ahead of his time. His patent was not only for communicating without wires, but for taking the electricity to do it with from the atmosphere. He apparently did not reason according to the radio theory, but the idea he patented certainly works that way. He wanted to make static send messages. He probably imagined wonderful possibilities "via static," but I daresay he didn't go so far as

to imagine then that the new baby across the street was destined to make money from automobiles; move (he might even fly) to Southern California to a place called Los Angeles and there buy a winter home

for a fabulous sum, retire and spend his time playing Mah Jongg or working cross word puzzles, and maybe even drinking home brew while listening to Washington jazz delivered without "wires," in 1925.



"HIGH POWERED" EQUIPMENT—IN 1903

The ten-inch induction coil which was standard during the early years of wireless as the transmitter. Nothing was simpler than the circuit used. About twenty volts was supplied to the primary of the coil and some eighty or a hundred thousand volts were produced between the electrodes the operator is adjusting. Ships and shore stations alike used the coils and sharp tuning was unknown. Those were the days when no one knew exactly what wavelength he was using and didn't care. The few wavemeters in existence were objects of curiosity in almost inaccessible laboratories



FIG. 1

A collection of modern tubes, nearly all of which are designed for the second audio stage where so much distortion due to overloading now occurs. The power tubes illustrated in this photograph are Western Electric 216-A, UX-112, UX-210, UX-120, UV-202, Cleartron, and Heliotron. The small "peanut" tube is the Western Electric "N" tube, and in the photograph are two tubes designed for resistance-coupled amplifiers, the Daven "MU-20" and the High Constron. Daven also makes a power tube known as the Daven "MU-6."

Tubes: Their Uses and Abuses

How to Use the Standard and the Latest Tubes to Attain High Quality in the Radio Receiver—Some Little Known But Easily Applied Facts of Increasing Importance About Audio Amplification

By KEITH HENNEY

Director, "Radio Broadcast" Laboratory

THE development of the vacuum tube has placed in the hands of engineers and scientists—and radio listeners—one of the most versatile and useful devices that has resulted from man's ingenuity. The applications of the vacuum tube device are so diverse and so important that it is indeed the modern "Aladdin's lamp."

Vacuum tubes in the early days were not what they are to-day. Any one who remembers trying to hook up two of the old "tubular" tubes into a two-stage amplifier knows that. Amplifiers in those days were practically unknown. Tubes did nothing but oscillate, and quite often not much of that. All receiving was done by "beats," that is with the tube oscillating and the circuit tuned so that a slight difference of frequency existed between the incoming signals and those generated in the tube itself. Operators read the signals by these difference notes.

Tubes were not pumped (as highly evacuated) as hard as they are to-day. No two were alike. Some had grids on the outside of the glass bulb. Often amateurs used a complicated system of permanent magnets placed about the tube so that the electrons would be drawn from the filament at a faster pace. All in all, modern radio listeners have a lot to be thankful for.

Tubes to-day are fairly uniform.

If you buy a 5-volt tube you know that its characteristics will be such and such within fairly narrow limits. This means that you can interchange tubes with out "spilling the beans." Some manufacturers of tubes take particular precautions to have their tubes all alike and in RADIO BROADCAST Laboratory, a consignment of tubes from one manufacturer have been tested that were all alike—all twelve of them—and they were not specially picked, either.

Tubes in radio communication serve several special purposes, but to the listener there are two services which are of paramount importance, detection and amplification. And like all delicate apparatus, there are certain con-

ditions under which they must be operated to get best results. It is the purpose of this article to deal with those best operating conditions and to attempt to point out a few noteworthy ideas in the design of radio receiving equipment that utilizes vacuum tubes as the central piece of apparatus.

HOW THE TUBE OPERATES

IT IS not necessary for the reader to know much of the theory of vacuum tube operation. It is sufficient if he knows that within the glass tube there are three metallic elements, a filament which lights up when you turn on the A battery, a grid which acts as a controlling valve for the plate current which flows from the third element, the plate, around through the B battery and back to the filament.

The filament emits electrons, according to the language of the physicist, but in ordinary terms, these building stones of all matter are actually boiled off the metallic filament when it is heated to a certain temperature.

These electrons are negatively charged and move toward the positively charged plate with a certain velocity depending on various controlable factors.

The grid is situated between the filament and the plate and is made of a mesh arrangement so that the electrons can go between its meshes

—◆◆◆—

SINCE the basic patents on the vacuum tube expired some months ago, there has been feverish activity among many manufacturers, and many new names have appeared on the market. The result is that a goodly number of experimenters are a bit at sea; tubes with capabilities quite beyond any of the previous well known types are available and many fans are groping for real information about them. The far sighted manufacturers who brought out the new tubes, the power type in especial, deserve much praise, for they have added infinitely to the acoustical refinement of radio. This article, we believe, contains some suggestions which will be highly valued by those experimenters who follow them. It is a plea, in short, for our audio amplifiers to be properly planned. By far the greatest number of radio experimenters use every tube they have in the conventional way: 90 volts on the plate and the rated filament voltage. The author, who by the way, knows a great deal about high quality in audio circuits, shows how the amplifier can be correctly planned—which appears almost to be a new idea.—THE EDITOR

—◆◆◆—

on their way toward the plate. If the grid is negative it repels electrons and less plate current flows; if it is positive, it draws more electrons from the filament out into the space of the tube and the plate current increases. In this way the grid is essentially a controlling element.

DETECTOR THEORY AND PRACTICE

THE theory of detection is complicated and will not be described here. It is only necessary to say that 45 volts on the plate of the detector is about the correct value with modern highly pumped tubes; that the grid return should be connected to the positive side of the filament; that for grid condenser-leak detection, the proper values seem to be about .00025 mfd. capacity and two megohms, although other values may be used; that there is little use in using a C battery detector unless very powerful signals are to be

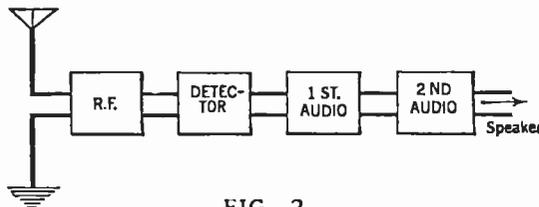


FIG. 2

Signals from an antenna go through several electrical devices before they finally emerge from a loud speaker. This illustration shows the path of these signals. At the input and output of each amplifier the voltages and power levels differ, increasing as the signal approaches the loud speaker

received, say in the second super-heterodyne detector.

Often a detector that will not work on 45 or even 22½ volts B battery will work very well indeed on 12 or thereabouts. If regeneration is not smooth, that is, if advancing the tickler, or the condenser in capacity feedback systems, is accompanied with growls and low frequency clicking noises, the trouble lies in too much tickler, wrong grid leaks, or too much B battery. The tube should slide into operation without fuss, and if it does not, something is wrong. With low loss receivers, not much tickler is needed. The higher the resistance of the coil into which regeneration is being introduced, the more tickler will have to be used and the more erratic will be the operation.

There is one point that may be mentioned here. It is a common statement that there is no necessity for low loss circuits in regenerative receivers since the addition of regeneration reduces the resistance of the circuit. Regeneration does reduce the effective resistance, making tuning sharper, and receiving more selective. If the receiver suddenly begins to oscillate after the regeneration has been set say when a crash of static comes along, or some loud signal, the

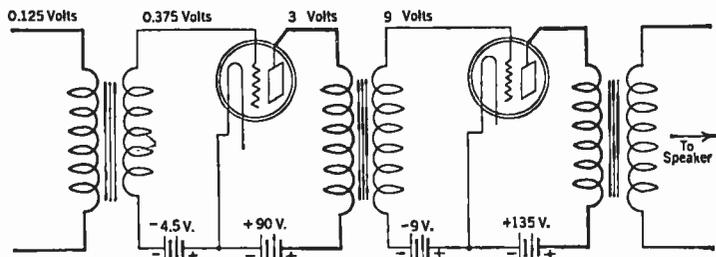


FIG. 3

A two-stage audio amplifier and the voltages that must appear at various points along the circuit if the full output of the last tube is to be delivered to the loud speaker. If lower voltages are delivered the volume will be "down." If more than nine volts peak are applied to the grid of the last tube, overloading will occur and a cone type loud speaker will, in popular parlance sound, "awful"

operator can look for a high resistance circuit in which the tuning is broad until much regeneration is added. Then it is time to read up on low loss circuits.

The use of low resistance grid leaks, say one half megohm, will improve the quality of music received but on the other hand, low valued grid leaks will cause some loss in volume—which may be made up in the audio amplifier.

Various methods of obtaining regeneration in a detector circuit have been described (see RADIO BROADCAST for October) and all produce the same results. Increased signal strength, increased selectivity, and, if it is pushed too far, decreased quality.

AMPLIFIERS: RADIO AND AUDIO

THERE is little that one can do to a detector tube or detector circuit beyond what has been mentioned above. When it comes to amplifiers, however, there is much to be said, and many false notions to be discussed.

There are two kinds of amplifiers in the usual radio receiver, those which are working at very high frequencies, and those which work at low audible frequencies, and there is a league and a half of distance between them.

In the first place there are two things to consider, voltage, and power amplification. These are two different things, and until quite recently little attention has been paid to the difference between them. Now that we have semi-power tubes appearing on the market from several tube manufacturers, we shall be able to plan our amplifiers with a little more engineering and a little less guess work.

Fig. 2 is a diagrammatic method of showing a receiver with its component parts. We shall begin at the loud speaker and work up toward the antenna circuit.

The speaker requires power—and there is a certain amount of power that is required by every good one to give a good, well-behaved sound. For example, the Western Electric 216-A tube, which until recently was the only semi-power tube available, has an output of .06 watts under the proper operating conditions, and if this is placed upon a good speaker, plenty of volume will result. Such volume will not be sufficient for a large auditorium, it will not be heard a mile or so up the street, nor will it drive any one out of the house—but who nowadays wants such volume?

Let us say, then, that a good signal requires .06 watts and since this figure represents power, the last tube in the receiver should supply power. Now there is an expression, due to Van Der Bijl, which amplifier designers seem to have overlooked, that says that the power output of any tube will be as follows.

$$\text{power} = \frac{(\mu \times \text{input voltage})^2}{8 \times \text{plate impedance}}$$

Now, using this formula, let us figure out the maximum power obtainable from several tubes under the usual operating conditions, namely, 90 volts B battery, minus 4.5 volts C battery, and assuming that the input voltage peak is just equal to the C battery voltage. In other words we are working

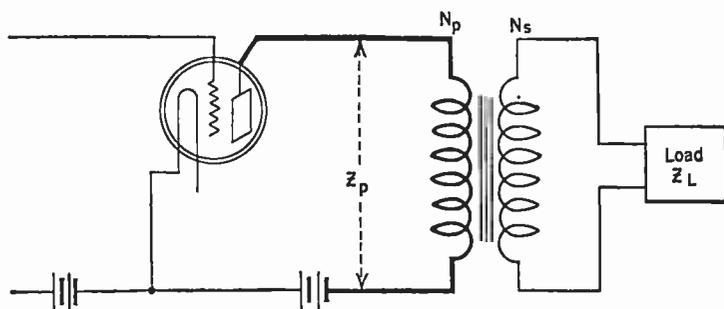


FIG. 5

Transformers are used to "match" impedances. In the case shown here, for maximum transfer of power from tube to load, the turns ratio of the transformer $\frac{N_p}{N_s}$ must be $\sqrt{\frac{Z_p}{Z_L}}$

the tube up to the limit of distortionless amplification.

Under these conditions the following table gives the power obtainable,

3-VOLT TUBE	5-VOLT TUBE	UX 112
.0066	.0135	.0184

Thus it is seen that none of the tubes ordinarily used will give sufficient output to operate a loud speaker at the desired level of .06 watts.

The following table gives the powers obtainable from tubes under conditions of greater input and plate voltages.

B-VOLTS	INPUT	5-VOLT	UX-112	216-A
90	4.5	.0135		
90	6.0		.0328	
135	9.	.058	.118	.059
157.5	10.5		.185	

From this table it may be seen that sufficient power is not obtainable for satisfactory reception with a 5-volt tube until 135 volts are used on the plate and until 9 volts are placed upon the input to the last tube. Under the same conditions, the newer 5-volt, one-half ampere filament tubes, such as the UX-112, and similar tubes for the same purpose, will deliver nearly twice as much power as is actually needed, and with 157.5 volts on the plate and 10.5 volts C bias will have an output that is still more favorable.

These figures mean that it will not be necessary to crank up a receiver to the top notch to hear the average level of an orchestra; and to endure distortion, or to turn down the set when a player bangs down on his kettle drums unexpectedly, or when the orchestra rises to a maximum output level.

In other words, a receiver properly operated with one of these semi-power tubes in the last

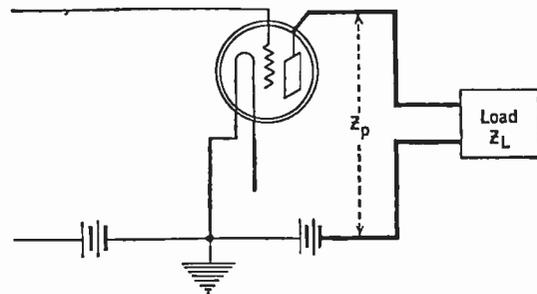


FIG. 4

The last tube in a receiver must deliver power to the load which is usually a loud speaker. If the impedances of the tube, Z_p , and the load, Z_L are alike, maximum power will be delivered

stage may always be somewhere short of the overloading point, and the range in volume, without the distortion due to overloading, will be much greater. For practically the first time in radio broadcasting reception it is possible to avoid overloading distortion without going to the bother of installing power tubes and high voltage

TABLE I

TUBE	USE	PLATE VOLTS	GRID VOLTS	PLATE RES.	POWER OUTPUT WATTS
WD-11	{ Amplifier Detector	90	4.5	14000	.0057
UV-199	{ Amplifier Detector	90	4.5	15000	.0066
UV-201-A	{ Amplifier Detector	90 135	4.5 9.0	12000 11000	.0135 .058
UX-112	{ Amplifier	90 112.5 135 157.5	6.0 7.5 9.0 10.5	8800 8400 5500 4800	.033 .054 .118 .185
UX-120	Amplifier	135	22.5	6600	.101
216-A	Amplifier	135	9	6000	.059
UX-210	Amplifier	90 135 157.5 250 350 425	4.5 9 10.5 18 27 35	9700 8000 7400 5600 5100 5000	.015 .071 .105 .41 1.08 1.84
Daven MU-6	{ Amplifier	120	7.5	6100	.0625
Cleartron	{ Amplifier	120	7.5	6260	.0312
Goldentone	Amplifier	120	7.5	5570	.058

B batteries. Tube builders who have had the initiative to bring out these new tubes deserve a large vote of thanks from the part of the radio public that really enjoys high quality.

In Fig. 3 is the conventional two-stage audio amplifier with the voltages marked as they appear at various points, considering that 9 volts at least are to be used as a C bias on the last tube, and that transformers of 3 to 1 ratio are used, and that the amplification factor, "Mu", of each tube is 8. It is seen that .125 volts must appear across the primary of the first audio frequency transformer, this must be the output voltage of the detector.

At the present time, nearly everybody has his receiver too near the point where the C battery voltage on the last amplifier is exceeded by strong signals. On a cone speaker this is signaled by a peculiar rasping, scraping, or rattling, and the user of the speaker believes the fault lies there when the trouble really exists in his amplifier. No loud speaker can be operated at sufficient volume from a 3-volt tube without overloading. This fact cannot be avoided.

One method of avoiding the semi-power tube problem is to use two 5-volt tubes in parallel in the last audio amplifier, that is, with their grids and plates connected together. From the above formula, the resultant output power with negative 4.5 volts on the grid and 90 volts on the plate is .027 watts and with 135 volts B battery and 9 volts C battery, the result is .117 watts. In other words, a single UX-112 will equal two 5-volt tubes in parallel.

All of these figures assume that the detector is turning out .125 volts—and if it does not, of course the C volts assumed above will not be available, and the power output will drop.

IMPEDANCE CONSIDERATIONS

THERE are other considerations in the audio amplifier end of a receiver that are important. One is the impedances of the loud speakers used with respect to the plate impedances of the tubes used. The layman need not know what these terms mean, but it is not difficult for him to see their importance. Fig. 4 represents a tube working into a load of some sort, say a loud speaker. Now it is an axiom among electrical power workers that any device will put the maximum power into a load when the impedances of the two are alike. When these impedances differ, the power drops.

Now, the impedance of a tube varies with the B battery applied, dropping as the battery voltage increases. The impedance of a loud speaker is under control of the designer, he can make it have, at a given frequency, practically any desired impedance. Therefore, let him design it so that the impedance of the speaker and that of the tube are alike, or as an engineer would say, let them "match" the impedances. This sounds easy but it is not.

The difficulty lies in the fact that the impedance of the loud speaker differs with each frequency, so that the designer

must pick out some particular frequency and match his impedances there.

Suppose that a manufacturer desires to place on the market a very high grade loud speaking device. He makes a number of experimental models and finally finds one that seems to be worth producing. He measures its impedance at various frequencies, finding that at low frequencies it has a low impedance and at high frequencies it becomes very high in impedance.

Then he selects a number of people to listen to the device, people who know music and who have a feeling for tone value. He starts at the low frequencies, matches his speaker to the tube impedance at say 200 cycles by means of transformers, as in Fig. 5. Then he matches the impedances at higher frequencies, and asks his audience to say which of the many impedance matches seems the best.

Perhaps they decide upon a certain impedance, knowing that the answer must be a compromise, for if the device is matched at 100 cycles the tube will transmit to the speaker a maximum of power at 100 cycles but very little at 10,000 cycles, and vice versa.

For example, the nominal impedance of the 540-AW Western Electric speaker happens to be in the neighborhood of 4000 ohms, and for the best transfer of power from tube to cone, the output impedance of the tube should be about 4000 ohms. Thus the UX-112 tube with 157.5 volts on the plate has an impedance of 4800 ohms, a good impedance match, while a UV-199 tube with 90 volts on the plate has an impedance of 15,000 ohms, a terrible match—all of the low frequencies would be lost no matter how good the transformers are.

From the standpoint of quality then, tubes should be worked below the overloading point, that is below the place where the available C battery voltages are exceeded, the loud speaker should have the same nominal impedance as the power tube, and the output tube should have sufficient power output to actuate the speaker

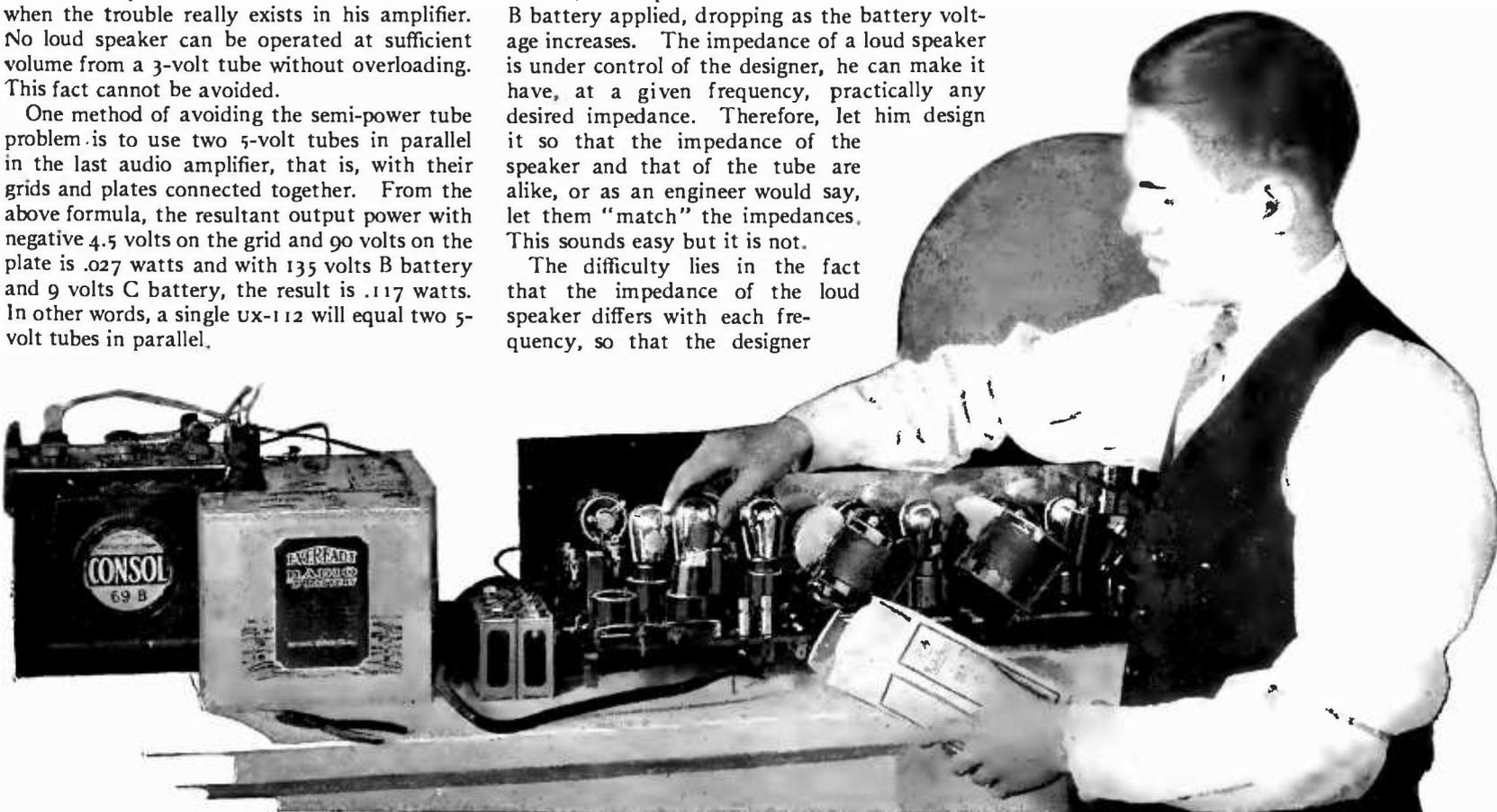


FIG. 6

As shown in the table of tube characteristics in this article, one UX-112 will have approximately the same output as two UV-201-A tubes in parallel. In receiving sets such as the Freed-Eisemann illustrated here power tubes may be used in place of the two parallel tubes ordinarily used.

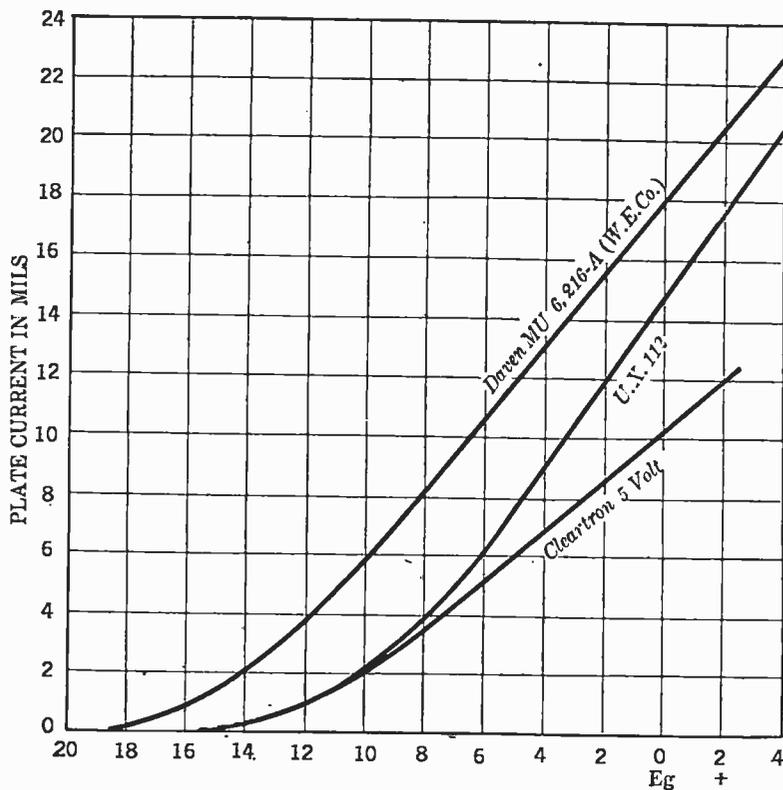


FIG. 7

Curves showing the relation between grid volts and plate current of three power tubes. These curves were made at a plate voltage of 120, and show that a C bias of about $7\frac{1}{2}$ could be used on the Daven MU-6 and the 216-A while for the Cleartron, and the UX-112, a bias of about 6 would be required at 120 volts of B battery

without forcing. Goodness knows what the impedance of loud speakers now on the market may be. There is no standard, for there has been no standard in tubes. Many people try to work cone type speakers on 3-volt tubes, and it cannot successfully be done without some distortion. Manufacturers of speakers should set upon some value of nominal impedance, say 5000 ohms and stick to it. Otherwise some careful designer should bring out an output transformer which will connect a high impedance loud speaker with a low impedance tube, and a low impedance speaker with a high impedance tube.

At the present time, the best combination for a transformer-coupled amplifier seems to be a standard 3- or 5-volt tube for the first audio amplifier, and a semi-power tube in the last amplifier. Since the amplification of 5-volt tubes is considerably above that of dry cell tubes, those who wish the best in quality and volume should use the larger tubes. As a final tube, the UX-112, the 216-A, the Daven MU-6, the Cleartron semi-power tube, the Heliotron power tube—all are excellent choices for that last audio stage. And of course for good quality, good transformers must be used.

TRANSFORMER RATIOS

THERE are several strange ideas prevalent regarding the ratios of transformers. There is no reason why good transformers must be low ratio affairs. In fact one of the best transformers on the market has a comparatively high ratio and for several years before the present broadcasting era, the telephone industry had a high ratio transformer with an essentially flat characteristic.

The difficulty is expense, and until people will pay for high ratio, high quality transformers they will have to be content with low ratio high quality ones.

With regard to the overloading of tubes, there is no difference whether a high ratio transformer comes before a low ratio instrument or not. It is overall amplification that causes overloading, and it is seldom indeed that the first audio

of higher plate voltages, but at the same time it is more difficult to control such an amplifier. As a matter of fact, a five-tube set, with two stages of radio-frequency amplification which are working properly will have all the voltage amplification that can be handled. If a potentiometer controlled amplifier is used, and many of the tuned "r. f." sets use this means of stabilizing, a large B battery current will be drawn when the potentiometer is swung to the positive side. There is no remedy for this, since such sets cannot under existing patent arrangements use C batteries and cannot be neutralized.

RESISTANCE-COUPLED AMPLIFIERS

AS LONG as radio constructors were limited to the usual 3- and 5-volt tubes, resistance- and impedance-coupled amplifiers were not to be advised. Due to the high resistances used as coupling devices, the voltage actually on the plates of tubes is very low, and no amplifier tube will work satisfactorily unless a certain voltage is maintained on the plate. This meant that at least double the ordinary B voltages must be used.

High "Mu" tubes, however, are a distinct boon to resistance- and impedance-coupled amplifiers. Curves taken by Mr. G. H. Browning are illustrative of the effect of using these new tubes and may be seen in his article on the Browning-Drake receiver in this number of RADIO BROADCAST.

Owing to the very high plate impedance of these tubes, they will not act as power amplifiers at all, and in the third stage of a resistance- or impedance-coupled audio amplifier a semi-power tube should be used. To get the same amplification—and the same power into a speaker—from such an amplifier as is obtainable from a good two-stage transformer-coupled amplifier, at least three stages must be used, the last of which should be a semi-power tube as indicated before.

Unless large capacities are used as the coupling units, at least 0.1-mfd., the low frequencies will be dropped out and the user is no better off than if he had used transformers.

Two "high Mu" tubes have come to the

amplifier overloads. From the standpoint of quality, however, the prevailing system of having high ratio transformers first and low ratios second is wrong. High ratio transformers will probably have a lower primary impedance than will low ratio instruments. A detector has a high plate impedance while an amplifying tube has a much lower impedance. If these impedances are to be matched at all, the higher impedance transformer (low ratio) should come next to the detector.

RADIO-FREQUENCY AMPLIFIERS

IT IS probable that the standard practice of using 90 volts B battery and negative 4.5 volts C battery is about correct for radio frequency amplifiers. It is true that somewhat greater amplification will result from the use

Laboratory of RADIO BROADCAST which may be recommended. These are made by Daven and by Cleartron. The former are known as "MU-20" tubes and the latter as the "High Constron." Both have an amplification constant of 20, have proven to be very uniform, and have a plate impedance at 90 volts B of about 30,000 ohms. Daven tubes are designed to operate on 6 volts without the use of rheostats. Since storage batteries retain their voltage output until nearly discharged, the full 6 volts is obtainable.

These high impedance tubes cannot be used, with profit, in a radio frequency stage of present receivers. Their field is in the usage discussed above, and Mr. Browning's curves show conclusively that they are of great value in this connection.

OTHER POWER TUBES

THE UX-120, a dry cell tube to be used to feed into loud speakers, has an amplification factor of 3.3, a plate impedance of 6600 ohms, and should be used with a plate voltage of 135 and a negative C bias of $22\frac{1}{2}$ volts. The power output under these conditions should be .1 watt which is sufficient for high quality high volume operation, but owing to the curved characteristic of this tube it is doubtful of this power output may be approached. This will be an excellent tube for use in super-heterodynes which at present use the ordinary 3-volt tube which has not the output required.

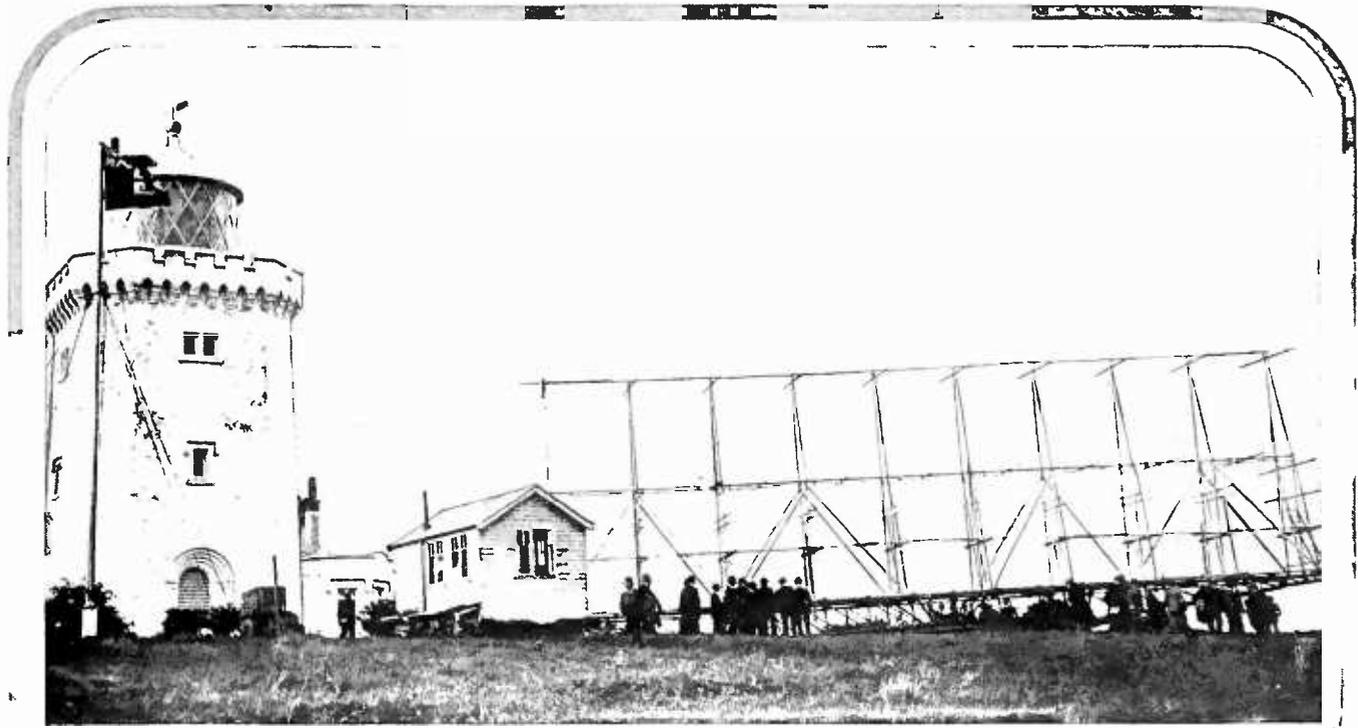
The UX-210 tube is essentially a power tube and should be operated from a source of alternating current by means of a step down transformer, as was described in November RADIO BROADCAST by James Millen. Only where considerable power is desired should this tube be necessary. In the Laboratory it has proved to be an excellent transmitting tube, and more than 30 watts have been applied to it without difficulty.

At the present time, the proper arrangement of tubes in a five-tube set seems to be as follows, 3- or 5-volt tubes for everything but the last where a UX-120, a UX-112, Daven MU-6, Cleartron 112, Heliotron power tube, WE 216-A, Seagull type P, or Goldentone, should be used. If more power is desired, two tubes may be used in parallel, two may be used in a push-pull arrangement, or the UX-210 type may be used.

In a future article the new Radio Corporation ballast and rectifying tubes will be described.

The data given in the table in this article must not be misunderstood. It gives the maximum undistorted power in watts that certain tubes will deliver under certain conditions, those conditions having to do with the plate voltage used and the variation in grid volts being applied to the tube. If these grid volts are not applied, less power will be delivered.

For instance, there is an idea prevalent, since the appearance of semi-power tubes, that the substitution of such tubes for standard 3- or 5-volt tubes will result in a marvelous increase in volume. Such is not the case although some increase will be noted due to the lower output impedance of these tubes over these in standard use. Under the same operating conditions, a standard tube and a semi-power tube will deliver about the same power. The great advantage of the newer type of tube is that it will handle more power, that is, a greater input voltage and corresponding greater output, than the 3- or 5-volt type. In other words, the substitution of a 112 type or 210 type tube will enable the user to use greater voltage amplification up to the last stage and by the proper use of C, and B batteries, distortion due to overloading will be less likely to result.



THE MARCH OF RADIO

By *J. J. Morecroft*

Past President, Institute of Radio Engineers

What Is the Matter With the Naval Radio Service?

ONLY a short time ago radio had one of the best opportunities in its history to prove its worth to the mariner in distress—and failed. It is not in a spirit of cynical criticism that we bring up this incident but rather with the purpose of inquiring whether something cannot be done to prevent similar occurrences in the future.

The whole country was enthusiastic several months ago over the idea of our naval aviators hopping from California to Hawaii. Three of the planes were to go, but due to mishaps only one made a serious attempt at the long flight. This trip had been planned very carefully and it seemed as if nothing could happen to prevent the goal being reached. Destroyers were used to mark the course and were ready to render assistance should the planes come to grief; every two hundred miles along the two-thousand mile course a destroyer or a supply ship was stationed to give the planes the proper direction and to record their progress.

The radio equipment of these planes was supposed to be of the very best. With a sending radius assumed to be in the hundreds of miles, and reliability of operation never before attained (as the description of the radio outfits specified), it was

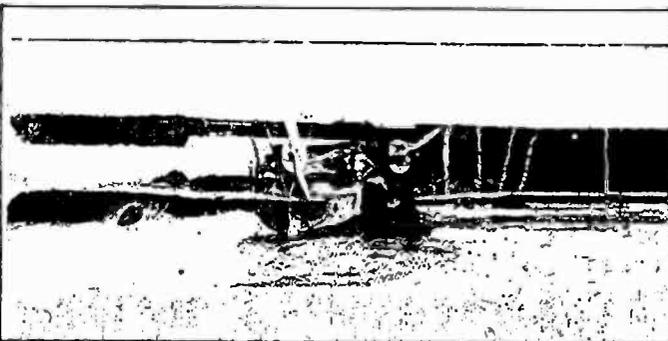
confidently assumed that the operators of these seaplanes couldn't help knowing exactly where they were, and could keep in constant communication with the marking vessels. The radio signals were to be used for compass bearings as is the case every day with hundreds of ocean-going ships, and altogether the planes were considered as safe as though they were close to their own home port.

One of the planes had mishaps and had to give up the trip after covering a short distance, another never even started. The third flying boat however, *PN-9 No. 1*, in charge of Commander Rodgers, got well away and picked up the first of the marking ships almost on schedule. The wind was not quite as favorable as had been hoped, so that the speed was considerably less than that reckoned on. Thus the gasoline supply was not quite sufficient to cover the two thousand miles and Commander Rodgers decided to come down near the *Aroostook*, two hundred miles from the end of his trip, to renew his gasoline supply.

And now, probably the only time during his trip that the radio channel was really needed, it failed. The radio compass bearings should have enabled the *PN-9 No. 1* to proceed at once to her supply ship, but the plane missed her completely. The

compass bearings indicating that the *PN-9 No. 1* was south of the *Aroostook*, her commander flew north until his gasoline supply gave out and he had to drop to the ocean. The plane's position was then calculated by her commander as fifty miles north of the *Aroostook*.

Having thus failed in its important work of keeping the plane on her course, the Naval radio now scored an even worse failure. With no gasoline to run her engines, the only thing the Commander of *PN-9 No. 1* could logically do was to call for help and supplies. It is exactly in emergencies of this kind that radio is supposed to be the mariner's most useful agency, but this failure was nothing short of dismal. Only fifty miles from the waiting patrol ship, the *PN-9 No. 1* was for some inexplicable reason helpless as far as radio communication was concerned. And to add, to its ignominious failure, radio served to agonize the souls of the crew by letting them hear all of the radio messages with which the air was filled. Gradually, their receiving set told them, the searchers were giving up hope of finding them; each succeeding day their would-be rescuers were becoming more discouraged and evidently soon would give up the search. And all this time their rescuers were only a couple of hundred miles away!



RADIO PICTURES OF THE CALIFORNIA-HONOLULU AIR FLIGHT

Sent from Honolulu to New York on Sunday, September 13, by the Ranger photoradiogram system. The distance is 5116 miles. Left: Commander John Rodgers of the *PN-9 No. 1* as he looked when he landed at Lihui, Kauai Island, after his rescue from the disabled plane shown in the view above. The ship was adrift for nine days, owing to failure of radio compass bearings when the ship was only about 200 miles from her goal. When she landed on the sea, there was no emergency transmitter to signal the rescue vessels. The operator of the plane was forced to hear all the conversations relating to the rescue work

There is no good reason why a single circuit regenerating receiver could not have been used as a transmitter for the short distance to be covered, if no other means were at hand. But why wasn't there a transmitter which would work if the plane was forced down? According to the plane's commander, a perfect landing on the ocean was made and nothing happened to interfere with the radio apparatus performing as it was intended to do. Why didn't it perform? Was there no emergency apparatus able to operate if the plane was forced down?

Favorable weather and fortunate winds enabled these trans-air travellers finally to reach land after nine days of hazardous drifting in their tiny craft. And with that loyalty to the service which the Navy officer feels to be his first duty, Commander Rodgers stated that "there was no failure of material at any time in the air or the water."

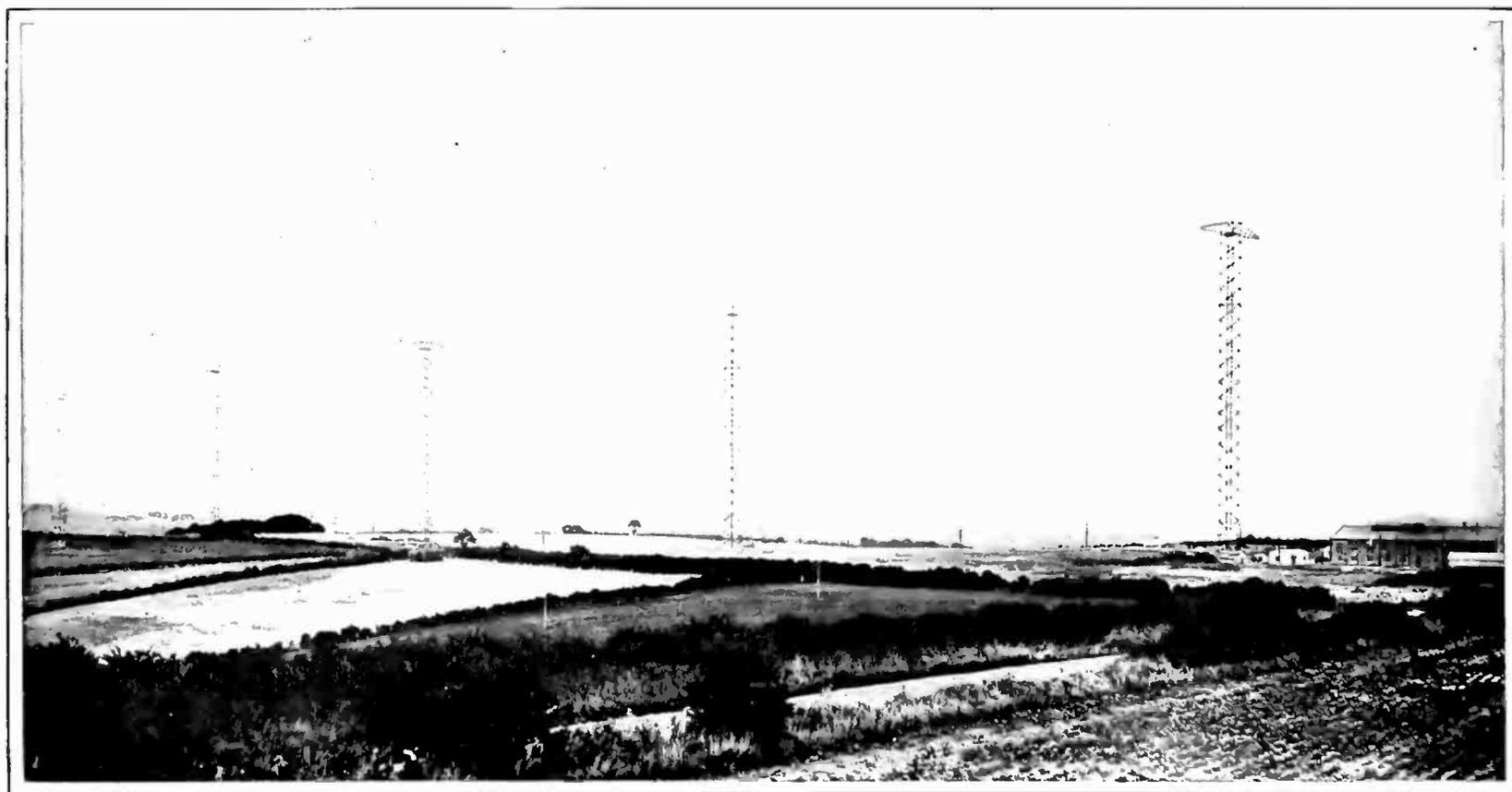
We are not under the restraint that

Commander Rodgers is, and we can say frankly that there was a failure, one of the worst that radio has scored. Some explanation should be forthcoming from those responsible in the Naval Radio Service for this blot on their reputation.

It transpired in the hearing which followed the disaster several years ago, when six Naval destroyers were wrecked off Point Arguello, that the compass bearings given to the leading destroyer by the Naval radio station were incorrect. The radio weather intelligence furnished the *Shenandoah* on her recent disastrous trip was incomplete or entirely lacking—to which one might lay a large share of the blame for the failure of her navigating officers to avoid the storm which destroyed the ship. Listeners who have heard the way in which sos traffic has been handled recently around the New York territory have observed that the Naval stations have handled that traffic in a singularly inexpert fashion. Taken all in all, there are unmistakable signs that there is something radically wrong with the Naval Radio Service. Who is to blame?

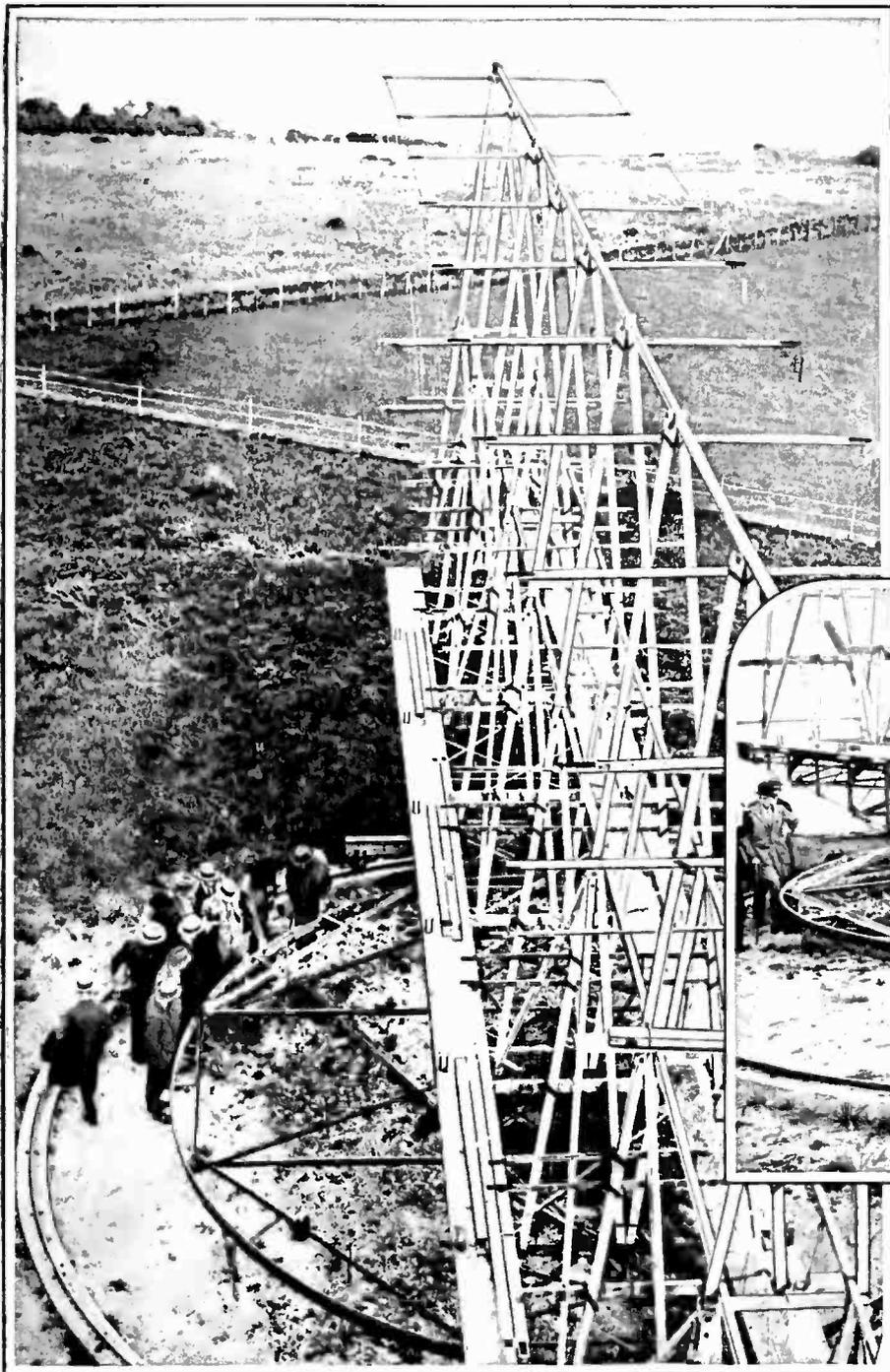
National Association of Broadcasters

ALTHOUGH the average broadcast listener probably knows nothing about it, their purveyors of entertainment have been organized for some time. The National Association of Broad-



THE NEW MARCONI DIRECTIONAL BEAM STATION AT DORCHESTER

About 120 miles from London. This is a new and exclusive photograph published for the first time in the United States. The picture shows five of the masts which are 277 feet high, and 750 feet apart. The masts are at right angles to the direction in which communication is to be established. The cross arm at the top is 90 feet across. The antenna wires, which are not yet in place, will be attached to triatics at one end of the cross arm and the reflector wires to the other. The distance between the antenna wires, reflector wires, and the number and distance apart of the separate wires making the antenna and reflector will depend on the transmitting frequency used. The installation shown is expected to communicate with New York. Others now in process of construction and test will connect England with Australia and the Dominions. On a recent four-day test, Senator Marconi announced that he had been in uninterrupted communication with Australia, using the beam system



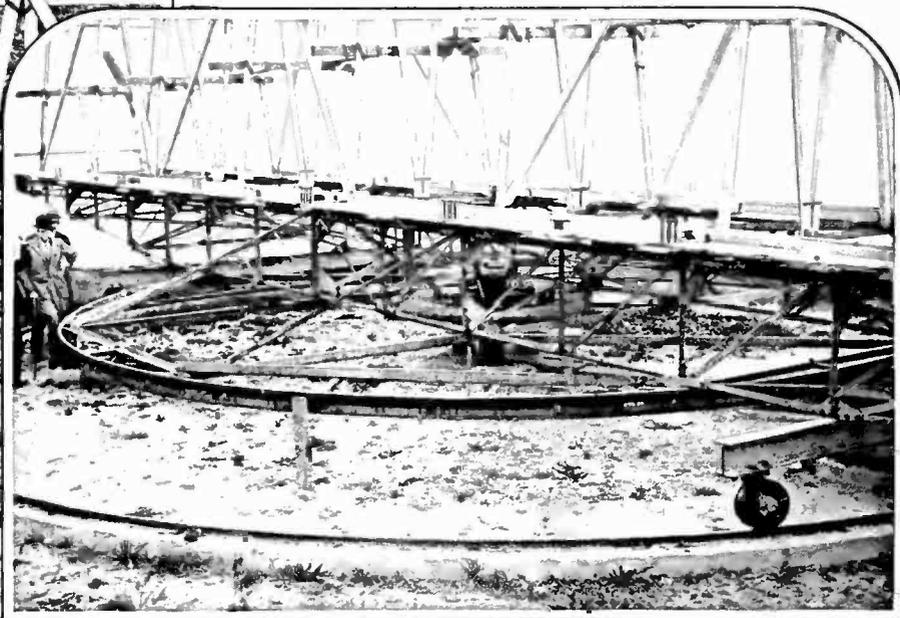
Be It Resolved that, it is the sense of this meeting that any agency of program censorship other than public opinion is not necessary and would be detrimental to the advancement of the art."

More Information on Super Power

AS THE first experiments on higher broadcasting power continue, the public is beginning to see that those engineers who advised caution in drawing conclusions as to what effect this increased power would have were wise. Many were the broadcast listeners who said 50 kw. for one station would blanket all that part

DETAILS OF THE RADIO "BEAM" LIGHTHOUSE AT SOUTH FORELAND, ENGLAND

Senator Marconi recently conducted tests with this installation from his yacht *Elettra*. The beam flashes signals ac-



ording to a schedule from all points of the compass. The loud speaker announced a letter at intervals, and the position of the ship was determined according to the letter heard. By means of a chart, it was possible to tell just where the ship was. The frequency was 49,970 kc. (6 meters). The heading for this department this month shows the lighthouse and the revolving antenna and this view shows the details of the antenna

casters had its annual meeting this month and its transactions are indirectly of interest to us all. The object of the society is to promote generally the welfare of our broadcasting stations through various cooperative arrangements.

It was started by a small but active group in the Middle West, with the able Mr. Paul B. Klugh as Executive Chairman. Its activities proved so worth while that the membership rapidly increased and now it bids fair to justify its name.

Among the members elected at this meeting was WEAJ, representing the American Telephone and Telegraph Company. When this company goes into an association of this kind it is undoubtedly a sign of its promised or accomplished success.

The question of broadcasting copyrighted material has been more troublesome to the National Association of Broadcasters than any other problem in their operations. At first the organization was averse to paying royalties for the privilege of putting music and songs on the air (the copyright law, of course, contains no pro-

viso for such an exigency). Now this association has changed its point of view. Among other resolutions passed was one which would put the broadcasting of copyrighted material on the same basis as the mechanical reproduction of such pieces (by player piano and phonograph) in so far as royalties are concerned.

Another matter which received consideration was that of the method of introducing the paid features of the program. One of our congressmen has advocated the complete separation of paid channels from the others. That attitude seems unnecessary and inadvisable. The broadcasters took this view of the matter and decided that paid programs could be "gently" introduced.

On the question of censorship, the society declares that "Whereas it is universally agreed that the success of radio broadcasting is founded upon the maintenance of public good will and that no broadcasting station can operate successfully without an appreciative audience, and Whereas the public is quick to express its approval or disapproval of broadcast programs

of the broadcast range, that it would be impossible to receive other stations which sent signals of anywhere near the same frequency. Some months ago we got several petitions (with requests to sign) directed to Mr. Hoover, requesting that he prohibit broadcasting stations using a greater power than 5 kw. The petitions stated what troubles were to be encountered if the Department did not block this anticipated move by the "Trusts."

Schenectady has carried on many tests with a 50 kw. outfit, and at the time this is written, very few complaints have been received. Many replies have been received to questionnaires sent out, and they are still being classified and compiled. It is interesting to note that the public must be depended upon to answer the question as to how much power the broadcasting agencies should use. All questionnaires received should be carefully answered, for it is the facts in the compilation of these answers that Mr. Hoover will depend on to determine his future policy regarding high power stations.

Although many of the letters received by WGY are contradictory, the average listener seems to think that a 50 kw. signal is two or three times as loud as a $2\frac{1}{2}$ kw. signal. In the recent tests, the two powers were alternated so that repeated comparisons could be made and but few of the reports say that one signal is more than ten times as strong as another. As a matter of fact, theory would indicate that the 50 kw. signal is twenty times as strong as a $2\frac{1}{2}$ kw. signal, yet most of the listeners say it is about twice as strong. Probably the signal is actually twenty times as strong and the factor ten by which the average listener misses the truth is due to his lack of skill in comparing noises of different strengths.

The unexpected absence of complaint regarding interference by the high power channel has encouraged the General Electric engineers to continue their tests and the Department of Commerce has given WGY permission to use 50 kw. regularly on Saturday and Sunday evenings. If this much power is found to give to the broadcast listeners more trouble than benefit it will be discontinued, but it is almost sure that such will not be the case. A few listeners near the station who want to hear other stations thousands of miles away, whose frequency is nearly the same as Schenectady's, will of course report interference. This can be predicted without any further tests. But as radio broadcasting develops the complaints of the distance hound will fall upon less sympathetic ears. High

quality reception for the most listeners is what radio must eventually supply and increased power, properly controlled, will help in the solution of this problem.

Canada as Our Instructor

WE MUST congratulate our Canadian friends on the way their governmental radio activities are conducted. It has been noted before in these columns that many radio questions were tackled in an intelligent and reasonable manner by our northern neighbors, even though some of their procedure (such as the licensing of receiving sets at one dollar a year) may not meet with our approval.

There has just come to hand a pamphlet put out by the Radio Branch, Department of Marine and Fisheries, Ottawa, which takes up the question of regenerative receivers. It is a circular letter addressed to all broadcast listeners and is written in a manner which will appeal to the average non-technical man. The letter starts with the paragraph "When using a receiver of the regenerative type for the reception of radio telephone programs, please avoid increasing regeneration to the point at which the receiver begins to oscillate, otherwise you will cause interference with neighboring receiving equipment." *Are you doing your best to observe this?*

The letter then proceeds to give an elementary, but clear and correct analysis of what regeneration is and why it causes interference, ending with easily followed instructions as to how to avoid spoiling neighbors' reception. With the government list of listeners available, as a result of the licensing feature of radio reception in Canada, this circular should reach the owners of nearly all the radio sets in that country and should do a deal of good.

The Facts About the Farmer and Radio

THE benefits which radio confers on the farmer have been represented to him repeatedly, but it is a fact that no one has really known whether the average farmer profited by broadcasting or not. A recent survey by the Department of Agriculture among the country's farms yields the information that there are 553,003 sets on farms, not as many as we had expected. This represents only $8\frac{1}{2}$ per cent. of the country's farms, so there is still a large virgin market for the active radio manufacturer.

A questionnaire was sent out and the returns for the State of Pennsylvania have been sent us by Mr. George F. Johnson of the Department of Agriculture at Harrisburg. Of 343 answers received, two thirds used tube sets with loud speakers. To the question "Have market reports ever made or saved you money?" exactly half answered "Yes." and half "No." We hasten to encourage the promoter of "radio for farmers" after this answer, because while it looks at first as though radio was not functioning very well here; that is really not the significance of the return. That fifty per cent. of the farmers saved money from the information conveyed over the radio channel is incontrovertible evidence of its utility.

The Month in Radio

ENGLISH employment agencies are finding that domestic help appreciates radio possibly even more than does the mistress of the house. Basting the roast beef in tune with the wedding marches, or washing dishes to the time of modern jazz proves to be so appealing that the agencies are said to be actually classifying the vacant positions as radio and non-radio, much to the detriment of the latter.

THE first attempts experimentally to determine the proper allocation of frequencies to the various European stations resulted in ethereal pandemonium,



HOW THE CANADIAN RADIO SERVICE HELPS THE LISTENER
The "Inductive Interference" car maintained by the Radio Service of the Canadian Government. The annual license fee of one dollar, paid by every Canadian listener is used to maintain a corps of inspectors. A specially trained "induction squad" operates with this car to locate interference hard to detect by the ordinary methods. The car is especially made for this purpose, with a body of insulating material and carefully screened ignition system. Two special super-heterodynes, several portable receivers, a sledge hammer, condensers, and chokes form the equipment of the trouble car. The chokes and condensers are applied to cure trouble when found. The sledge hammer is often used to tap electric light poles in a suspected territory, and the trouble is quickly located by a listening inspector





© Harris & Ewing

SENATOR C. C. DILL

Washington; United States Senator for Washington

"The organization of a Government Commission on Communications to act for the telephone, telegraph, and radio, such as has been proposed, would probably end in disaster for broadcasting. It would be the beginning of the end of freedom of action in the radio business. I also wish to emphasize the necessity of immediate action on the part of the United States Supreme Court to arrive at a decision regarding the broadcasting of copyrighted musical numbers. If it is decided that such broadcasting is done for profit, and therefore a fee is due to the publishers of the music, I intend to introduce a bill to regulate the payments, so that radio broadcasting will not be at the mercy of any one group of men."

according to a dispatch from London. About sixty stations going at once in an expanse of territory perhaps less than a quarter the area of our country proved too much. The interference was truly international. Newcastle, England, heterodyning with Gratz, Austria, and Norway stations beating with some in England, Germany and France, show us what a difficult question the Europeans have compared to ours. The radiophone center in Geneva was notified of all the interference and in the next test period changes will be made to keep the interfering stations farther apart in frequency.

THE research laboratory of the Westinghouse Company announces that the metal, thorium, is now available in such quantities that the filaments of vacuum tubes may be made of pure thorium instead of thoriated tungsten as is now the practise. The present tubes have a layer of thorium on the surface of tungsten filament, the layer being only about one atom deep. If the filament is improperly used, this thin layer of thorium disappears and the electron emission practically stops, the tube is useless. By considerably overheating the filament, without B batteries, a new layer of thorium will appear, this new

thorium diffusing to the surface from inside the filament.

Now, it is announced, solid thorium filaments will soon be available. This is a real advance because the possibility of the disappearance of the thorium atom-deep layer no longer threatens. The new tubes will very likely have much longer life than the present ones and not be so sensitive to improper adjustments.

A RECENT discussion in the semi-popular press, having to do with the use of super-power, ventured the statement that if a 5 kw. station was audible on a crystal set at twenty-five miles distance, the 50 kw. station would be audible on the same crystal set for a distance of "several hundred miles." It seems that if we interpret "several hundred" as five hundred miles, the power of the 5 kw. station would have to be increased to at least 250 kw. to increase the crystal set range as much as the writer suggested—and then it would probably fall short. Schenectady's tests should soon give us some reliable information on this point.

ACCORDING to the Department of Commerce, Japan's long distance radio telegraph stations are to pass from the control of the government into the hands of a private company which expects to erect two new stations in addition to the two now in operation and that when their four stations are in operation the company will communicate directly with the United States, Germany, and France. With the 50 kw. of power which the new stations are to have it seems very unlikely that signals can be sent directly to Europe except under most favorable conditions. Most of the time one or two relay stations will undoubtedly be required if any reliability is to be obtained.

Interesting Things Said Interestingly

POWELL CROSLY, Jr. (Cincinnati; president Crosley Radio Corporation): "Very few broadcasting stations are operating with any direct profit. No broadcasting station in the country is making money to-day. Some handle indirect advertising with some source of revenue; so far, I believe, no stations have been able to meet expenses with this income. Our own revenue at WLW from this source would not pay for the direction of the studio. We have a large investment in broadcasting equipment—whether it is profitable for us to broadcast is a question; whether the good will created by a broadcasting station justifies its continued existence is merely a matter of opinion. No one can check the results. If all broadcasting stations face an additional expenditure of from \$5,000. to \$50,000. per year, due to the royalties imposed by the Society of Composers, Authors and Publishers, and perhaps more, because no limit has yet been set—how many of these stations will continue? Imagine the feelings of a man who appreciates the serious-



CARDINAL HAYES

New York; Speaking at the opening of station WLWL:

"Among the most recent and wonderful gifts of science comes the radio. As Cardinal Archbishop of New York, I congratulate the Paulist Fathers upon the great work they have undertaken in opening up station WLWL. I congratulate also the people of this immense city and of this whole country of ours upon the inauguration of an enterprise so admirable. May I add that in the building of this station, the Paulists have shown themselves worthy sons of their founder, for nothing was more characteristic of the first Paulist, Isaac Hecker, than this readiness to utilize every new instrument of good. How his noble soul would rejoice to witness this scene, the dedication of the twin towers of steel that overlook the Paulist Church here at Fifty-ninth Street, as an agency for the spread of truth and wisdom. We who employ radio are responsible for our use of it. We must take care that we use it not for harm. But, further, we are strictly bound to use it for good, to make it fruitful. Whoever would be great, must serve. He who has power must turn it to the welfare of his fellows."

ness of this situation, playing a gambling game in which no limits are set—where the more he pays the more he will have to pay—and you will appreciate how serious the situation is."

GOVERNOR ALFRED E. SMITH (Albany, New York): "Radio broadcasting has revolutionized political campaigning. It makes it possible for a candidate to reach the by-ways of politics. The stay-at-home gets your message as clearly and intelligently as the man who is able to come out to the meetings. A great event can be recorded at the fireside. The opening of the extraordinary session of the New York State Legislature this year is an example. It brought to the people young and old an important lesson in civics and gave them exactly the procedure which occurs when a session of the Legislature is opened. Radio gives you the widest possible audience and also the benefit of public opinion. I have had occasion to use the radio on many important occasions including my inauguration as Governor and in making an appeal for public support of important and vital policies. Just as it has served my needs and opened up a tremendous avenue for political education, I am glad to have the opportunity to say so to the radio public."

A Five-Tube Receiver of Dual Efficiency

A Late Development of the Famous Browning-Drake Receiver Employing Impedance-Coupled Audio Amplification Producing the Highest Quality—Some Valuable New Data on Radio-Frequency Transformers and a New Method of Balancing Them

By GLENN H. BROWNING

QUESTIONS are frequently being asked concerning the necessary requirements of the ideal radio receiver. The answer pictures a set which is sensitive enough to receive great distance, gives perfect reproduction of the program being broadcast, tunes sufficiently sharp to separate transmitting stations, does away with interference, and accomplishes all this without batteries, tubes, or other trouble making devices. At the present time, our ideal seems far from the realm of realization, but at least we may take a step in the right direction, by scientifically investigating radio and audio frequency amplification.

The receiver to be described, which consists of one stage of balanced, tuned radio frequency amplification, regenerative detector, and three stages of impedance-coupled audio amplification, is still far from perfect, but it is sensitive enough to do DX work, selective enough to cut through locals, is properly designed for good quality reception, and does not radiate.

Let us consider the component parts separately. The tuned radio-frequency transformer is probably the most important part of the receiver, for into its development went almost a year of theoretical

and laboratory work by Mr. F. H. Drake and the writer, with a result that a piece of apparatus was designed, which gave almost 90 per cent. of the amplification predicted by mathematical calculations.

Several interesting discoveries were made during this time, among which was the fact that the "turn ratio" of a tuned radio-frequency transformer was not so

regeneration is present in any radio-frequency amplifier to a greater or less extent, and the necessity of providing a method of controlling it arises sooner or later. A little experimenting showed that greater signal strength could be obtained by balancing the radio tube and regenerating on the secondary of the radio frequency transformer, rather than regenerating directly on the antenna tuning system. The former course, besides giving greater signal strength, has the added advantage that it does away with any radiation tendencies the receiver might otherwise have.

SELECTING THE AUDIO AMPLIFIER

IN CHOOSING an audio amplifier for the circuit, some experimenting was necessary, as one can use

transformer, resistance-, or impedance-coupled systems with varying results. Two stages of, say, 4 to 1 transformers will undoubtedly give sufficient volume, but the quality or naturalness of the received program must, in some measure, be sacrificed.

Three stages of impedance-coupled amplification has as good quality as resistance, and, if properly built and operated, gives greater volume and does not require an abnormal B battery voltage. It was con-

ALTHOUGH Mr. Browning has made few fundamental changes in the original design of the justly famous Browning-Drake receiver which was originally described in RADIO BROADCAST for December, 1924, the reader will find that the receiver described here contains some distinct improvements which place this model in the vanguard of current receiver design. The improvements are in the audio circuit, and impedance-coupled amplification has been chosen. The four-tube model of the Browning-Drake receiver does frequently overload, but the set described below is almost free from that disadvantage. In this article, the author presents some interesting data on comparison between transformer-, resistance-, and impedance-coupled amplification, and suggests a new method of balancing the radio-frequency transformer. It should be read with much interest.—THE EDITOR.

important as the resistance of the secondary circuit, and the relation between primary and secondary. It was also found that any capacity between these two windings tended to decrease the efficiency, so that the final design consisted of a "bunched" primary winding coupled closely to a low resistance secondary coil. Having designed the radio frequency part of the circuit, the question of regeneration was then encountered. As most radio fans know,

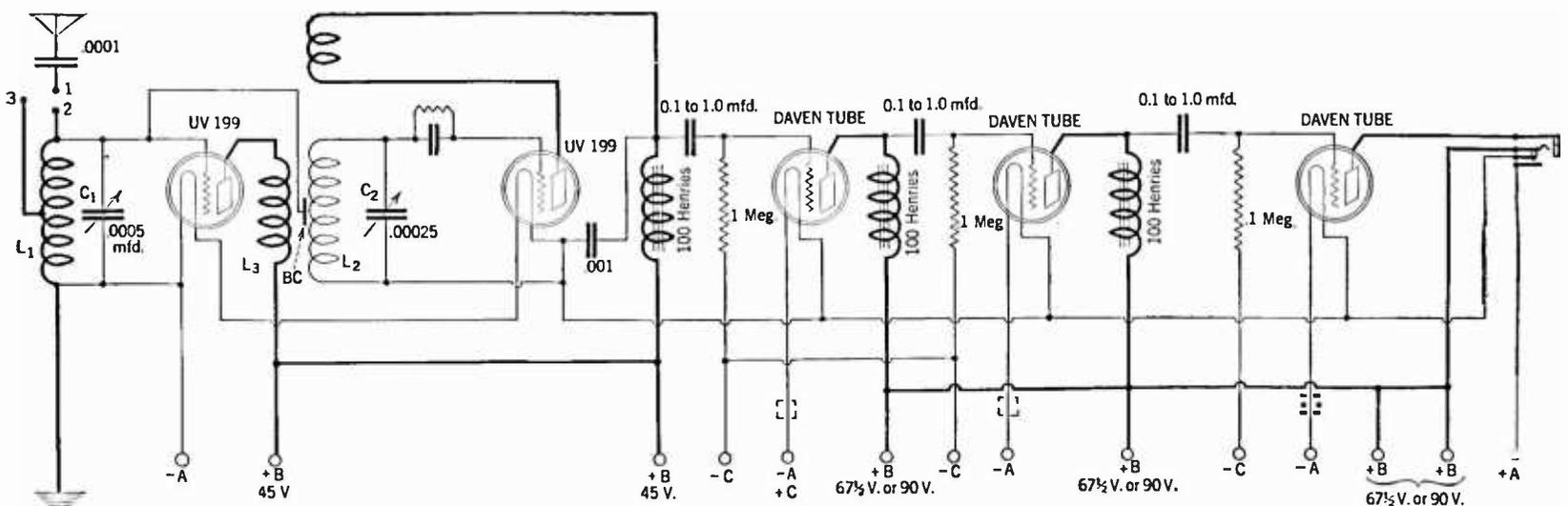


FIG 1

□ 1/2 Amp. Ballast for 5 Volt Tubes
 ▭ 1/2 Amp. Ballast for Power 5 Volt Tubes

The schematic diagram of the circuit employed in the receiver. The several battery terminals of similar markings are paralleled and connected to the terminal of the indicated polarity of the battery in question. For instance, there are four minus A posts. This group is connected together as one terminal, thence connecting to the proper battery. The same holds true of the two plus B 45-volt terminals, and the three plus B 67 1/2-volt or 90-volt terminals. However, in the case of the minus C battery terminals, the last audio stage will require more voltage than the first two

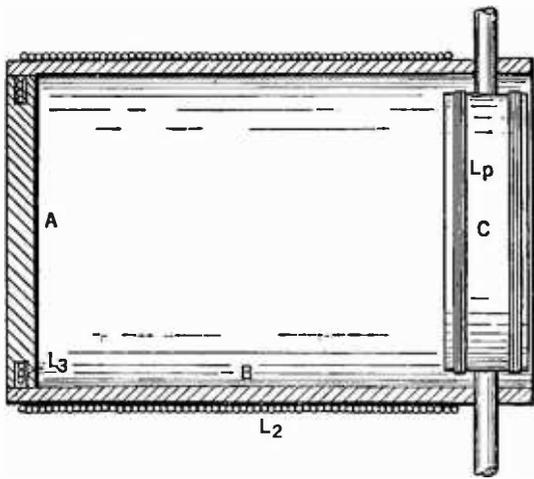


FIG. 2

Details of the winding of the radio frequency coupler. L₃ is the primary; L₂ the secondary, and L_p the variable tickler coil. The actual winding specifications are contained in the accompanying article

sequently chosen for the receiver to be described.

For those who are interested in laboratory measurements, a comparison between the three systems is shown in the accompanying chart, where signal strength is plotted for frequencies ranging from 100 to 10,000 cycles per second. It will be seen that the more constant the amplification for the frequencies shown, the better is the quality of the received signals.

The conclusion to be drawn from this data has lead us to choose three-stage impedance-coupled amplification with high-Mu tubes.

The parts listed below were used in building the set. Whether or not the builder follows the exact list given, he will need the parts listed below or their equivalent.

One panel—21 x 7 inches.

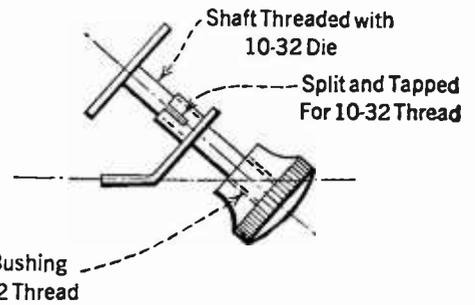


FIG. 3

Shows the mechanical arrangement of the balancing condenser plate and mount. It is to be mounted on the sub-panel in the rear of the radio frequency secondary coil

One sub-panel (bakelite) 18 x 7 inches.

One National Kit (containing the two variable condensers and Browning-Drake coils.)

Five Na-ald sockets (2 UV-199 and 3 UV-201A).

One Daven Leakandenser (the leak should have a resistance of 6 to 8 megs.)

