DEC. 1924

RADIO BROADCAST

35 CENTS

How to Make a Current Supply Set

AND OTHER GOOD CONSTRUCTION ARTICLES

Advertising by Radio---?

DOUBLEDAY, PAGE & CO. GARDEN CITY, NEW YORK

Christmas

---and the whole world is young again

THE Air is a-quiver, the Ether crowded, with the Yule-tide Music. The carols, the simple songs, that carry us back to a rose-tinted childhood are beating . . . beating . . . . beating . . . . their soundless tattoos at our Hearth-Stones.

Radio is the Magic-Key that translates it all into vibrant glorious sound.

Only a Scrooge, untouched by the Christmas Spirit, will leave the Key unturned.

Of course, for the utmost in Radio enchantment, you will equip your set with tubes of the rarest scientific accuracy—

Quality Plus Service
Since 1915

Cunningham
RADIO TUBES

PATENT NOTICE: *Cunningham tubes are covered by patents dated 2-18-08, 2-18-12, 12-30-13, 10-23-17, 10-23-17, and others issued and pending. Licen ed only for amateur experimental and entertainment use in radio communication. Any other use will be an infringement.*

Cunningham 40-page data book fully explaining care and operation of Radio Tubes now available by sending 10c in stamps to San Francisco office.

Price the same on all five types—
C-301A, C-299, C-300, C-11, C-12

C. F. Cunningham Inc.
182 S
Home Office: SAN FRANCISCO CHICAGO NEW YORK

★ Tested and approved by RADIO BROADCAST ★

How many radio miles did you go last night?

HOW many radio miles did you travel last night?—that's the up-to-the-minute question. Did you voyage from New York to Chicago? Did you look in on Boston fifty seconds after, and on Philadelphia half-a-minute after that? If you *didn't*, why didn't you? There's fun and excitement, too, in a De Forest Radio—and it's ready to "get to work" five minutes after it enters your home.

Here is a radiophone so astonishingly simple for the work it does that it's your best introduction to the marvels of radio space. Here is one so perfectly developed that it invites graduation from other less efficient instruments.

Here is a receiving set sponsored by the very genius who made radio, as we know it, possible—an instrument that offers a really remarkable demonstration in radio performance at a price far less than any instrument whose achievements compare with it. Here is a practical, a modern Radiophone, depending upon no out-strung wire to obtain results, but which, with a simple loop the size of a picture frame, opens to you a far-flung range of concert, speech and lecture—and all with a tonal purity, a sensitive choice, as

DE FOREST RADIOPHONE

TRADE MARK REG. TRADE MARK REG.

For beauty and clear reproduction

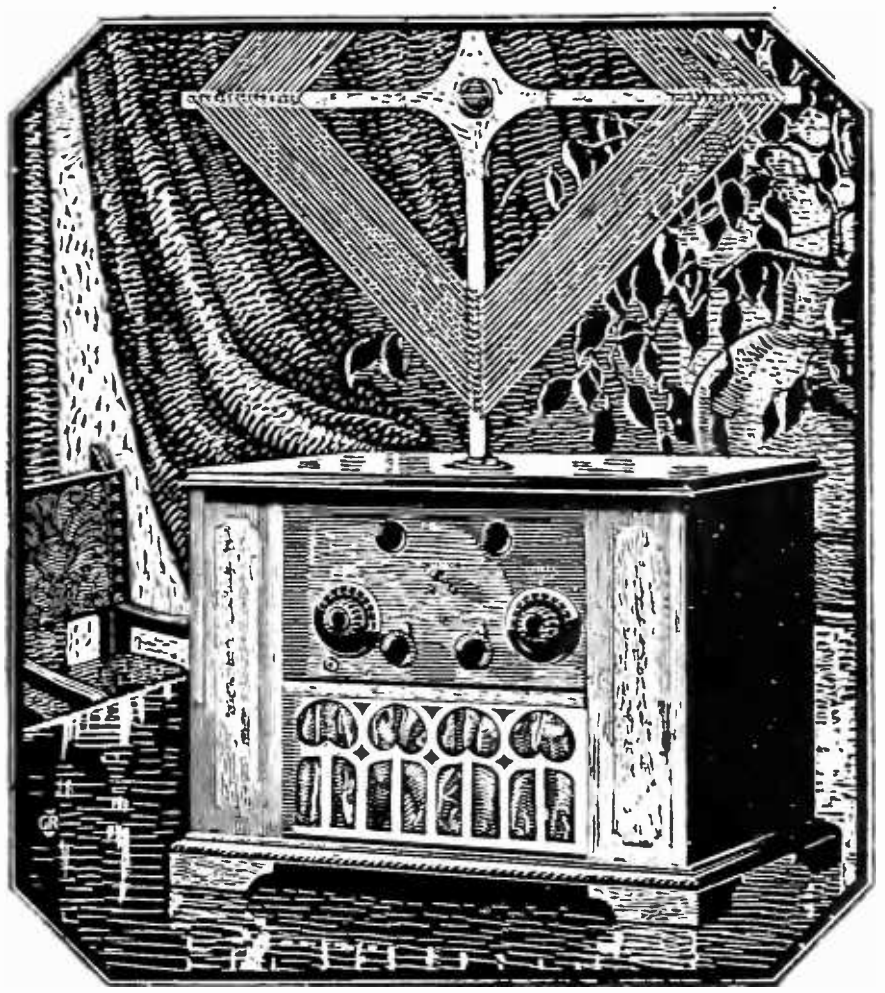
Use the De Forest Loud Speaker. It reproduces naturally, brilliantly, without distortion. Its horn is shaped to retain the full brilliancy of the original sound, and also to add volume. The complete unit is free from rattles. Every De Forest Loud Speaker is thoroughly tested, and is guaranteed free from defects. Sold by authorized De Forest dealers only. Price, with 6 feet of cord, $25.00.

★ Tested and approved by RADIO BROADCAST ★

RADIO BROADCAST. December, 1924. Published monthly. Vol. VI, No. 2. Published at Garden City, N. Y. Subscription price $4.00 a year. Entered at the post office at Garden City, N. Y., as second class mail matter. Doubleday, Page & Company, Garden City, N. Y.

between station and station, that is rare to any but De Forest users.

The De Forest Radiophone is a complete four-tube receiver, built on the best reflex principle. Its four tubes and crystal detector do the work of seven tubes. We could be extremely technical in telling you how the four tubes do the work of seven and why the crystal detector gives both power and economy to this instrument. If you are technically inclined we shall be glad to do so if you will write us. Technical or not, however, know this: You can get splendid results from a De Forest D-12 Radiophone. Its upkeep is low. Its tone is clear and pure. It can be moved easily from room to room.



Why it pays to look for the De Forest agent

De Forest from first to last stands for all that is substantial and thorough and fundamentally right in radio. De Forest agents are qualified to give you sound and practical advice and help in radio. When you find a De Forest agent you find a man who knows radio—a man who has given us his word that he will see that every instrument he sells is thoroughly inspected and properly serviced after the sale. He has been carefully picked and schooled in the operation and servicing of De Forest Radiophones.

He will install your instrument and explain to you simply how to get the fullest satisfaction and enjoyment from it.

Prices on De Forest D-12 Radiophones

(COMPLETE)

Including loop, self-contained loud speaker, four De Forest tubes, A and B batteries, and all equipment ready to operate.

With Dry Batteries

In two-tone gray and black Fabrikoid cabinet	$161.20
In two-tone Mahogany cabinet	176.20

With Storage Batteries

In two-tone gray and black Fabrikoid cabinet	180.00
In two-tone Mahogany cabinet	195.00

De Forest D-14 Radiophone

In burl walnut cabinet with loop and loud speaker built in. Price, including five DV-2 tubes, four B batteries, and storage batteries	371.50

DE FOREST RADIO COMPANY
Jersey City, N. J.

DE FOREST RADIOPHONE

TRADE MARK REG. TRADE MARK REG.

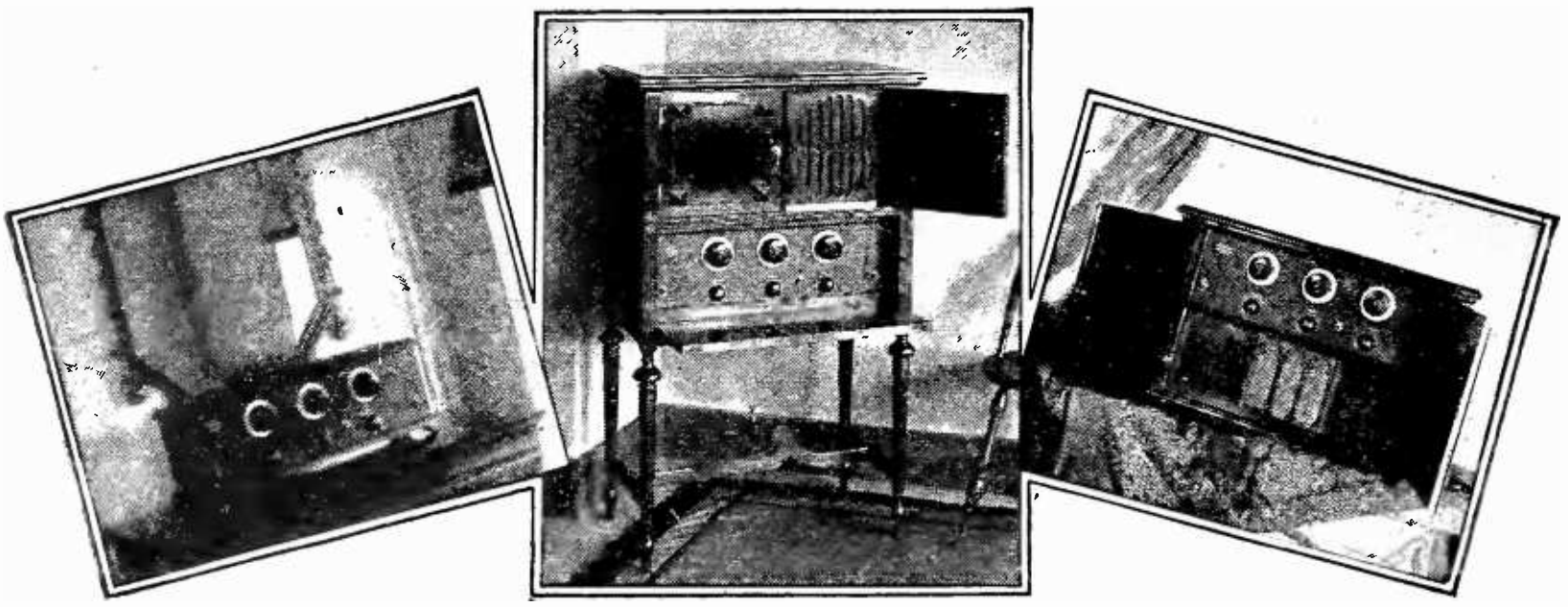
Your set deserves De Forest tubes

De Forest DV-3 Tube for use with Dry Cell Batteries.

The original De Forest vacuum tube was the first of many millions of De Forest tubes that have stood foremost in quality of workmanship and performance. They are noted for uniformity, volume, and clarity. Use DV-3 with dry batteries, DV-2 with storage batteries. They are guaranteed against defects in material and workmanship. Sold only by authorized De Forest dealers. Price $4.00 each.

De Forest DV-2 Tube for use with Storage Batteries.

★ Tested and approved by RADIO BROADCAST ★



The Newport Brings Happiness

★

You can give your loved ones the greatest thrill Christmas morning by surprising them with a Newport Radio Receiver. They will be not only surprised but pleased because they *know* that the Newport is one of the best receivers built.

It combines every element that makes for delightful reception: Tone Quality, Selectivity, Range, and Volume and it sacrifices none of them. The highly unpleasant squeals that are present in so many receivers are absolutely eliminated.

The Newport has been designed by the most competent engineers. It is thoroughly and sturdily constructed of the best materials and, with ordinary care, it will last many years. The receiver has been tested under trying conditions by some of the best authorities in the industry and it carries their unqualified stamp of approval, It operates at less by 30% A and B battery than the average set. In short, the Newport Radio Receiver is not an experiment at your expense.

The Newport is built in cabinets of three designs —designs that will harmonize with the finest appointments—designs that are a joy to all lovers of fine furniture.

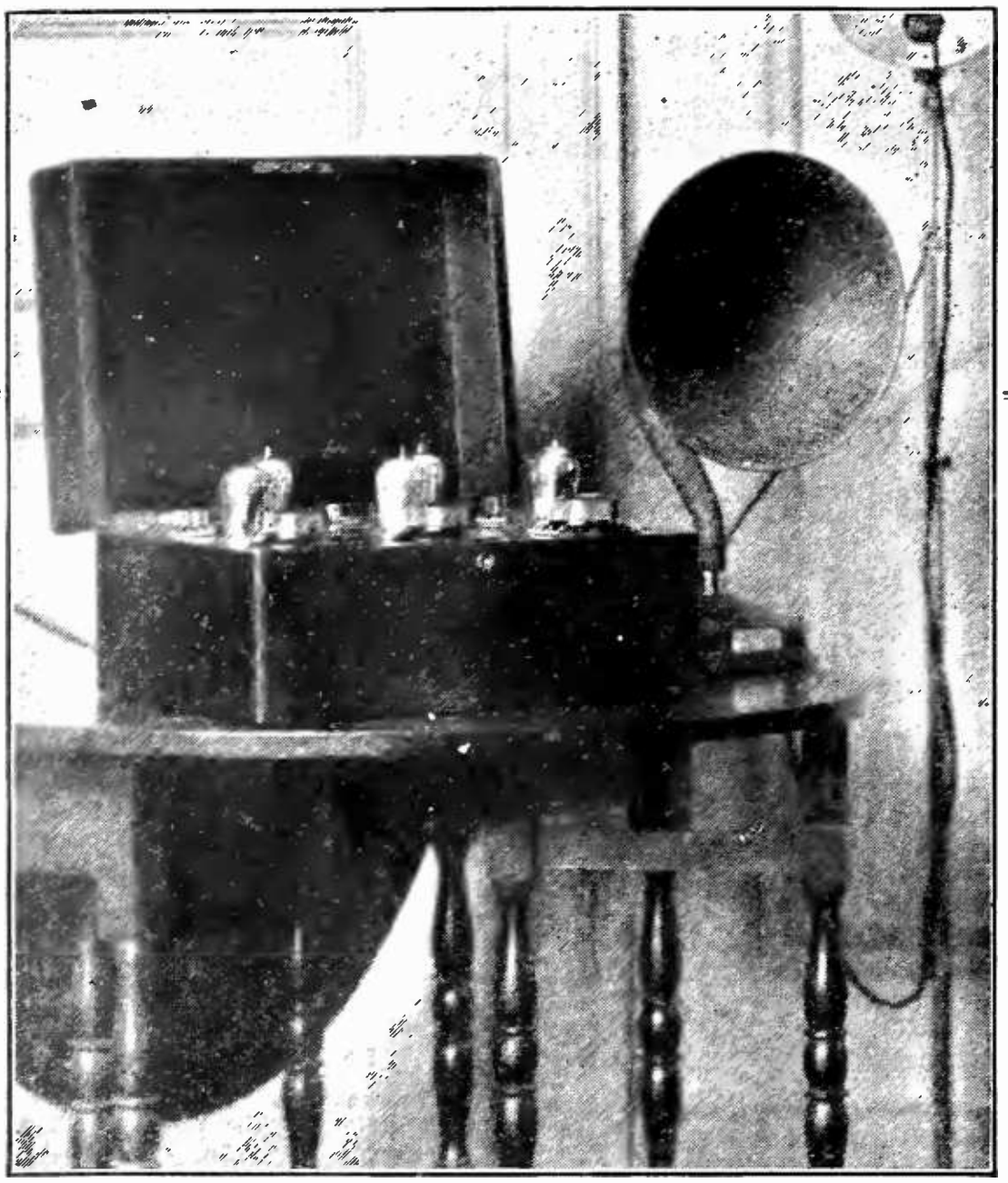
It is just the receiver you want for an ideal remembrance. And yet it isn't expensive. Small model, $118.00. Second model, $170.00, equipped with loud speaker ($180.00 West of Denver). Console model $250.00 equipped with loud speaker, ($260.00 West of Denver).

The Newport Is a Good Receiver
Built in a Piece of Fine Furniture

Newport Radio Corp.

250 West 54th Street,
New York City

★ Tested and approved by RADIO BROADCAST ★



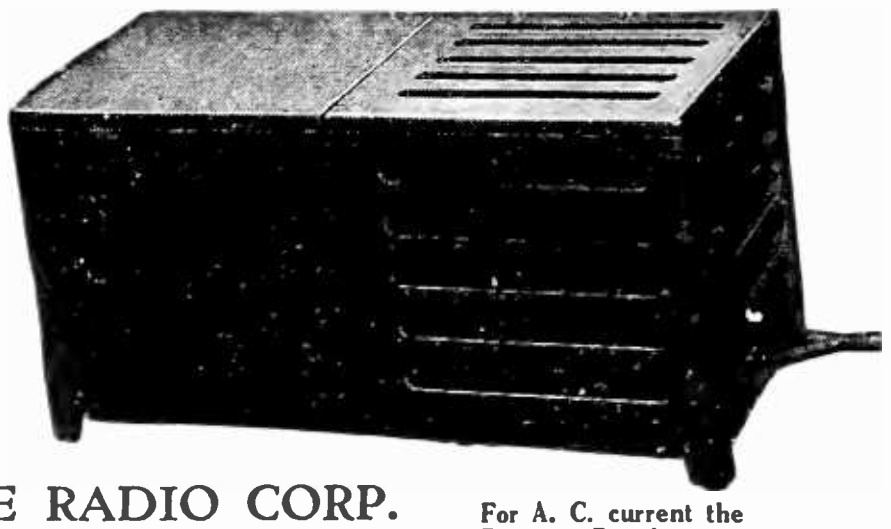
The Dynergy Receiver is complete as shown for D. C. current.
(This does not include tubes and speaker.) $185.00

Authorities Agree on the Dynergy

THE Dynergy Radio Receiver is the first receiver ever built to operate directly and entirely from the electric light socket. To be absolutely sure that no unjustified and misleading claims would be made for the Dynergy, every sort of test under all kinds of varying conditions was made.