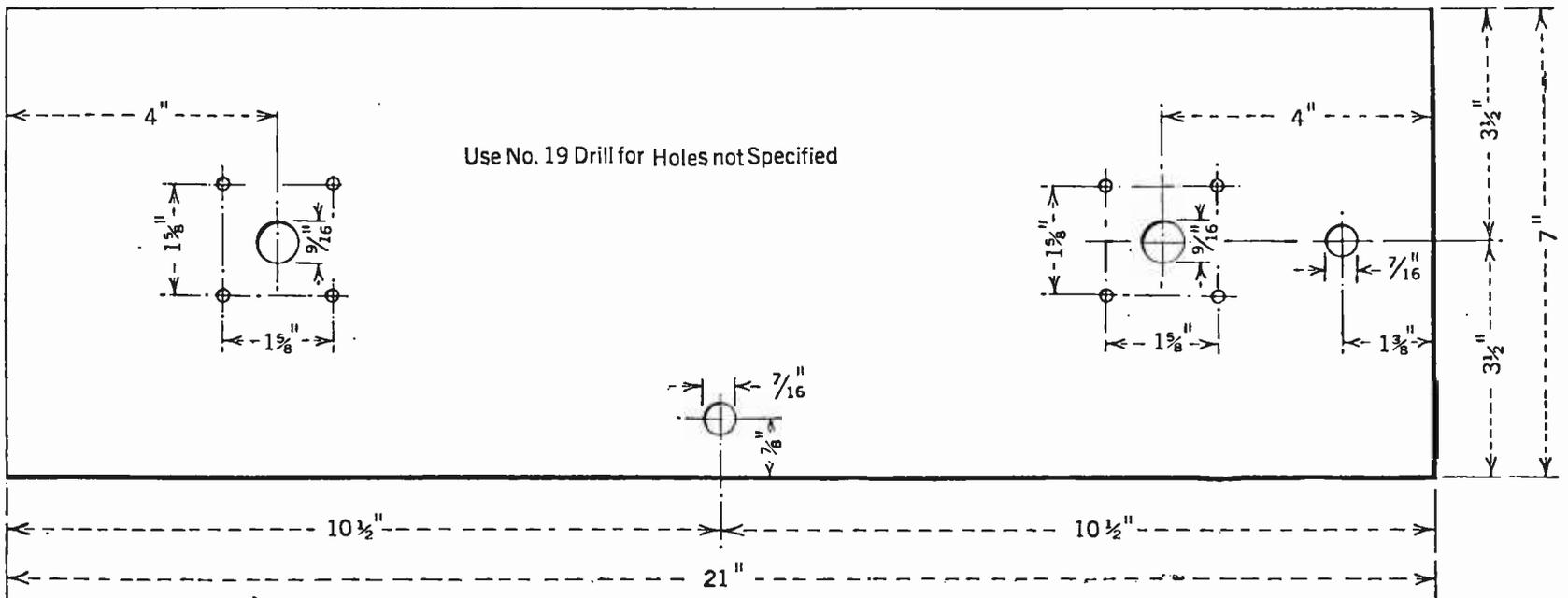
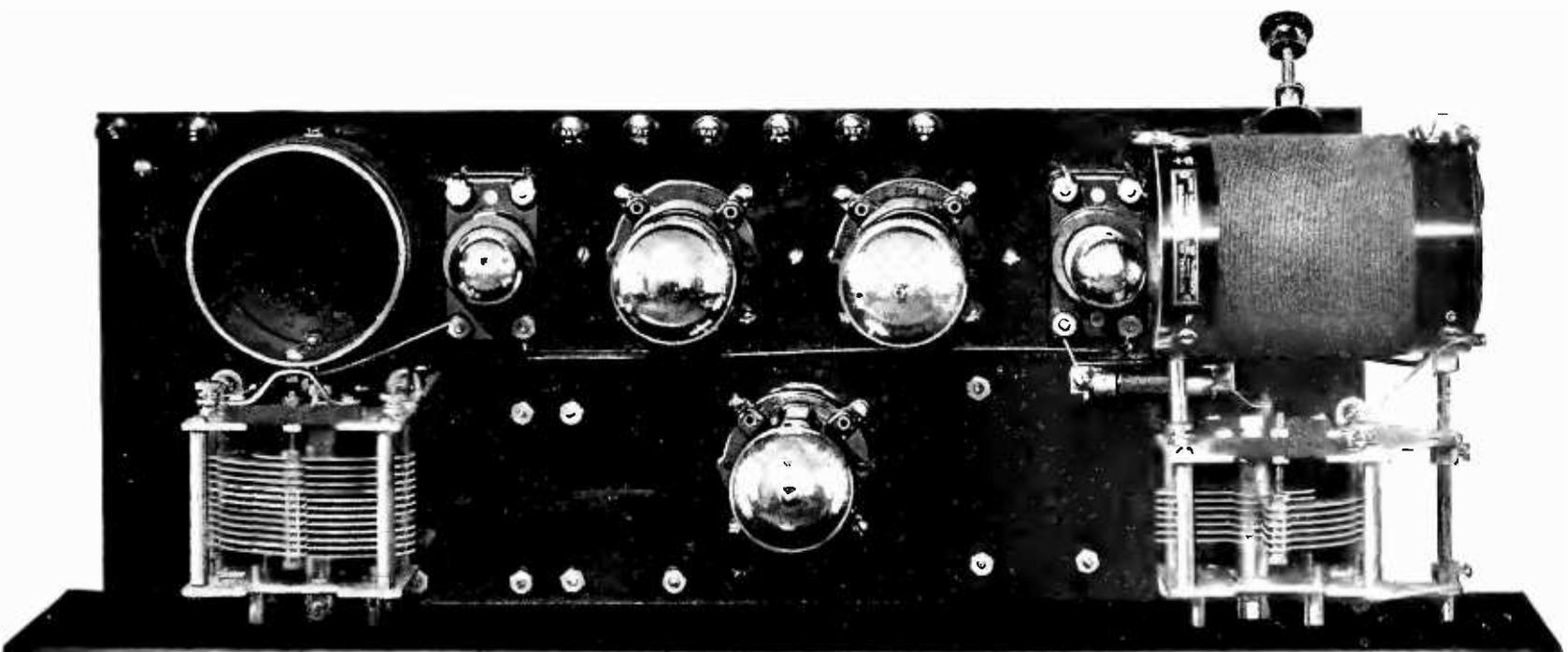


FIG. 4

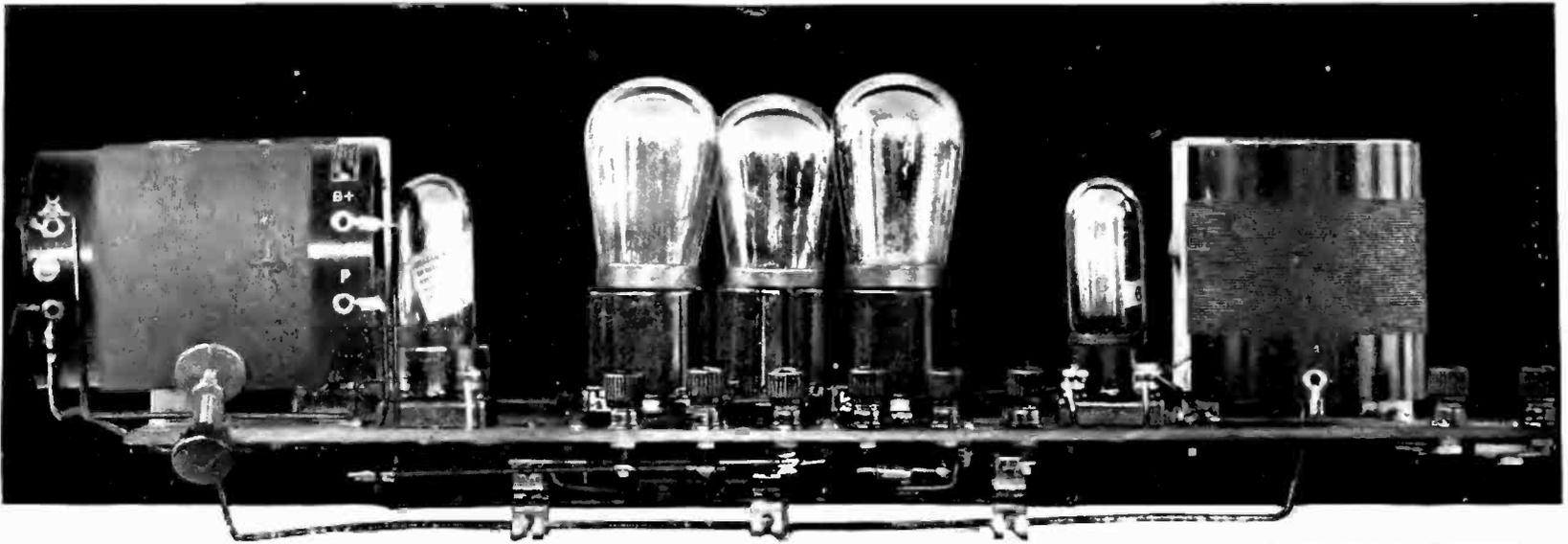
The panel layout. There is room enough between the two tuning condensers to include a filament voltmeter which would not only add to the appearance of the receiver, but prove exceptionally advantageous in knowing the value of voltage delivered to the tubes



RADIO BROADCAST Photograph

FIG. 5

Looking down on the sub-panel, the position of the balancing condenser may be observed. Much of the wiring is below the sub-panel



RADIO BROADCAST Photograph

FIG. 6

The simplicity of assembly is evident from this view. Note that the two coil units are at right angles to each other and on the same plane. This is necessary to prevent uncontrolled oscillation

Three Daven .1 megohm grid leaks, and mounts.

Three 100-henry National chokes.

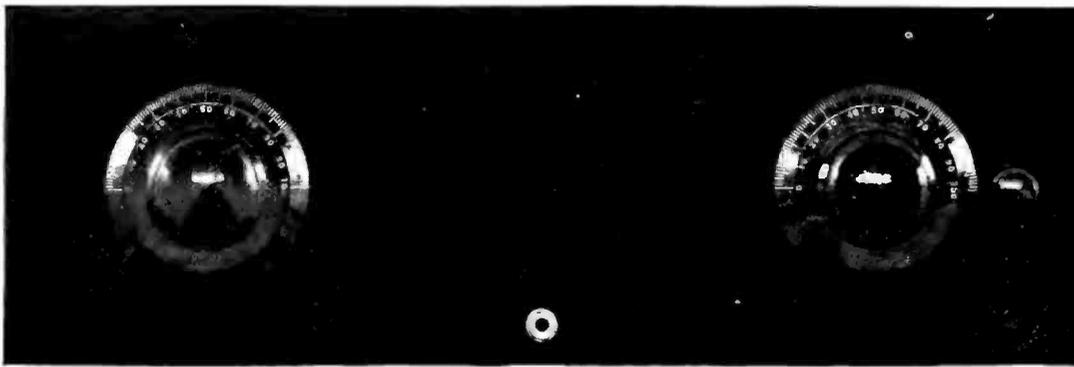
One Yaxley filament control jack.

One .001 mfd. fixed by-pass condenser.

One .0001 mfd. fixed condenser.

One balancing device.

Nine binding posts.



RADIO BROADCAST Photograph

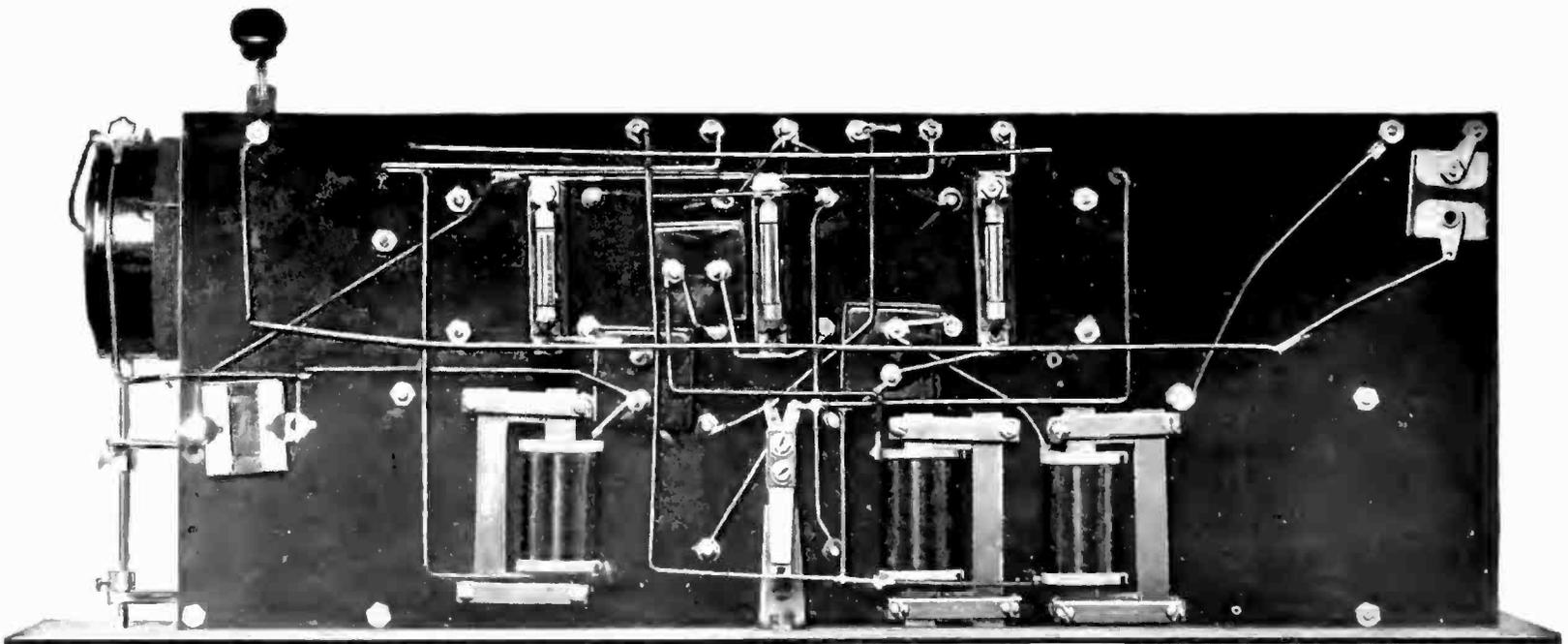
FIG. 8

The panel appearance of the completed receiver: simplicity itself

Fig. 1 shows the schematic diagram of the circuit used. The antenna tuning coil L_1 consists of 46 turns of No. 20 d.s.c. wire on a three-inch bakelite form with a center tap taken off. The radio-frequency transformer, commercially familiar as the "regenaformer," consists of three windings, a primary, a low resistance secondary, and a rotor coil. The details of its mechanical

construction are given in Fig. 2. The primary, L_3 , consists of 24 turns of No. 28 or 30 d.c.c. wire, wound in a groove and placed at the low potential end of the secondary coil (under the first few turns of the secondary at the filament end). The secondary, L_2 , is a single-layer solenoid made by winding 75 turns of No. 20 d.s.c.

rotor coil L_p is made up of 20 turns of No. 28 d.s.c. on a $2\frac{1}{2}$ -inch form and so mounted that it may be rotated with respect to the secondary of the tuned radio-frequency transformer. The condensers chosen to tune the two circuits are of such construction as to separate the high frequency (short wavelength) stations considerably



RADIO BROADCAST Photograph

FIG. 7

An under-view of the sub-panel where most of the wiring is placed. Convenient holes in the sub-panel allow the passage of wires connecting parts above the sub-panel with those below it

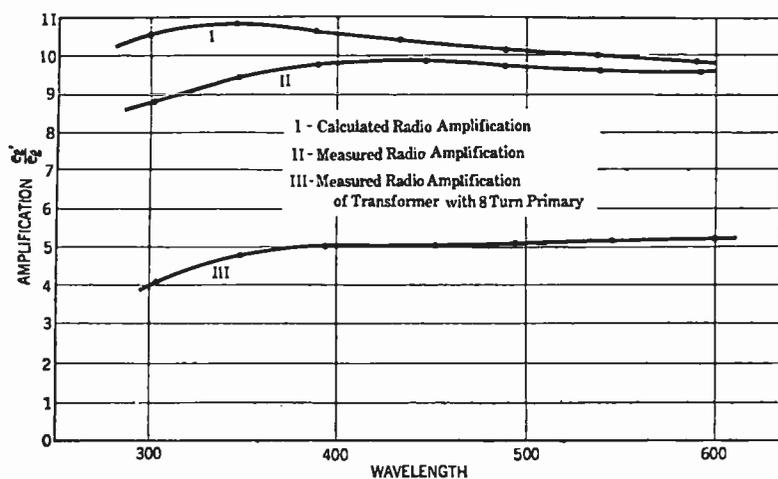


FIG. II

Three curves which are both interesting and instructive. Note how approximately correct in comparison is the calculated and measured radio frequency amplification while manifestly the 8-turn primary is not as good

also be kept well away from other connections. A center tap is provided on the first coil, L_1 , to be used with a long antenna of 100 feet or over, but as some antennas, which are even much shorter than this, have a large amount of capacity, it is well to make the connection from the .0001 mfd. condenser to the point of the coil which makes the two dial settings most nearly coincide at mid-scale. Only one jack is used, as most radio enthusiasts use a loud speaker except when tuning for extremely distant stations, and then it has been found that three stages of impedance-coupled amplification can be used conveniently with head phones. This is due to the fact that the noise which is apparent with transformer coupling, and which tends to draw comfortable reception of distant

in such a way that greatest signal strength will be obtained

Connect batteries, phones, and ground to the set, but do not connect the antenna. Turn the rotor or tickler coil to a point where placing a finger on the stator plates of the condenser, C_2 , gives a loud "pluck" in the phone. This shows the secondary of the radio-frequency transformer is oscillating. Now rotate the coil until oscillations cease, as determined by the finger test. The first condenser should then be turned through its range, and if, at any setting of this condenser, the secondary of the radio-frequency transformer oscillates, the balancing device should be adjusted until this test is satisfactory, and the two tuning circuits are entirely independent of each other.

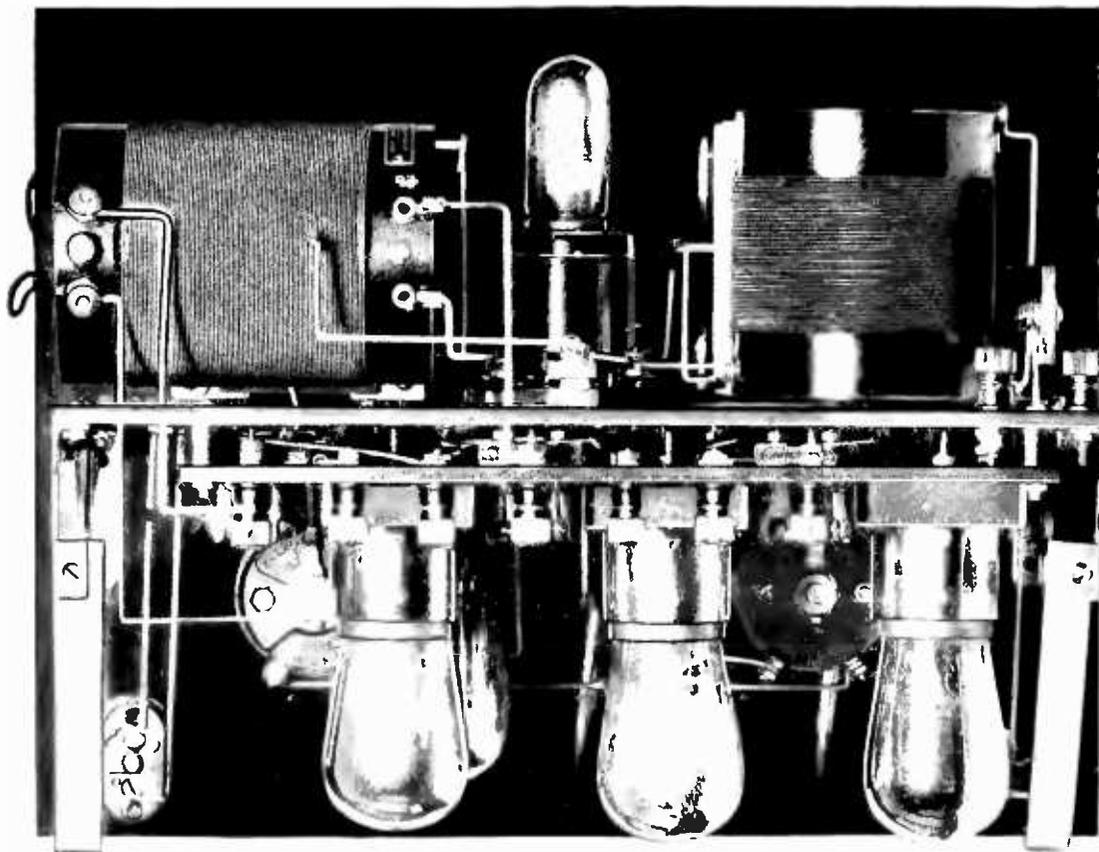


FIG. 12

RADIO BROADCAST Photograph

A compactly built modification of the Browning receiver, which could be made to fit in a phonograph cabinet as described in this magazine for June, July, and August 1925. This one employs resistance-coupled audio amplification. The amplifier units are situated below the sub-panel

stations on the headphones, is absent with the impedance amplifier. Instead of using a filament switch, the jack is made to do double duty, so that placing the plug in the jack lights the tubes.

BALANCING AND OPERATING THE RECEIVER

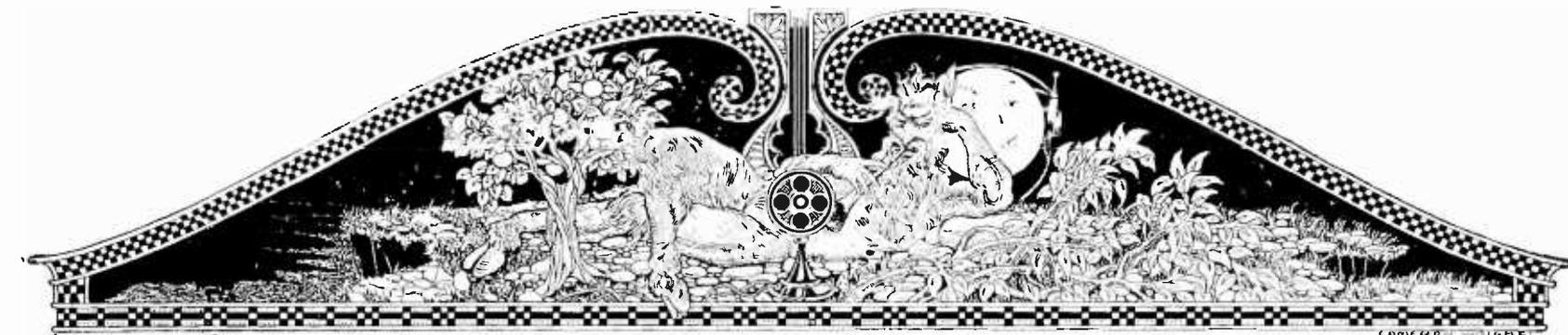
THE first thing to do after the receiver has been constructed as shown, is to balance the first tube so that no radiation will occur, and

A few notes on tuning may be helpful, though actually operating the set is the only way one can acquire the knack of doing DX work. If the set is performing normally, the volume coil, L_p , can be turned to such a position that placing a finger on the stator plates of the .00025 mfd. condenser gives a "pluck" in the receivers. This means circuit L_2 , C_2 , is oscillating. With the volume coil in that position, turn the dial of the .00025 mfd. condenser until this whistle is loudest and adjust the volume coil until the whistle disappears, and by slightly retuning, the station should come in. If the detector tube has a tendency to "snap" into oscillation instead of going in gradually, the resistance of the grid leak should be increased.

The receiver described is capable of extraordinary results, for not only is it a fine distance getter, but quality of the received concerts is almost above reproach. Combined with this is its non-radiating property, and the fact that an extremely short antenna of only ten or twelve feet of wire may be used with satisfaction.

Questions Concerning the Receiver Which Are Commonly Asked

- Q. What is the trouble if the receiver tunes broadly?
- A. The .0001 mfd. condenser in series with the antenna may be of incorrect value or an excessive amount of loss would give this effect. The blame might also be laid to poorly soldered connections to the two coils, L_1 and L_2 .
- Q. What makes the detector tube go into oscillation with a "snap" instead of going in gradually?
- A. The grid leak is not the correct size. Try one whose resistance is higher. The grid condenser might be larger than .00025 mfd. (It is much better to use a condenser smaller than .00025 mfd. rather than one larger).
- Q. What length and type of antenna works best with the receiver?
- A. A 50 to 70-foot antenna is usually ample with as much of this vertical as possible. Very good results have been obtained with a piece of wire about 30 feet long extending from a pine tree down vertically to the receiver.
- Q. Will the set work with a loop?
- A. Yes; but even an antenna of fifteen feet located in the same room as the receiver has been found to give better results, and is easier to erect.



The Listeners' Point of View Conducted by Kingsley Welles

Is the Popularity of Jazz Music Waning?

WHEN radio broadcasting was a novelty and one called in the neighbors to hear the voices coming in "right out of the air," little or no attention was paid to what the voices were saying. "Radio is a marvellous instrument, a tremendously potential medium, but what difference does it make if it is being used to give currency to worse than second-rate stuff," is about the gist of the very vocal objections made by these observers. George Jean Nathan, the rapier-worded dramatic critic of *The American Mercury* said in a recent issue of that green-jacketed organ of dissent:

Nightly the front parlors of the proletariat resound to the strains of alley jazz pounded out by bad hotel orchestras, to lectures on Swedenborgianism by ex-veterinary surgeons, to songs about red hot mammas, and Beale street melancholias by hard-up vaudeville performers.

Now all the criticism of radio programs made along these lines is true in that it is possible to hear the thing described from some radio station or other at one time or another. We should not judge broadcasting by that method any more than we should judge the thinking processes of the American citizenry by what we hear a chance street orator mouth. Broadcasting is not nearly as badly off as its hostile critics would have you think, and the aerial offerings of the radio season now upon us are daily justifying that belief.

"If it weren't for the constant stream of jazz flowing from nearly every broadcasting antenna," remarked a listener to us the other day, "I would enjoy radio a lot more. These jazz orchestras from every station in the country, all practically banging away at the same piece at practically the same time are much more than annoying." The trouble with a criticism such as this is that it groups all dance music as jazz, which is only true because we have no term which allows us to distinguish between the grades of jazz. We use the same term to describe the soft symphonic effects of Art Hickman, Ben Bernie, and Vincent Lopez as we use for the fifth rate Five Melody Kings of Four Corners, Oklahoma.

"I believe," writes D. M. Craig, of Lamar, Missouri, "that the universal condemnation of jazz is contrary to the true feeling of a majority of radio listeners, if all music is classified as jazz. Would these objectors want to stop the broadcasting of such organizations as those of Paul Whiteman, Vincent Lopez, Jean Goldkette, and many others?" Decidedly not. While there are those who are utterly opposed to jazz whatever its origin, the more liberal among us recognize that jazz music has a very strong hold on a large percentage of the public of several continents, that it is not wholly as bad as it is pictured, and that, in moderation, jazz is excellent entertainment.

The trouble with broadcasting programs, and up to the past six months this has been true of almost every American station, is that they have been too heavily loaded with this orchestra and that, playing the currently popular tunes. Too much of the program has been devoted to



FRANK W. ELLIOTT
The new president of the National Association of Broadcasters, who succeeds Eugene F. McDonald, of Chicago. Mr. Elliott is business manager of station woc at Davenport

dance orchestras, or to soloists who had nothing on their repertoire but whatever numbers were being sold in the music shops as "the latest thing" or, worse, to song "pluggers" in the employ of the music publishers. This practise of the broadcasters, we firmly believe, has shortened the life of many moderately good popular numbers, which otherwise might have retained popularity for a considerably longer time.

Mr. Frank McEniry, of station KOA at Denver, in answering a recent inquiry of ours about this subject replied:

On the whole, I believe listeners tire of jazz much more quickly than they do of the classical or semi-classical presentations. This belief is of course, wholly a personal one, but it is based on a daily study of mail from our listeners. Here is an excerpt from the letter of a Western listener which seems typical of a great mass of mail we are receiving on the subject: "One cannot be unmindful of the lovely entertainment last evening; especially beautiful was the Floradora Sextet by the Municipal Band. Likewise, the same selection with the lullaby on the saxophone. It was such a relief from the slap-stick stuff one gets from many stations." That letter was from Charles G. Hickman of Forsyth, Montana.

And here is another from Mrs. Walter Burke of New Plymouth, Idaho: "Almost without exception, we like the better class of music. Jazz ceases to have any appeal after the first two or three selections—it is all alike."

They are doing some good things at KOA, and by the time this magazine is in the hands of the reader, the competitive program of classical music as opposed to jazz music will have been given from that station. All the listeners will have a chance to express their opinion and a complete record will be made of the results. We hope to announce the findings in an early number. There should be some interesting letters after this contest.

Mr. Freeman H. Talbot, that able musician responsible for the programs of KOA set down some of his thoughts about the subject of jazz especially for this department. "For many years," he says, music critics have been periodically announcing the death of jazz. Probably the

so-called music of jazz is largely responsible for the belief that it is moribund. To those who would shed no tears over its demise, jazz displays a most disheartening vitality. Phoenixlike, it arises fresh after each reputed annihilation." Mr. Talbot continues:

Jazz has been called primitive, uncouth, banal. It has been charged with disrupting homes, weakening Church ties, and undermining the morals of the nation. Personally, I feel that jazz is not all bad—it is not clever enough for that. It may be banal, and at times it is discouragingly stupid, but it is not essentially bad. Lately, jazz has gathered to itself some notable defenders among the musically correct. Serious minded musicians have perceived under the battered and tattered appearance of jazz, evidence of a new vitality in music, a struggle after a new form of expression, crude as the hieroglyphics of Cubism, but genuine art, nevertheless.

The moans, shrieks, cat calls and sobs of jazz will eventually disappear, but the vibrancy of its stimulating rhythms will remain to be caught some time by a master composer on a new work or series of works as revolutionary as the cacophonies of Wagner.

How do all these remarks apply to present programs? Well, they are some of the signs—if indeed any are needed—which show that the old preponderance of jazz on programs is greatly lessening. For some time, one of the two outstanding stations in New York City has had a rule, somewhat flexible, it is true, that no dance music can be broadcast until after ten thirty in the evening. Mr. Carl Dreher discusses this matter more fully on another page of this number. The fact that the musical parts of programs are being more devoted to more serious efforts by stations in nearly every part of the country except Chicago, simply means that there is less time left for jazz.

To mention a specific type of program

which has brought improvement in its tone, consider some of the "indirect advertising" programs put on through the WEAJ chain of stations. Here is what the director of broadcasting for that station, Mr. J. A. Holman, says about them: "Programs have been presented of a type that previously would have been considered impossible by radio—impossible in the sense that they assumed too high a degree of musical and general culture on the part of the radio audience. The public accepted them at their real value and enthusiastically availed itself of their educational activities. . . . No music was too "highbrow." For example, George Barrère's Little Symphony Orchestra presented a series of chamber music recitals, which while beautiful and perfect gems of instrumental music, are generally considered above the understanding and appreciation of the average music lover. The interesting fact is that the American public welcomed the innovation. . . ." The radio audience is not required to listen altogether to the sad stuff outlined by Mr. Nathan. The signs are unmistakable that

the taste of the radio public is changing, and for the better.

A New Note in Broadcasting: Coöperation

TO MOST listeners in this country east of the Mississippi River who heard the broadcasting of the radio industries dinner from the Commodore Hotel not so long ago, it probably seemed as if very little was occurring except the presentation of an exceptionally fine purely entertainment program announced by the active Major J. Andrew White. A good program it was, too, with some of the Capitol radio family, the Happiness Boys, the shy Will Rogers, busy explaining why he was not there, Rudy Weidoeft, Vincent Lopez and his Orchestra, and several speakers, including Senator Dill. The radio lambs and lions, however, were lying down together and at executive sessions before and after the dinner, various associated organizations arrived at some decisions whose effect may be far reaching.

The National Association of Broadcasters, whose member-stations include a good proportion of the broadcasters of the country, elected Dr. Frank Elliott of station WOC at Davenport, president, succeeding E. F. McDonald, Jr., of station WJAZ.

And among other applicants, station WEAJ, New York, was admitted to membership. This is somewhat important, because thus far, WEAJ has played a lone hand in broadcasting. It probably means that broadcasters are going to coöperate to a greater degree than ever before, with inevitable benefit to the listener.

Ever since the first broadcaster was licensed, there has been a quarrel on between the owners of the radio stations and



REINALD WERRENRATH, MME. LOUISE HOMER, TOSCHA SEIDEL, AND A. ATWATER KENT

The Atwater-Kent Manufacturing Company has arranged a series of Sunday evening concerts given at 9:15, Eastern Standard time through WEAJ, WCAP, WJAR, WEEI, WCAE, WSAI, WWJ, WOC, WCCO, WGR, WOO, KSD, and WIAG. The series presents some of the best-known artists familiar to concertgoers and is regarded by radio listeners as one of the real treats of the Fall and Winter radio season. There will be thirty concerts and the last will be given some time in May, 1926. Mr. Werrenrath, baritone, gave the first concert on October 4th, and was followed by Mr. Seidel, the well known Russian violinist. Mme Homer, the contralto of the Chicago Civic Opera Company, presented a popular program as the third concert of the series.

Mr. Kent is shown in the photograph at the top



JEAN GOLDKETTE AND HIS LITTLE SYMPHONY ORCHESTRA—AT WJR

The photograph at the left shows one of the orchestras heard regularly from station wjr. Left to right: J. Schwatzman, cello; Gaston Brohan, bass; M. Shapiro, violin; Victor Poland, violin; Jean Goldkette, pianist and conductor; Joseph Gerner, violin. The Book-Cadillac Hotel is shown at the right and houses the Detroit studios of wjr-wcx. The transmitting apparatus of the two stations operating on 580 kc. (517 meters) is located at Pontiac, Michigan

the organization which claims to have control of most of the copyrighted musical numbers, both popular and more classical—the American Society of Authors, Composers, and Publishers. This Society to the outsider appears to have what amounts to a monopoly in the control of the performance of copyrighted music. And also to the outsider they seem to have exercised that control in a most arbitrary fashion. Whatever the merits of the disputes between the two opposed parties may be, the situation now seems to be that the broadcasters are unwilling to pay for a yearly license from the Society for the simple reason that they have no assurance that they will be fairly treated from year to year. The broadcasters have taken the sensible position (to use their own phraseology): “we desire to see that the writer of the songs as well as their assignees shall be paid a fair sum. . . . *Resolved*, that the principle involved in the reproduction of music by mechanical means now embodied in the present copyright law be extended to the reproduction of music by radio. . . .”

This means, simply put, that the listeners will benefit, for after the smoke of legal battle clears away, it will undoubtedly be possible for more stations to broadcast much good music which is barred to them now by the provisions of the copyright. It also means that radio is advancing toward a firmer and sounder basis, for there is no doubt that the dispute over payment and copyright has hampered the arrangement and presentation of programs.

Radio Plums for the Present Season

WHILE the optimistic estimate of Mr. W. E. Harkness of the American Telephone and Telegraph Company that the largest of the WEAf wire tie-ups reached sixty-five per cent. of the listeners of the United States may be viewed with the raising of an slightly doubting eyebrow, it is certainly true that the new concerts of the Atwater Kent Company which began on October fourth have jumped into immediate popularity with a great number of listeners. When the Victor and Brunswick Companies broadcast their concerts last year, the radio audience sat up before its assorted loud speakers and wondered if something new hadn't happened in broadcasting. It had. The tone of all broadcasting was raised and it is our belief that it will never be lowered. The first concert of the Atwater Kent series with Reinald Werrenrath, one of the best of American baritones, set the pace for the rest of the series. Other artists who will be heard in the thirty concerts, which begin at 9:15 P. M. Eastern Standard time, on Sunday evenings, are among the foremost opera and music stars of the world: Louise Homer, Edward Johnson, Mabel Garrison, Maria Kurenko, Salvatore de Stefano, Alexander Brailowsky, Leo Luboshutz, Charles Hackett, Florence Austral, Albert Spalding, Benno Moiseiwitch, Toscha Seidel, Felix Salmond, Vincente Ballester, John Powell, Eva Gauthier, Anna Case, Freida Hempel,

Paul Althouse, Arthur Middleton, May Peterson, Paul Kochanski, Mischa Levitski, and Hulda Lashanska.

Then there are the concerts of the Victor and Brunswick Phonograph Companies which will be heard from the Radio Corporation group of stations, which will present other opera stars. It looks like an embarrassment of riches for the radio audience. Whatever the internal politics among the broadcasters and however strong the grimly competitive spirit, the listener is sure to benefit.

Learning, Via the Loud Speaker

THOSE who have a burning desire to increase their store of knowledge can accomplish a good part of that end by radio if they are so minded during the radio season now upon us. During the last two years, many radio “extension courses” have been offered over the air, and the State University of Iowa was probably the first higher educational institution to offer a regular air course, which was begun last year. Station wsu1, 620 kc. (484 meters) is broadcasting a course of lectures on Monday and Wednesday from seven thirty to eight fifty P. M., Central Standard time. On Mondays lectures on “Early Iowa History,” “American Literature,” “Iowa Flora” and “Population Problems” On Wednesdays wsu1 offers lectures on “The Teaching of English,” “Political Parties in the United States”, and “Elementary Psychology.” Actual university credit is offered to those radio listeners

who complete the requirements of the course. Full information can be secured from Edward H. Lauer, director, extension Division, State University of Iowa, Iowa City. In Pittsburgh, station KDKA will resume its extension courses in cooperation with the University of Pittsburgh and the Pennsylvania State College. In Springfield, WBZ is laying plans for another excellent series of extension lectures. In Oakland, KGO, is broadcasting regularly to the grade schools of the city according to a very well worked out and ambitious plan. Throughout the country, educational programs, most of them well planned out and presented can be regularly heard with little more trouble than a reference to the newspaper programs and the effort of revolving a dial.

Why the Farmer Likes Radio

VERY early in its experience with radio in the broadcasting of economic information, the Department of Agriculture proceeded on the theory that radio broadcasting, when established as a regular part of the machinery of our present day living, would render a greater measure of service to the farmers than any other group or section of society," writes J. C. Gilbert, the Marketing Specialist of the Department of Agriculture. "The



THE AIR COLLEGE FACULTY AT WSUI

At the State University of Iowa, Iowa City. A series of lecture courses, of college standard are broadcast from WSUI throughout the winter, and college credit is given to those who comply with the requirements. Left to right: Edward B. Reuter, Frank Luther Mott, Bruce E. Mahan, Christian A. Ruckmick, Helen Williams, M. F. Carpenter, Kirk H. Porter, Bohumil Shimek, and Edward H. Lauer

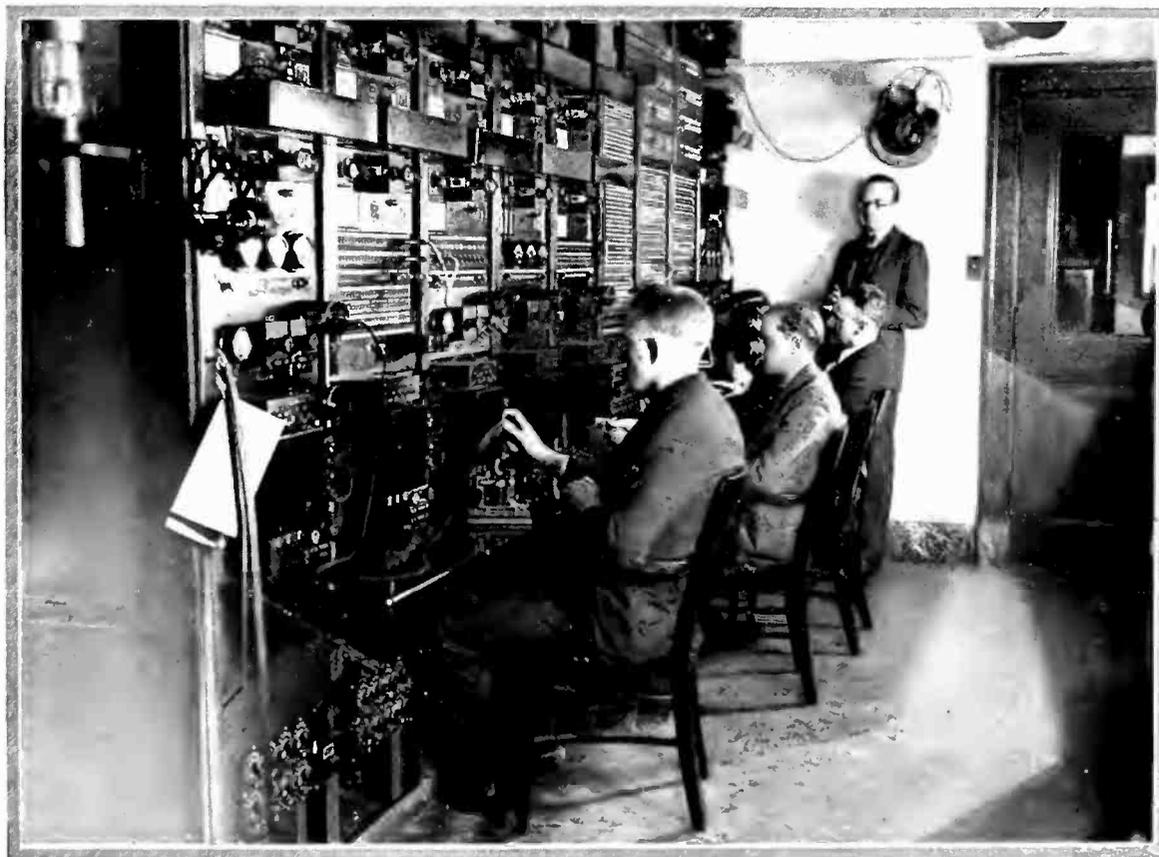
Department is firm in its belief that radio is a permanent fixture on the farm, as strongly entrenched, perhaps, as the Ford.

The experts of the Department estimate that there are 553,003 radio sets in use on the farms of this country, as against an estimated total of 364,800 receivers in use in 1924. While most of us depend on radio broadcasting for entertainment and perhaps a bit of news, the farmer is growing to think of his radio set as a source not only of pleasure but of genuine profit.

One of the most interesting letters among a large number written by the farmers to show just what radio is doing for this interested class of listener was written by Fred Buchanan of Granger, Iowa who said:

As early as 8:30 in the morning we get livestock market report and from 10 o'clock on, grain reports. The market reports will revolutionize the farming business. The farmer gets the news about markets right off the bat—he does not have to take the buyer's word for anything, and knows as much about them as the man at the principal market points. . . . If everything in broadcasting is cut out, save the market reports, for they are bread and butter to us out here.

The increasing number of radio sets on farms, suggests the Department of Agriculture, places a responsibility upon those who conduct broadcasting stations and those who have information to distribute. When half a million farmers turn a listening ear toward the broadcasting stations of the country, they expect to hear something worth while. They expect the weather reports, market reports, agricultural lectures, instruction



"WEAF AND TWELVE OTHER STATIONS. . ."

The "speech input equipment" of the Bell System at 195 Broadway, New York where the program, originating at the WEAF studio is sent to the stations connected to it by wire. On some programs as many as thirteen stations—as far west as Davenport and St. Louis—are connected. At the control board shown, much of the wire "routing" is done. The second panel from the left contains the board on which the program comes from the microphones in the studio. The small hooded lamps are speech amplifier tubes, which increase the strength of the energy before it is sent out by wire to the distant broadcasting station. The three switchboards at the right take the programs for the various wire lines to the Middle West. Two complete "set-ups" are always maintained—one wire for broadcasting, called the red layout, and another, the "order wire," so that instructions can go out independently between the control office and the various stations. If the broadcasting line should go bad, it is possible to swing in the "order wire" and so the program continues without interruption. No other traffic goes out over the broadcasting wires—contrary to regular long distance telephone practise, some lines carrying many other telephone and telegraph messages



LOUIS WILEY

Business Manager of the *New York Times* who recently spoke over WMCA, New York. "The daily newspapers published in English on Manhattan Island," said Mr. Wiley, "exclusive of trade newspapers, have the astounding total daily circulation of 4,039,286 copies. The total is approximately twice the number of families in the entire metropolitan district. There is no other cohesive force, not even our schools, which is so important in the life of our community as the newspaper."

on various subjects from their agricultural colleges and experiment stations. The Kansas State Agricultural College at Manhattan, Kansas, station KSAC, ever since 1923 has taken the lead in broadcasting air courses for rural residents on agriculture, engineering, home economics, and general science. Those who have heard the lectures in these excellent courses will agree that they are well worth an hour's listening.

Broadcast Miscellany

IT IS sometimes fortunate that the radio artists do not hear all the remarks—well intentioned enough for the most part—made by the radio announcers. It was only the other night that a soloist failed to appear at a certain large station. "However," vocally beamed the announcer, "Mr. Edward Gumph, a very dependable artist, will entertain you." Memo for the desk pad: "Be sure to tune-in radio to-night to hear "dependable artist."

THE publicity man of WNYC was doing his best to drum up interest—on paper—about the broadcasting of recent municipal election returns from the station. Quoth he, "The first official election figures available will be heard from this station, since it will operate in conjunction with the Police Department. As votes are counted at the *poles*, each district reports to its Police precinct. . . ." Italics ours, or is it "our'n?" It is so hard to remember

these days when spelling books are out of print.

LEO FITZPATRICK, the "Merry Old Chief" of the Kansas City Star station WDAF has left Kansas City and will now be heard from WJR, Detroit. He was the organizer of the phenomenally popular "Nighthawks" whose membership is said to reach 200,000.

NEXT to WGY, now licensed to use 50,000 watts on Saturday and Sunday nights, KDKA with a license to use as much as 10,000 watts is the most powerful broadcaster in the country. There are ten 5000-watt stations, WSAI, WLW, WOC, WCCO, WCBD, WORD, KOA, WOK, WHO, and WEAF. Stations WGY, and WTAM follow with 3500 watts each, and KFI and KGO each, with 3000 watts are next in power rating. Station WTAS and WJR-WCX use 2500 watts. There are now three stations employing 1500 watts, 25 using 1000, and seven with 750 watts.

THE present conductor of this department is relinquishing his duties with this number of RADIO BROADCAST because of his heavy duties in other departments of the magazine. His successor, Mr. John Wallace, of Chicago, a writer and critic of more than ordinary ability, will continue "The Listeners' Point of View" in the January number.

THE new station, WLWL, 1040 kc. (288.3 meters) operated by the Paulist Fathers, in New York went on the air with its first program not so long ago. A frankly religious station, operated by a branch of the Catholic Church, its first programs have been all that one could ask for in the

matter of dignity and high quality. The work of WLWL is being watched with some interest by listeners in the Eastern part of the country. Those who can hear the station on its high frequency band are missing a rare treat if they do not hear the Paulist Choristers, frequently broadcast from this station, which is on the air between 8 and 10 P. M., Eastern Standard Time, on Sunday, Tuesday, and Friday nights.

A NEW broadcasting station is scheduled for St. Louis which will be sponsored by sixteen firms in that city, the St. Louis *Globe-Democrat*, the Colin B. Kennedy Corporation among them. It will be a 5000-watt installation, located, as is the growing practise, a number of miles outside the city. This is the second large station to be installed by a group of business interests and operated coöperatively by them. The first station of this kind was the excellent WCCO, Minneapolis-St. Paul. Nashville, Tennessee, has a new station, WSM, which took the air early in October on a frequency of 1060 kc. (282.8 meters).

IT IS reported that *Liberty* has bought the erstwhile WTAS at Elgin, Illinois and will soon come on the air with its own programs. It is to be hoped that the publishers of *Liberty* will be enabled to present programs of a better type than WTAS. The mental level of WTAS is best indicated by their slogan, "Willie, Tommy, Annie, Sammy." The writer defies any one to distill sense out of that. *Liberty* is owned by the same group which publishes the *Chicago Tribune* and the new station, WLIB, will thus join WGN, making two stations in the Chicago area owned by the same interests.



THE COON-SANDERS "NIGHTHAWKS"
Frequently heard from station KYW, playing from the Congress Hotel in Chicago

into a few letters messages of considerable import and significance. A few samples of this esoteric language will serve to indicate the principles upon which it is founded.

First amateur:

CQ CQ CQ CQ CQ CQ U1AQR U1AQR
U1AQR U1AQR CQ CQ
CQ CQ U1AQR U1AQR U1AQR

Second amateur:

U1AQR U1AQR U1AQR G2BAO G2BAO
G2BAO G2BAO QRA?

First amateur:

G2BAO G2BAO G2BAO U1AQR U1AQR
U1AQR QRA WALTHAM MASS GE OM
U VY QSA HR BUT QRM FM U6CIX
WL WK U LATER HV 2 MSGS 4 CUL 73
OM

Second amateur:

R R UR SIGS GD BUT QSS CUL

This seemingly cryptic communication is pregnant with information and good manners. CQ is a general invitation to communicate. CQD, the predecessor of the now universally adopted SOS distress call, is derived from CQ, the D being added to signify "danger."

U1AQR is the first amateur's official call. The letter prefix designates him as a resident of the United States. The figure 1 indicates his location in the New England district. The United States is divided into nine districts, each headed by a radio inspector. AQR are the letters assigned to this particular amateur by the Department of Commerce.

The acknowledgement of the second amateur consists of the first amateur's call, followed by that of the second amateur's.

The letter G—called in amateur parlance, the intermediate—indicates him to be a resident of the British Isles. The prefix A indicates an Australian amateur; B, Belgian; BZ, Brazilian; C, Canadian; CH, Chilian; D, Danish; I, Italian; J, Japanese; M, Mexican; O, South African; PI, Philippine Islander; R, Argentinian; Y, Uruguayan; and Z, New Zealander. The QRA? means, "Where are you located?"

The answer of the first amateur consists of the usual acknowledgement followed by, "My location is (QRA without question mark) New Britain, Connecticut. Good evening, old man (GE OM). You are very loud here (U VY QSA HR) but I am having interference from U6CIX an American amateur on the Pacific Coast (BUT QRM FM U6CIX) I will work with you later (WL WK U LATER). I have two messages for you (HV 2 MSGS 4 U). I'll see you later (CUL) Best wishes, old man (73 OM)."

The reply means: "I received your message satisfactorily. (RR) Your signals are good (UR SIGS GD) but they fade in and out (QSS). I'll see you later (CUL)."

Eavesdropping on short wavelengths has its fascination but almost invariably, it serves only as an introduction to the creation of a "dyed-in-the-wool ham." The term "ham" is used to describe the owner of an amateur transmitting outfit. Possessed of a transmitter, amateur radio becomes a personal and living thing. It is no longer an external world which you visit as an onlooker. You too can press the key and become a part of the international dot-and-dash whirl.

Those of you who have seen giant trans-

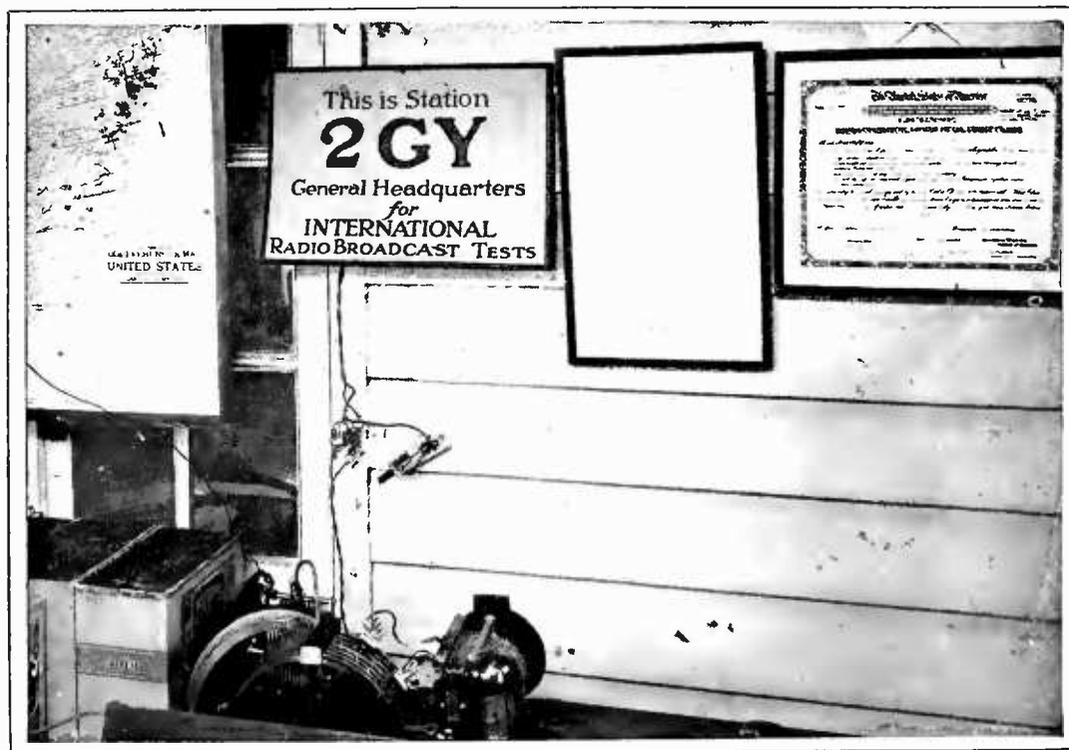
oceanic radio stations, with their immense and stately towers, overshadowing power houses, and buildings filled with transmitting and receiving apparatus, may hesitate to believe that tiny miniatures of these imposing equipments have sent their message half way 'round the world. But the remarkable feature of short wave transmission is the fact that only very minute power is required to set up ether waves which radiate for thousands of miles. Recently an amateur in British Columbia maintained a regular schedule of transmission and reception for fourteen successive nights with a radio-found friend in Australia, using only a five-volt receiving tube, powered by heavy duty B batteries, designed for use with receiving sets! Think of it, you owners of five-tube sets—one receiving tube, efficiently used, is capable of transmitting half way round the world.

SIMPLE APPARATUS IS USED

THE circuits used in these diminutive transmitters are very simple. The all-important thing is the correct arrangement and placement of high grade components. In a characteristic way, RADIO BROADCAST is leading the way to the new field, by collecting data and designing transmitters and receivers for the special benefit of broadcast listeners. As rapidly as the engineers conducting the RADIO BROADCAST-Eveready short wave experiments progress with their work, descriptive articles will be printed in the magazine, giving full details of construction and operation.

Although primarily a sport and hobby, there are serious aspects to amateur transmission. Feelings of sectionalism and nationalism vanish when personal friendships are built up between amateurs in the four corners of the globe. As the boundaries of friendship have been extended through the ages by means of easy communication and transportation, from tribe to community, community to state, and state to nation, we have gradually acquired a unified national consciousness. Tribes no longer fight tribes; rivalries between cities, as that of Carthage and Rome of old, no longer result in bloody warfare, as the telegraph, telephone, railroad and steamship have cemented friendships and demonstrated powerful common interests.

Now we have short wave, low power radio, producing the citizen of the world, with friends whom he calls by name through the radio night, in Melbourne, Paris, Tokio, and Rome! If short wave radio spreads as rapidly as has broadcasting during its first five years, international peace will have a recruit and ally of significant influence. Predictions seem visionary, but we need contemplate only the influence of the telegraph and telephone, which has lifted us out of community interest to a true national consciousness, to lend the color of realism to the hope that the seeds are firmly planted for a new recognition of international bond, established through the agency of short wave radio!



TWO ESSENTIALS FOR AMATEUR TRANSMITTING

The regulations of the Department of Commerce, the Bureau in charge of radio in this country, are that for a transmitting station capable of sending signals outside of the state in which the set is located, a license is necessary. The operator of the station must have a license also. The amateur station license is the long one in the center and the operator's license is shown at the right of that. There is no fee for either license and the examination is not difficult. Licenses are granted to those who can send and receive ten words per minute in the Continental code and who can pass a simple theoretical examination, dealing with the theory and operation of amateur apparatus

Plans for the Third of the International Radio Broadcast Tests

The First Announcement of the Tests Which This Year Will Take Place in January—Coöperation in All Branches of the Radio Industry Will Make the Third Yearly Test More Successful Than Ever

By ARTHUR H. LYNCH

Director, International Radio Broadcast Tests

FOR two years, now, we have, during the early part of the winter, had an opportunity to listen to foreign stations with American broadcasters off the air. Listeners in the far West have heard programs directly from France, England, Spain, and other countries. Our European neighbors have listened to our concerts, and many reports have reached us from South America, Australia and, in fact, almost every nook and corner of the globe.

But every effort which has been made in the past is to be outdone this year. Preparations are now being undertaken to assure some very worth while features on the programs themselves, as well as for the immediate check-up of the origin of certain numbers broadcast, which will make it a simple matter to recognize a station, even when the call letters cannot be understood.

The great difference between this year's tests and those we have formerly conducted, however, lies essentially in the period we have selected. The matter was put to a vote at the Associated Manufacturers of Electrical Supplies Convention at Hot Springs several months ago; at the Radio Manufacturers Association Convention at Atlantic City; the National Radio Trade Association Convention at New York in September; and a referendum was recently taken by mail. In every instance the majority was in favor of the latter part of January, when receiving conditions would be better than at any other time during the year.

Many of the trade associations have already signified their intention of coöperating, and during the annual meeting of the National Radio Trade Association, a fund of several thousand dollars was raised to assist in letting the public know about International Radio Week. Powel Crosley was re-elected Chairman of International Radio Week and L. A. Nixon was

put in charge of the publicity and other matters of a kindred nature.

Among those whose aid has been secured are Mr. F. N. Doubleday, President of Doubleday, Page & Co., who is now in England, where with the assistance of his friend, Rudyard Kipling, he hopes to arrange for the King to address a few words to President Coolidge while millions of us radio-eavesdrop.

Our Canadian friends, under the direction of Jacques Cartier, who is in charge of the week for Canada, are also attempting an exchange of greetings between the King and his Western Dominion representatives.

Radio organizations which for the last two years have been tolerant spectators, are now enthusiastic supporters of the International Test idea and many such groups are taking it upon themselves to see that the entertainment provided for our foreign friends will be of a superior nature.

Nor are we forgetting about the folks at home. Even though the programs are being specially designed for our foreign listeners, they will be of such high quality as to meet the demands of the most sophisticated dial twisters.

The success of the tests this year is made doubly secure, because in Europe and America there are more high-power broadcasters than heretofore, and there will be, by the time the tests are under way, a direct short wave tie-up between our headquarters at Garden City and most of the countries taking part.

From our experience during the last two years, we have learned much and hope to eliminate some of the difficulties by applying what we have learned. One of our greatest troubles was caused by lack of accurate knowledge of what was being broadcast by the foreigners. This year we hope to overcome this bothersome obstacle by having the foreign programs well in advance so as to be able to send them to the press. We are going to arrange to have to-night's program appear in tomorrow morning's paper and in this way make it possible for the listeners in any part of the country to make a check-up for themselves, instead of writing to us, or telephoning us from San Francisco or Houston, to verify a program, as has been the case heretofore.

In the past, many imaginative listeners heard all sorts of things, some of them based on fact. This year we are going to arrange to mislead the misleaders by inserting one or two false numbers in the programs. These numbers will appear in the newspapers, but will not actually be played. Thus, when we get a report from some listener who claims to have heard a number which we know was not broadcast, we will see that his membership in the Ananias Club be entered at once.

For the serious listener, however, who wants to enjoy the thrill of personal contact with many foreign nations within a single short hour, or the scientist who, by properly co-relating data from various sections of the world, taken during the tests, a golden opportunity will be provided.

Months of preparation will result, this year, we feel certain, in European and other foreign stations being heard in every corner of our country and vice versa. Every listener in America is invited to take part in these tests and assist in making them the greatest we have had thus far.



THE COMMITTEE IN CHARGE OF THE TESTS

Powel Crosley Jr., is at the head of the table; at his left is Arthur H. Lynch; others in the group include L. A. Nixon, second from Mr. Crosley's right, R. W. Demott of *Radio News*, third from Mr. Crosley's left; H. S. Fraine, of RADIO BROADCAST next to Mr. Demott on his left. Mr. George Furness of the National Carbon Company is in the right foreground

An Improved Plate Current Supply Unit

How to Build a Universal B Battery Substitute Which Is Highly Satisfactory in Operation and Low in Cost—The Parts Are Readily Obtainable—A Description of the New Raytheon Rectifier Tube Which is the Essential Feature of This Device

By ROLAND F. BEERS

SO MUCH has been published in the last six months with regard to B-battery substitutes that the average broadcast listener is in doubt as to what type will give him the most satisfaction. It is natural that certain prevailing types of eliminators will be suited for particular types of receivers, while they are entirely unsuitable for use on others. In order to make an intelligent choice between these various designs, the broadcast listener has had to try out one after another until he has obtained satisfaction. Even after a comparatively thorough test, he may find that the short life of the rectifier elements will cause an expense equal to that of maintaining B batteries.

It is the purpose of this article to describe the theory and construction of a universal B-battery substitute having excellent operating characteristics on all types of receivers, and an unusually long life. The cost of construction will not exceed twenty-

underlying the design of eliminators that are appearing this fall have brought forth new facts which are extremely important for the attainment of high quality performance. Many weaknesses were present in the designs of last year's models: but the research of the last twelve months has succeeded in building up units of recognized quality and dependability.

unit using them will certainly surpass that of the home-made model. The photographs, Figs. 4 and 6, show the construction of models employing factory parts.

THE RAYTHEON TUBE

THE very heart of this device is the new Raytheon rectifier tube, which has been developed for this specific purpose. The characteristics of this tube are quite revolutionary in their nature.

In the construction of this tube, two anodes are provided, so that the tube rectifies both halves of the alternating current wave. This feature is of first importance because it greatly simplifies the problem of filtering to obtain a pure d.c. supply. An additional feature made possible by the small anode area is that it permits but a minute fraction of the current to flow during the reversed voltage period of the current-flow cycle. Many rectifiers operating on the gaseous conduction principle give forth an extraordinarily high "back current", as it is called, which

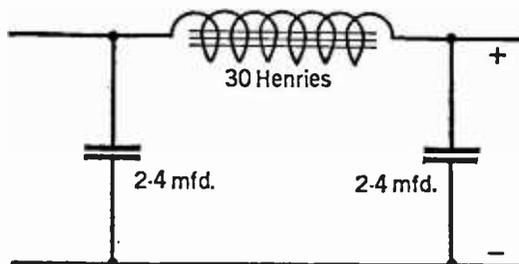


FIG. 1A

In the discussion given below, the reader will find complete instructions and drawings for making a B battery substitute. The general design is similar to that developed by several manufacturers of new B battery substitutes that will be marketed this fall. Complete dimensions, list of materials, size and turns of wire, etc., are given for those who want to make up a complete unit at home. This construction can be very easily accomplished, but for the convenience of those who prefer to use factory-made transformers and choke coils, units are described wherein use is made of these parts manufactured by the Acme Apparatus Company, General Radio Company, Dongan Electric Manufacturing Company, and Jefferson Electric Manufacturing Company. On 60-cycle supply, any of these manufactured parts may be employed with excellent results, and the appearance of the

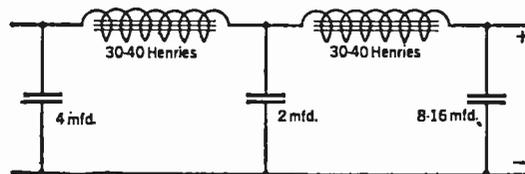


FIG. 2

A filter circuit common in new models. The intelligent use of chokes and filter condensers here insures smooth output

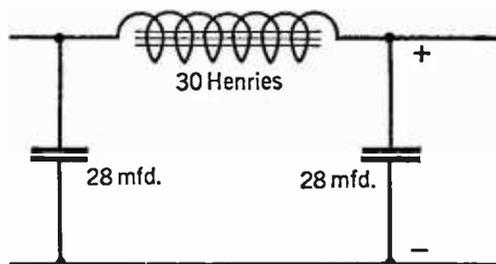


FIG. 1

Two types of filter circuits. That shown in Fig. 1A is the "smoothing" filter popular in 1924 while the circuit, shown directly above, is the "brute force" or reservoir type so highly efficient

five dollars, and, as all parts are readily available, the entire unit may be constructed at home. Several advanced features are present in the design described below.

Battery eliminators generally consist of three major elements: A Transformer to convert the 110 volt a.c. supply to the required voltages; a rectifier which converts the a.c. into pulsating d.c. and a filter circuit which smooths out the irregularities of the rectified voltage into a uniform d.c. Most of our readers are already familiar with these elements from previous articles in this magazine. However, the study and development

frequently rises to such a value as to become of great danger to the life of the tube and unnecessarily complicates the filter circuit problem. In the Raytheon tube it is extremely difficult to detect the back current by even the most sensitive measuring instruments.

The Raytheon rectifier has been designed to meet the requirements of most of the standard B-battery substitutes. Its starting voltage is very low—approximately 155-160 volts—and its current carrying capacity is high. The Raytheon tube type B is rated at 60 milliamperes at 150 volts d.c. output. As there is no filament to burn out, the life of the rectifier is extremely long. Standard Raytheon tubes

SINCE our September, 1924, number RADIO BROADCAST has printed the best and almost without exception the only material on chemical and tube-rectified plate supply units. The present article invokes nothing startlingly new, but it does describe a new rectifier tube which should have a very wide application and popularity for this type of service. The Raytheon tube, whose use is described here, has no filament. This simplifies the step-up transformer winding, since no extra tap-off from that winding is necessary to supply current for a filament. This unit is also a full-wave rectifier which produces a much smoother potential supply than the other types and simplifies the problem of filtering the output. One of the features of construction of the transformer in this unit is a shield around the primary of the transformer which effectively prevents any stray noises present in the power line from reaching the secondary and being communicated to the rest of the radio circuit. Such a device has never been described before. The problems of construction and assembly are unusually few.

—THE EDITOR.

have been on test at maximum output for more than 4000 hours, and have not yet shown signs of deterioration. It is doubtful if the maximum life of these tubes can be determined at intermittent operating periods such as they would receive in the ordinary operation of a current tap. If they were not abused by overload or continued short-circuit, they should last for years.

The operation of the Raytheon tube in a B-substitute is unusually quiet. The reason for this is that the gaseous discharge is entirely enclosed. There cannot be any sputtering of the discharge which might occur if the elements were exposed to the glass tube or insulators. This act conserves the helium gas with which the tube is filled, and greatly prolongs the tube life.

The operation of a properly designed current tap employing the Raytheon rectifier tube has unusually good characteristics. Some of these will be pointed out in connection with points previously explained. First of all, we have exceptionally good "regulation." The impedance of the Raytheon tube increases with load, causing an upward curve in the load characteristic, in distinction to the usual straight line falling curve that gives low voltage at full load current. The fact that the output voltage does not fall off as rapidly as usual obviates the necessity of providing an excessively high transformer secondary voltage. The lowered a.c. voltage is an important contribution to the safety of operation of the device.

The current and power capacity of the Raytheon tube are sufficient to supply the greater majority of radio receivers. The current output is rated at 60 milliamperes at 150 volts and it has been found from measurements of the plate current consumption of large numbers of receivers that

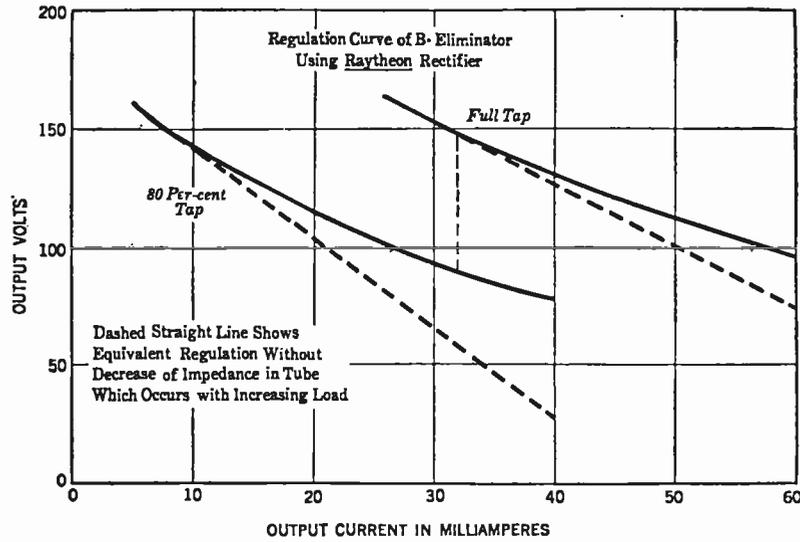


FIG. 3

this value is more than sufficient for the demands of most receivers.

The filtering problem in plate current supply units is usually one of high cost and considerable difficulty. When the Raytheon tube is employed, as it gives rectification of both halves of the a.c. wave, the filtering requirements are much simpler.

LIST OF RAW MATERIALS REQUIRED	
6 lbs. Silicon Steel	\$ 1.20
28 ozs. No. 31 d.c.c. wire	2.19
12 ozs. No. 32 d.c.c. wire94
7-2-Mfd. Condensers	12.25
1-0.5 Mfd. Condensers90
2-0.1 Mfd. Condensers	1.40
1 Bradleyohm No. 10	2.00
1 Raytheon tube	6.00
1 Standard socket25
1-10,000-ohm resistance	1.00
	<hr/>
	\$28.13

The prices quoted above are maximum retail prices. In some cases substantial reductions can be obtained from the costs given.

Here one tube does the work of two at a great saving in cost, and at a higher efficiency. As indicated previously, there is no back-current perceptible. Back-current is a bad feature from a filtering standpoint, as it complicates the filtering problem, and heats up the choke coil windings often to an injurious degree.

Another important feature presented by the Raytheon rectifier is that it requires no power for lighting a filament. This power very often demands a large transformer supply, the cost of which is an item of great importance. With the use of the Raytheon tube, a complete B-substitute can be made up in a space no larger than a heavy duty B-battery.

After a consideration of the foregoing remarks, we may write a set of specifications for the ideal B battery eliminator of to-day:

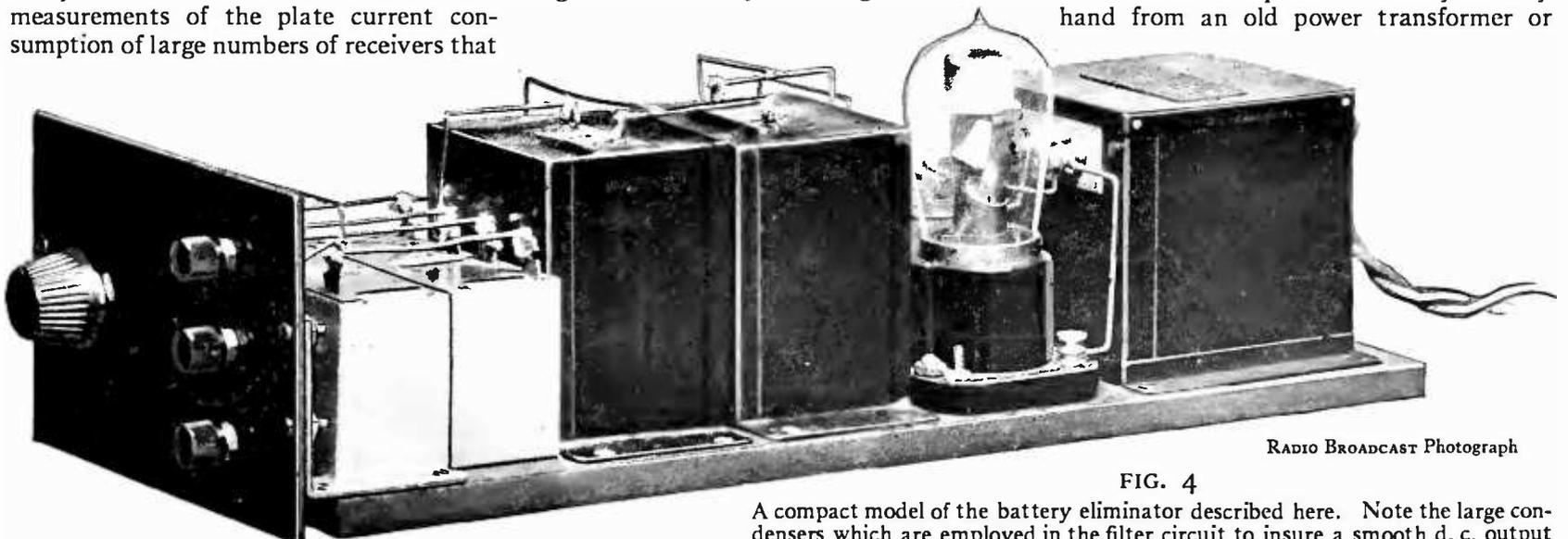
HOW TO BUILD THE APPARATUS

WE WILL now proceed with the building of the eliminator. Figs. 4 and 6 show the arrangements of the parts when the unit is assembled from factory models. The basis of these models lies in the circuit diagram, a schematic drawing of which is shown in Fig. 7. The values of capacity, inductance, and resistance shown in this diagram have been determined after considerable investigation, and the builder will do well to adhere to these quantities as strictly as possible. These instructions also apply to the construction of the home-made transformer and choke's described below.

Dimensions for the transformer used in this eliminator are shown in Fig. 8. The reader will do well to refer to pages 640-650 of the September RADIO BROADCAST for a general discussion on the proper method of winding and assembling transformers. For the benefit of

those who cannot secure copies of this number, a brief discussion of the general procedure will be helpful.

The transformer is made up of three coils of insulated copper wire wound over a core composed of a large number of strips of No. 29 gauge Apollo special electrical steel. These strips are carefully cut by hand from an old power transformer or



RADIO BROADCAST Photograph

FIG. 4

A compact model of the battery eliminator described here. Note the large condensers which are employed in the filter circuit to insure a smooth d. c. output

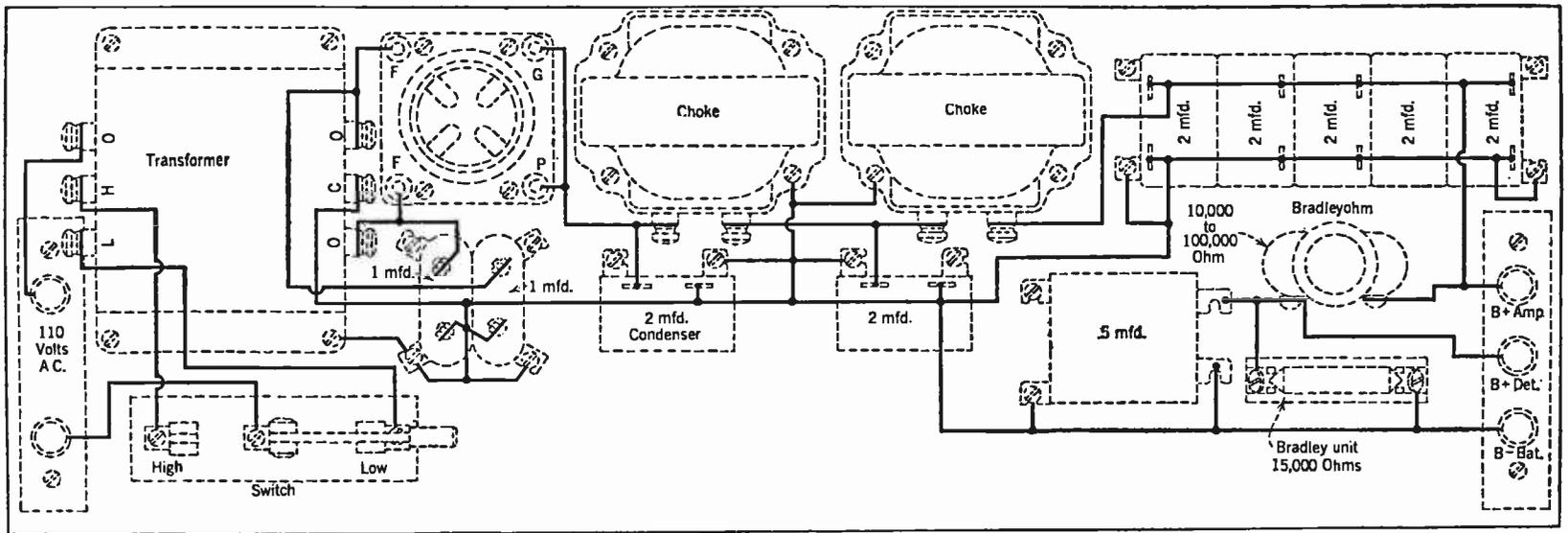


FIG. 5

A picture diagram and wiring layout of the eliminator whose circuit is embodied in the diagram Fig. 7

from sheets of the proper material, and shaped into the forms shown in Fig. 8. Enough pieces are cut out to make up a complete core of the dimensions given in Fig. 8, when they are assembled and clamped together in a vise to determine if the required amount of steel has been prepared. All rough edges must be removed, and the dimensions shown must be uniformly attained.

There are three windings on the transformer which are wound in place on the winding form illustrated in Fig. 9. The winding spool may be assembled on a long stove bolt with nut and clamped in a hand drill, carpenter's brace, or in the chuck of a lathe for convenience in winding the coils. Some means should be provided for counting the turns exactly as they are applied. If the ratio of turns of the hand drill is known for one turn of the handle, it is a very simple matter to use this factor in counting the turns as they are applied. Care should be used to obtain within one per cent. of the specified number of turns on each winding. The primary winding is

applied first over the entire length of the winding form, and consists of 1250 turns of No. 31 enameled copper wire, with a tap taken out and insulated at the 1000th turn. Two layers of Empire cloth are placed over the primary winding, then the two separate secondary windings are wound, each of which consists of 2900 turns of No. 32 enameled copper wire. These two secondary windings are insulated from each other at the middle of the winding form by means of a rectangular separator of .010-inch fiber. This separator is cut out after the primary insulation has been applied, and is put in place by means of a slot cut in one face of the separator. See Fig. 9.

While the first secondary is being wound, the remaining winding space is tightly filled up with a number of strips of cotton muslin or cotton tape, in order to prevent the wire from crowding the winding separator out of place. In all cases, insulated leads 8 inches long, of flexible stranded wire (six No. 30 d.c.c. wires twisted together are satisfactory) are soldered to the

ends of the windings for terminals, before the ends are brought out from the winding. Each terminal is tied in place in order to prevent its being ripped from the coil by accident. If it is necessary, thin strips of paper may be laid over each layer of wire as it is completed, in order to insure smooth layers in the winding. When the coils are completed, the outside is wrapped with two layers of Empire cloth or heavy manila paper as a protection and an insulator.

The steel laminations are now inserted one by one in the completed winding, as shown in Fig. 8 and the transformer is bolted together. If it is not convenient to drill holes in the laminations for the clamping bolts, the builder may cut out clamping plates from hard wood or angle iron. In such case, the bolts will pass through the ends of the clamping plates at the ends of the core, instead of through the holes therein. Fig. 12 shows the method of clamping adopted by the author in preference to drilling holes in the core. If the builder desires, he may put mounting

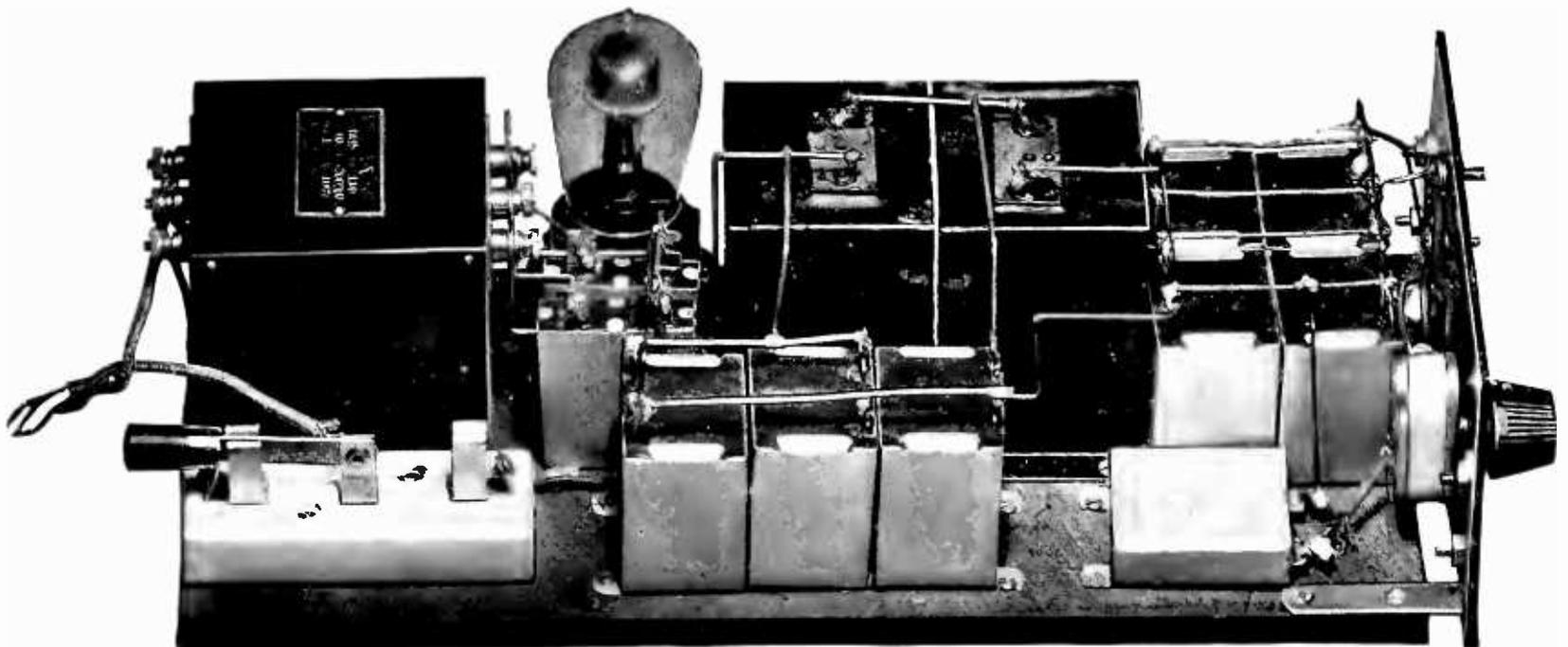


FIG. 6

A different view of the eliminator employing manufactured parts

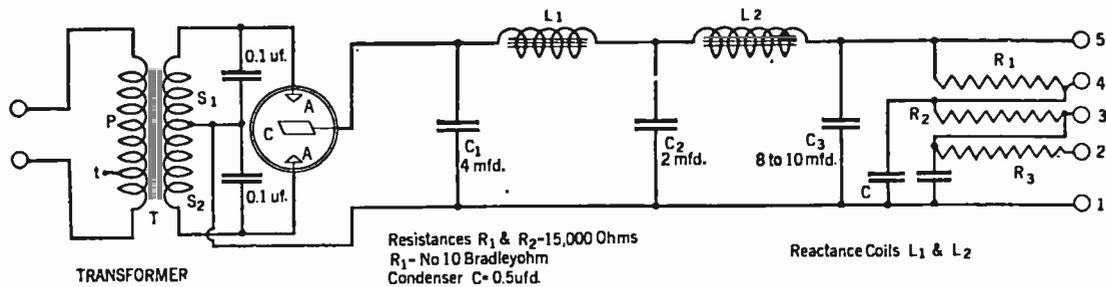


FIG. 7

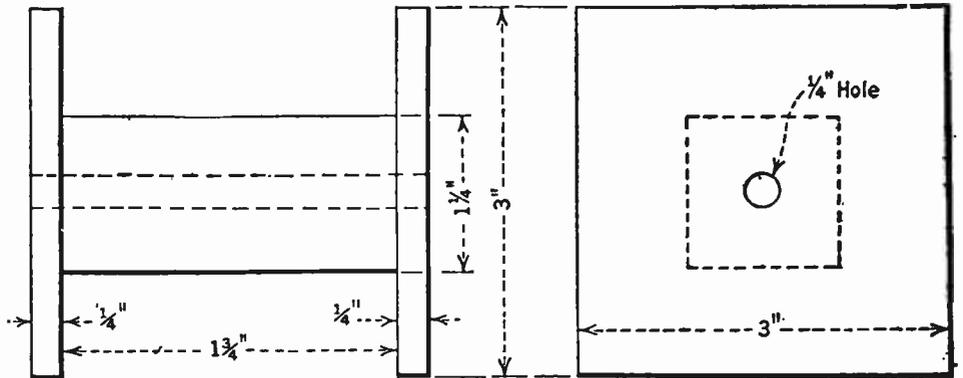
The circuit diagram of the entire eliminator unit. The transformer at the left steps up the line voltage, passes it to the double-wave tube which rectifies both halves of the cycle. Thence it is passes to the filter where it is smoothed out into pure d. c. The resistances permit the tap-off of the desired voltages necessary to the operation of the receiver

brackets on the base of the transformer to aid in securing the instrument to the base board.

NEXT, THE CHOKE COILS

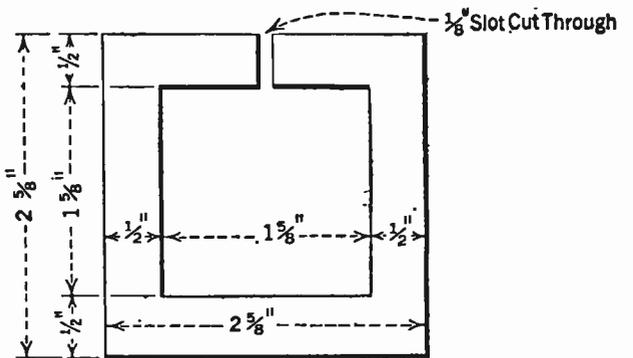
THE choke coils, shown at L_1 and L_2 , Fig. 7 are constructed in a manner similar to that employed in the making of the transformer. Each of these coils will have an inductance of approximately 20 henries if care is taken in constructing and assembling the cores. All rough edges should be removed and the cores should be assembled in an orderly manner.

The winding on each choke coil consists of 5000 turns of No. 31 enameled copper wire, wound in smooth layers with the necessary interleaving papers. The outside of the completed coil is wrapped with one layer of heavy manila paper as a protection. The laminations shown in Fig. 10 are inserted in the completed windings, and the entire coil is assembled in accordance with the description of the power transformer above. A piece of .005-inch paper is inserted in the air gaps of the choke coil cores, to insure the magnetic stability neces-

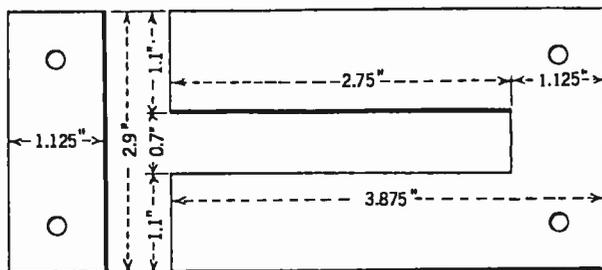
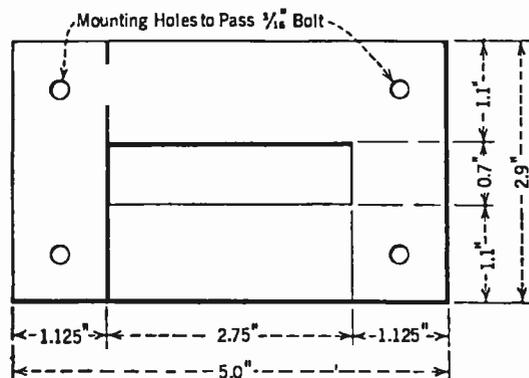


WINDING FORM FOR TRANSFORMER COILS

FIG. 9



WINDING SEPARATOR FOR SECONDARY WINDINGS - 1/8" FIBRE

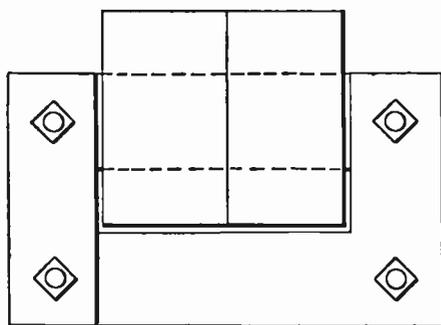


LAMINATIONS FOR TRANSFORMER CORE

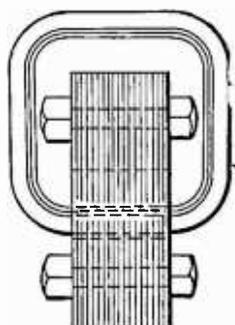
Material: No 29 Gauge Apollo Special Electrical Steel.
Required: Approx. 80 Pieces of each Type
Total Core Weight: Approx. 3 Lbs.



ASSEMBLED TRANSFORMER CORE



ASSEMBLED TRANSFORMER WITH WINDINGS IN PLACE



Transformer Coil
Primary Winding 1250 Turns No.31 Enamel
2-Secondary Windings each 2,750 Turns
No.32 Enamel
.005" Copper Shield between
Primary and Secondary

FIG. 8

Transformer core details

sary under the operating conditions. When this has been accomplished, the clamping plates are secured as described above.

The filter condensers, shown in Figs. 4 and 6 were procured from Tobe Deutschmann, Cornhill, Boston, Massachusetts, and have passed the most severe operating conditions. They were subjected to repeated charging and discharging at 700 volts d.c., and

withstood the strain upon the dielectric successfully. None of the samples examined in this way were found to break down. The equivalent series resistance was found to be low enough to give excellent results in connection with the B battery filter circuit. The particular arrangement of the filter circuit shown in Fig. 7 requires a total capacity of 14 mfd. and the distribution of this quantity is more important than the absolute value. If this circuit does not meet with the requirements of the attached receiver and loud speaker, a slight improvement will be effected by increasing the value of C_3 to 12 or 16 mfd. Increasing this capacity beyond 20 mfd. does not add greatly to the standard of quality already established and, for average conditions, this capacity need not exceed 8 mfd.

The arrangement of the detector voltage control shown in Fig. 7 is unique in some respects, and is an improvement over the usual series resistance method. A 0.5 mfd. condenser is used to by-pass any disturbance that might reach the detector through other paths. The amplifier volt-

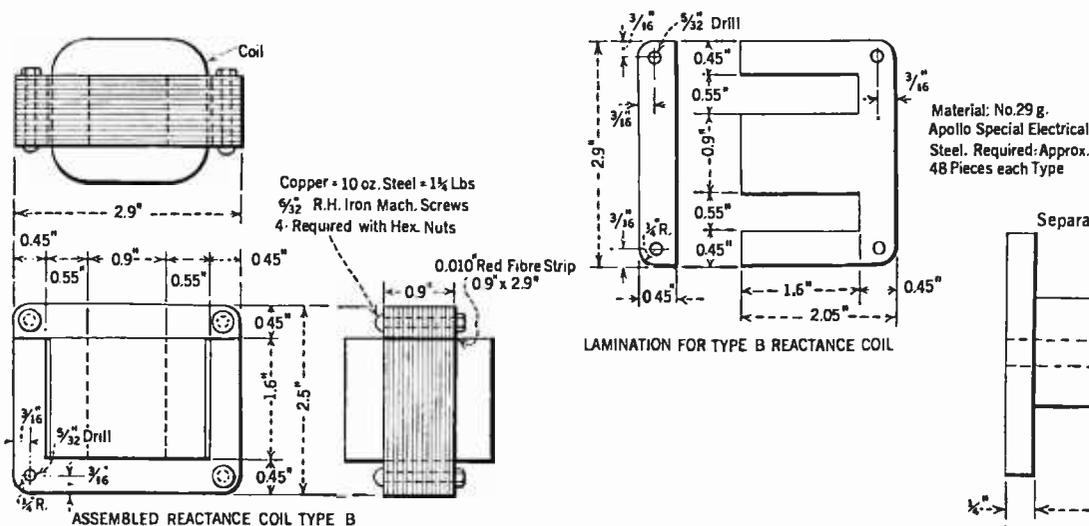
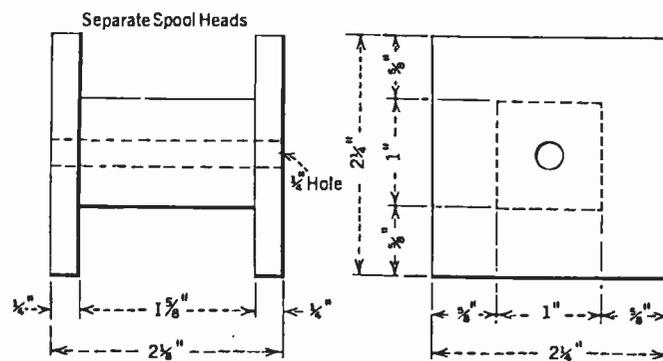


FIG. 10
Here are given all the specifications necessary for the construction and assembly of the choke coil cores

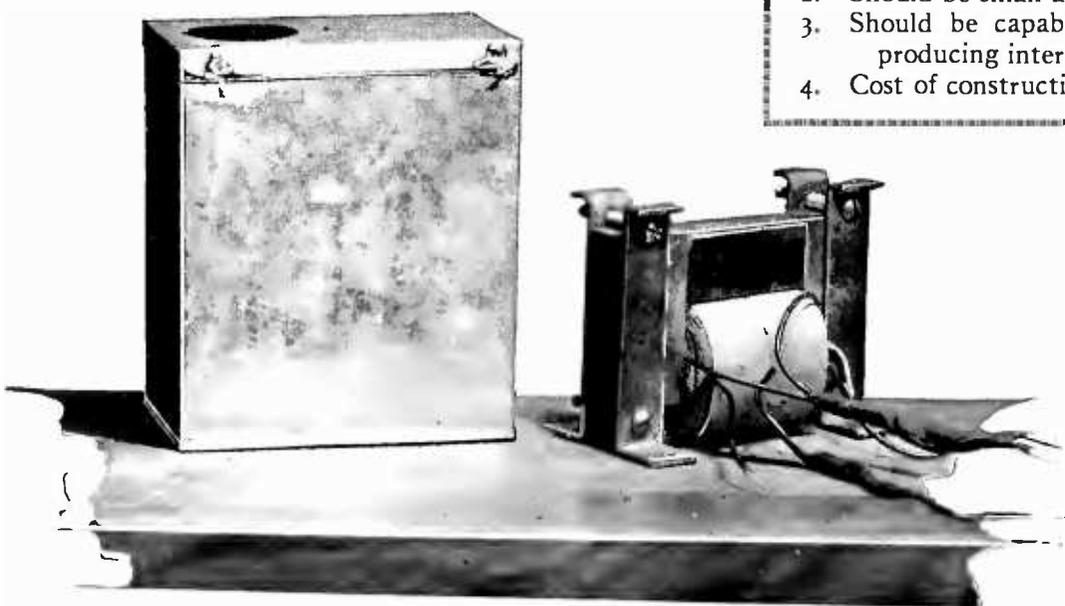


WINDING FORM FOR CHOKE COILS
Material: Wood Winding: 5,000 Turns No 31 Enamel Copper Wire
FIG. 11

age is controlled by means of the switch shown at S, Fig. 7. The blade of this single pole, double throw switch is connected to one side of the 110 volt a.c. line; one lug goes to the 1000th turn tap on the primary, the other lug goes to the full secondary terminal at 1250 turns. When the switch is thrown to the 1000-turn tap, the output voltage will be from 30 to 50 volts higher than on the 1250 tap, depending upon the connected load.

The Raytheon rectifier tube will ordinarily run at a temperature in the neighborhood of 200 degrees F. In case the cup should become red hot, there is evidence that the circuit is being overloaded. Although no permanent damage will be done, it is not advisable to continue this load for more than a few minutes. Continued overloading will soon saturate the cores of the choke coils and render them useless as filter chokes.

In order to prevent the transmission of power line noises through the eliminator circuit, a copper shield has been placed between the primary and secondary windings, and thoroughly insulated therefrom. This consists of a strip of .005-inch copper carefully wrapped over the Empire cloth insulation, and extending within 1/4 inch of the entire periphery of the primary winding. A flexible lead is soldered to the shield, brought out from the winding, and later connected to the ground terminal of the eliminator. All cores of the instrument should be connected together and to the ground terminal. The homemade unit should be placed in an iron or steel case which completely encloses the unit. In the case of the factory units, each part has been placed in an iron magnetic shield, and this is connected to ground to prevent induction of hum in the receiver. Another means for preventing the transmission of line noises through the eliminator is the use of the buffer condensers, shown shunted across the mid-tap and outer leads of the secondary of the transformer, Fig. 7. These



each have a capacity of 0.1 mfd. and serve the purpose of balancing the admittance of each secondary to the neutral or ground side of the line. There is in this way an easy path to ground provided for any disturbing unbalance that might arise in any part of the circuit. The inclusion of these condensers is an important feature, and one that will more than repay their cost.

FIG. 12
A made-up transformer with its tin-can shield

Specifications for the Design of Ideal B Battery Substitute

I. TRANSFORMER

1. Power loss should not exceed 10 watts.
2. Should operate on 25 to 75 cycles a.c.
3. Secondary voltage should not exceed 300 volts for safety.
4. Should be shielded in magnetic shield.
5. Should have electrostatic shield between primary and secondary windings to prevent transmission of line noises to radio receiver. Secondary winding should be balanced for inductance and capacity.

II. RECTIFIER

1. Should have life of at least 5000 hours.
2. " deliver sufficient current at all times.
3. " have low impedance, preferably rising characteristic. (See Fig. 3).
4. Should rectify completely with no reverse current, and with quiet performance at all times.
5. Should rectify both waves of cycle.
6. Should have low starting voltage—i.e. not greater than 160 volts.

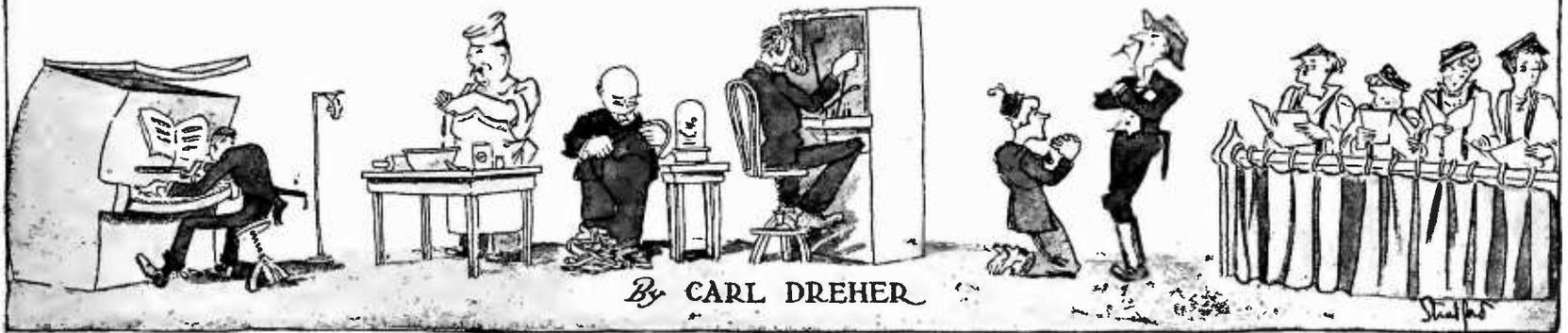
III. FILTER CIRCUIT

1. Should filter perfectly, leaving no hum in headphones.
2. D.c. resistance should not exceed 750 ohms.
3. Should consist of two or more sections instead of one section.

IV. MISCELLANEOUS

1. Should give complete control of amplifier and detector voltages.
2. Should be small and light in weight.
3. Should be capable of being installed in receivers without producing interference.
4. Cost of construction and maintenance should be low.

AS THE BROADCASTER SEES IT



Drawings by Franklyn F. Stratford

In Defense of Broadcasting

IN THE September issue of the *American Mercury*, under the rubric of his monthly department, "The Theatre," Mr. George Jean Nathan pays his respects to broadcasting in terms which will descend harshly on the ears of radio impresarios who were beginning to believe what their own publicity representatives write about them.

Supporting the cheap magazines and moving pictures in their campaign to moronize the country, writes Mr. Nathan, we now have the radio. The roofs of houses from the Atlantic to the Pacific presently take on the aspect of so many sailless schooners. And nightly the front parlors of the proletariat resound to the strains of alley jazz pounded out by bad hotel orchestras, to lectures on Swedenborgianism by ex-veterinary surgeons, to songs about red hot mammas and Beale Street melancholias by hard-up vaudeville performers and to the names of the notables who have just come into Reuben's delicatessen restaurant. Where a few years ago, a family living in the hinterland occasionally after dinner read a book or at least looked through an album of "Famous Masterpieces of Painting," it presently glues receivers to its ears and is thrown into wild aesthetic transports by some Harlem coon's *recitativo* on his *Heimweh* for Alabama or some two-a-day De Pachmann's interpretation of Mozart on a saw. There are two radio broadcasting stations, one in New York and one in Philadelphia, that have made an effort periodically to give their customers something better in the way of music than that which, for its finest effect, must be played on kitchen utensils and cowbells and something better in the way of educational talks than lectures on hygiene by press agents for new mouth-washes, but I understand that they have found the going rough and, in self-preservation, have been forced to fall back more and more on the gibberish and caterwauling that the aerial connoisseurs admire.

Readers who have never before encountered Mr. Nathan's mode of expression will observe that he does not deal in weasel words. He makes it plain that no high-pressure salesman is going to sell him a \$575. radio set. Not that Mr. Nathan has anything against broadcasting in particular. In the article from which I have quoted he rends and tramples on the twenty cent magazines, the movies, tabloid newspapers, and other such agencies of popular

enlightenment. If you were the editor of a tabloid newspaper, how would you like this projectile: "A tabloid newspaper, you need not be told, is a newspaper reduced in size, sense, taste, and decency." Mr. Nathan lets radio off easy, comparatively speaking.

Many broadcasters, unused to criticism along old fashioned football lines, will roar indignantly and let it go at that. That attitude possesses neither maturity nor good sense. If the critic has no case, what he says will in time dissipate itself, like gasoline vapor on a boulevard, and there is no need to get het up about it. If what he says is true, wholly or partially, we might as well let him rub our noses in it and then see what we can do about it. And then, criticism is advertising, and no one can tell me that broadcasters don't like advertising. In this they are

like George Moore, who used to say, according to Frank Harris: "Attack me as you please; slang me, but write about me. I'd rather have a libelous article than silence; indeed, I think slander more effective than eulogy. If you hate my books, say so, please, at length; that will get me readers."

As for me, I can discuss this subject in a serene and unprejudiced spirit. While I am a professional broadcaster and derive most of my income from radio, my responsibilities are purely technical. I am an engineer and I put out on the air what is given to me, just as a telephone installation man wires up equipment indiscriminately for crooks, philanthropists, theatrical ladies who drive Minerva cars on an apparent income of \$35. per week, and gentlemen of the cloth. The gentle rain falls alike on the just and the unjust, and I don't care what I broadcast.

It's no skin off my back if the programs are rotten. As long as the transmission is good, I get my check and the V.P. & G. M. smiles on me. So much for the benefit of those spectators who might imagine that I am moved in my defense of broadcasting—to the extent that I feel called on to defend it—by my need for Hungarian goulash and French pastry.

Mr. Nathan's indictment is true enough, alas, but it should be added that he has selected the holes in the cheese for his discussion. There is considerable nourishment in the solid portions. Among some 600 broadcasting stations in operation in the United States, at any given time, some will be radiating respectable stuff, others will be carrying a load of aspiring sopranos and so-so material, still others will be engaged in purveying aerial garbage for the listeners who like that sort of thing. A cross-sectional view of the burden of the ether waves would show as great a variety in quality as the same process applied to periodical publishing, say. If one walked blindfolded up to the newsstand at the corner of Sixth Avenue and Forty-Second Street in New York, picked out a magazine, opened it at random, and analyzed the pages exposed for ideas, the percentage revealed would probably run even with the birth rate among mules. And that newsstand, be it noted, carries all the respectable magazines



WHEN IN DOUBT, THEY WIELD THE BLUE PENCIL

as well as the cash girl trade; at most magazine stores the chances of lighting on something in the cultural Class A would be even less. If you are after intellect and good taste, you must pick it out from amid the rubbish. Likewise in radio. If you want jazz issuing from your loud speaker, there are certain wavelengths in every radio locality where you can get it at any time. If you want something better, you may be able to get it if you have learned to discriminate between stations. You may not be able to get it just when you want it. But there is just as wide a range between the best and the worst broadcasters as that between the most estimable and the most trashy books or magazines. And, owing to the vast and, perhaps, excessive amount of broadcasting, there is also a great variation with respect to time in the case of any given station. In order to arrive at a fair judgment, one would have to assess a lot of broadcast material and to do far more listening than Mr. Nathan has either the time or the inclination for, in all probability. As one of his customers in his present vocation, I should lament his engaging in any such Augean task. But I, perforce, have done something of the sort. In the last two and one half years, equipped, gratis, with a very fine receiving set, I have put in some 3000 hours listening to my own stations and others. Some of the stuff was not fit to inflict on an ursine howler. Most of it, culturally, was neither here nor there, like the columns of a newspaper or the counters of a five-and-ten-cent store, it had nothing to do with learning the arts, or civilized taste. It neither assisted nor came into conflict with these things. Some of it, the cream, required no apologies to any one. For three summers, now, any one who cared to tune to 600 kc. (455 meters) could hear the New York Philharmonic on the air two or three nights a week, absolutely "without concessions", as the management puts it, to the popular taste for operatic selections, easy overtures, and the like. Having thus thoroughly sampled the etherial waves, and emerged sound and articulate, I depose and say that the average metropolitan broadcasting performance is no more offensive to

good taste than the average printed book or magazine, not half as disturbing to the same as the average city newspaper, and not one quarter as flagrant as the average big time vaudeville show or moving picture. As for the tabloid newspapers and other such dung-hill enterprises, broadcasting, with all its glaring faults, is positively a civilizing influence; by contrast, its entrepreneurs and managers become so many Schopenhauers, and Sidney Laniers.

It is true that a great many silly and obvious talks get a hearing *via* radio, and that not a few of the lectures have an unpleasantly sanctimonious and oily tone. The second fault is caused partly by the influx of people quite without qualifications for radio lecturing, who try to compensate for their deficiencies by slobbering over the listeners. On the other hand, one hears more than a few people on the air whose natural frankness and sincerity manages to get through to the orifices of the loudspeakers. Dr. John H. Finley is one such engaging speaker; even if one does not agree with what he says it is pleasant to listen to him. As for the content of the talks, it varies all over the map. I have heard everything from an inspirational speaker (he broadcast in a frock coat, incidentally) declaring, "All the evils of the world are due to incorrect thinking," to a lecture on Whitman by such a recognized authority as Prof. Emory Holloway, the reading of a story by Sherwood Anderson, and performances of one act Provincetown plays.

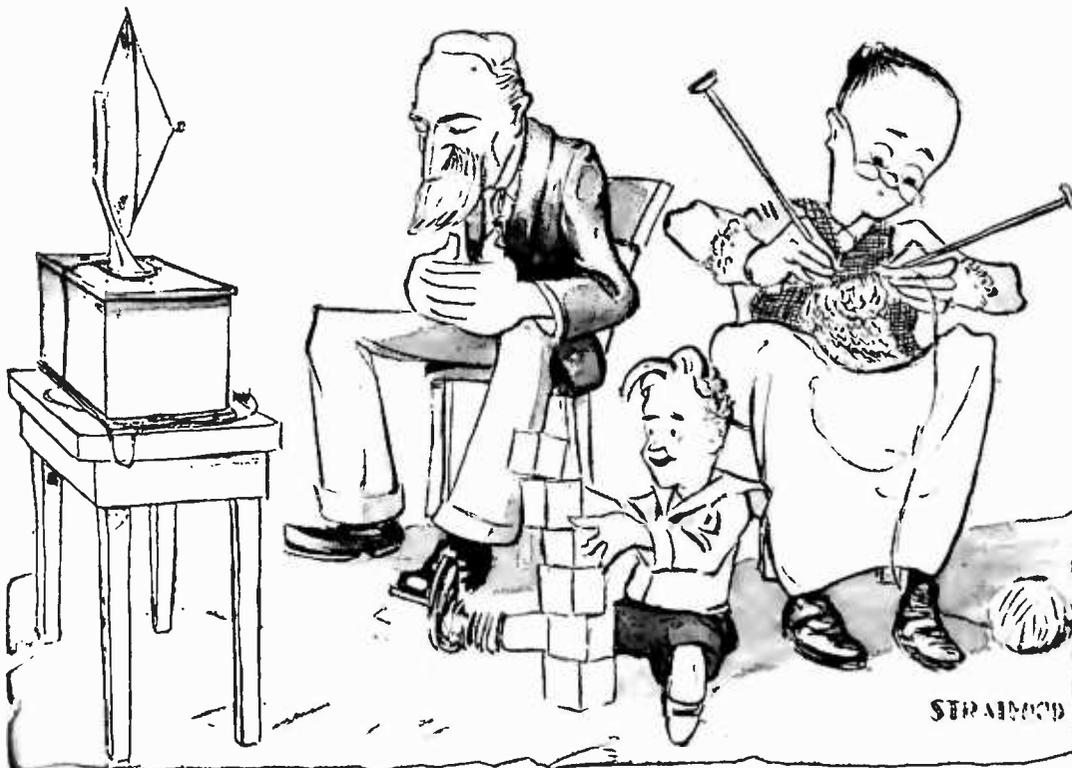
The trouble with radio talks is mainly that the owners and program managers of the stations feel it incumbent on them not to offend *anyone*. They are in a constant stew about "adverse publicity." A few letters from irate listeners give them the horrors. They run their stations for advertising or good will, and as soon as any one looks at them cross-eyed their knees shake. When in doubt, they wield the blue pencil, and any one who tries to please the whole world is in doubt most of the time. In such large audiences as those they figure they are catering to, there are thousands of inferiority complexes ready to be triggered off. Eddie Cantor once delivered a first-rate humorous talk

over the radio, and at one point he remarked extemporaneously, "For all I know a lot of Polacks are listening to me." The comedian, of course, had no offensive intention, but during the next few days he received twenty protests from Polish listeners, including a formal denunciation from a society. If I wrote a story containing some reference to an elderly Jew in a green sport suit, and there was nothing else the matter with it, there would be no difficulty in getting it published and receiving payment for it. But broadcasting that phrase, at the present stage, would be out of the question. No program manager would touch it. In his audience of several hundred thousand there must be several elderly Jewish gentlemen who wear green sport suits, and he wouldn't make them sore for the world. No one must be offended, no one's morals must be impaired, a thousand dignities must be tenderly preserved, the lecture must be fit for everyone between the ages of eight and eighty. If, under these conditions, the content of the talk is also to be mature and significant, you have a large order.

Even controversy is often frowned upon. Admiral William Ledyard Rodgers and General Tasker Howard Bliss recently broadcast a debate on "Shall America Arm for War?" under the auspices of the *Forum*. The debaters did not come to blows, no riots were reported, and the more thoughtful among the listeners spent a profitable half-hour. The magazine next wanted to put on the air a debate between Professor Osborn and Mr. Bryan on the subject of Evolution. But this was declared to be "too controversial" by all the station managers interviewed. So it was not broadcast.

Mr. Nathan's conclusion that jazz is the staple radio musical diet does not jibe with my observations. There is a great deal of jazz on the air, and a few stations emit almost nothing else, but they are decidedly atypical. The average musical radio offering is rather something on the order of the Silvestri-Toselli "Rimpianto" serenade—pretty and obvious. In short, the sort of thing all dining room orchestras in big hotels turn out. Some of the hotel "ensembles" are very good, incidentally. They broadcast popular classics. If I have heard "Mon coeur s'ouvre a ta voix" once, I have heard it a hundred times. There is a lot of Old Black Joeing and Silver Threads Among the Gold on the air, but, after all, these are decent folk songs, objectionable only when overdone. Down another peg are college things like "Rolling Down to Rio," and the bombastic "Invictus." Not over a third of the total is jazz, and on top you have beautiful *Lieder*, the best symphonies, including all the Brahms, the tone poems (I have heard *Don Juan* on the air in its entirety seven times) and the Strauss waltzes. At one station in New York, for example, absolutely no dance music is allowed on the air until after 10.30 in the evening. All in all, not so bad.

Such inventions as the motion picture and the radio telephone have cultural and artistic possibilities, which are rarely realized because, with a large initial investment and heavy operating expenses, the only way to get a return on the money is to produce something attractive to the masses. The result is what we know. Only two copies of Thomas Hardy were sold in Boston in the six months from January 1 to July 1, Mr. Nathan points out. Still, the movies could do something even for Hardy's art. Needless to say, I don't mean any such shameful burlesque as the movie version of *Tess of the d'Urbervilles* which appeared a while ago. But if I had a few million dollars, I'd make a moving picture of Hardy's *The Dynasts* and perform it, serial fashion, a competent actor, to be



RADIO IS TRYING TO PLEASE ALL BETWEEN EIGHT AND EIGHTY

selected by Mr. Nathan, intoning the lines, to the accompaniment of a first class symphony orchestra. I should do this, not to improve the movies, which can go straight into the sewer for all I care, but purely for the benefit of the few who care for that sort of thing. The Napoleonic wars forming the background of Hardy's great epic, the transparent tentacles of the Immanent Will, moving irresistibly those great columns of soldiers wearing the expression of men in a dream, could only be portrayed in the medium of the cinema.

Similarly, some day, somewhere, a millionaire with *American Mercury* tastes may endow a radio broadcasting station to disseminate material which is agreeable to him. If so, I shall be pleased to oil the generators for same, and to be counted among its listeners. Mr. Nathan might buy an eight-tube "super" on that remote to-morrow. In the meantime, radio is neither as good as the publicity artists would have us believe, nor as bad as Mr. Nathan has painted it.

Technical Routine in Broadcasting Stations

1. Wire Lines

LAST month, in our discussion of "Personnel and Organization in Broadcasting," we took up in some detail the responsibilities and functions of the various employees, program and technical. However, the bulk of the discussion was on the problem of securing programs, rather than broadcasting them. In this issue we shall get down to the actual business of putting the program material out on the air, with all the technical preliminaries involved.

The technical staff, as we have seen, is divided into transmitter, control, and field divisions, all reporting to an engineer-in-charge or chief technician of some sort. These men work with the announcers and the studio manager during the actual broadcasting. First, however, we shall take up the technical routine which precedes it.

This technical routine, in many respects, is not radio at all. For example, the testing of wire lines is no more characteristic of broadcasting than of wire telephony, but it is equally important in both. Practically every large broadcasting station finds it necessary to go after its programs by means of telephone lines. These lines are in a few cases owned outright by the broadcasting company, but as a rule they are leased from some pre-existing telephone or telegraph company. Lines are costly and one does not generally buy them outright, any more than one buys a railroad in order to commute. When the lines are leased from some public service corporation, they are usually maintained by the owners. Such a system will consist of certain trunks running through the principal part of the town, possibly in the form of a ten-pair cable devoted exclusively to radio, for it is important that these wires should not be subject to inductive disturbances and that they should not interfere, in turn, with other public services.

A week or more before the time scheduled for broadcasting, the program department sends a list of projected field events to the line company. On a certain day, for example, a musical comedy is to be broadcast from a theatre. The

wire company then runs a twisted pair from a convenient terminal box on the nearest trunk, over housetops and streets, to the theatre in question. This lead is called a "lateral." If the broadcasting company is leasing an adequate wire system these laterals are normally only a few blocks long. The expense of work and material is charged to the broadcasting company, so it is wise for the latter to balance trunk costs against additional construction in order to get a minimum total for the two. When the wire is placed in the theatre, with a long lead left in a coil so that the broadcasting operators can set up at a convenient point in the house, the telephone or wire company's lineman calls up the station, using an ordinary portable telephone, and tests through. He rings the station with a magneto, causing a telephone relay to release a drop on the station switch board, and says to the control operator who answers. "This is—at the Criterion Theatre. Will you test this loop?" The operator then puts 110 volts on each side of the line through a voltmeter to ground. If the loop is properly insulated the meter will read only a few volts, the resistance in series with it being of the order of many megohms. The ends of the pair are then short-circuited at the theatre and a continuity test is made to locate high resistance joints and the like. If the line is in good shape, the meter will read practically full voltage, the line resistance being negligible compared to the resistance of the voltmeter. So far we have merely the standard procedure which thousands of wire chiefs go through every day on telephone and telegraph lines. However, a further test is now made in which radio standards are rather more critical than those of the older services. The men on the line listen for noise. If they can hear any noise at all with an ordinary pair of telephones bridged across the line, they are apt to run into trouble during quiet intervals in the broadcasting.

Noise comes in from various sources, such as stock-tickers, parallel Morse circuits, elevator motors, etc. Each of these machines has a characteristic sound, and men who work on lines become familiar with the various types. Usually noise interference is due to some unbalance of the line. It is necessary to have the circuit accurately symmetrical, electrically, about an imaginary reference line in the middle. Fig. 1 shows this condition, the line terminating at either end in repeating coils, or 1:1 transformers, with grounded midpoints. Each side is assumed to measure 60 megohms to ground. If, now, one side of the line should be opened

or grounded, a roar of noise would probably come in, although in the balanced condition the circuit might be perfectly quiet. But it is not sufficient to have the two sides of the line equal in insulation resistance. It is also necessary to transpose or interchange the two wires frequently, so that induction picked up in one stretch is neutralized in the next stretch of equal length. On an open wire line running on cross-arms fastened to poles, each pair of wires will be transposed at, say, every tenth pole. Likewise, in a cable, the various wires must be "paired." "Twisted pair" is used, never simply a pair of wires lying side by side. In a properly paired cable several miles long, a few hundred feet of "straight-laid" conductor will ruin the entire circuit for broadcasting purposes, because of the excessive noise picked up. The telephone engineers put it this way: "A telephone circuit balanced in all respects, including balance to other circuits, is immune to inductive interference."

When trouble is encountered on wire circuits, it is hunted down by the process of "localizing." On long lines it is necessary to use special tests which show the distance of the fault from the testing point, but on short local circuits the lineman simply cuts out a section and by proceeding in this way sooner or later reduces the trouble to one section. He usually knows the weak spots in each section—here the wire runs through a damp cellar, and there it rubs against a roof coping, and so on; and sooner or later he finds the particular spot which is causing the trouble.

Of course no circuit of any length is ever exactly balanced, in practice, and in the presence of very powerful inductive fields noise will inevitably be picked up. For example, nearby lightning will register on the best lines; high tension leaks, power plant troubles, certain types of automatic and multiplex telegraph circuits, will interfere on almost any loop near them. Even if a man has armor on, you can probably kill him with a sledge-hammer or an elephant rifle. The only answer is to keep away from trouble-making types of service as much as possible. However, various devices, such as shielded, paired cables; anti-noise sets, which slow down electrical impulses to a point where they no longer interfere, have been used with considerable success. Again, some types of interference clear themselves through the cessation of business activity in the early evening. Ticker noise encountered on a morning test of a certain circuit, which is to be used in the evening for broadcasting, may be ignored if it

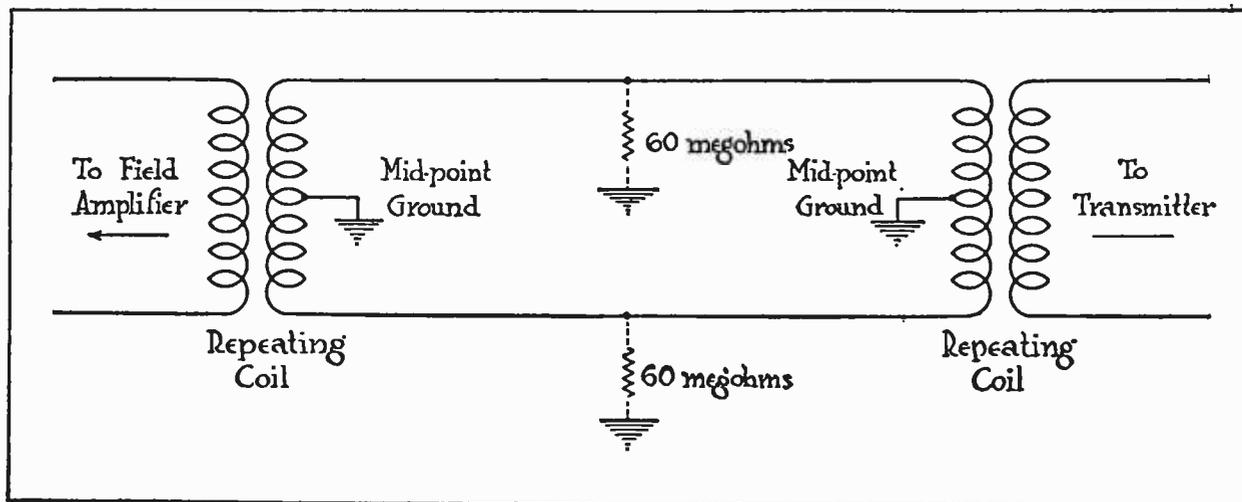


FIG. 1

Electrically symmetrical lines are necessary in order "pick-ups." The diagram shows the circuit used. The field amplifier is controlled by an operator at the actual point of broadcasting

is known to come from certain financial houses which close down at 4 p. m. In case of emergency, it is sometimes possible to shut down parallel, interfering circuits during the period of broadcasting.

Broadcast operators and the lineman who work with them know all these kinks and utilize them in their work. The organization chart shown last month did not include a lineman among the technical employees, but as a matter of fact, although this man is usually not on the broadcasting station's payroll, he works in the closest cooperation with the station staff and is to all intents and purposes a member of it, and, if he knows his business, no mean asset.

Regardless of previous tests, it is important that every wire circuit which is to be used on a certain day for broadcasting, should be tested on that day some hours before the event is scheduled. Accidents often happen at the last minute. If the event is a very important one, such as a presidential broadcast, or a major prizefight, it may even pay to have the lineman around till the job is done on the air. For these occasions, also, it is quite necessary to have two or three pairs, one for broadcasting, one as a breakdown pair, and one for an "order wire." For ordinary jobs a single pair is generally sufficient. The operators talk over it until it is time to take the air, and use it for post-mortems afterward. Sometimes the wire is simplexed or used for telegraph conversation during the broadcasting without interference between the two functions. This is not very common in local work, but it is the usual thing on long out-of-town circuits, where the cost of the line is so great that all its potentialities must be utilized.

Wire tests must not be left to any one's memory, but a log book, as shown in Fig. 2, is kept, showing the condition of the circuit at the time tested, and who is responsible for the observations.

It is possible to have one control operator in the station who is exclusively detailed for wire line work, but the usual procedure is to have the men rotate, so that everyone takes a turn at it. Often the station is on the air in the morning and the operator who runs the control room at that time also takes care of the wire line tests for the day, since as a rule the observations are quickly made, and there are long intervals between tests while the lineman goes from one remote point to another. In a large station one operator may be "on the channel," as the saying is—watching what goes out on the air and making necessary adjustments—while another man handles the wire tests and does maintenance work in the intervals.

One point that should not be neglected is the removal of all laterals not in use on any given trunk. Otherwise the laterals pile up, increasing the capacity of the line to the point where the higher frequencies are lost and quality of transmission is adversely affected. These sections hanging on uselessly may also bring in noise. In a properly maintained wire system the trunks are stripped of laterals at frequent intervals—and that does not mean every few weeks.

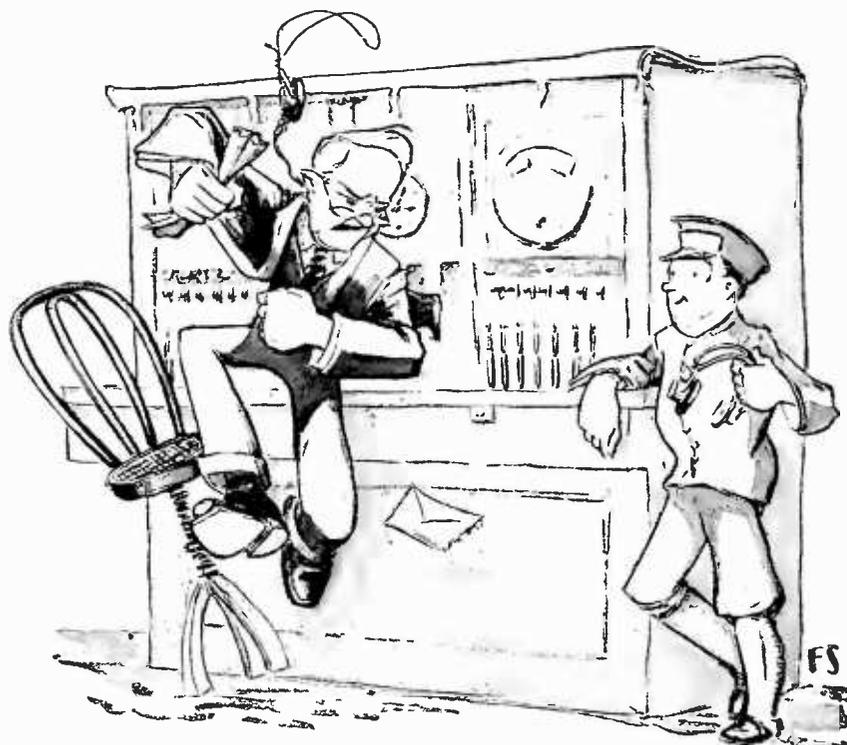
If the lines pass through telephone exchanges

or telegraph offices the utmost care must be taken to avoid interference by employees who don't know what is going on. The broadcasting lines should be red-tagged and a special notice sent around cautioning all unauthorized people to keep away. Most telegraph and telephone men have little notion of what broadcasting quality is and they will sometimes innocently break up a circuit in order to get a little amusement during idle periods. At one station it was noticed that music coming over a long line (some five miles) was curiously tinny—lacking in the lower frequencies. This was

just the opposite of what one would expect—the suppression of the higher frequencies by the line capacity. The engineers were somewhat puzzled until one day one of them happened to be at the main telegraph office in the city in question and saw an idle operator plug a 60-ohm telephone into the jack panel of the broadcasting station, in order to listen to the music. The circuit was one terminating in 500-ohm impedances, so this low inductance was effectively by-passing all the lower frequencies. The engineer sent a 2000-ohm headset down to the telegraph office with a polite note to the wire chief suggesting that if the operators wanted to listen in they could use the high impedance telephones without ruining quality on the air. But the wire chief, receiving this epistle, flew high up in the air, returned the 2000-ohm phones with thanks and apologies, and posted a notice informing his staff that any one who plugged anything into those circuits without authority would be summarily fired. Then there was peace.

Radio Lingo, Past and Present

SOMEWHERE in his writings or conversations Anatole France compares a synthetic language to a doll, while a natural language, with its centuries of use, growth, and development, he likens to a living woman. On a more modest scale, the technical terminology of an art or science, as it reflects the achievements and changes of years of effort on the part of many men, takes on an almost organic meaning and color. We usually think of objects like antennas and microphones as purely inanimate and lifeless, forgetting that they are the tools of human aspirations and carry with them an emanation of human emotions. The names of these tools, and of the scientific ideas which they em-



"THE WIRE CHIEF WENT UP IN THE AIR"

body, and the way in which people talk about them, all change with time. Not only do they change, but they show a tendency toward poetic figures of speech, and many terms which we use daily in the most matter of fact way, if we stop to examine them, show an interesting technical and literary history. This is particularly the case with radio terms, and I purpose to classify and discuss some of these, now popular expressions in the light of their origin and history.

Radio, contrary to the notion of many of its devotees, did not start in 1920. It had its period of development in the minds of men like Maxwell, Henry, Heaviside, and Hertz, it was born three decades ago, and it is now past its infancy. It has borrowed from all the older engineering arts both words and ideas. If, as someone has asserted, one can understand a thing only by understanding how it became what it is, an examination of the technical jargon of radio should be as instructive as an article on hook-ups and super-circuits—and a little more out of the ordinary.

Physical Characteristics

As in every field, the obvious physical characteristics of objects suggest suitable names. We speak of cat-whisker detectors, bulbs, tubes, condenser plates, plugs, knobs, etc. Position in space acts in the same way; *aerial* is the most prominent instance. The types of aerials are all named in the same way: umbrella, harp, fan, V, inverted-V, flat-top, inverted-L, and T. In these cases the name, or the figure of speech, was suggested by the physical appearance. Somewhat the same process occurs with inductance coils. We refer to inductance spirals and helices, and to honeycomb, latticework, basket-wound or cellular coils where the criss-

FIG. 2

A typical test report made by broadcast operators on the condition of an outside wire used for picking up programs

LOOP NUMBER	TO	LEAKS TO GROUND		CONTINUITY	DATE	OPERATOR
		Tip	Sleeve			
465	Criterion Theatre	8	8	118	9/15 25	GN
...
...

crossing of the turns results in a cellular structure. This is the simplest and least imaginative portion of radio philology.

Figurative Expressions

If to call an aerial by that name is an obvious procedure—as well as a trifle out of date in those instances where the aerial has been taken in out of the wet to share the rarified atmosphere with the vases and porcelain dogs on the Dutch shelf of the living room—the term *antenna* is a step higher in the literary if not in the physical sense. This was originally a zoological name, applied to the organs of feeling with which lobsters, cockroaches, and other noble animals poke their way. No one who has seen an insect waving his antennae around when in an uncertain situation, confronted, for example, by an angry housewife with a mop, could have overlooked the analogy with a crystal set owner striving to receive Los Angeles from the Eastern coast. A radio antenna is, in fact, an artificial feeler or organ of sensation.

We speak of a "phantom" or "dummy" antenna, as used for testing purposes where radiation must be suppressed. Another figurative expression in connection with antennas is "counterpoise"—literally a counterweight—applied to a network of wires beneath an antenna, the purpose being to keep the electric field away from poor conducting materials, such as dry earth, and thereby to reduce the losses of the transmitting system. It might really be called a "counter-capacity."

The Memoirs of a Radio Engineer VII

NOWADAYS radio gets the bulk of its publicity through broadcasting. Some famous opera singer performs for the radio, or the President delivers a speech, and the headline writers get busy. In the pre-broadcasting era, maritime disasters in which radio played a part were the principal source of publicity for the art. Of course, at that time there was a novelty about the whole business which has largely disappeared since, so that incidents like two stations exchanging messages over a distance of a few thousand miles, would get into the newspapers, while now no one pays any attention to them. But anything that saves human lives interests everybody; and it was in connection with accidents at sea that many people first heard of radio or had it called strikingly, often unforgettably, to their attention. It must be remembered that at this time, around 1910, communication with a vessel at sea was still a novelty. The act requiring passenger-carrying vessels making sea voyages more than 100 miles in length to be equipped with "wireless" was passed by the United States Congress in that year. It was not much more than ten years before that the first radio set had been installed on a ship. Along in the early part of the first decade of the Twentieth Century, it was still the usual thing for vessels carrying hundreds of passengers to leave land and not be heard from again till they reached their destination, or, in some instances, not to be heard from again at all. The sea swallowed them up, and that was all. After radio was introduced, such episodes became rare. Radio cannot prevent shipwrecks altogether, but a great percentage of them may be avoided by its use, and practically always help can be summoned when needed. That help may be only partially effective, or it may arrive too late, for, unfortunately, men and ships cannot be transported with the speed of the ether waves, and there are storms and situations

in which every ship has all it can do to take care of itself, but at least one has the consolation of knowing that what man can do was done. Before radio got into the picture, a vessel could burn up or founder with hundreds of people on board, and another ship near by might go on its way oblivious of what was happening. There is no tragedy like an avoidable tragedy.

It was in 1909 that through the intervention of radio such a tragedy was averted. The White Star passenger steamship *Republic* collided near Nantucket Light with the freighter *Florida* and sank some hours later. But before she went down she called for help on her wireless set, operated by Jack Binns. That call, picked up at Siasconsett, Massachusetts and by various other coast and ship stations, resulted in all the passengers and crew being taken off the *Republic* before she sank, and what would probably have amounted to a loss of hundreds of lives was limited to the six casualties which had occurred during the actual collision. The world sat up and took notice. Many people who had thought of the wireless telegraph as merely an interesting scientific toy, changed their minds overnight. Some of them bought stock in radio companies, not all of it good.

Three years passed, with the number of wireless stations and activities in general increasing rapidly. Then, once more, the aerial telegraph played its part, effectively enough, and yet it was not sufficient to obviate a great loss of life when the S. S. *Titanic*, then the largest ship in the world, sank 800 miles off the Grand Banks of Newfoundland, at 2 a.m., April 15, 1912, after striking an iceberg. The *Titanic* was driving through the night on her maiden trip, trying to make a record for the crossing (Those were the days of rivalry between British and German shipping interests) when her nose crashed into a "growler" of moderate size, but large enough to open the liner's compartments, so that she sank only a few hours later. Although the accident occurred in midocean, many vessels were near, and if the *Titanic* could have managed

to stay afloat six or eight hours almost everyone might have been saved. The nearest ship was the *Carpathia* and it was she who sped 58 miles, under forced draught, in three and one half hours, arriving at the scene of the disaster at 4.10 in the morning, to find lifeboats filled with survivors dotting the icy sea. The dead numbered 1635, among them Jack Phillips, the senior wireless operator, to whom the surviving 700 owed their lives, for it was his CQD and SOS calls that summoned the *Carpathia* to the rescue. Other vessels, the *Olympic*, the *Birma*, the *Virginian*, and the *Baltic*, were on their way, but turned around on hearing that the *Carpathia* had already done all that human sailors in iron ships could do.

Great as the service of radio proved on this occasion, luck and uncertainty played too great a part in what followed the collision of the ship and the iceberg. The *Titanic* carried an adequate transmitting set, with a day range of more than 400 miles and a night range which carried her cry of distress far over the sea, and yet she might easily have missed altogether the *Carpathia*, the one ship near enough to give quick assistance. It was also rumored at the time that one freighter, unequipped with radio, was even closer and might have taken off passengers who could not find a place in the lifeboats and whose lives ended shortly in the cold water. The fact was that the *Carpathia's* one operator, H. T. Cottam, was going to bed before the *Titanic* smashed her nose on the iceberg, and it was only by chance, or, if you please, the intervention of Providence, that he stayed up a little longer to get off some messages, and heard the *Titanic's* CQD buzzing into his headphones, at 12:35 in the morning. Cottam already had his coat off. Had he taken off the phones and grounded his antenna a few minutes earlier, the *Carpathia* would have continued tranquilly on her course while 2000 people were perishing 60 miles away. The necessity of a *continuous* watch by two or more operators was impressed on everyone

(To be continued)



MARINE RADIO GAVE THE ART ITS FIRST PUBLICITY

The "ARISTOCRAT"

A Gallery of Interesting Models of the RADIO BROADCAST "Aristocrat" Receiver, Especially Adapted for the Phonograph Cabinet —the High Quality Audio Channel is Assured by Resistance-Coupled Amplification

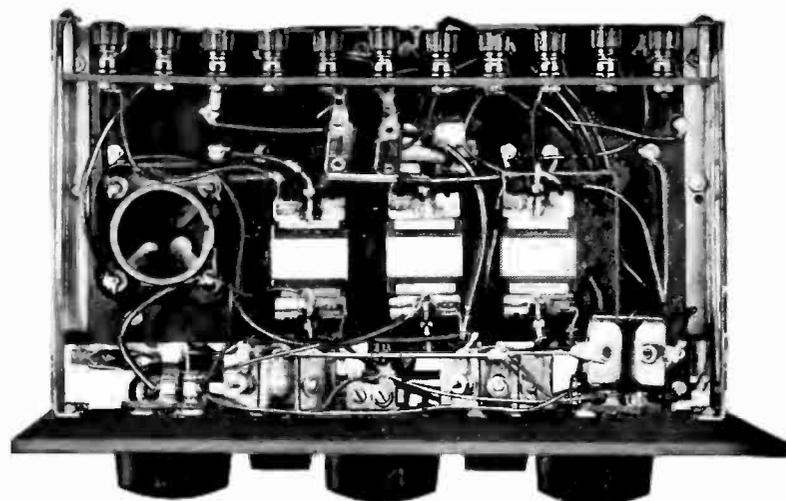


FIG. 1

One of the Phonograph Receivers described in RADIO BROADCAST for June, July, and August, converted into a RADIO BROADCAST "Aristocrat" by the addition of one tube and by replacing the transformers with Dubilier condenser and resistance units for making a resistance-coupled amplifier

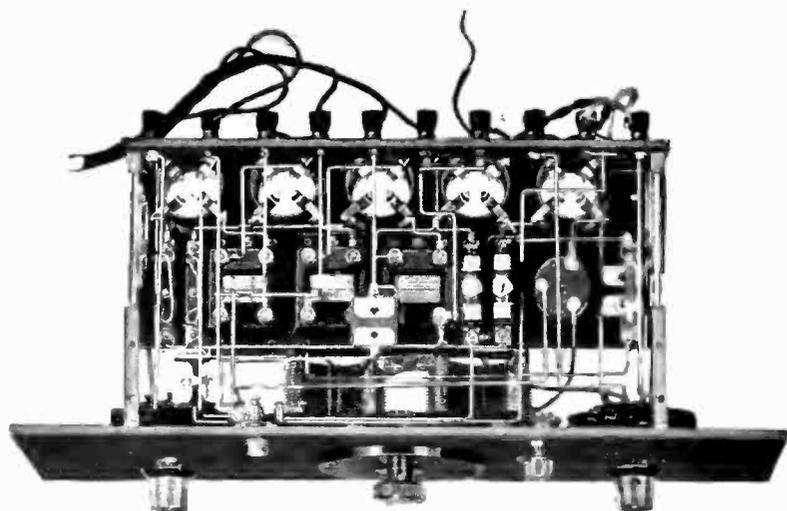


FIG. 2

This is a bottom view of the receiver, shown in Figs. 5 and 8. The filament circuit in this receiver has been somewhat altered in that $\frac{1}{4}$ -ampere ballasts, one each, have been used in the detector and radio-frequency amplifier filament circuits. A half-ampere ballast is used in the first two audio tube circuits and another is used in the output tube circuit. Where six-volt tubes are used instead of the five-volt type, short pieces of bus wire may be employed in place of the ballast resistors as indicated at the left hand side of the illustration, where two such base connections have been made. It will be noted that in this receiver Brach resistance coupling units and Brach ballast resistors have been used

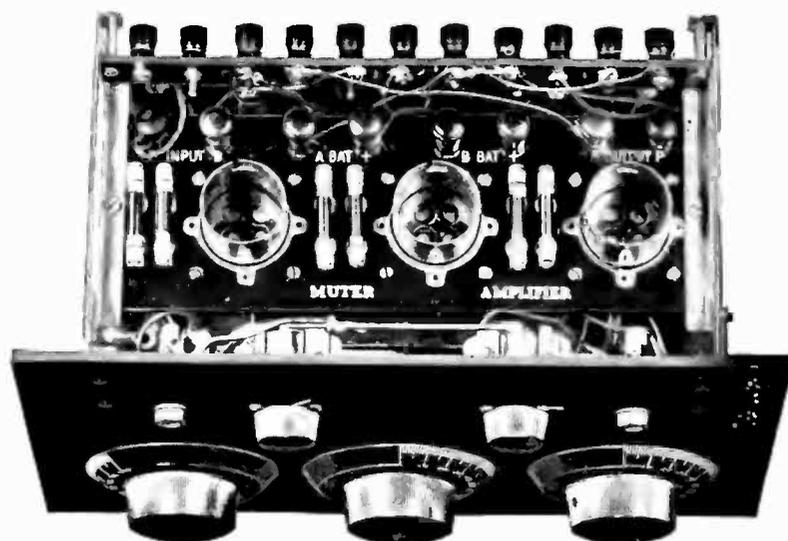


FIG. 3

Another RADIO BROADCAST Phonograph Receiver converted into an "Aristocrat" by the use of a three-stage Muter resistance-coupled amplifier

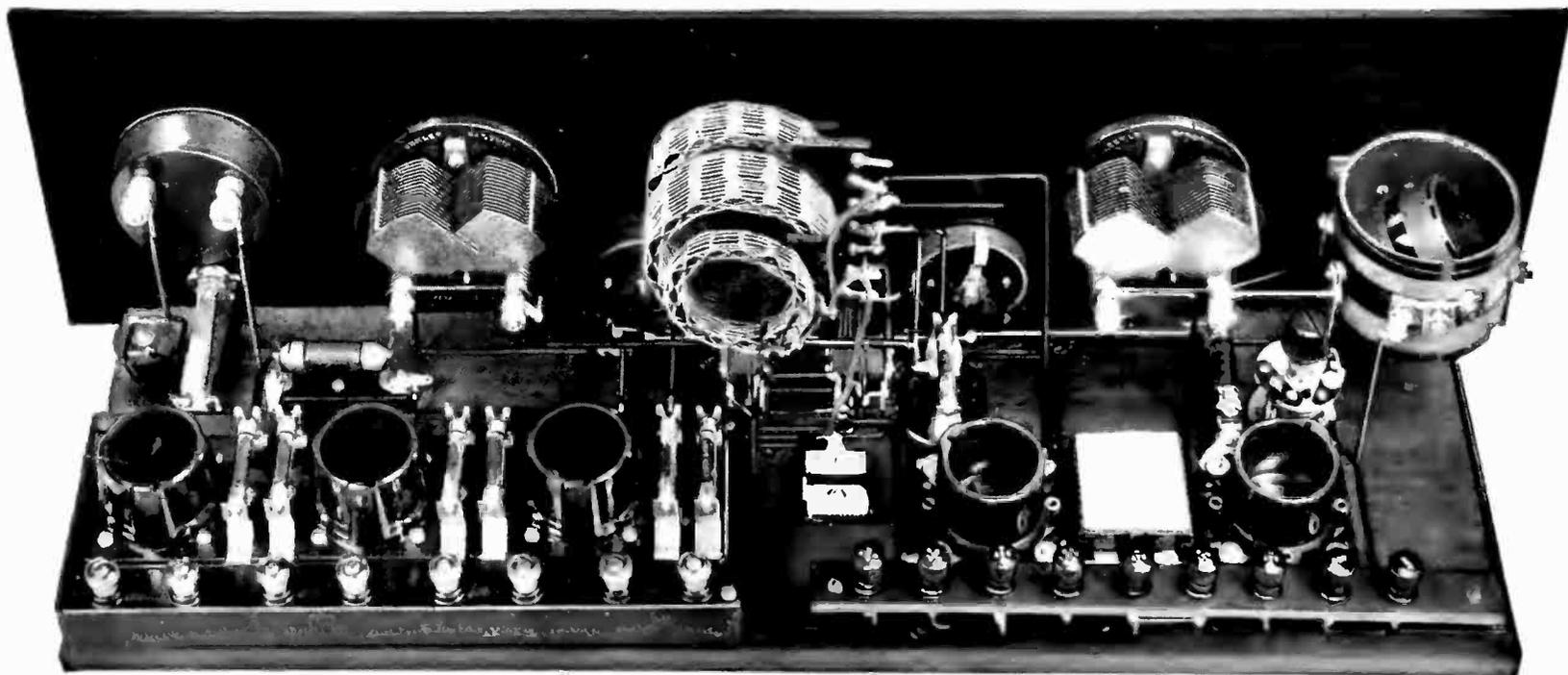


FIG. 4

This RADIO BROADCAST "Aristocrat" was made by Radio Research Laboratories, New York, and they have incorporated some slight modifications of their own, which are to be commended. For instance, the General Radio variocoupler used in the antenna circuit makes it possible to compensate for various antennas without tap switch. The voltmeter has a multiplier in series as it is one of the double scale type. Victor coils have been used in the radio frequency unit, and they have been found very satisfactory. Two Pacent 10-ohm rheostats are employed, one in the detector circuit and one in the radio-frequency amplifier circuit. The latter makes a particularly good volume control. The entire assembly is an example of the kind of workmanship that any home constructor may accomplish if he will devote himself sincerely to the job

How to Use Meters in Your Receiver

The Meter is a Comparatively Inexpensive and Valuable Refinement—How Meters Work and How to Use Them for Best Results

By JAMES MILLEN

NOT a few broadcast listeners have the idea that meters in a radio receiver, if they are built in at all, are there for appearance and not for any good they may do in enabling the operator of the set to use his receiver more effectively. Of course, everybody knows that a set will work without a meter, but few know how much the proper meters will help in obtaining economy and quality performance.

A small voltmeter, connected in the filament circuit enables one quickly to turn the control rheostats to the proper point so that enough current is flowing

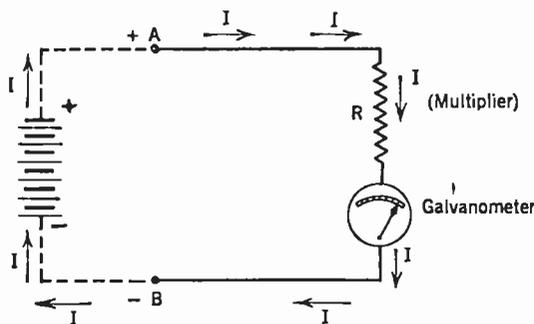


FIG. 1

This diagram shows how a resistance and a current measuring device are employed to determine voltage

through the circuit to heat the filament wire to insure emission of electrons in the proper quantity. This is one of the conditions for the production of good quality. At the same time, the filament is not operated above its rated voltage. This prolongs the life of the tube. When a tube is used with a very slight increase over its rated voltage, its life is greatly reduced.

Depleted B batteries are frequently a source of noise and distortion in radio

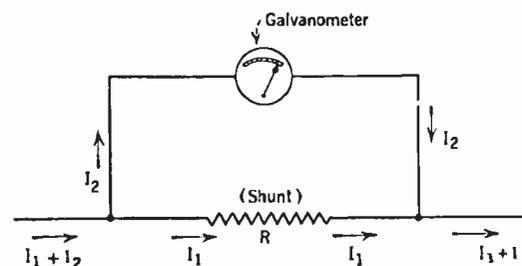


FIG. 2

A shunt resistance is employed in order that only a small percentage of the total current in the circuit passes through the meter

THIS article might have an alternative title, "How to Get More Out of Your Receiver," for that is exactly what will happen if Mr. Millen's suggestions are followed. It is easy enough for anyone to tell how a radio receiver is operating acoustically, but electrically, meters are required to tell the operator how the circuits are functioning. The addition of the proper meters to any set is neither an inordinately expensive matter nor a very difficult one. The mere assurance that one is using his tubes at the proper filament voltage is enough reason for installing the meters. In addition, the use of a plate current milliammeter will register instantly the slightest distortion occurring in the audio circuit, after the fashion described by Mr. Crom in his article in RADIO BROADCAST for October. Mr. Millen's excellent suggestions can aid every home constructor and not a few of those who have manufactured sets which they would like to improve.

—THE EDITOR.

receivers. And when, as is frequently the case, the B batteries are located in the cellar or some out-of-the-way place, it is inconvenient to test them frequently with a pocket voltmeter. So they are often neglected and as a result the quality of reception becomes poorer, all unnoticed by the owner, because the process is gradual. But some evening, when the receiver is put into operation it refuses to work. Had the set been provided with a conveniently arranged panel voltmeter, the operator could have made a frequent and easy check on the condition of the batteries.

The third meter which helps toward good quality and economical operation is a plate-current milliammeter. A plate milliammeter primarily indicates the rate at which energy is being drawn from the B batteries. If this plate current is excessive, the life of the batteries and the tubes will be seriously impaired. By means of proper C voltages it is possible to vary the plate current and thus secure the value specified by the manufacturers of the tube for any given plate voltage.

A second, but not a lesser important function of the plate milliammeter, is to indicate how an amplifier tube is "modulating." For quality reception it is absolutely essential that the d. c. component of the space current of a tube, as indicated by a d. c. milliammeter does not vary. If the needle on the milliammeter drops down on a strong signal, the tube is said to be "modulating down" and the C voltage must be increased. If, on the other hand, the needle advances on a strong signal, the amplifier is said to be "modulating up," which indicates that the C voltage is too high for the plate voltage being

used. Should the needle fluctuate violently in both directions, the tube is very much overloaded and both B and C voltages must be materially increased.

MANY USES FOR METERS

THERE are also a number of other uses for meters in connection with radio receiving sets, but with the equipment as available at present, their use is of value mainly in the laboratory. Such a meter is an ammeter for indicating the rate at which a storage battery is being charged. As the charging rate on the majority of home battery chargers is not variable, there is little to be gained by the use of a meter in such cases.

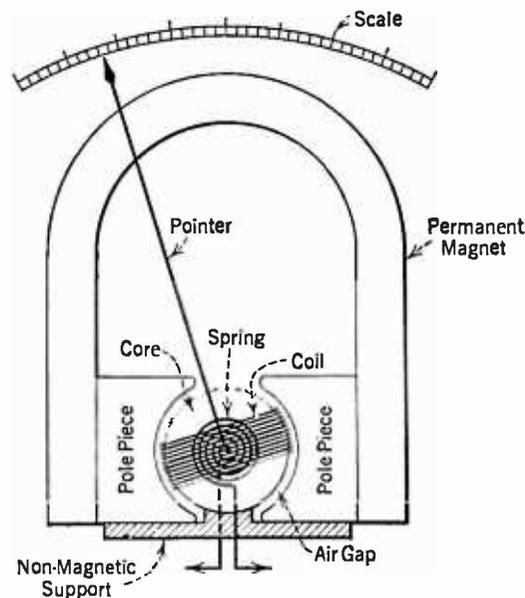


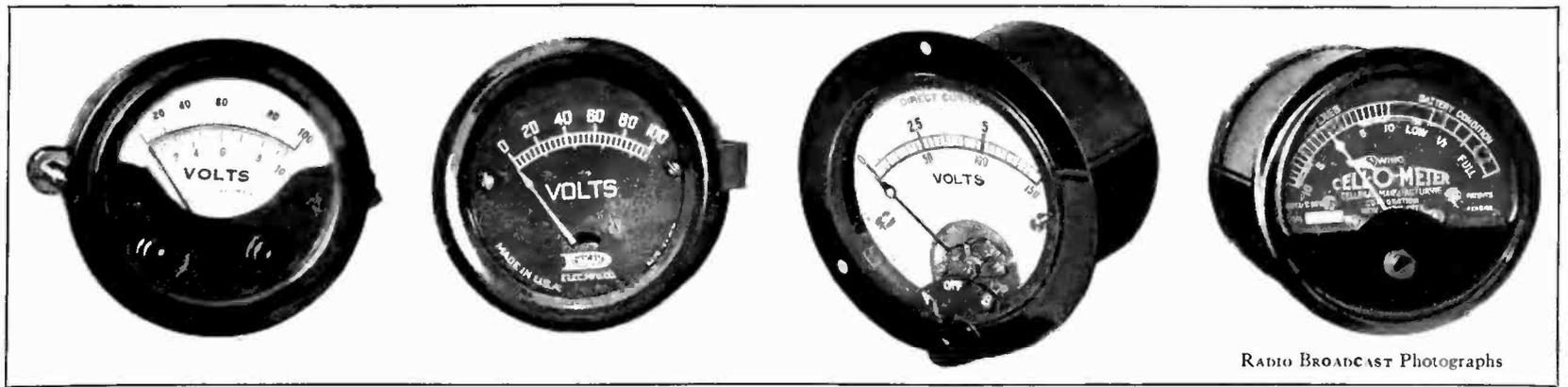
FIG. 3

The most accurate meters are of the moving-coil type, such as shown in this diagram. The photograph below shows a meter of the moving coil type, apart. The D-shaped piece on the base of the meter, center, is the permanent magnet



FIG. 3A

RADIO BROADCAST Photograph



RADIO BROADCAST Photographs

FIG. 4

There are a number of different concerns making meters for radio use. The products of Hoyt (Burton and Rogers), Dongan, Jewell, and Cellokay are shown

Another such meter is a wavelength or frequency meter, but this too may be dispensed with in the modern radio broadcast receiver by the simple expedient of calibrating the dials on the receiving set.

All of the meters referred to above with the exception of the wavemeter are fundamentally the same—that is, they are essentially galvanometers, or devices for indicating current flow. If a voltage is to be measured, then a high resistance unit, called a multiplier, is connected in series with a galvanometer and the combination connected to the source whose voltage is to be measured. This arrangement is shown in Fig. 1. A small current will flow through the resistance and galvanometer. The galvanometer will indicate the value of this current. Now, by means of one of the fundamental laws of electricity, it is possible to compute the voltage readily across the terminals A, B, Fig. 1, as the value of the resistance, R, and the current I, are known. This, known as "Ohm's Law," says that the voltage across a resistance due to current flowing through the

resistance is equal to the product of resistance in ohms and the current in amperes, which, in symbols is $E = IR$.

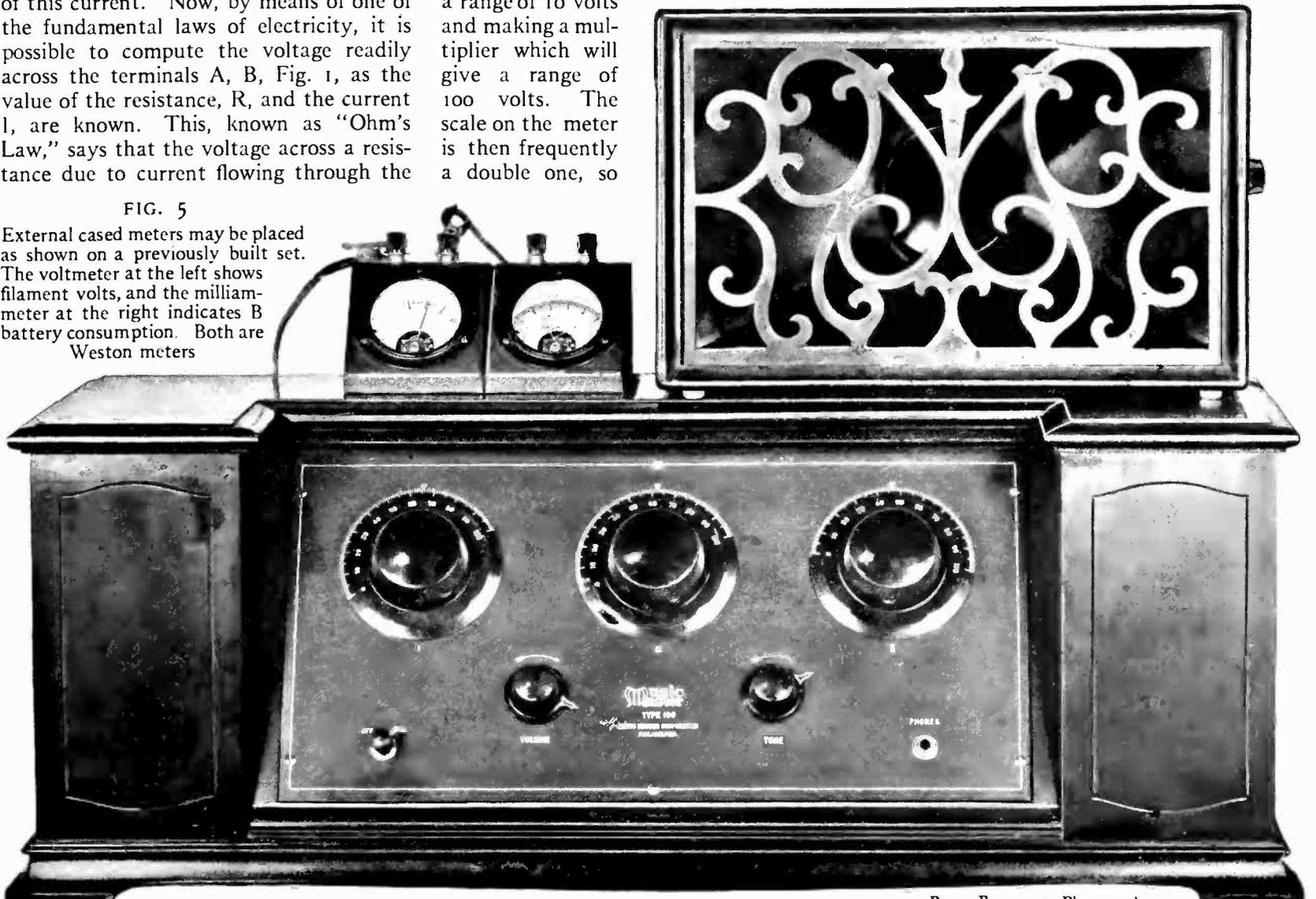
Of course, it is not convenient to make even this simple calculation every time one wants to know the voltage of his batteries, so the manufacturers put a special scale on the galvanometer which reads directly in volts. Then they go still another step farther and build meters having an inherent resistance of such a magnitude that, for voltages under say 50 volts, the use of an external resistance or multiplier is dispensed with. For higher voltages, such as B battery voltages, it is generally customary for the meter manufacturers to take a lower voltage meter, such as one having a range of 10 volts and making a multiplier which will give a range of 100 volts. The scale on the meter is then frequently a double one, so

that either the 0-10, or 0-100-volt scale may be referred to depending upon whether or not the multiplier is being used.