As a result this receiver has been tested by men in the radio industry who *know*. There follows a list of a few of the prominent radio authorities who have tested and endorsed the Dynergy: Mr. Pace of the New York Edison Co.; Mr. Wm. Hedges of the Chicago Daily News; the Chief Engineer of KYW., Chicago; the Editor of Radio Broadcast Magazine; the Radio Editors of the New York Sun; Telegram-Mail; World; Journal; and the Springfield Republican. Tests have also been conducted in the radio laboratories of Radio Broadcast; Brooklyn Navy Yards; and practically every radio publication of any national significance.

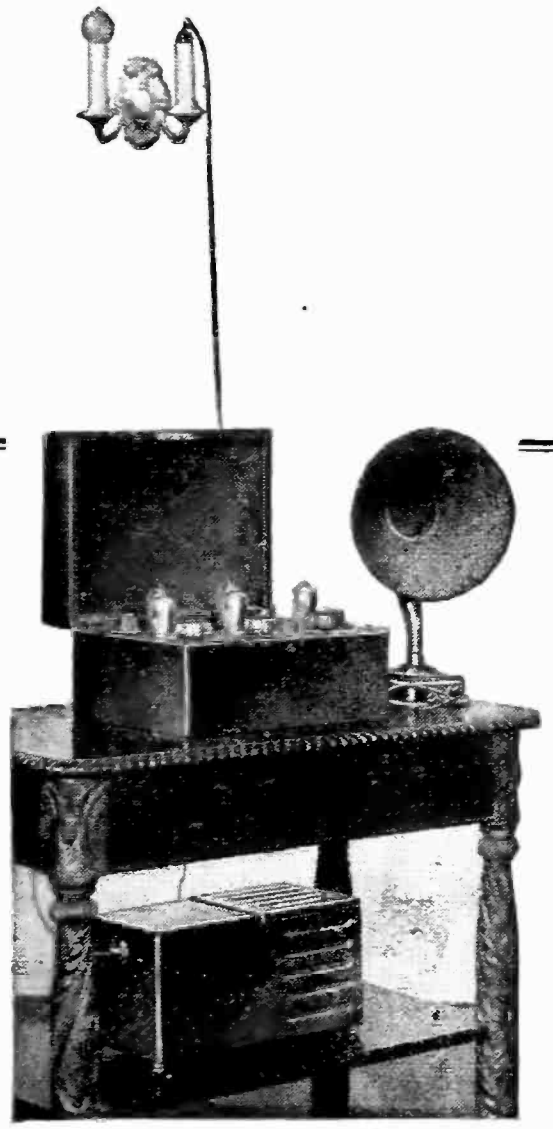
It was not enough that these men and organizations approve it. It was given out to responsible jobbers and dealers, who are perhaps the greatest critics in the radio field, for their opinion. In every instance the report was more than favorable, it was downright enthusiastic.



For A. C. current the Dynergy Receiver requires only the Dynergy Rectifier. $50.00

DYNAMOTIVE RADIO CORP.
47 NINTH AVENUE
NEW YORK CITY

★ Tested and approved by RADIO BROADCAST ★



The Dynergy Receiver and Dynergy Rectifier are shown complete. A. C. or D. C. current may be used.

"Isn't that a sweet tone, dear? Listen to the Volume! And to think the Dynergy operates without batteries. Just turn on the light switch and it is ready to receive anything. No more batteries for mine!"

"Yes, and just think how much we will save on batteries. And besides, I won't need to be cleaning around your Dynergy all the time to save my floors and rugs from damage."

Hear Dynergy and You Will Agree, Too!

TO THE radio enthusiast who is constandly bothered with battery recharging, battery expense, and battery inconvenience, the "Dynergy" Radio Receiver is a dream come true, for it operates directly from the light socket (either A. C. or D. C.) absolutely without batteries of any kind.

Here is the receiver for which you have been waiting. It takes all its power (filament lighting, plate and grid voltages in detector and four amplifying tubes) directly from the light socket. Turn on the switch and the Dynergy is ready for reception. Fussing with run-down batteries is a thing of the past to Dynergy owners. In the place of unreliable batteries has been substituted a dependable, unvarying and constant flow of quiet, perfectly controlled electrical power.

The Dynergy is a complete radio receiver in which all unpleasant hums, disturbing tube noises, and annoying battery crackles are singularly absent. It is a five tube receiver with two stages of condenser tuned radio frequency amplification, a detector, and two stages of audio frequency amplification. It is inexpensive to operate. On A. C. current the operating cost is less than ½ cent per hour; while on D. C. current the current consumption runs less than ¼ cent per hour.

Replacement cost is eliminated except for vacuum tubes and in case of A. C. current, rectifier tubes. But even this expense is kept to a minimum because a burnt out tube is an impossibility, for the removal of one or more tubes does not vary the voltage input. As a consequence, tubes will last from one and one half to two years.

The Dynergy Radio Receiver presents to thoughtful radio enthusiasts one of the best receivers built. It is a receiver that operates entirely from the electric light socket (no A, B, and C batteries). It is highly selective and sharp in tuning, especially sensitive, non-reradiative, clear in tone, and simple to tune. It compares favorably in price to any receiver on the market. Replacement cost is practically eliminated in the Dynergy.

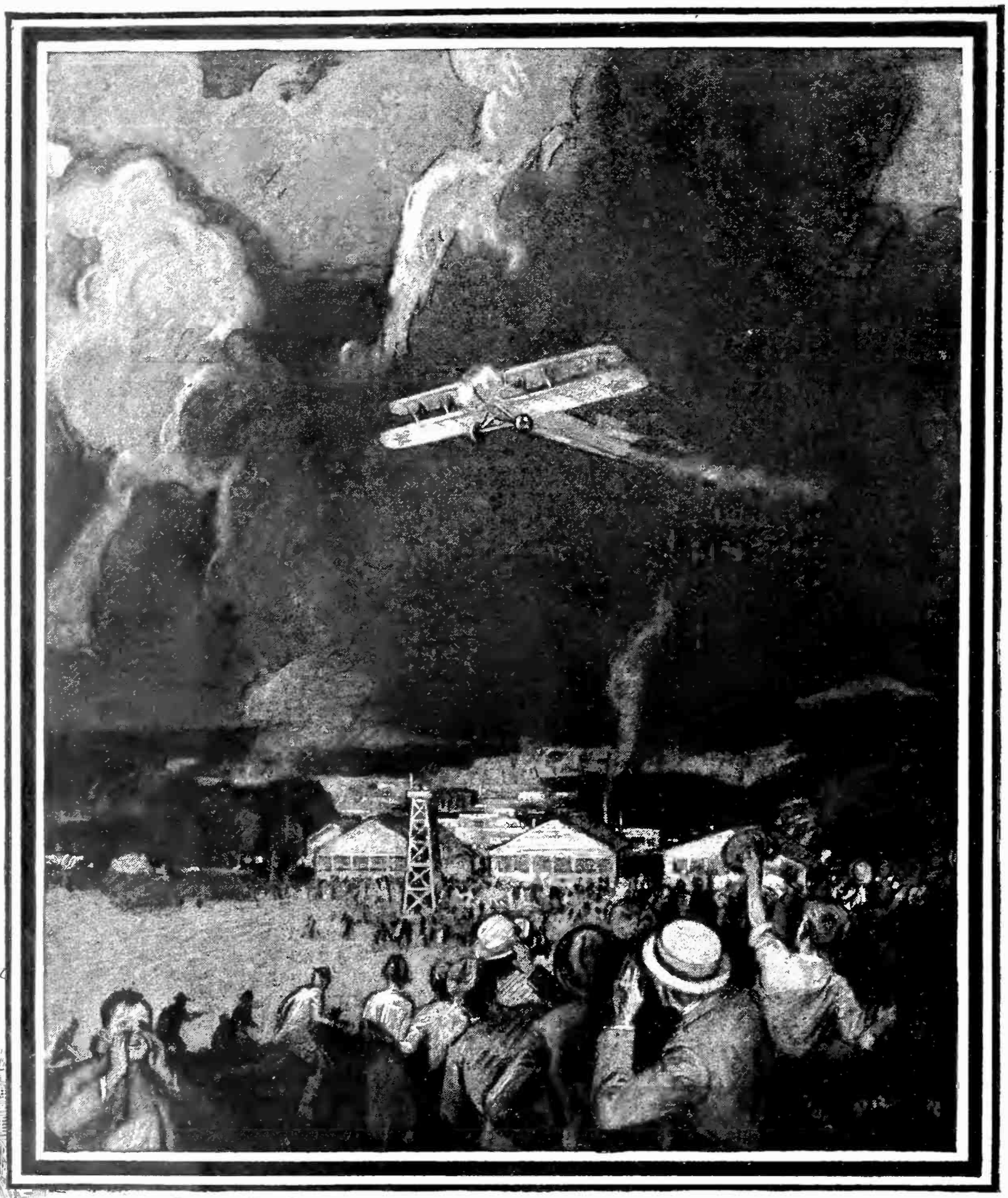
The Dynergy Radio Receiver is complete in itself for D. C. current. For A. C. current the Dynergy rectifier is supplementary to the receiver.

DYNAMOTIVE RADIO CORP.
47 NINTH AVENUE
NEW YORK CITY

★

Over 2,000 Satisfied Owners, Already.
Over 20,000 Ordered

★ Tested and approved by RADIO BROADCAST ★



Maughan arrived at dusk on June 23, 1924, at Crissy Field, San Francisco.

"this flight is epochal"

"CONGRATULATIONS on the achievement of a wonderful feat. You have fulfilled every confidence I had in you. You have brought prestige to yourself, the Army Air Service and to America. Not only from a military but from a commercial standpoint this flight is epochal. I am proud of you. God bless you."—*Telegram of greetings received by Lieutenant Maughan from Major General Patrick, Chief of the Army Air Service.*

Lieutenant Maughan took off at daybreak on June 23, 1924, at Mitchel Field, Long Island.

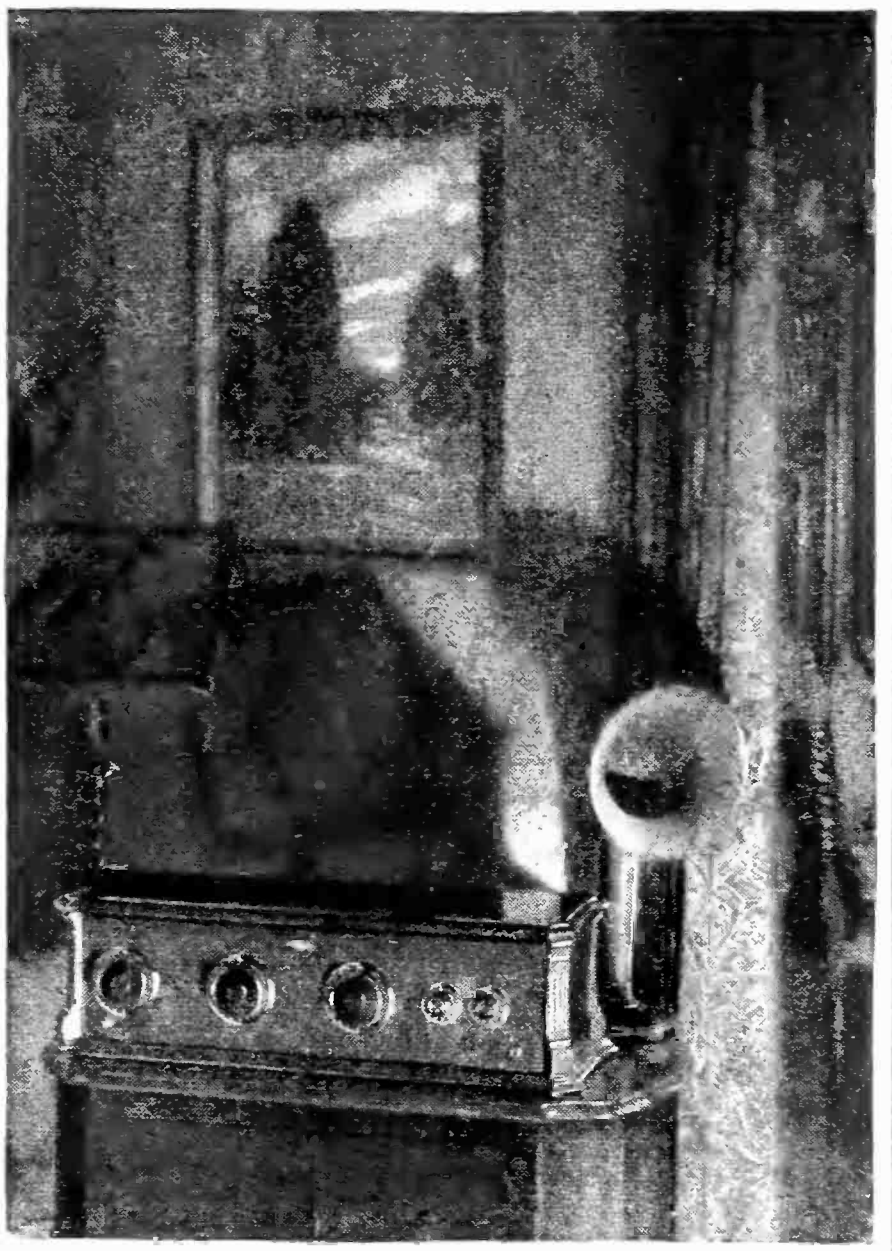
Coast to Coast *with* SPLITDORF

THIS supreme effort of Man in the conquest of the air was made possible by a twelve-cylinder Curtiss pursuit plane, with Splitdorf Magnetos firing the mixture with never-faltering regularity while the engine turned over 2400 revolutions per minute.

And the mechanical genius that played such an important part behind the scenes of this epochal flight is the genius of design and manufacture that has been represented by the Splitdorf trade-mark on electrical devices for nearly three-quarters of a century.

SPLITDORF ELECTRICAL COMPANY
Newark, New Jersey

TRADE SPLITDORF MARK ESTABLISHED 1900



SPLITDORF 5-TUBE RADIO SET

The inherently neutralized receiver

THE Splitdorf receiver was designed for the man who wants to *enjoy* radio reception; the man who demands clarity and purity of tone and plenty of volume without squawks and squeals and without "tinkering."

The Splitdorf 5-tube Radio set represents many marked improvements in tuned radio frequency receivers: The circuit is *permanently* balanced; it will not oscillate and will not radiate under any operating condition. The necessity for critical adjustments has been eliminated; set tunes sharp and is extremely selective yet it is simple to tune and operate—stations always come in on the same dial settings. Gives excellent results with any antenna—outside aerial and ground; inside antenna and ground; aerial alone; or *ground alone.*

Write for descriptive booklet

★ Tested and approved by RADIO BROADCAST ★

For a Merry Christmas—for a merry time every day and for many years to come—give your loved ones a Thompson Radio Receiving Set, a Thompson Speaker, or both.

THOMPSON RADIO

Thompson Radio Receiving Sets and Thompson Radio Speakers deliver the highest quality of simplified and economical radio entertainment. Both nearby and distant radio programs cannot be more faithfully reproduced than with a Thompson Radio Receiving Set.

One of the many reasons for the advanced development and perfection in Thompson Radio products is an organization composed of radio engineers who have been making radio apparatus *exclusively* ever since "radio" was called "wireless."

The 5-tube GRANDETTE is $125. The 5-tube PARLOR GRAND, (shown in large picture below) is $145. The 6-tube CONCERT GRAND, is $180. Prices are without tubes or batteries. The Thompson Speaker, with conical diaphragm and other special features, is now $28.

If your dealer does not handle Thompson Radio products, write direct to us for attractive literature and name of dealer near you.

R. E. THOMPSON MANUFACTURING CO.

Manufacturers of Radio Apparatus for the U. S. Army and Navy and many foreign governments

NEUTRODYNE

30 CHURCH ST.
NEW YORK, N. Y.
FACTORY:
JERSEY CITY, N. J.

★ Tested and approved by RADIO BROADCAST ★

Of Course It's a CROSLEY
Better-Costs Less Radio

THINK of the boundless delight of that dear old mother, confined to the house by the rigors of winter or the infirmities of age, when she listens in for the first time on a Crosley Radio. Imagine the joy of the kiddies, when they awaken you Christmas morning with the glad tidings that "Santa has brought us a Crosley Radio." Then decide to make this a Crosley Christmas.

There can be no gift with greater possibilities for continued happiness than a Crosley set. It carries Christmas along through the year, continually giving new thrills and happiness, and bringing pleasant thoughts of the giver.

It is a delight to operate a Crosley. The immediate response to the turn of the dials; the clearness of reception from far distant points; the real ease with which local stations may be tuned out; all help to make Crosley reception destinctive and exceptionally pleasurable. The very low cost at which this really remarkable radio performance can be obtained places Crosley sets within the reach of all—the ideal Christmas gift.

BEFORE YOU BUY—COMPARE
YOUR CHOICE WILL BE A CROSLEY

For Sale By Good Dealers Everywhere

Crosley Regenerative Receivers are licensed under Armstrong U. S. Patent 1,113,149. Prices West of the Rockies add 10%

Write For Complete Catalog

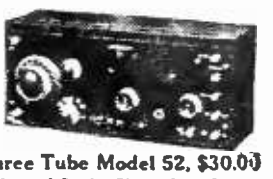
THE CROSLEY RADIO CORPORATION
Powel Crosley, Jr., President
1220 Alfred Street **Cincinnati, O.**

Crosley Owns and Operates Broadcasting Station WLW.