Ammeters are also fundamentally galvanometers, which would be burned out if a heavy current were to be passed through them. In order that they may be used to measure heavy currents, resistances are connected across them so as to "by-pass" most of the current and thus let only a small fraction of the total current pass through the meter. This "by-pass" resistance is known as a shunt and in the case of the small panel mounting type of milliammeters used for radio work, the shunt generally consists of a small piece of resistance wire contained within the meter case.

FIG. 5

External cased meters may be placed as shown on a previously built set. The voltmeter at the left shows filament volts, and the milliammeter at the right indicates B battery consumption. Both are Weston meters



RADIO BROADCAST Photograph

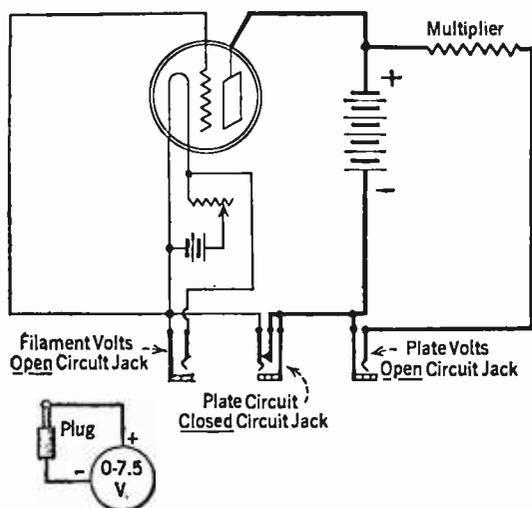


FIG. 7

By connecting three jacks in each tube circuit, it is possible to use one meter for many different purposes. In order that several different multipliers will not be required, one multiplier may be arranged with a short-circuiting switch in the plug circuit

HOW THE METER WORKS

THE galvanometer units generally, in the higher grade instruments, consists of a movable coil, to which is affixed a pointer, pivoted in a strong magnetic field set up by a permanent magnet of the "horseshoe" type. This arrangement is illustrated in Fig. 3. When a current passes through the coil, an electro-magnetic field is set up which reacts with that set up by the permanent magnet and the coil tends to rotate. It is held back by a small hair spring. The force (or as it is technically called, torque) tending to rotate the coil is directly proportional to the current flowing through the coil. Furthermore, the deflection of the coil is governed by the spring, whose deflection with certain limits, is directly proportional



FIG. 9

This is the panel view of the "Aristocrat" receiver shown in Fig. 4 on page 196 of this issue. The switch below the meter at the right side of the panel allows the meter to read either filament or plate voltages

to the torque. Thus the deflection of the galvanometer is directly proportional to current.

Instruments, such as the Weston and the Jewel employ the movable coil type of movement illustrated in Fig. 3. The less expensive meters, especially the small pocket volt and ammeter used for testing dry cells are of what are known as either the pluggers, and iron vane type. The iron vane type consists of a small electro-magnet with a soft iron core. When a current is passed through the winding of the electro-magnet a small iron "vane," which is mounted on a shaft, is attracted. The vane is held back by the permanent magnet, and a pointer is affixed to the shaft so as to indicate the deflection.

The electro-magnet in an ammeter of this type consists of a half dozen turns of very heavy wire, whereas the voltmeter electro-magnet is wound with many turns of very fine wire.

In the past, instruments of the iron vane type have not been considered very accurate for high grade work. Furthermore, they consumed considerable power, and

thus could not be left in a circuit for any length of time, as they would run the batteries down. This is especially true of voltmeters since they are shunted across the supply and if left in circuit would deplete the batteries very rapidly.

At present, however, there are at least two well-known concerns manufacturing improved instruments of this type which are well suited for radio use, particularly for measuring B battery voltages. Such a meter mounted on the panel of a tuned radio frequency receiver is shown in Fig. 8. Two push buttons are provided so that either the detector or the amplifier B voltages may be instantly read with the same meter. When push-buttons are used for this purpose there is no danger of the meter remaining connected to the B batteries for long periods and thus unnecessarily running them down.

Fig. 4 shows a group of different meters for mounting on the panel of a radio receiving set. The meters may be mounted in small cases, and connected to the set with flexible lamp cord. Such an arrangement is shown in Fig. 5.

Fig. 6 shows how these meters are connected in a RADIO BROADCAST Four-Tube Knockout receiver. By carefully examining the way in which the meters are connected in this circuit, the manner in which they should be connected in any circuit will be evident.

If a meter is equipped with an ordinary phone plug and flexible cord, jacks may be arranged on the panel of the receiver so that it may be plugged into any part of the circuit. Fig. 7 indicates how to connect the jacks in a circuit.

Instead of having three separate meters—A voltage, B voltage, and plate current—for use with the set in Fig. 7, one meter may be made to serve the purpose most excellently. If a 0 to 7.5 voltmeter is available it may be used directly to read filament volts, with a resistance in series (8825 ohms for Weston 0-7.5-volt No. 301) to read up to 150 volts (multiply scale readings by 20) and without any attachments, as a milliammeter. For the model 301 Weston meters, a full scale deflection requires 16.1 milliamperes or for the 0 to 7.5 volt Weston meter, each division is equal to 2.146 milliamperes or approximately 2 milliamperes.

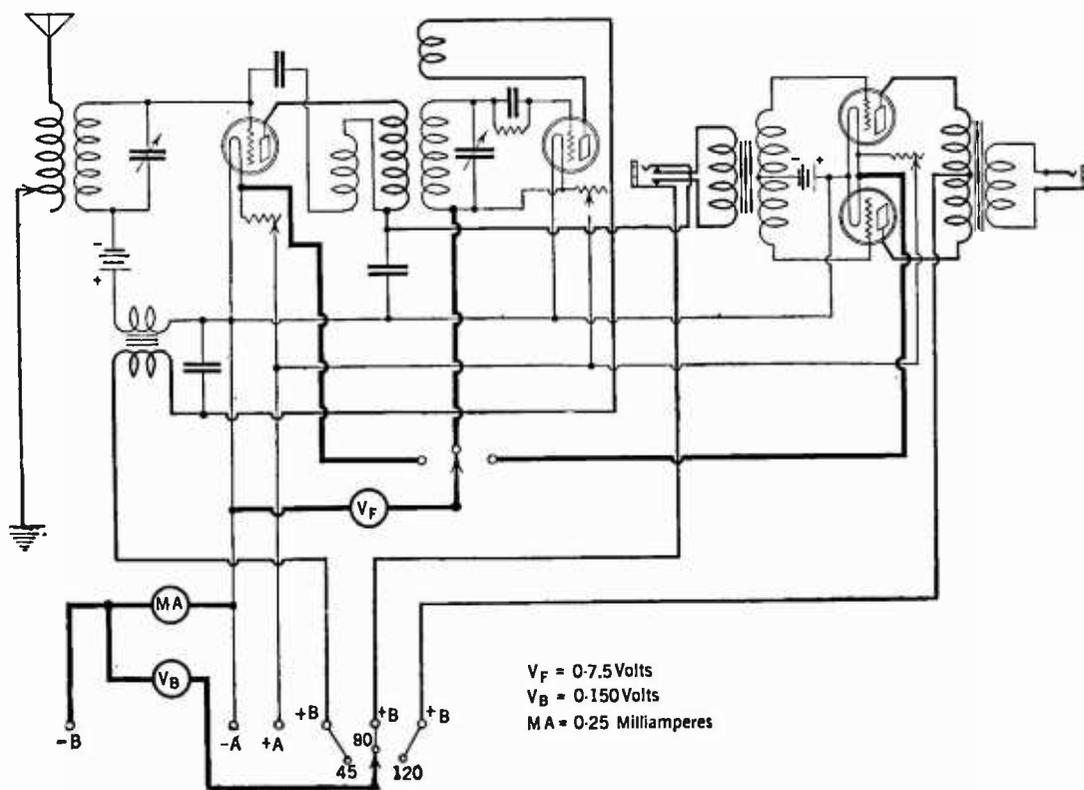


FIG. 6

This circuit diagram shows how to connect a filament voltmeter, a plate voltmeter, and a plate milliammeter in a RADIO BROADCAST Four-tube Knockout receiver

New Fields for the Home Constructor

The Second of a Series of Articles—Each Complete in Itself—Showing the Jaded Home Builder How He Can Use His Present Equipment to Make Valuable and Useful Measurements and Experiments in His Own Home

By KEITH HENNEY

Director, "Radio Broadcast" Laboratory

THERE can be little doubt that radio is one of the most attractive fields for home experiment that has ever offered itself to the average layman. The ramifications of this specialized part of electrical engineering are so many and so varied that "that tired feeling" of having solved all is always far in the distance, and the home experimenter, with inexpensive and not too complicated apparatus, can approach so closely to actual scientific research that he cannot help attaining a distinct feeling of having accomplished something of value at the end of each day's experiment.

For a long time the Editors have been sure that there were many who felt they had built enough receivers, but who still had a craving to construct something with their own hands that would work in some useful way. Tools accumulated through days of receiver building cannot lay idle; radio junk collected during those same days, is always too good to throw away; experience in radio matters causes a yearning for more experience—and yet, to build one more receiver might be the breaking of the proverbial camel's back. What is the home constructor to do?

This series of articles, of which this is the second, has been planned with but one object in view, to lead these jaded souls into a field where there is endless variety, and where each thing accomplished leads to something else. And for those who really want to know more about radio, who want to find out for themselves what is going on behind laboratory doors, these articles will be written so that they will be in some degree helpful. The home constructor naturally fits into the field of radio experiment since he has already tasted the joys of building successful apparatus, and in this way he has learned the "feeling" of electrical equipment

The first article, in the September number, described a simple piece of laboratory equipment that is efficient enough to grace the best laboratory, useful enough to make it worth while for any one to build, and at the same time inexpensive and not compli-

cated. It is a two-tube oscillator, one of the tubes working at broadcasting radio frequencies, and the other at a fixed audio frequency. Either tube may be used alone, or the two may be operated together as a source of modulated high frequency energy.

USES OF AN AUDIO OSCILLATOR

FOR example, the audio part of the oscillator referred to above is used in the Laboratory of RADIO BROADCAST for the following purposes:

1. Source of tone for testing open circuits.
2. Tone for measuring capacity, inductance, or resistance.
3. Measuring the characteristics of audio instruments, such as audio-frequency transformers, loud speakers, etc.

It is common practice among radio workers to use a battery and a pair of headphones to test open circuits, and at times a dry-cell operated buzzer is used. For example in a receiver which is inoperative due to a broken connection, the wiring may be traced until the break is found.

In testing audio frequency circuits in which transformers are used, it is extremely bad practice to use direct current for testing. After such a test it may be found that the iron cores are magnetized with the result that distortion occurs when the amplifier is again placed in operation. In the laboratories of the telephone companies, where hundreds of telephone transformers are used, it is strictly against the rules for laboratory assistants to "buzz" out circuits either with the phones and dry cell or with a buzzer.

The 1000-cycle tone emitted by the

audio oscillator described in the September article, is an alternating current of small amplitude which cannot magnetize the cores of any transformers. Fig. 1 shows the usual method of testing open circuits with battery and headphones, as well as the correct method of using the audio oscillator as a tone tester. The jack in the oscillator provides an outlet for the 1000-cycle tone and a plug in this jack will have the alternating voltage across its terminals. One terminal should go to the receivers, and the remaining wires, one from the oscillator and the other from the phones, should go across the suspected broken connection.

Capacity and inductance, as well as alternating current resistance, are measured by what is known as an "impedance bridge" which operates from a source of alternating current. The audio part of this oscillator is again useful here, and Fig. 2 shows how it is used in the Laboratory. It is not necessary to have much power for work of this kind, and if extraneous noises make it difficult to get proper balance on the bridge, a one- or two-stage audio amplifier is connected to the bridge and thence to the receivers. For example, in the Laboratory, the noise and vibration from presses, in action several floors below, makes it difficult to obtain correct measurements, without the aid of the amplifier shown in Fig. 2.

A simplified form of bridge will be described soon in this series and, with the aid of the audio oscillator, will enable the experimenter to measure his own inductances and capacities just as is done in any large and well equipped laboratory.

This will eliminate much of the cut-and-try method that is now in order when the radio builder decides to make new coils, or to try different sizes of condensers to tune to certain frequencies. The bridge shown in Fig. 2 is made by the General Radio Company.

By varying the tuning condenser across the secondary of the oscillator, notes may be secured varying from about 200 cycles to the natural frequency of the transformer itself, which is usually around 5000 cycles. These tones may be amplified if necessary,

TO SHOW how the home constructor can go on in radio after he has built the radio sets that to him are satisfactory, is the purpose of these articles. The first "What Is to Become of the Home Constructor?" appeared in this magazine for September and has created a phenomenal amount of interest. Each of these articles really gives a complete set of experiments and useful tests which may be made by any experimenter who is properly equipped. The apparatus, most of it at least, in the form of parts, is in the radio "junk pile" of almost every constructor. Each article is complete in itself, the experiments are related and they have a very definite use in any one of a number of ways. Using the audio oscillator to test receivers and the radio oscillator to calibrate them, is, for example, of great use to radio dealers who take pride in their repair and service departments. The uses of the radio oscillator suggested here are novel and ingenious and bound to be helpful. Those who are interested in laying out a modest little "lab." of their own will be interested in the suggestions given at the end of this article.—THE EDITOR.

and used to determine the characteristics of audio-frequency transformers as well as the resonance peaks which exist in many loud speakers. Methods of testing these low frequency instruments will be described later. Calibrating the oscillator is not difficult provided access is had to a musical instrument that is accurately tuned.

Middle C on a properly tuned piano corresponds to a frequency of 256 cycles per second, and is a good starting point for the calibration of an audio oscillator. The tuning condenser should be varied until the sounds emitted by the piano string and the oscillator are the same. Other frequencies may be obtained in the same

manner. The relation between frequency and the piano scale will be shown graphically in the January RADIO BROADCAST.

Tuning forks may be purchased from musical supply houses and a small set, say, those of 256, 512, 1024, and 4196 cycles, will enable any one to calibrate an oscillator.

USING THE RADIO OSCILLATOR

In the Laboratory, the radio

FIG. 1
A source of pure alternating current is useful in testing audio-frequency transformers. There is no danger of magnetizing the cores when such a tone source is used. The battery "click" method is dangerous. An Erla cruciform audio transformer is being tested in this view



RADIO BROADCAST Photograph

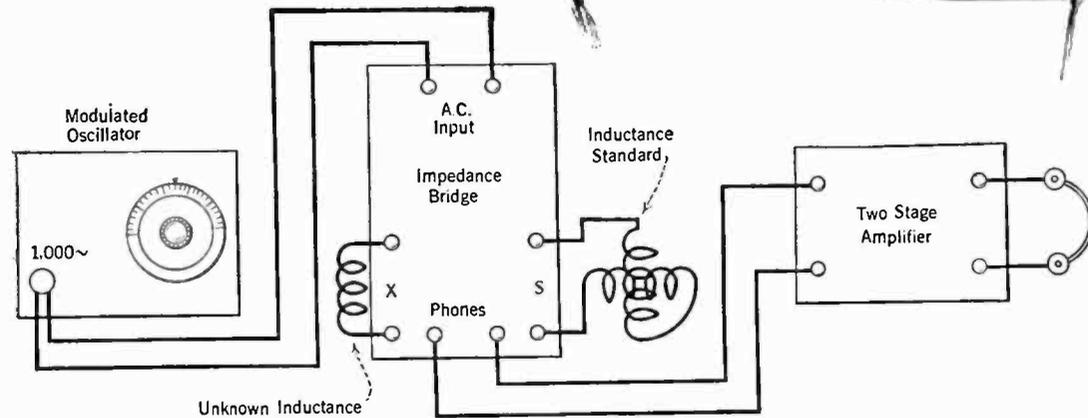


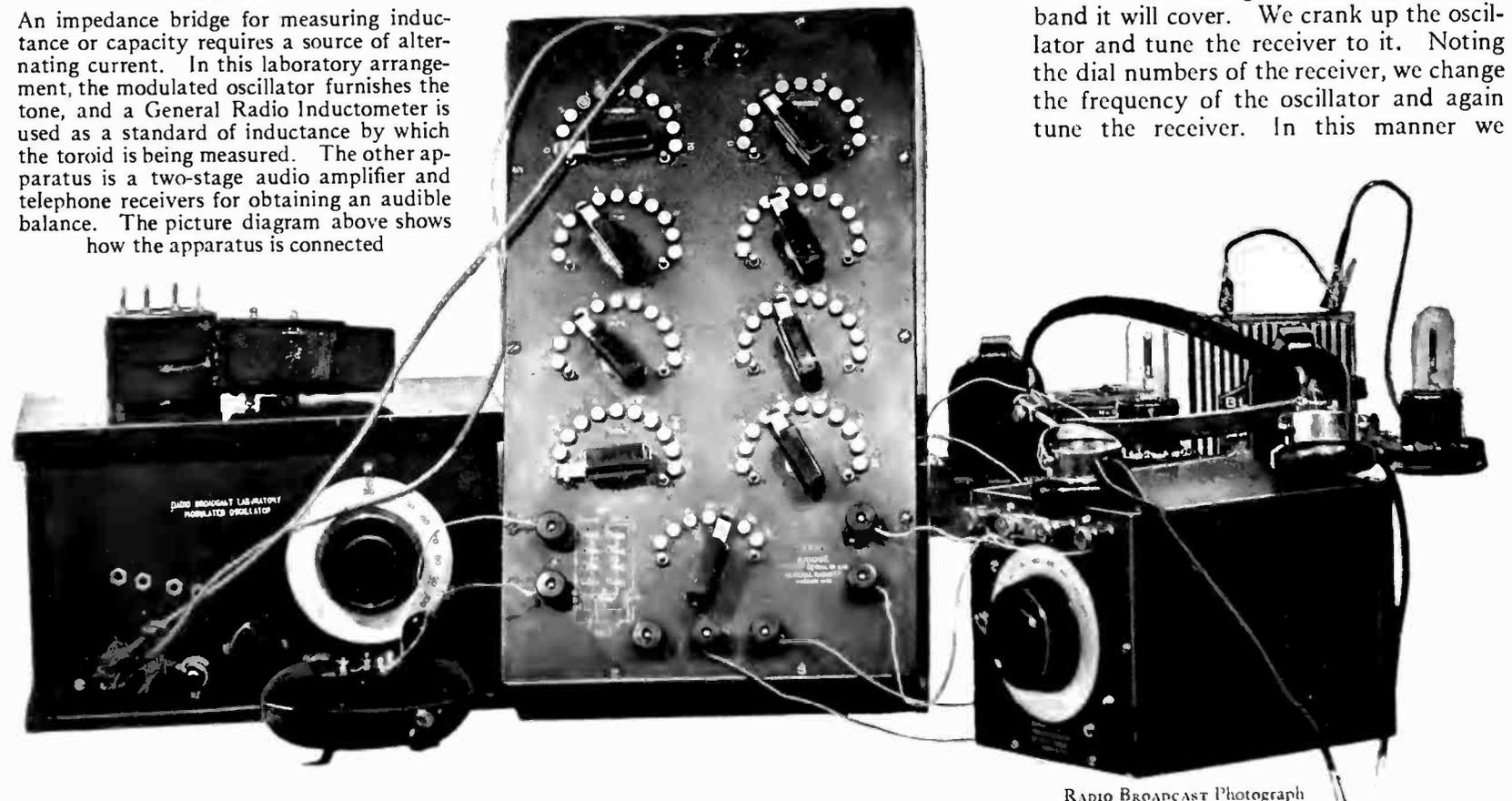
FIG. 2

An impedance bridge for measuring inductance or capacity requires a source of alternating current. In this laboratory arrangement, the modulated oscillator furnishes the tone, and a General Radio Inductometer is used as a standard of inductance by which the toroid is being measured. The other apparatus is a two-stage audio amplifier and telephone receivers for obtaining an audible balance. The picture diagram above shows how the apparatus is connected

part of this simple device is used for the following purposes:

1. Calibrate receiving sets.
2. Set receiver for a given frequency.
3. Measure the frequency of incoming signals.
4. As a separate oscillator for superheterodynes.
5. Source of radio frequency energy for measuring losses in coils, etc.
6. Wavemeter.
7. Energy for neutralizing receivers.

As an example, let us suppose that a new receiver is constructed and we are desirous of finding out what frequency band it will cover. We crank up the oscillator and tune the receiver to it. Noting the dial numbers of the receiver, we change the frequency of the oscillator and again tune the receiver. In this manner we



RADIO BROADCAST Photograph

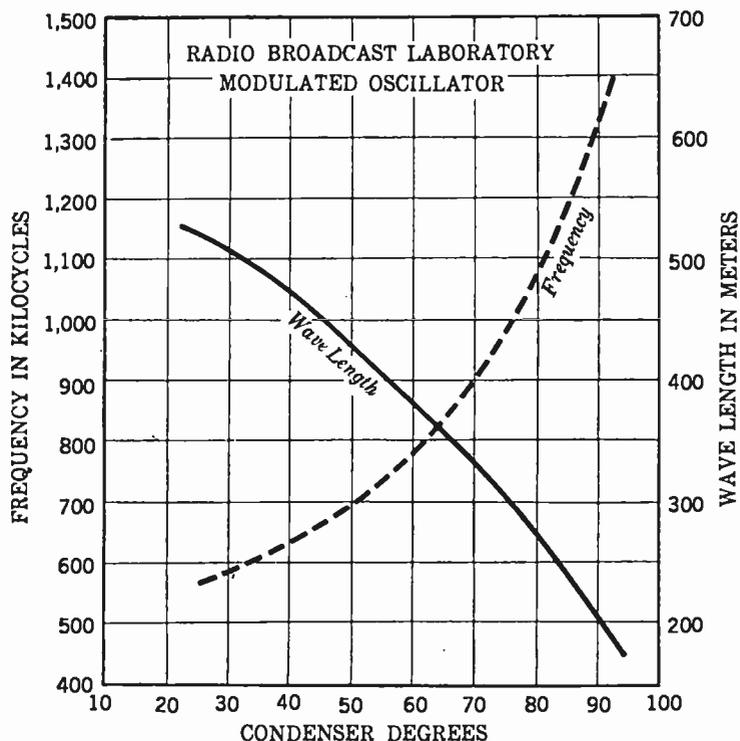


FIG. 3

A calibration of the Laboratory's oscillator. Both frequencies and wavelengths are plotted against condenser settings. This calibration will be true only of the coil and condenser used in this particular case. All other combinations must be calibrated against standard frequency signals either from a known broadcast station or from the standard frequency signals sent out by the Bureau of Standards

may have an exact tuning curve of the receiver before a single station is heard. Fig. 3 shows a calibration of the radio part of the Laboratory's oscillator. This of course will differ for each coil and condenser used and the effect of connections will not be negligible.

This means that each constructor will have to calibrate his own oscillator, but at night this is not a difficult task. With both tubes functioning it is only necessary to tune a receiver to a known station. Then the oscillator is varied until the tone is heard in the receiver. Now that radio stations stay closely to their required frequencies, it is possible to own a very accurate wavemeter using this simple means of calibrating it.

Incoming signals on any receiver may be measured for their frequency by tuning the oscillator until it is heard together with the stations signals. A glance at the calibration will show what station is being received.

The receiver may be set at a required frequency by setting the oscillator for this frequency by means of its calibration curve, and then tuning the receiver until the sound is heard. In other words, the modulated oscillator will make a good wavemeter, and due to the fact that both audio and radio waves are tube-generated they will be very sharp. The old time buzzer with sparking contacts is notoriously broad in the frequency spectrum it turns out.

USE IN NEUTRALIZING RECEIVERS

THERE is another use of the radio part of the apparatus that is very important, and in the Laboratory it has

been used many times for this purpose and may easily find the same use in many home laboratories. This is the neutralization of radio-frequency amplifiers. Tuning-in a signal and then, with the radio frequency tubes turned out, to adjust the neutralizing condenser until no sound is heard is one method, and the modulated oscillator, with both tubes burning, provides a good source of energy for this purpose.

There is another method that may be used, especially where a regenerative detector is in the circuit, and it is somewhat more accurate. This is particularly true if high gain amplifiers are used, characterized by many plate turns in the amplifier coils, and correspondingly large fields.

The detector is made to oscillate, and with the radio frequency tube of the oscillator set at some frequency in the middle of the broadcast band, the detector tuning

condenser is varied until a beat note between the detector current and that emitted by the oscillator is heard. Then the radio-frequency amplifier condenser is varied. If the amplifier is not properly neutralized, the beat note will change pitch rapidly as the amplifier is tuned. If far from the neutralizing point, the amplifier may oscillate, or reaction between the amplifier and detector may be so great that the detector will refuse to oscillate.

The neutralizing condenser is then varied until changing the amplifier tuning has little or no effect upon the detector circuit. This balanced condition will be noted when the beat note between detector and oscillator does not change appreciably when the radio-frequency amplifier is tuned.

Since it is not always possible to pick up broadcasting stations, especially where

constructors are out of the daytime range, the oscillator provides an excellent source of both pure radio and modulated radio frequency energy for neutralizing purposes.

TO GET GREATER ENERGY FROM THE OSCILLATOR

FOR some purposes it is necessary to have greater power than is turned out by the WD-12 tubes used in the Laboratory oscillator. In this case it is only necessary to use standard 5-volt tubes, or better yet, the new one-half ampere, 5-volt tubes, such as the UX-112, the Daven MU-6, Cleartron 112, etc., and to push up the B battery voltage until the required power is obtained. It will be necessary to recalibrate the set owing to the changed grid-filament capacity, but the differences will be small and unless very accurate work is to be done, recalibration will not really be necessary.

The audio output may be sent through an audio-frequency amplifier such as is illustrated in Fig. 2 if greater tone volume is needed.

Another method of getting greater voltages out of the radio part of the device is shown in Fig. 4, which gives the entire circuit. Currents in tuned resonant circuits are usually high, and this is particularly true when those circuits are of low resistance. Thus the output of the oscillator may be coupled to a tuned circuit and part of the voltage of that circuit used for whatever purpose is necessary, such as for measuring the resistance of coils and other radio frequency apparatus.

The oscillator is first tuned to the required frequency. Then the output circuit is tuned, and finally the circuit to be driven. Unless considerable power is required, it is not necessary to tune the output circuit which is then acting as an untuned "transmission line," and serves simply to transfer energy from one circuit to another.

Little current will flow through the transmission line, if it is untuned, but in the tuned circuit at the end there will be heavy currents.

Fig. 5 shows the apparatus required for measuring the high frequency resistance of coils. With the addition of a vacuum tube voltmeter, such as was described in RADIO

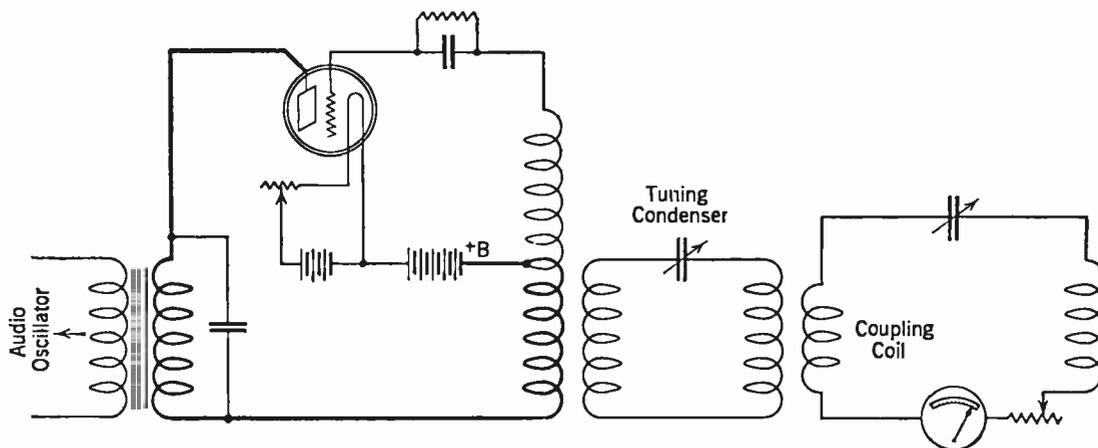


FIG. 4

A use for the radio frequency part of the oscillator. By use of a coupling coil, energy may be transferred from the oscillator to some other circuit. If this intermediate circuit is tuned by means of the condenser, much more current will flow in it and correspondingly greater voltages may be transferred to the circuit under test

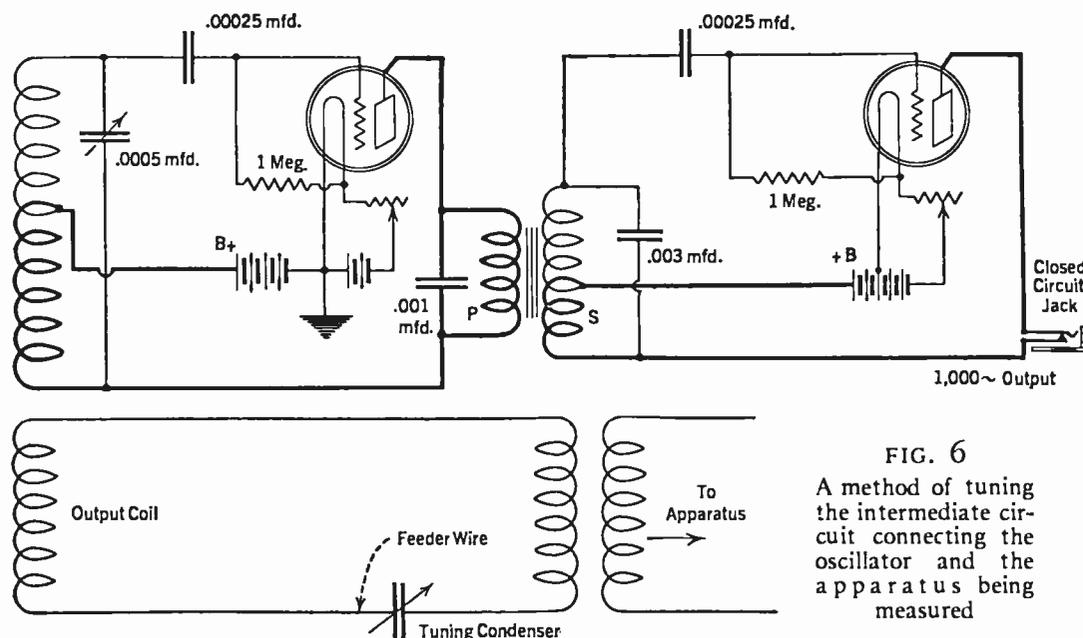


FIG. 6
A method of tuning the intermediate circuit connecting the oscillator and the apparatus being measured

BROADCAST for February, 1925, page 1101, the gain of radio-frequency amplifiers may be measured.

Many experiments are now being simplified in RADIO BROADCAST Laboratory for inclusion in this series. A simple and fairly accurate impedance bridge will be described, methods of measuring the amplification of both audio- and radio-frequency transformers and the losses in coils will be explained, and among other apparatus described there will be a vacuum tube voltmeter with which many important experiments can be performed. Wherever possible references to current literature will be cited as well as to standard texts. Readers are invited to write of their experiences or difficulties or to state what particular problems they would like to see treated in this series.

WHAT SHOULD THE HOME "LAB" BE?

IT SEEMS to the writer that there are two methods by which the experimenter may carry out his work. He may have a regular place for his apparatus and for his work, or he may not. Naturally, the laboratory should be a fixed place, where apparatus may be set up and not disturbed until the experiments in progress are finished.

In this place there should be a work bench and a laboratory bench, and the latter should be kept free for the actual work at hand. It often happens that a certain set-up of apparatus will be used for some time, for instance where one is measuring the gain of radio-frequency amplifiers, and it is a waste of time and energy to tear down and set up the equipment each time

an experiment is completed. Added to the nuisance of such movement there is the likelihood that readings taken on successive days will not check—for radio frequency circuits are tricky affairs.

The tools that are needed are no more than are required for constructing receivers, but, like the electrical equipment, they should be of the best make possible. A good drill, a pair of long nose pliers, a pair of cutters, and a long, narrow screw driver are vitally necessary. Added to these may be the usual wood working tools, such as a hammer, a saw, and a plane.

Electrically speaking, the home experimenter should begin his collection of apparatus by purchasing a good voltmeter and a good milliammeter. The meters may be of the Weston 301 type installed in student bases, or corresponding meters made by Jewell, Roller-Smith, General Radio, etc. The voltmeter should have a range of 0 to 10 volts and an ammeter which will be found to have many convenient uses should read from 0 to 10 milliamperes. This will read the plate currents of 5-volt tubes under ordinary conditions, and with some simple accessory apparatus will enable the experimenter to measure the constants of tubes as well as to check up on the other experiments that go on.

Such meters can be purchased for about \$10 each with base, and are the first equipment that the experimenter should possess. Additional equipment will be cited in future articles.

RADIO BROADCAST Laboratory wishes success to prospective home laboratory owners, and will be glad to hear from readers who are interested in the experiments described here.

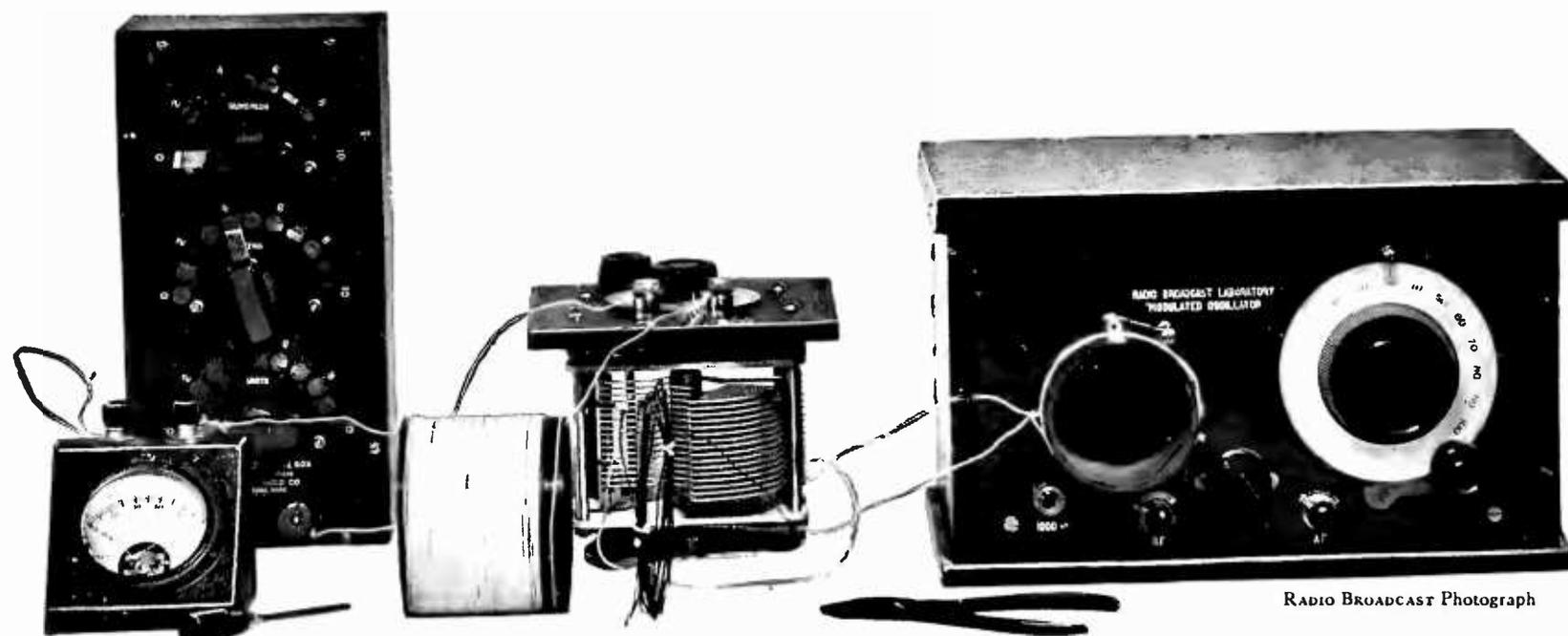


FIG. 5

A photograph of apparatus actually being used to measure the high frequency resistance of coils. The oscillator supplies the energy, a Weston galvanometer, Model 425, measures the current flowing, and a General Radio Laboratory condenser and resistance box aid in the actual measurement. In this case the intermediate coupling circuit is not tuned, consisting merely of two very small coils, one coupled to the oscillator, one to the coil under test. Later articles will contain descriptions of simple apparatus which is capable of performing similar experiments to those described in this article

Ozarka Senior Console \$197.50 East of Rockies

Complete with Tubes, Batteries and Speaker



The Sweetest Story Ever Told



If Your Radio is Bought Right It will be a Life-Long Pal

A LITTLE more time, a little more care in making the selection in the first place generally tends to more lasting satisfaction.

Out of every 100 Ozarka's sold in 1922 only eight are not today in the hands of the original owners—this does not include 17 out of each 100 who have purchased later Ozarka models in newer type cabinets. If there is a single Ozarka that is not in active service today, we have never heard of it.

Without the Ozarka Service in charge of direct factory trained representatives, such a record would not be possible. Ozarka service can be had today in almost every country. Purchasers in South Africa, Alaska, Sweden, Newfoundland, New Zealand, and Japan all receive the same practical service as those in Canada, United States, Mexico and Cuba. Whenever you find the sign of the Ozarka long distance goose, you'll find a man who knows Ozarka instruments perfectly.

If such service added more to your cost price it might be a matter to consider, but it doesn't. Quality for quality you'll find Ozarka prices lower—four tube Ozarka's with built-in loud

speakers retail for \$58.00—five tube with built-in speaker \$64.00, up to solid walnut console design, \$160.50.

Our nearest representative will gladly set up an Ozarka in your home, without any obligation whatever. He won't tell you what it will do—he will let you do all the tuning. With the Ozarka you must satisfy yourself, as to distance, tone, volume, ease of tuning and selectivity.

More than this you will be very agreeably surprised at Ozarka prices—selling as we do, thru our own direct factory representatives, our selling expense is very low—we give Ozarka purchasers the benefit of it.

Where is there a value to compare with the one shown above—solid walnut cabinet (no walnut finish or veneer), imported English loud speaker of a marvelous tone, five tube instrument with 75 ampere Exide storage battery, 90 volts of Eveready "B" battery, 5 tubes, aerial equipment all erected and the price is only \$197.50.

A Few More Men are Needed to Sell Ozarka

In a great many counties we have the man we want. He is rapidly building up a permanent and profitable business of his own because he has an instrument that will more than meet all competition. More than this, he is trained to back up his sales with the kind of service that counts.

Many well established Ozarka representatives started by giving us only their spare time—their evenings. If your county is open you can do the same.

The investment in cash is very small. The investment in time necessary for study is considerable. It requires patience, but the results have enabled many men to get out of the salary and time clock class.

Any previous sales experience is helpful but not necessary. We can and will teach you how to sell.

Send for 84 Page Book — "The Ozarka Plan"



This book is entirely too expensive to be sent out on postal card requests. It will be sent FREE to any man who mails the coupon below and who is really anxious to improve his condition. Tell us about yourself—ask for Ozarka Plan No. 100 and don't fail to give the name of your county.

OZARKA

122 Austin Avenue B
Chicago, Illinois



Ask the Man Who Wears this Button

INCORPORATED

122 Austin Avenue B
Chicago, Illinois

Gentlemen: Without obligation send book "Ozarka Instruments No. 200" and name of Ozarka representative.

Name.....
Address..... City.....
County..... State.....

Gentlemen: I am greatly interested in the FREE book "The Ozarka Plan No. 100," whereby I can sell your radio instruments.

Name.....
Address..... City.....
County..... State.....

★ Tested and approved by RADIO BROADCAST ★

There's Economy and Satisfaction in these Valley units

You will find both economy and satisfaction in the use of the Valley B-Eliminator and the Valley Battery Charger.

Economy in the B-Eliminator because it stops forever the expense of buying new B batteries. . .

Economy in the charger because it recharges your own storage battery at home overnight at one-tenth the cost of service station charging. . .

And satisfaction in both because, by using them, you need never miss a program on account of low or worn-out batteries.



THE VALLEY B-ELIMINATOR operates from ordinary light socket; provides a steady, noiseless flow of B current at a constant voltage all the time.

With it, there can never be any decrease of signals or frying noises due to low B batteries. Volume is maintained. Reception is uniformly good.

For receiving sets of from one to eight tubes. Costs less at the start than wet B batteries. Costs less in the long run than dry cells. Much more satisfactory than both.



THE VALLEY BATTERY CHARGER is the only charger needed for all radio storage batteries. Its correct 6-ampere charging rate makes overnight charging a possibility.

The Valley Charger also functions on any lamp socket. It takes about a dime's worth of current for an average charge. Quiet in operation. Most radio dealers handle the Valley B-Eliminator and Valley Charger. Any one of them will be glad to show you these units and explain their advantages.

Radio Division
VALLEY ELECTRIC CO. ST. LOUIS, U. S. A.
Branches in Principal Cities

Valley Electric

"NOW, I HAVE FOUND . . ."

A Department for the Exchange of Ideas and Suggestions of Value to the Radio Constructor and Operator

CONTRIBUTIONS to this department are welcome and those used will be paid for at the usual rates, that is from two to ten dollars each. A prize of twenty-five dollars is given for the best idea used during each three-month period. The prizewinner for the last period was announced in the November RADIO BROADCAST. All manuscripts intended for this department should not exceed about three hundred words and should be typewritten. Little consideration can be given to manuscripts not typewritten. Envelopes should be addressed to this department, RADIO BROADCAST, Garden City, New York.

TRACING RADIO NOISES

MANY radio listeners have been led to believe that certain objectionable noises accompanying reception were caused by power-line interference, or other neighborhood operated devices, from the advice, "if the noise ceases when the antenna is disconnected, it is an indication of outdoor interference," and as such, was largely beyond the individual efforts of the set owner to control. This is not always true.

A particularly bad case of interference, which had the characteristics of outdoor interference, was discovered to be coming from the residence main switch and branch terminal cabinet, which was located fourteen feet from the receiver, in the same room.

The switch cabinet and receiver were installed on opposite sides of this room, and the lead-in wire paralleled the house wiring through the adjoining rear room at a distance of five feet, for fifteen feet, and did not enter nearer to the switch than the width of the room.

The receiver, a five-tube neutrodyne, with loud speaker, was adjusted until noises were loudest. The time selected for test was 2 a. m. when no interference was encountered from street cars, regenerative sets, or neighborhood electrical devices.

Disconnecting the antenna produced silence. Replacing the antenna and operating the room switches, the noise was still present in full volume.

Next, the residence main switch was opened, and the mystery was solved. For the noises could be produced and made to disappear by closing and opening this switch.

The continuous "crackling" or "frying" noises, similar to that produced by bad tubes, were caused by loose connection screws of the main switch, branch terminal fuse blocks, and bad contact of plug fuses.

An occasionally loud "zip," or "buzz," similar to nearby code interference, or arcing of defective receiver jacks, was caused by loose rivets fastening the main

switch blades to the switch block and was traced through applying test loads using heater coils, although arcing was not visible to the eye. Thus, all noises present at this time of day were eliminated. The remainder heard during usual broadcasting hours, such as code, sparking trolley wheels, and during heavy rain or snowfall were satisfactorily reduced to a minimum by various methods which have often been described and which will not be gone into here.

A. H. KLINGBEIL,
Ashtabula, Ohio

A RATCHET COIL WINDER PREVENTS UNWINDING

OFTEN in the middle of the winding of a coil, the hold will be released momentarily to straighten out the wire, and as a result the carefully arranged

turns of wire may loosen, and the work has to be done over again.

A method of improving the usual winder, is shown in the sketch, Fig. 1, involving an ordinary ratchet type screw driver, which many radio experimenters have in their tool equipment. As shown, the handle of the tool is gripped in a vise, or held stationary by other means. The spindle of the winder is fixed to the barrel, and the ratchet is set so as to prevent unwinding. A ratchet type of brace bit obviously has the same advantages

for this use, and the spindle is gripped in the jaws in the same manner as is the screw driver method.

The best method of restraining the wire while winding, may not be available to radio workers, for which reason the restraining reel, shown in the lower section of the sketch, will solve their problem.

Make this up of four ordinary spools, used for thread. Mount these spools on nails or screws, so that the wire will feed through with enough tension to make it tight when wound on the coil. This reel will not only restrain the wire, but will also take out kinks and make it uniform and even throughout the length of the wound coil.

G. A. LUERS,
Washington, District of Columbia.

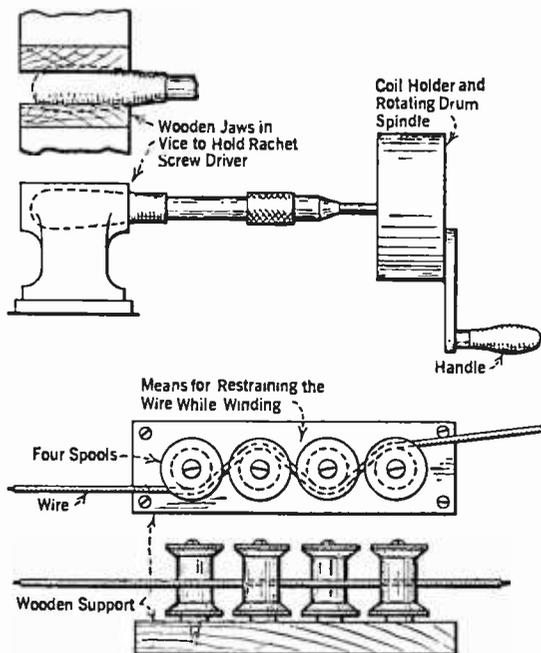


FIG. 1

No Dials, No Panel, Built-in Loudspeaker



Designed by R. E. Lacault, E.E., Chief Engineer of this Company, and formerly Radio Research Engineer with the French Signal Corps, Radio Research Laboratories.

To protect the public, Mr. Lacault's personal monogram seal (R.E.L.) is placed on the assembly lock bolts of all genuine ULTRADYNE Model L-3 Receivers. All Ultradyne Receivers are guaranteed as long as these seals remain unbroken.

\$135.00

The Quiet Manner and The Eloquent Tone

UNOBTRUSIVENESS with sufficiency—the rule of good taste—is the distinguishing grace of the ULTRADYNE Model L-3 Radio Receiver. Ushers in a new era of radio reception—a new, easier command of the air's treasures.

A new artistic form of a radio receiver that blends happily with every scheme of interior decoration. Pleases the eye with its charming lines, its beautiful two-tone mahogany cabinet, its fine proportions. Has the appearance of a decorative tablepiece. Utter simplicity with superb receptive and reproductive qualities. Your local radio dealer will gladly give you a demonstration of this new modern receiver.

The Ultradyne Model L-3 is a six-tube receiver employing the fundamental principles of the best circuits greatly refined and marvelously simplified. No dials—no panel; just two inconspicuous levers, which constitute a station-selector. Volume adjustment the only other control.

Write for descriptive folder

ULTRADYNE

MODEL L-3



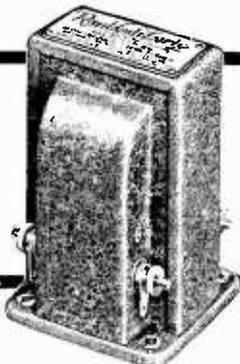
PHENIX RADIO CORPORATION, 116-C E 25th St., N. Y.

★ Tested and approved by RADIO BROADCAST ★



Carol

Far out over hill and valley —into the homes of rich and poor alike—come the waves that carry the glad tidings of the Savior's birth. Little does it matter whether the set is of new mahogany and gold or of humble cardboard coils. Tonal beauty in the amplifier is the one indispensable need for the real joy of radio. Happy indeed is the owner of Rauland-Lyric!



A New Gift for Every Radio Listener
Two Rauland-Lyrics in this beautiful holiday box (fully sufficient for any radio set). See it at your dealer's!



ALL-AMERICAN RADIO CORPORATION
4201 W. Belmont Ave., Chicago

Rauland-Lyric
AN
ALL-AMERICAN TRANSFORMER
The Choice of Noted Music Critics

A COUPLING DEVICE FOR THE ROBERTS CIRCUIT

A SIMPLE device for varying the coupling between the tickler and secondary coils is presented here for the benefit of builders of receiving sets using the Roberts circuit. This device provides a 90-degree coupling, or less, with a 180-degree turn of the dial. The rotation may be in either direction to provide the same effect, and the dial may be turned more than one revolution without altering conditions.

From Fig. 2 B, it may be seen that the

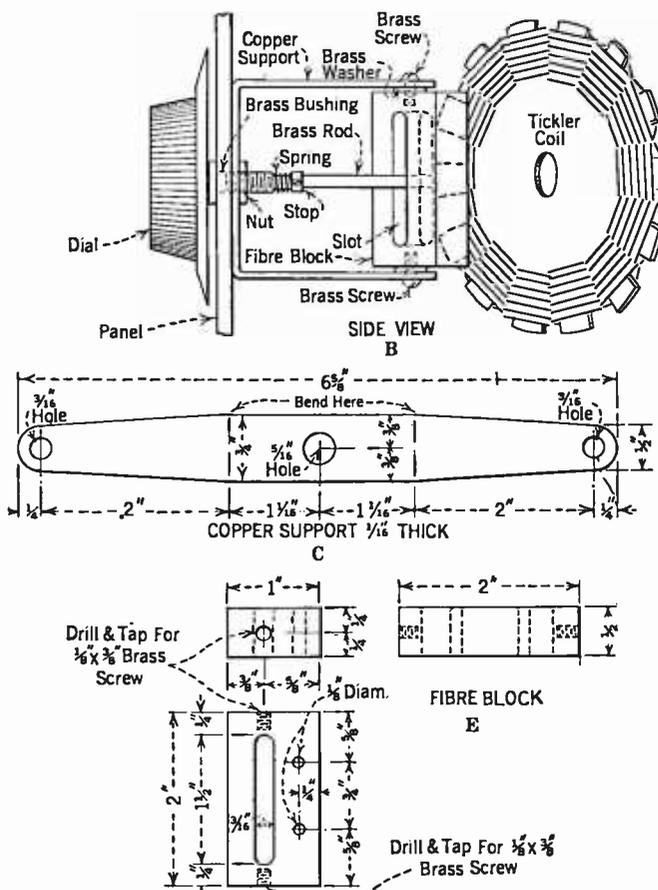


FIG. 2

whole idea of the device rests in the use of a brass rod bent as shown in Fig. 3 D, and a slotted fibre block as shown in Fig. 2 E. The slot takes up all the up-and-down motion of the bent rod and makes use of the side motion as the rod is rotated. Bending the rod at an angle of less than 45 degrees will produce a coupling of less than 90 degrees. The angle of coupling will be twice the angle to which the rod is bent.

The materials used are shown in the sketches, which are self-explanatory. The same materials and dimensions need not necessarily be used however. The fibre block is shown with square corners but these may be bevelled off so that other positions of the tickler may be obtained. The center lines of the rod and block must coincide to produce smooth operation.

CLARENCE J. FRENCK,
Wauwatosa, Wisconsin.

A FILE FOR IDEAS

IDEAS are elusive. They come and go. Some means should be found for catching and using them. Memory is short-lived, not always

dependable, and ideas that are worth remembering are also worthy of preservation.

By having a well-organized plan for systematically preserving and storing away the best ideas constantly appearing in the pages of magazines one does not have to depend upon memory, since an idea-file will always keep them on tap, available at a moment's notice when you want them. The necessity of having to remember where you last saw such and such an idea, and having to spend a lot of unnecessary time trying to dig it up is obviated by the use of a good file.

The idea-finder saves you this annoyance and bother. It also saves time and labor, for if you have filed away your material for safe keeping, it is always going to be on hand, right at your finger tips, ready for instant use.

Good ideas are always finding their way into print. Plans are being constantly evolved by others and heralded in the pages of magazines. There is always a wealth of various kinds of information at hand, simply awaiting collection, coordination, and preservation in organized form.

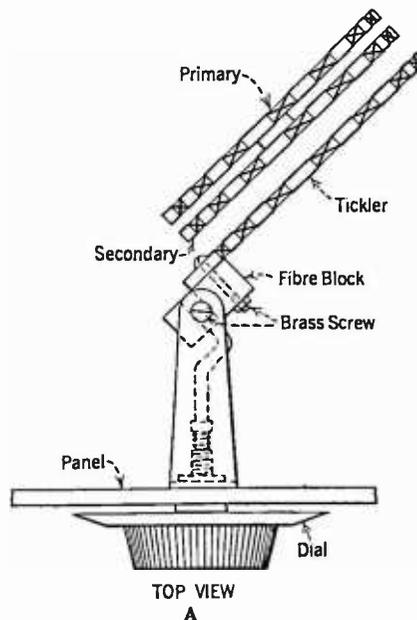
By starting such an idea-storehouse you can have within elbow reach the most useful data that can be obtained from literature of all kinds—data which might otherwise, for want of assimilation and organization, go to seed, be forgotten or neglected.

As you read a magazine you can mark articles of particular interest which suggest fruitful ideas for future application, and index them in synopsis form on a 3 x 5 inch card, which is filed in a card tray, with alphabetic guide cards. These are arranged according to subjects in which you are vitally interested.

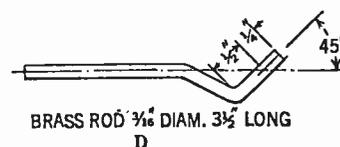
Then again, you can clip these articles and file them away, either in filing folders, or in a desk-book file, with pocket pages, an old time bill file, or a work-organizer. Any of these simple accessories may be obtained from a local stationery store at small cost.

If you want to put your own ideas to work immediately, you scrimp-age through your file and find data already in your idea-storehouse which enables you to carry out your own plans effectively, and with greater assurance of success. Or, your own ideas may start you on a scouting expedition for similar plans in the magazines to which you regularly subscribe, and so open up a new subject for further investigation and data-gathering.

F. E. KUNKEL,
Washington, D. C.



TOP VIEW
A



BRASS ROD 3/8" DIAM. 3 1/2" LONG
D

FIG. 3

The World Expected a Supreme Radio Set from **KELLOGG** *and here it is!*



A Separate Circuit for Each 40 Meter Wavelength Band!

Kellogg — for 28 years makers of precision telephone instruments and equipment — producers of quality parts since radio began — Kellogg has perfected a radio receiver worthy to bear the Kellogg name.

In the illustration we visualize this wonderful engineering achievement.

In the new WAVE-MASTER there are nine separate circuits — one for each 40 meter wavelength band. Each circuit gives that maximum efficiency heretofore found only in one short section of the dials of ordinary radio frequency sets. Each circuit brings within the range of the tuning dial a different group of stations.

How wonderfully simple tuning becomes! Merely set the pointer to the wave zone in which you are interested and bring in the desired station with the single Selector dial.

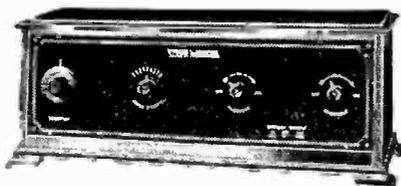
This remarkable tuning dial actually has a tuning range of 540 de-

grees — equal to 1½ times around a complete circle — over three times the station finding range of any other set.

All other radio frequency sets have variable capacity which must be tuned, usually with three different dials, to balance with their inductance coils.

The WAVE-MASTER'S inductance is not fixed but variable and is easily and quickly tuned, with the one Station Selector dial, to balance the fixed capacities.

Write us for the name of your nearest dealer. We will also send on request, a complete explanation of the WAVE-MASTER circuit. Ask for Folder No. 5-L.



WAVE-MASTER
Standard Model
\$125.00



WAVE-MASTER
Brown Walnut Console
with inbuilt horn
\$275.00

Kellogg Switchboard & Supply Company
1042 W. Adams St., Chicago, Ill.

Radio Dealers and Jobbers

The WAVE-MASTER franchise, backed by Kellogg resources and our powerful advertising campaign, is most valuable. Open territory is being closed rapidly. Wire us, or get into Chicago, quick, and see us.

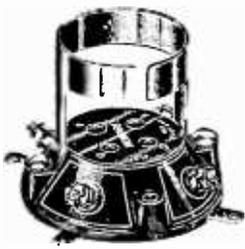
KELLOGG **WAVE MASTER** SWITCHBOARD & SUPPLY CO.



Radion Panels in black and Mahogany come cut in standard sizes for all sets.

Be Sure of Lowest Losses

RADION Panels are most effective in reducing surface leakage and leakage noises because they are moulded from the insulating material *made to order for radio purposes exclusively.*



No. 2 Socket for new UX tubes with collar adapter for old type tubes. No. 4 same as No. 2, without collars, for new UX tubes exclusively.

Tests after tests have proved that Radion insures lowest losses and highest efficiency. Radion Sockets, Dials, Insulators and Tubing have the same high-resistant characteristics as Radion Panels. They embody the latest developments in radio. Ask your dealer to show you the complete line of Radion low-loss parts.

Send 10 cents for booklet, "Building Your Own Set"

AMERICAN HARD RUBBER COMPANY
Dept. C-12 11 Mercer Street New York City
Chicago Office: Conway Building
Pacific Coast Agent: Goodyear Rubber Co.
San Francisco Portland



New No. 10 4-inch Radion Dial. Nine other styles in several sizes to meet all requirements.

RADION

The Supreme Insulation

Made to order for radio purposes exclusively

AMERICAN HARD RUBBER CO.
Dept. C12, 11 Mercer St.
New York City

Please send me your booklet for which I enclose 10 cents in stamps.

Name

Address

.....

SUPER-HETERODYNE NOISES

I HAVE been troubled at times with a peculiar sort of throbbing, spluttering noise which was sometimes accompanied by a low whine which sounded as if it was under a strain, on my super-heterodyne.

I tried almost everything to obviate this trouble and inquired of several radio men as to the cause—without result, and was almost baffled. I finally discovered that it was due to corroded A and B battery terminals.

I used battery clips to connect to the battery and when the clips all happened to bite through the corrosion I did not get the noise. "How simple!" the reader will probably say, but I will confess that it bothered me at times for two months before I finally ran it down.

I hope that this may be of benefit to some other fan.

I. T. SUGGS,
St. Paul, Minnesota.

CHECKING UP ON B BATTERY LEAKAGE

MANY magazines are advising the use of incandescent lamps in series with the B battery to protect tube filaments, and to lengthen the life of such batteries, by lighting up to indicate shorts.

When such a lamp is used with a multi-

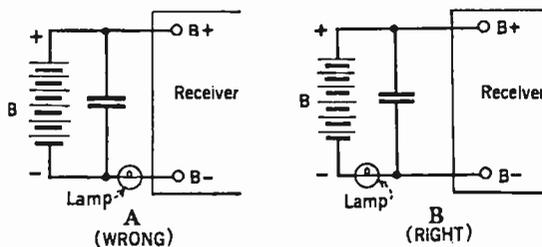


FIG. 4

tube set having no by-pass condenser, or else a very small one, oscillations and howling often result. The effect is the same as using a B battery partly run down—it adds resistance to the circuit. Therefore put a large condenser directly across the B battery as shown in Fig. 4 B.

If the lamp lights dimly when the set is turned on, of course a short circuit exists in the set and can usually be easily located. But the fact that the lamp does not light is no indication there is no B battery leakage in the set—a small leak wouldn't pass sufficient current to light the lamp. So it is advisable, before any home-made set is put in use, and after making tests for shorts and remedying any found (a short would ruin the meter in the next test), to connect a high resistance voltmeter in place of the lamp in B. Turn up the rheostats, when a small deflection on the meter should result. Then turn the rheostats completely off and the meter should read zero. If it reads even slightly past zero, there is a leak in the set which will run the B batteries down even when the set is not in use.

For example, one set checked this way showed a very small deflection, which, measured with a milliammeter, amounted to only $\frac{1}{2}$ milliamperes. The set required seven milliamperes in operation, but because such a leak goes on whether the set is in use or not, this one would cut the B battery life in half where average use of the set was one

and a half hours per day. The trouble in this particular set was traced to a by-pass condenser of .002 mfd. size (of reliable make, probably damaged by soldering), and replacing it stopped the leakage. Another leak of this sort was located between the windings of one long-wave transformer in a super-heterodyne outfit.

The measurement by a milliammeter was not necessary to locate the leakage, it was made merely to show by calculations how serious such troubles might be. Where the B battery life is short in any set, the above test is certainly advisable.

CLAUDE SCHUDER,
Sumner, Illinois

A VARIOMETER TO TUNE ANTENNA CIRCUIT OF THE ROBERTS SET

A VARIOMETER can be used to replace the two antenna coils, variable condenser, and switch, in the Roberts circuit. It is much simpler to construct than the standard arrangement, is easier to tune, just as selective, takes up less space, and makes a neat panel appearance, and there are fewer possibilities of losses. If you are mechanically inclined, you can easily make a variometer.

The sketch, Fig. 5, shows the part of the set that is changed. From the grid of the amplifying tube and the plus terminal of the C battery, the hookup is the same as in the original circuit diagram. Connect the stator terminal to the antenna binding post. The rotor goes to the ground post. Some variometers may work better with the rotor terminal connected to the antenna post and stator to the ground. Connect the terminal of the variometer that is connected to the antenna, to the grid terminal of the amplifier tube as shown. Connect the ground terminal of variometer to the negative post on the C battery. A small fixed condenser of about .00025 mfd. will probably be needed in series with the antenna as shown, otherwise the average variometer will not reach below 999 kilocycles (300 meters) when used this way, especially if you have a long antenna. It is interesting to experiment with a variable condenser in series with the antenna.

There have been many interesting suggestions on improving the Roberts set and

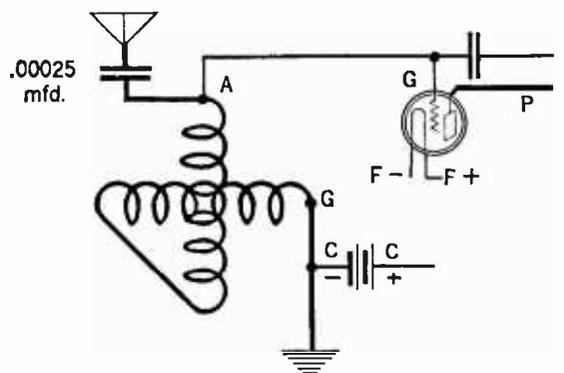


FIG. 5

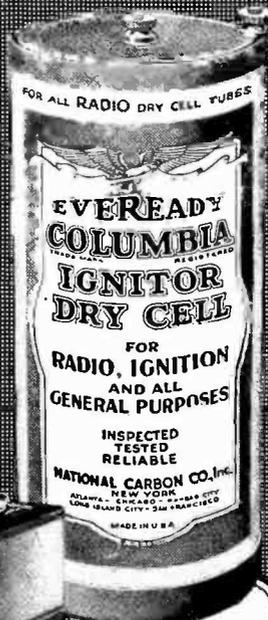
the variometer will work equally well with two or four tubes. A set in Washington, District of Columbia, using four dry cell tubes, gave good loud speaker volume on KHJ. With two tubes, KHJ was easily heard on head phones. I logged seventy-five stations on a loud speaker in one month.

JOHN L. LEE,
Washington, District of Columbia.

EVEREADY HOUR
EVERY TUESDAY AT 9 P. M.
Eastern Standard Time

For real radio enjoyment, tune in the "Eveready Group," broadcast through stations—

WEAF New York	WCAE Pittsburgh
WJAR Providence	WSAI Cincinnati
WEEL Boston	WWJ Detroit
WTAG Worcester	WCCO Minneapolis
WFI Philadelphia	WOC St. Paul
WGR Buffalo	WOC Davenport
	KSD St. Louis



No. 764
Portable
22½-volt
Vertical
Price \$1.75

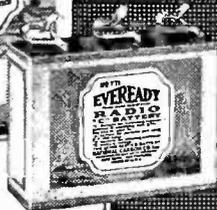


Eveready Columbia Ignitor "A" Battery, the proven dry cell for all radio dry cell tubes 1½ volts

No. 779
22½-volt
Large
Vertical
Price \$2.00



No. 771
4½-volt
"C"
Battery
Price 60 cents



For radio economy

EVEREADY Radio Batteries are noted for their long service and economical operation. They are made in different sizes and types so that every radio user can enjoy the economy and convenience to be had by fitting exactly the right Eveready to his receiver. The five dry cell types of Eveready Radio Batteries are here illustrated and described to make it easy for you to decide just which will give the longest and most economical service on your set. A dealer near you sells Evereadys.

Eveready Heavy-duty "B" Battery for four or more tubes

No. 486. *Extra-large Layerbilt*. 45 volts. Vertical. Eveready's latest contribution to radio. The new Layerbilt construction which gives much greater service. Same size as No. 770. Price \$5.50.

Eveready "B" Battery for one to three tube sets

No. 779. *Large*. 22½ volts. Vertical. Especially adapted for Radiola 25, DeForest D-17 and Operadio receivers. Same capacity as No. 766, and suitable wherever variable taps are not required. Price \$2.00.

Eveready "B" Battery for portable sets

No. 764. *Portable*. 22½ volts. Vertical. For portable sets where medium weight and size are permissible. Price \$1.75.

Eveready "A" Battery

Eveready Columbia Ignitor Dry Cell Radio "A" Battery for all dry-cell tubes. 1½ volts. The dry battery used by vacuum-tube engineers in developing the dry-cell tube.

Eveready "C" Battery

No. 771. 4½ volts. Saves "B" Batteries, improves tone. Price 60 cents.

Manufactured and guaranteed by

NATIONAL CARBON COMPANY, Inc.

New York

San Francisco

Canadian National Carbon Co., Limited, Toronto, Ontario

EVEREADY

Radio Batteries

—they last longer



No. 486
45-volt
Layerbilt
Extra-large
Vertical
Price \$5.50

for Christmas
A set of NA-ALD
Colored Dials
to dress up your radio

*Give 'em to your wife and
get the benefit yourself!*



WHEN fans first built radio sets, the womenfolk registered silent objection to their ugly appearance but they endured the clutter because radio was such a novelty and because they thought maybe you'd soon get over the craze.

But soon as they saw your craze was a permanent obsession, they began asking for better-looking sets.

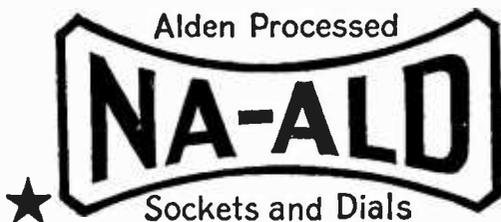
The latest, up-to-the-minute advancement in making a set harmonize with its surroundings is represented by the New Alden Colored Dials. They will make your old set most attractive. To the new set they will add the pleasing qualities of color and beauty.

The colors are Garnet; Malachite Green, like mottled green and white marble; Brilliant Tortoise, that blends with every color combination; or in beautiful Grained Mahogany. \$5.00 a set, any color, in hardware, electrical, radio or department stores and in gift shops.

Give a set to someone in your family and then—all of you can enjoy their beauty! Or here's a stunt. Leave this magazine open on the living room table at this page, with a big pencil check mark beside this ad, and see if the family doesn't take the hint and buy a set for you. If the wife of one of your radio fan friends asks you what to give her husband for Christmas, you might mention Alden Colored Dials.

Mail the coupon below if you'd like some free but worthwhile information on the New Colored Dials.

ALDEN MFG. CO.
Dept. B13. Springfield, Mass.



ALDEN MFG. CO.
Springfield, Mass. Dept. B13.

Please send me "What to Build" information together with information on Na-Ald Colored Dials.

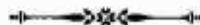
Name
Street
City State

HOW TO ELIMINATE LOCAL INTERFERENCE

Part 2

Some Practical Information Based on the Results of an Investigation on Radio Inductive Interference

LAST month's RADIO BROADCAST presented the first of two articles to be printed herein on the above subject. The information has been taken from a very excellent little pamphlet which has been specially prepared by the Radio Branch of the Department of Marine and Fisheries of the Dominion of Canada Government, and which is entitled "Radio Inductive Interference, Bulletin Number One." The previous article was devoted chiefly to determining the source of various forms of interference while this concluding part gives much practical information for the elimination of the trouble once it has been found.



MEANS OF SUPPRESSING RADIO INDUCTIVE INTERFERENCE

IN CASES where electrical apparatus suspected of causing interference appears to be in good mechanical and electrical condition, it is very often possible to supply some means of preventing electrical surges, originating in the apparatus, from getting out to the power line where they would radiate and cause radio interference.

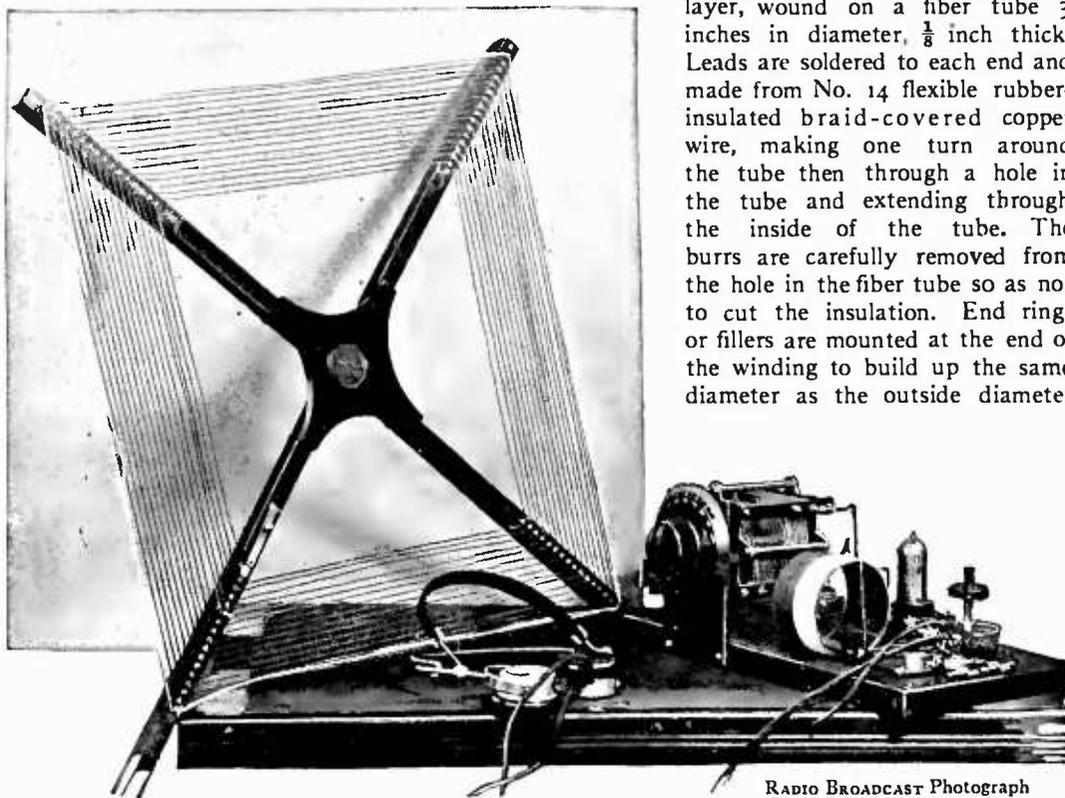
These electrical surges have the property of passing through condensers more readily than through inductances. The method employed, therefore, in preventing electrical surges from traveling along the power lines and thus causing radio interference, is to provide a path to ground

sufficient insulation to withstand the voltage of the line. These installations should be approved by the local electrical inspector to ensure that there are no fire or accident hazards introduced by the installation.

It is important in the design of these choke coils that they should have low distributed capacity in order to prevent the electrical surge passing through the choke coil by means of this capacity.

CHOKE COIL

ATYPE of choke coil recommended for cases where the current is less than three amperes, is constructed according to Fig. 1. It consists of a hundred turns of No. 18 double cotton-covered copper wire in a single layer, wound on a fiber tube 3 inches in diameter, $\frac{1}{8}$ inch thick. Leads are soldered to each end and made from No. 14 flexible rubber-insulated braid-covered copper wire, making one turn around the tube then through a hole in the tube and extending through the inside of the tube. The burrs are carefully removed from the hole in the fiber tube so as not to cut the insulation. End rings or fillers are mounted at the end of the winding to build up the same diameter as the outside diameter



RADIO BROADCAST Photograph

AN INTERFERENCE FINDER

Of typical form. This was made in the RADIO BROADCAST Laboratory. One Duplex variable condenser tunes both loop and the R. F. secondary, which feeds into a crystal detector

in the form of a condenser to filter or drain off this surge. In order to make this filter more effective, it is often advisable to introduce between the line and the source of the disturbance a trap, which will make the passage of the surge more difficult. This trap preferably takes the form of a choke coil which consists of a number of turns of wire of sufficient size to carry the required current without overheating, and

of the winding. These may be made of tape or a suitable size of fiber tube. The whole coil is then covered with five layers of Empire cloth and then taped with black friction tape and painted with insulating varnish. Mounting lugs made of fiber are then attached to each end of the coil.

This coil should be mounted on a board covered with asbestos $\frac{1}{8}$ inch thick and the leads

★ Tested and approved by RADIO BROADCAST ★

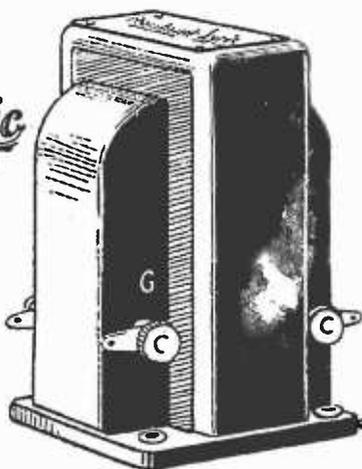
ENDORSED BY TEN LEADING RADIO ENGINEERS

Built on the  DURHAM
 Reputations of  UNION
 Leading Manufacturers  Hammarlund
 and  NA-ALO
 Pioneering Engineers  Carter

AMPERITE



Rauland-Lyric
AN ALL-AMERICAN
TRADE MARK
TRANSFORMER



Read the Story
on the
following
pages

Hammarlund
Roberts

Send for the
Book
Described on the
third page

Hammarlund-Roberts 1182-A Broadway New York

How This Master Receiver ★ Was Designed

WHEN you analyze the engineering skill that brought the Hammarlund-Roberts receiver into existence, you realize again the force of the Englishman's classic reply, "Madam, my tastes are very simple. I want only the best."

This then is the keystone upon which the Hammarlund-Roberts receiver was built—simplicity of design, quality of materials. Price was a last consideration, for, too often, building down to a price has terribly handicapped radio research.

Back in 1924, a remarkable new receiving circuit, the Roberts, was introduced to the public. It won instant popularity because of its obvious superiority and particularly for its new feature, regeneration (the equivalent of two stages of radio frequency) in combination with proper tube neutralization. The designers of this circuit were proud of their achievements, but saw beyond it. An ideal five-tube receiver with even greater and more radical changes was visualized—a five-tube receiver that should excel in volume, tone, selectivity and sensitivity. It was a thrilling idea, almost in-



credible at first and only in the coordination of the inherent characteristics of each component part was true perfection realized. Ten leading engineers were responsible for this new vastly improved Roberts receiver. Each of these men a specialist in his own field. One devoted all his effort to resistance research work; another had made a special study of condensers, their characteristics and construction. Even the smallest units were represented by an engineer who had made a special study of them.

These engineer-designers saw the vast possibilities in the circuit and offered their services enthusiastically. Each studied the unit he was interested in, carefully selecting and rejecting the various parts that the market offered. Efficiency in itself was not the prime consideration in the selection of a unit; it was far more important that the unit selected should be *the instrument* that synchronized perfectly with the rest of the set. Imagine the magnitude of this task—the patient, painstaking laboratory work that was necessary!

At last, however, the goal was reached. A few minor changes were made. The various parts, the "cream" of their particular

fields, were assembled. The last wire was soldered in place, the two dials were carefully operated—and the dream came true!

Here indeed was the ultimate in five-tube reception! A set so simple that any layman might put it together with ease; so simple to tune, with its two dials and automatic filament control, that a child could operate it.

The next step—last of all—was price.

The manufacturers of the parts selected were told of the set. They were shown the set, heard its performance, and submitted blueprints to their staff engineers for a report. The result was the hearty approval of each and every one of them, and the promise to do their best to hold prices down to a minimum.

Their promise was more than fulfilled. The necessary parts for the Hammarlund-Roberts receiver, complete (except for the cabinet) are sold for \$60.85. This amazingly low price can not be approached by any receiver of nearly equal quality on the market.



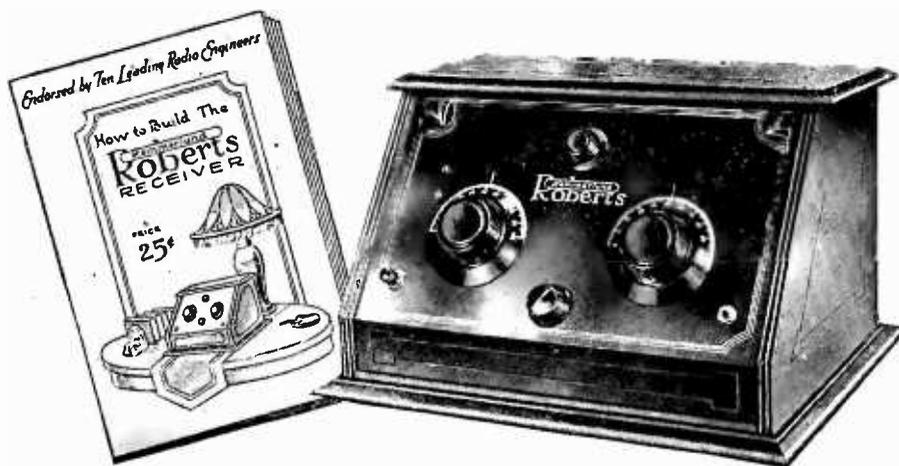
Endorsed By Leading Radio Manufacturers

NO ORDINARY standards of five-tube reception or ease of operation can be applied to the Hammarlund-Roberts receiver. This set compels so complete a revolution in all previous ideas of performance and value that you can understand its sensational results only through a personal experience.

The Hammarlund-Roberts receiver is not only guaranteed by its designers *when each of the specified parts is used*, but each part is absolutely guaranteed by its manufacturer. This fact alone is sufficiently distinctive to place the set apart from other receivers.

You will find elsewhere in this advertisement a list of those famous manufacturers who vouch for the parts used, together with a description of their product. These manufacturers, in addition to their guarantee of quality, join with the engineer-designers of the set in *warning against the substitution of any part*. The set is so completely synchronized, the harmony of operation so completely dependent upon the presence of each and every part specified, that no guarantee can be offered if the list of parts is not followed to the smallest item. The panel and sub-panel of the Hammarlund-Roberts Foundation Unit are *drilled to fit only those parts*.

In other words, to use an inferior part in place of that specified, would mean throwing aside the result of months of patient experimenting on the part of master engineers.



\$60.80 CABINET
EXTRA

Send For This Book

You can build the Hammarlund-Roberts receiver from the interesting "How To Build" book. It is elaborately illustrated and tells you exactly what parts are required. The step-by-step instructions can easily be followed by anyone, no matter how slight their mechanical ability. Send for your copy to-day.

25c.

★
**Hammarlund
Roberts**

Hammarlund-Roberts 1182-A Broadway New York City

These Are Some of The Famous Parts Used in The Hammarlund-Roberts

Rauland-Lyric

Contributes to the Superb
Tone Quality of the

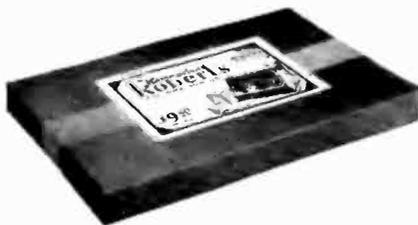
Hammarlund-Roberts Receiver

The secret of pure, musical tone at all volumes is in the amplification of the current which actuates the loud speaker device. The audio transformer is, therefore, the actual musical heart of a receiver. By selecting RAULAND-LYRIC TRANSFORMERS for the Hammarlund-Roberts Receiver, the engineer-designers assured faultless musical reproduction at all cycles sound at lowest and highest volume, under all conditions. Noted critics are unanimous in their commendation of the beautifully rounded, full, clear reproduction by Rauland-Lyric Transformers—truly a musical instrument, just as much as a fine violin or piano. Manufactured to the hair-breadth distinction and absolute uniformity which have made the name "All-American" a synonym for reliability.



★ **Durham
Resistors**

A rare metal compound sealed in a glass tube—noiseless, permanent, tested and accuracy guaranteed.



The
**Hammarlund-Roberts
Foundation Unit**

This is the basic unit upon which you build the Hammarlund-Roberts receiver. It contains a drilled and engraved Bakelite panel, drilled Bakelite sub-panel, and all the necessary metal brackets hardware and wire, \$9.40.

★ **Hammarlund
Roberts**



★ **NA-ALD
"De Luxe" Sockets**

*Add Better Connections and Superior
Insulation*

Contacts of tubes and sockets are automatically brightened when tubes are inserted. Microphonic noises minimized by an adjustment of the vibration period of these cushioned sockets. Genuine Bakelite, Alden processed. Without a doubt the most efficient tube socket ever devised—so they are used in the Hammarlund-Roberts receiver.

**NA-ALD
"Super De Luxe" Dials**

Seemingly a mere detail, yet the selection of these particular dials assures easy, precise tuning and freedom from backlash.



★ **Union Phone Tip Jacks**

One inferior connection is sufficient to destroy the efficiency of any receiver. That is why the engineer-designers insisted that for even this minor part, Union Phone Tip Jacks must be used.



Supplants the hand-operated rheostats and the filament meter with an automatic control of tubes. Saves tubes, current, thought and effort. Gets the best out of every tube. Fool-proof, more efficient, simpler. No moving parts and therefore louder signals and greater distance. Every AMPERITE is guaranteed to function properly.



CARTER "Imp" Rheostat

Selected by the engineer-designers because it embodies the latest, advances in rheostat design. Smallest rheostat made—only 1 3/8" diameter. 25 ohm. Single hole mounting. Durable, precise, mechanically perfect.



**HAMMARLUND
MODEL C
Variable Condensers**

A standard of precision. The receiver gains immeasurably by the use of these condensers. Soldered brass plates; aluminum ends; noiseless, adjustable bearings; clockspring pigtail; minimum dielectric, smooth cam operated vernier. The new Hammarlund Straight-line Frequency Condensers of the same capacity, incorporate the same characteristics, may also be used.

THE HAMMARLUND "MIDGET"

Smaller size but the same careful construction that characterizes the larger Hammarlund Condensers

UNIT
4

HAMMARLUND

Space-Wound COILS

Unit 4
of the
New
Hammarlund
—Roberts
Receiver

NEVER before were coils of such high efficiency available. By an ingenious process Hammarlund engineers have devised a way to wind the famous solenoid coil, with a definite space between turns, supported and anchored by a mere film of dielectric material. Thus inductance is kept high, with low distributed capacity, low resistance and absolutely no chance for short circuits. Columbia University Laboratory rates them the best of low-loss coils.

They are regular equipment in the wonderful new Hammarlund-Roberts receiver and the Eagle Neutrodyne. Various sizes, and arrangements available for other standard circuits.



H-R ANTENNA COUPLER

"Hammarlund, Jr."

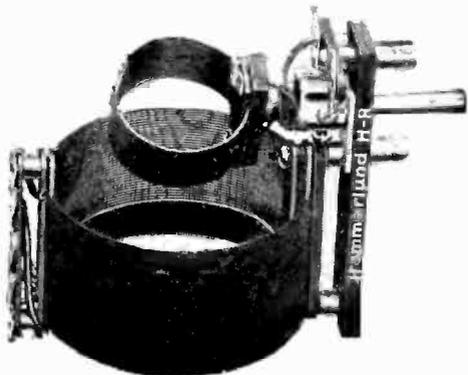
"Hammarlund, Jr.," the superior Midget Condenser is used to neutralize the radio frequency tube of the Hammarlund-Roberts Receiver. It is a precision product, possessing every quality and feature of the larger Hammarlund models. It has many other uses besides neutralizing in high grade receivers. Diagrams sent on request.

Unit
2

Hammarlund S-L-F Condenser

The New Hammarlund Straight-Line-Frequency Condenser used in the Hammarlund-Roberts Receiver is an outstanding contribution to modern radio. It is rugged, compact and remarkably efficient in reducing interference between low-wave stations. The frame is heavy, non-warping aluminum, grounded to the rotor. Sturdy tie-bars insure perfect alignment of the brass plates. There are adjustable ball-bearings at both ends of the rotor shaft. Only one small piece of Isolantite insulation is used, placed outside of the electrostatic field. Bronze clockspring pigtail. One-hole mounting. Made in all standard capacities.

Unit
3



H-R VARIO-COUPLER

Fifteen years experience in manufacturing precision instruments for telephone, telegraph and radio use, is back of Hammarlund Products. Their reputation is world-wide. Their efficiency unexcelled. Their prices are moderate.

Write for Literature

HAMMARLUND MANUFACTURING CO.

424-438 West 33rd St., New York City

For Better Radio
Hammarlund ★
PRECISION
PRODUCTS

RADIO 'RITHMETIC

as an example



How Near are the Far Stations

That's an easy one. They're not far away at all; they're right with you, performing antics on your aerial, trying to make themselves heard.

Give them a real chance by keeping your batteries full of pep. That's another easy one! Just put the job up to a Westinghouse Rectigon.

It's for "A" batteries and "B" batteries;

and your automobile battery will get a full kick out of this handsome little helper.

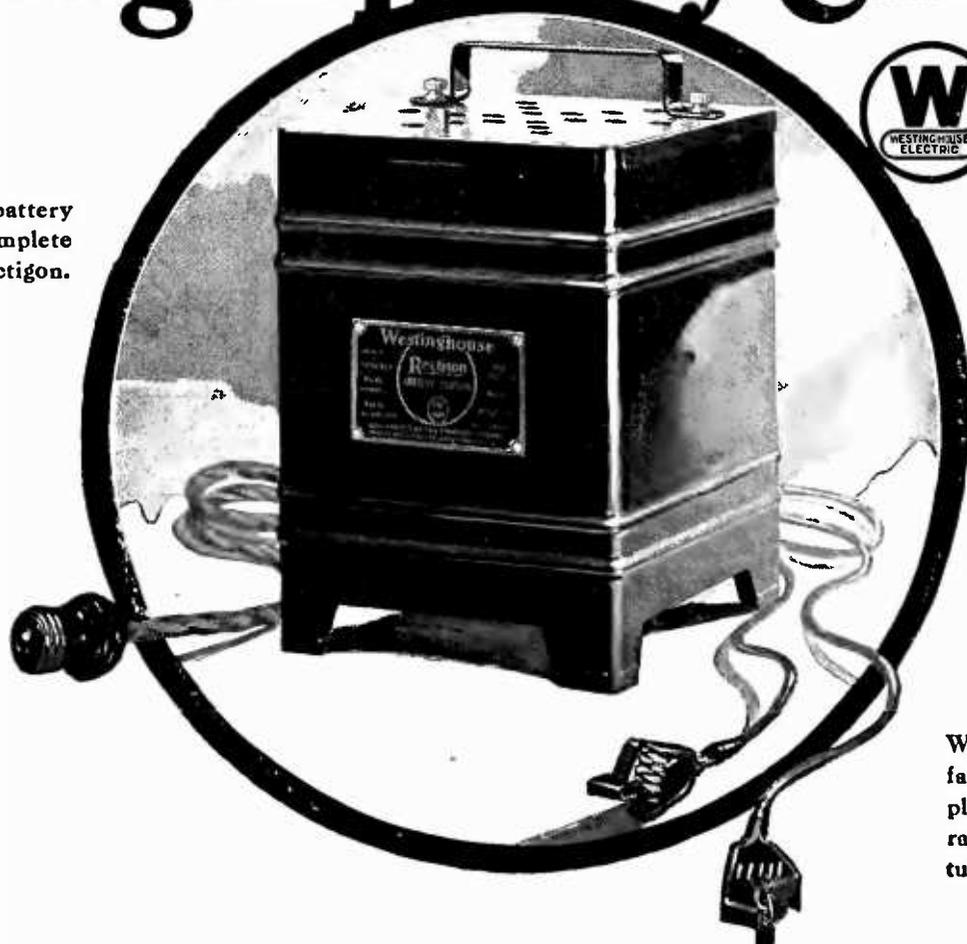
There's no muss or fuss when you use the Rectigon. No acids or chemicals. No moving parts and no noise! It's a high-quality Westinghouse Product throughout, guaranteed to make your storage-battery radio set satisfying and *complete*.

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY

SOUTH BEND, INDIANA

The Westinghouse Rectigon Battery Charger

No storage-battery
radio is complete
without a Rectigon.



© 1925,
W. E. & M. Co.



Westinghouse manufactures, also, a complete line of Micarta radio panels, Micarta tubes and instruments.

★ Tested and approved by RADIO BROADCAST ★

Take a Tip from KDKA



Pick a good, stiff backbone for your radio set—

MICARTA RADIO PANELS

Like KDKA, the world's pioneer broadcasting station, Micarta started something! From a modest beginning in 1904, time and experience developed it into the finest kind of material for radio panels and tubing.

Micarta comes in four popular

effects—mahogany, black, walnut grain and walnut burl. All beautiful finishes, with high gloss; strong and lasting.

Drill, or saw it, without a worry. Micarta doesn't chip, check, crack or break-out. Be particular. Get the genuine article by asking specifically for Micarta.

Westinghouse manufactures, also, a complete line of Micarta tubing, instruments and Rectigon Battery Chargers.

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY
Offices in All Principal Cities Representatives Everywhere
Tune in with KDKA—KYW—WBZ—KFKX

Westinghouse

© 1925, W. E. & M. Co.



PAUL GOLDSTEIN & CO., Inc.
54-56 Franklin Street
New York, N. Y.

[Fabricators of Micarta
for the Radio Trade]

CALVERT SPECIALTY CO.
141 North 11th Street
Philadelphia, Pa.

**THE
PARTS**

then

**THE
BLUE-PRINTS**

and finally

**THE
RECEIVER**

That's The Way To Make
**Radio Broadcast's
 Knockout Four-Tube Roberts Receiver**

—○—
TWO FULL-SIZE BLUE-PRINTS
 AND A
16-PAGE INSTRUCTION BOOKLET

Put you on the road to the construction of the type of Receiver that has satisfied thousands of its builders. A dollar brings the Blue-Prints and Booklet to you.

NEUTRALIZED TUNED RADIO FREQUENCY AMPLIFICATION
 REFLEXED AUDIO-FREQUENCY AMPLIFICATION
 REGENERATIVE DETECTOR
 PUSH-PULL AUDIO AMPLIFICATION
ALL WITH FOUR TUBES

USE THE COUPON IF YOUR LOCAL DEALER'S SUPPLY IS EXHAUSTED

Doubleday, Page & Co.
 Garden City, New York

Enclosed find my dollar for the Blue-Prints and sixteen-page Instruction Book for building RADIO BROADCAST's Four-Tube Knockout. It is understood that my dollar will be returned if the material sent me does not come up to my expectations.

Name.....

Address.....

RB—D

ATWATER KENT RADIO



“But why
he go?”

WHEN they struck oil on the Indian lands in Oklahoma many of the Indians became suddenly rich. One of them, anxious to begin his life of luxury, went to buy an automobile.

The salesman launched into a description of the car in detail. Technical term followed technical term in a bewildering stream. Finally the salesman thought his work was done. He produced an order blank and paused.

“Now,” he asked, “is there anything else I can tell you?” The Indian scratched his head.

“Um,” he said. “You tell me: He no have horse. Why he go?”

We could give you a description of the Atwater Kent Radio Receiving Sets and Speakers that would fill hundreds of pages.

But what would be the use? You would still judge an Atwater Kent, as you should, by its performance. We want you to judge it that way, to compare it with any other radio you are considering.

By looking at it and listening to it, you will get some of its technical perfection. When you have owned it and lived with it, you will *know* how good it is.

Hear the Atwater Kent Radio Artists every Sunday evening at 9.15 o'clock (Eastern Standard Time) through stations:

WEAF . New York	WEEL Boston	WCAE . . Pittsburgh
WFI } Philadelphia	WGR Buffalo	WOC . . . Davenport
WOO } alternating	WWJ Detroit	WSAI . . Cincinnati
WJAR . Providence	KSD St. Louis	WTAG . . Worcester
WCAE . . Washington	wcco . . . Minneapolis-St. Paul	

Write for illustrated booklet of Atwater Kent Radio
ATWATER KENT MANUFACTURING COMPANY
A. Atwater Kent, President
 4726 WISSAHICKON AVENUE PHILADELPHIA, PA.



Model R, \$12



Model L, \$17



Model H, \$22



Model M, \$28



Model 12 (without tubes), \$100



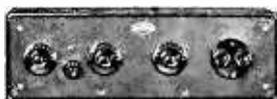
Model 10 (without tubes), \$80



Model 19, \$60



Model 20 Compact, \$80



Model 20, \$80



Model 24, \$100

Prices slightly higher from the Rockies west, and in Canada

Prices slightly higher from the Rockies west, and in Canada



For EVERY Radio Set

A stunning piece of furniture that restores order in the room where you have your Radio! No more cluttered table-tops, nor litter of equipment under-foot.

No unsightly horn in evidence, either! This console has its own loudspeaker, in-built. It's out of sight, but with very apparent tonal superiorities. For it has the highest-developed type of unit. With horn built of special non-vibrating, extra-hard, ceramic material. Produces clear non-vibrant tone.



Non-Vibrant Ceramic Horn

The clearest tone producer on the market. Made of special composition which defeats vibration.

There's ample room for everything; space for *largest* A and B wet batteries—or battery eliminator—required for any home set; and for a big charging outfit, too.

Finished in mahogany, or walnut color. Dainty design of parqueterie on two front panels. Top, 38 in. x 18 in. Substantially built; the product of a 40-year-old furniture maker.

The price, forty dollars, is for the *complete* console and includes the loudspeaker horn and unit. Thousands of dealers are showing this artistic addition to home radio equipment.



Rear View—Set Hooked Up

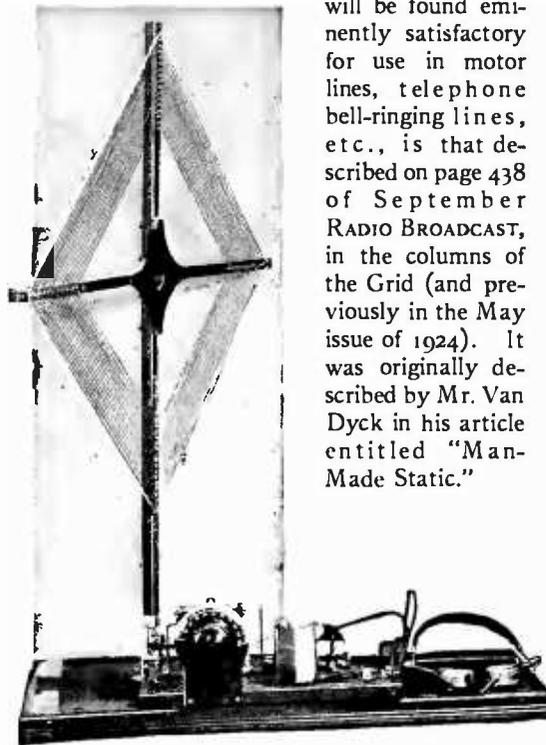


Price, \$40
West of Rocky Mts., \$42.50

Windsor Furniture Co.

1420 Carroll Ave.
Chicago, Ill.

soldered and thoroughly taped according to standard wiring practice. Another type of choke coil which will be found eminently satisfactory for use in motor lines, telephone bell-ringing lines, etc., is that described on page 438 of September RADIO BROADCAST, in the columns of the Grid (and previously in the May issue of 1924). It was originally described by Mr. Van Dyck in his article entitled "Man-Made Static."



RADIO BROADCAST Photograph

A PORTABLE INTERFERENCE FINDER

Consisting of a stage of radio frequency amplification followed by a crystal detector. A collapsible loop will greatly improve the portability possibilities

INSTRUCTIONS FOR MOUNTING CONDENSERS

CONDENSERS which will stand a test voltage of 1000 volts d. c. may be connected across an alternating current or direct current circuit of 250 volts or less. On circuits which are protected by fuses of not more than 15 amperes capacity, no additional fuse is required for the condenser. On circuits protected by fuses of greater than 15 amperes capacity, a separated cutout base and small fuse (of approved type) not exceeding 15 amperes, must be installed between the condenser and each ungrounded power wire. Where condensers are not installed in metal boxes and are to be placed on wooden surfaces, they should be mounted on pads of asbestos at least $\frac{1}{8}$ inch thick, and these pads should be sufficiently large to extend beyond the clamps used for holding the condenser in place.

Where condensers are to be used on 550 volt circuits, two condensers of the approved type must be connected in series between the lines and the common point may be grounded. In such installations, the condensers are to be protected by 600-volt fuses not greater than 10 amperes in each live line, and both the condensers and fuses are to be enclosed in a grounded metal case. Where the condensers are to be connected to two-phase or three-phase circuits not greater than 600 volts, one condenser may be connected from each live line to ground and installed with fuses in boxes as stated above.

As these condensers contain wax, they should not be placed where they may be subjected to excessive heat.

Condensers when connected to a circuit as stated above have no objectionable effect on the circuit or the operation of any electrical apparatus and they do not consume any power.

APPROVED TYPES OF CONDENSERS

THERE are now many condensers on the market suitable for the purposes detailed in this article. Those chosen must be capable of standing a test voltage of 1000 volts d. c. At

the time of the publication of this bulletin by the Department of Marine and Fisheries of the Dominion of Canada Government, special condensers having No. 14 rubber-insulated leads suitable for installing without metal boxes, were obtainable from the Radio Branch of the above Department, at cost.

TREATMENT OF TYPICAL CASES

IN MANY cases it is possible to make slight changes in the connections of the electrical apparatus causing the surge in order to use some existing apparatus as a choke coil and thus prevent the necessity of adding additional choke coils to the system.

A series commutator motor causing a surge by sparking at the brushes may have its leads reversed to reduce the radio interference. Where one wire is grounded, radio interference from such a motor is sometimes reduced by reversing the leads supplying the motor, so that one of the brushes is connected to the ground side of the line and the field coil is connected to the live side of the line. In this case, the field coil is used as a choke. It may also be necessary to place a

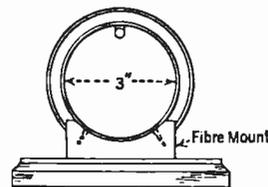
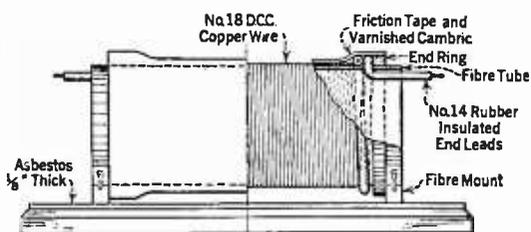


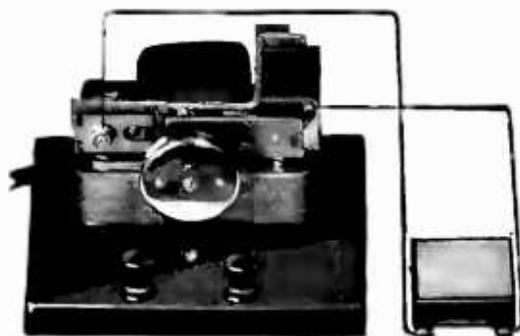
FIG. 1

Details for the choke construction. It consists of one hundred turns of No. 18 d. c. c. copper wire on a three-inch tube

condenser of one or two microfarads capacity across the brushes. This is shown in Fig. 3.

In cases where neither side of the line is grounded, a choke may be inserted on the line connected directly to one of the brushes, while the field coil may act as a choke in the other line. In this case it is recommended to use two 2-microfarad condensers in series and ground the middle point according to the diagram.

In cases where it is not convenient to make connections with the brushes of a motor, the condenser may be placed across the line as near the motor as possible, and a choke coil may be



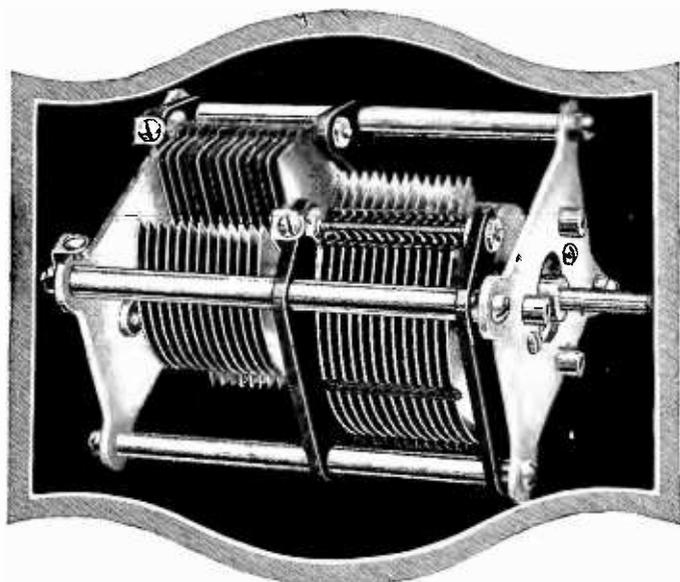
RADIO BROADCAST Photograph

FIG. 2

Showing condenser connection across vibrating contacts of a battery charger

inserted in the live line when necessary. See the instructions above regarding approved condensers and the use of fuses.

The S. L. F. that doesn't "hog" panel space



The principal objection to many Straight line Frequency condensers now on the market is that they "hog" too much panel space; thus making it necessary to re-arrange other instruments on the panel or rebuild the set entirely to allow enough room for the scythe-like sweep of the S. L. F. rotor.

The new General Radio type 374 S. L. F. condensers eliminate entirely all such difficulties. They occupy the same panel space as the well known types 247 and 334 condensers—and no more. In fact they may be used interchangeably with those condensers since the mounting holes are the same.

By using smaller rotor plates of correct shape and double the number of plates General Radio condensers have a straightline frequency calibration curve without the mechanical disadvantages encountered in the average S. L. F. with fewer plates of larger area. The assembly of the type 374 condensers with respect to bearings, soldered-plates, and correct spacings are the same as the types 247 and 334.

For further description and prices ask to see them at your local dealer's or write for our latest Bulletin 923-R.

GENERAL RADIO COMPANY

30 State St.

Cambridge, Mass.

For over a decade General Radio parts have been the universal standards of quality.

They have been developed by the same engineers who designed the precision apparatus now used as standard equipment in nearly all the leading commercial and technical school laboratories throughout the entire world.

Since 1915 the General Radio Company has supplied scientific instruments in ever increasing quantities to such prominent institutions as the General Electric Company, Westinghouse, Bell Telephone System, and the Bureau of Standards for use in electrical and radio research.

No one company in the history of radio has contributed more in laboratory equipment than the General Radio Company.

The same outstanding skill, materials, and workmanship are embodied in General Radio parts for use in the construction of broadcast receivers.

Through the merits of design, performance, and price General Radio instruments for the scientist or set-builder are universally recognized as the Standards of Excellence.

Every instrument made by the General Radio Company is thoroughly guaranteed.



GENERAL RADIO

"Behind the panels of Better Built Sets"

Christmas On the Air!

Are Your Tubes in Shape?

At Christmas Tide! Listen to sweeter "Christmas Carols"—clearer chimes and more celestial music broadcast by the great cathedral choirs throughout the land.

A Rhamstine★ TUBE BOOSTER



Rhamstine★
Tube Booster
Only \$6

★ will renew your old tubes with all the pep and freshness of new ones. Just put them in the socket and turn on the current—do it once a month—it will treble the life of your tubes and give you better distance, volume, and a tone as clear as a bell at all times. It will pay for itself in a few days. Works on any alternating current 110-120 volts, 50-133 cycles. It matters not, whether you use 201-A or 199 Type Tubes. Send no money—check the coupon below—pay on delivery.

"B" Rectifier Eliminates "B" Battery



Rhamstine★ "B" Rectifier
Only \$25
(Tube not included)

Eliminates all your "B" Battery troubles such as recharging, dead cells, and chemical action. A Rhamstine "B" Rectifier will more than take the place of a "B" Battery—it will give a continuous and uniform current year in and year out with absolutely no trouble at all. Small, compact, good looking, endorsed by the leading radio manufacturers, and reasonably priced. You should have one.

Send no money—just check the coupon.
Tube Boosters are Trade Boosters.
DEALERS write for our attractive proposition.

Mail the Coupon To-day

J. THOS. RHAMSTINE★ (12)
506 E. Woodbridge, Detroit, Mich.

Please send me
 Rhamstine★ Tube Booster at \$6
 Rhamstine★ "B" Rectifier at \$25
by express C. O. D. subject to inspection. If I am not entirely satisfied with the "B" Rectifier I will return it to you in five days and receive a refund of the full purchase price.

Name.....

Address.....

J. THOS. RHAMSTINE★
Radio and Electrical Products
506 E. Woodbridge St., Detroit, Mich.

The live side of a low voltage lighting circuit may be determined by means of a test lamp connected from ground first to one wire and then to the other. The lamp will light when connected from the live line to ground.

Battery charger of the vibrator type may be prevented from causing radio interference by connecting a condenser of 1/2 microfarad capacity across the vibrating contacts. This is illustrated in Fig. 2 on the previous page. In the case of battery chargers it is useless to put condensers

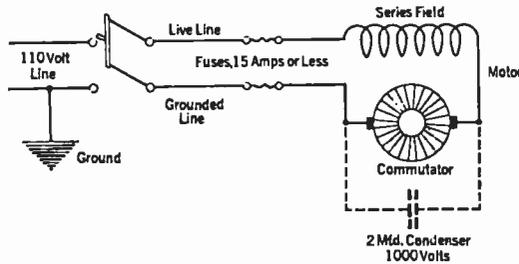


FIG. 3
Method of connecting a large capacity condenser across the brushes of a small motor

across the mains, as it is necessary to make use of the choke consisting of the wire and coil within the battery charger, to prevent this surge from getting out on the line.

Flashing electric signs may usually be prevented from causing radio interference by connecting condensers of from 1/2 to 2 microfarads capacity across the contacts of the circuit breaker. It is sometimes necessary, however, to add a choke coil at the line side of the circuit breaker and also connect the condenser across the contacts of the circuit breaker. As the radio interference from such sources depends upon the conditions of the installation it is necessary to make these few experiments, as suggested above, in each case in order to reduce the radio interference most effectively.

Sometimes the radio interference from a flashing sign installation is caused by sparking at the commutator of the motor which drives the flasher. This may readily be determined by the nature of the sound in the radio receiver and may be remedied by the method described for dealing with interference from commutator motors.

Internal combustion engine ignition systems may cause radio interference, but this is usually of a very local nature. Such interference may be considerably reduced by making the leads from the magneto or spark coil to the engine as short as possible and running them in a grounded shield, such as metal conduit or lead-covered cable. The frame of the engine, magneto, and all shields, should be thoroughly grounded.

Rotary converters sometimes cause radio inductive interference by producing a surge which travels out both on the alternating and direct current lines. In some such cases it may be necessary to introduce choke coils into the alternating current lines and put condensers across the lines between the choke coils and the converter. Before putting these choke coils in the alternating current lines, it is recommended to try the effect of condensers across the brushes as described previously for the case of commutator motors.

Electric ozonators which are used for purifying the air in large buildings and for bleaching purposes in flour mills, sometimes cause radio inductive interference by producing a surge which travels along the primary lines supplying the ozonator.

This interference may easily be eliminated by connecting two choke coils of the cylindrical type previously described, one in each of the low voltage lines placed as near as possible to the ozonator.

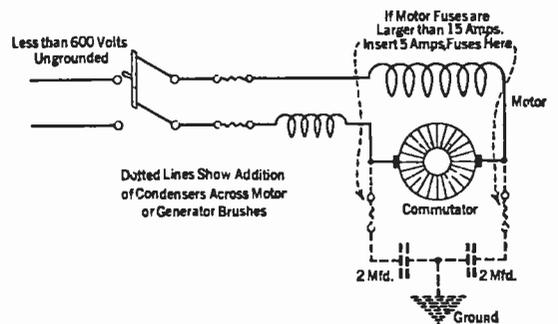


FIG. 4
Connection for two condensers in series across the brushes of a motor generator. The position for extra fuses, if the motor fuses are larger than 15 amps., is clearly shown

A List of Australian Broadcasting Stations

Here is a complete list of Australian broadcasting stations now active in that country. It is not generally known that one of these stations, that at Brisbane, Queensland, can vie with some of the important American stations as far as power is concerned, for they use 5000 watts. As will be seen by the list, three of the seven other stations use as much as 3000 watts. American stations are often heard in Australia, especially those located on the Pacific Coast. We are indebted to Mr. A. W. Watt, editor of Australian Wireless Weekly, for the appended list.

LOCATION	OWNER	CALL SIGNAL	FREQUENCY IN KC.	WAVELENGTH IN METERS	POWER IN WATTS
Sydney, New South Wales	Farmer and Company Ltd.	2FC	261	1150	3000
Sydney, New South Wales	Broadcasters, Ltd.	2BL	857	350	500
Melbourne, Victoria	Australian Broadcasting Co. Ltd.	3LO	809	371	3000
Melbourne, Victoria	Associated Radio Co., Ltd.	3AR	789	380	500
Adelaide, South Australia	Central Broadcasters Ltd.	5CL	937	320	500
Perth, West Australia	West Australian Farmers Ltd.	6WF	240	1250	3000
Hobart, Tasmania	Associated Radio Co., Ltd.	7ZL	769	390	500
Brisbane, Queensland	Government Radio Service	4QG	779	385	5000

The broadcasting from the above stations is usually divided into four sessions, morning, afternoon, early evening, and evening. The exact times of these sessions, taking 3LO as an example, are as follows: Morning, from 11 a. m. to 2 p. m.; afternoon, from 3 p. m. to 5.15 p. m.; early evening, from 6 to 7.15 p. m.; evening, from 7.15 to 11 p. m., the program always concluding with "God Save the King." The difference between New York and Melbourne time is fifteen hours, thus, when it is midday in New York on a Monday, it is 3 a. m. Tuesday in Melbourne. Appropriate allowances must be made when comparison is being made between Melbourne time and United States time in points west of New York, and also for Australian points west of Melbourne.

★ Tested and approved by RADIO BROADCAST ★

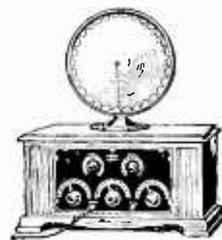
THE · PERFECT · UNION · OF · ART · AND · SCIENCE



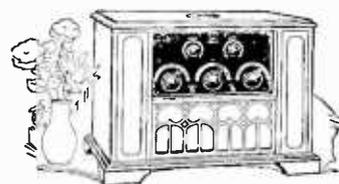
DE FOREST W 6
RENAISSANCE TYPE



DE FOREST AUDION
is the world standard in tubes. De Forest created the first successful radio tube, and his invention made broadcasting possible. The De Forest policy of a specific type tube for each socket insures finer reception and greater distance. Price, \$3.



DE FOREST F-5 AW
A compact, powerful set in polished walnut that will bring joy to many a household. Gives rich volume, and has the capacity to separate stations positively so that you can pick the broadcast gems without interference. Extremely easy to operate. Price (minus tubes, loud speaker and batteries) \$90.



DE FOREST F-5 M
A superb 5-tube set in two color mahogany cabinet with built-in loud speaker and concealed compartments for "A" and "B" batteries. A great distance-getter, with uncanny power to tune in and out stations at will, and gifted with splendid tonal qualities. Extremely simple to operate. No howling or hissing in tuning in. An unsurpassed value at \$110.

De Forest Radio Sets can be bought at prices ranging from \$85 to \$450.

De Forest Genius now Humanizes Radio!

MARVELOUS new circuit, just perfected, reproduces flawlessly the mellow, soft modulations of the human voice and captures the hitherto elusive overtones of the musical register . . . tuning simplified . . . a new ease in operation . . . all embodied in the new and beautiful De Forest W5 or W6 Radiophones.

The voice of radio is no longer flinty and metallic, but mellow, human and musical—thanks to the development by Roy A. Weagant, Vice-President and Chief Engineer of the De Forest Radio Company, of a new and marvelous circuit.

This ingenious circuit, and all the joy it means to radio lovers, makes its first public appearance in the De Forest W5 and W6 Radiophones, masterpieces of cabinet art worthy only of a scientific development so outstanding.

So wonderful is the reproduction of tone in the De Forest W5 or W6 that only the presence of the lovely instrument dispels the illusion that the living artist is in the room.

Piano chords come to you with their full rich resonance—true piano tone. High notes

dance, ripple and sparkle . . . clearly, distinctly . . . *musically!* Those brooding low notes, never caught in average reception, are heard distinctly—as though from the next room.

In the reproduction of orchestral music the full importance of the De Forest achievement stands out. For the first time you get the overtones as well as the middle tones . . . the majestic roll of the kettle drums, the crooning of the bass viols, the strident crash of the brasses and the piping heraldry of the cornets and trombones. A symphony orchestra heard over the De Forest W5 or W6 stirs the soul. No incoherence, no oscillating jumble of noise—every instrument, every octave, in its true value. *A magic achievement!*

To the lover of dance music the De Forest W5 or W6 brings more sprightliness, more beauties of syncopation . . . you should hear Vincent Lopez, Joseph Knecht, The Night Hawks, or any others over either of these instruments!

All the tenderness of song, every shading of the soprano's voice, all the pathos of the folk song—exquisite but elusive elements so much desired but lost in practically all present-day reception, are captured by these De Forest masterpieces.

To everything that is broadcast, the De Forest Radiophone gives animation, life and humanness.

But Tonal Supremacy is Not All—

Elbert McGran Jackson, renowned sculptor, architect and painter, put into this hand-wrought, hand-carved cabinet the spirit of radio, in design, in motif—it is not an adaptation of a phonograph. An image of charming individuality, it harmonizes with the setting of any home.

One unit, everything self-contained—not a wire in sight, nothing to connect . . . and *portable*; move it any place! Only charm and beauty for the eye.

The artistic conical reproducer is an inseparable part of the cabinet and its tonal mechanism peerlessly attuned to that of the Weagant circuit. There are just two controls for tuning, and these operate on one dial, which makes the normally perplexing task of "tuning in" extremely simple. There are special power tubes in the fifth and sixth sockets which can give you volume to flood an auditorium, if you desire it. And, at your fingers' tips, the means to tune in a far-distant station you want no matter how powerful nearby stations may be.

See the incomparable De Forest W5 and W6 at your De Forest dealer's or write for an interesting booklet describing these masterpieces in detail.

DE FOREST RADIO CO., Jersey City, N. J.

DE FOREST

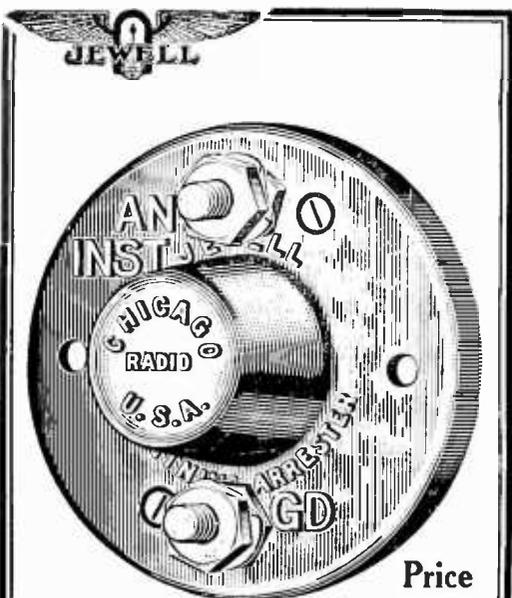
The Greatest Name in Radio



DEALERS IN ALL CITIES AND RADIO COMMUNITIES
THE EPOCH-MAKING ACHIEVEMENT WHICH MAKES ORDINARY RADIO RECEPTION A THING OF YESTERDAY

★ Tested and approved by RADIO BROADCAST ★

www.americanradiohistory.com



Price \$1.10

BE SAFE—

—the Fire Underwriters Radio Code calls for the installation of a lightning arrester wherever an outside antenna is used.

The Jewell Arrester—

—has been approved by the Underwriters (see their Certificate No. E-5403) for both indoor and outdoor installations. It is mounted in an attractive brown porcelain case and is easily installed.

Radio Instruments—

ask your dealer for a Jewell 15-B Radio Catalog—or write to us.



Jewell Electrical Instrument Company

1650 Walnut St., Chicago, Ill.

Making Good Instruments for 26 Years

THE GRID

A Department Devoted to Solving the Problems of our Readers

QUERIES ANSWERED

1. WHAT IS THE PROPER METHOD FOR PLACEMENT OF COILS IN A TUNED RADIO-FREQUENCY AMPLIFIER?—F. H. J.—Houston, Texas.
2. WHAT ARE THE PRECAUTIONS THAT SHOULD BE OBSERVED IN ERECTING AN ANTENNA NEAR POWER LINES? C. A. C.—Buffalo, New York.

3. WILL YOU DESCRIBE A METHOD OF MEASURING THE RESISTANCE OF COIL UNITS TUNED TO PREARRANGED FREQUENCIES?—B. H. R.—Utica, New York.
4. WHEN I REPLACE THE 3-VOLT TUBES IN MY SET WITH 5-VOLT TUBES, THE SET OSCILLATES. WHY? T. M. B.—Boston, Massachusetts.

COIL PLACEMENT IN AN R. F. AMPLIFIER

IN A receiver employing one or more stages of radio-frequency amplification, satisfactory results depend largely upon whether or not these amplifiers are properly neutralized. Now, neutralization depends upon several things. The internal capacity of the amplifier tube must be balanced; the wiring to the tube must be such that no coupling effects are obtained; and the

right angle coupling between the coil units be employed. See Fig. 2.

It is most important that, in the construction of a radio-frequency amplifier, or a receiver containing one or more stages of radio frequency amplification, the tube sockets be so placed that the grid leads are as short as possible.

PRECAUTIONS IN ANTENNA ERECTION

THE other day a serious accident occurred in Waltham, Massachusetts, caused by a young man drawing an antenna wire across an electric power line. The fact that the line was insulated did not matter as his antenna wire soon cut through the insulation, and thus the current was communicated to his body. The problem of antenna installation has caused carelessness on the part of a great many fans throughout the country, and it has been the cause of many fatalities. The following general "Don'ts" relating to antenna erection are given in a paper by Mr. Clarence V. Purcell, of the Boston Edison Company, for the benefit of those who would profit by the example of others who have been unfortunate enough to become involved in some needless mishap:

Don't run an antenna over or under any other wires carrying an electric current of any sort,

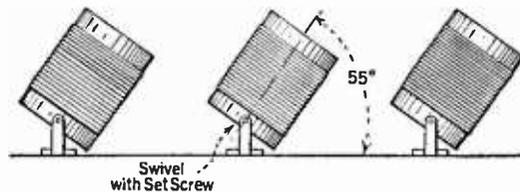


FIG. 1

several radio-frequency transformers should be so placed and located that there is no electromagnetic coupling between them. It is this last point which we will discuss here.

Most of us have had an opportunity to view the inside of a neutrodyne and to observe the peculiar angle at which the coil units are turned. At such a setting there is a minimum of coup-

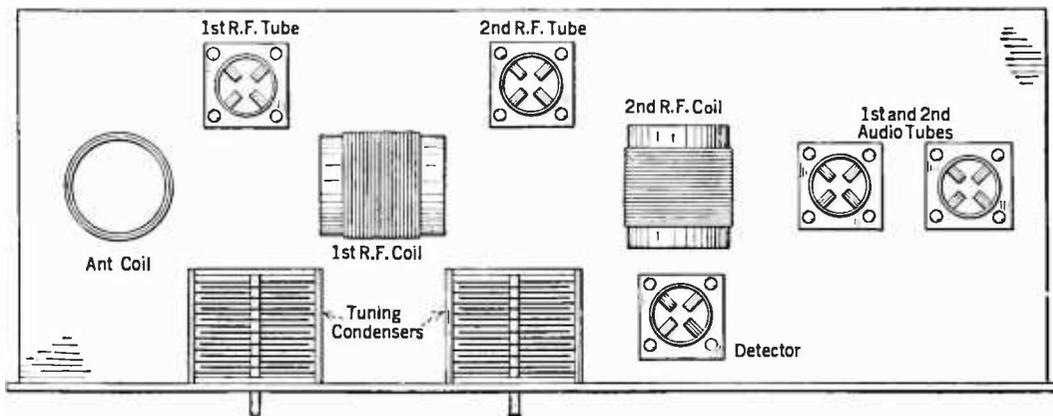


FIG. 2

ling between the coils. This placement can be approximated by the home experimenter in his own construction. Individual test must be made to determine the point at which satisfactory neutralization is obtained in the regular manner.

As an aid in obtaining the desired results, it is suggested that in the construction of a receiver the coil units be only temporarily fastened to permit ready change and variation in the angle at which they are to be set. See Fig. 1. If it is not possible to approximate this angle, which is about 55 degrees from the horizontal, or if there is plenty of space in which to construct the amplifier, then it is suggested that a

whether these wires be high tension wires, service wires, or telephone lines.

Don't attach an antenna to any pole or tower to which other wires are attached, or climb or attempt to climb such poles or towers for any purpose.

Don't run an antenna over or across any public highway.

Don't attach an antenna to any electric light, telephone or telegraph pole, even though no other wires are attached thereto. If using an outside antenna, always comply with the regulations governing the installation of an approved lightning arrester. Such a device is inexpensive and easily installed.



Radio Receiver

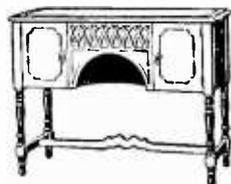


This new principle of radio is exclusive in the Valleytone

Appearance

The Valleytone is mounted in a solid walnut cabinet, finished in two tones with inlaid gold stripes. It may also be procured in beautiful console models. Special Valley tables with built-in loud speaker may be obtained for the cabinet model.

Valleytone Console Model



Valley table with built-in loudspeaker

Set the dials of a Valleytone for any station you choose. Bring in the signals strong and clear.

Then turn the dials one point beyond or back from the correct tuning. You merely diminish volume. The quality of the signals remains the same. There is no incoherent babble of noises.

Turn the dials two or three points either way from the correct tuning. Your program is gone.

Such tuning is possible only in the Valleytone. It is due to the *potential balance* method of preventing distortion and oscillation. . . a new principle for radio which is exclusive in the Valleytone 5-Tube Radio Receiving Set.

The *potential balance* gives a balanced tone to the Valleytone. The results are an amazing clearness and naturalness of reproduction. If you have never heard the Valleytone, a new experience in radio reception awaits you.

The *Valley Toroidal Coils* make possible a selectivity not previously achieved. Stations four or five meters apart can be brought in clearly and distinctly one after the other whether they are distant or local stations.

Before you buy a radio, hear the Valleytone. Judge it by results. Avoid regrets later by listening to the Valleytone now. Any authorized dealer will be glad to demonstrate the Valleytone for you.

VALLEYELECTRICCOMPANY, Radio Division, ST. LOUIS, U.S.A.

Branches in Principal Cities

★ Valleytone Receiving Sets

Valley Battery Chargers

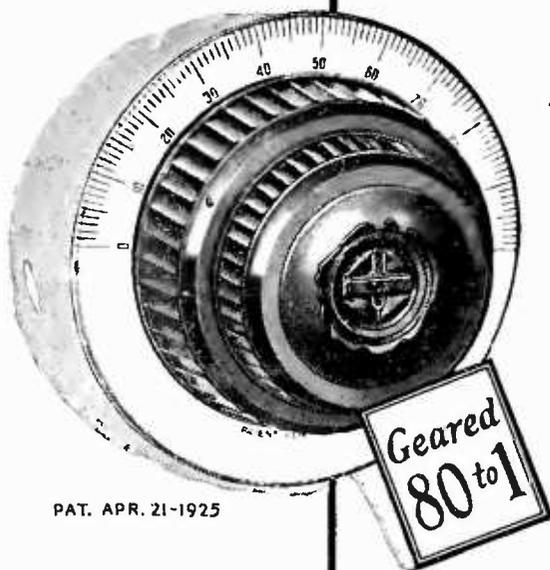
Valley B-Eliminators

Valley Electric

★ Tested and approved by RADIO BROADCAST ★

Refine Your Receiver

WITH ONE OF THESE 3 DIALS



PAT. APR. 21-1925

ACCURATUNE

REGISTERED GEARED 80:1 U.S. PAT. OFF.
MICROMETER CONTROLS

ACCURATUNE dials not only enhance immeasurably the attractive appearance of your set but they insure clear and precise reception of programs, and with even those stations now so closely grouped on the lower wave lengths easily and readily segregated. This type recommended for Neutrodyne and Radio Frequency sets.

Priced at \$3.50



PAT. PEND.

A. J. VERNIER

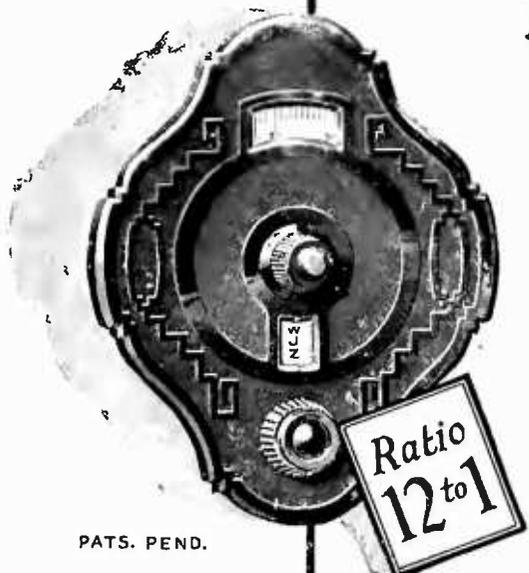
FOR use on Super-Heterodyne and Regenerative receiving sets, the A. J. offers a degree of tuning efficiency not usually associated with dials that sell at this price. Beautifully constructed of genuine Bakelite, the A. J. possesses a dignity of appearance that lends an air of richness to your receiver.

Priced at \$2.25

Recording Dial

ON this new style recording dial, ample space has been provided to jot down call letters, thus insuring a permanent record of dial settings. The dial itself is beautifully proportioned, made of genuine Bakelite with handsome embellishments on a matted background. Truly a product of master craftsmen who specialize in the manufacture of dials.

Priced at \$1.75



PAT. PEND.

MYDAR RADIO CO. ★
3 CAMPBELL ST.
NEWARK, - N. J.

Don't borrow your neighbor's antenna by attaching your lead-in to the far end of his wire. You don't know what he is doing and besides, antenna wire is cheap and serves the purpose far better.

Don't attach your antenna to a kite. Don't use your telephone line for an antenna. Connection to an electric light socket is not encouraged or recommended; light socket attachments are approved.

MEASURING THE RESISTANCE OF COIL UNITS

HERE is described a method whereby those having the proper facilities may measure the resistance of coils tuned successively to several prearranged frequencies.

With the aid of a radio oscillator, a thermogalvanometer and a resistance box, a curve, plotting resistance against frequency, may be

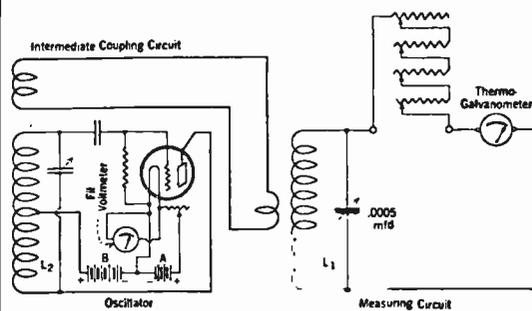


FIG. 3

made from the several readings obtained. The circuit diagram for the layout is shown in Fig. 3. To measure the resistance of a coil, the procedure is as follows, assuming that readings are to be taken at 1500 kc. (200 meters) 1200 kc. (250 meters) 1000 kc. (300 meters) and so on, for every 50 meters up the scale to 545 kc. (550 meters.)

Put the oscillator into operation setting its frequency control at 1500 kc. (200 meters). Couple the coil to be measured, L₁, to the oscillator output coil L₂. This will cause a deflection of the needle of the thermo-galvanometer. Now by varying the coupling between L₁ and L₂, the galvanometer reading may be varied to one of the numbered markings of the meter scale such as 20-40-60-70-80, etc.

Since the next step requires the addition of resistance to the measured circuit, until the reading of the meter drops to one-quarter of its original value, it is well to vary the coupling to a point where this division will be simple. At an original reading of 60 or 80, it is quite easy to add resistance to the circuit until the reading falls to 15 or 20. Resistance is added to the circuit by means of the controls on the resistance box which, until this time, had been set at zero. When the one quarter reading is obtained, reference is made to the resistance box and the resistance noted. This constitutes the resistance of the coil and the meter at that particular frequency. Usually the resistance of the meter is known and its value may be deducted from the reading obtained.

This whole system is repeated for each frequency point to be measured.

TUBES AND R.F. COILS: HOW THEY SHOULD BE MATCHED IN A RECEIVER

TO OBTAIN maximum efficiency in a receiver using radio frequency amplification, it is necessary to have transformers designed for the type of tube used in the set. This statement has been amply justified as the result of exhaustive tests made by independent engineers who were interested in the problem.

If a receiver is using the C-299 or UV-199 type of dry cell tubes, with proper transformers, and is changed over to the C-301-A or UV-201-A

DISTANCE

THE OBEDIENT SLAVE TO YOUR DESIRES



Upon request, we will gladly mail descriptive folder

APEX mastery over the most advanced radio engineering principles makes distance the obedient slave of your desires and places at your instant command the whole continent of radio enjoyment.

The infinite care and skill employed in perfecting the mechanical construction of APEX Radio Apparatus is radiantly reflected in the rich beauty of design, harmony of proportion and elegance of finish that stamp all APEX sets with an unmistakable mark of master craftsmanship.

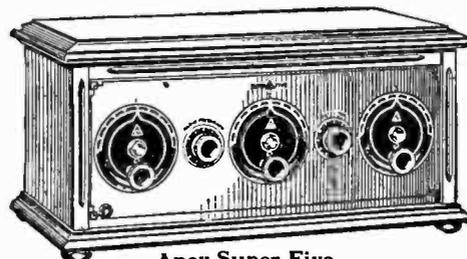
You are cordially invited to inspect this complete showing of Quality Radio Apparatus. Only a dependable merchant is given the APEX dealer franchise. Your APEX dealer will gladly make a personal demonstration of APEX Quality Radio Apparatus.

APEX ELECTRIC MFG. CO.
1410 W. 59th St., Dept. 1204 CHICAGO, ILL.

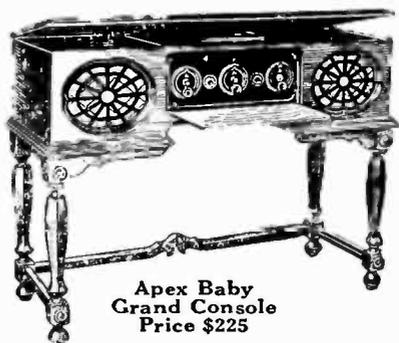
Also makers of the famous APEX Vernier Dials and APEX Rheostat Dials which are sold by every good dealer in Radio.



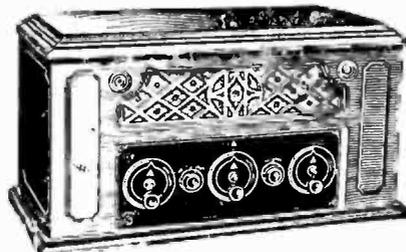
Apex Entertainer
Price \$22.50



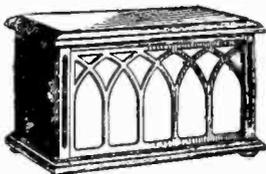
Apex Super Five
Price \$95—without accessories



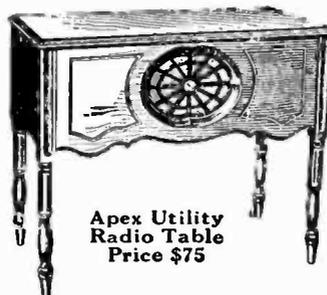
Apex Baby Grand Console
Price \$225



Apex De Luxe—Price \$135



Apex Console Entertainer
Price \$27.50



Apex Utility Radio Table
Price \$75

Prices West of Rockies Slightly Higher

Canadian Prices Approximately 40% Higher

Helps to Land Everything You Catch

The "Electrad" Lead-in meets that high quality standard set by all "Electrad's" products. There is a difference.

The convenient lead-in. Now you need not scar or mar your walls or sash with unsightly holes or ugly porcelain tubes. This flat, highly insulated and water-proofed lead-in fits under locked windows and doors. The windows may be closed tightly—there need be no loss of heat in the room. Pliable, it bends into any shape—meeting your every need. Price 40c.



Other Guaranteed Electrad Radio Products

which simplify construction, facilitate installation and improve reception of radio sets—Vari-ohms, Lamp Socket Antenna, Certified Grid Leaks, Resistance Coupled Amplifier Kits and many others. At your dealer's, if he can't supply, write us.

ELECTRAD, Inc.

428 Broadway New York City



"ELECTRAD" AUDIOHM

A necessary tone and quality controlling device. Placed across secondary of first audio transformer it eliminates distortion and transformer noises. Requires no drilling, soldering or tools to attach. Fits any transformer. \$1.50 each.

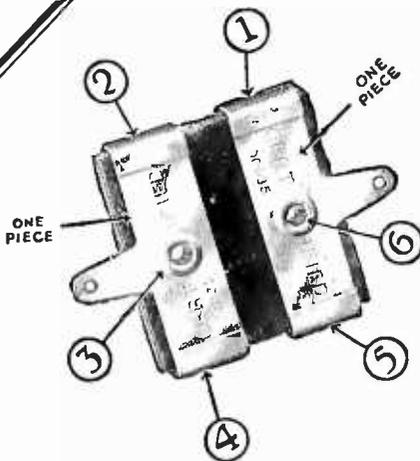


"ELECTRAD" LIGHTNING ARRESTER

Price 50c. Indoor type. Approved by Underwriters. Should fire occur from lightning you will have insurance difficulties unless you have an approved arrester.



ELECTRAD



The Six Point Pressure Condenser

The "Electrad" Certified Fixed Mica Condenser is a revelation in accuracy and design. Ingenious, rigid binding and firm riveting fastens parts securely at Six different points insuring positive electrical contact. Impervious to temperature and climatic variations. Exerts even pressure upon the largest possible surface—can't work loose. Binding strap and soldering lug in one piece. Accuracy and quietness assured always. Value guaranteed to remain within 10% of calibration. Standard capacities, 3 types. Licensed under Pat. No. 1,181,623 May 2, 1916 and applications pending. Price 30c to 75c in sealed dust and moisture proof packages.

type of tubes, it will be necessary to change the radio-frequency transformers also, if equally efficient results are to be obtained.

This is made necessary by the fact that the characteristics of the tubes vary according to their internal construction. In the UV-199 tube, the elements are very close together, making it possible and advantageous to use more wire on the primary of the transformer. The tendency for a vacuum tube having a tuned input circuit to oscillate, is proportional to the inductive load or the number of turns on the primary of the transformer in the plate circuit.

If the tubes were replaced with the C-301-A or UV-201-A type, the circuit would become unstable and oscillate readily, due to the difference in construction of the elements of the latter type of tube. Fewer turns of wire should be used on the primary of the transformers. The curve of the transformer will fall off at one end of the scale and result in poor amplification of either the high or low waves, if the proper type of tube is not used. This is due to the capacity of the input circuit of the tube, which varies in different tubes. As this is shunted across the secondary winding, it has sufficient tuning effect on that winding to shift the area of maximum amplification from the desired band.

When the tube characteristics are matched up with the correct amount of wire on the primary of the transformer, then the circuit will cover the whole wave band evenly, with good amplification. In some types the core of the transformer is filled with finely powdered iron or iron laminations. The use of iron in the core broadens tuning so that the transformer may be used over the entire wave band, without the need of a variable condenser for tuning.

When Writing to the Grid—

A TYPEWRITTEN letter, written on one side of the paper only, is to be preferred, as it aids in the quick formation of a satisfactory reply.

Don't fail to send a stamped addressed envelope with your inquiry.

Don't send a second inquiry about the first.

Don't include questions on subscription orders or inquiries for other departments of Doubleday, Page & Company.

In asking questions give us all the information that will aid in advising you. If the question relates to apparatus described in RADIO BROADCAST, give the issue, page number, and figure number of the circuit diagram, etc.

Be explicit yet brief.

GRID INQUIRY BLANK

Editor, The Grid
RADIO BROADCAST
Garden City, New York

DEAR SIR,

Please give me the fullest information on the attached questions. I enclose a stamped envelope.

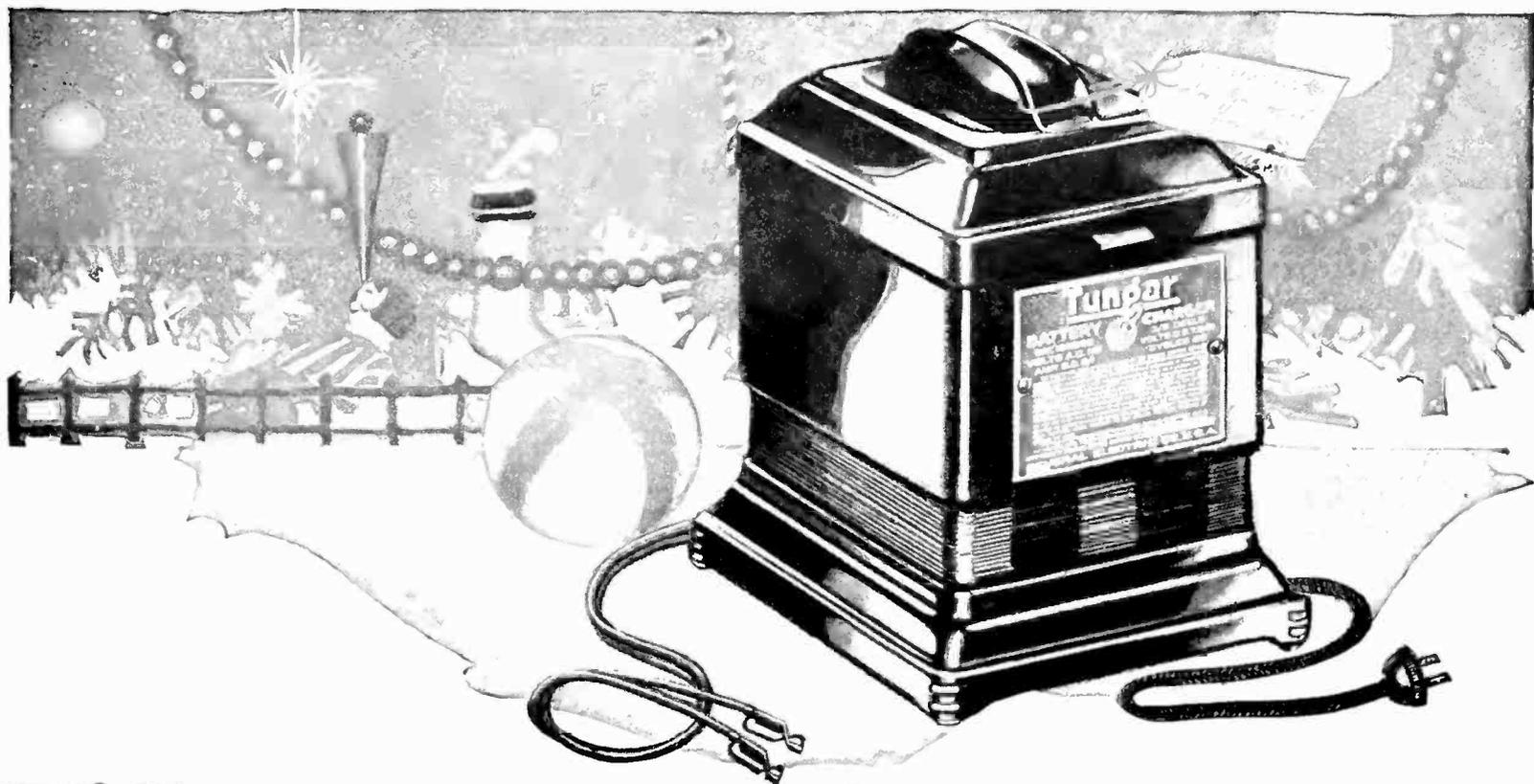
I am a subscriber to RADIO BROADCAST and therefore will receive this information free of charge.

I am not a subscriber and enclose \$1 to cover cost of answers.

NAME

ADDRESS

G. D.



What to give the radio fan

Give him a two-ampere Tungar if he has a storage battery *of any kind*. It will charge all his radio batteries and his auto battery, too.

Or, for bigger jobs, give him a five-ampere Tungar—built to do the same work but to do it more than twice as fast.

Every man who has a storage battery wants a charger. And every man who wants a charger wants the original General Electric bulb charger—the Tungar.



The Tungar is a G-E product, developed in the Research Laboratories of General Electric.

The new Tungar charges any make and size of storage battery: radio "A" and auto batteries, and "B" batteries as high as 96 volts in series.

Prices

Two ampere size . \$18.00
Five ampere size . \$28.00

60 cycles . . . 110 volts

Tungar

REG. U.S.

PAT. OFF.

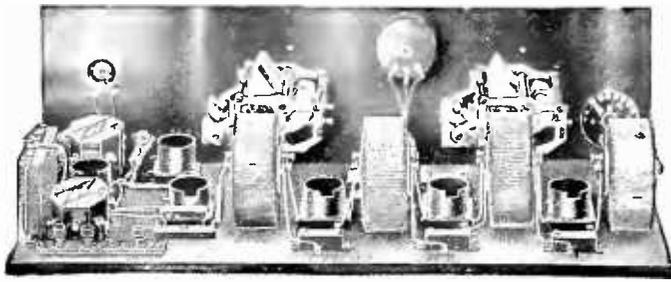
BATTERY CHARGER

Tungar—a registered trademark—is found only on the genuine. Look for it on the name plate.

Merchandise Division

General Electric Company, Bridgeport, Connecticut

GENERAL ELECTRIC



B-T "COUNTERPHASE-SIX" (Built from Kit)

New System of Instructions Simplify Building the "COUNTERPHASE"

THE B-T "Counterphase" is a combination of the best apparatus ever put in a receiver and the exclusive patented B-T method of oscillation control which gives *maximum efficiency on all wave lengths.*

You can build the "Counterphase" with one, two or three stages of R. F. or buy a complete factory built 6-tube receiver. Two tuning controls give the most simple as well as sensible tuning.

"Counterphase" kits for the home builder include a complete set of instructions with progressive circuit charts in nine colors (the same colors as wires furnished.) There's no excuse for error.

Ask your dealer, he'll tell you about B-T performance.

"The Best We Ever Tested—"

says a leading laboratory of the B-T "Euphonic" Audio Transformers.

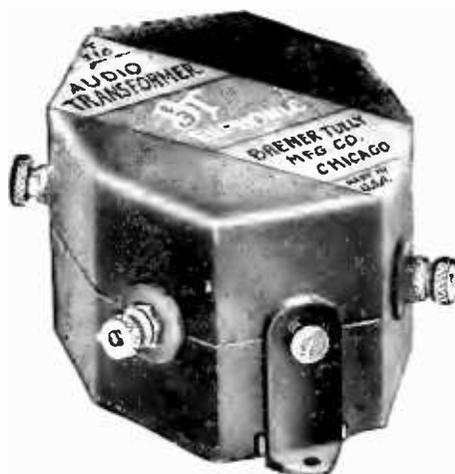
Listen to a set equipped with "Euphonics" and you'll appreciate the improvement on both high and low notes.

The B-T "Euphonic" is the only transformer designed to permit mounting in such manner that terminals may always be brought where they are needed to prevent crossed wiring, a frequent cause of howling and distortion.

Compare the tone and you'll use only "Euphonics."

Because It's Different
You Should Read
Better Tuning

before you buy a set or parts. 80 pages of facts, hook-ups, tuning hints, discussions of latest radio topics. Postpaid, 10 cents. Literature describing B-T products free on request.



RADIO: 2.2 to 1 Price \$5.00
4.7 to 1 Price \$5.75

BREMER-TULLY MFG. CO.

532 S Canal Street

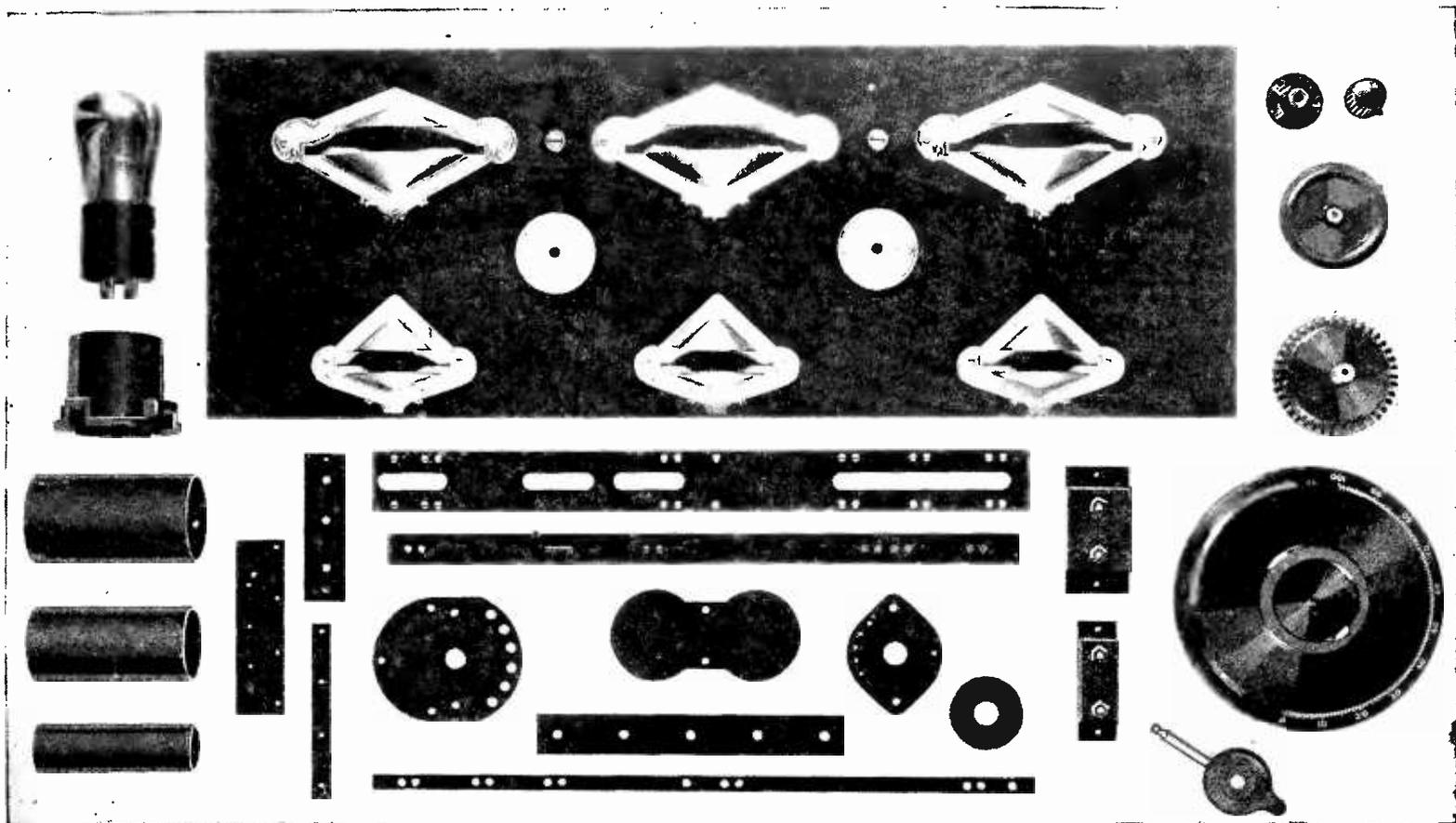
Chicago, Ill.

A KEY TO RECENT RADIO ARTICLES

By E. G. SHAULKHAUSER

THIS is the second instalment of references to articles which have appeared recently in various radio periodicals. Each separate reference should be cut out and pasted on cards for filing, or they may be pasted in a scrap book either alphabetically or numerically. A brief outline of the Dewey Decimal System (employed here) appeared in the November RADIO BROADCAST.