Crosley One Tube Model 50, $14.50
With tube and Crosley Phones $22.25

Crosley Two Tube Model 51, $18.50
With tubes and Crosley Phones $30.25

Crosley Head Phones Better—Cost Less $3.75



Crosley Three Tube Model 52, $30.00
With tubes and Crosley Phones $45.75

Crosley Trirdyn Regular, $65.00
With tubes and Crosley Phones $80.75

Crosley Trirdyn Special, $75.00
With tubes and Crosley Phones $90.75

Crosley Trirdyn Newport, $100.00
With tubes and Crosley Phones $115.75

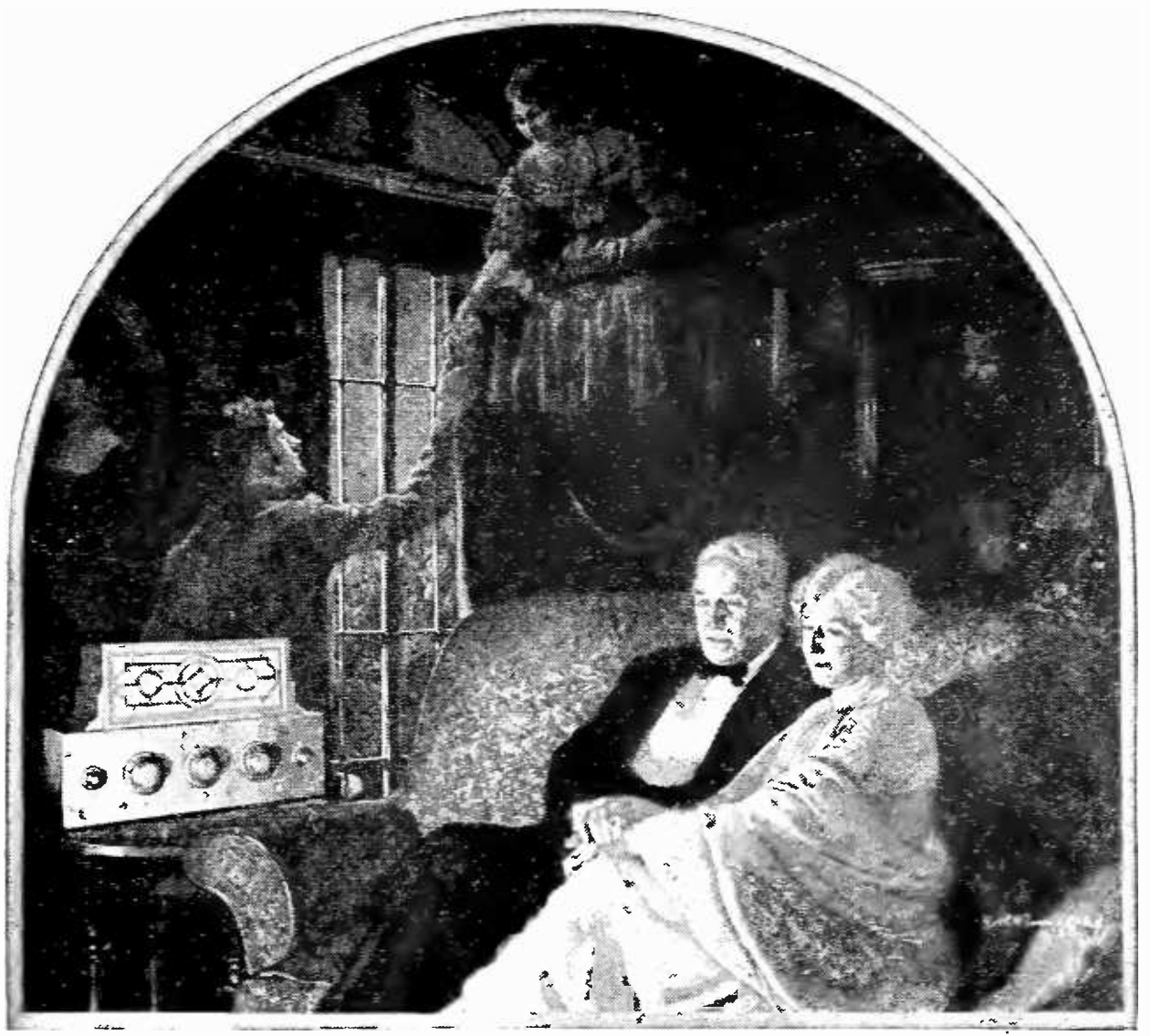
Mail This Coupon At Once

The Crosley Radio Corp'n.
1220 Alfred St.
Cincinnati, O.
Mail me, free of charge, your catalog of Crosley receivers and parts.

Name_____

Address_____

★ Tested and approved by RADIO BROADCAST ★



The Difference Is—*Finesse*

THE easy way to build a radio receiver is to assemble it. The right way is to *create* it, unit for unit, testing each step.

That is why Freed-Eisemann Condensers are Freed-Eisemann-designed for Freed-Eisemann Receivers. That is why our specially wound radio frequency coils are individually matched with the condensers to achieve the greatest possible co-relation of dial readings.

Not an inch of bus wire, not a single screw is in its place without scientific consideration of its capacity and inductive effect in relation to the super-sensitive Freed-Eisemann Neutrodyne circuit.

Thus, it is in *finesse* that the Freed-Eisemann is great . . . in the trifles that make Perfection—which is no trifle.

The man who has progressively owned all types of radio receivers comes to the Freed-Eisemann at last with a new enthusiasm for radio . . . a new appreciation of what listening-in can mean. A demonstration is a revelation.

Four-tube and five-tube models. Price, $100 up . . . slightly higher in Canada and west of the Rockies. Booklet, "Buying a Radio" free on request.

NEUTRODYNE

FREED-EISEMANN RADIO CORPORATION
MANHATTAN BRIDGE PLAZA, BROOKLYN, N. Y.

NEUTRODYNE

FREED-EISEMANN

★ Tested and approved by RADIO BROADCAST ★

Music is Immortal

THE EARLIEST HISTORY OF MAN was told to the strumming of primitive melody. His wars, defeats and triumphs are written in our symphonies to-day.

Music will outlive our present system of radio a hundred—a thousand years from now. But, until then, the RESISTANCE COUPLED AMPLIFIER—the only system that does justice to the qualities that make music live—will be first among fans of discrimination.

Amplification truly without distortion—reproduction that is auditively perfect—is the distinctive achievement of the DAVEN SUPER AMPLIFIER illustrated below.

On Sale at Your Dealers

Resistance Coupled Amplifier KITS

Without sockets and condensers:

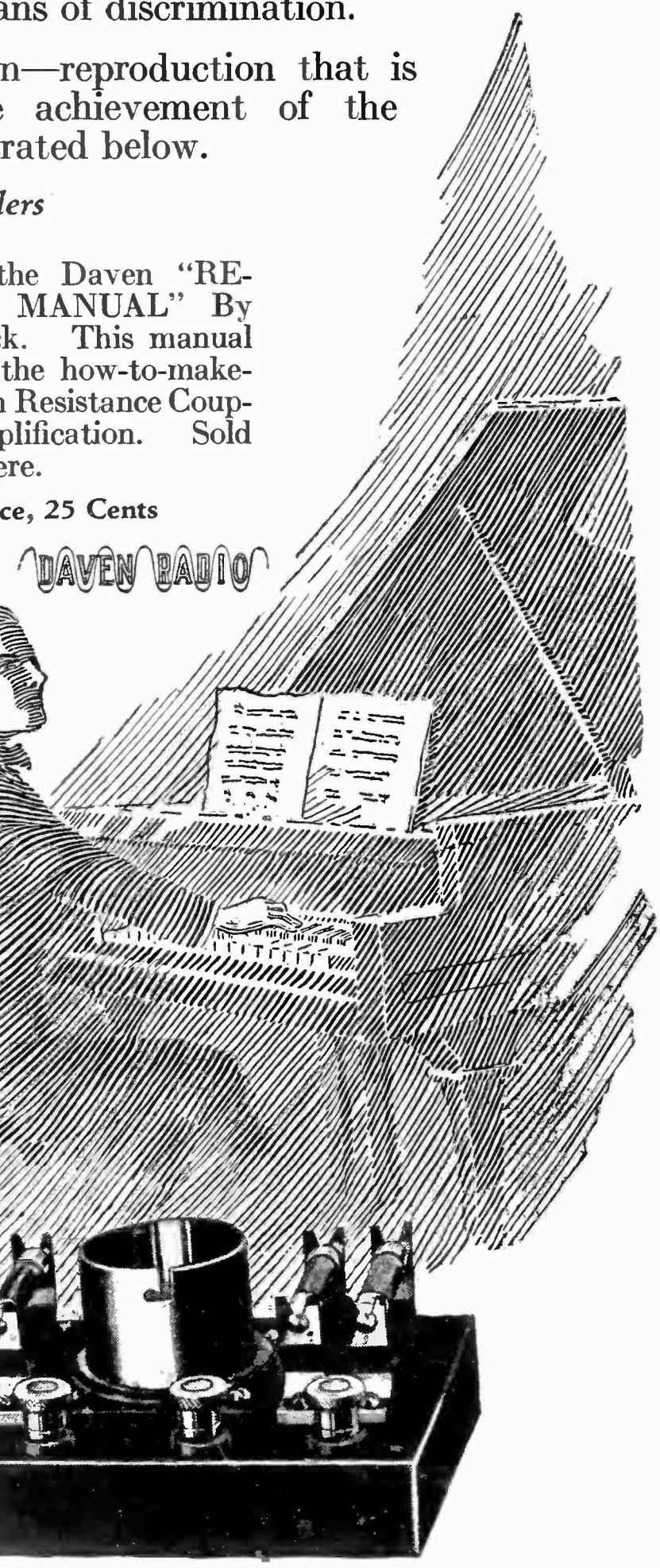
3-Stage	$ 8.00
4-Stage	10.50

Complete with sockets and condensers:

3-Stage	$12.50
4-Stage	16.00

Read the Daven "RESISTOR MANUAL" By Zeh Bouck. This manual contains the how-to-make-it data on Resistance Coupled Amplification. Sold Everywhere.

Price, 25 Cents



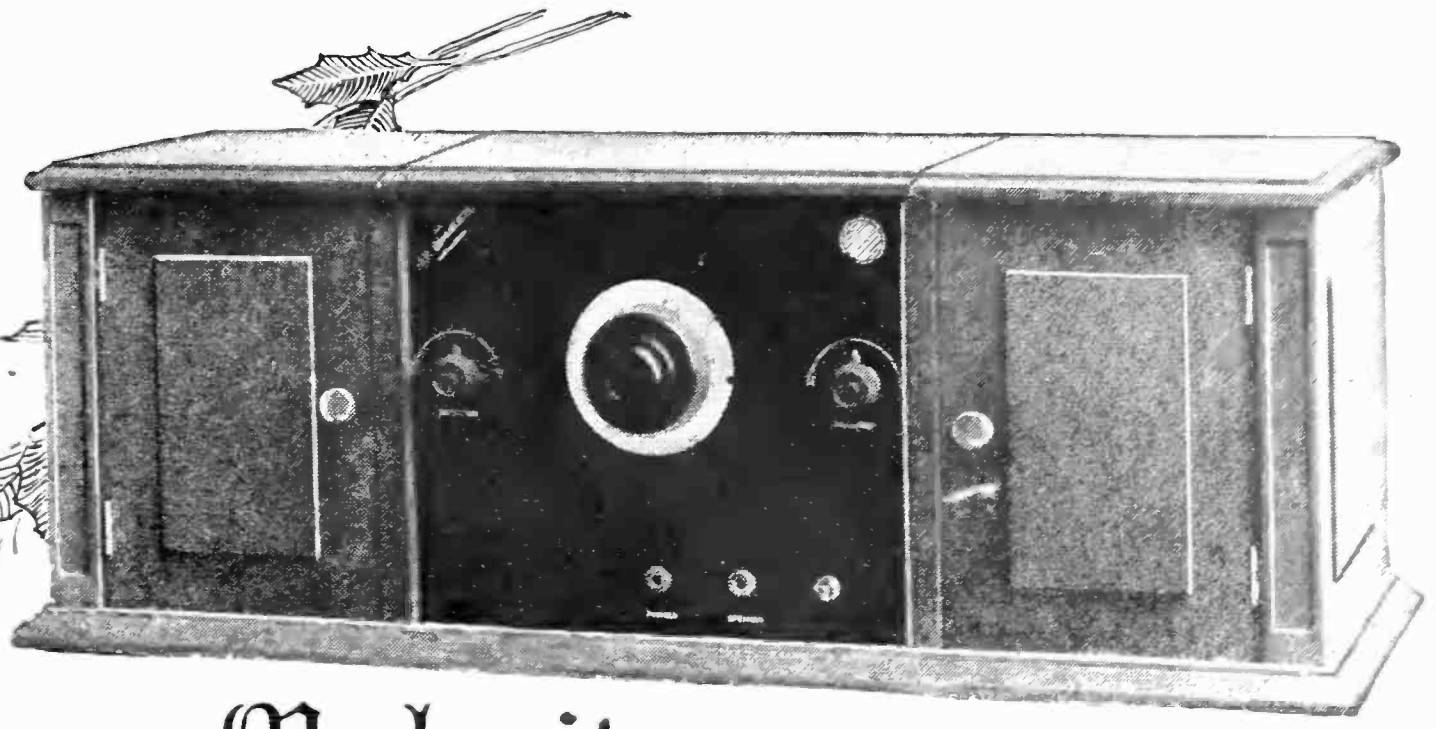
Daven Radio Corp.

"Resistor Specialists"

Newark - New Jersey

★

★ Tested and approved by RADIO BROADCAST ★



Make it a Radio Christmas

The "*Brandola*" is without question the most charming gift—one the entire family can operate and enjoy. With its simplified *one-dial control* it has made radio reception so simple, that a mere novice can operate it with the same success as would be expected of a radio engineer. The "*Brandola*" is extremely sensitive and very selective—because of these features extraordinary distant range is made possible even though the set be operated within a circle of local broadca ing stations. Ask your dealer to demonstrate this feature for you.

By the use of Resistance Coupling in its amplification, the tone quality of the "*Brandola*" is so perfect, that reception of music has been transferred into the realms of higher musical expression. The delightful clarity, mellowness and the absolute natural reproduction of the voice and musical instruments is a revelation to the radio art. Loud speaker reception of stations two thousand miles distant were recorded daily throughout the summer. Under favorable conditions, coast to coast reception should be obtainable with regularity.

Sold Everywhere. List Price $125; West of the Rockies $135; Canada $165

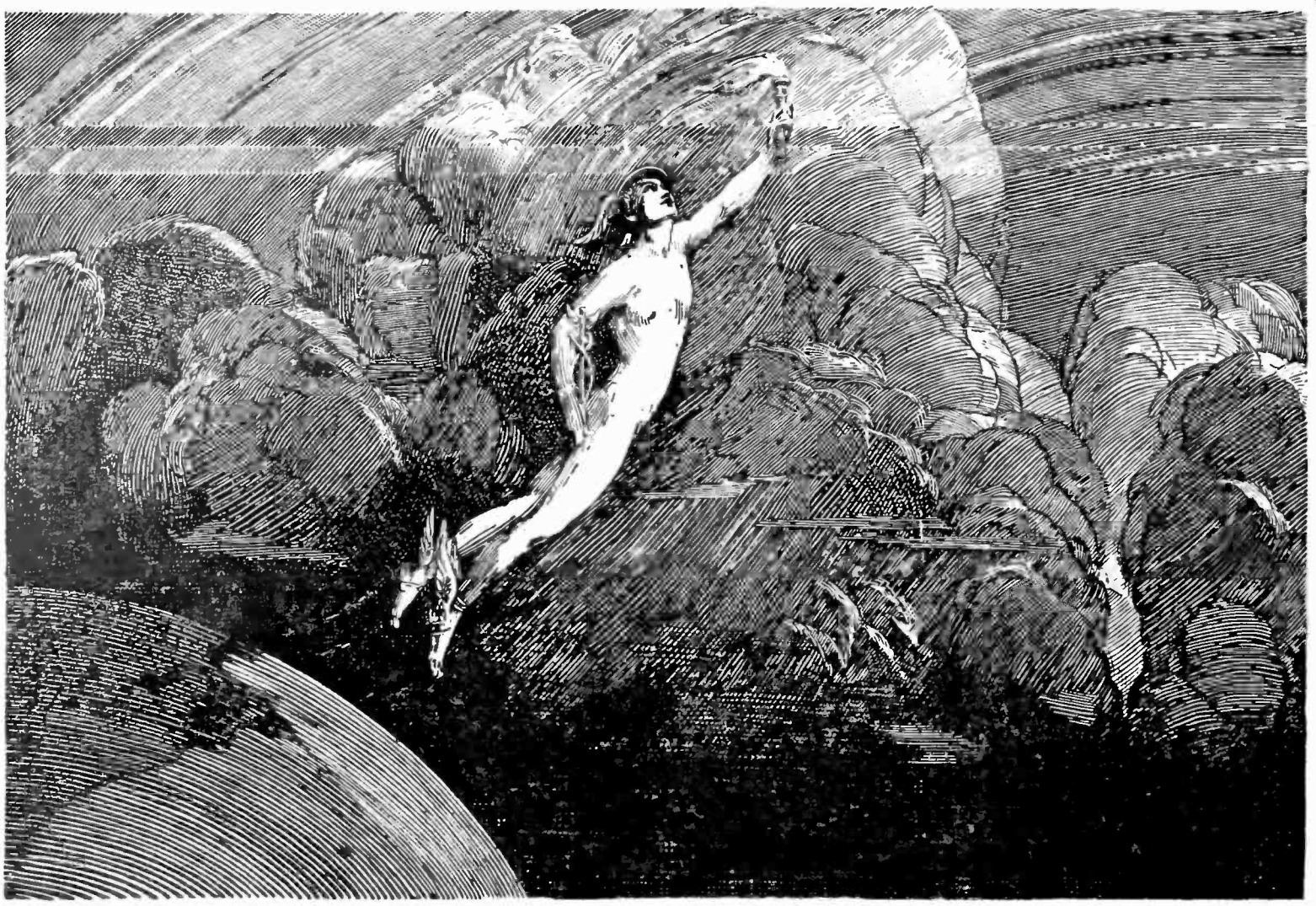
The Brandola

One Dial — Six Tubes

TRADE BRANDOLA MARK

The J. F. Brandeis Corporation
36 Oxford Street
NEWARK NEW JERSEY

★ Tested and approved by RADIO BROADCAST ★



★ To You and Yours from Across the World

THE air holds no secrets from the *Mercury*. With incredible sensitivity and matchless fidelity of reproduction this instrument searches keenly the vast reaches of the ether at the touch of a finger.