- R113. TRANSMISSION PHENOMENA. TRANSMISSION PHENOMENA.
Popular Radio, Sept. 1925, pp. 199-206.
"How the Air Affects Radio," E. E. Free.
In a simple non-technical way the author tells us how the two theories of wave propagation, the Heaviside Layer theory and the Gliding Wave theory, may affect radio transmission. Probably both theories are correct. Apparently the ions and free electrons in the air account for fading, bending, and absorption. Sir Joseph Larmor, on October 27, 1924, stated that he believes most of the phenomena pertaining to wave reflection occurs about fifty miles above the earth's surface. How free electrons may affect radio energy distribution is explained in greater detail.
- R113. TRANSMISSION PHENOMENA. ABSORPTION.
Popular Radio, Sept. 1925, pp. 207-211.
"How Radio Dead-Spots are Found by a Wandering Broadcasting Station," J. O. Perrine.
The distribution of radio wave energy about a broadcasting station located in a city, has been determined with the aid of a mobile receiving set. Energy received is compared with that given out by a local oscillator, and field strength is recorded in microvolts per meter. The area about the Washington, District of Columbia station, WCAP, within a radius of 50 miles, is shown in diagram with contour lines. These tests have given very valuable and interesting results, showing effect of ground condition, buildings, hills, and various conducting materials found in the earth, on the direction and intensity of the wave.
- R080. COLLECTIONS, TABLES, MISCELLANIES. TABLES
Popular Radio, Sept. 1925, pp. 221-226.
"Useful Charts for Amateurs," Lieut. C. C. Todd, jr.
Simple and valuable information to guide the constructor in designing coils and determining proper size condensers to cover certain wavebands, is contained in this article. Eight charts show the relation between capacity, inductance, wavelength, and coil turns, to cover both short and long wavelengths. The information is very well presented and the diagrams are clear.
- R800 (530) PHYSICS. ATOMS
Popular Radio, Sept. 1925, pp. 232-236.
"The Atom," Sir William Bragg.
Article No. 2 deals with the nature of gases. The arrangement of the electrons in various atoms, their number, and how the various combinations account for the different elements, is described. Models illustrate the facts outlined in a very simple way. The author relates the theory of the electrons and atoms and the part they play in our present day research, in simple language.
- R360. RECEIVING SETS. FREED-EISEMANN.
Popular Radio, Sept. 1925, pp. 244-254.
"How to Get the Most out of Your Ready-Made Receiver," S. G. Taylor.
The new Freed-Eisemann five tube receiver, NR20, is discussed, illustrated, and described in great detail. A description of the theory, operation, and equipment, with plenty of photographs and diagrams, give the set owner all the desired information. The B battery life for this set, using various sizes of B batteries, is shown in a table.
- R304.1 WAVEMETERS. WAVEMETERS.
Popular Radio, Sept. 1925, pp. 267-271.
"An Oscillating Wavemeter," S. G. Taylor.
A description of an oscillating wavemeter, using a vacuum tube in a simple oscillating circuit, is given. Parts required, and size of coils to use in order to cover frequencies from 9091 kc. (33 meters) to 498 kc. (602 meters), are listed. The instrument is valuable in measuring capacities and inductances. The circuit diagram shown is the modified Hartley.
- R343. ELECTRON TUBE RECEIVING SETS. RECEIVER, RX-1.
Radio Engineering, Sept. 1925, pp. 433-441.
"How to Build the RX-1."
This receiver is one especially developed in the Darien Laboratory. It is a non-regenerative four-tube set known as the RX-1 receiver. The receiver was designed to give easy control, good quality, and precise tuning, together with plenty of volume. Diagrams and data are ample to permit the constructor to build this receiver. The best parts available are listed, the cost of these being only about \$32.
- R720. PROCESSES. MOULING BAKELITE.
Radio Engineering, Sept. 1925, pp. 455-458.
"Why Not Do Your Own Moulding."
The article describes the equipment necessary for moulding bakelite parts on a rather small scale. The process is not difficult and the equipment can be installed in small establishments without excessive cost. The method used in making molded parts is described in detail. Photographs of the machinery are shown.
- R384.1. WAVEMETERS. LECHER WIRES.
QST, Sept. 1925, pp. 11-12.
"Practical Lecher Wires," E. C. Woodruff.
Description and arrangement of Lecher wires with constants of construction are given in detail, showing diagram. In making measurements of waves the wires are connected to a vacuum tube circuit as shown in Fig. 1, and a millimeter in the plate circuit indicates resonance. A calibration chart and graph show the method of using these parallel wires.



Imagine a Radio Set stripped of these parts

What a useless collection of wood, wire and metal it would be. Realizing that the parts and accessories shown here are wholly or partly of Bakelite, gives you a vivid picture of its importance to Radio.

To-day Bakelite is used in a greater variety of radio parts than ever before—and the number grows constantly. This dominance of Bakelite in radio

reflects the experience and the opinions of radio manufacturers, great and small.

Radio set and parts manufacturers have every facility for testing all insulation materials and over 95% have standardized on Bakelite. This indicates how really important it is for you to make sure that the set or parts that you buy are Bakelite insulated.

Write for Booklet 29

BAKELITE CORPORATION

247 Park Avenue, New York, N. Y.
Chicago Office: 636 West 22d Street



Bakelite is an exclusive trade mark and can be used only on products made from materials manufactured by the Bakelite Corporation. It is the only material which may bear this famous mark of excellence.

BAKELITE


BAKELITE
is the registered trade mark for the phenol resin product manufactured under patents owned by the Bakelite Corporation.

THE MATERIAL OF A THOUSAND USES

★ Tested and approved by RADIO BROADCAST ★

www.americanradiohistory.com



Merry Christmas
for Everybody

A BRISTOL Loud Speaker will bring everlasting Christmas joy to the whole family.

It has all the volume you will ever wish, but its fine point,—its outstanding claim for distinction, is its tone, a true, clear, natural reception of voice or instrumental music. This is because it is a true musical instrument not merely a phone unit in a horn.

Bristol Loud Speakers have highly developed electromagnetic tone mechanisms, and non-metallic horns with long, freely vibrating sound chambers.

The super S and super C models are equipped with the Super-Unit which contains a specially designed diaphragm of broad pitch range. It reproduces not only the low pitched notes but the high as well.

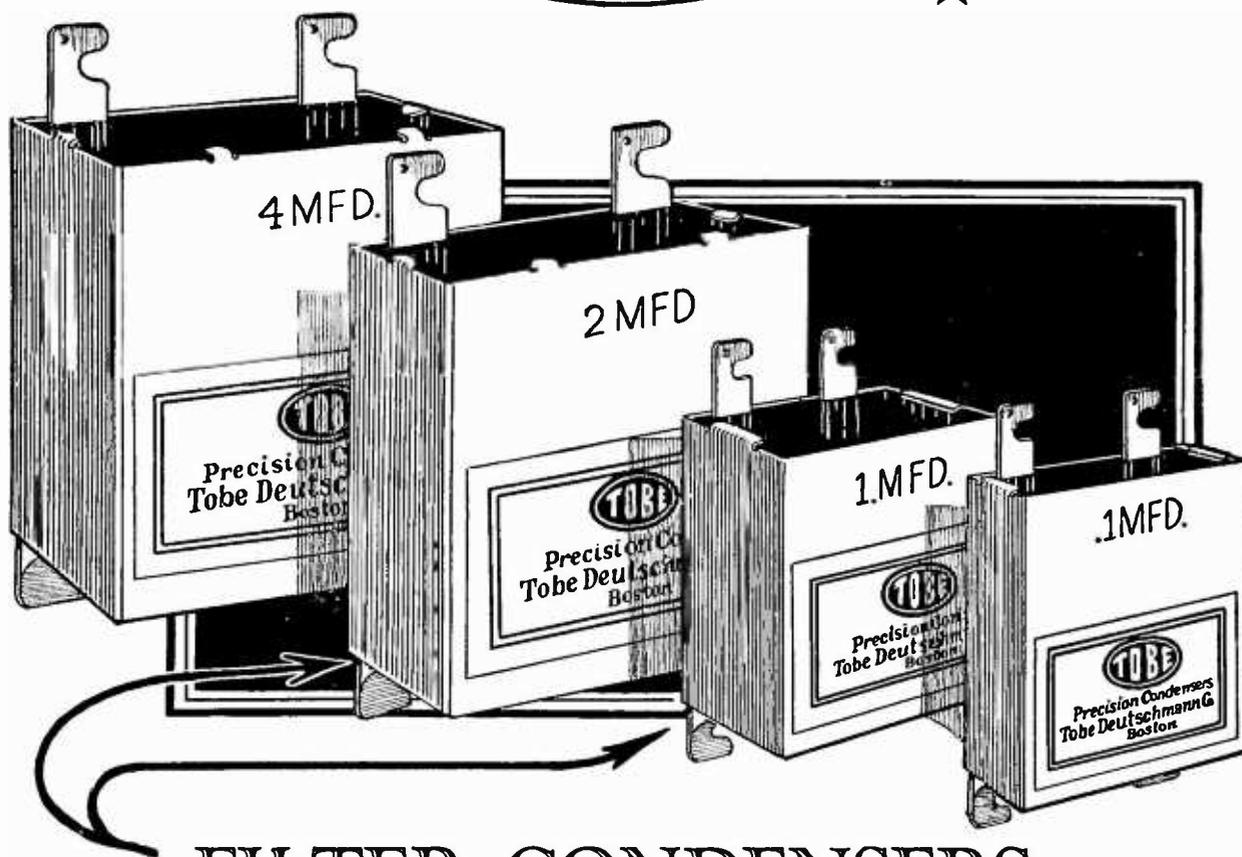
There are four Bristol Speakers, horn or cabinet type, priced at \$15.00 to \$30.00. If not at your dealer's, send for our new booklet. "How to select your loud speaker."

THE BRISTOL COMPANY, Radio Div. WATERBURY, CONN.
AH.

For 36 Years Makers of highly accurate and sensitive Bristol Recording Instruments. ★

BRISTOL MADE IN U.S.A. AUDIOPHONE Loud Speaker

- Ro84. TABLES.** CHARTS.
QST. Sept. 1925, pp. 16-17. *Ind. & w. I.*
"Designing the Secondary Coil," G. H. Burchill.
Using double cotton covered wire, the inductance and wavelength of cylindrical coils, closely wound, can readily be determined with the aid of the chart in the form of a graph. A simple description of coil design and method of procedure is given.
- R800 (535.3). PHOTOELECTRIC SELENIUM CELLS.** PHENOMENA
Radio Engineering. Sept. 1925, pp. 442-443.
"Selenium and Photoelectric Cells," S. Wein.
The third chapter on selenium cells gives the construction of different types of cells by various scientists: Tainter, Bell, Mercadier, Townsend, and Cherry. References are listed.
- R356. TRANSFORMERS.** TRANSFORMERS.
QST. Sept. 1925, pp. 21-24.
"Transformers and Reactors in Radio Sets," R. H. Chadwick.
In the first article on transformers and reactors, the author takes up the general theory, regulation, and efficiency, and describes the construction and operating principles of various types of commercial transformers. The leakage reactance is a governing factor in proper transformer design. Useful information for users of these instruments.
- R342.15. AMPLIFIER TRANSFORMER.** AMPLIFYING TRANSFORMERS.
QST. Sept. 1925, pp. 27-29.
"High Ratio and High Amplification," R. S. Kruse.
Some misunderstood principles about audio and radio-frequency transformers are cleared up by the author. Stage to stage amplification depends on the regeneration as well as the transformation ratio and the tube constants. When the transformer is largest, both regeneration and amplification are strongest. A 2:1 transformer may give much better amplification than a 6:1, depending upon design. Diagrams illustrate the points under consideration.
- R402. SHORT WAVE TRANSMITTERS.** SHORT WAVE TRANSMITTER.
QST. Sept. 1925, pp. 30-32.
"A Power-Amplifier Transmitter for the Low Waves," W. H. Hoffman.
The circuit arrangement in a Colpitts oscillator, using an added power amplifier, is described. The transmitter operates well on very short wavelengths. It transmits a very steady frequency and with the apparatus recommended, has a tuning range from 14990-3894 kc. (20-77 meters). Since the set uses UV-202 tubes it can be operated on storage or dry batteries, and used as an emergency layout. Operating adjustments and list of parts required, including circuit diagram, give complete construction data.
- R113.4. IONIZATION: HEAVISIDE LAYER.** HEAVISIDE LAYER THEORY.
QST. Sept. 1925, pp. 33-34.
"Is There a Heaviside Layer?" G. W. Pickard.
A brief discussion concerning some of the transmission phenomena, with particular reference to various theories on reflection and refraction, is contained in a letter to *QST* by the writer.
- R512. RADIO BEACONS.** LIGHTHOUSE.
RADIO BROADCAST. Oct. 1925, pp. 719-724.
"And Now—The Radio Lighthouse," J. C. Young.
Radio service to ships at sea has become absolutely necessary. Radio signals help guide ships when near the coast and give bearings when needed. What advances have been made in guarding against danger, what pleasure and enjoyment has been derived through the use of radio to those sailing the waters, is well pictured in this article.
- R140. RADIO CIRCUITS.** ROBERTS RADIO BROADCAST. CIRCUIT.
RADIO BROADCAST. Oct. 1925, pp. 725-731.
"New Developments and Experiments with Receiving Circuits," K. Henney.
The Roberts Knockout receiver offers possibilities for development along many lines. In this article some of the experiments carried on at the RADIO BROADCAST Laboratory with this circuit, are discussed. How a fifth tube may be added, how the reflex stage may be eliminated, how the circuit is neutralized, how regeneration may be employed in either detector or amplifier, are changes that may be tried with success.
- Ro07. 2. U. S. RADIO INSPECTION SERVICE.** RADIO RADIO BROADCAST. CONDITIONS.
RADIO BROADCAST. Oct. 1925, pp. 743-744.
"Guiding the Good Ship Radio," D. K. Tripp.
An interview with W. D. Terrell, Chief Supervisor of Radio, concerning radio conditions in the U. S. at present, reveals his views about the department's attitude toward the amateur, the broadcaster, and the service both can render toward bettering conditions in radio.
- R132. AMPLIFYING ACTION.** AMPLIFYING RADIO BROADCAST. PRINCIPLES.
RADIO BROADCAST. Oct. 1925, pp. 745-750.
"Some Remarks on Audio Amplification," G. C. Crom, Jr.
Good radio reception depends upon proper amplifier design. The functions of each part in the amplifier circuit are discussed in detail. Good parts must be used for best reproduction. Distortion may be produced by any one of four things as stated. High plate voltages are recommended and are of advantage when proper C battery voltages and by-pass condensers are inserted, as shown in Fig. 2.
- R373. 2. MICROPHONES.** MICROPHONE PLACING.
RADIO BROADCAST. Oct. 1925, pp. 769-770.
"More About How to Place the Microphone."
Methods of placing microphones for picking up band and orchestra music in and out of the station studio, are shown. In particular, the placing of several microphones at the Lewisohn Stadium in New York City and on the campus of New York University, in order to broadcast music from large organizations, is of interest.
- R375.3 ELECTROLYTIC RECTIFIERS.** RECTIFIERS, RADIO BROADCAST. CHEMICAL.
RADIO BROADCAST. Oct. 1925, pp. 774-780.
"Notes On Chemical Plate Supply Units," J. Millen.
The chemical rectifier here described, employs two or more jars in order to handle output voltages up to 150 volts and enough current for the receiver, at the same time giving absolutely no line hum in the output circuit. The discussion covers all phases of construction and operation in a very thorough manner. List of parts and diagrams of circuits and complete unit are added.



FILTER CONDENSERS

*recommended for Raytheon Plate
current circuits*

RADIO BROADCAST'S article in this issue on "An Improved Plate Current Supply Unit" shows that the following TOBE condensers can be used in building the set: 5 type 708 and 7 type 709.

.1 M.F.D.	Type 705	Price \$.70
1. M.F.D.	Type 708	Price 1.25
2. M.F.D.	Type 709	Price 1.75
4. M.F.D.	Type 711	Price 3.75

Any 'B' battery eliminator circuit depends very largely for its operating efficiency upon the filter condensers used. TOBE condensers alone possess all of the following favorable characteristics:

Will operate at voltages up to 700 D. C. without breakdown or overheating.

High megohm resistance—indicating perfect insulation. Capacities guaranteed to be within 5% of accuracy.

Extreme heat or cold has no effect on TOBE condensers. Compact and handsome in appearance.

Tobe condensers are better condensers—distinguishable by their silvered finished case. Ask your dealer for them by name "TOBE."

Tobe Deutschmann Company
CORNHILL BOSTON, MASS.

NOW you can buy Matched Tubes

and be certain your reception will be
clear, smooth, loud and uniform



Sylfan

Blue Specials

cost a trifle more and are worth it. Try them, and you'll never again bother to try to match tubes yourself. 501-A is for storage batteries, and is packed singly and in kits of three and five *matched tubes*. 499 is for dry cells, with peanut base and is packed singly and in kits of four and six *matched tubes*.

Price \$2.75 each

Buy them by the box
for best reception.



Sylfan



Matched Blue Tubes

(Peanut or Standard Types)

mark a new step in Radio. They are what every radio "bug" has been looking for and wondering when and where they could get them.

It is most important to good radio reception that your tubes are matched—and pull in harmony. Equal pull in the tubes means smoothness of reception—sweetness of sound—full throated volume—resonant clarity.

Sylfan BLUE SPECIALS are *matched tubes*. After careful selection by actual test the individual characteristics are plainly indicated and they are packed in kits of three and five *matched tubes*—ready for immediate use. Made for storage batteries only.

This process of selection enables us also to discard all inferior tubes and retain only the first grade.

Sylfan BLUE SPECIALS give wonderful results. Try them. Find out for yourself what a big advantage it is to have *matched tubes*. Remember they are *unconditionally guaranteed*.

See the Sylfan line Booth No. 34
Chicago Radio Exposition

Manufactured and Marketed Exclusively Thru Jobbers by

BAKER-SMITH CO., Inc.

New Call Building, San Francisco

Branch Office Addresses

Portland, Ore., Henry Bldg.	New York City, 1270 Broadway
Salt Lake City, Atlas Bldg.	Chicago, 30 N. Dearborn St.
Seattle, L. C. Smith Bldg.	Denver, McClintock Bldg.
Los Angeles, 443 South San Pedro Street	
Vancouver, B. C., 179 Pender Street, West	

R550. BROADCASTING. SUPER-POWER RADIO BROADCAST. Oct. 1925, pp. 761-768. STATIONS. "A Debate: Resolved, That 500-watt Stations Are Not Sufficient for Program Service." Affirmative: Mr. Dreher. Negative: Prof. Williams. The pros and cons of so-called super-power stations, is given in two articles. Much information is contained in both, especially in regard to power and noise level.

R113.1. FADING. SIGNALS. *Radio News*. Sept. 1925, pp. 278ff. "Concerning the Nature of Fading," J. H. Dellinger. The problem of fading has become more serious than the problem of static, primarily because so much fading occurs on the high frequencies (1500 kc. and up) where much research is being done at present. The Bureau of Standards has undertaken a series of tests to determine the cause of fading. It is probably due to the shifting of the upper atmospheric conducting surface.

R582. TRANSMISSION OF PHOTOGRAPHS. PHOTOGRAPH TRANSMISSION. *Radio News*. Sept. 1925, pp. 278ff. "See With Your Radio," W. B. Arvin. The Jenkins-Moore system of television is described. A photoelectric cell converts the black and white of a picture into electric currents while a lighting device, the Moore lamp, picks up these currents and changes them back to light and shadow on the screen. The breaking up of the picture for transmission is done with the prismatic disc, a very simple method. Synchronization is accomplished with synchronous motors at both ends. This system is said to be the best one developed to-day, and was demonstrated at Washington last June.

R323. GROUND AND UNDERGROUND ANTENNAE. UNDERGROUND ANTENNAE. *Radio News*. Sept. 1925, pp. 301ff. "Underground Radio," W. H. M. Watson. Experiments with underground antennas with frequencies of from 5996 kc. (50 meters) to 1666 kc. (180 meters) are described in detail, with varying results. Good transmission distance is possible with low power input after proper adjustments are made and antenna placed properly. The antenna is very directional.—An article on underground and under-water antennas, is reprinted from Dec. 1919, *Radio News* showing what was accomplished along this line several years ago.

R381. CONDENSERS. CONDENSERS, S. L. F. *Radio News*. Sept. 1925, pp. 308ff. "More About Straight Line Frequency Condensers," S. Harris. A general discussion concerning condensers, in particular the straight line frequency condensers, is presented to clear up certain points. The question of low minimum capacity for definite sized condensers, of condenser resistance when plates are nearly all the way out, and of tuning with straight line frequency condensers, is considered.

R140. RADIO CIRCUITS. REGENERATIVE CIRCUITS. *Radio News*. Sept. 1925, pp. 310ff. "Single-Tube Circuits," L. W. Hatry. The author reviews regenerative circuits, inductive and capacitive, using one tube. All other circuits are merely combinations of these simple circuits. A good understanding of these, makes the "dynes" and "plexes" comparatively simple. The Reinartz, the ultra-audio, the Cockaday, and others, receive considerable attention in this discussion.

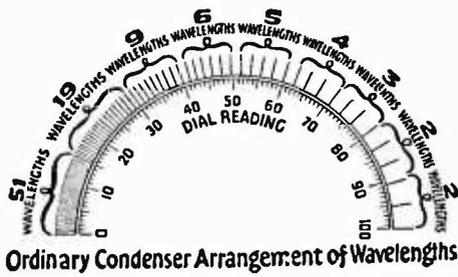
R430. INTERFERENCE ELIMINATION. INTERFERENCE REDUCTION. *Radio News*. Sept. 1925, pp. 290ff. "Directional Reception Reduces Interference," P. C. Hoernel. A method of reducing interference is here described, utilizing loops for directional reception. The system is developed by Mr. Friis of the Bell Telephone Company. In order to neutralize or reinforce the voltages obtained from the two loops, the latter are mounted on a long turntable at some distance apart (depending on wavelength). Fig. 3 shows the general form of the directional characteristics, and Fig. 1 the circuit used. Several photographs give an idea of the general layout. The tuning is simple and the results obtained were very good. Amateurs and experimenters can amplify along these lines.

R375. DETECTORS AND RECTIFIERS. RECTIFIER TUBE. *Radio News*. Sept. 1925, pp. 293ff. "A New Neon-Filled Rectifier Tube," J. Riley. The tube used as rectifier for B battery eliminators has two electrodes of aluminum, a rod and a cylinder, and contains neon gas at a pressure of six millimeters of mercury. Its action in d. c. and a. c. circuits is discussed in detail and illustrated by diagrams. Other possibilities of the neon lamp are enumerated and offer a field of research.

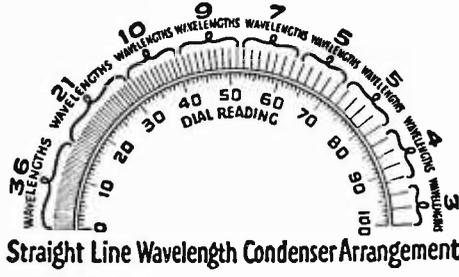
R351. SIMPLE OSCILLATORS. OSCILLATOR. *Radio Journal*. Sept. 1925, pp. 12-15. "A Laboratory Oscillator," H. W. Leighton. The author describes the construction of a laboratory oscillator and gives some of its uses. The circuit is shown in Fig. 1. Calibration of the oscillator is simple when a standard wavemeter is available. Measurements of transformers and filter for use in super-heterodynes are made according to Fig. 2, and curves plotted showing how one can determine just how to select the proper apparatus to match. Small fixed condensers can also be measured with this oscillator.

R343. ELECTRON TUBE RECEIVING SETS. RECEIVER, BROWNING-DRAKE. *Radio Journal*. Sept. 1925, pp. 14. "New Type Browning-Drake," Bill Massaggee. The constructional details of the Browning-Drake receiver are described, particular attention being called to several minor details which nevertheless are essential if the set is to operate well. A proper design of the coils used is essential. Extreme selectivity and sensitivity is claimed for the 4-tube set in comparison to other sets of similar size. (Further details in Oct. issue)

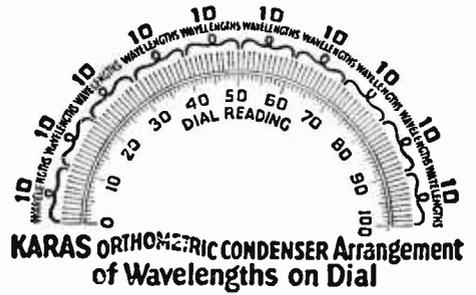
R300. RECEIVING SETS. GREBE CR. 17. *Radio Journal*. Sept. 1925, pp. 15. "The New Grebe CR-17," M. Best. Photographs and wiring diagram of the Grebe short wave receiver, including a short description of the operating principles, is given.



Ordinary straight capacity condensers crowd 70 of the 100 wavelengths into the first 30 points of the dial.



With straight-line-wavelength condensers 57 of the 100 wavelengths are crowded into the first 30 points of the dial.

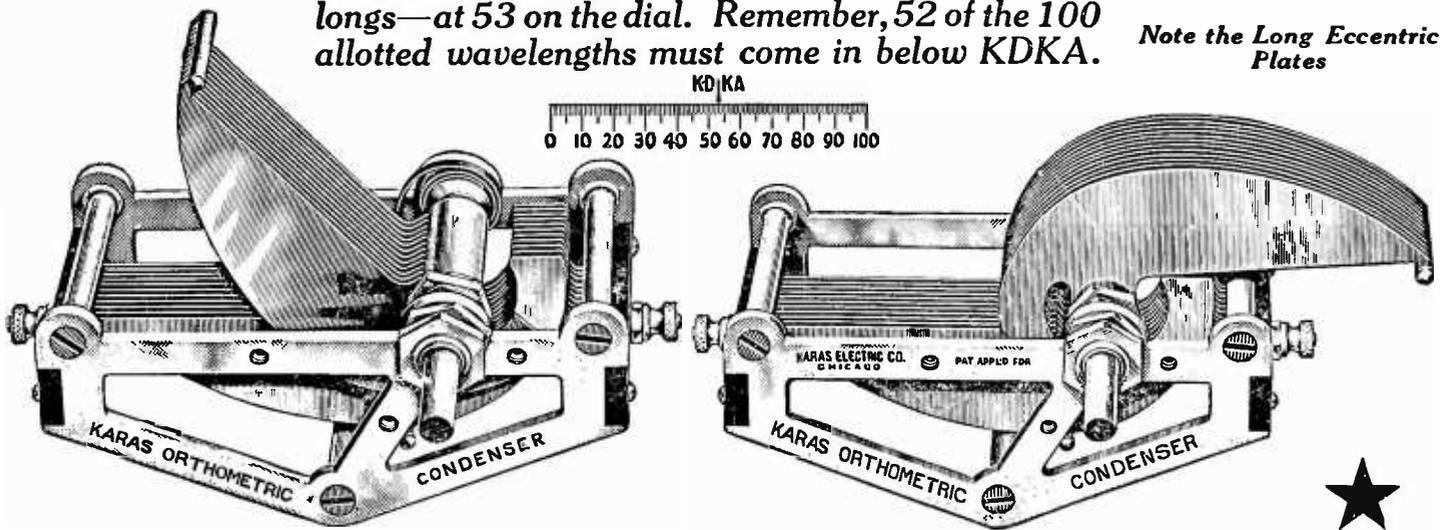


The New, Scientific Karas Orthometric Condensers insure absolutely equal separation on the dial of all wavelengths throughout the entire broadcasting range.

Tuning Marvelously Simplified with Karas Orthometric Condensers

The condenser that brings in KDKA where it belongs—at 53 on the dial. Remember, 52 of the 100 allotted wavelengths must come in below KDKA.

Note the Long Eccentric Plates



Spreads Stations Evenly Over the Dial — No Crowding Whatever

THE Karas Orthometric Condenser positively separates all adjoining wavelengths by EQUAL distances on the dial, giving you the full benefit of the 10 Kilocycle frequency separation fixed by the Government.

Ordinary condensers jam 70 of the 100 Government allotted wavelengths into the first 30 points of the dial — even straight-line-wavelength condensers crowd 57 of them below 30.

With Karas Orthometrics, each point on the dial corresponds exactly to one of the 100 allotted wavelengths. The result is marvelous simplicity in tuning — better, clearer reception — you get all the side bands without interference.

The Karas Orthometric stands absolutely alone! — an eccentric condenser, scientifically designed for present

day broadcast receiving sets—the Last Word in making REAL SELECTIVITY POSSIBLE.

The Karas Orthometric is a “job” that will delight the eye of the mechanical critic. It is made entirely of brass — frame and plates all die stamped — plates, patent leveled and solidly bridged to insure permanent rigidity and alignment. Every joint throughout is soldered. Grounded frame and rotor, with stator plates supported on hard rubber insulation. Tapered adjustable cone bearings, spring copper pigtail connection, automatic stops — in short, a condenser that is both theoretically and mechanically perfect.

If Your Dealer is Not Yet Supplied, Order on this Coupon

We are supplying Jobbers and Dealers as fast as the output of our factory permits. If your dealer is not yet supplied, order direct on the coupon. You need send no money with your order. Condensers will be delivered C.O.D., and you receive them subject to our unconditional guarantee of satisfaction. Why run the risk of delay? Order NOW!

Money Back Guarantee

Karas Orthometric Condensers are unconditionally guaranteed to give you absolute satisfaction. They may be returned for full refund any time within 30 days.

SIZES AND PRICES
 23 plate, .0005 Mfd., \$7.00
 17 plate, .00037 Mfd., 6.75
 11 plate, .00025 Mfd., 6.50

Karas Electric Co., 4042 Rockwell St., Chicago
 For Over 30 Years Makers of PRECISION Electrical Apparatus

Send No Money With this Coupon —

Karas Electric Co., 4042 N. Rockwell St., Chicago
 Please send me _____ Karas Orthometric Condensers, size _____ at \$ _____ each. I will pay the postman the list price, plus postage, on delivery. It is understood that I have the privilege of returning these condensers any time within 30 days if they do not prove entirely satisfactory, and you will refund my money at once.

Name _____

Address _____

Dealer's Name _____

If you send cash with order, we'll send condensers postpaid.

★ Tested and approved by RADIO BROADCAST ★



The ORIGINAL HI-MU TUBE

for
Resistance-Coupled
\$3.00 ~ Amplifiers

CLEARTRON

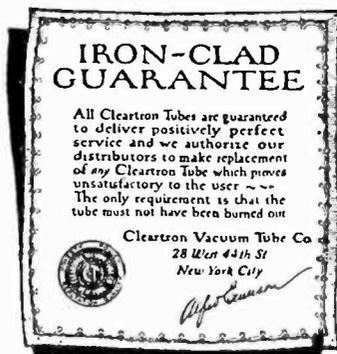
GUARANTEED

To increase the efficiency of a receiver employing Resistance-Coupled Amplification, and to get the full measure of tone purity and faithfulness of reproduction, for which this method of amplification is noted, use Cleartron Hi-Constron Tubes—Type 101A.



RADIO TUBES

The Cleartron Hi-Constron is a Hi-Mu Tube with an amplification constant of 20, especially designed for Resistance-Coupled and Reactance-Coupled Amplifiers. It is the result of years of research work and is the original and genuine Hi-Mu Tube.



The Following Types \$2.50

C-T 201 A	CTX 120
C-T 199 Standard Base	C-T 400 Rectron Tube for "B" Battery Eliminators
C-T 199 Small Base	

CTX 112 Power Tube \$6.50

All Types Equipped With Genuine Bakelite Bases

At All Reliable Dealers ★

Write for FREE six-page folder giving valuable information regarding radio tubes

Cleartron Vacuum Tube Company

Executive Offices
28 West 44th Street
New York City

Factories
West New York, N. J., U. S. A.
Birmingham, England

Is Your Set A Blooper?

How to Prevent Your Receiver Causing Interference and Thus Spoiling Your Neighbor's Reception

THERE are still many single-circuit bloopers in use, although the general trend in design, as far as commercially made receivers are concerned, seems to be toward receivers which are almost incapable of causing interference, however carelessly handled. The excellent instructions appearing below have been specially prepared by the Radio Branch of the Department of Marine and Fisheries of the Dominion of Canada, for circularization among all Canadian broadcast listeners. On the back of all Canadian receiving licenses is the following note. "When using a receiver of the regenerative type for the reception of radio telephone programs, please avoid increasing regeneration to the point at which the receiver begins to oscillate, otherwise you will cause interference with neighboring receiving equipments. Are you doing your best to observe this?" The point is that many owners of receiving sets capable of radiating squeals, cause such interference purely from inadequate knowledge of the handling of their sets, and it was for their benefit that this circular was printed. These instructions should help many readers of RADIO BROADCAST who are looking for clear directions on how properly to use their regenerative sets.—THE EDITOR.

HOW MUCH INTERFERENCE A RECEIVER CAN CAUSE

A RECENT survey of radio broadcast reception conditions in the more populated centers of the Dominion of Canada indicates that approximately fifty per cent. of the "preventable interference" which prevails, is caused through the incorrect operation of regenerative receiving sets by the broadcast listeners themselves.

The survey further indicates that most of the interference is due to a lack of knowledge of correct methods of adjusting a regenerative receiving set, and it is accordingly hoped that a material reduction in the same way may be effected if the broadcast listeners can be persuaded to cooperate in an endeavor to clear the air of regenerative whistles, and, with this end in view, the following instructions for operating this class of receiving set have been drafted.

WHAT IS REGENERATION?

THE principle of regeneration, as used in radio receiving sets, is that a part of the output of the detector vacuum tube feeds back into its own input and thus greatly increases the volume of the signal.

The electric waves reaching the receiving set from the transmitting station travel down the antenna wire through the primary coil in the set and so to earth down the ground wire. The weak electric current resulting from this influences the vacuum tube in such a way as to set it functioning.

The resulting output from the plate circuit of this tube is fed back in such a manner as to set up a "field," or "influence," in the part of the circuit connected to the input (the grid) of the tube. This "field" induces in the input circuit a current of electricity of the same frequency as that of the received electric waves. The energy, therefore, which comes down the antenna wire is automatically strengthened by an impulse from the output of the detector tube.

FOR BETTER RECEPTION

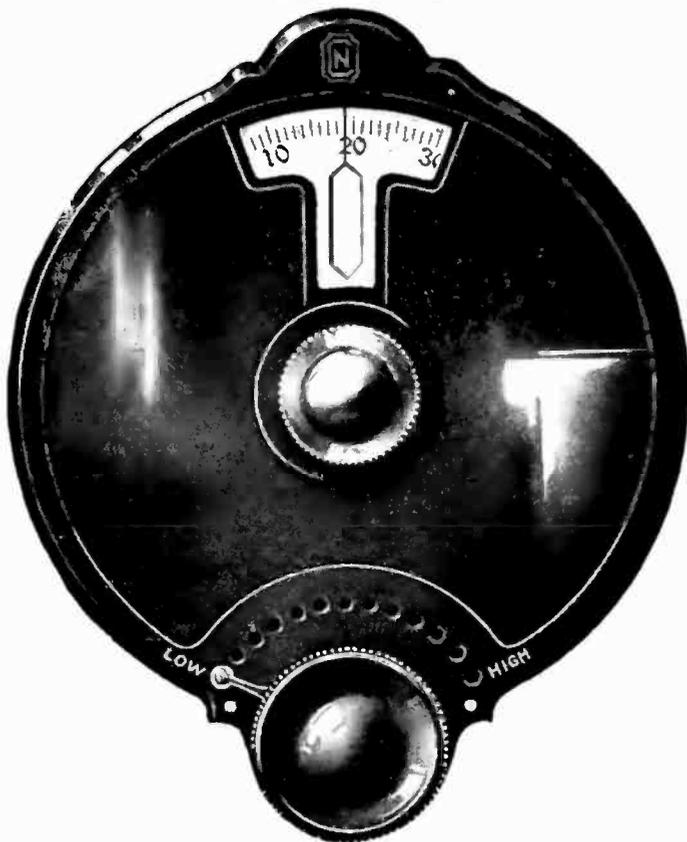
★ Tested and approved by RADIO BROADCAST ★

NATIONAL Velvet Vernier DIAL

Type B, Variable

(Patents Pending)

Positive Control
Easily Mounted
Gearless



Variable Ratio
Velvety Smooth
Graceful Design



With This NEW National Type B, Velvet Vernier Dial,
YOU Control the Reduction Ratio!

WHAT a difference in the tuning of your set when you replace your plain dial with a new NATIONAL Type B Variable (patents pending). You'll be astonished.

Any ratio you desire, from a minimum of 6 to 1 to a maximum of 20 to 1 is instantly obtained by shifting a small lever. Note how it separates the stations operating on the lower wave lengths.

Easily mounted on the $\frac{1}{4}$ " shaft of any standard type of variable condenser. The only tool you need is a screw driver.

The same velvety smoothness, the same freedom from backlash, the same mechanical drive as the famous Type A Velvet Vernier Dial, (patents pending). Price \$2.50.

The NATIONAL KIT

for the popular circuits and hook-ups gives amazing results to amateur set-builders.

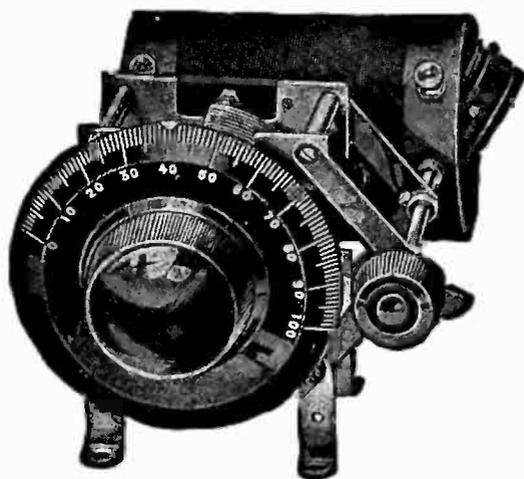
Comprises the NATIONAL CONDENSER and the wonderful BROWNING-DRAKE TRANSFORMER. Complete in one package, Price \$22. Makes a most welcome Christmas Gift.

Write for Bulletin 106 R. B.

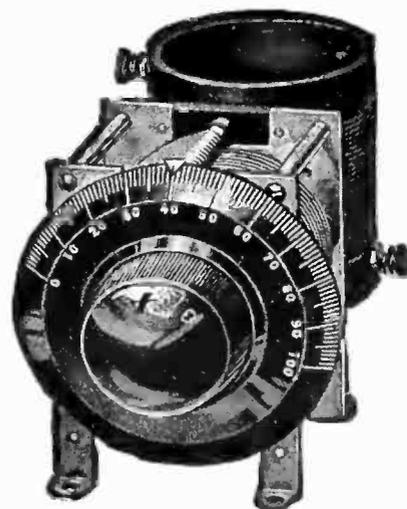
NATIONAL CO., INC.

W. A. READY, *President*

110 Brookline St. CAMBRIDGE, MASS.



NATIONAL Tuning Unit
Type B D-2



NATIONAL Tuning Unit
Type B D-1



ACME WIRE RADIO PRODUCTS



Stranded Enameled Antenna

The best outdoor antenna you can put up. 7 strands of enameled copper wire; maximum surface for reception. Enameling prevents corrosion and consequent weak signals. 100, 150 or 200 ft. coils, boxed.



Loop Antenna Wire

You can make a good loop with Acme wire made of 65 strands of fine copper wire, green silk covered. Flexible; non-stretching, neat.



The Original Celatsite Wire

Celatsite is a tinned copper bus bar wire with a non-inflammable "spaghetti" insulation in five colors. Supplied in 30 inch lengths.

Flexible Varnished "Spaghetti"

A perfect insulation tube for all danger points in set wiring. Costs little more and is worth a lot more than the cheaper substitutes offered. Black, yellow, red, green, brown; for wires No. 10 to No. 18. 30 inch lengths.

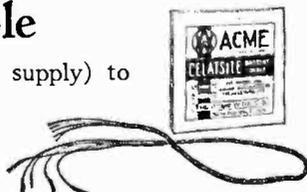
Flexible Celatsite

Flexible stranded wire for "point to point" and sub-panel wiring—latest method of wiring sets. 5 colors, black, yellow, green, red and brown, one for each circuit. 25 foot coils.



Celatsite Battery Cable

For connecting A and B Batteries (or current supply) to radio set. Silk braid covering 5 flexible Celatsite wires—5 feet long—a different color for each terminal. Prevents messy wiring and "blown" tubes. Adds greatly to the appearance of your set.



Send for Folder

THE ACME WIRE CO., Dept. B
New Haven, Conn. ★

WHAT IS OSCILLATION?

UNLESS controlled, this action will continue until the saturation point or climax is reached, the tube then being said to be in a state of oscillation. When a receiving set is in oscillation, it causes howling and squealing in your own and your neighbor's receiving sets. Regeneration should therefore never be allowed to proceed to this point as it then constitutes a public nuisance. On commercial receivers, regeneration is not always described by this name, and the dial which controls this feature of the equipment may be designated by any of the following terms: Regeneration; Reaction; Tickler; Feedback; Amplification; Varind; Sensitivity, etc.

When a radio receiving set in a state of oscillation is being tuned to a broadcast station:

(1) It causes whistles in radio receiving sets, of all types, which are tuned to the same station. This interference may be heard up to a distance of several miles.

(2) It distorts the quality of your own music.

(3) It uses more B battery power and therefore the life of the B battery is reduced.

(4) It tends to reduce the life of the detector tube.

When a radio receiving set, in a state of oscillation, is exactly tuned to a broadcast station, it is said to be in the state of zero beat. This distorts the broadcast reception and also interferes with neighboring receiving sets which are tuned to the same station.

In a word, regeneration carried to oscillation causes great annoyance to your neighbors, poor reception and expense to yourself, and has no advantages whatever.

DOES YOUR RADIO RECEIVING SET CAUSE INTERFERENCE?

THE interfering whistle which you hear in your receiving set may originate in your own set or it may be interference caused by your neighbor. In order to determine this point you may make the following test:

Leave the regeneration control in a fixed position, slowly rotate the tuning dial, and note particularly the change in sound of the whistle. If the whistle rises and lowers in pitch sympathetically with the movement of your tuning dial it indicates that your receiving set is in a state of oscillation and probably causing interference to other sets. On the other hand, if the whistle does not change in pitch corresponding to each movement of your tuning dial, but simply varies in volume, the whistle is not caused by your receiving set, but is interference produced by some other oscillating receiving set in the neighborhood.

Many so-called non-radiating receivers will, under certain conditions, radiate and thus cause interference. Make it your business to see that your set is not causing trouble.

If you are in doubt as to whether your set can cause interference you can check the same by making the following test, but be careful to do so at a time when only a few people are listening in, so as not to cause annoyance:

Call a neighbor on the telephone and ask him to listen in on a particular station at a pre-arranged time and then tune your own set to the same station. Turn up your detector tube filament to normal and put the regeneration control to its maximum; move your tuning dial five times slowly across the point corresponding to the tuning of that station, then telephone your neighbor and ask him if he heard the interference corresponding to these five movements of the dial on your receiving set. If he heard your interference, the probability is that hundreds of others have also been annoyed at times by radiation from your receiving set. You should

FROST-RADIO

TUBE ★
CONTROL
UNIT

\$1.75

(6, 25 or 35 ohms)

COMBINES Vernier Rheostat and Potentiometer. Single hole mounting. 6, 25 or 35 ohm rheostat, 400 Potentiometer. Genuine Moulded Bakelite. List: \$1.75. Pacific Coast price slightly higher.



HERBERT H. FROST, Inc.
314-324 WEST SUPERIOR STREET, CHICAGO
New York City Cleveland Kansas City Los Angeles

22½ Volt
un-acid
everlasting
rechargeable
"B"

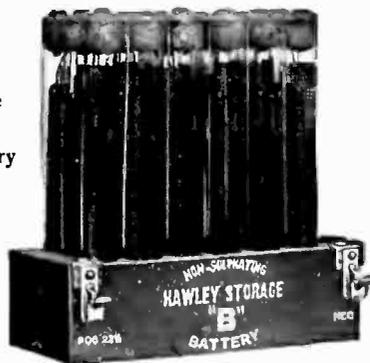
Storage Battery

\$2.95

includes
chemical

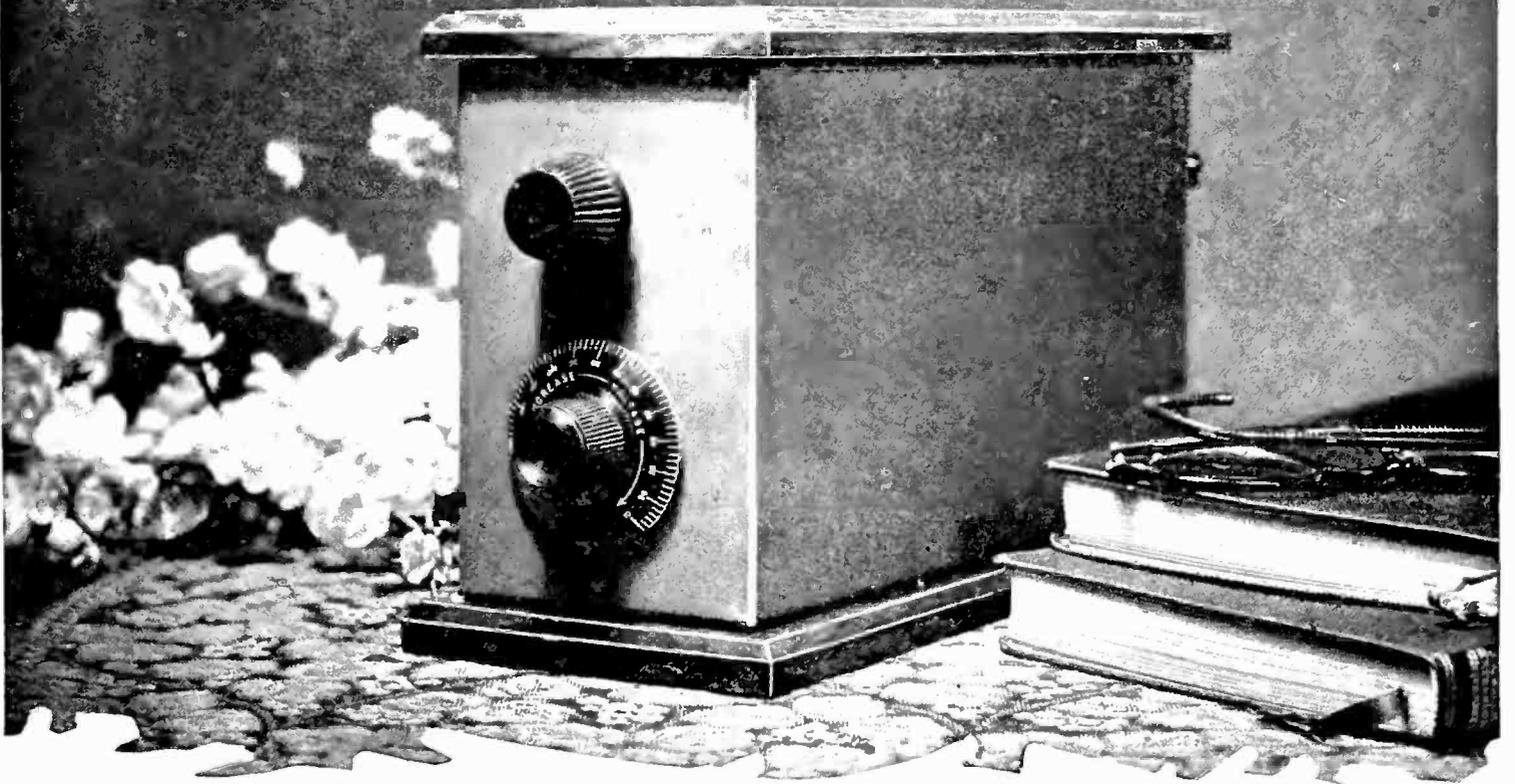
45 volts \$5.25, 90
volts \$10.00, 112½
volts \$12.50, 135
volts \$14.75, 157½
volts \$16.80.

Truly the biggest buy today. Easily charged on any current including 32 volt systems. Any special detector plate voltage had. Tested and approved by leading authorities such as Popular Radio Laboratories. Over 3 years sold on a non-red tape 30 day trial offer with complete refund if not thoroughly satisfied. Further guaranteed 2 years. Knock-down kits at greater savings. Complete "Hawley" "B" Battery Charger \$2.75. Sample cell 35c. Order direct—send no money—simply pay the expressman cost on delivery. Or write for my free literature, testimonials and guarantee. Same day shipments.



B. Hawley Smith, 312 Washington Ave., Danbury, Conn.

DIS-TON



Employs no fluids of any kind. Uses only one rectifying tube. Separate adjustment for detector and amplifier tubes. Handsomely finished in rich velvet-green Duco with solid walnut, satin finish top and bottom. Ample continuous "B" current for one to ten-tube sets.



Remarkable Tone Quality — — Amazing Volume and Selectivity—without "B" Batteries

DIS-TON, in place of "B" Batteries, is guaranteed to improve the overall efficiency of your set. It provides constant "B" current at proper potential for your particular receiver circuit, tubes and loud speaker.* DIS-TON is noiseless in operation—no crackles and popping such as you get with run down "B" Batteries—no hum of any kind to distort the finest aria or drown out the faint signals from distant stations.

A self-contained electrical instrument using A C

DIS-TON is trouble free—the special Trans-Filter Unit is sealed in, protected against tampering and deterioration. It can't wear out. Consumes only eight watts from the nearest lamp socket and puts your "B" load on the big, powerful, carefully watched generators of your central station. You can rely upon DIS-TON to give you the best from your receiver.

Without attention of any kind after simple initial adjustment to your set—DIS-TON insures you the equivalent in performance of new "B" Batteries every time you listen in.

DIS-TON requires no change in the internal wiring of your set to secure either utmost efficiency or entire safety. Accidental improper connections can't result in tube "burn outs."

DIS-TON complete ready for operation
110 volt, 60 cycle
\$40.00
Other voltages and cycles on application

Know how much DIS-TON adds to radio

The advantages that DIS-TON will give you are outstanding and unusual. You have the opportunity to verify them all on your present receiver. A DIS-TON demonstration is yours for the asking. Send for Leaflet B and full details as the first step to greater radio enjoyment this season.

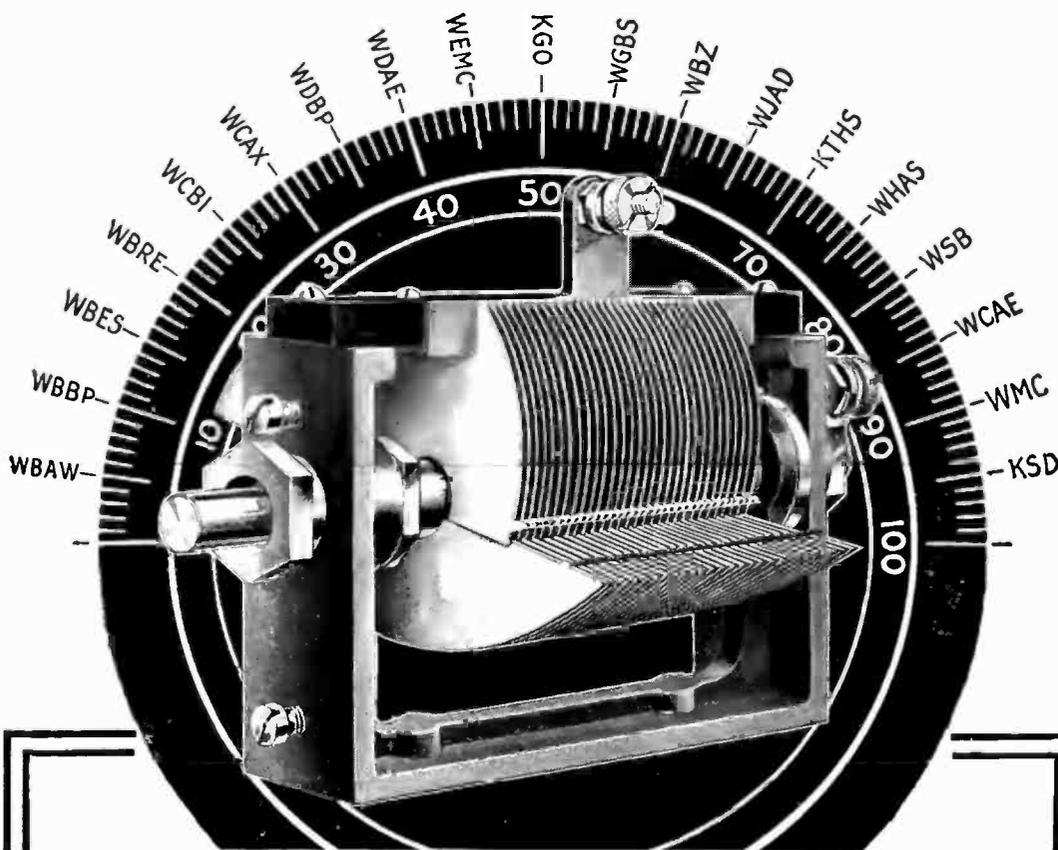
DIS-TON KITS Essential Parts for Home Builders
110 volt, 60 cycle
\$28.50
Other voltages and cycles on application

RADIO PRODUCTS, Inc.

Dept. RB

Richmond, Ind.

*DIS-TON will not make a "single tube" into a "super-het." but it will modernize the performance of any of the good, older receivers in an amazing fashion.



Smallest Uniform Frequency Condenser Easily Fits Into Present Sets

FULL size illustration above shows Samson Condensers are but $2\frac{3}{4}$ " diameter with plates fully extended—half to a third the size of others.

You can easily increase the selectivity of your present receiving set having ordinary condensers, and do away with the crowding of station readings—where 85 out of 100 come in below 50 on dial—by using

Samson Uniform Frequency Condensers

Samson Uniform Frequency Condensers are built to a tolerance of $1/1,000$ inch, silver plated all over for high surface conductivity, and—in addition—have gold plated rotor and stator plates to prevent oxidization.

These grounded rotor type instruments have losses lower than the average laboratory standards. This condenser, due to its design does not have the defects caused by either solid metal or dielectric end plates. 500 mmf., \$7.00; 350 mmf., \$6.75; 250 mmf., \$6.50.

SAMSON ELECTRIC COMPANY

Manufacturers Since 1882

Canton, Mass.

Sales Representatives in Thirty Leading American Cities



Why not subscribe to *Radio Broadcast*? By the year only \$4.00; or two years, \$6.00, saving \$2.40. Send direct to Doubleday, Page & Company, Garden City, New York.

ACME CHARGERS

Best by Test ★

\$ 850 minus bulb

Your dealer can get it for you

THE ACME ELECTRIC & MFG. CO.

1410 Hamilton Avenue

Cleveland, O.



therefore learn how to operate without causing this interference.

ADJUSTING A REGENERATIVE SET

IF YOU will take the trouble to observe the rules which follow, you will obtain greater satisfaction and enjoyment from your radio receiving set, and at the same time cause minimum annoyance to your neighbors.

(1) Practise on tuning *powerful stations first* and do not try to pick up weak distant stations until you become expert.

(2) Use *both hands*, one hand for the regeneration control and the other hand for the tuning control.

(3) Keep the regeneration control always just *below* the point of oscillation, your set is then in the most sensitive condition. This is the reason for using your two hands for tuning.

(4) If your set then accidentally breaks into oscillation, turn *back* the regeneration control at once.

(5) Do not try to *find* a station by the *whistle*. If your set is tuned just below the whistling point, the signals will come in *clear* and your regeneration control can then be tuned a *little* further to increase the volume.

(6) Do not *force* regeneration in an attempt to obtain loud speaker volume from a set not designed for the purpose.

(7) Do not *force* regeneration in an attempt to hear stations beyond the range of your set; be content with those you can really hear.

The fact that you once heard a distant station on your receiving set is no indication that you can hear this station regularly, for occasionally a radio broadcast from a distant station is received with extra strength due to some freak condition. When you have tried to tune in to a station in the correct manner for a minute or two and are not able to hear it, do not unduly increase your regeneration and persistently wiggle your dials, for in so doing you may be causing annoyance to some other broadcast listener who would otherwise be able to hear this distant station on his multi-tube set.

If you are not satisfied with the range your present receiver is giving you and providing local conditions are satisfactory, the only remedy is a more sensitive receiver or the addition of more tubes to your existing set. Don't at your neighbors' expense, try to force your receiver. Besides being unfair to your neighbors, you are also spoiling your own quality.

You can accordingly assist in eliminating these whistles by:

(a) Learning to operate correctly yourself.

(b) Not allowing children, who are not old enough to understand the correct method of operation, to cause interference from your set. (A crystal set causes no interference).

THE LICENSE

ALL radio receiving sets in Canada are required, by law, to be licensed. Licenses are issued yearly and are required to be renewed on the first of April each year. They may be obtained for one dollar from local Radio Inspectors, many Post Offices, many Radio Dealers, or from the Radio Branch, Department of Marine and Fisheries, Ottawa, Canada.

The proceeds of the license fees are used to maintain an inspection staff for the administration of radio and for the improvement of radio conditions in the Dominion.



For the benefit of listeners who are desirous of obtaining this article in circular form, it should be stated that copies may be had, on request, from the nearest Canadian Radio Inspector, or direct from the Radio Branch, Department of Marine and Fisheries, Ottawa, Ontario, Canada.

★ AMPERITE

REG. U.S. PAT. OFF.

The "SELF-ADJUSTING" Rheostat

A BASIC Need in Every Circuit

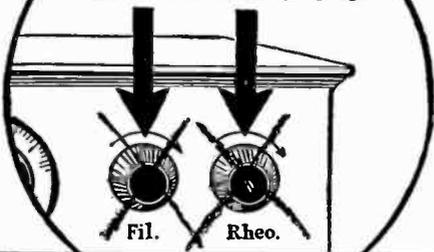
BECAUSE—AMPERITE not only modernizes any set—it keeps it modern.

- 1—Eliminates Hand Rheostats, thereby simplifying control.
- 2—Permits use of the latest types of tubes or any combination of tubes.
- 3—Simplifies and reduces set-wiring, thereby making for greater compactness and avoids losses.
- 4—No moving parts, hence no grinding noises; clear and full tones.
- 5—Prolongs tube-life by keeping filaments at a constant temperature.
- 6—No filament meters needed.
- 7—Brings the most out of each individual tube—automatically—no guessing.
- 8—Makes every set-owner a master operator, no knobs to turn.

Write today for
FREE
Hook-Ups



Obsolete



Sold Everywhere
\$1.10 complete with mounting

AMPERITE is used in every popular present-day construction set. Why? Because of its many outstanding exclusive features, and because it solves the perplexing problem of tube-control—**COMPLETELY** and **AUTOMATICALLY**.

For the new tubes:

Amperite No. 112—for the UX-112 and CX-112
Amperite No. 120—for the UX-120 and CX-120

Radiall Company

Dept. R.B.-13 50 Franklin Street New York City

Mf's of "TUNE-RITE" Straight-Line-Frequency Dial

Be sure that the set you buy or build is equipped with AMPERITE.

The Amplion Pedigree

Thirty-eight years ago—

In 1887 Mr. Alfred Graham invented and demonstrated the first practical loud speaker which the world had ever heard (illustrated above).



In 1893 Graham Loud Speakers placed upon market. Illustration shows the "1893 model."



In 1894 Graham Loud Speakers first used in British Navy. Graham transmitters applied to phonographs for loud speaker reproduction.

In 1896 Graham Loud Speaking Naval Telephones developed and adopted by British Admiralty.

In 1898 Graham Watertight Loud Speakers patented. Placed on many warships and mercantile vessels, throughout world.

In 1902 Complete Graham Loud Speaker installations, on central battery plan, erected on warships as sole means of communication.

In 1906 The most extensive loud speaking naval installation to date was made by Grahams. Included a Graham exchange system fitted to H. M. S. Dreadnought.



Onwards Graham Loud Speakers applied to all sorts and conditions of service at home and abroad, ashore and afloat.

By 1919 No less than 12,000 Graham loud speaking installations in operation on ships alone.

In 1920 (before radio loud speakers were in common use) "AMPLION" Loud Speakers produced for radio by Alfred Graham & Co. "AMPLION" trademark registered.

1920 Model



In 1922 Amplions adopted as standard equipment by leading makers of radio sets abroad.



1922 Model

In 1923 Amplions introduced into United States, Canada and other countries. Quickly attained largest throughout-the-world sale of any loud speakers.

In 1924 To supply demand The Amplion Corporation of America was formed to market and manufacture Amplions here.

In 1925 More Amplion companies formed and agents appointed throughout world to keep pace with international demand. The Amplion Corporation of Canada, Limited, organized.

Created by the actual originators and world's oldest makers of loud speakers, it is only logical that the Amplion should be unrivaled for clarity of tone. Some of the countries in which Amplions rule as favorites:

- UNITED STATES
- CANADA
- ENGLAND
- SCOTLAND WALES
- IRELAND
- NORWAY SWEDEN
- DENMARK
- HOLLAND BELGIUM
- FRANCE SPAIN
- SWITZERLAND
- ITALY JAPAN
- SOUTH AFRICA
- NEW ZEALAND
- AUSTRALIA



The Amplion of 1926

AMPLION



Alfred Graham & Co., London, England Patentees

The World's Standard Loud Speaker

THE AMPLION CORPORATION OF AMERICA

Executive Offices: Suite L, 280 Madison Ave., New York City

Canadian Distributors: Burndept of Canada, Ltd., Toronto

To hear this new Amplion Dragon AR-19 is to appreciate why Amplions, year after year, internationally lead in sales. Six models, including phonograph units, \$12 to \$42.50. Write for interesting literature and dealer's address.

Associated Companies and Agents: Alfred Graham & Co., London, England; The Amplion Corporation of Canada, Limited, Toronto; Compagnie Francaise Amplion, Paris, France; Compagnie Continentale Amplion, Brussels, Belgium; Amalgamated Wireless (Australasia), Ltd., Sydney and Melbourne; British General Electric Company, Ltd., Johannesburg and Branches; Indian States and Eastern Agency, Bombay and Calcutta; C. J. Christie E. Hijo, Buenos Ayres; David Wallace & Co., Valparaiso; Mestre & Blatge, Rio de Janeiro; F. W. Hammond & Company, London and Tokio.

This is a good time to subscribe for

RADIO BROADCAST

Through your dealer or direct, by the year only \$4.00

DOUBLEDAY, PAGE & CO.

GARDEN CITY, NEW YORK

WHAT OUR READERS WRITE US

Say "Pico" Instead of "Micro-Micro-Farad"

WHY not adopt and familiarize the prefix 'pico' for 'micromike?' wrote Mr. F. I. Anderson in the September RADIO BROADCAST (page 662). "Thus, instead of saying a 'triple-o-five' condenser, for an instrument of 500 micro-micro-farads, let us say 500 picos, which is correct and simple, if we once get used to it. To be precise, we should say pico-farads, but we could drop the farads once we get used to the pico end of it." From Robert S. Kruse, technical editor of QST, comes a letter informing us that he is heartily in agreement with this idea and has already taken steps to make it take on definite shape.

Editor, RADIO BROADCAST,
Doubleday, Page & Company,
Garden City, New York.

SIR:

I want to enter an enthusiastic endorsement of the idea expressed by Mr. F. I. Anderson on page 662 of your September issue. By a strange coincidence we received this issue on the exact day when we had been discussing the extremely unsatisfactory nature of the micro-micro-farad. This letter is only to offer you my personal coöperation in anything you would care to do along this line, although we have already half formed a plan of more general technical coöperation. This plan has now been submitted to our Executive Committee which is investigating its practicality.

Very truly yours,
ROBERT S. KRUSE,
Technical Editor, QST.

Radio Developments in New Zealand

WE ARE always pleased to hear from our readers abroad and we think that fans in this country are interested to know what progress is being made in foreign parts too. There is a certain amount of satisfaction in knowing that one's local station is heard regularly in some remote spot of the globe, and perhaps a certain amount of chagrin when one reads that such and such a station may be heard very well, in New Zealand for example, while the native fan, who may be merely two or three thousand miles nearer, is unable to receive it. We wonder what percentage of East Coast fans have received KGO, KFI, and KPO, as often as Mr. Haggett has?

DOMINION RADIO COMPANY
WELLINGTON, NEW ZEALAND

Editor, RADIO BROADCAST,
Doubleday, Page & Company,
Garden City, New York.

SIR:

Just a few lines to express my appreciation of your excellent magazine. I have always found it an ideal publication in every way. I have just received the July issue and I think it is the best yet. I was very sorry to learn of the death of Miss Mix, as her column was of great interest to us. Broadcasting here is not of a very high order just yet, but this year will see New Zealand with one of the best broadcasting services in the world. Parliament is making provision this session for the erection of several main stations and several satellite relay stations. The revenue is derived from fees to be



TRADE MARK REG.

Above types in copper—tinned copper—enameled copper—tinned bronze.

Loop wires in silk or cotton covered.

Litz wires.

Enameled wires.

RADIO WIRES

We manufacture all types.

Round braided antenna wires

Flat braided antenna wires

Round stranded antenna wires

Antenna supporting springs.

Cotton and silk covered wires for set wiring.

Write us for descriptive catalogue.



ROSS WIRE COMPANY

69 Bath St., Providence, R. I.

★ Tested and approved by RADIO BROADCAST ★

Perfect Precision!

Radio technicians and engineers as well as seasoned amateurs know that "General Instrument" is satisfied with nothing short of *perfect precision*.

For example: The General Instrument laboratories developed the eccentric type straight line frequency condenser at great expense—only TO ABANDON IT!

Try to rotate an eccentric type straight line frequency condenser and note the effect on the bearing and then you will realize why "General Instrument" discontinued the eccentric type and created the CONCENTRIC straight line frequency condenser.

CONCENTRIC straight line variable condensers represent the latest development in condenser engineering. Observe the even distribution of weight of the rotor plate.



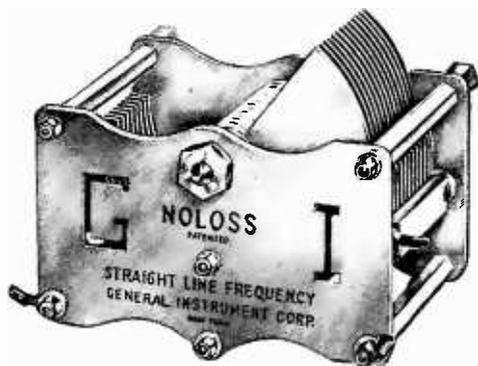
STATOR

"General Instrument" thinks more of its reputation than the cost involved in creating a perfect instrument. Hence—the CONCENTRIC straight line frequency condenser.

CONCENTRIC Straight Line Frequency Condenser

(Pyrex Insulated)

The perfect instrument created by General Instrument. Type 80.



PATENTED



TYPE 40

THE INIMITABLE RHEOSTAT

Built only by General Instrument, this rheostat can NOT be imitated. To get it, you must make sure of the name "General Instrument."

OBTAINABLE AT BETTER CLASS RADIO DEPARTMENTS



General Instrument Corporation

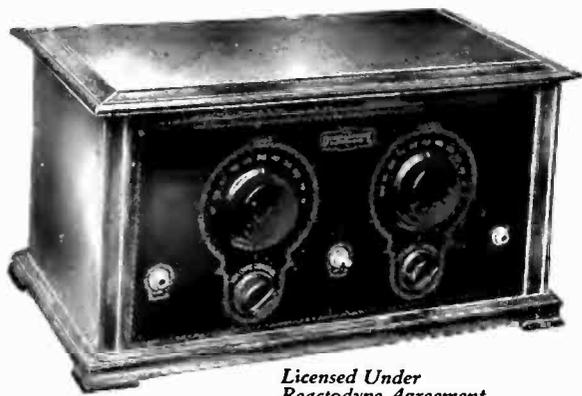
Manufacturers of Laboratory Equipment

423 Broome Street

New York City

★ Tested and approved by RADIO BROADCAST ★

Superadio Receiver



Licensed Under
Reactodyne Agreement

5 Tubes
2 Dials
\$56

At last—true beauty is combined with scientific design so that results never before expected are now easily achieved. Loose, extravagant claims are not made for this set, which must be seen and heard to be appreciated.

Results Undreamed of Now Secured

Employs a radically new principle—inductive reaction. Housed in a handsome, compact, solid walnut cabinet with black bakelite panel engraved in deep gold. Produces full rounded tones with all their color and shading. Oscillations automatically controlled. Use of low loss S. L. F. Condensers and highly developed Solenoid R. F. Transformers results in tremendous power without disturbing squeals, while simple controls, only two, regulate the thunderous volume to fairylike whispers, if desired.

Send for circular giving engineering details why the Superadio is so far ahead of present day conceptions.

Tested Tubes Now Possible With the Superadio Dynamometer

Remember—you can now buy TESTED tubes—where the Superadio Dynamometer is on the job. This meter is direct reading. Measures the amplification factor, plate impedance, and mutual conductance of any radio tube. Extremely easy to operate. Tests three tubes per minute.

Special Model S-2 Amplifier \$30.

Jobbers and Dealers

Write for details on the Dynamometer, and our liberal selling proposition. Be the first in your town to sell TESTED tubes.



Superadio Dynamometer equipped with phones and plug. Price \$120. (Patents Pending)

De WITT-LaFRANCE CO., Inc.

54 Washburn Ave., Cambridge, Massachusetts

Boston Representative:

Martin, Hartley & Dewitt Sales Co., 99 Bedford St.

Chicago Representative:

William A. Welty & Co., 36 So. State St.

This is a good time to subscribe for

RADIO BROADCAST

Through your dealer or direct, by the year only \$4.00

DOUBLEDAY, PAGE & CO. GARDEN CITY, NEW YORK

3 Mexican Crystals

"The Catwhisker's Delight"

The BEST, bar none. For Crystal sets, "Silver Galena." For Reflex sets, "Placerite."

Once tried, always used.

★ 40c Each, 3 for \$1.00
★ Special for DeForest, 50c

70,000 users. You are next.

Dealers write

H. D. HATFIELD & SON

1762 Vermont Ave.

Hollywood

California

FREE

Diagram for ultra-selective Crystal circuit free with 3 crystals at \$1.

BROADCAST CONTROL OPERATORS

who read Carl Drehers's discussion in the September RADIO BROADCAST on "Microphone Placing in Studios," should not miss "Additional Notes on Microphone Placing" to be printed in the January magazine.

RADIO CATALOG

DEALERS!

Send for our big new live Catalog. Contains hundreds of standard nationally advertised sets, kits and parts. Use your letterhead

Western Radio Co. MFG
134-136 W. Lake St. Chicago, Ill.

charged listeners—in which will be the equivalent of nearly five dollars. At the present time my company is running the broadcasting stations in this city and local companies are doing the same in the other towns, but that will cease of course when the new Broadcasting Company (now in course of formation) is ready. The reception of American stations here is achieved nightly using only single "valve" sets, and loud speaker volume using one stage of radio, detector and two of audio. I have heard KGO, KPO, KFI, and others using a Kennedy Model XV Receiver and have logged any number of "Yanks" on a low loss set of my own construction. I am at the present time building a RADIO BROADCAST Phonograph receiver as described in your paper. I expect great results from it and no doubt you will be pleased to hear how I get on with it. This quarter of the globe is excellent for reception as is evident by the long distance records made by New Zealanders. At the time of writing we are expecting the arrival of the American Fleet here and I have already heard their "sigs." from Lieutenant Schnell's short wave set.

The "star" on your advertisements means a lot to us here in New Zealand. We cannot tell what is the latest apparatus and whether all the goods one sees advertised are what they are supposed to be, but in buying for this firm I have never once fallen in when guided by the "star." We have up to the present only handled small quantities of goods but we anticipate an increased volume of business this year. Thordarson, Belden, Na-ald, Peerless, Daven, Bell, Walnart, and Federal are amongst the lines we handle and we are satisfied that they are the best. So you can see what a valuable guide your paper is to us who "have no mother to guide us", as it were. We all enjoy your column "As The Broadcaster Sees It"—it is a scream.

Wishing you all the success you deserve with your excellent paper.

Very truly yours,
R. J. HAGGETT
Wellington, New Zealand.

The O'Connor Frequency-Changer

THE O'Connor Frequency-Changer, which was described fully in the June and August, 1925, RADIO BROADCAST, has caused much comment, and we have received numerous letters from readers who have had success with this circuit. By its use it is possible to convert any existing receiver to a super-heterodyne, and thus increase range and selectivity. Used in combination with a neutrodyne receiver it is possible to efficiently reduce the number of tuning controls to two, instead of the usual three. Here is a letter from an enthusiastic constructor.

Editor, RADIO BROADCAST
Doubleday, Page & Company,
Garden City, New York.

SIR:

I have read with interest the controversy relative to the O'Connor Frequency-Changer, and as to its being a dud I can give evidence to the contrary.

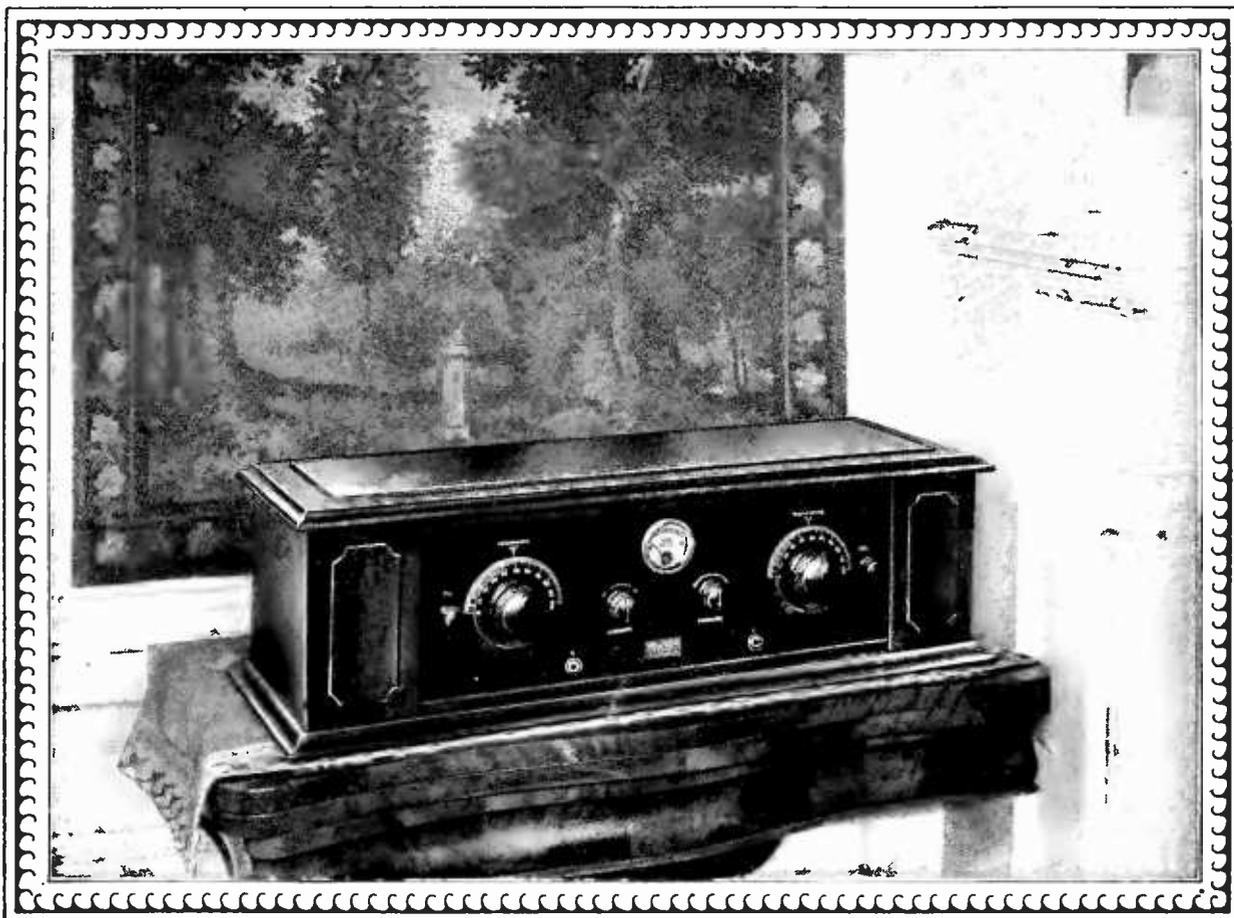
I have one of the first ones made in this territory and what it did to my five-tube neutrodyne is more than satisfying, in selectivity and volume and distance, and I had what was considered an exceptional set before.

Atlantic City, Elgin, Providence, and Pittsburg come in between two degrees on the dial, and with no interference.

Detroit and Toronto come in within half a degree on the dial, also with no interference. I am getting Fort Worth nightly now, and practically all stations above 500 watts in power.

Very truly yours,
C. F. RODGERS,
Conneaut, Ohio.

Introducing
the
**BROWNING-DRAKE
RECEIVER**



IN the quest for a set that would give greater distance and selectivity and still be economical and simple in design, Frederick H. Drake and Glenn H. Browning, both doing research work at Harvard University, set to work mathematically to see just how much could be developed by a tuned radio frequency transformer.

It was found that with the aid of a special primary to minimize capacity coupling, radio frequency amplification amounting to over 90% of the maximum could be obtained.

The resultant circuit, known as the Browning-Drake Regenaformer Circuit, has been so successful in getting extreme

distance with exacting selectivity that it is now presented to the public in three styles of receivers.