Here is an ever-ready flood of crystal-clear melody totally without distortion. Here also are an exactness and simplicity of tuning which have been hoped for but previously never achieved.

The *Mercury* Broadcast Receiver is fortunate in that it appeals as much to the seasoned radio enthusiast as to the public at large. The wonderful performance of the *Mercury* is fittingly crowned by a physical beauty worthy of the finest home.

MERCURY RADIO PRODUCTS CO. ~ 50 CHURCH ST., NEW YORK CITY

Visit your dealer or write direct for De Luxe Catalog

TECHNICAL

Highest existing development of Grimes Inverse Duplex System. Four tubes reflexed and equal to six straight (two tuned radio frequency, tube detector and three stabilized audio frequency). Operates from loop (furnished) also indoor or outside antenna *without change in set*. "Last word" low-loss engineering at every point.

MERCURY

BROADCAST RECEIVER

Licensed under Grimes Patents — issued and pending

"The STRADIVARIUS *of* RADIO"

APPEARANCE

Solid American Walnut Cabinet. Hand rubbed *genuine* piano finish. Inclined panel of heavy-gauge, etched ordnance bronze. Set rests on felt protecting buttons. Balanced panel arrangement of controls. All "A" and "B" dry batteries self-contained. Price, with loop; but *without* tubes and batteries, $165.00 list.

INVERSE DUPLEX SYSTEM ~ INSURES NATURAL TONE QUALITY

★ Tested and approved by RADIO BROADCAST ★

Sherma-Flex Two-Tube Set

Here is your chance to get a really good set without risk

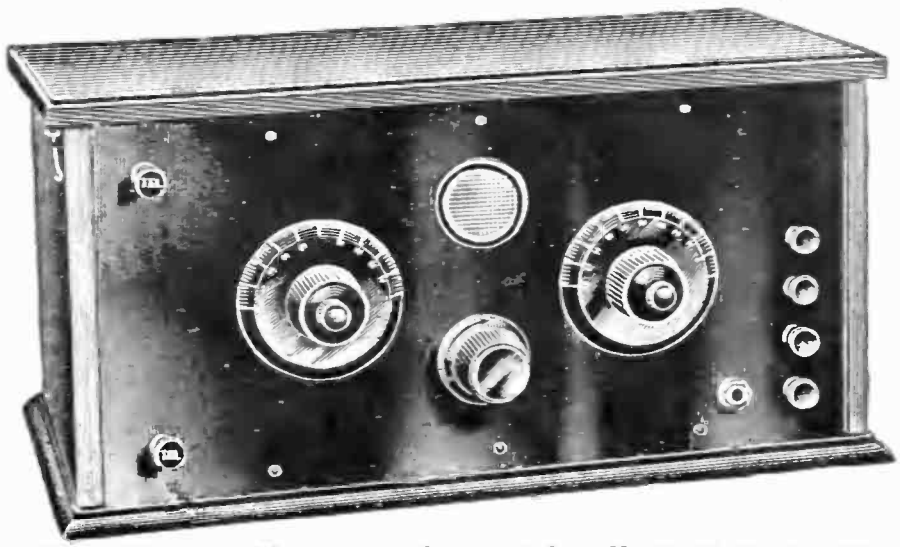
SHIPPED ON APPROVAL! —SEND NO MONEY!

Just invest in a 2c stamp—say you are willing to look at the set in your express office. If you like it, give the agent the price, and take it away. If after testing and using it a reasonable time, you are not absolutely sure you got your money's worth, we will take it back and refund every cent you paid.

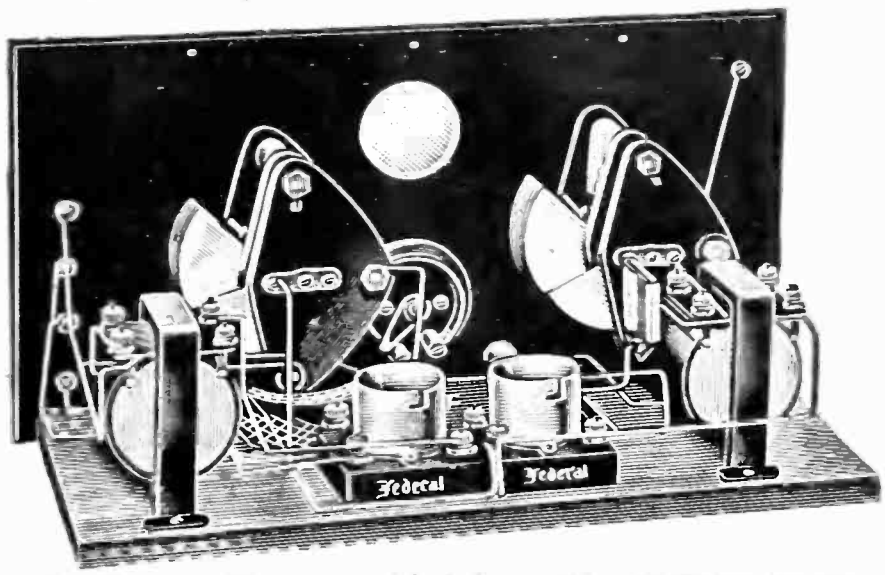
We pay all transportation charges in U. S.

The Sherma-Flex is a two-tube receiver in which only one of the tubes is reflexed. It uses a tuned plate impedance which does away with the radio frequency transformer.

The Sherma-Flex produces most unusual results. It is highly selective. It brings in local and distant stations with a fine clearness, and so strong that many users say the volume equals that of a five-tube set! It has been subjected to numerous severe tests under different trying conditions and in many locations, and in every case it has proved extremely satisfactory alike to novice and expert.



The Sherma-Flex complete with all accessories assembled and ready for use **$53.78**



The Sherma-Flex assembled, but without accessories **$37.72**

We know it will please you, or we could not afford to make such a wide open offer.

14S73 All Parts for Receiver Unassembled

$27.72

1 Cabinet, 7x14 in., mahog. finish
1 Baseboard 1 Panel, 7x14 in.
2 Shermatran Transformers
2 26-Plate Sherman Kant-Short Vernier Condensers
2 Honeycomb Coils 1 Rheostat
2 Sockets 2 Micadons
1 Fixed Crystal Detector
1 Single Circuit Jack
6 Binding Posts
12 ft. Bus Bar 1 Bezel
¼ lbs. No. 20 DCC wire

The Sherma-Flex has done this:

From New York it has received Hastings, Nebr., on head phones, with the use of a Ducon Plug for an aerial, and Miami, Fla., on loud speaker, using an outside aerial. Mr. John A. Rhea, 208 West 14th St., New York, says. I am bringing in Chicago easily and regularly. But the most unusual thing about my Sherma-Flex took place when I first set it up. It was pouring rain, and for this reason I hurriedly twisted my antenna wires around iron pins and wooden posts. Imagine my surprise therefore, when Chicago came in with great volume on my loud speaker—with no insulation whatsoever.

14S55 All Accessories

$16.06

2 UV-201A Tubes
1 Pair Guaranteed Phones
1 Phone Plug
2 "B" Batteries, 45 volts each
1 "A" Battery, 4 dry cells
1 Coil Aerial Wire
1 Coil Lead-in Wire
1 Ground Clamp
1 Insulator Tube
2 Insulators

POSTPAID

The Sherma-Flex complete, with all parts assembled, in a nice piano-polished, dark mahogany-finish cabinet, and with all accessories, ready for use—nothing more to buy—for only $53.78
The Sherma-Flex Receiver, assembled 37.72
If you want to save the cost of assembling, we will sell you the parts unassembled, including the cabinet for only. 27.72
You—anyone—can put the parts together in a few hours. Easily followed charts and instructions go with every set.
As the price of all accessories is only 16.06
The whole outfit, with receiver unassembled, then will cost you only 43.78

Don't let this opportunity get away—Order from this Advertisement to-day!

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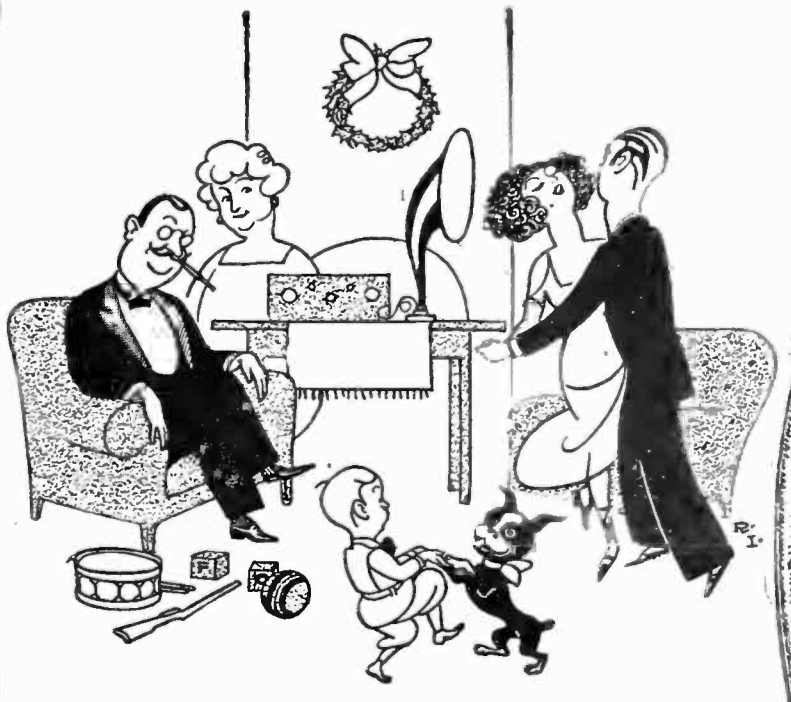

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Radiola Loudspeaker
TYPE UZ-1325
Now $25.00

This symbol of quality RCA *is your protection*

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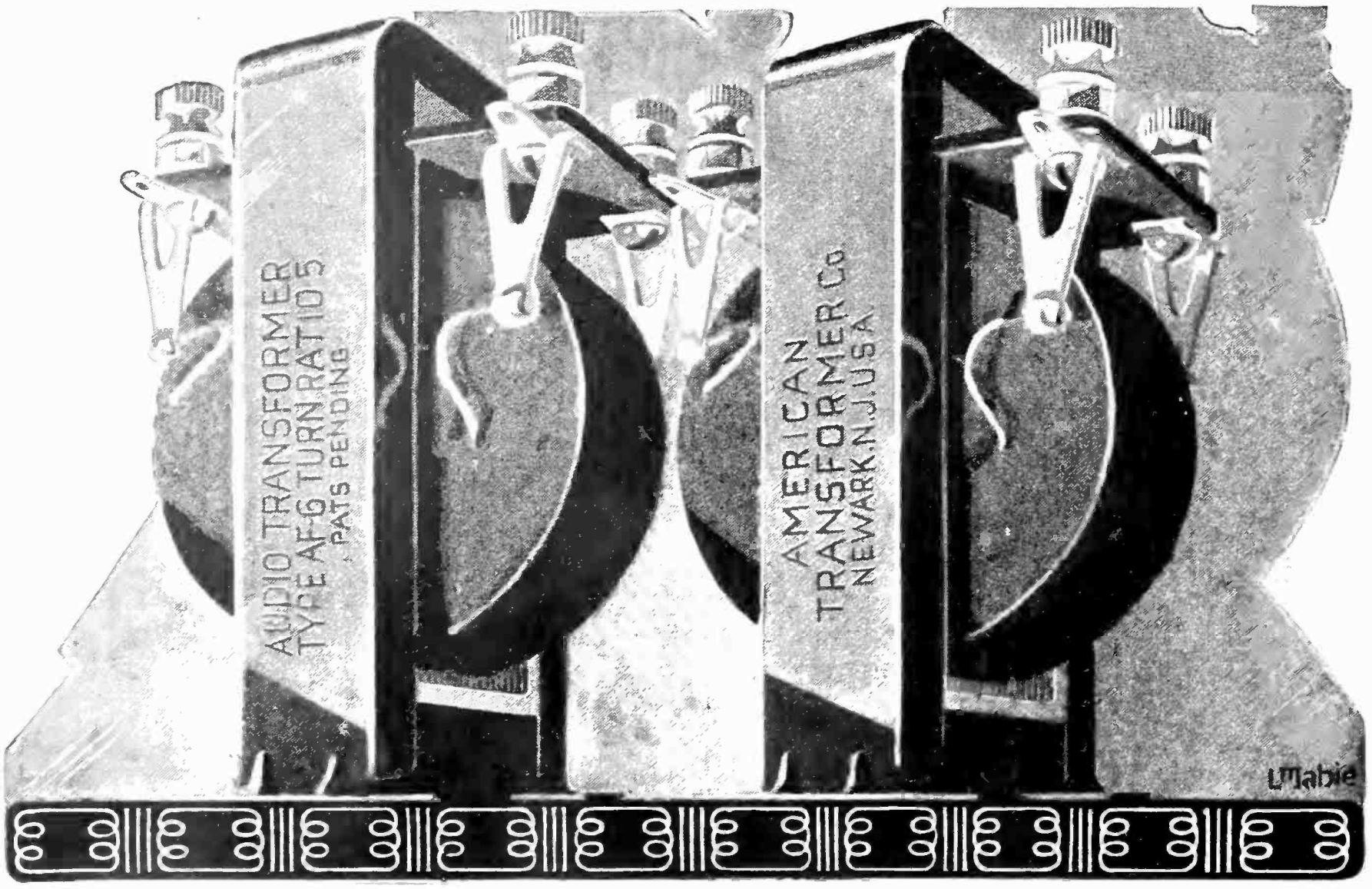

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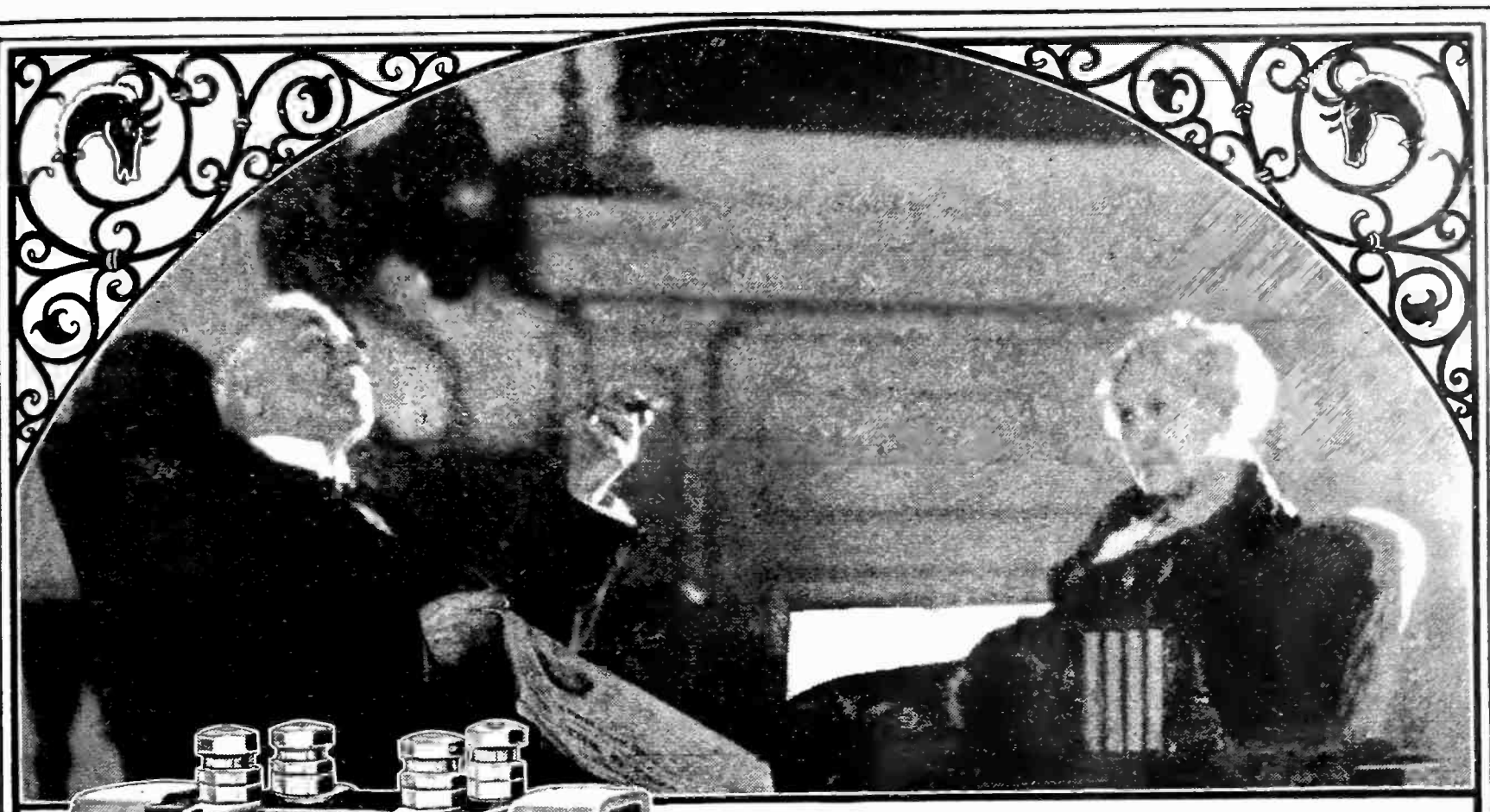

The Satisfaction of Perfect Reception

An evening of reminiscence with the radio; cherished memories recalled by songs of younger days—school—and sweethearts—and shady lanes—songs long unsung but not forgotten; scenes of the present—jazz—orchestra—speech—all perfectly received with no distortion to mar their full enjoyment.

That's the work of Jefferson Transformers! Perfect reproduction of the voice or instrument with the natural tones faithfully preserved. Full, smooth amplification over the entire musical range. Radio fans the world over will attest as to these Jefferson qualities.

Such excellent performance is but the natural outgrowth of over 20 years specialization in the perfection and manufacture of high-grade transformers. Jefferson Transformers meet matched construction specifications. You have the advantage of the best transformer that science and engineering can produce, at a most nominal price.

Sold by all reputable dealers and distributors.

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Write for our latest booklet giving information on how to secure proper amplification. It's free.

Jefferson Electric Mfg. Co.
442 S. Green Street, Chicago

Jefferson Super Sensitive Transformers

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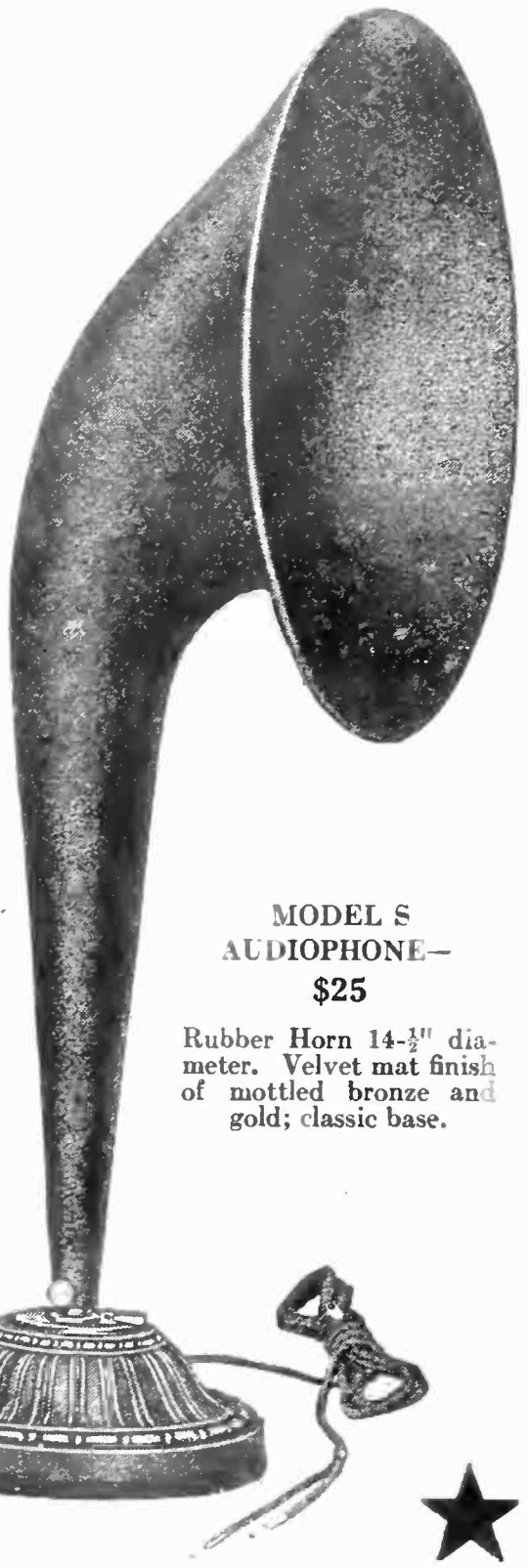

MODEL S
AUDIOPHONE—
$25

Rubber Horn 14-½" diameter. Velvet mat finish of mottled bronze and gold; classic base.

Both Must Be Musical Instruments

IF you are to enjoy the rich resonance of an old Cremona violin, your loud speaker must also be a true *musical* instrument. So designed and powered as to respond as faithfully to the inspiring crescendos of a Wagner opera as to the whispers of a Moonlight Sonata.

The new Bristol AUDIOPHONE does that. With its joyous, open-throated, Rubber horn, and its finely adjusted tone mechanism, it is on a musical plane with the noblest instrument or voice at your favorite station.

In addition to Model S, shown here, the Bristol line includes Model J, $20, Baby Grand, $15, and the "Baby" at $12.50. Send for Bulletins AH-3011 and 3017, mentioning name of your dealer.

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LOUD SPEAKER

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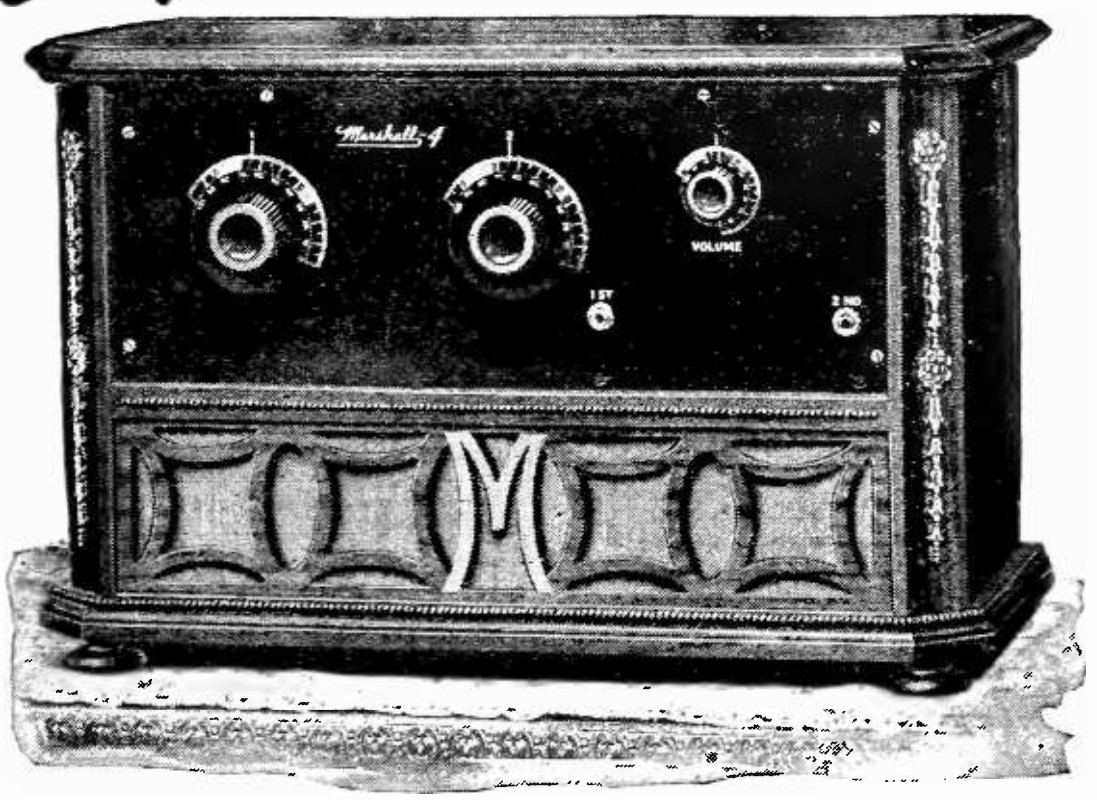
Marshall Radio Frequency Receivers

Embodying a Marvelous New, Non-Oscillating Principle



Receiver and Loud Speaker in Combination Cabinet of Solid mahogany

Sold Direct to You on FREE TRIAL and TERMS as low as $5.00 DOWN

WRITE TODAY for full particulars of this most exceptional offer. Marshall Sets embody the very latest improvements known to radio. The wonderful new principal involved is proving the sensation of the 1924-25 radio season. Zero Coupling—the problem which radio engineers have been working on for years—has at last been solved. As a result, the Marshall has no need of neutralizing condensers or other make-shift methods of avoiding internal oscillations which invariably reduce efficiency. The Marshall Tuned Radio Frequency Receiver brings to radio a new degree of musical quality. Its selectivity will delight the experienced radio operator. Yet it is so easy to tune that the novice will handle it like an expert.

Small Monthly Payments—2 Weeks Free Trial

That is the remarkable offer we are prepared to make you. Two weeks to prove that the outfit you select is everything we have said for it. If it doesn't make good our claims, back it comes, and your deposit will be cheerfully refunded. But if it fulfills all your expectations, you may pay for it in easy monthly installments. You don't risk a cent when ordering from us. You *must* be satisfied, or we don't do business.

Is it any wonder that radio buyers, the country over, are rushing to take advantage of such an offer? If YOU are interested, figure on getting your order in early, while prompt shipment can be made. Everyone predicts a serious shortage of radio supplies this season. Send for full particulars today.

Beautiful Solid Mahogany Combination

Compare the beautiful Combination Cabinet, pictured above, with the usual radio box and horn. Here the Receiver and Loud Speaker are contained in a single handsome cabinet. Or, if you prefer, we also have the Receiver in a separate cabinet of the same design. These cabinets are the work of a master designer—fashioned of solid mahogany. They will harmonize with the furnishings of the finest homes. In spite of the extra value, these Marshall sets are surprisingly low in price. Compare them with others which sell for cash. Then remember you can order a Marshall outfit on two weeks' free trial and pay for it on very easy terms.

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If you have any idea of buying a radio set this year, don't let this chance slip by. Our terms and liberal guarantees have set a new pace in the radio business. The low prices we will make you on a 3, 4, or 5 tube Marshall set will surprise you. A letter, postcard, or just the coupon will do. But send it today.

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Radio Broadcast

ARTHUR H. LYNCH, EDITOR

DECEMBER, 1924

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"Are those Tubes Genuine?"

The question is heard at every radio counter: "Is it a genuine Radiotron?" Almost every dependable manufacturer uses genuine Radiotrons in his sets. Everyone who builds his own knows enough about radio to know that nothing else but the genuine will do. And the man who replaces used-up tubes in his set knows that to get the same performance, he must have the same tubes—genuine Radiotrons only. So everybody asks "Is it genuine?" And asks to see the marks that prove it—the name "Radiotron" and the "RCA" mark.

All Radiotrons Now Reduced to $4.00

It isn't a genuine WD-11 unless it's a Radiotron.

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It isn't a genuine UV-199 unless it's a Radiotron.

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This symbol of quality is your protection

Radiotrons

REG. U. S. PAT. OFF.

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"G.H.Q." FOR THE INTERNATIONAL RADIO BROADCAST TESTS

The offices and grounds of Doubleday, Page & Company, at Garden City, Long Island, where RADIO BROADCAST *is published. The circle shows the Laboratory of the magazine where the transoceanic signals will be received. Special lines of the telegraph companies lead to the laboratory, where messages to the magazine, telling of successful reception of the foreign signals from all over the country will be received and tabulated. The results will then be sent at once by radio to London. The Radio Corporation of America has made a special control connection with Radio Central at New York. A key in the Laboratory will control the transatlantic telegraph circuit during the tests*

RADIO BROADCAST

Vol. 6, No. 2 December, 1924

Making Wireless History With De Forest

Thrilling Days of Trial and Error in the True Pioneer Wireless Times—A Ten-Kilowatt Set that Sent Four Miles—Thrills for the Natives at the St. Louis World's Fair—Twenty Years of Wireless in Retrospect

BY FRANK E. BUTLER

Former Chief Assistant to Dr. Lee De Forest

TO BE able to look back twenty-odd years, practically to the very inception of radio, and view the development of this wonder art through personal experiences gained from gruelling years of hopes, disappointments, and successes, is a privilege that only a few of us can share with Dr. Lee De Forest, the famous radio inventor.

Surely, the most enthusiastic radio fan cannot realize the exceptional thrill which is now mine as I listen-in on my radio receiver and compare its wondrous achievements to those of the struggling, experimental days when I assisted Dr. De Forest in his elementary pioneer work; in the building of his first few "audion bulbs", and shared with him the marvel of listening-in for the first time to a wireless telephone.

MR. BUTLER IN 1904

A photograph of the author, taken by the official photographer of the St. Louis World's Fair, where he and Dr. De Forest were exhibiting the marvels of wireless

For radio is not, as many believe, a new thing. Its development has passed through the crucible of a thousand failures with their resulting disappointments. Its progress was constantly blocked by unknown scientific laws against which we pitted our puny knowledge. Every secret extracted from Nature was gained by relentless tests carried on frequently without funds and often without adequate laboratory equipment or tools, and with comparatively little encouragement from humans or from Nature. But always there was the inspiring guidance of "Determined De Forest."

It was in the early spring of 1904 when, with no more electrical knowledge than that possessed by the average telegraph operator, I gave up a promising position as train dispatcher on the New

York Central to take up the then new work of wireless telegraphy. A short time before this, Marconi had startled the world by successfully sending and receiving telegraphic signals over a short distance without wires. De Forest, who was then a young student at Yale, took up research work in this unknown field of "wireless," and thereby became one of the first American experimenters to turn his entire attention to this work. When I joined him, practically all of my friends and relatives with the exception of my father, chided me and advised against the move. My father thought best to let me choose my own career, and while he never lived to listen to modern radio, he was familiar with and proud of the achievement I had made up to the time he passed away. The railroad position carried a large salary with abundant opportunity for advancement, while my new "job" paid only a meagre amount and offered no apparent assurance of a future. The idea of communicating through space without wires was at that time considered fantastic, an idle dream, an impossibility, a game for fools. Many thought it was a fake.

"The Man Is Crazy"

At least that is what almost everyone thought of Dr. Lee De Forest back in those early pioneer days, more than twenty years ago. Then, you could easily count all the men in the country who even pretended to know anything about wireless. No one of the few who were working with wireless then, knew whether a set carefully put together would work at all, and how far the signals could be heard was nothing but a guess. Transmissions of a hundred miles or more were hailed as remarkable. Present-day radio listeners are quite prone to think of radio as nothing more than telephonic broadcasting. But before the wireless telephone, came tremendous amounts of hard, sometimes discouraging, but always fascinating and essentially romantic work. Dr. De Forest is one of those pioneers. Mr. Butler's memories of the early days are mightily worth reading, since he not only saw the early wireless drama, but himself acted in it.—THE EDITOR.

WIRELESS STARTLES THE WORLD'S FAIR IN 1904

SO, AFTER "burning my bridges behind me," I went to St. Louis and joined De Forest at the World's Fair where he was planning the first public wireless exhibit. Immediately, my troubles began.

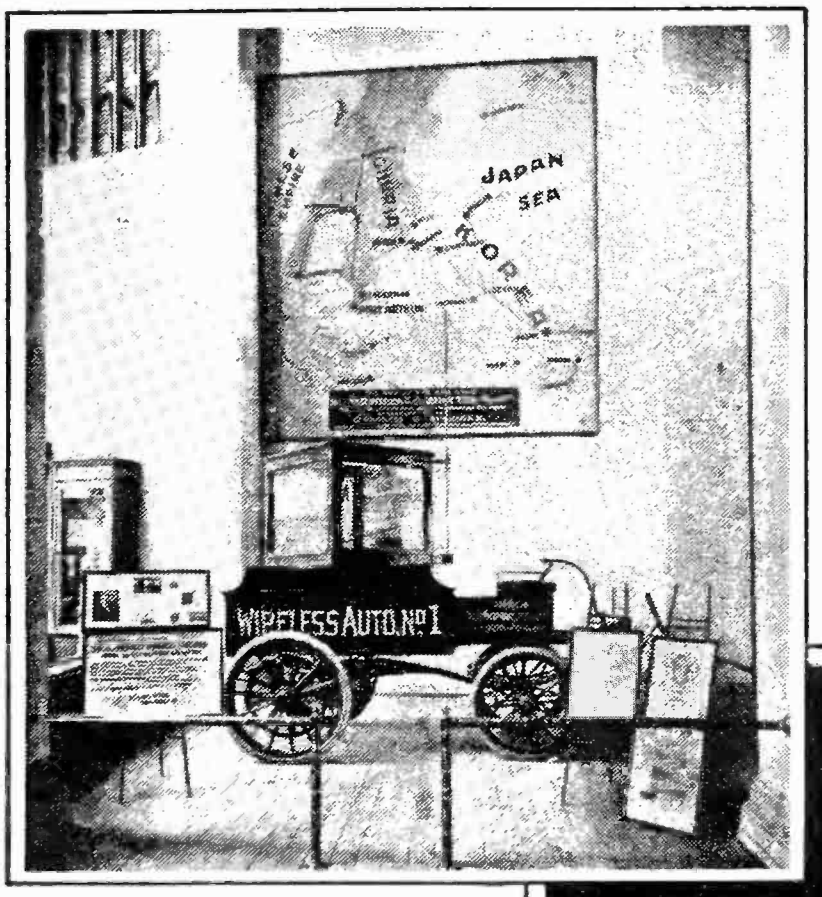
Due to some slip in the arrangement, I found, upon my arrival, that our "financier" had decided upon another man for the job, and the company could not afford to pay two employees. After some scheming on ways and means, the two of us decided to double up on the salary question, and in that way we both stayed. Within a week or two I was chosen as special assistant to De Forest because I could telegraph while he could not. From that time on, and for many years, I was perhaps closer to him in his interesting work than any other of his employees. Subsequent events and severe trials in which I stood by him through thick and thin convinced me that he appreciated my efforts. Others of his employees likewise never deserted him through even his most crucial periods. He called us his "Old Guard" and we were as faithful as Napoleon's followers. Our working mottoes were, "Never say die," and "You can't stop a Yank." We never accepted failure as a finality, but tried to find out why we met it, and then attempted to overcome it.

At that time there was, of course, no radio public, and the range of wireless was only a few miles. The sending and receiving instruments were unbelievably crude, resembling in no way the marvels of today. Messages were sent at the snail-like pace of a few words per minute, in the dots, spaces, and dashes of the Morse code, instead of the International code which is now generally used. Sending music or talking by wireless was then undreamed of. There were many mountainous obstacles to meet and conquer before we even had the vision of a wireless telephone, which was the forerunner of radio.