Three stages of resistance coupled amplification give the Browning-Drake Receiver on unsurpassed quality of tone.

During the Trans-Atlantic tests made earlier in the year the Browning-Drake Receiver received Madrid, Spain. Owners of Browning-Drake Receivers living in the East have verified reception from KGO, Oakland, California; KFI, Los Angeles, California; Mexico City and Calgary, Canada.

Ask your radio dealer to show you the new Browning-Drake Receivers.

The B-D Standard

Five tubes with standard sockets. Provides for power tube. Mahogany cabinet with battery compartments at either end. List price, without tubes and batteries, \$130.

Distributors and Dealers—Write us for details

BROWNING-DRAKE CORPORATION

353 Washington Street

Brighton, Mass. ★

BROWNING-DRAKE



The B-D Senior

Six tubes with new type sockets. Built-in-loud-speaker. Battery compartments. List price, without tubes or batteries, \$185.

The B-D Junior

Five tubes with new type sockets. Power tube may be used. Mahogany finish cabinet. List price, without tubes and batteries, \$95.



★ Tested and approved by RADIO BROADCAST ★

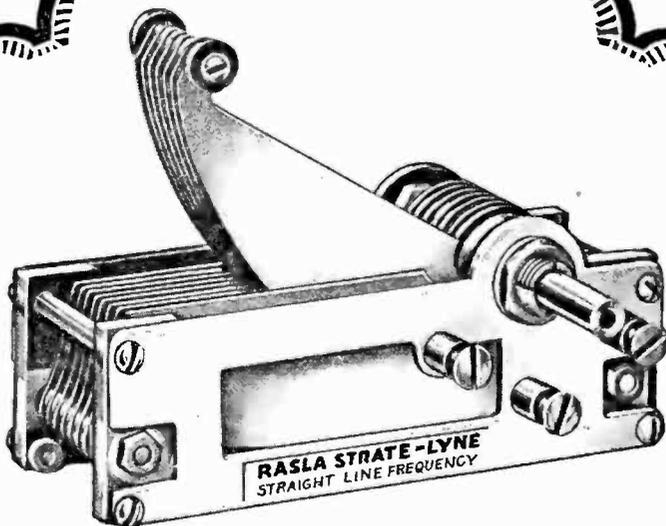
No More Crowding!

HERE is a *real* straight line frequency condenser at last—a condenser that *really* eliminates crowding, that *really* spaces stations evenly over the dials. It is the creation of Rasla, a name made famous by fine parts.

The RASLA STRATE-LYNE is built to standards usually adhered to only for laboratory precision instruments. The plates are *heavier* than on any other condenser, the spacing and alignment is more accurate. Split bushings are provided at *both* ends. The plates are acid dipped, the end-plates nicked and highly polished. Transparent bakelite insures *true* low loss.

RASLA STRATE-LYNE

Straight Line Frequency Condenser



The Rasla Fixed Detector is sensitive—and remains so. Best for reflex or any circuit. At your dealer's \$1.25

FREE—Write for the complete Rasla hook-ups Davidson Radio Corp., 222 Fulton St., New York

List Prices

.00025.....	\$4.60
.0003.....	4.75
.00035.....	5.00
.0005.....	5.25

At your dealer's or direct if he can't supply you



Premier Blue Ribbon
20ft. Extension Cord
★ and Connector
\$1.75 Complete

Premier Jr. (Lighter Weight) 20ft. \$1.25

Longer lengths to 100 ft. with "Quick as a Wink" Connecting plug, you can take your loud speaker anywhere.

5 WIRE BATTERY CABLES,
with terminals that fit every need \$1.00

Makes wrong connections impossible and removes all unsightly wires. Longer lengths that will permit putting the batteries in the cellar or closet. Prices on application.

Premier Blue Ribbon Products
at your dealer or drop a line to us.

CRESCENT BRAID CO., Inc. Providence, R. I.

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

Complete Kit Parts for!
this Wonderful Receiver!

Hammarlund Roberts



Also—

COCKADAY'S New LC-26 Receiver
McLaughlin 8 Tube Single Control Superheterodyne Kit

Cockaday 8 Tube Superheterodyne Kit

Radio Broadcast Browning-Drake Receiver

Write for Booklet about These Kits

See Our Ad in December Issue Popular Radio

Volumes of Praise for Quality of Tone

Better---an adjustable, compensated Unit

THE R. F. I. SPEAKER



*Licensed under the Lectophone
patents*

PRICE, \$22.50

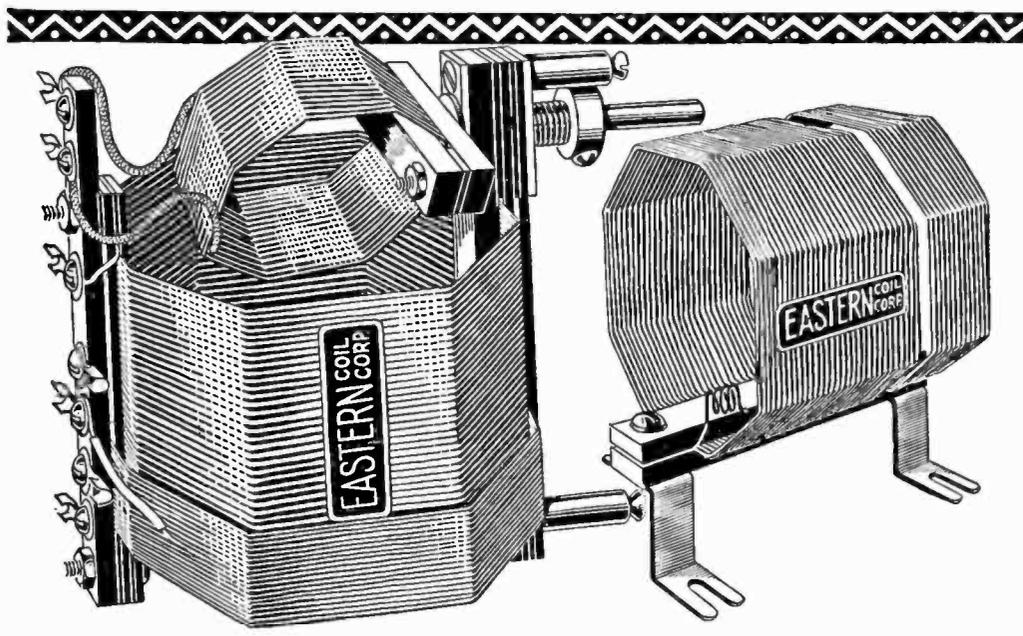


Ask Your Dealer

Jobbers---Write Us---Now



Radio Foundation, Inc. ★
25 West Broadway New York



**Specified
by
RADIO
BROADCAST
for the
"Aristocrat"
Set**

EASTERN KNOCKOUT COILS ★ (TYPE R)

Designed in strict accordance with all Radio Broadcast Laboratory's latest specifications and unreservedly guaranteed for incomparable results in the "Aristocrat" or any Radio Broadcast Roberts Knockout Circuit, reflexed or unreflexed.

Minimum of capacity between N. P. winding and secondary; mid-tap on single-layer wound N. P. coil—simplifies neutralization and tuning, and brings in the lower wave length stations with a heretofore unequalled efficiency.

Price, \$8.50 per set.

EASTERN Pickle Bottle COILS

TRADE MARK

Ever Increasing in Popularity

No matter what the circuit, they guarantee the best possible results from it because they incorporate every feature essential to low loss coil design, in conformity with every known radio engineering principle.

Highest inductance, combined with lowest distributed capacity and dielectric losses, least insulating material in the field, wires free of *any injurious substance—no celluloid or collodion binders used.* These are some of the advantages of this extremely efficient pickle bottle form of winding.

Elimination of losses keeps the high frequency resistance at the minimum, insuring increased selectivity, volume, and natural tone quality.

Eastern Pickle Bottle Coils may be had in types for other popular and leading circuits, as follows—

- TYPE ED—For the BROWNING-DRAKE Circuit. \$8.00
 - TYPE 3C—For the 3-Circuit set. \$6.00
 - TYPE RX-1—For the new revolutionary M.B. Sleeper RX-1 Circuit. \$6.00
 - TYPE L-C—For the G. M. BEST L-C Circuit. \$4.50
 - TYPE F C Coupler—For the O'CONNOR Frequency Changer. \$6.00
- A one-tube outfit which converts any set into a super-heterodyne. Oscillator Coils (Type OC), for same with special .00013 mfd. fixed condenser. \$4.75

At your dealers or direct, postpaid.

EASTERN COIL CORPORATION

22 Warren Street

Dept. R. B.

New York

Who Is to Pay For Reading Radio Broadcast?

YOU went to a newsstand or a radio store and you purchased this copy of RADIO BROADCAST. Perhaps this particular copy came to you through the mails, for you may be a subscriber. You read Mr. So & So's construction article. You build the set, you sell it, you make money. You build another and sell that too, you make some more money. Who paid for you to read RADIO BROADCAST? Figure it out yourself! When you buy this magazine, or you subscribe to it, you advance the money, someone else pays the price. You may make a quick turnover and get your money back the first set you build, or you may wait until something a little different comes along and you make a killing. If you are a live, wide awake set builder you can make money reading RADIO BROADCAST. You should subscribe to the magazine because a subscription is a very necessary investment for you to make for the future development of your own knowledge of radio. One year four dollars, two years six dollars. Write RADIO BROADCAST, Garden City, N. Y. Dept. M.

★ Tested and approved by RADIO BROADCAST ★

ROPE-CORE AERIAL

A marvelous, new aerial that is guaranteed to give greater distance, easier tuning, more perfect selectivity. Consists of pure copper ribbon, heavily enameled, wound around sturdy, weather-proof rope. Try this new aerial for better reception.

- ★ 50 ft. \$3.00 100 ft. \$5.00
- 75 ft. 3.85 150 ft. 7.00



ACORN WINDOW LEAD-IN

Fits into sash as pictured. Made of pure copper ribbon—1/2 inch wide, heavily enameled by special process. Triply insulated with waterproofed fabric. Thousands of users recommend them for satisfactory service. Each 35c. (Unenameled—25c.)

ACORN MASTER-SWITCH

Instantly connects your Battery to charger or to your receiver.

- Single socket type, \$5.00.
- Double socket type, \$6.25.

(For use with B-Eliminator)

Send for circulars on Acorn Products.

Dealers—Write for Discounts—Jobbers

Acorn Radio Products Co.
708-A W. Madison St. Chicago



NO MORE LOOSE CONNECTIONS X-L PUSH POST

A Binding Post that really does excel, looks, action, service and convenience. Push it down—insert wire—cannot jar loose from vibration. No screwing or danger of shearing off wires. Furnished attractively plated with soldering lug and necessary markings.

Price Each, 15 Cents

X-L RADIO LABORATORIES
2424 Lincoln Ave. CHICAGO

Big Money In Radio

Demand for high pay radio men is so great that a big Kansas City wholesale concern is now fitting men free to get into the radio business for themselves and make \$60 to \$200 a week without any capital invested. Select territory open. Send to-day for free catalog and amazing offer. Write direct to Mr. H. J. Saizow, Standard Radio Co., 1426 Walnut St., Kansas City, Mo.



CROSS SECTION SHOWING
INTERNAL CONSTRUCTION

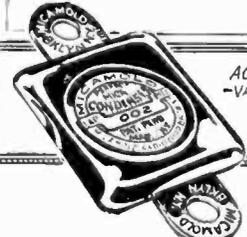
Micamold

REG. **FIXED
CONDENSERS**

The crowning achievement of Condenser manufacture. Internal construction of the best India Mica and Tin Foil moulded in genuine Bakelite to withstand heat and cold, thus moisture proof and noiseless. Guaranteed within 5% of commercial marking and constant in value. ★

At Good Radio Stores
"Made of Mica & Moulded in Bakelite"

MICAMOLD RADIO CORPORATION
Flushing & Porter Avenues, Brooklyn, N. Y.



ACCURACY GUARANTEED
—VALUES REMAIN CONSTANT

MOULDED
UNDER
PRESSURE
OF 50
TONS

The ^{TIMMONS} B-Limiter

is a small package weighing but 6 pounds, completely eliminates B batteries from your radio—Time Tested!

Price **\$28.50**

With Special Tube



Radio Broadcast has endorsed the B-Limiter after the most severe tests which covered 600 hours. When this test was finished, the tube was apparently as good as new. This is equal to six months' average use. The B-Limiter operates on any 110-volt 60-cycle alternating house current.

Seventeen other radio publications and newspapers have endorsed the B-Limiter. We have letters from hundreds of fans who use B-Limiters daily. Let us send a folder quoting some of these publications and users. It will be mailed promptly.

★ *And now we announce the Beautiful Timmons Cone Talker (14" Cone) \$25.00 list*



Represents one of the greatest values of the new radio season, developed by Timmons engineers, long known throughout the industry as experts in acoustics.

This year radio enters the *quality* stage—and with it comes the Cone Talker, which has a larger and more responsive reproducing surface. The new Timmons Cone Talker is fourteen inches across. This gives a full tone range—the mellow bass of the organ and the sweet high tones of the violin are re-created with equal fidelity—even the piano is reproduced with an absolute trueness of tone.

Moderate Price

Best of all, too, this really remarkable reproducer, which needs no auxiliary equipment, is now available to all classes of listeners at the moderate price of \$25.00.

We'll send a folder on the new Timmons Cone Talker. Your dealer will be glad to demonstrate it.



Both B-Limiter and Timmons Cone Talker make excellent Christmas gifts.

Timmons Radio Products Corp.
Germantown, Philadelphia, Pa.

TIMMONS *Radio Products*

★ Tested and approved by RADIO BROADCAST ★

RADIO BROADCAST

Offers You A PERSONAL GRID SERVICE

If you are a subscriber to Radio Broadcast the GRID SERVICE is FREE. If you are not a subscriber the GRID SERVICE FEE is one dollar. The dollar, however, can be applied toward a subscription to the magazine.

What The Grid Service Is

By GRID SERVICE we mean technical information on your particular problem answered by the Technical Editor. He is the Doctor for your sick radio set. Describe the symptoms to him in a letter and enclose one dollar, or better still, a year's subscription, which is four dollars, and then you can call on the Doctor all year 'round and get free consultation and read Radio Broadcast for twelve months.

GRID INQUIRY BLANK

Editor, The Grid,
RADIO BROADCAST,
Garden City, New York.

Dear Sir:

Attached please find a sheet containing questions upon which kindly give me fullest possible information. I enclose a stamped return envelope.

(Check the proper square)

- I am a subscriber to RADIO BROADCAST. Information is to be supplied to me free of charge.
- I am not a subscriber. I enclose \$1 to cover costs of a letter answering my questions.
- I would like to become a subscriber and enclose \$4.00.

My name is _____

My address is _____
Gda.

Radio Broadcast's NEW BOOK

Written by

Walter Van B. Roberts



W. VAN B. ROBERTS
Originator of the famous Roberts Circuit

EVERYONE will be delighted with the news we have to unfold. Mr. Walter Van B. Roberts, whose circuit has been used by so many enthusiastic constructors, has compiled a book entitled "How Radio Receivers Work."

In this book he has covered the entire field of radio in a most interesting, intelligent, and capable manner. He understands his subject well enough to cut the corners without leaving the reader to take any of the facts for granted merely because they are given as facts. He has proof for everything, and very interesting proof at that.

The titles of the chapters will give you an idea of the material contained between the cloth covers of this book, so we list some of them herewith: "One Syllable Electrical Theory," which includes information on what electrons are and what they do; and the use of condensers and transformers. "What Antenna Is Best," both for receiving and sending, and information as to the best time to tune in for good reception. "Common Vacuum Tube Circuits," with descriptions of the vacuum tube as a detector, oscillator, and amplifier, the method of feed-back and push-pull amplification and the requirements for a tube oscillator circuit. "Essential Accessories," which include loud speakers, batteries and tubes. There are other chapters of like interest.

It is difficult to find an author who really knows all these subjects thoroughly and who is gifted with the happy faculty of telling what he knows in language which may be understood by other than scientific minds. Mr. Roberts is such an author, and we are pleased to broadcast the announcement that this 53-page book is now ready for distribution at the nominal price of \$1.00.

A dollar and the accompanying coupon will make you the possessor of Walter Van B. Roberts' book—"HOW RADIO RECEIVERS WORK."

DOUBLEDAY, PAGE & CO.
Garden City, New York

Enclosed find my dollar for Radio Broadcast's new book by Walter Van B. Roberts, "How Radio Receivers Work." It is understood that my dollar will be returned if the material sent me does not come up to my expectations.

Name.....
Address.....

Three-fourths of Your Christmas Shopping Done in Five Minutes TO-DAY!

Why not, this year, dispense with all last minute shopping and give yourself the luxury of a leisurely unharassed (and unharassing) merry Christmas, incidentally giving your friends what they will like above all things.

We are not making extravagant claims for Harpers Magazine as the perfect universal Christmas gift. Several on your list, frankly, won't be interested in it.

Ingeborg, the new laundress will doubtless get more real comfort out of a serviceable blouse; the baby is a little young for some of the articles—especially Rebecca West; and Fido would only worry it and make a mess. BUT, the great majority will find more to amuse and enliven them in 12 monthly visits of Harpers than in any other gift you could present.

Your father will find food for thought in the unconventional, clear sighted discussions on American life by Duncan Aikman, Charles Merz, Bertrand Russell. Aunt Valerie, that lady of dazzling clothes and sparkling conversation, confesses that like all of the smart people she knows, she is finding the new Harpers indispensable for the sophisticated, enquiring mind.

For Kenneth, one of the younger intellectuals, it is the obvious choice. Likewise, for Honoria. These two follow, with lively comment, the stories of Christopher Morley, Aldous Huxley, Van Loon, and the poetry of Edna St. Vincent Millay.

Moreover, there are countless features which are absorbing to all; Dr. Fosdick's monthly department, "Religion and life," the finest fiction from America and England, points of view from and about Europe, and brilliant biography and history.

Fill in the coupon below, return it to us, and the major part of your Christmas gifts are purchased and wrapped—to be delivered with a gay Christmas card at the proper time. Moreover, for every gift subscription over one, we will give a holiday price of \$3.00—instead of the regular yearly rate of \$4.00.

SPECIAL HOLIDAY OFFER

HARPERS MAGAZINE R
49 East 33d Street, New York, N. Y.

Take a load off my mind and send Harpers Magazine for a year to the following names. Bill me later, three dollars for each subscription.

Name

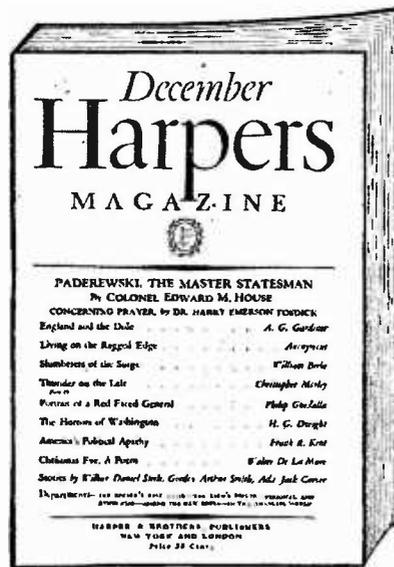
Address

Name

Address

My Name and Address.....

(You may send an unlimited number. Attach this coupon to a list of your own if this doesn't give you enough space.)



The New Harpers Magazine is Established!

From the moment its vivid cover first appeared, the new Harpers has been phenomenally successful. As the first number—September—disappeared with gratifying rapidity from the newsstands, hundreds of letters, spontaneous and enthusiastic, flooded the editorial offices.

Then the October number appeared—and the November, more than fulfilling the bright promise of September, and the letters began to say, "You've done it! You're getting out numbers each one better than the last."

Meanwhile the newsstands sales and new subscriptions continue to mount. And in all circles where educated Americans gather, where talk is spirited and fearless, Harpers Magazine is once more acclaimed as the leading magazine of American thought.

THE DECEMBER NUMBER CONTAINS

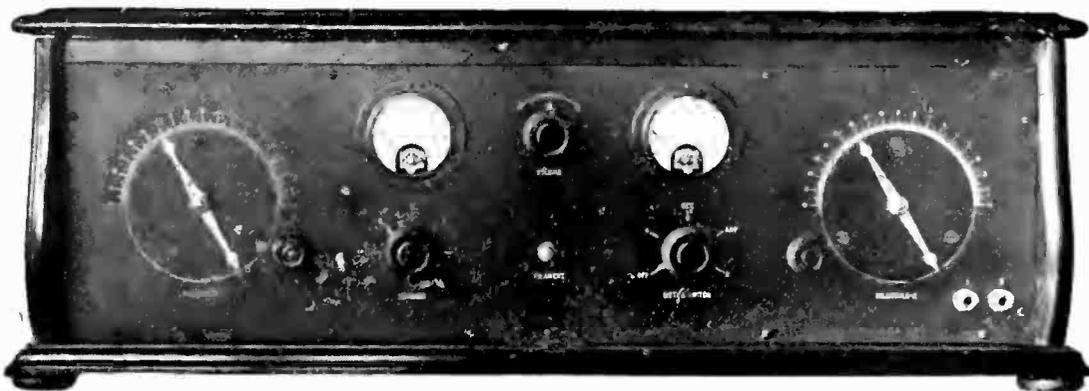
MODERN MARRIAGE <i>by Dr. Beatrice M. Hinkle</i>	COLONIAL HISTORY DEBUNKED <i>by Harold W. Faulkner</i>
PADEREWSKI, THE PARADOX OF EUROPE <i>by Colonel Edward M. House</i>	THUNDER ON THE LEFT, PART IV <i>by Christopher Morley</i>
CONCERNING PRAYER <i>by Dr. Harry E. Fosdick</i>	PORTRAIT OF A RED FACED GENERAL <i>by Philip Guedalla</i>
ENGLAND AND THE DOLE <i>by A. G. Gardiner</i>	THE HORRORS OF WASHINGTON <i>by H. G. Dwight</i>
LIVING ON THE RAGGED EDGE <i>Anonymous</i>	AMERICA'S POLITICAL APATHY <i>by Frank R. Kent</i>
SLUMBERERS OF THE SURGE <i>by William Beebe</i>	CHRISTMAS EVE <i>by Walter de la Mare</i>

STORIES: *Wilbur Daniel Steele, Gordon Arthur Smith, Ada Jack Carver*

DEPARTMENTS: The Editor's Easy Chair—The Lion's Mouth—Personal and Otherwise—Among the New Books—In the Financial World.

Harpers

MAGAZINE



The Best in the World

No Batteries

are required even to operate the most powerful 10-tube receiver pictured above, if you use the new laboratory type

Model A Power Unit

One Customer Telegraphs:

"Receiver assembled, performing like a thoroughbred."

The Amateur or Experimenter with his ultra-modern high-powered receiver is years ahead of Commercial Radio.

It is significant that unsolicited testimonials are constantly being received from even the far corners of the earth, where Norden-Hauck Engineers have furnished the finest radio apparatus known to the art today.

Quotations gladly furnished on radio parts and apparatus having non-infringing uses.

Write for Literature ★

NORDEN-HAUCK, Inc.

Engineers

1617 Chestnut Street, Philadelphia, Pa.

The November Radio Broadcast

Like a gilt edged bond issue was over subscribed and sold out almost before the ink had become dry. If you have difficulty in getting December number send us your subscription at once. One year Four Dollars, Two years Six Dollars

ELIMINATE Your STORAGE "A" BATTERY for Reflex Radios

With a BLAX A. C. POLARIZER as part of your Reflex Radio equipment all "A" Battery troubles are eliminated. It saves the inconvenience and cost of monthly recharging and provides against interruption and "hum".

Attach Set to Light Circuit
Get Constant Reception—

—you can, the same as thousands of others are. Simply use a

BLAX A.C. POLARIZER

and you'll provide for uniform reception all the time. BLAX A. C. POLARIZER is simple to attach, cannot get out of order and will last a life time.

First Cost is the Last Cost.—Order NOW!

Don't be bothered again, affix a BLAX to your Set as soon as you can and you'll wonder how you ever did without one. State Representative wanted. Dealers investigate. **\$1.00 Postpaid**

BLACK BROS., INC.
917 Black Bldg., Los Angeles:

Enclosed find \$1.00 bill. Send Blax at once.

Name

Address



New Perpetual LOG

Loose Leaf for Revisions — Radio Map FREE

New 64 page log. Corrected sheets may be secured as changes in calls, wave lengths, owners, etc., occur. Holds 504 stations. Shows call, city, wave lengths, a dial settings, remarks, etc. Tuning suggestion. Station list by wave lengths — by states, etc. Other valuable information. So convenient. Worth many times small cost. A joy to use. Only \$1. Pay postman after log arrives. Postpaid if pay with order. Money refunded if not delighted. Order today—now. Radio Printers, Dept. 3379, Marengo, Ill.

A Laboratory Product ★ CRESCENT LAMITE RESISTANCES

for Distortionless Amplification

Used by chief radio experimenters and amateurs in America. All capacities, 12,000 ohms and up. Special sizes made to order. Write today for full information. Liberal discounts to dealers.

Crescent Radio Supply Co. Liberty St., Jamaica, N. Y.

The MOLLIFORMER "B" UNIT REPLACES "B" BATTERIES



SEND FOR complete description of this powerful B Unit, that you can build in an hour, at most reasonable cost. Uses the current from the light socket. Excellent for Supers and all TRF sets. Assures greater clarity, DX and volume—noiseless, no tubes or acids—utilizes full wave rectification. GUARANTEED TO GIVE COMPLETE SATISFACTION OR YOUR MONEY REFUNDED.

BUILD your own, and have enough voltage for the new tubes or resistance coupled amplification. The Molliformer will supply 20 milliamperes at 135 volts or 40 milliamperes at 90 volts. Has variable detector and amplifier tap. Guaranteed to be free of hum even when used for DX work with best audio transformer. Operating cost is 1/10¢ per hour.

Read "Notes on Chemical Plate Supply Units" by James Millen in October Radio Broadcast

PRICE

COMPLETE KIT 60 Cycle Unit 110-125V... \$22.50
COMPLETE KIT 25 Cycle Unit 100-120V... 24.50

Price includes full wave rectifiers
Parts sold separately if desired

DEALERS write for discounts ★

C. E. JACOBS, Sole Mfr.

2804 N. Kedzie Ave. Chicago



DRILL and machine the Goodrich Silvertown Radio Panel with full confidence—no special tools are required—it won't break at the edge, crack or chip.

It is made with a full degree of Goodrich skill and rubber knowledge, after long study of radio requirements—the product of a company that has always held quality and service as first considerations.

Science says that rubber is the best material for panels. Then by all means buy the *best* rubber panel—and that brings you straight to Goodrich Silvertown.

Fifty-five years of rubber manufacturing experience are a guarantee of greatest efficiency in the following products Goodrich has built for radio—

Goodrich V. T. Sockets Spaghetti Tubing
Goodrich Variometers Unwound Battery Mats
Goodrich Radiophone Ear Cushions

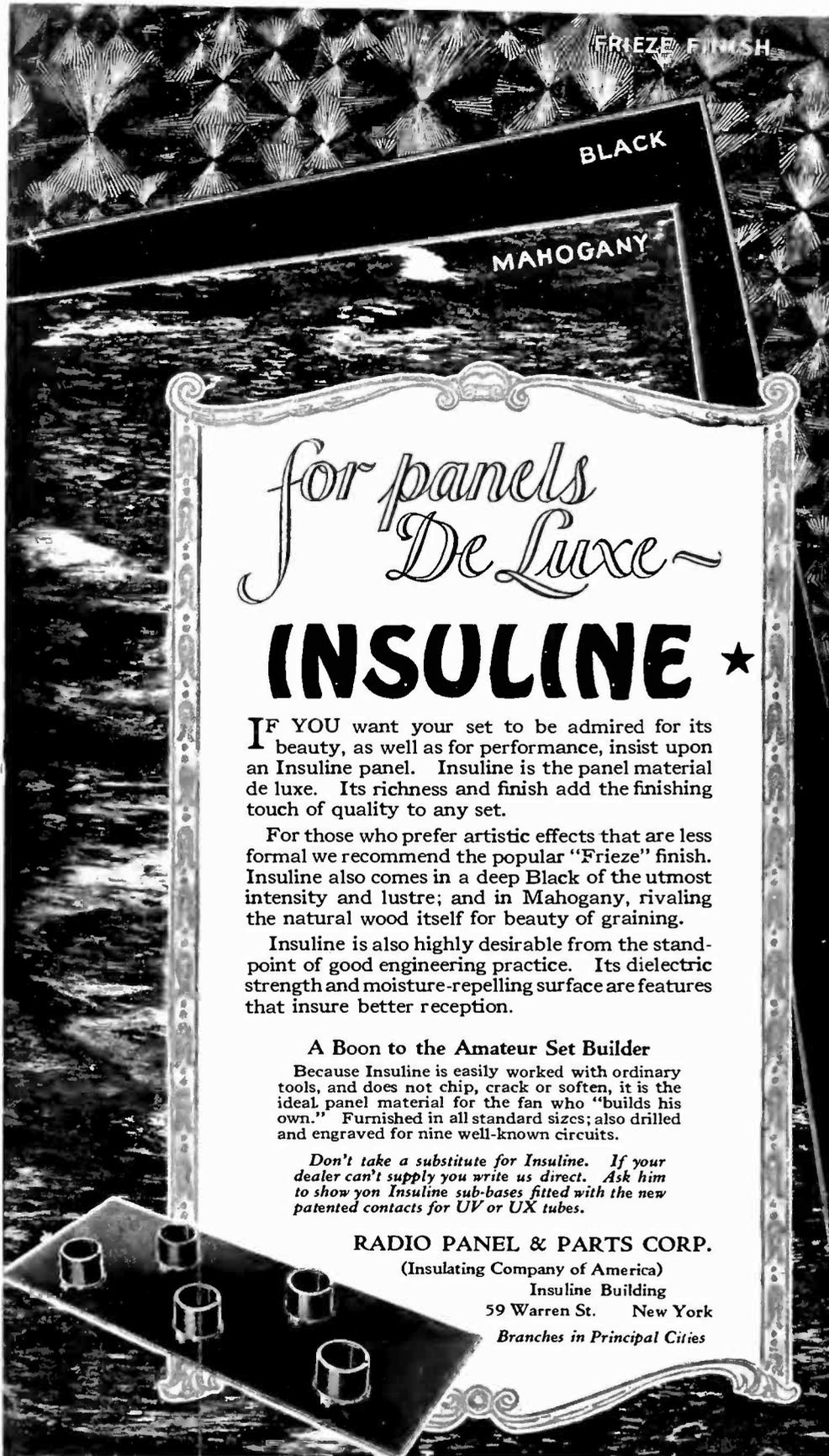
The B. F. Goodrich Rubber Company
Established 1870 Akron, Ohio

- 1 Easier to drill and machine.
- 2 Better color, lasting luster.
- 3 Lower free sulphur — no discoloration.
- 4 Higher softening point — no warping.

Goodrich Silvertown

The Radio Panel Supreme!

★ Tested and approved by RADIO BROADCAST ★



FRIEZE FINISH

BLACK

MAHOGANY

for panels
De Luxe

INSULINE

IF YOU want your set to be admired for its beauty, as well as for performance, insist upon an Insuline panel. Insuline is the panel material de luxe. Its richness and finish add the finishing touch of quality to any set.

For those who prefer artistic effects that are less formal we recommend the popular "Frieze" finish. Insuline also comes in a deep Black of the utmost intensity and lustre; and in Mahogany, rivaling the natural wood itself for beauty of graining.

Insuline is also highly desirable from the standpoint of good engineering practice. Its dielectric strength and moisture-repelling surface are features that insure better reception.

A Boon to the Amateur Set Builder

Because Insuline is easily worked with ordinary tools, and does not chip, crack or soften, it is the ideal panel material for the fan who "builds his own." Furnished in all standard sizes; also drilled and engraved for nine well-known circuits.

Don't take a substitute for Insuline. If your dealer can't supply you write us direct. Ask him to show you Insuline sub-bases fitted with the new patented contacts for UV or UX tubes.

RADIO PANEL & PARTS CORP.
(Insulating Company of America)
Insuline Building
59 Warren St. New York
Branches in Principal Cities

Could You Use More Money?

No matter what your present income is, wouldn't you like some extra cash?

Well, here's your chance to get it!

DOUBLEDAY, PAGE & CO. wish to enlist earnest and reliable men and women throughout the country who will appreciate an opportunity to make money.

Our plan insures immediate cash returns, in amounts limited only by your own ability.

This is no ordinary subscription proposition. You can't afford to overlook it.

Write Agents' Service Division

DOUBLEDAY, PAGE & CO.

Garden City, N. Y.

DURHAM

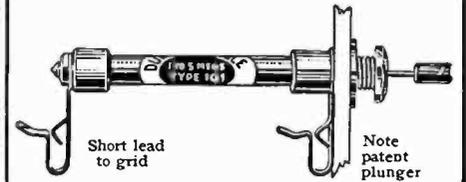
Variable Leaks

Make Good Tubes Better



Standard Type

For any set. Snap in place of present fixed leaks. Adjustable in line with tube makers' instructions. **75c**



New Panel Mount

Accurate control of detector or audio at your finger tips brings better results. Put in a DURHAM to-day. **\$1**

There's a DURHAM for every need

No. 100—1,000 to 100,000 ohms (audio)
No. 101—0.1 to 5 megohms (for UV-200 and WD-12 tubes)
No. 201A—2 to 10 megohms (for UV-199 or 201A tubes)

DURHAM & CO., Inc.
1930 Market St., Philadelphia

Increase Distance, Volume, Clarity

"Colytt" adjustable grid leak improves receiving. Gives proper value of leak in grid circuit, and holds it. Simple, compact, easy to install, only one hole in panel. Tunes any tube perfectly.

\$1.00

Complete



Try the "Colytt" on Money-back guarantee. \$1.00 complete, with full directions. 3301

R. B. Colytt Laboratories

565 Washington Blvd., Chicago



Why not subscribe to *Radio Broadcast*? By the year only \$4.00; or two years, \$6.00, saving \$2.40. Send direct to Doubleday, Page & Company, Garden City, New York.

GENUINE
BAKELITE

Radio Panels

We cut, drill and engrave for you Radio Panels of genuine Bakelite.

Send rough sketch for estimate. A properly drilled and engraved panel ready for mounting is half the job of construction. Plain panels shipped C. O. D. same day order is received. Write for New Catalog on Radio Panels, Tubes and Rods—all of genuine Bakelite.

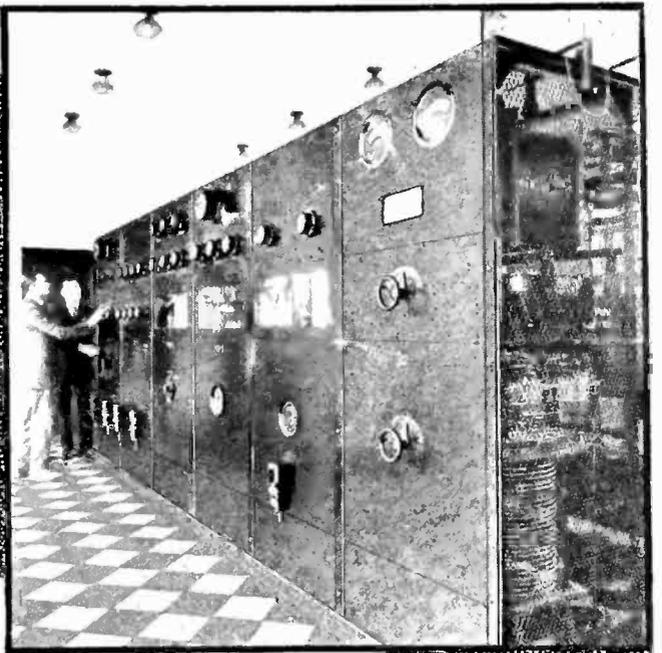
STARRETT MFG. CO.
521 South Green St.
CHICAGO

Be a RADIO EXPERT

They Earn \$50. to \$250 a week in Radio—most fascinating work on earth



Learn Quickly And Easily At Home This Practical Way ~ ~ ~ ~



Train At Home For A Big-Pay RADIO JOB

Radio to-day is urgently in need of trained men—Radio Experts. Astonishing opportunities—thousands of them—have been opened up by enormous strides of the Radio Industry. That's why it's easy to make big money in Radio—\$50 to \$250 a week. Here's a field that is teeming with opportunities and room for expansion—a brand-new, wide-awake, and uncrowded industry. If you're earning a penny less than \$50 a week, clip coupon now for Free Book and proof.

Instruments Given With Course

Receiving sets, from simplest kind to thousand mile receiver, included without extra charge in your course. Other apparatus given to help you learn. An UNEQUALLED OFFER. Many other big features for limited time only.

Get This Book

"Rich Rewards in Radio"—most amazing book concerning Radio ever written, will be sent to you promptly when you send the coupon. ACT NOW.



Your Satisfaction Guaranteed

Master Radio Engineers will show you how to qualify, quickly and easily at home, for Radio's fine jobs. We guarantee to train you successfully. You don't risk a penny, for we will gladly return every cent paid in tuition if upon completion of course you aren't absolutely satisfied. Back of this guarantee stands all the resources of National Radio Institute, U. S. Government-recognized and the oldest and largest Radio home-study school in the world.

Famous Course That "Pays For Itself"

Spare time earnings are easiest in Radio-receiving sets everywhere nowadays. In every neighborhood there are scores of jobs you can turn your hand to in an hour or so after supper. Right at the start of your course we give you practical money-making lessons which teach you how to do this work, then how to get it—so by our practical plan you can make your course pay its own way while you're studying.

Age or Lack of Experience No Drawback

You don't need experience before taking this course, and common schooling is enough. Our tested, practical methods make learning clear and easy—the most natural thing on earth.

Get All The Facts At Once

Astonishing facts on the marvelous new industry of golden rewards—Radio—the fastest-moving, live-wire line. Free Book puts all the facts before you. No obligation. Send coupon for it now.

NATIONAL RADIO INSTITUTE
Dept. 31-OB Washington, D. C.

Government Spending Millions on Radio

U. S. Government now spends millions developing, using Radio. Ex-Postmaster General Hays said: "Probably the biggest part in the future of the postal service will be played by Radio." Photo above—sending out time signals at Arlington, great Government Radio station at Washington—Radio is fitting new uses, filling new needs never dreamed of before. Radio Experts are in greater demand than ever.

Send Coupon Now

Get out of the low-pay rut, get into the most fascinating, easiest big-pay profession on earth. Free Book tells you how. ACT AT ONCE—SEND FOR BOOK TO-DAY.

N.R.I. TRAINED MEN ARE SUCCEEDING BIG



Operates WMAQ

"Accepted a position with Chicago Daily News—Station WMAQ. My income practically doubled, thanks to your fine course." Keith Kimball, Chicago, Ill.



Gets Big Job

"Just been made Sales Manager of this Radio concern—a big raise in pay. Regret I did not take course sooner." R. E. Jones, Bay City, Mich.

"Your course so completely covers Radio it is worth \$40 a week more to anyone in the electrical line. Since graduation have averaged \$50 to \$80 a week more." Preston Fowler, Gordon, Nebraska.



"My charges for consultation now \$250 per hour. The course is worth to me at least \$50,000." R. W. Blackhill, Brooklyn, N. Y.



"The N. R. I. Course has been worth \$500 a year to me, \$3500 in another year. Thanks a million times to your training." Andrew Shurie, Latrobe, Pa.



"Your course worth \$500 a year to me—Radio a gold mine. All my success due to your splendid course." A. R. Herke, Winnipeg, Canada.



You Can Do What Others Have Done

Why go along at \$15 or \$25 or \$35 a week, when thoroughly-trained Radio Experts earn a hundred or more in the same six days? What this training has done for hundreds of others it can do for you. Send coupon at once.

MAIL THIS COUPON

NATIONAL RADIO INSTITUTE,
Dept. 31-OB, Washington, D. C.

Without obligating me in any way, send your Free Book "Rich Rewards in Radio"—also full information on your practical, home-study Radio course.

Name

Address

Town..... State

LARGEST RADIO SCHOOL IN THE WORLD

ORIGINATORS OF RADIO HOME-STUDY TRAINING



Revolutionizing because of the application of new and fundamentally sound principles to the rectifier.

Cl B-eliminators or parts, specially designed for use with RAYTHEON tubes are made by these and other well-known manufacturers, and are now on sale at your dealer's:

- Acme Apparatus Co., Cambridge, Mass.
- All-American Radio Corp., Chicago, Ill.
- Dongan Electric Mfg. Co., Detroit, Mich.
- General Radio Co., Cambridge, Mass.
- Jefferson Electric Mfg. Co., Chicago, Ill.
- Mayolian Radio Mfg. Co., New York, N. Y.
- Thordarson Electric Mfg. Co., Chicago, Ill.
- Tobe Deutschmann Co., Boston, Mass.

RAYTHEON ★

Long Life \$6 Economy
No Filament Reserve Power

RAYTHEON MANUFACTURING CO., Cambridge, Massachusetts
Formerly AMERICAN APPLIANCE CO.

BLUE PRINTS FOR THE "ARISTOCRAT" RECEIVER DESCRIBED BY ARTHUR H. LYNCH IN THE NOVEMBER MAGAZINE CAN BE NOW OBTAINED AT YOUR RADIO DEALER. IF HE CANNOT SUPPLY YOU SEND US HIS NAME AND ADDRESS.

Price one dollar for complete set.

The VEBY Resistance Coupled Amplifier

At last! The VEBY, a Resistance Coupled Amplifier that will actually fit within any of the present day commercial sets. Size 5 x 7 inches—just right. Absolutely the smallest, yet the most perfect amplifier offered the public—nothing else to buy. The price is \$12.00.

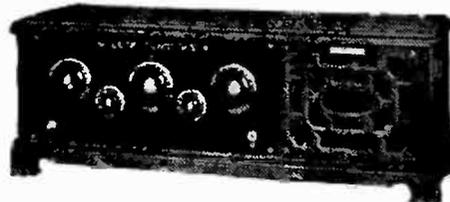
VEBY TUBES for Resistance Coupled Amplifiers A. F. 20..... \$3.00
VEBY POWER TUBES A. F. 6 for the last stage of Amplifier..... \$4.50

VEBY PRODUCTS are uniform at all times—you can depend on them. Resistors, Grid Leaks and Mounts. Manufacturers, Distributors and Dealers write or wire for particulars.

VEBY RADIO COMPANY
"Quality Resistors"
47-51 Morris Avenue
NEWARK N. J.

RADIO AGENTS WANTED

You Can Now Earn a 5 Tube Demonstrator FREE!



In addition to \$25 to \$100 a week, part or full time. Everyone a prospect. Complete line standard sets and accessories, \$5 to \$90. Write today for illustrated catalog and exclusive selling plan for live dealers and community agents. 20TH CENTURY RADIO CO., 1045 Coca Cola Bldg., Kansas City, Mo.

This is a good time to subscribe for
RADIO BROADCAST
Through your dealer or direct, by the year only \$4.00
DOUBLEDAY, PAGE & CO. GARDEN CITY, NEW YORK



PUR-A-TONE AUDIO COUPLER

An Improved Resistance Coupler



Standardized, interchangeable for all stages, capable of withstanding high voltages. Pur-A-Tone is recognized by radio engineers of national repute who seek to attain maximum results.

BRACH-STAT Automatic Filament Controls eliminate need of hand rheostats on all amplified circuits.

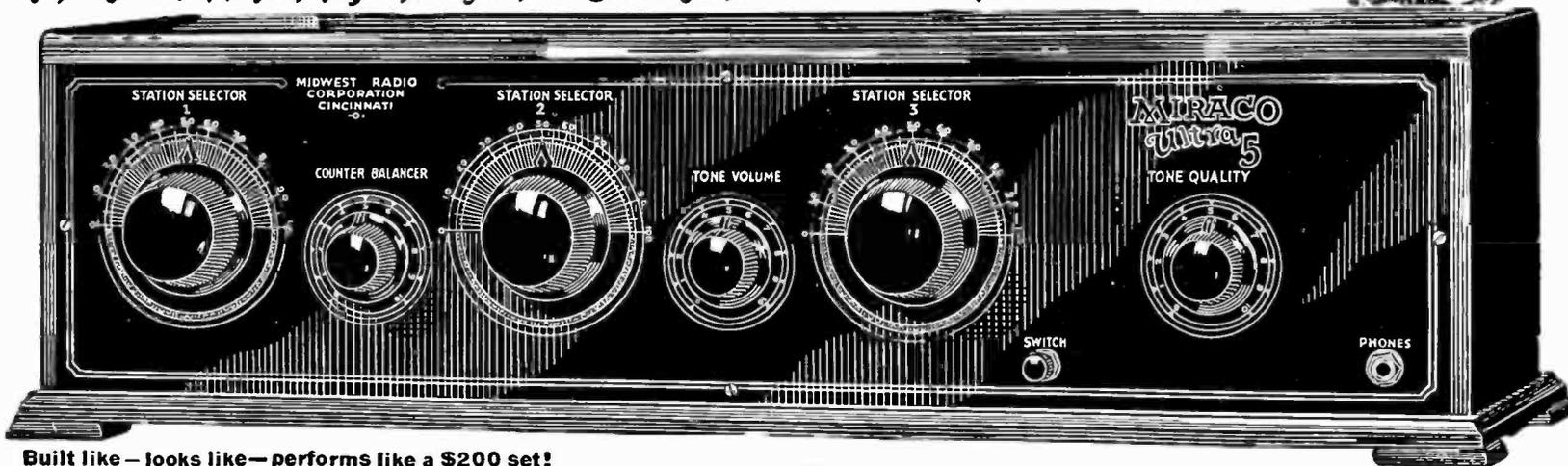
At All Dealers ★

L. S. BRACH MFG. CO.
NEWARK NEW JERSEY

"It's a real musical instrument—clear as a crystal"
"Unsurpassed for clearness, selectivity, long distance and volume"
"Tone is wonderfully clear and powerful"
"Distant programs come in loud and clear on speaker"
"Friends say it's the best and clearest they've heard"
"Beats 'em all for distance and clear tone"
Amazingly selective—easy to tune and log"

Our Amazing Special Offer will interest you—send for it!

Now only
\$59.50
 Retail



Built like—looks like—performs like a \$200 set!

MIRACO RADIO GETS 'EM COAST TO COAST

Notice!

Enormous demand for the celebrated Miraco Ultra 5 (resulting from its many enthusiastic users so highly recommending it to their friends) enabled us to add hosts of costly new features, latest refinements and up-to-the-minute improvements such as you might expect to find only on the newest sets selling at much higher prices. So the Improved Ultra 5 for 1926 is even a hotter set—a more beautiful set—a more selective and more powerful set—incredible as this may sound!—for less money than ever before.

COAST TO COAST RECEPTION VERIFIED BY USERS

Reports from Ultra-5 users everywhere leave little for us to add. These are only a few of the many in our files and which we receive daily. Send coupon for plenty of additional proof. Let testimony of users instead of high-sounding claims convince you.

MANY SAY IT'S BEST THEY'VE HEARD

"Ultra 5" more than meets my expectations of a good radio set. Many think it is the best that they have heard. For volume, selectivity, clearness and long distance it is unsurpassed in my estimation. Penna. Auto Supply, Alleutown, Penna.

PRaises THE FINE TONE AND VOLUME

The Ultra-5 has a fine tone and good volume; last night had 24 different stations from 8 to 10—all on loud speaker. O. T. . . . Malone, New York.

THE TONE IS "WONDERFULLY CLEAR AND POWERFUL"

Am more than pleased with my 5 tube Miraco. Tone wonderfully clear and powerful. D. C. . . . Detroit, Michigan.

MORE PRAISE FOR MIRACO TONE QUALITY

The Ultra-5 received from you is the best I ever heard. It is just as clear as a crystal. Raymond W. . . . Massachusetts.

ONE OF THE CLEAREST EVER HEARD

All who have heard my Ultra-5 set pronounce it one of the clearest they have heard, and I must say that the MIRACO in every way is represented by you. George Colville, Washington.

MONTANA HEARS BOTH COASTS

Ultra-5 set in O. K. Have got them. New York to Los Angeles. Winnipeg to Dallas, Texas, W. H. Pelson, Montana.

OHIO GETS 'EM COAST TO COAST

We are enjoying the Ultra-5 Radio. It is all you recommended. We get stations on the east coast, south and west coast. Walter Buren, Ohio.

CALIFORNIA THE FIRST NIGHT

Headphones are not necessary with the Ultra-5 I had KFI, California, the first night with same volume as Pittsburgh. Fred G. Liverpool, Ohio.

COAST TO COAST FROM OKLAHOMA

With Miraco five tube set am getting stations on the Pacific and Atlantic coasts. Yerker E. Pauls Valley, Okla.

"COAST TO COAST" A REALITY

The two Miraco-5's have been working fine, in fact far beyond our expectations. Your statement of "coast to coast" reception proved absolutely a reality. T. D. Houston, Texas.

MICHIGAN GETS COAST TO COAST

I am overly pleased with the Miraco Ultra-5. Can get stations from coast to coast and from Texas to Canada. Geo. O' Gordon, Michigan.

LOTS OF VOLUME—20 STATIONS FIRST NIGHT

Will drop you a few lines to let you know that I received my Miraco Ultra-5 and that it works fine. Had 20 stations the first night. It has lots of volume. Fred Versailles, Ill.

The reports we print are from UNSOLICITED letters sent us by pleased users.

INDIANA HEARS BOTH COASTS

Miraco Ultra-5 is a first-class set in every respect. It can't possibly be beat for the price. The first night I received over twenty stations from both coasts. Adolph M. Indianapolis, Indiana.

MINNESOTA HEARS COAST TO COAST

Received Ultra-5 in fine condition. Has received programs from stations all over the United States and Canada. We find it is one of the best sets in this locality. We are well pleased with the wonderful results. Clarence Nashwauk, Minn.

HEARS CALIFORNIA TO EUROPE

Enclosed is a partial list of the stations I received with the Miraco Ultra-5: KSD, WEBB, WBAV, WEA, WLW, WCHD, WHB, WOR, WJAZ, WOC, WHAS, WWJ, WKYC, WCKY, WCK, WQ, WJ, KFAB, WHAA, WAST, WCAF, WTAS, WQJ, KFXX, WAAW, WTA, WOA, WSOE, WGO, WDK, WBA, WMO, WCR, WLS, WHI, WEZ, WNH, KFNE, KFI, WEJ, WVL, WFAA, WAF, WGY, CKY, WRR, WCAE, WEAQ, WRC, FFD, WJD, WGR, WABN, WCA, WLB, WBN, WMA, WJL, WLS, WOA, WOO, WOS, CFAC, Sheffield (Eng.), Paris (France), Carl H. Waukesha, Wis.

MONTANA HEARS CALIFORNIA TO IRELAND

I am more than pleased with the Ultra-5 Receiver. I have 30 stations on my record in 20 days' time, including: D.K., WCAL, KFLE, WFC, WCC, WIAM, WEA, WEM, WGM, WCA, WLW, CAM, GCF, WJ, WAB, KAF, KOOW, WCOO, WOC, WCA, WHO, WCO, WOA, CFAC, WOA, WOS, WCK, KPPU, KBB, KPO, KFAA, WMC, CKY, WCFE, WMAW, WBA, WGN, KJR, WHI, WOS, WMC, WJ, WGAN, KRU, WGV, WLW, WOI, WHB, WFAI, WJAZ, KGB, WCAF, KSAC, WTAP, KSKI, KFAA. On February 16th at 12:15 o'clock I received Ireland, the distance being several thousand miles. Richard Comertown, Mont.

WEST VIRGINIA HEARS AUSTRALIA

Got 2-XB Wellington, Australia, plain last night at 12:40 A.M. over the Ultra-5 Miraco you sold me. I am delighted and would not trade for any instrument in town. Geo. Glen Ferris, West Va.

ALL WE CLAIM . . . AND MORE.

Miraco Ultra "5" Set installed yesterday evening—had wonderful results last night. Think Ultra "5" is all you claim and more. V. A. Hampshire, Tennessee.

The Powerful New
MIRACO Ultra 5

Guaranteed by One of the Oldest Radio Builders

Tested and Approved by Radio's Highest Authorities

[ULTRA SELECTIVE FIVE TUBE SET IN MAHOGANY CABINET]

You can either save or make a lot of money on sets and supplies by sending coupon today for our Amazing Special Offer! It will astonish you. Big profits easy—accepting orders for Miraco Sets. Only necessary to order one set to demonstrate in your home. No agreements to sign—no salesmanship required. The performance of Miraco Sets does the selling. Greatest demand in the six years we have been building sets—we need more user-agents to supply it.



The improved new Miraco Ultra-5 is a beautiful Hand-etched genuine Formica panel and large Bakelite knobs with "arrow point" indicators (for fine tuning) add to the stylish appearance. Mahogany cabinet is hand rubbed. A radio you will be proud to have your friends see and proud to have them hear perform.

This latest improved 1926 model Miraco Ultra 5—completely built, thoroughly tested and factory guaranteed by the Midwest Radio Corporation, one of America's oldest, reliable and most successful makers of quality sets—is an astonishing bargain

In the opinion of radio experts. Selectivity, long distance reception, clarity of tone, power and volume have been amazingly increased—"B" battery consumption is minimized—oscillations are easily controlled on all wavelengths, through use of latest radio inventions. Among these are: "Duoformers" (ultra low-loss inductance coils); the "Counter-Balancer" (patented); flexible wiring which prevents broken or noisy connections; an adjustment for different length aeriels; use of only two rheostats; a cut-out switch; concealed wiring under genuine Formica base-board and other features of costliest sets. Literature describes them fully. Send for it—and Special Offer that will surprise and interest you.

AGENTS! DEALERS!

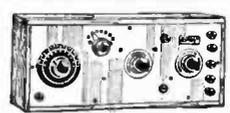
Write for the new Miraco proposition. Nation-wide use and popularity of Miraco sets, coupled with their amazingly low prices make them wanted everywhere.



Other Miraco Long Distance Sets \$13.75 up, retail



Wonderfully improved new models in one-tube and three-tube Miraco Long Distance Sets also ready at lower prices! New Miraco R-3a only \$27.35 (retail) operates loud speaker on distant stations. New one-tube Model R is also a record-breaker for distance at \$13.75. All Miraco sets work on storage or dry batteries, are easily connected and operated. Unmatched values! Let testimony of users convince you. Write for literature and Special Offer—use coupon.



All the Proof you want is waiting for You!

Reports from hosts of users in every state prove Miraco sets—at rock-bottom factory prices—outperform sets costing up to three times as much. Send for latest literature, SPECIAL OFFER and plenty of additional testimony leaving no doubt that "Miraco Radio Gets 'em Coast to Coast."

MIRACO RADIO GETS 'EM COAST TO COAST

Send coupon for Amazing Special Offer!

MIDWEST RADIO CORPORATION
 Pioneer Builders of Sets
 Cincinnati, Ohio

406-L East Eighth Street
 Send free literature, AMAZING SPECIAL OFFER and all particulars regarding your big money-saving proposition on Guaranteed Miraco Sets and all radio supplies.
 Agent User Dealer.

NAME.....
 ADDRESS.....



The
SAAL
Soft **SI** **PIEAKIER**
with the Bakelite Bell



\$25
West of Rockies,
\$26.50
In Canada, \$35

THE bell of the Saal Soft Speaker is of genuine Bakelite, the most perfect and resonant of all radio materials. The neck is of aluminum. There is no wood, no tin, no composition. The reproducing unit is of all-metal construction and cannot be harmed or "blasted" by the loudest receiver. It maintains its tone with any volume. There is no adjustment knob to complicate tuning.

When your customer has bought the Saal he has bought once and for all. He has bought a speaker built to last a lifetime, one that will render permanent service and satisfaction and build up good will for you. It has nothing to wear out or deteriorate. It is guaranteed to give satisfaction.

The Saal Soft Speaker does not choose between

volume and tone quality. It combines volume with a velvet tone. It is not a fad. It is not a trumpet. It is a faithful reproducer of radio programs, properly constructed and shaped for the accurate reproduction of sound. It removes the objection to loud speakers. It has no blare, no blast, no metallic ring.

In appearance the Saal, with its black bell, black crackle throat and graceful lines, is the aristocrat of horns. Also furnished with a brown bell and gold or silver stippled throat at \$5 extra. The Saal Soft Speaker is manufactured by a company with years of experience in the music business. A large plant insures prompt delivery. It is thoroughly advertised. Order from your jobber. Jobbers write to us.

SAAL Jr.
The same in every respect as the Saal Soft Speaker, except it is 18½" instead of 21½" in height. **\$20**
West of Rockies, \$21
In Canada, \$27.50

Manufactured and guaranteed by

H. G. SAAL COMPANY, 1800 Montrose Avenue, Chicago, Ill.

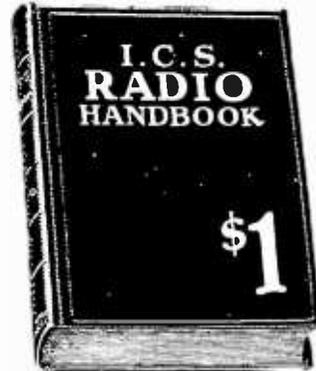
Are You a Radio Dealer?

WE want Radio Dealers to get in touch with us as we have an interesting proposition for them in connection with *Radio Broadcast Magazine*.

Radio Broadcast is read by a class of readers who have money to spend on radio. The majority of them are radio constructors, they are buying parts and building sets all the time. They are always experimenting because radio is their hobby. Write us for our Dealer's proposition and information on how *Radio Broadcast* will create sales for your store.

Radio Broadcast, Garden City, N. Y.

This
RADIO BOOK
will save you money!



Compiled by
HARRY F. DART,
E.E.

Formerly with the
Western Electric
Co., and U. S.
Army Instructor
of Radio.

Technically edited
by F. H. DOANE

514 PAGES—ONLY \$1

ONE of the most complete books 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. Contents—

Electrical terms and circuits, antennas, batteries, generators and motors, electron (vacuum) tubes, most receiving hook-ups, radio and audio frequency amplification, broadcast and commercial transmitters and receivers, wave meters, super-regeneration, codes, license rules. Many other features.

Just mail the coupon with a dollar bill and your name and address, and this 514-page I. C. S. Radio Handbook will be sent to you by return mail. Note the other good books listed below at low prices.

INTERNATIONAL CORRESPONDENCE
SCHOOLS

Box 8296-E, Scranton, Penna.

I enclose \$....., for which send me, post-paid, the Handbooks marked X, at \$1 each. It is understood that if I am not entirely satisfied I may return them within five days and you will refund my money.

- RADIO HANDBOOK, 514 PAGES, \$1
- Automobile Handbook, 354 pages - - - \$1
- Electrical Handbook, 414 pages - - - \$1
- Chemistry Handbook, 348 pages - - - \$1
- Pharmacy Handbook, 324 pages - - - \$1
- Traffic Handbook, 386 pages - - - \$1
- Building Trades Handbook, 409 pages - - - \$1
- Machine Shop Handbook, 335 pages - - - \$1
- Salesman's Handbook, 352 pages - - - \$1
- Advertising Handbook, 445 pages - - - \$1
- Bookkeeper's Handbook, 302 pages - - - \$1
- Civil Engineer's Handbook, 411 pages - - - \$1
- Steam Engineer's Handbook, 298 pages - \$1

Name.....

Address.....

Enclose \$1.50 instead of \$1 for each book if you want the Leathroid binding. All of the above books can be had in this binding except the *Traffic Handbook* and the *Building Trades Handbook*.

IF you like this magazine with its coated paper and enlarged size—then why not subscribe and get it regularly—by the year, \$4.00, Six months, \$2.00.

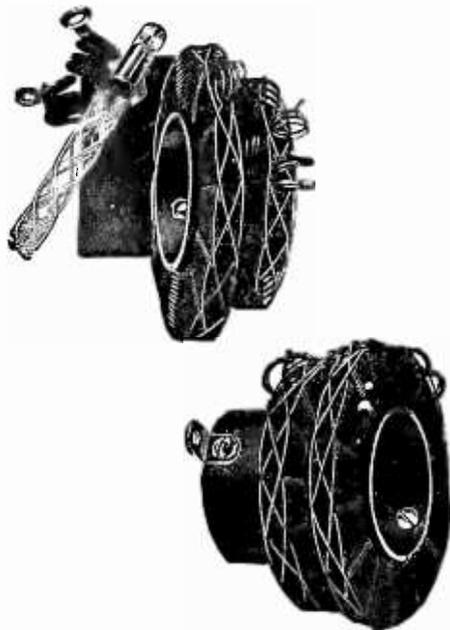
Doubleday, Page & Co.
Garden City New York

A new line of
COIL UNITS

USING



HEXCELL COILS



Complete set of coils for Roberts circuit, List Price \$8.

	List Price
3 circuit HEXCELL tuner 200-575 meters.....	\$3.00
Complete set of HEXCELL coils for Roberts circuit.....	6.00
Complete set of HEXCELL coils for Browning-Drake circuit with new improvements.....	6.00
Short wave HEXCELL extra low loss 3 circuit tuner 40-115 meters.....	3.50

We have put real electrical and mechanical engineering into our inductances. Particular attention is given to efficient operation at the lower end of the Broadcast Wave Band.

Our coils are finished in beautiful silk shades, each coil having a different color. Highly polished bakelite and nickel mounting parts used. Merchandise packed in attractive boxes.

A live line for live dealers
Liberal jobber and dealer discounts

Write for information

EASTERN ELECTRIC & MANUFACTURING COMPANY

Providence, Rhode Island

Licensed manufactures of Zig-Zag Coils

RADIO BROADCAST

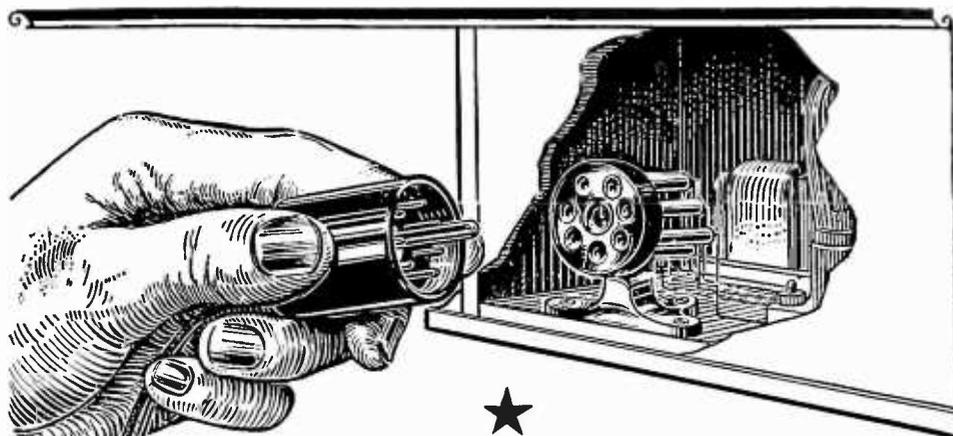
For January

will be a better magazine than this. Make sure of it by telling your newsdealer to hold one for you—or better still, subscribe through him or direct.

RADIO BROADCAST

Garden City

New York



Affording a plug and socket connection between the radio set and all outside connections, Jones Multi-Plug is as essential to the radio as a cord and socket to the electric iron. For safety and convenience, leading set manufacturers have adopted this item as standard equipment. You, too, need a Multi-Plug for the set you are building or the set you now have. See your dealer or write direct for descriptive folder F.

TYPE BM—For Set Building—\$4.50

TYPE BP—Adaptable to any set—\$5.00

HOWARD B. JONES

614-18 S. Canal St.

Chicago, Ill.



Jones
MULTI-PLUG
THE STANDARD SET CONNECTOR

This is a good time to subscribe for **RADIO BROADCAST**
Through your dealer or direct, by the year only \$4.00
Doubleday, Page & Company Garden City, New York



Old Tubes Made Good As New

THIS latest Laboratory product will recondition any old, run-down, even worthless tubes, as long as the filament still lights. Makes them as good as new in a few minutes' time. Costs but few cents more than new tubes! Simple, efficient, practical, and a big money-saver. Operates on either A. C. or D. C.—110-120 Volts. Bound to do the work on our

Money-Back Guarantee

Money cheerfully refunded if desired results fail. But we are sure you will find the Mack Reconditioner pays for itself in one evening. Many making good money restoring friends' and neighbors' old tubes. You cannot lose! Act quick on this special short-time introductory price. Sent postpaid with full directions on receipt of \$3.65. Be sure to state if for 199 type or 201 type. Our guarantee refund price protects you. Send now.

MACK LABORATORIES

716 Cass St.

Chicago, Ill.

\$3.65

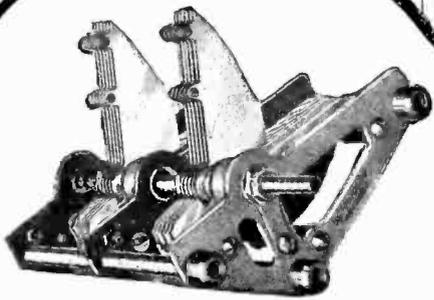
For:
UV199 and
201A Tubes
and all similar
types

MACK RECONDITIONER

"THE CURE FOR RUN-DOWN TUBES"



★ Tested and approved by RADIO BROADCAST ★



Made under Hogan Patent No.
1,014,002 Jan. 9, 1912

U. S. Tool Straight Line Frequency Condensers

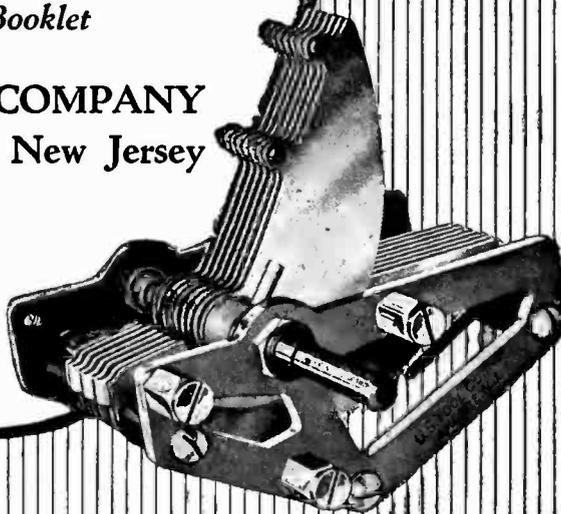
Combine the utmost in selectivity with simplicity and ease in tuning.

For sharp tuning and dependable accuracy ask your dealer for the U. S. Tool Straight Line Frequency Condenser—and accept no other.

Made by the largest makers of quality condensers with whom the manufacture of fine condensers is an art.

Write for Booklet

U. S. TOOL COMPANY
Ampere New Jersey



Radio Broadcast's "Universal" Receiver

will be described by Arthur H. Lynch in January. This Receiver employs five tubes, tuned Radio Frequency with Rice method of neutralization, Regenerative Detector with Fixed Tickler with Resistance Control and an exceptionally high quality Audio Channel.



TRANSFORMERS & CHOKES

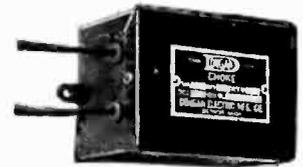
Share in Big Demand
for New B-Eliminators

Are you one of those radio lovers who have waited patiently for a perfected B-Eliminator? Because the new type Filament and Non-Filament Tubes have definitely answered the problem. With these tubes you can build a perfected B-Eliminator that improves your radio enjoyment more than you have thought possible. Dongan Transformers and Chokes are important parts in the construction of these remarkable new B-Eliminators.



TRANSFORMERS

- No. 509 Full wave For Raytheon Tubes
 - No. 537 Full wave For R. C. A. UX 213 Tubes
 - No. 537 Full wave For Cunningham CX 313 Tubes
 - No. 538 Half wave For R. C. A. UX 216-B Tubes
 - No. 538 Half wave For Cunningham CX 316-B Tubes
- LIST \$7.00



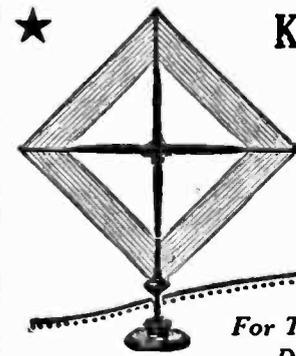
CHOKES

- No. 514 20 henry
 - No. 506 30 henry
 - No. 539 50 henry
- LIST \$5.00

Instructions on building your own B-Eliminator sent free on request. Dongan quality radio products at most dealers. Money orders filled promptly. **Set Manufacturers**—Dongan Audio Transformers are the accepted standard among Set Manufacturers. For quality products and a fair price you cannot equal Dongan Audio Transformers. Quotations on request.

DONGAN ELECTRIC MANUFACTURING CO.
2991 Franklin Street Detroit, Mich.
Transformers of Merit for 15 Years

RADIO FANS, a one-year's subscription to Radio Broadcast will cost you four dollars, two years six dollars. Consider this expenditure as being a necessary investment on your part for the future development of your own knowledge of Radio.



KORACH TUNED LOOP
Multiple Switch
Board Tuner
Directional. Base
Compass for Logging.
Collapsible.

For Those Who Demand

Superior Results

Leads the march toward perfect radio reception under all conditions. Not merely a "loop" but an ingenious arrangement of mechanical skill designed for superior results. L. M. Cockaday, using this loop, reached out across the Atlantic to hear many trans-continental Stations.

Selectivity Plus Distance

unheard of with common loop aerials. The Korach excels on all sets designed for loop reception. Priced at \$16.50 and for sale by all good dealers. Full particulars sent for 2c stamp and name of local dealer.

KORACH RADIO CO.
20 E. Jackson Blvd. Dept. 8 Chicago, Ill.

Dealers and Jobbers:
Write to-day for attractive proposition.



A modification of the "Senior" but possessing all its important features—\$12.50.

AMERICA DEMANDS MILLIONS

After all, the public is the final judge of quality, in radio parts as in everything else. Year after year the story is the same—more people go into stores and buy ALL-AMERICAN Transformers than any other make on the market.



Precision manufacture, insuring reliability, is the reason for the unequalled demand for ALL-AMERICANS. Every ALL-AMERICAN Standard Audio Transformer is guaranteed under a serial number stamped upon the metal. Look for it and know that you are buying satisfaction.

Largest Selling Transformers in the World

ALL-AMERICAN RADIO CORP.
E. N. RAULAND, President
4213 Belmont Ave. CHICAGO

OWNING AND OPERATING
STATION WENR-266 METERS

ALL-AMERICAN
Pioneers in the Radio Industry

FOUR THINGS to look for in any RADIO REPRODUCER

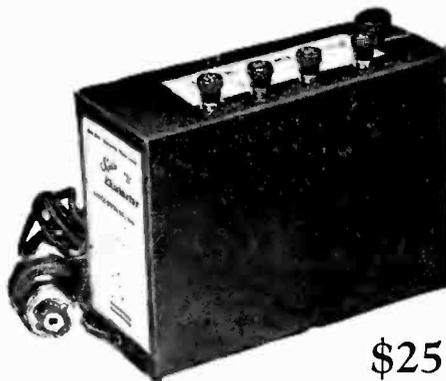


faithful reproduction
price value appearance

You have all four, to a superlative degree, in

★ Syllan "B" Eliminators

- take the place of "B" Batteries, and increase your range—clarify your reception—give positive, perfect, satisfying results not obtainable from "B" Batteries. Operate from 110-120 Volt A. C. only.
- Nothing to put together.
- Nothing to spill.
- No acids or water to add.
- Nothing to test.
- Nothing to charge.
- No tubes to burn out, nor will it injure, in any way, vacuum tubes in your set.
- No vibration.
- No fire hazard.
- Needs no attention.
- Costs 1 cent to operate 16 hours on 10 cent power rate.



\$25

Syllan REPRODUCERS

Every inch of Syllan Reproducers is constructed by scientific formula, designed to pick up and amplify the fine shading of vocal and instrumental artists to a degree long sought but seldom realized. No need to coddle it for fear of having to apologize.

Even at much higher price it would be difficult to obtain a loud-speaker as nearly attuned to perfect reception.

\$25 at your dealers

See the Syllan line Booth No. 34
Chicago Radio Exposition

Manufactured and Marketed Exclusively
Thru Jobbers by

BAKER-SMITH CO., Inc.
New Call Building, San Francisco

Branch Office Addresses

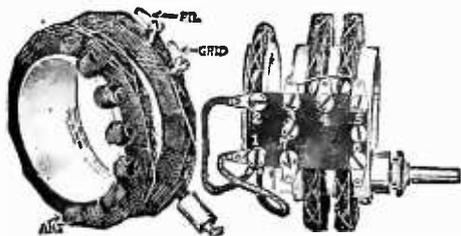
Portland, Ore., Henry Bldg. New York City, 1270 Broadway
Salt Lake City, Atlas Bldg. Chicago, 30 N. Dearborn St.
Seattle, L. C. Smith Bldg. Denver, McClintock Bldg.
Los Angeles, 443 South San Pedro Street
Vancouver, B. C., 179 Pender Street, West

Why not subscribe to *Radio Broadcast*? By the year only \$4.00; or two years, \$6.00, saving \$2.40. Send direct to Doubleday, Page & Company, Garden City, New York.

★ Tested and approved by RADIO BROADCAST ★

DIAMOND-WEAVE

(TRADE-MARK REGISTERED Aug. 4, 1925)



Sickles Coil Set No. 18A for Roberts Circuit. \$8.00 per set.

Sickles Coils for the "Aristocrat" Circuit, designed upon new scientific discoveries, set highest standards of efficiency.

SICKLES COILS

*For the "Aristocrat,"
Browning-Drake, Roberts,
Craig, and Hoyt Circuits*

(Patented Aug. 21, 1923)

Our Coil Set No. 25 is specifically designed for the new "Aristocrat" Circuit, already very popular.

Compactness of form, rigidity of construction, and the supremely efficient Diamond-Weave method of winding are well-known characteristics of Sickles Coils.

These refinements of design and construction result in low distributed capacity, low dielectric losses and large range of frequency with small variable capacity.

There are Sickles Diamond Weave Coils for all leading circuits.

COIL PRICES

No. 18A Roberts Circuit	\$ 8.00 set
No. 24 Browning-Drake	7.50 set
No. 20 Craig Circuit	4.50 set
No. 19 Acme Reflex	4.50 set
No. 8 Knockout Reflex	4.00 set
No. 21 Hoyt Circuit	10.00 set
No. 25 "Aristocrat" Circuit	8.00 set

Send for descriptive catalog

The F. W. Sickles Co.

132 Union Street
SPRINGFIELD, MASS.



Do It Yourself

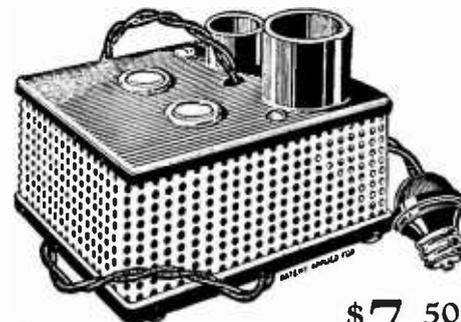
— It's Easy

Manufacturers FLASH tubes during the process of building them. In doing so, they boil out the thorium with which the filament is impregnated and deposit it on the surface. This permits the filament to function at less heat and less A-battery consumption than when a tungsten filament alone is used — as with the old style tubes.

As the tube is used in the set, the thorium coating gradually drops away. FLASHING will boil out some more thorium to the surface of the filament and bring the tube back as good as new.