DE FOREST'S CHANGES IN THE NEW ART

ONE of the first changes to be accomplished by De Forest was to use a headphone for receiving instead of the telegraph sounder used by Marconi in early experiments. The first receiving device was called a "coherer" and was made of a glass tube filled with metal filings. These filings "cohered" when the ether impulse passed through them, thus making an electrical circuit which caused the sounder to click. This method was extremely crude and inaccurate, and the device had the unpleasant habit of occasion-

ally failing to "de-cohere." In other words it would not go back to normal after the signal had passed through. It was sometimes necessary to tap the tube with a pencil in the left hand while writing with the right.



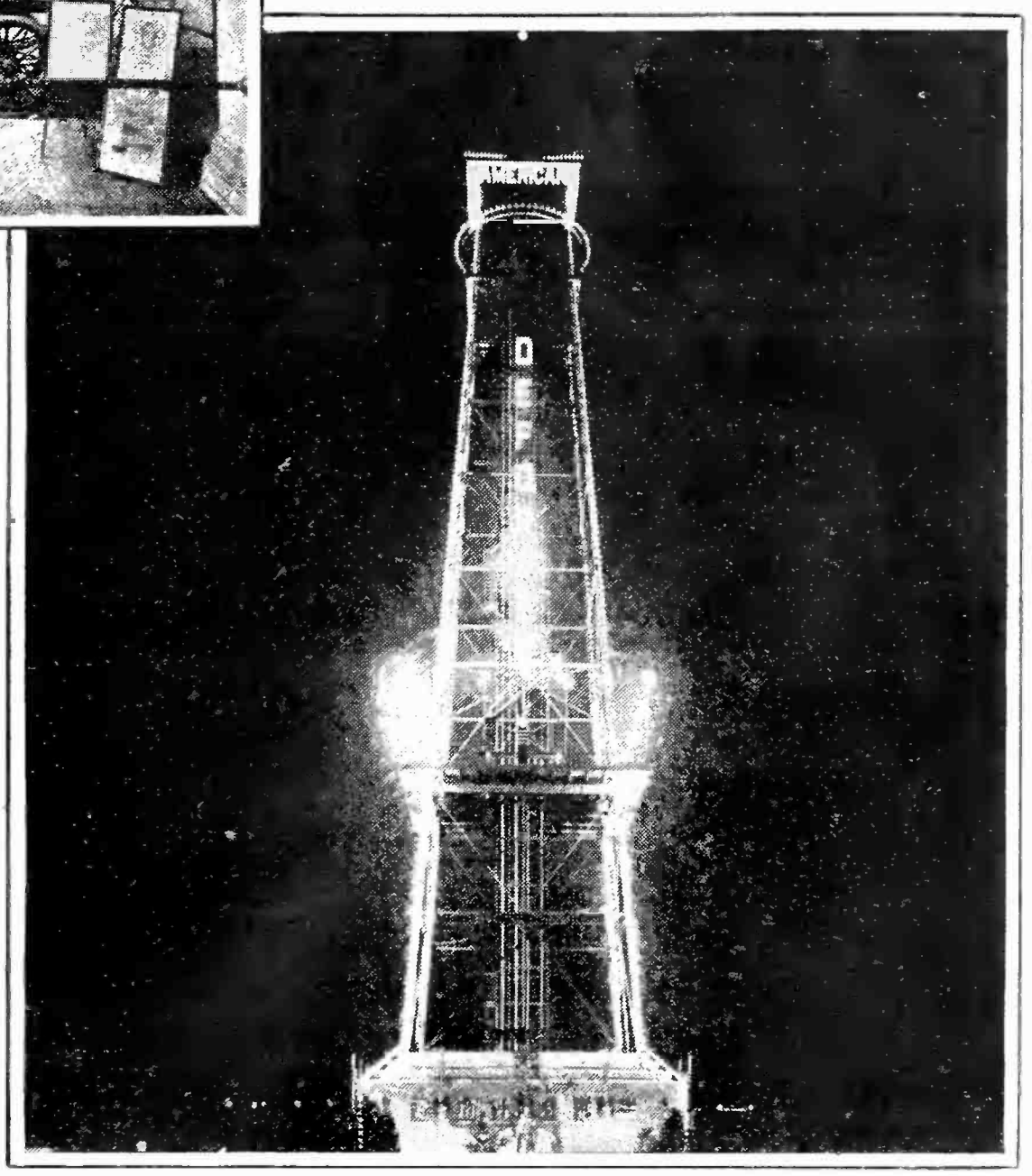
Short words we guessed at, while long words were so badly disjointed that we figured those out as a child does a rebus puzzle.

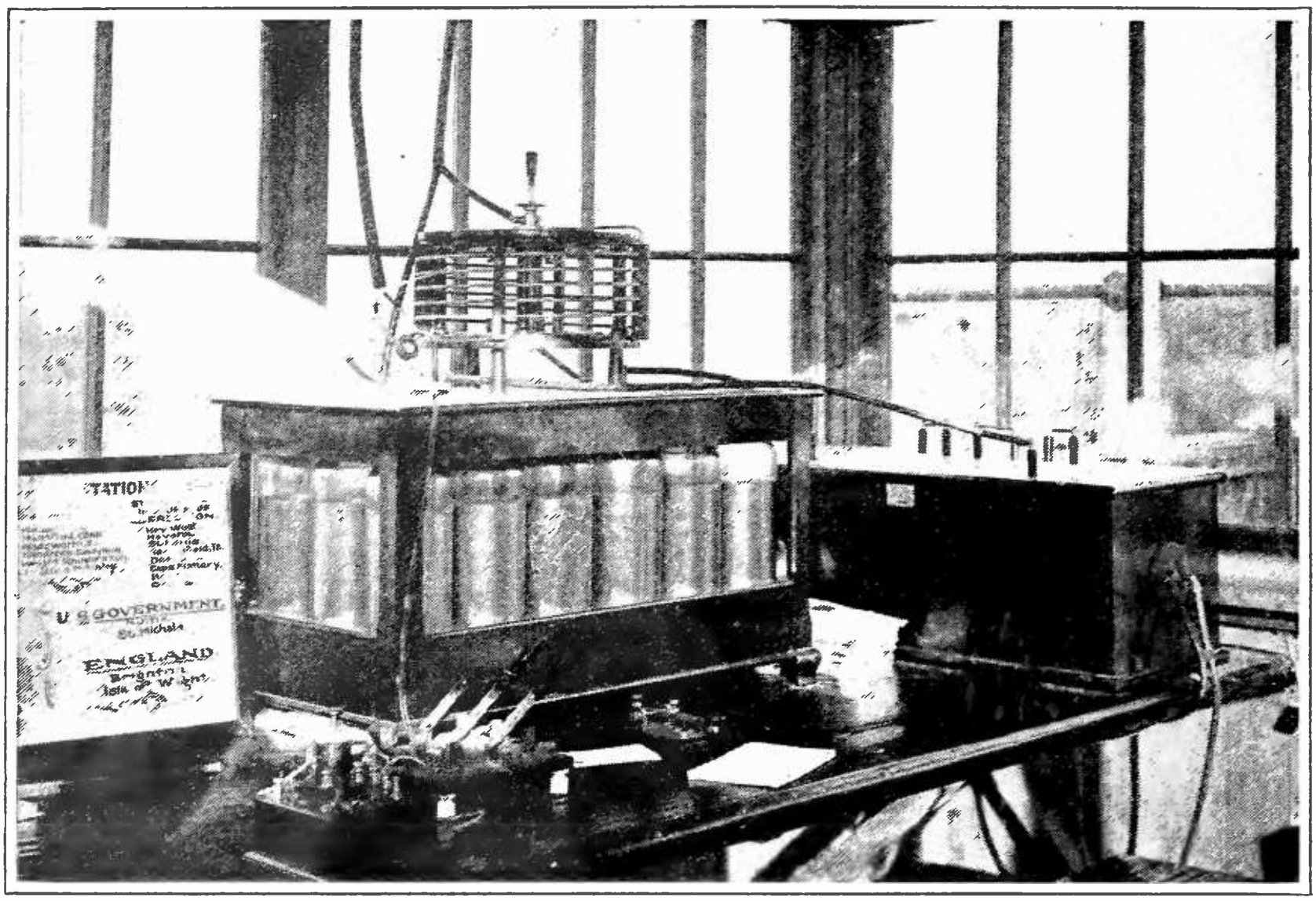
The apparatus for sending was a Ruhmkorff induction coil with a vibrator on one end. Direct current was used in the coil and the vibrator converted it into alternating current of slow oscillations as compared with those used to-day. The power used then to send six miles would to-day send almost six thousand.

One of Dr. De Forest's earliest achievements was to produce a transmitter operated by alternating current of high frequency. This gave a strong firm spark and signal far superior in carrying quality, and far easier to read than the thin weak notes from an induction coil. The transformer coils were specially wound, and near at hand were placed a "spark gap" and "helix" or tuning coil, and thus "tuning the signals" was brought into reality. Then we started to talk about certain waves of different lengths, etc., and we used the tuning fork as an illustration. Mathematics had no place in the embryo radio of those days and it was many years before we learned how to measure the wavelengths and use such complicated and fearful sounding terms as of meters, kilocycles, etc. Leyden-jar condensers of various kinds of hookups were placed across the "spark-gap," and we noted the phenomenon of changing the pitch or note of the spark as we changed the capacity of the jars. We found that this new form of transmitter easily outranked the old induction coil, so a decided step in advance was made. Little did we then think that this was the beginning of the rocky, curved road over which radio was to pass before reaching its goal of to-day.

WIRELESS AT ITS FIRST WORLD'S FAIR

The De Forest tower—300 feet high—was a remarkable feature of the fair and was illumined at night with great numbers of incandescent lights. The insert shows a wireless automobile which was equally in style for the period as far as radio and automotive construction was concerned





PIONEER EQUIPMENT

A close-up of the De Forest transmitting equipment on top of the wireless tower at the World's Fair. Note the anchor gap at the left of the direct connected helix, which, by the way, contains the open zinc spark gap

THE "GOO" DETECTOR

MANY experiments were carried on to find a more sensitive receiver than the coherer. We knew nothing about "rectification" then. There were no text books on the subject, nor any radio editors to write to for advice. We were merely electrical eccentrics playing with a dream, so one guess in the way of an experiment was usually as good as

EAGER CROWDS SEE MESSAGES FLASH FROM WIRELESS TOWER

Post-Dispatch Sending Station for World's Fair News Fairly Sings as Words Leaps Across the Copy—Visitors Attracted Manifest Keen Interest.

WORLD'S FAIR GROUNDS,
Via De Forest Wireless.

Flashing messages through space from the Fair to the office of the Post-Dispatch continues to be the wonder of Fair visitors and crowds watch the process from morning until night.

The flash of 20,000 volts every time the operator presses his key is to them a thing of fascination. Then they turn from it to look from the great De Forest tower out eastward across the large city, but they see no sign of the message which the clicking instrument is sending out there through space.

Sometimes they stop the operator at his work to ask him if it is really so. They shake their heads in amazement when he answers "yes," and explains that in the Post-Dispatch office another instrument is ticking in response to his, and thus carrying Fair news to the newspaper and the world. The loud buzzing of the powerful instrument surrounding the operator 200 feet above the ground in the De Forest tower does not prevent the visitors from crowding about him.

It is so loud that the operator must keep his ears full of cotton. It fairly deafens visitors and sending them away with a headache if they stay too long, but nevertheless they stay, for the power of the mystery is very great.

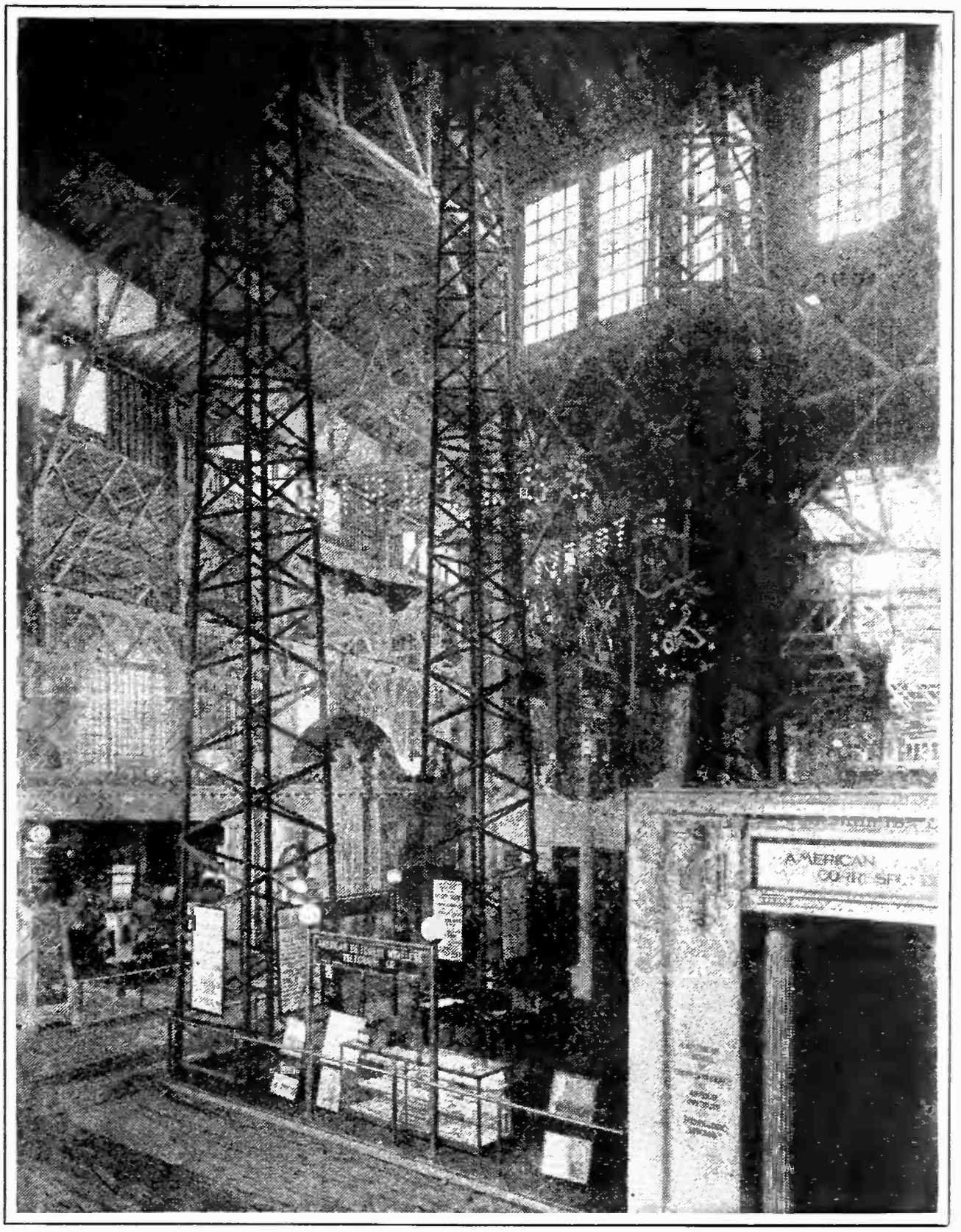
This buzzing is caused by the powerful electric spark which the operator's key releases and corresponds to the click of the ordinary wire telegraph instrument. The dots and dashes are so audible that operators for telegraph companies and the police and fire departments anywhere within two blocks of the wireless tower amuse themselves with reading the wireless messages as they are buzzed off by the sending operator.

—Published in the St. Louis Post-Dispatch during 3rd Week of June, 1904.

another. One day, while working on receivers, it was discovered that a salvy mixture of various ingredients reproduced the signals in the headphone. The "discovery" was thoroughly tried out but found lacking in any definite merit, although it did get as far as to receive a name. It was called the "goo" receiver, and I believe that somewhere in the archives of the Patent Office may be found a formal application for a patent made for it by Dr. De Forest. Finally the electrolytic receiver was introduced. This was such an advance over anything previously introduced that it seemed to be the height of perfection. It consisted of a small glass cell containing a dilute solution of caustic potash and water which formed one anode of the circuit. Into this solution was immersed a cathode point, and the incoming wave was rectified by electrolytic action. Fessenden employed a fine wire coated with silver which was dipped into nitric acid to burn off the coating and make a fine whisker point. De Forest used a different type terminal called the "spade electrode" because of the shape of the terminal. This was found to be both practical and sensitive and not subject to "burning off points" in the middle of a message as was that involved in the Fessenden principle. In this circuit was introduced the potentiometer, a name coined for radio work. This set also contained the first "variable condenser." Instead of the movable plates so common to-day, we used a small brass tube split in halves lengthwise and rotated one half within the other without moving them backward or forward. We knew nothing about "measuring" capacity. Either our experiment worked or it didn't. If it failed, then we would "change things" until it did work.

WHAT TO NAME THE CHILD?

IT WAS always characteristic of De Forest to call every new item discovered by a simple homely name which was significant of the act it did or the thing it resembled. Most of the names coined by him many years

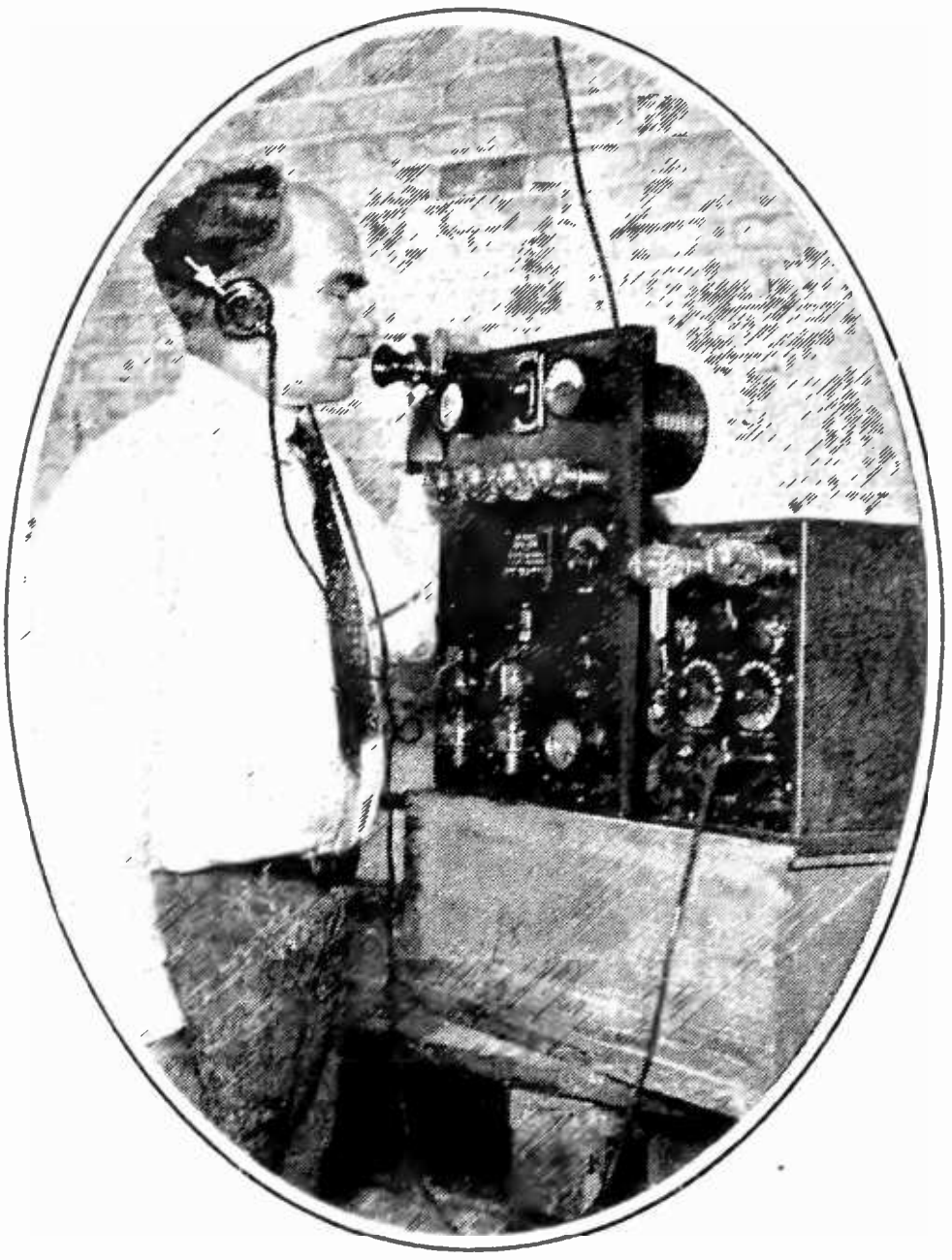


THE EXHIBIT

Of the "American De Forest Wireless Telegraph Company" at the St. Louis World's Fair in 1904. A sample transmitting and receiving set is installed in the booth. Its noisy crackle could be heard for great distances

ago, are still used in radio to-day. Some of these are the "fan" antenna, the "helix," the "spade" electrode, the "pancake" tuner, the "spider-web" tuner, the "wing" (now called plate), the "grid" of the audion bulb; the A and B battery; and audio and radio frequency.

The first transmitters made were of 4-K.W. power. They were soon supplanted by a 10-K.W. set. It was this latter size that was used on the large 300-foot steel tower erected on the World's Fair Grounds at St. Louis. Two spacious elevators carried visitors to the top of this observation tower where the wireless instruments were installed. Many amusing incidents happened. One day, a lady desiring her full share of information, listened intently to our explanation of wireless and then bluntly told me in front of the crowd that the whole thing was a fake. She agreed that we "sent without wires," but she insisted we did this by using a silk thread instead of a wire between the two stations, thus making it "wireless." Many persons would go outside and look up to see if anything was visible from the top of the mast when the signals left.



DR. LEE DE FOREST

In a corner of his laboratory. This picture was taken years after the others which appear with this article. Dr. De Forest is standing before one of his vacuum tube telephone transmitters which he designed to operate from the ordinary 60 cycle lighting current

From this tower we transmitted daily news to the St. Louis *Star* and the *Post-Dispatch*, a distance of five miles. Thus was established the first newspaper radio service, and the reprint on page 214 from the *Post-Dispatch* during the third week of June, 1904, is the first radio news message to be flashed through the air and published in a newspaper upon a predetermined and established schedule.

WIRELESS A MIRACLE—OVER FOUR MILES

AT NIGHT the tower was illuminated by thousands of electric lights which could be seen for many miles. In addition to this station, another exhibit was maintained in the Electricity Building and from both places we demonstrated "wireless" to endless streams of curious people. In an adjoining booth was displayed "Wireless Auto No. 1," which was the very first wireless automobile. Its range of reception was only a few blocks but it always created much interest whenever it was driven about the streets or viewed at its exhibitor's stand. Its design of chassis in comparison with present-day automobiles shows its antiquity.

Not content with the honors the 10-K.W. station had won for him, De Forest started a special experimental station on the western limits of the Fair Grounds near the Boer War Exhibit. The object of this was to increase distance of transmission. Obviously there were but two methods by which this could be done. We had either to increase the power of the transmitter or develop the sensitivity of the receiver. The former plan was adopted and a twenty-kilowatt station was planned—of exactly twice the power used in any previous experiment. It seemed as though when we doubled our power we increased our troubles at a compound ratio. As there were no stations operating at that time it was not necessary to concern ourselves about selectivity of tuning. The immense void of ether above us was free to use without the least fear of interference.

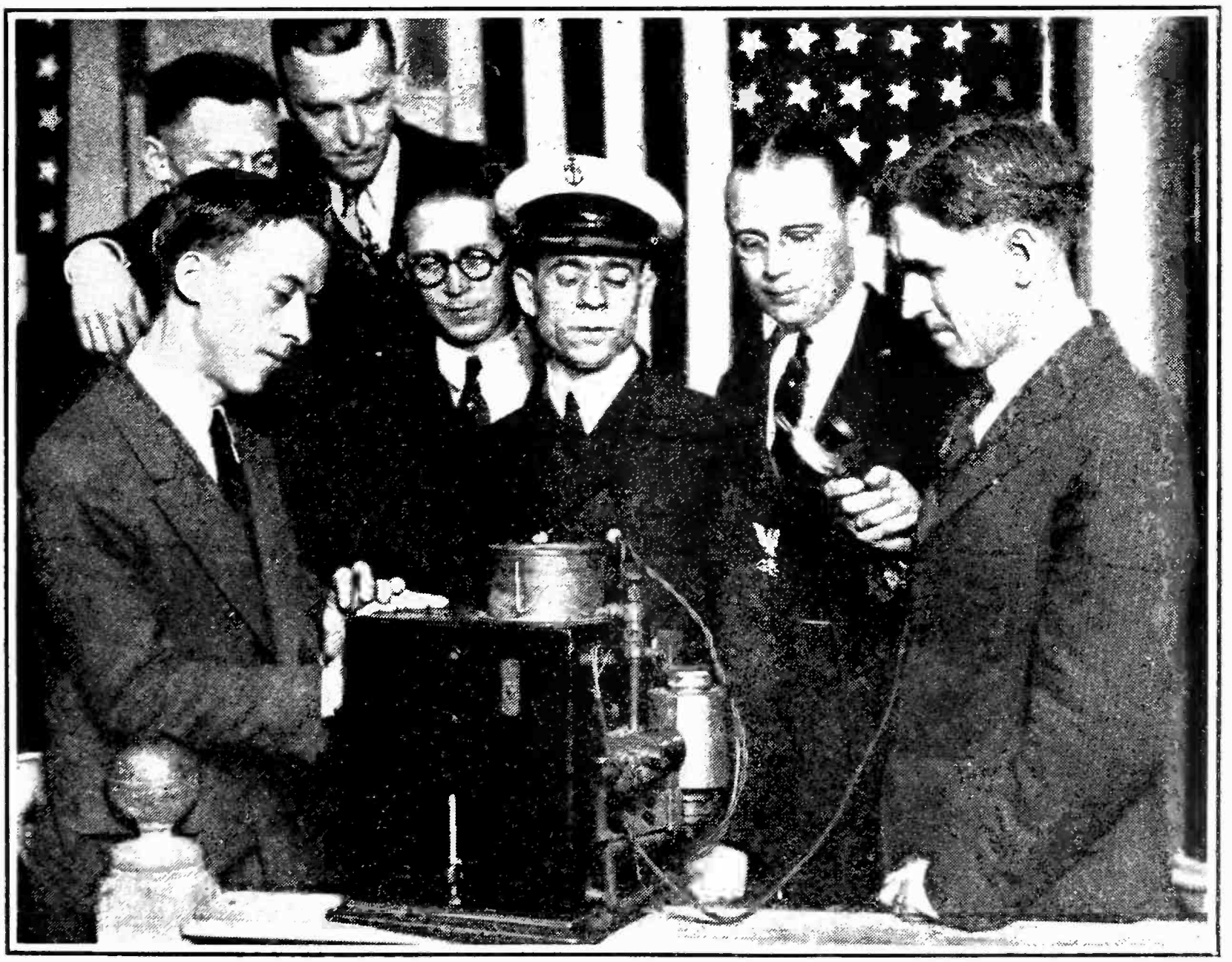
I was placed in charge of this station, where, in company with Dr. De Forest, we experimented for many weeks in privacy and free from the madding crowds around the other wireless exhibits.

The new experimental station was called the "Jerusalem station" because of its proximity to the Jerusalem Exhibit. It was the first high-powered station in the world. It was soon found that many of the principles employed in the ten-kilowatt station did not apply to the new station with its 60,000 volts of oscillating current. Heretofore we had been handling just a big lot of current, while now, comparatively, we were playing with miniature lightning of static electricity and did not know very well how to handle it.

CONDENSERS SEVEN FEET LONG

THE spark-gap condensers, instead of being Leyden jars, were made in heavy two-inch plank boxes, seven feet long, two and one half feet high and equally wide, and liquid-tight to hold kerosene. Immersed therein were two large sections of plate glass upon which heavy sheets of tinfoil were pasted on both sides. Each complete tray weighed about a ton, and from four to six of these tanks were used. Huge transformers six or seven feet high "stepped up" the tremendous voltage. The spark gaps had terminals one and one half inches in diameter upon which a cold blast of air from an electric blower was constantly blown. Telegraph keys, even of extra large design, were impossible to use, so we devised a long handle arrangement which operated like a pump. The contact points were encased in a tank of oil to prevent arcing and fusing. Imagine pumping water at the old town pump for half an hour,—that's how we sent signals before we discovered a better way. Our test signal was always the Morse letter "D" consisting of "dash, dot, dot." This would be sent out for hours at a time. We occasionally changed the helix adjustment or the condensers.

Our experiments continued to result in nothing but one failure after another. Some-

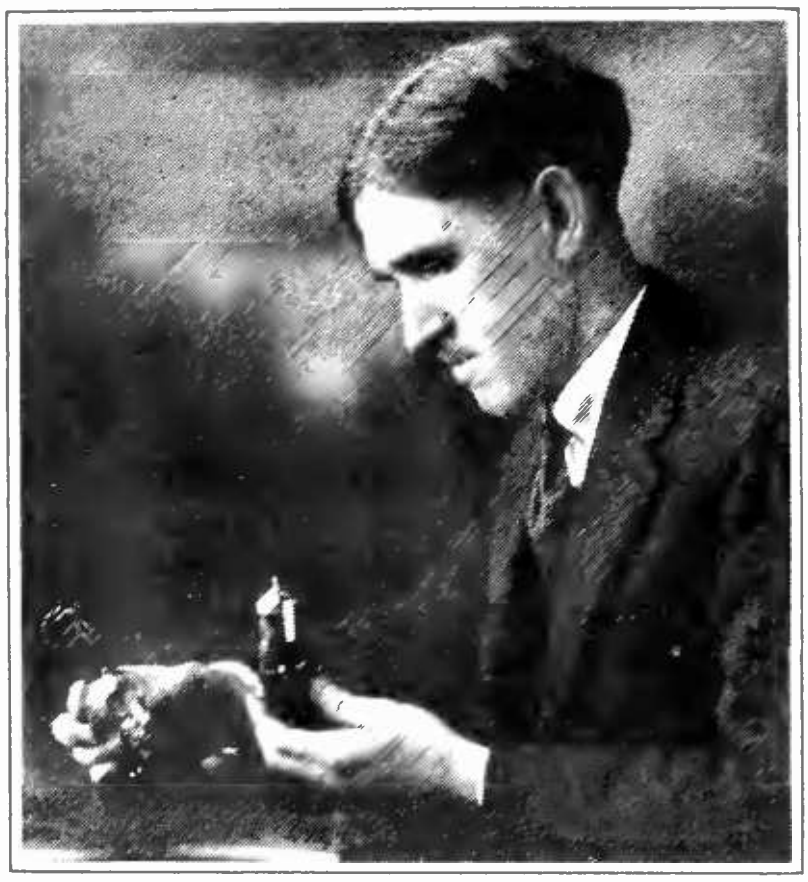


AT THE NEW YORK RADIO SHOW

Last October. Mr. Butler is talking into a microphone connected to a De Forest "singing arc," built in 1907. The "singing arc" was one of the earliest methods of producing continuous waves for wireless telephony and the three-element vacuum tube of DeForest successfully superseded it

times, after days and nights of hard, painstaking work building up the series of condensers we would "blow up" the entire set in an instant, smashing the heavy glass plates to small pieces, blowing kerosene all over us and over the premises, only to gather up the fragments, rebuild with new glass and tinfoil, change the experiment, and try another hook-up. Static electricity was so free and unharnessed in this station, that it was not at all uncommon to get a "poke" in the head or elbow if one came within a foot of the apparatus while it was sending. The roar from the spark gap could be heard a block away and it held its own in noise intensity with the ballyhoo bagpipe of the Jerusalem Exhibit on the one side and the cannonading in the Boer War Exhibit on the other. The odor of ozone, mixed with kerosene, was always present.

And hour after hour, one of us was listening-in with the headphones with ears strained to the utmost. Nothing in that long period of experimenting was more tiresome than this.



1907–1924

Mr. Butler is holding a De Forest audion tube made in 1907 and contrasting it with a tube made by the same company in 1924. He hazards that the 1907 one is perhaps the oldest tube in existence. The old tube was made with a fragile double filament so that when one burned out, the remaining one could be used. Their life was very short. The grid and "wing" were on opposite sides of the tube. The "wing"—now called the plate—was a flat piece of metal and not a tube as is used to-day

DOING THINGS NEVER BEFORE DONE

THUS, blazing the radio trail, we encountered the immensity of space. We listened-in on this infinite space and heard nothing. The silence was at times unbearable; the waiting, nerve racking; but always there were hope and expectancy. It was a royal game of angling. We changed things, fussed and fussed and experimented, still hearing nothing except an occasional rift of static which at that time was a blessing, because it meant that we were at least "getting something." Oftentimes we were awed at the thing we were trying to do. There was something uncanny in trying to snatch the tangible out of the intangible nothingness of the free air. No wonder folks doubted our sanity. However, our longest waits were always rewarded, and finally, we accomplished what we had aimed to do. The thrill then was indescribable because the very thing we had just accomplished had never before been done by man. We never thought then that in our little way we were piecing together some of the foundation stones of the huge radio structure which exists to-day. In his memoirs of those days, Dr. De Forest writes:

"Night and day there is no respite from care, from toil, from interest. But it is a life well worth the living, the full accomplishment such, perchance, as is not given to many. Those who once enter this work, on whom the enticing spell of the wireless once falls, never quit it, no matter what the demands on patience, nor how great the sacrifices—always hopeful, always in effort, fascinating forever."

Control of the apparatus having been achieved, we immediately began to smash records for distance. The first event was on September 5th, when communication was established between St. Louis and Springfield, Ill., a distance of 105 miles. On this occasion, President Francis of the World's Fair sent the following wireless message to Governor Yates of Illinois:

> I salute you as the distinguished executive of a great commonwealth by the modern means of communication, the wireless telegraph, a great achievement of science, of the marvelous advancement of which this universal exposition furnished many interesting evidences. I hope to see you within these grounds often during the remaining three months of the St. Louis World's Fair.

Shortly afterwards, communication was established with the Railway Exchange Building in Chicago, a distance of 300 miles.

In writing of this event of September 18th, 1904, Dr. De Forest says:

"This was indeed a stride in progress, fulfilling careful promises, crowning long and discouraging efforts. Especially significant was it that the formal opening of the St. Louis-Chicago service should occur on Electricity Day at the Fair with the Jury of Awards and the Delegates of the Electrical Congress present."

It is amusing to recall the elaborate precautions this austere body of officials took to make certain that this new service was actually by wireless. Some of the party was stationed at Chicago and the remainder at St. Louis. Complete communication was maintained all afternoon to their entire satisfaction, and as a result we were awarded the Grand Prize which was one of the highest honors bestowed upon any exhibitor.

Upon the strength of these singular accomplishments the United States Government became so interested that a contract was signed to erect five similar high-powered stations in the West Indies, each station guaranteed to work successfully one thousand miles. This was a distance *three times* greater than that we had just bridged, but with light heart and high hopes we packed up our tools and started south for new worlds to conquer.

Little did we dream of the tremendous difficulties awaiting us and the months of tedious, sweltering days ahead before our task was accomplished.

***The next article of this series will describe and illustrate the events of this tropical venture.*—THE EDITOR.**

WEATHER BUREAU

U. S. DEPARTMENT OF AGRICULTURE

Program for Broadcasting Weather Forecasts and Reports by Radio—Illinois Section

NAJ, Great Lakes: (151 Kc.) 9.45 A. M.—Morning lake forecasts; 4.00 P.M.—storm warnings; 10.00 P.M.—evening lake forecasts. (In code).

WLS, Chicago: (870 Kc.) 1.00 P.M. to 2.00 P.M., except Sundays (probably about 12 M. after Sept. 14)—morning state forecasts, general forecast, special forecasts, weather—crop summary on Wednesday, special warnings issued after sending hour, broadcast immediately.

KYW, Chicago: (560 Kc.) 12.00 noon, (11.00 A.M. during local "Daylight Saving") —morning local forecast, state forecasts, lake forecast; special warnings at 2.15 and 4.15 P.M.; 9.25 to 9.30 P.M.—evening local forecast, state forecasts, lake forecast, aviation forecasts. Monday, "silent night."