YOU CAN DO IT YOURSELF
WITH A

BURTON & ROGERS TUBE FLASHER



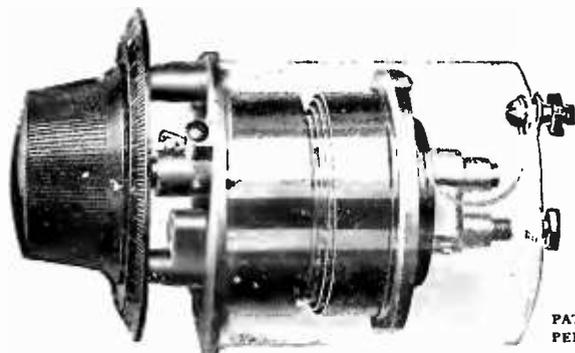
\$7.50



Send for pamphlet "Save a Life"

Burton & Rogers Mfg. Co.

755 Boylston Street, Boston, Mass.



PATENTS
PENDING

"The Hit of the Show"

At the recent Radio Shows in New York — wherever it has been shown or demonstrated — the Furnell Taper Coil Condenser aroused a veritable furore of interest.

Mechanically and electrically, professionals claim that the Furnell offers in the simplest, most practical form, the correct solution of the straightline frequency problem.

By the use of the Furnell Condenser, the crowding of low-wave stations is entirely done away with. Regardless of wavelength, all stations are tuned in with remarkable ease and clarity, over a complete revolution of the 360° dial, furnished with each condenser.

Write for Literature

No matter what type or model you build, buy, or sell, you can't know its best performance until you use this wonderfully improved type of condenser. In three capacities, single and multiple.

THE FURNELL
MANUFACTURING CORP.

24L Scott St. Newark, N. J.

FURNELL

360° TAPER COIL
CONDENSERS



★ Tested and approved by RADIO BROADCAST ★

400 CENTS RESISTANCE

is the subscription price to Radio Broadcast for one year. This is less than the cost of a good low loss variable condenser. Let us enter your subscription to begin with the next issue. Send \$4.00 with your name and address to Radio Broadcast, Garden City, N. Y.



**For
Volume
without
Distortion**

MOST radio receivers have ample volume but few have volume without distortion. Turn your rheostat on to its full power and notice how the range of tones dwindle and the crescendo rasps harshly on your ears. Be sure your drawing room radio entertainment gives pure tone quality.

The new Precise Supersize No. 480 Audio Transformer was designed to bring forth with magnificent volume a remarkable range of pure tones. With the Precise No. 480 you can dance and entertain with radio music that is ample in volume and harmonious in tone.

Mr. James L. McLaughlin, the noted superheterodyne authority specifies the Precise No. 480 for his new One Control Receiver.

Price \$7.50

Precise Syncrodenser

The Syncrodenser is a scientifically designed improved type straight line frequency condenser. This unusual instrument is the only condenser that ideally spreads the broadcasting stations uniformly over the dial range. The Syncrodenser is strongly built and can be mounted on panel or sub-panel in any position.

Price, \$4.50

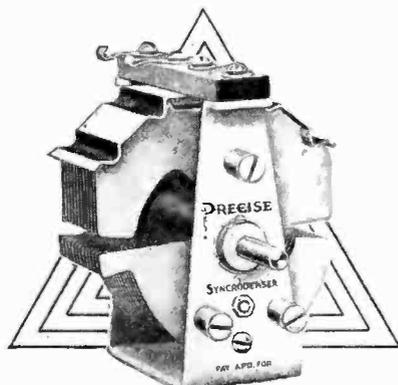
**PRECISE MFG. CORP.
ROCHESTER, N. Y.**

Branch Offices:

- 126 Liberty St., New York City
- 205 W. Harrison St., Chicago, Ill.
- 821 Market St., San Francisco, Calif.
- 454 Builder's Exchange, Minneapolis, Minn.
- 1127 Pine St., St. Louis, Mo.
- 701 A. O. U. W. Bldg., Little Rock, Ark.

Canadian Distributors:

- PERKINS ELECTRIC LTD.
- Toronto Montreal Winnipeg

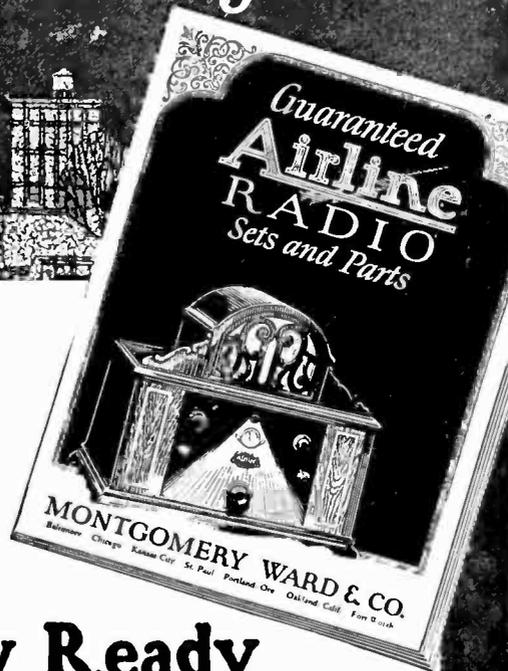


PRECISE SYNCRODENSER



**Ward's
New Radio
Catalogue**

Is Now Ready



Are you interested in seeing what is new in Radio — what is best and what has been approved?

And do you wish to know the lowest prices on tested sets, prices made without the usual "Radio profits?"

**This Catalogue is a
Complete Guide to Radio**

Ward's is headquarters for Radio, with probably the largest retail radio department in the whole world.

This new 52 page Radio Catalogue shows everything in parts, batteries, cabinets, contains a list of stations, a radio log for recording stations. It shows the best of the new sets. One tube sets that give amazing results. Five tube sets with a single dial to turn. Think of tuning in one station after another by turning a single dial!

Every price quoted means a big saving to you. Everything offered is tested by our own Radio Experts. In fact, the best experts compiled this Catalogue for you.

Write for this 52 Page Book. It is yours free.

Our 53 Year Old Policy

For 53 years we have sold only quality merchandise under a Golden Rule Policy. You can rely absolutely upon the quality of everything shown in this Radio Catalogue.

**ESTABLISHED 1872
Montgomery Ward & Co.**

The Oldest Mail Order House is Today the Most Progressive
Baltimore Chicago Kansas City St. Paul Portland, Ore. Oakland, Calif. Ft. Worth

To Montgomery Ward & Co., Dept. 27-R
Baltimore Chicago Kansas City St. Paul
Portland, Ore. Oakland, Calif. Fort Worth
(Mail this coupon to our house nearest you.)
Please mail my free copy of Montgomery Ward's New
Radio Catalogue.

Name.....
Local address.....
Post office..... State.....



EVERYONE'S TALKING ABOUT THIS NEW DIAL

The mechanical superiority of the Fynur Vernier Control is making it the most talked of vernier dial on the market.

You'll like it because it gives the utmost possible accuracy. No backlash! No gears! No lost motion! The dual control permits of a quick, general setting as well as the infinitely fine vernier adjustment.

It's beautifully made—and so simple in construction that a child could take it apart and reassemble it. Will fit any standard 1/4" shaft.

If you want the utmost accuracy in reception equip your set with Fynur dials.

If your dealer cannot supply you, write to us.

AUGUST GOERTZ & CO., Inc.
270-286 Morris Ave. Newark, N. J.

FYNUR

VERNIER CONTROL



Price \$3.50

High Grade SETS BUILT TO ORDER

Repaired—Adjusted
Specialists in Hammarlund-Roberts,
Roberts and Super-Hets

RADIO RESEARCH LABS.,

154 Nassau Street New York City

This is a good time to subscribe for
RADIO BROADCAST
Through your dealer or direct, by the year only \$4.00
DOUBLEDAY, PAGE & CO. GARDEN CITY, NEW YORK

RADIO DEALERS

Send for our catalogue
New Circuits New Parts
Silver-Marshall Distributors

VAN-ASHE RADIO CO.
202 N. 10th St. St. Louis, Mo.

Just Published
Our **NEW**
96 Page
RADIO GUIDE

Hundreds of
Exceptional Radio Values

MONEY BACK GUARANTEE

Chockfull of valuable and interesting data for the fan—should be in every radio Library. Complete list of Broadcasting stations, trouble shooting chart, Log chart, etc.

**WRS SERVICE IS GOOD!
WRS QUALITY IS BETTER!
WRS VALUES ARE BEST!**

Prompt Service

IN LESS THAN A DAY YOUR ORDER IS ON ITS WAY



Note that word "SERVICE" in our name, it's your insurance of thorough and complete satisfaction backed by an iron-bound MONEY BACK Guarantee. Orders shipped the same day received. Be sure to address to Room 101

WHOLESALE RADIO SERVICE CO.

Room 101

6 Church St.

New York City

FREE Send for NOW your copy SHOULD BE IN EVERY FAN'S LIBRARY

Immediate Delivery

McLAUGHLIN
SINGLE CONTROL
SUPER-HETERODYNE
ALL AUTHENTIC PARTS

NEW HAMMARLUND-ROBERTS and every other APPROVED CIRCUIT as originated and recommended by all of the Leading Radio Engineers

COCKADAY SUPER
ROBERTS KNOCKOUT
BREMERTULLY SUPER-DYNE-NEUTRODYNE
RASLA-SUPER
PRESSLEY-SUPER ULTRA-DYNE



\$3.25 RADIO Storage "B" Battery

32 Cells 24 Volts Lasts Indefinitely—Pays for Itself

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

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

WORLD BATTERY COMPANY
1219 So. Wabash Ave., Dept. 78 Chicago, Ill.
Makers of the Famous World Radio "A" Storage Battery
Prices: 6-volt, 100 Amp. \$11.25; 120 Amp. \$13.25; 140 Amp. \$14.00.
All equipped with Solid Rubber Case.

World STORAGE BATTERIES

Set your Radio Dials at 210 meters for the new 1000 watt World Storage Battery Station, WSBC, Chicago. Watch for announcements.

RD-1A - WFAF - WGN - WJS - KHJ - KGO - KFAP - WJY - KOP

WRITTEN 2-YEAR GUARANTEE

Battery Prices SMASHED!

To Consumers Only Here is a real battery quality, guaranteed to you at prices that will astound the entire battery-buying public. Order Direct From Factory. Put the Dealer's Profit in your own pocket. You actually save much more than half, and so that you can be convinced of true quality and performance, we give a **Written 2-Year Guarantee**. Here is your protection! No need to take a chance. Our battery is right—and the price is lowest ever made. Convince yourself. Read the prices!

Auto Batteries	Radio Batteries
6 Volt, 11 Plate, \$9.50	6 Volt, 100 Amp. \$9.50
6 Volt, 13 Plate, 11.50	6 Volt, 120 Amp. 11.50
12 Volt, 7 Plate, 13.00	6 Volt, 140 Amp. 13.00

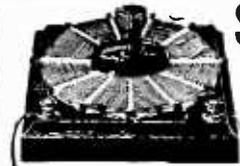
Buy Direct—Send No Money
We ask no deposit. Simply send name and address and style wanted. Battery will be shipped same day we receive your order Express C.O.D. subject to your examination on arrival. Our guarantee accompanies each battery. We allow 5% discount for cash in full with order. You cannot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

ARROW BATTERY CO.
Dept. 10, 1215 So. Wabash Ave., Chicago

Steinite LOW Interference Eliminator

No Radio Set Complete Without It

Now you can select stations at will, cut out interference and undesired stations—tune in loud and clear. Wonderful results with any tube or crystal set using any kind of aerial except loop antenna. Partially absorbs static.



\$1 Amazing Results, Better Reception Guaranteed or We Refund Your Post-Dollar. Send paid. Order Today

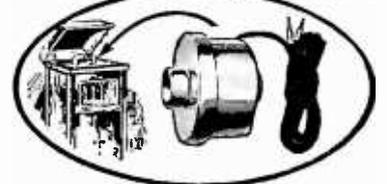
Select Stations At Will

Try this Interference Eliminator on your set—no tools—nothing to add—attached in 2 minutes to aerial. Doesn't disturb present log. Directions easy to follow. Two big banks testify to our reliability. Order today—dollar bill will do—we take the risk—money back if you say so.

STEINITE LABORATORIES

305 Radio Building, ATCHISON, KANSAS
Write for complete Steinite Radio literature—it's FREE. Most beautiful and least expensive radio sets in America.

Morrison



Loud Speaker

Matchless Reproduction with the **MOCKING BIRD UNIT \$5.00** and your phonograph

For complete enjoyment of all that is best in radio, for purity of tone and plenty of volume on distant stations, be sure your set reproduces through a Morrison Unit—a standard for four years. Attach the Mocking Bird Unit to the tone arm of your phonograph (fits all popular makes) and you have the finest possible means of reproducing radio reception.

MOCKING BIRD CABINET, \$30



Dealers Be sure your holiday orders are in early. Remember the rush for Morrison Loud Speakers will surpass all previous years.

Set M's We are able to supply units in quantity orders at attractive prices. Deliveries are assured with acceptance of order.

The Mocking Bird Cabinet is the peer of all loud speakers. You will be proud of your Mocking Bird—not only its performance but the artistry of its design and workmanship. If your dealer cannot supply you send money order or check to factory. If you prefer we will ship C. O. D. Every Unit sold on money back guarantee.

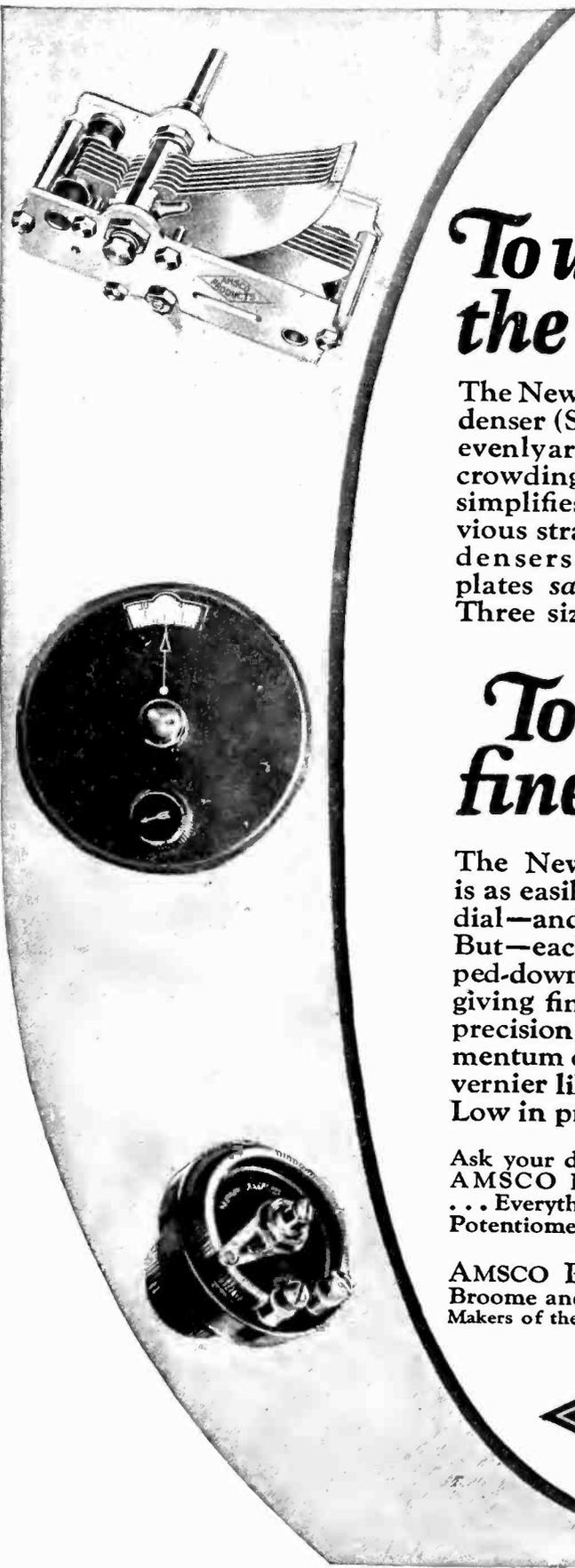
MORRISON LABORATORIES
347 E. Jefferson Ave. Detroit, Mich.

★ Tested and approved by RADIO BROADCAST ★



TRIMM Entertainer is a quality speaker at an intermediate price. The large Trimm Unit may be adjusted to give desired tone and volume. Volconite horn stands 19½ inches high, has a bell 12 inches in diameter. The Entertainer is one of the biggest values in radio because it gives the satisfaction and performance of highest grade speaker at a truly reasonable price. Order a sample from your jobber for trial.

TRIMM	
Superior Reproducers	
HEADSETS	
Professional - -	\$5.50
Dependable - -	4.40
PHONODAPTERS	
Giant Unit - -	\$10.00
Little Wonder -	4.50
SPEAKERS	
Home Speaker -	\$10.00
Entertainer - -	17.50
Cabinette - - -	17.50
Concert - - -	25.00
Chello - - -	30.00



To unscramble the stations

The New AMSCO Allocating Condenser (S.L.F.) spreads the stations evenly around dials. Eliminates the crowding of low wave stations and simplifies tuning. And unlike previous straight line frequency condensers, its "half-a-heart" rotor plates save space in the cabinet. Three sizes—single or Siamese.

To get the finest tuning

The New AMSCO Vernier Dial is as easily installed as an ordinary dial—and as easily manipulated. But—each turn of the dial is stepped-down to 1-13th the motion—giving finesse to your fingers. A precision instrument, without momentum or back-lash. There is no vernier like it for distance-getting. Low in price.

Ask your dealer for these and other AMSCO Engineered Radio Products . . . Everything in Condensers, Rheostats, Potentiometers, tube sockets, dials, etc.

AMSCO PRODUCTS INC., Dept. E
Broome and Lafayette Streets, N. Y. City
Makers of the Melco Supreme Radio Receiver

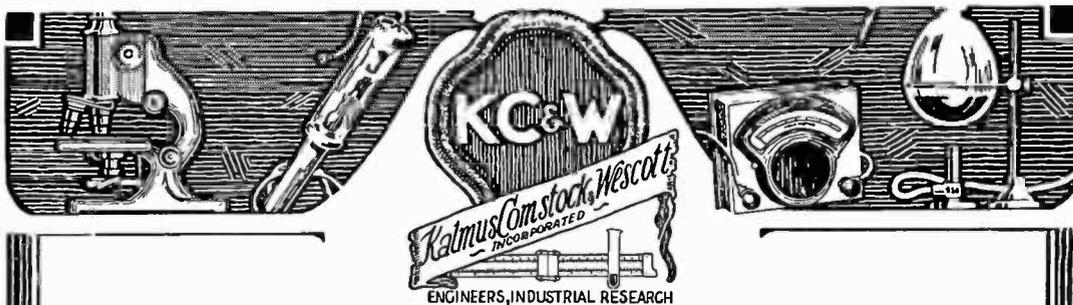


Make your set a Super-Het

THE circuit described in Radio Broadcast for June and August will change any set into a super-heterodyne. It is particularly applicable to five-tube neutrodyne and tuned RF sets. It changes these two circuits into super-heterodynes as good as most, and considerably better in some respects than any super-heterodyne circuit ever devised. Stations come in at but one point on the oscillator dial. There is mathematically no possibility of harmonics. Full scale blue prints with reprint of article \$1.00.

Eastern Coil antenna coupler	\$6.00
O'Connor oscillator coupler	6.00
Special fixed condenser	.60
Complete parts including panel, drilled and engraved, special formica bushings, screws, and wire, blue prints and reprint	37.50

★ **A. O'CONNOR & COMPANY**
Super-Heterodyne Headquarters Since 1923
9702 Euclid Avenue Cleveland, Ohio



"RESEARCH IS THE KEY TO THE FUTURE OF RADIO"—

says R. E. Renaud in "Popular Radio"

RADIO manufacturers, radio investors and the buying public are beginning to realize the tremendous importance of research work based on science and method.

Large manufacturers maintaining research departments of their own find our services of great value for the solution of problems which arise from time to time outside the more specialized field of their own research departments.

Smaller manufacturers may now have their necessary research work done without the financial burden of maintaining research departments of their own.

A descriptive booklet will be furnished on request.

KALMUS, COMSTOCK & WESCOTT Inc.

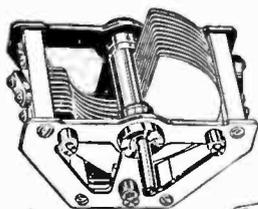
110-114 BROOKLINE AVE. Industrial Research Engineers.. BOSTON, MASSACHUSETTS

Better Results With Less Space—Using

DUPLEX

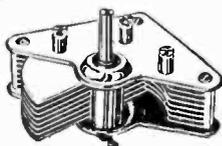


CONDENSERS



Duplex Standard

Learn the secret of **DUPLIX** superior construction. Sample plate and literature sent on request.



Duplex Junior

Their specially shaped-out stators afford separation on all wavelengths, increasing selectivity and eliminating interference. Their carefully-planned design retains all low loss advantages and keeps **DUPLIX S. L. F.** Condensers as small as the previous models.

Duplex Condenser & Radio Corp.
46 Flatbush Ave. Extension, Brooklyn, N. Y.

You Save 50%

Approved!
Listed as Standard by Leading Authorities including Radio News Laboratories, Popular Science Institute of Standards, Popular Radio Laboratories, Radio Broadcast Laboratories, Radio in the Home and Le-fax, Inc.

World Radio "A" and Auto Batteries are famous for their guaranteed quality and service. Backed by years of successful manufacture and thousands of satisfied users. Equipped with **Solid Rubber Case**, an insurance against acid and leakage. You save 50 per cent.

Radio Station W S B C
Set your Radio Dials at 210 meters for the new 1000 watt World Storage Battery Sta., W S B C, Chicago, Ill. Watch for announcements.

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

Solid Rubber Case Radio Batteries
6-volt, 100 Amperes . . . \$11.25
6-volt, 120 Amperes . . . 13.25
6-volt, 140 Amperes . . . 14.00

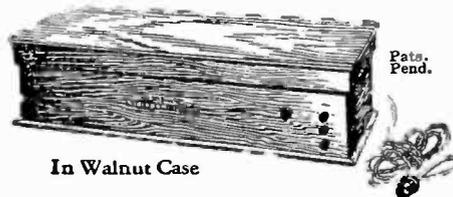
Solid Rubber Case Auto Batteries
6-volt, 11-Plate . . . \$11.25
6-volt, 13-Plate . . . 13.25
12-volt, 7-Plate . . . 16.00

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

WORLD BATTERY COMPANY
Dept. 24
1219 So. Wabash Ave., Chicago, Ill.

World

The Wilson "B"
Radiopower Unit



In Walnut Case

This new unit makes it possible to use a light socket for "B" voltage, *without any troublesome hum from alternating current.*

Supplies the constant voltage necessary for perfect reception. No acid to spill. No moving parts. Requires no attention. Semi-automatic in operation. The least expensive type of unit because of low first cost, minimum current consumption and long life. In handsome walnut case. Price \$35.

The Andrews
Paddlewheel Coil

Pats. Pend.



Price \$3.00

For best results in home-built sets it is safer to use equipment employed in the best commercial receivers. Here is a superior coil used in such high grade receivers as the *Deresnadyne* and *Buckingham*. It can be used in any hook-up requiring a high type inductance.

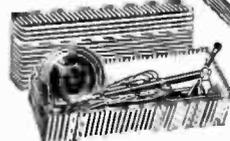
Has exceptionally high ratio of inductance to resistance with minimum distributed capacity. Improves tone. Increases range, volume and selectivity. Blue prints of tested hook-ups employing this coil are available.

Our Technical Dept. will answer inquiries.

Duo-Spiral Folding Loop

Handsomely finished in silver and mahogany to harmonize with the finest home furnishings.

Price \$8.50



Pats. Pend.

Easily portable. Has insulated handle and graduated dial. Reduces static and other interference. A special model for every circuit.

See these standard units at your dealers or write for complete information.

Radio Units Inc.

1305 First Avenue Maywood, Illinois
Perkins Elect. Ltd., Montreal, Toronto, Winnipeg

400 CENTS RESISTANCE

is the subscription price to Radio Broadcast for one year. This is less than the cost of a good low loss variable condenser. Let us enter your subscription to begin with the next issue.

Send \$4.00 with your name and address to Radio Broadcast, Garden City, N. Y.

*“Lighted
Continuously
72 Days
—and Still in Good
Receiving Condition”*



One astonishing report of the many hundreds received, proves unmistakably Sea Gulls' exceptionally long life. A user kept six Sea Gull Tubes lighted for over 1700 hours and found them all operating efficiently at the end of the period.

The original letter containing the above statement is on file in our office and will be shown to any one interested.

SEA GULL TUBES

Have four points of superiority. 50% longer life, higher mutual conductance, uniformity, interchangeable at any stage, and they are positively non-microphonic.

At Your Dealers

\$2.50 ★

or by mail plus parcel post.

We also make

- Tube R—Rectifying Tube . . \$3.00
- Tube P—Semipower Tube . . \$5.00
- Tube X—Double Duty Rec. Tube \$5.00

Dealers and Jobbers write us for full information and discounts.

Sea Gull Tubes give greater satisfaction

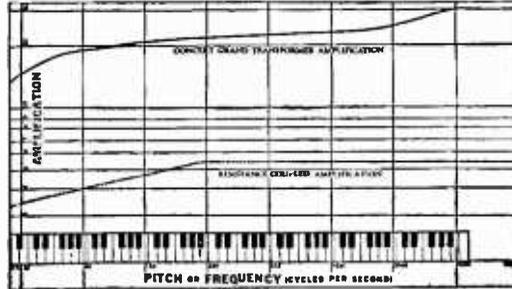
ABERDEEN SPECIALTY CO., Inc.

Factory
1640 N. Hutchinson Street, Philadelphia
Main Sales Office
Suite 406, 1001 Chestnut Street, Philadelphia

This Amazing Test Proves Tone Troubles Ended

Exacting laboratory tests show that amazing new audio gives greatly superior tone curve. Remarkably uniform and even amplification of all tones at frequencies from 32 to 10,000 cycles

Send Coupon

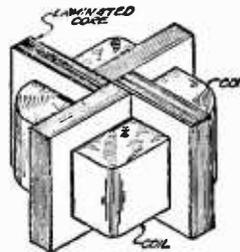


Note the smooth even progression of the Concert Grand curve, revealing supreme uniformity of amplification, from lowest notes to highest in the musical scale.

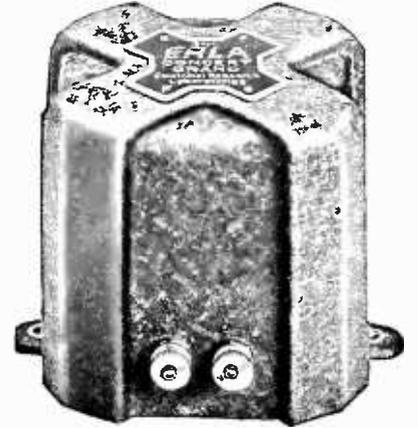
A NEW audio frequency transformer has been perfected, the Erla Concert Grand. It is built on a new principle and gives results far superior to any other system of amplification.

Amazing improvement

Ordinary designs permit too much leakage to amplify properly at low frequencies. So we use the "quadriform type," heretofore unknown in radio work. In this design magnetic leakage is practically eliminated by providing twice as many paths for the magnetic field and by a better distribution of the core metal around the copper wire coils. Each of the four core units are complete magnetic circuits within themselves without breaks or joints to the main central core, and it will also be noticed that the central core section has a far greater area than conventional core types. The large area thus obtained reduces the effect of the direct "B" battery current on the pulsating voice currents and eliminates a cause of distortion common to



Note the quadruple core surrounding the coil, forming an almost perfect path for the flux within the coil. The core is a special grade of laminated silicon steel that provides highest permeability and lowest hysteresis loss, with consequent maximum conductivity in the magnetic circuit of the transformer. Price \$10.00. West of Rocky Mts., \$10.50.



One-piece drawn steel shell provides magnetic shielding. Finished in black crystalline lacquer and attractive in appearance

transformers using smaller core sections.

The Concert Grand saves you money, too. Resistance coupling depends solely upon the tubes for amplification. Consequently they must be operated at maximum for efficiency, requiring more "A" battery current and higher plate voltage—135 to 150 volts. Filaments wear out more rapidly as result and battery life is more than cut in half. The higher initial cost of Concert Grand amplification is therefore saved many times over not only in improved performance but also in lowered up-keep cost.

Booklet sent FREE

Get the Audio Grand at your dealer's today. See what a tremendous difference it will make in your set. If you wish to return the coupon we will send you a new booklet giving the latest information on audio frequency amplification.

ELECTRICAL RESEARCH LABORATORIES
Chicago, U. S. A.

ELECTRICAL RESEARCH LABORATORIES,
2500 Cottage Grove Ave., Dept. 10-C, Chicago.

Send me information about the Erla Concert Grand Audio. Also latest developments on audio frequency amplification.

Name

Address

City.....County.....State.....

ERLA ★

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., required by the Act of Congress of August 24, 1912, of RADIO BROADCAST, published monthly at Garden City, New York for October 1, 1925. State of New York, County of Nassau.

Before me, a Notary Public in and for the State and County aforesaid, personally appeared S. A. Everitt, who, having been duly sworn according to law, deposes and says that he is the Treasurer of Doubleday, Page & Company, owners of Radio Broadcast and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Doubleday, Page & Co., Garden City, N. Y.; Editor, Arthur H. Lynch, Garden City, N. Y.; Business Managers, Doubleday, Page & Co., Garden City, N. Y.

2. That the owner is: (If the publication is owned by an individual his name and address, or if owned by more than one individual the name and address of

each, should be given below; if the publication is owned by a corporation the name of the corporation and the names and addresses of the stockholders owning or holding one per cent. or more of the total amount of stock should be given.) F. N. Doubleday, Garden City, N. Y.; Arthur W. Page, Garden City, N. Y.; S. A. Everitt, Garden City, N. Y.; Russell Doubleday, Garden City, N. Y.; Nelson Doubleday, Garden City, N. Y.; John J. Hessian, Garden City, N. Y.; Dorothy D. Babcock, Oyster Bay, N. Y.; Alice De Graff, Oyster Bay, N. Y.; Florence Van Wyck Doubleday, Oyster Bay, N. Y.; F. N. Doubleday, or Russell Doubleday, Trustee for Florence Van Wyck Doubleday, Garden City, N. Y.; Janet Doubleday, Glen Cove, N. Y.; W. Herbert Eaton, Garden City, N. Y.; W. F. Etherington, 50 E. 42nd St., N. Y. C.; S. A. Everitt or John J. Hessian, Trustee for Josephine Everitt, Garden City, N. Y.; Henry L. Jones, 120 W. 32nd St., N. Y. C.; Wm. J. Neal, Garden City, N. Y.; Daniel W. Nye, Garden City, N. Y.; Mollie H. Page, Syosset, N. Y.; E. French Strother, Garden City, N. Y.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent. or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) NONE.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security hold-

ers, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the six months preceding the date shown above is..... (This information is required from daily publications only.)

(Signed) DOUBLEDAY, PAGE & COMPANY

By S. A. Everitt, Treasurer.

Sworn to and subscribed before me this 1st day of October, 1925.

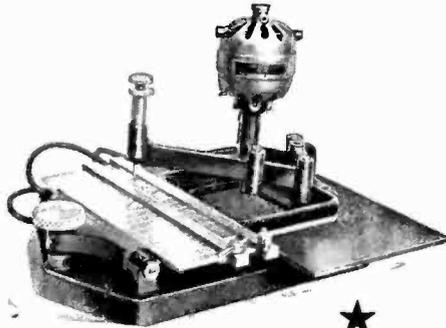
[SEAL] (Signed) Frank O' Sullivan
(My commission expires March 30, 1926.)

★ Tested and approved by RADIO BROADCAST ★

At Last!

A Real Panel Engraving Machine at a Price you can afford.

Low in price because it is designed for panel engraving only.



Capacity 14 x 40" ★

For engraving your own panels, or panels for others with any marking desired, including Trademarks, special designs and serial numbers.

Being designed particularly for panel engraving it is the most rapid and accurate machine for engraving panels. Simple to operate.

Price of machine with full equipment, including master letters and characters, \$135.00 f.o.b., Forestdale, R. I.

Wire or write

BRANCH TOOL CO., Dept. G
Forestdale Rhode Island



THE Antennaphone
REPLACES THE AERIAL
NO AERIAL
NO LOOP

AN IDEAL XMAS GIFT

Increases selectivity. Gives wonderful results. Not attached to, but merely placed under the telephone. Price One Dollar. Complete with insulated wire and simple instructions. At Your Dealer or Mailed C.O.D. on 3 days' approval. ★

ANTENNAPHONE CO., 90 West St., New York City

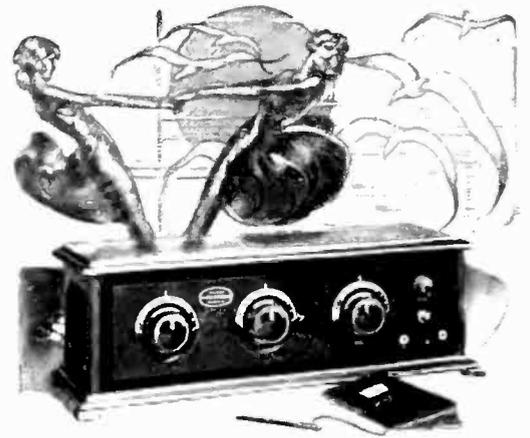
Building Better Service into RADIO PARTS



Aside from recognized radio uses in which no other metals can be substituted, COPPER and its alloys help you to make good radio sets *better* sets.

For instance, binding posts are superior posts, and battery nuts give best service and satisfaction when made of dependable free-cutting BRASS rod. And—their speedier production makes labor costs lower.

★ **COPPER & BRASS**
RESEARCH ASSOCIATION
25 Broadway, New York



1926 Improved Radio

ALL the practical improvements developed during the season are incorporated in the new Arborphone Receiver. For clarity of reception and simplicity of tuning just compare the Arborphone with any other set, regardless of price. Arborphone owners can match performance with anyone.

Distance—coast to coast—is at your command. While not elaborate, the cabinet that houses this precision-built circuit is really beautiful in its simplicity of design.

For a thorough and consistent enjoyment of Radio's ever-improving programs Arborphone will satisfy completely those who demand simplified and perfected reception.

A most interesting catalog will be mailed on request. Dealers will gladly give you an Arborphone demonstration.

\$55⁰⁰

\$60.00 in Rocky Mt. and Pacific Coast States

MACHINE SPECIALTY COMPANY
ANN ARBOR MICHIGAN

ARBORPHONE

This is a good time to subscribe for
RADIO BROADCAST
Through your dealer or direct, by the year only \$4.00
DOUBLEDAY, PAGE & CO. GARDEN CITY, NEW YORK

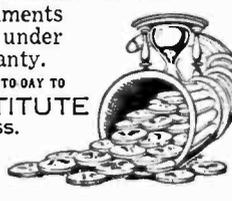
EARN BIGGER PAY

"I have more than doubled my income during the past year," writes one of our students. TYREAN Instruction shows how to find and take your proper place in the world. It develops executive ability and lifts you out of the poorly paid class. Entirely different from all others. Enrolments accepted only under money-back guaranty.

CLIP THIS AD AND MAIL IT TO DAY TO
TYREAN INSTITUTE
PALMER, MASS.

Tell me about your **GUARANTEED** Salary-Raising Courses.

Name _____
S.S. _____ Address _____



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 to 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** Catalogue describing three models. **DO IT TO-DAY.**

THE OMNIGRAPH MFG. CO., 13K Hudson St., New York City
If you own a Radio Phone set and don't know the code—you are missing most of the fun



QUICK ACTION FAHNESTOCK CLIPS ★

Standard in the Radio Industry

Ask your dealer for FAHNESTOCK Antenna Connectors. Eliminate splicing and soldering of wires and secure a perfect connection.



FAHNESTOCK ELECTRIC CO.
L.I. CITY, N.Y.

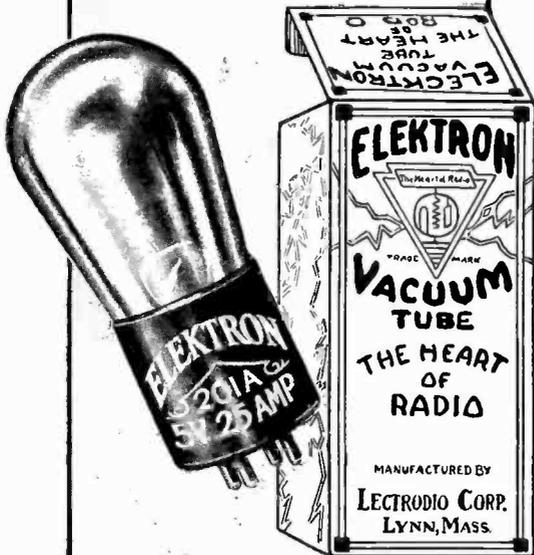
★ Tested and approved by RADIO BROADCAST ★



Guaranteed

Electron Quality Tubes are rigidly tested for oscillation and emission, possess long life and produce uniformly excellent results.

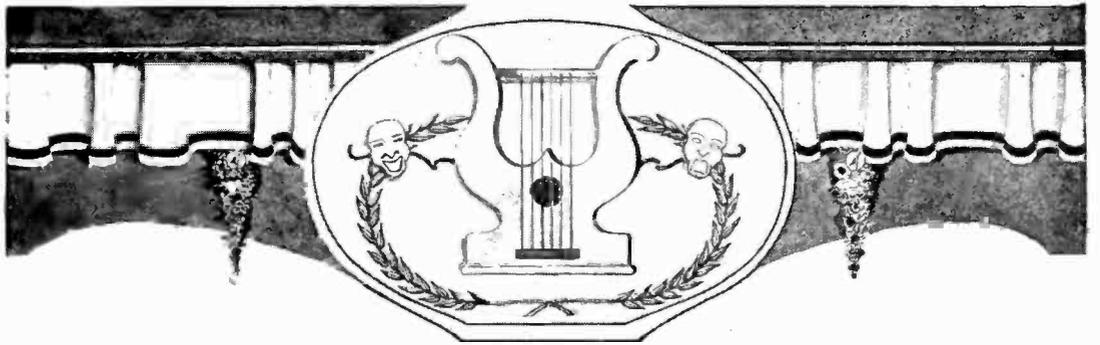
There's an Elektron for every type of circuit at \$2.50 each.



Lectrodio Corp.
LYNN MASS

If Your Set Won't Percolate

write us about it. RADIO BROADCAST is establishing a special repair department to assist set builders in getting the best out of the receivers they build from plans published in the magazine. Write for complete information about this new department established for your benefit.



Speaking From Experience

The marked superiorities of tonal qualities in the Holtzer-Cabot Radio Loud Speaker are distinctly traceable to our fifty years' specialization in the manufacture of fine electrical apparatus.

By comparison let your own ear be the judge, let your eye rest on the beauty of line, and let your judgment decide the security that this half century of stability lends to your purchase.

Ask your dealer to demonstrate a Holtzer-Cabot Speaker before making a choice of any kind.

National Loud Speaker
\$12.00
Adjustable Control



1875-1925
For **FIFTY YEARS** manufacturers of **Quality Electrical Apparatus**

The **HOLTZER-CABOT ELECTRIC CO.**
125 Amory St., Boston, Mass.

Holtzer-Cabot

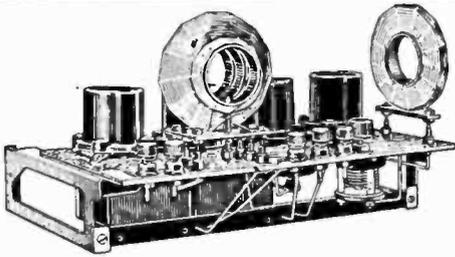
WOULD YOU HELP YOURSELF TO OUR CASH BOX—if we said "GO AHEAD"?

ALL RIGHT, THEN—GO AHEAD!
THE CASH IS THERE. . . . And it's easy to get
The Holiday Season is approaching with its heavy drain on your income. What are you doing about it?
Will it be just as it was last year? Or do you really want some spare-time cash.
If you are in earnest, let us tell you how you can get it.
There's much to gain and nothing to lose.

Write: Agents' Service Division

DOUBLEDAY, PAGE & CO.

Garden City, N. Y.



Introducing "SUPERUNIT JUNIOR"

A little brother to the standard Type A and Type B "Superunits."

He measures 5 x 10" and he consists of a stage of tuned R.F., the detector and two stages of Thordarson audio.

He has plug-in coils, and the standard set of coils which he uses will tune from 170 to 570 meters when used with the S-C Capacity Element to make a one dial set. Other coils for other wave lengths.

He makes the most efficient set for use with an aerial and there are just 11 connections to complete him.

**YOU SHOULD MAKE HIS
ACQUAINTANCE!**

Price, complete with instructions \$37.50

MATERIALS NEEDED FOR A COMPLETE SET

- 1 "Superunit, Jr."
- 1 S-C Capacity Element or 2 .0005 condensers.
- 1 Front panel, size 7 x 10 or larger.
- 2 Bradleystats.
- 1 Double circuit jack.
- 1 Single circuit jack.

Note: No baseboard is required

Hanscom Radio Devices

Mfgs. of the S-C Capacity Element, the one dial control for two control sets.

Woonsocket, R. I., U. S. A.

SOME startling new ideas on audio amplification will be given in an article in the January Radio Broadcast by an authority on the subject, Mr. Kendall Clough.

Potter BY-PASS Condensers

- Prevent "B" voltage fluctuation
- Allow undistorted amplification
- Make possible full bass tones
- Improve reception with "B" Supply Units.

Made in $\frac{1}{10}$, $\frac{1}{8}$, $\frac{1}{4}$, 1, 2, 3 and 4 Microfarad sizes

Order from Your Jobber

POTTER MANUFACTURING COMPANY
North Chicago, Illinois



BAKELITE BASE

TWENTY LOOSE CONNECTIONS IN A FIVE TUBE SET

That's possible—but not if you use the new EBY Cushion Sockets.

These ingenious devices make it possible to maintain a positive wiping contact at all times, regardless of the size of the tube prong or the amount of solder on the prong tip.

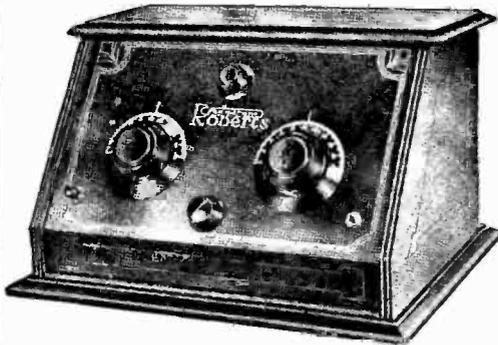
By a special shock-absorbing feature EBY Cushion Sockets not only eliminate microphonic noises but are a guarantee against tube damage. Old style tubes will not give the advantages of interchangeability and other features of the new U. X. Tubes. EBY Cushion Sockets are especially built for them.

The list price for the EBY Cushion Socket is 60c. If your dealer can't supply you write direct to us sending his name.

H. H. EBY MFG. COMPANY
4710 Stenton Ave. Philadelphia, Pa.
Makers of EBY Quality Binding Posts

An inexpensive short wave transmitter operating entirely on dry batteries will be described in the January issue of Radio Broadcast.

For Quality Corbett's Cabinet's For Quality



HAMMARLUND-ROBERTS CABINET

Built exactly to specifications with fancy panel effect line grooves, full length piano hinge and lid stay.

List Prices:

GENUINE AMERICAN WALNUT... \$14.00
GENUINE MAHOGANY..... 14.00
MAHOGANY OR WALNUT FINISH 11.50

Shipping charges prepaid

"CORBETT'S CABINETS" have been preferred for several years by quality set builders and are unquestionably superior in design and finish. They are backed by our guarantee to please you. Carefully hand-rubbed piano finish. Well packed for shipment.

WRITE FOR CATALOG showing attractive models for all sizes of radio cabinets, consoles and tables.

Jobbers and Dealers write for discounts.

CORBETT CABINET MFG. COMPANY
St. Marys Pennsylvania

Radio Dealers WANTED!

If you are the type of dealer who hustles after business, who isn't content to wait for trade to come in but who takes sets out to demonstrate, can talk and sell quality merchandise, and knows Radio values, we have a big proposition for you. Are you that dealer?

50% Discount to Dealers

We manufacture a complete line of high grade receivers and sell to dealers at 50% discount. We are distributors for more than 225 Nationally advertised lines.

FREE Write today for amazing offers, new 112-page catalog and regular monthly catalogs quoting below-the-market prices on radio merchandise—all free. Everything in Radio for less.

AMERICAN RADIO MFG. CO.
1416-18 McGee St., Dept. T. Kansas City, Mo.

★ Tested and approved by RADIO BROADCAST ★



Oh boy!

KESTER

Rosin Core

Radio SOLDER

Sure! is Safe and Simple

Approved by
Radio Engineers

A Genuine Solder

CHICAGO SOLDER COMPANY

4222 Wrightwood Ave., Chicago, U. S. A.

Originators and
World's Largest Manufacturers of
Self Fluxing Solder

YOUR DEALER
CAN SUPPLY YOU



ALMOST TOO GOOD TO BE TRUE X-L VARIO DENSERS INSTALL THEM IN YOUR SET AND LEAVE THEM SPEAK FOR THEMSELVES

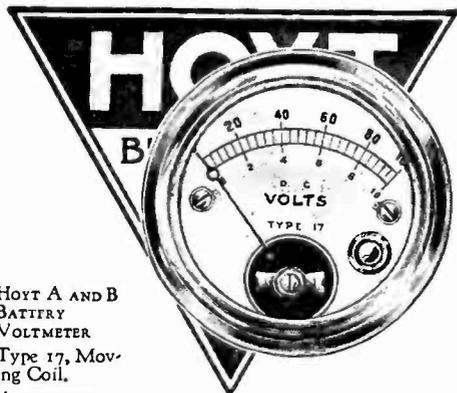
Endorsed and Used by the Foremost Radio Engineers
MODEL N—Capacity range 1.8 to 20 micro-microfarads, for balance in Roberts two tube, Browning-Drake, McMurdo Silver's Knockout, Neutrodyne and tuned radio frequency circuits. Price \$1.00

MODEL G—Two capacity ranges, .00016 to .00055 and .0003 to .001 Microfarads, for the Cockaday circuit, filter and intermediate frequency tuning in super-heterodyne and positive grid bias in all sets. Price \$1.50

X-L RADIO LABORATORIES
2424 Lincoln Avenue CHICAGO



Don't Blame the Set



HOYT A AND B BATTERY VOLTMETER Type 17, Moving Coil. A two-range voltmeter with pushbutton in cover glass.

WHEN your radio set begins to act queerly and symptoms of hoarseness appear in your loud speaker, when distance dies and locals lose their accustomed appeal, don't blame the set — first. The best car in the world won't run on flat tires. You probably have a tire gauge to tell you the air pressure in your tires. Hoyt meters in your radio set will prevent the flat tires of radio — discharged batteries, loose connections, and poor tubes. Without meters, a radio set in trouble is anyone's guess. With meters, you can diagnose the trouble. Usually you can prevent it. Don't blame the set — use Hoyt meters and place the blame where it belongs.

Send for catalogue describing the entire line of Hoyt Radio Meters — an instrument for every use.

Burton-Rogers Company
26 Brighton Ave. :: Boston, Mass.
National Distributors



\$15⁰⁰

THE KODEL MICROPHONE LOUD SPEAKER is an exact replica of the transmitting microphone used in broadcasting.

The efficient Kodel reproducing unit, with an ingenious new snail-shellhorn, mounted inside the microphone case, produces a remarkably clear, full-toned volume. Non-vibrating tone chamber eliminates distortion.

The \$15 model incorporates the new Kodel, Jr unit; with the large Kodel unit, \$20.

Radio dealers everywhere have them
THE KODEL RADIO CORP.
505 E. Pearl St., Cincinnati, O.

Design Patented

The KODEL MICROPHONE LOUD SPEAKER

The new, big *Radio Broadcast* is better than ever. The November magazine sold out completely a few days after it was issued. December will go over just as big. Better send four dollars now and get your subscription in beginning with January. Tune in with *Radio Broadcast* for 1926. Subscribe NOW. Write RADIO BROADCAST, Garden City, N. Y.

MEGGIT RESISTOR

When you build the Radio Broadcast "Aristocrat," use Meggit Resistors, for with them you will understand the joy of perfection in amplification.

Send 10c for Booklet "Resistance Coupled Amplifiers"

COLE RADIO MFG. CORP.
Bloomfield, N. J.

For Clear Radio Reception Use
'PARKSTON' Detectors
Quality Guaranteed



Mail orders 30c each
Attractive dealers' prices.

THE PARKSTON COMPANY
SCHENECTADY P. O. Box 914 NEW YORK

Order your copy of *Radio Broadcast* from your news dealer or radio store. Make sure that he reserves a copy for you each month. If your favorite radio store does not stock the magazine write us giving name of radio dealer and address.

To Roberts Knockout Fans

Do you know that we have published two books on the Roberts Knockout Receivers? One is a treatise containing all the articles printed, and the other is just one article with complete blue prints on how to build this wonderful receiver. Price one dollar each. Write to Booklet Dept. Radio Broadcast, Garden City, N. Y.

Gosilco Super Aerials

Heavy burnished silver plate on 14 copper sheathed with 24 karat gold. Permanently efficient. Outdistance all others. Sets re-wired with Gosilco show 35% increase volume, range. K N X Lab. test. Approved Popular Radio, Radio News. All American Radio Corp. 4½¢ per ft. round bus wire 12¢ per length, postpaid. C. O. D.

American Luminous Products Co.
Patent Applied for
Huntington Park California

INDEX TO ADVERTISERS

IN THIS ISSUE

A

Aberdeen Specialty Co.....	269
Acme Electric & Mfg. Co., The.....	242
Acme Wire Co., The.....	240
Acorn Radio Products Co.....	250
Alden Mfg. Co.	212
All-American Radio Corp.....	208-263
Allen-Bradley Co.....3rd Cover	276
American Electric Co.....	152
American Hard Rubber Co.....	210
Amer. Luminous Products Co.....	252
American Mechanical Laboratories...	148
American Radio Mfg. Co.	272
American Transformer Co.....	151
Amsco Products Co.....	267
Amplion Corp.	244
Antennaphone Co., The.....	270
Apex Electric Mfg. Co.....	229
Arrow Battery Co.....	266
Atwater Kent Mfg. Co.....	221

B

Bakelite Corp.....	233
Baker-Smith Co., Inc.....	263-236
Belden Mfg. Co.	141
Black Bros.	254
Brach Mfg. Co., L. S.....	258
Branch Tool Co.	270
Bremer-Tully Mfg. Co.....	232
Bristol Company, The.....	234
Browning-Drake Corp.	247
Burton-Rogers Co.	264-273

C

Cardwell Mfg. Co., Allen D.....	142
Central Radio Laboratories.....	156-D
Chicago Solder Co.....	272
Cleartron Vacuum Tube Co.....	238
Cole Radio Mfg. Co.....	273
Colytt Laboratories.....	256
Conneway Elec. Laboratories.....	146
Copper & Brass Research Ass'n.....	270
Corbett Cabinet Mfg. Co.....	272
Corning Glass Works.....	150
Crescent Braid Co., Inc.....	248
Crescent Radio Supply Co.....	254
Crosley Radio Corp.....4th Cover	
Cunningham Co., E. T.....2nd Cover	

D

Daven Radio Corp.....156-B	
Davidson Radio Co.	248
De Forest Radio Co.	225
Deutschmann Co., Tobe C.....	235
DeWitt-La France Co.....	246
Dongan Electric Mfg. Co.....	262
Dubilier Cond. & Radio Corp.....	147
Duplex Cond. & Radio Co.....	268
Durham & Co.	256

E

Eastern Coil Co.....	250
Eastern Electric & Mfg. Co.....	261
Eby Mfg. Co., H. H.....	272
Electrad, Inc.....	230
Electrical Research Lab.....	269

F

Fahnestock Electric Co.....	270
Ferguson, Inc., J. B.....	145
Ford Radio & Mica Corp.....	270
Frost, Inc., Herbert H.....	240
Furnell Mfg. Co., The.....	264

G

General Electric Co.....	231
General Instrument Co.	245
General Radio Co.....	223
Goertz & Co., August.....	266
Goodrich Rubber Co.....	255

H

Hammer Radio Co., S.....	248
Hammarlund Mfg. Co.....	217
Hammarlund-Roberts.....	213-214-215-216
Hanscom, Allan T.....	272
Harper & Bros.....	253
Hatfield & Son., H. D.....	246
Heins & Bolet.....	275
Holtzer-Cabot, Inc.....	271
Hommel Co., Ludwig.....	146

I

International Corres. Schools.....	260
------------------------------------	-----

J

Jacobs, C. E.....	254
Jewell Electrical Inst. Co.....	226
Jewett Radio & Phonograph Co.....	157
Jones, Howard B.....	261

K

Kalmus Comstock & Wescott, Inc....	268
Karas Elec. Co.....	237
Kellogg Switchboard & Supply Co....	209
Kodel Radio Corp., The.....	153-273
Korach Radio Co.....	262

L

Lectrodio Corp.....	271
Liberty Elect. Mfg. Co.....	150

M

Machine Specialty Co.....	270
Mack Laboratories.....	261
Martin-Copeland Co.....	275
Micamold Radio Corp.....	250
Midwest Radio Corp.....	259
Montgomery-Ward & Co.....	265
Morrison Laboratories.....	266
Mu-Rad Radio Corp.....	143
Mydar Radio Co.....	228

N

National Carbon Co.....	211
National Company.....	239
National Radio Institute.....	257
Norden-Hauck.....	254

O

O'Conner Co., A.....	267
Omnigraph Mfg. Co., The.....	270
Ozarka, Inc.....	205

P

Parkson Co. The.....	273
Pathé Phonograph & Radio Co.	152
Phenix Radio Corp.....	207
Potter Mfg. Co.....	272
Precise Mfg. Co.....	265

R

Radiall Co.....	243
Radio Corp. of America.....	155
Radio Institute of America.....	152
Radio Foundation.....	148-249
Radio Panels & Parts Corp.....	256
Radio Printers.....	254
Radio Products Inc.....	241
Radio Research Lab.....	266
Radio Units, Inc.....	268
Rathbun Electric Co.....	144
Raytheon Mfg. Co.....	258
Reichmann Co.....	149
Rhamstine, J. Thos.....	224
Ross Wire Co.....	244

S

Saal Co., H. G.....	260
Samson Electric Co.....	242
Sickles Co., The F. W.....	264
Silver-Marshall, Inc.....	156-A
Smith, B. H.....	240
Standard Radio Co.....	250
Starrett Mfg. Co.....	256
Steinite Lab.....	266
Supertron Mfg. Co.....	148

T

Thordarson Elect. Mfg. Co.....	156-C
Timmons Radio Products Co.....	251
Trimm Radio Mfg. Co.....	267
Twentieth Century Radio Co.....	258
Tyrean Institute.....	270

U

U. S. Tool Co.....	262
--------------------	-----

V

Van-Ashe Radio Co.....	266
Veby Radio Co.....	258
Valley Electric Co.....	227-206

W

Western Radio Mfg. Co.....	246
Westinghouse Electric & Mfg. Co.....	218-219
Wholesale Radio Service Co.....	266
Windsor Furniture Co.....	222
World Battery Co.....	266-268

X

X-L. Radio Laboratories.....	250-272
------------------------------	---------

We Have Specified Parts TO BUILD THE 6 TUBE **Silver - Marshall** "MODERN BROADCAST RECEIVER"

Model 1926

Build this receiver but be sure you use only the parts specified and you will not only have the satisfaction of possessing the finest receiver yet developed, but you will be a year ahead of all others.

- 3—S-M 311 .00035 S. L. F. Condensers
- 3—4" Naald moulded dials
- 3—S-M 515 Coil Sockets
- 2—S-M 112A Inductances
- 1—S-M 110A Inductances
- 6—S-M 510 Sockets
- 1—Carter 6-ohm imp. Rheostat
- 1—Central Laboratory 500,000 ohm Modulator
- 3—Muter or Daven Resistance couplers complete
- 1—Carter 101 Jack
- 1—Carter 102A Jack
- 1—Benjamin On-off Switch
- 1—.002 M. F. Condenser
- 2—S-M .5 M. F. By-pass Condensers
- 1—7 x 24 Drilled, Sanded and Engraved Panel
- 1—7 x 23 Oak Base Board, Bus-bar, Screws, Lugs, etc.
- 1—Belden 5-lead color cable

Complete Parts \$49.50
as Specified, Only . .

Wired and Ready to Use \$57.50

EXTRAS

- Daven MU-20 Tubes \$ 4.00
- Daven MU-6 Power Tube 5.00
- Western Electric 540-A.W. Cone Speaker 24.50

WE ALSO CARRY ALL THE PARTS FOR THE
ROBERTS-HAMMARLUND
Circuit

This is the circuit described, illustrated and listed on pages 73 to 78 in

NOVEMBER RADIO BROADCAST

Complete Parts as specified . . \$57.50

Cabinet for this Receiver \$14.00

100 Page Reference Book

Latest 1926 Radio edition—Just off the press. Contains latest parts and those hard to get; everything needed in radio, liberal discounts on standard quality parts.

Sent FREE on Request

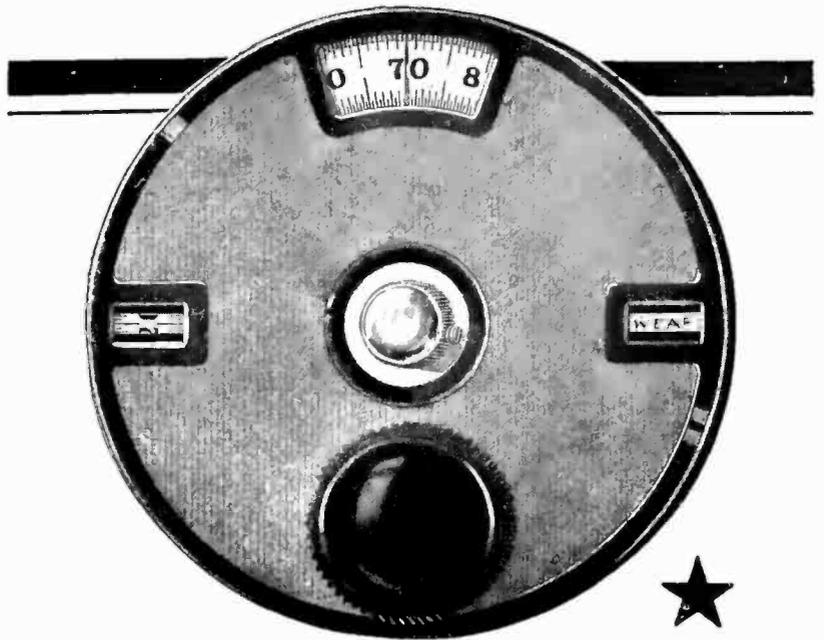
SPECIAL NOTICE

We also carry complete parts for the

McLAUGHLIN 8 Tube Receiver

The new 1 Dial Control Super-Heterodyne described in the Popular Radio Magazine for October and the sensation of the Radio Show at the Grand Central Palace, New York.

HEINS & BOLET, 46 Park Place, New York



Once turn this dial—

*and you'll know the reasons
for its sensational popularity*

SELDOM, if ever, has any single radio instrument been accorded the immediate and widespread approval that has come to the Mar-Co Dial.

Already it has been used in Radio Broadcast's "Aristocrat"—for Popular Radio's "Single Control Super-het"—for Radio News' "Balanced Intra-flex"—and for many others of this season's most advanced circuits.

Ask your dealer to show you this big improvement in tuning controls. Feel, for yourself, its responsiveness, its supreme accuracy. Notice the entire absence of backlash.

Try it on your set—you'll quickly decide no other dial will do.

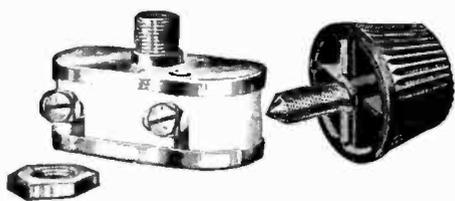
<i>Nickel Plated</i> \$2.50	Furnished with Scales reading 0 to 100, or 100 to 0, as preferred.	<i>Gold Plated</i> \$3.00
------------------------------------	--	----------------------------------

MARTIN-COPELAND CO.

Providence

Rhode Island





Bradleystat



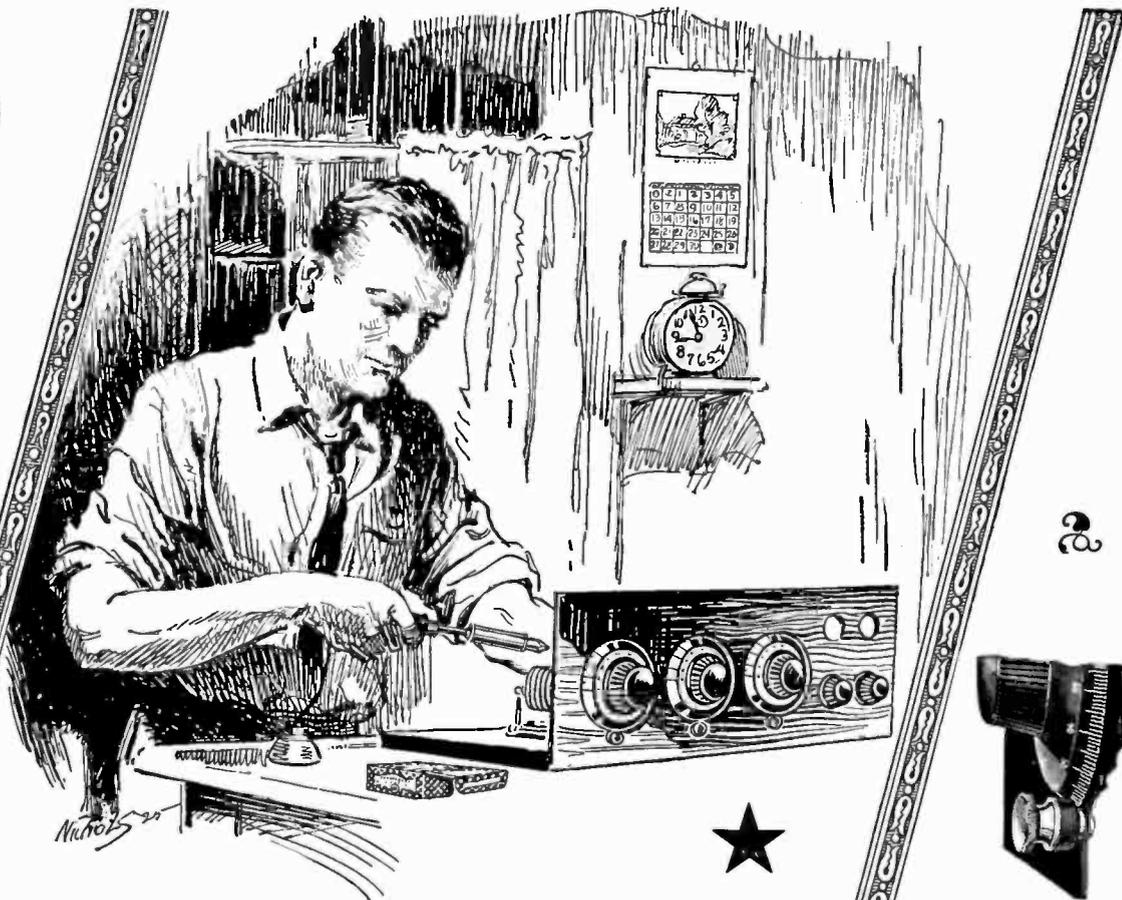
Bradleyleak



Bradleyometer



Bradley-switch



For Genuine Satisfaction Use Allen-Bradley Parts

RADIO SETS, like all electrical devices, are no better than the parts used in their construction. The experienced set builder has discovered the futility of using poorly made, inefficient units in his set.

Allen-Bradley Perfect Radio Devices are so carefully made and so beautifully finished that they assure perfection in performance and appearance. In fact, the noiseless, perfect control of Allen-Bradley radio devices has never been surpassed and many of the finest factory built sets today are equipped with Allen-Bradley parts.

Ask your dealer for Allen-Bradley perfect radio devices when you build your next set. If you are not acquainted with the entire Allen-Bradley line mail the attached coupon today for our latest illustrated literature.



Bradlynier



Bradleyunit



Bradleyohm

Allen-Bradley Co.

Electric Controlling Apparatus

278 Greenfield Ave.



Milwaukee, Wis.

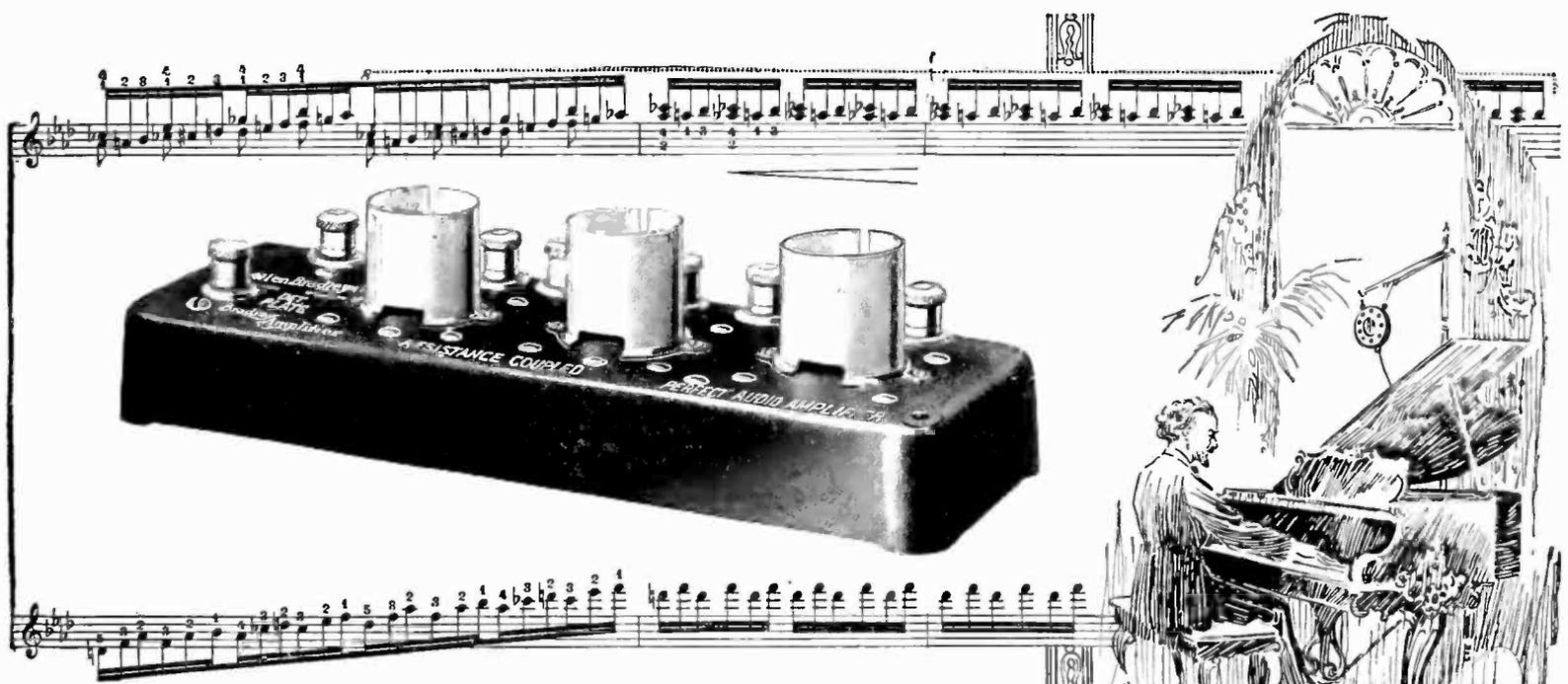
Manufacturers of Graphite Disc Rheostats for Over 20 Years

ALLEN-BRADLEY CO.,
278 Greenfield Ave.,
Milwaukee, Wisconsin

Please send me, by return mail, your latest illustrated literature of the complete Allen Bradley Line.

Name

Address.....



Hear ALL the Music with the Bradley-Amplifier

THE delicate variations and shadings of instrumental music and the exquisite strains of the vocalist are amplified with faithfulness and clarity by the Bradley-Amplifier. It matters not whether you own a factory-built set or a home-built receiver, either will be improved by using the Bradley-Amplifier.

Bradleyunit resistors, that are impervious to moisture and unaffected by atmospheric changes, take the place of the audio-frequency transformers of ordinary amplifiers. There is no distortion and no loss of low or high frequencies. All tones are reproduced with equal facility.

Ask your dealer for the Bradley-Amplifier today and substitute it for your present audio-frequency amplifying transformers. Resistance coupled amplifiers are acknowledged by radio experts to be the most perfect type of amplifier. You can make your set perfect with a Bradley-Amplifier.

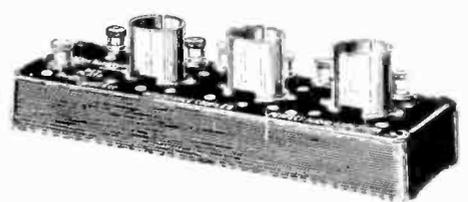
Retail Prices—In U.S.A. \$15
—In Canada \$21



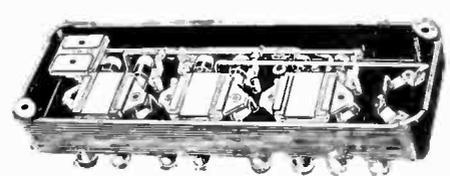
Allen-Bradley Co.
Electric Controlling Apparatus



MILWAUKEE,
WISCONSIN



Can be installed within radio cabinet. UX as well as old tubes can be used.



All resistors, condensers, and wiring, are concealed within Bakelite base.



Bradleyunit resistor is made of solid molded material which does not change with age. All units are soldered.

ALLEN-BRADLEY CO.
278 Greenfield Ave., Milwaukee, Wisconsin

Please send me your latest literature on the Bradley-Amplifier, explaining how it will improve my receiver.

Name

Address

**Mail
the Coupon**

★ Tested and approved by RADIO BROADCAST ★

The wonderful performance of these CROSLEY Radios will be duplicated this year — and with these New Prices they should be Radio's best values!

Lives in Lawrenceburg, Ind.—Listens to U. S. with a Crosley 2-Tube 51

"I received program under normal conditions from New England States including Canada, the Western Coast and as far South as Florida and Texas."

Edgar F. Feist, Lawrenceburg, Ind.

Vermont Man Appreciates Selectivity of Crosley 2-Tube 51

"KOA, Denver, Colorado, as you know is very close to WGBS of New York City. Come in on my dial only one point from each other, yet I get no interference."

Allon D. Farington, Putney, Vermont.

Lives in the Heart of Chicago—Gets the Country's Best in Radio with a Crosley 2-Tube 51

"E. W. Plauk of 5130 Sheridan Road, Chicago, sends a list of 46 stations he hears regularly outside of Chicago from New York City to Los Angeles, California, to which he adds 'all praise and credit to Crosley Radio.'"

Vancouver to Torrington, Connecticut, is a Short Distance for the Crosley 2-Tube 51

"Following are only a few of the stations I have received:—WBAP, Fort Worth, Texas; 6 KV, Cuba; KOA, Denver, Colorado; WTG, Manhattan, Kansas; KPO, San Francisco, Manchester, England and Vancouver, for which I can furnish sworn statement if desired."

Harris C. Rodsefellow, Torrington, Conn.

Easy Tuning is a Feature of the Crosley Trirdyn

"My little daughter, two and a half years old is a real radio fan. For an honest fact, she can tune in the most powerful stations and get some music."

L. F. Infanger, Rome, New York.

35 States in the Union Report to this Crosley Trirdyn Owner

"Here is a list of States from which I have received verification stamps—from one or more stations in each state. I have also heard Scotland during international test."

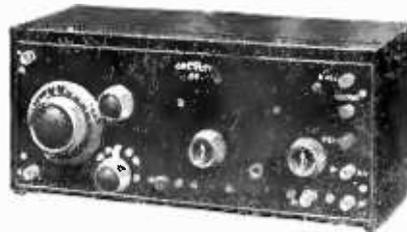
John H. Pulhoff, Akron, Ohio.

Crosley 2-Tube 51 Regular

This efficient little set uses any make of tubes. Nearby stations on loud speaker, long range on headphones.



Now \$14⁷⁵ was \$18⁵⁰



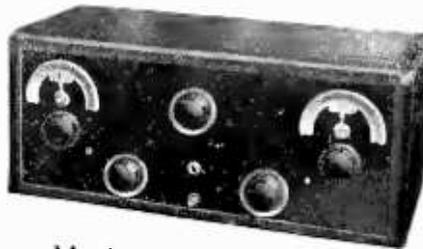
Crosley 3-Tube 52 Regular

For a less expensive 3-tube set the Crosley 52 Regular cannot be surpassed at the new low price.

Now \$25³⁰ was \$30

Crosley Super-Trirdyn Regular

In the Super-Trirdyn, 3 tubes do the work of 5. Matchless performance. Beautifully finished solid mahogany cabinet.



Now \$45⁵⁰ was \$50 ★

These prices do not include accessories. Add 10% to all prices west of the Rockies.

Crosley Trirdyn has Brought him 178 EKKO Stamps and KZKZ, Manila, Philippine Islands

"In all I have logged 208 stations and received 178 EK KO stamps. The farthest I have received is 7,000 miles, which is Manila, Philippine Islands (KZKZ). I have received one Alaska Station and four California stations."

Leo Cassell, Indianapolis, Ind.

Hot Weather Did Not Keep this Crosley Trirdyn Owner Home

"During hot weather I bring in New York, Schenectady, Detroit, Omaha, Cincinnati, Cleveland, New Orleans, Denver, St. Louis, and Atlanta on any night. No matter how many stations are broadcasting in Chicago I can always pick up 10 to 20 outside stations on my set."

Orrille G. Daily, Chicago, Illinois

Low Power Stations Heard Across the Country, with the Crosley 3-Tube 52

"One big asset of Crosley '52' is its ability to pick up low powered broadcast. I have picked up KFON, Long Beach, California and KFUM, Colorado Springs, Colo., both stations using only 100 watts and KFEL a 50 watt station in Denver."

Phillip S. Williams, Bristol, Pa.

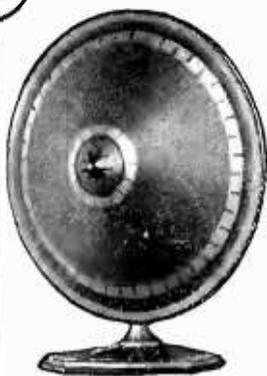
Lives in California—Lists 35 Stations East of Rockies Heard on Loud Speaker

J. F. McGinley living in Hallster, Calif., sends us a list of stations in the East including Ohio, Pennsylvania and New York, whose broadcasting he enjoys constantly on his loud speaker. He emphasizes the fact that he owns no ear phones.

"Coast to Coast" Reception with a Crosley 3-Tube 52

"I have a record of reception of practically all the large radio stations in this country and Canada from WBZ, New England to WMBF, Miami, from Fort Worth, Texas to CURT, Toronto and from CYL, Mexico City to KGW, Portland, Oregon and KFI, Los Angeles."

Waller Hagerly, Burlington, Iowa.



The Famous MUSICONE

This marvelous loudspeaker—well on its way to REPLACE HALF A MILLION HORN TYPE SPEAKERS by January 1st—substantially reduced because of assembly improvements developed by Crosley engineers. Reproduces all tones—without distortion. Crosley patented unit, not cone, secret of its amazing perfection.

Now \$14⁷⁵ was \$17⁵⁰

CROSLEY RADIO

BETTER · COSTS LESS

THE CROSLEY RADIO CORPORATION Department 20 Cincinnati

★ Tested and approved by RADIO BROADCAST ★

THE COUNTRY LIT PRESS, GARDEN CITY, NEW YORK