WAAF, Chicago: (1050 Kc.) 10.30 A.M.—morning local forecast, state forecasts, general forecast, general weather conditions, aviation forecasts, shippers' advices during winter season; weather-crop summaries on Wednesday during crop season; 12.30 P.M.—repeats the 10.30 A.M. information and on Saturday gives weekly outlook. Silent Sundays and important holidays.

WGN, Chicago: (810 Kc.) 10.00 A.M.—morning local forecast, state forecasts; 9.35 P.M. or later, at end of regular program—evening local forecast, state forecasts, lake forecasts, aviation forecasts, general forecast, general weather conditions. Monday, "silent night." Sundays and holidays irregular.

WOC, Davenport: (620 Kc.) 11.00 A.M.—morning local forecast, state forecasts, river forecast, general weather conditions, weather —crop summaries on Wednesday; 12.15 P.M. —forecasts repeated; special cold wave warnings sent as flashes. Tuesday, "silent night."

WJAN, Peoria: (1070 Kc.) 9.15 A.M.—morning local forecast, state forecast, shippers' forecasts, general weather conditions, special warnings; repeated at 10.30 A.M. and 12.30 P.M.

WEW, St. Louis: (1072 Kc.) 10.00 A.M.—morning local forecast, state forecasts, general weather conditions, river forecasts; special warnings at 5.00 P.M.

KSD, St. Louis: (550 Kc.) 10.40 A. M.—morning local forecast, state forecasts, general weather conditions, river forecasts and stages; special warnings at 12.40 P.M., 1.40 P.M., and 3.00 P.M., 10.00 P.M.—evening state forecasts.

Amateurs receiving weather forecasts are requested to advise (by mail) Weather Bureau Office, Springfield, Ill., of the quality of service received and how distinctly the stations are heard.

W. F. FELDWISH
Meteorologist in Charge.

The Rolls Royce of Radio

A Simplified Story of the Super-Heterodyne, Removing, for the Layman, the Mystery of Its Workings—Who Developed the Receiver and How It Works—Another Family Tree Diagram

BY JULIAN KAY

THE fourth article by Mr. Kay in his "What's in a Name?" series should be of interest to the great majority of radio readers. His first article (June, 1924), sorted out and classified the radio receivers in present use. The next, in July, explained radio-frequency amplification. The third (November, 1924), discussed audio frequency amplification. Each article was accompanied by the novel Family Tree diagram. One hears so much these days of the super-heterodyne and what it will and will not do, and glib bandyings about of names common to the "super," that it is not unnatural to wonder if all the radio conversationalists really know their subject. Mr. Kay has here tried to bring together the facts about the "super" without growing too technical. The Family Tree diagram for the super-heterodyne will be found more than usually helpful.

—THE EDITOR.

OF ALL the dynes and supers of modern radio, there is one receiver that seems to have preëminent claim to be both a "super" and a "dyne." That receiver is the Super-heterodyne.

The "superhet" as this receiver is familiarly called, is the result of much work by many men. The names most closely connected with it, Fessenden, Armstrong, and Houck, are only a few of those who have devoted time and energy toward making the receiver an electrical and a commercial possibility.

The invention of the "heterodyne" part of the name is due to Professor Fessenden of Pittsburgh, one of the earliest investigators in the realm of wireless telegraphy. The "super" part was attached by Edwin H. Armstrong after he had applied the heterodyne idea to vacuum-tube circuits.

To this creator of circuits is credited much of the development of this remarkable receiver as we know it to-day.

One of the most interesting demonstrations of the practical efficacy of the super-heterodyne was given by Paul Godley, a very well known Eastern amateur, in his famous Scotland experiment three years ago. Using a home-made receiver of this type, at Androssan, Scotland, he succeeded in receiving and identifying many American amateur signals at a time when neither transmitting nor receiving stations had advanced to their present efficiency.

Although the fundamental idea underlying the super-heterodyne is simple enough, the practical difficulties are many, and to build one of these "Rolls Royce" of radio is more a task for an experienced radio constructor than for the ordinary radio layman. From the Greek origin of the term, one may gather that this receiving system has something to do with a force that arises through a "change." A dyne in modern science is a unit of force equal to about one five hundredth thousandth of a pound, and "heterodyne" suggests a change or variation. In fact this receiver is a "frequency-

Do You Know—

—What "beats" are?
—What heterodyning is?
—The principle on which the "super" works?
—Why the super-heterodyne is so sensitive?
—Why a super-heterodyne should not be used with an antenna?
—What the "local oscillator" is?
—The function of the "first detector" tube?
—The advantage of the second harmonic super-heterodyne?

changing" device, and therein lies its great selectivity and the remarkable amplification of signals it brings about.

WHAT THE SUPER-HETERODYNE IS

NOW, just what is the super-heterodyne principle?

The fundamental idea is based on a physical phenomenon known as beats, which occurs

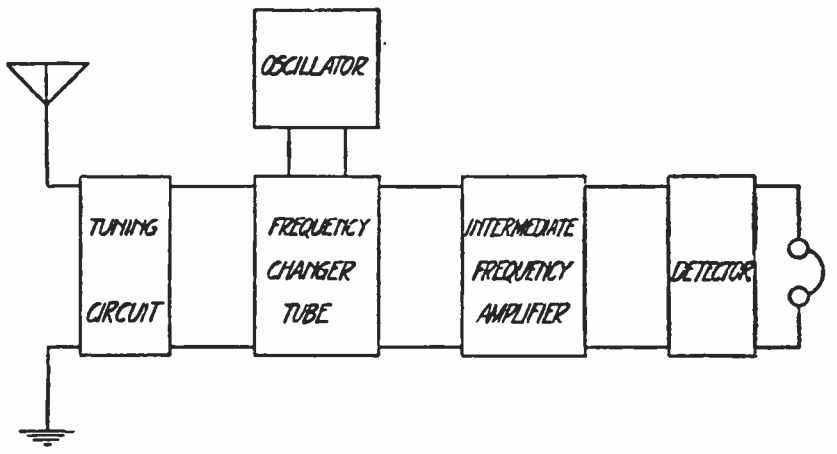


FIG. 1

The super-heterodyne idea. The frequency changing or mixing tube, is often incorrectly referred to as the "first detector" tube

when two slightly differing vibrations are compounded. For instance, if two tuning forks are struck, one of them corresponding to middle C, or 256 vibrations per second, and the other, a few vibrations more per second, a sensitive ear will distinguish three tones. Two correspond to the vibrations of the two forks, and the third will be much lower in note, in fact it will be the difference between the other two.

In the article in this series on radio-frequency amplification, it was pointed out that it is much more difficult to build an amplifier for high frequencies than for low frequencies. This becomes a real problem when we realize that the middle of the broadcast range (about 300 meters) corresponds to frequencies of the order of a million cycles per second.

The trick of the super-heterodyne then, is to "beat" the incoming high-frequency signals with a local oscillator, and to amplify the resulting low-beat frequency.

Now, strangely enough, this beat frequency has all of the irregularities of the original radio frequency, that is, the voice and music will appear in the low beat as well as in the high transmitted note.

And therein lies the efficiency of this type of receiver—it amplifies comparative low frequencies where it is easily possible to build good amplifiers.

THE SUPER-HETERODYNE

THE "superhet" of Armstrong is really a complete receiving system, consisting of detector, "mixing tube," oscillator, and amplifiers, for both beat and audio frequencies.

Fig. 1 shows how the super-heterodyne performs its function of frequency changing. The input circuit, usually consisting of a receiving loop and a condenser, is tuned to the incoming signals. Then beats are produced by the local oscillator tube, then these beat frequencies are amplified by the "intermediate frequency" amplifiers to be finally detected and passed on to audio amplifiers and the usual output.

So much amplification is possible with this receiver that a small energy collector, such as a loop will suffice, thereby eliminating the unsightly and unhandy antenna. The receiver, however, may be loosely coupled to an external antenna.

The connection to the antenna may be made by running a single loop of wire about the cabinet, or by merely placing a turn of the antenna-ground system near it. In some cases the antenna may be attached to the loop, and on distant signals the external connection will be of aid, *provided* and only provided that the listener is out of the city away from the noises that Mr. Van Dyck in his series, "Man-Made Static," discussed in RADIO BROADCAST.

If used with an antenna, the super-heterodyne will radiate because of the local oscillator. It is entirely possible to use a

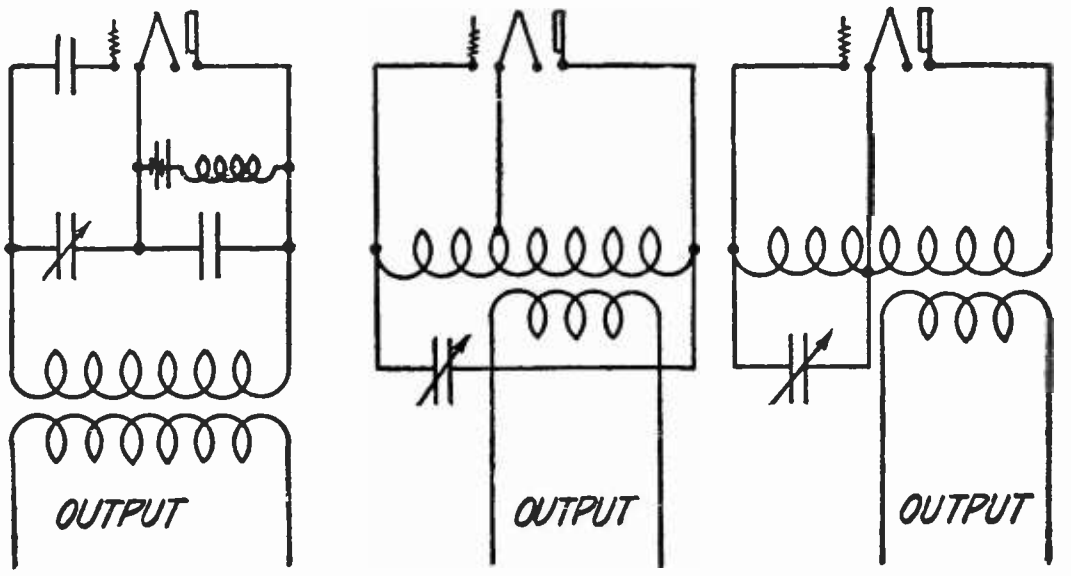
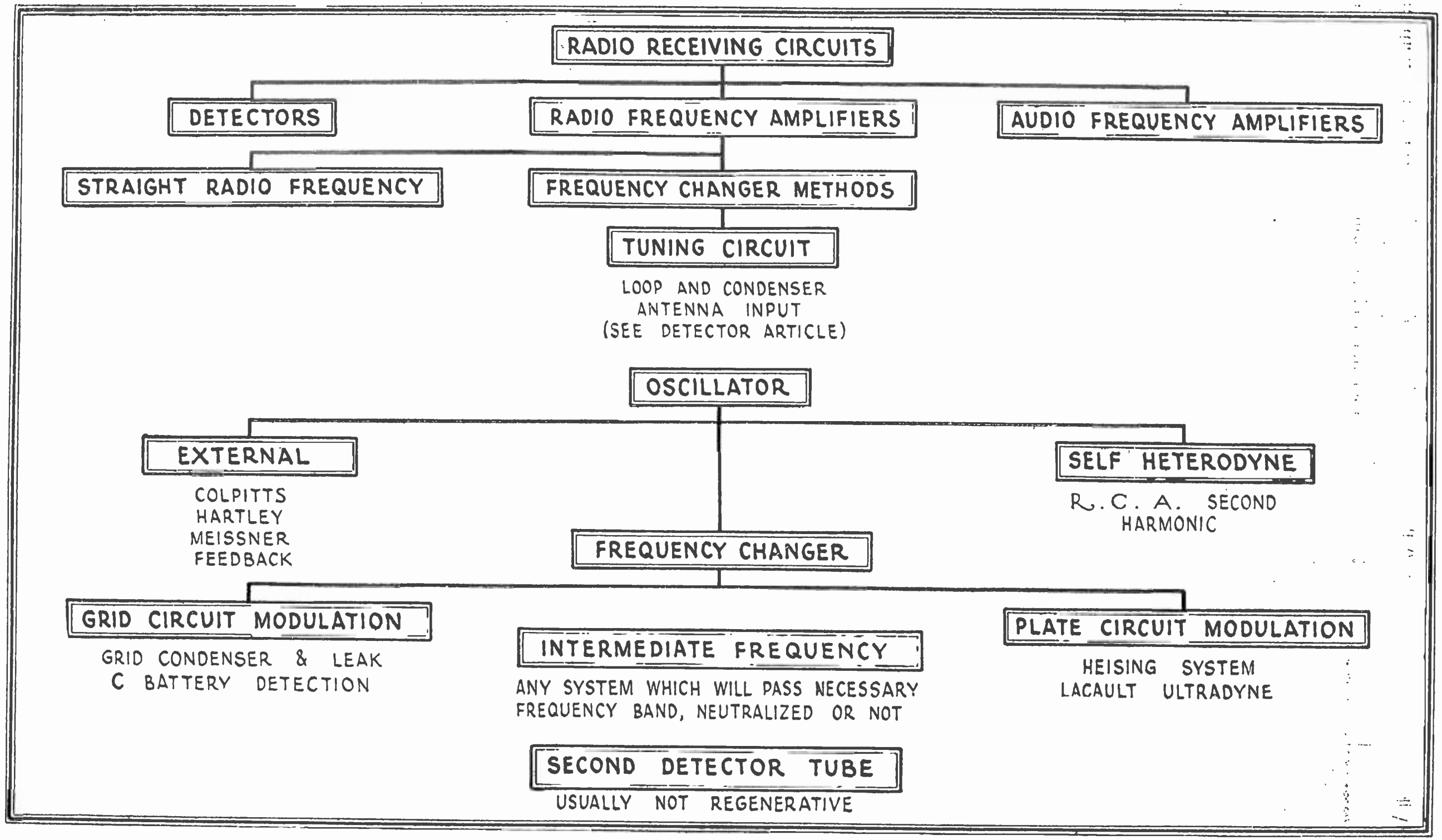


FIG. 2

Various types of oscillator connections. The Colpitts system is shown at the extreme left, and the others are two types of the Hartley circuit



SUPER-HETERODYNE FAMILY TREE

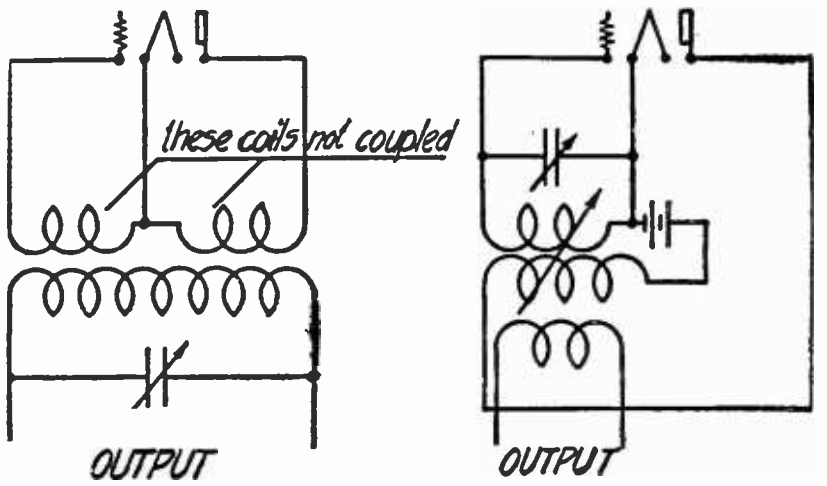


FIG. 3

Various other types of oscillators. The Meissner is at the left and a feedback system at the right

stage of radio-frequency amplification ahead of the first tube. Such a stage may be one of the several types described in the second article of this series. This radio-frequency amplifying tube will eliminate all possibility of radiation. The better plan, however, is to stick to the conventional method of using loop, detectors, and amplifiers.

The real superiority of the super-heterodyne actually fades almost to insignificance if its satisfactory operation requires an outside antenna because the development of modern receivers with a reasonably large antenna will practically duplicate in selectivity, volume, and distance the super-heterodyne's performance. A very striking example of such a receiver is the Roberts circuit when used with a good push-pull amplifier such as the four-tube arrangement known as RADIO BROADCAST's four-tube Knock-Out.

WHAT THE SUPER-HETERODYNE WILL DO

A PROPERLY constructed super-heterodyne is one of the most sensitive receiving systems; that is now available, although not the most satisfactory from several points of view. The only limit to its range is the level of local noise, that is the interference from "bloopers," arc lamps, door bells, X-ray machines, street cars, elevators, etc. The "superhet" will receive anything that is in the ether, and anything that is above the level of the noise can be picked up and identified. But so will other receivers, lately developed.

The writer's idea of a radio Utopia is an island, say in the middle of Lake Superior, where the noise level is 'way, 'way down with a super-heterodyne to keep one company. It is to be understood that this is a *radio* Utopia!

On the other hand, if the owner lives in a congested area where the noise level is high, all the amplifiers in the world won't help him to hear signals from great distances, and a super-heterodyne will not work to full advantage.

THE LOCAL OSCILLATOR

FIGURES 2 and 3 show several common types of oscillators. The Hartley circuit is probably to be preferred. It is a simple, cheap, and good oscillator covering a wide range without change of coils.

The latest development in the super-heterodyne history is, as Major Armstrong has pointed out in RADIO BROADCAST, the "second harmonic" idea. Instead of using a separate oscillator, the first detector is made regenerative, and the frequency of oscillation such that its second harmonic will beat with the incoming waves. Use of the second harmonic makes the two tuning controls independent of each other, and eliminates one tube, which is an obvious advantage.

THE FREQUENCY-CHANGER TUBE

THE first detector, or the tube in which the actual shift in frequency takes place, may be one of two general types as the Family Tree shows. The two frequencies may be mixed in the grid or the plate circuit. Of the two the former seems to be preferred.

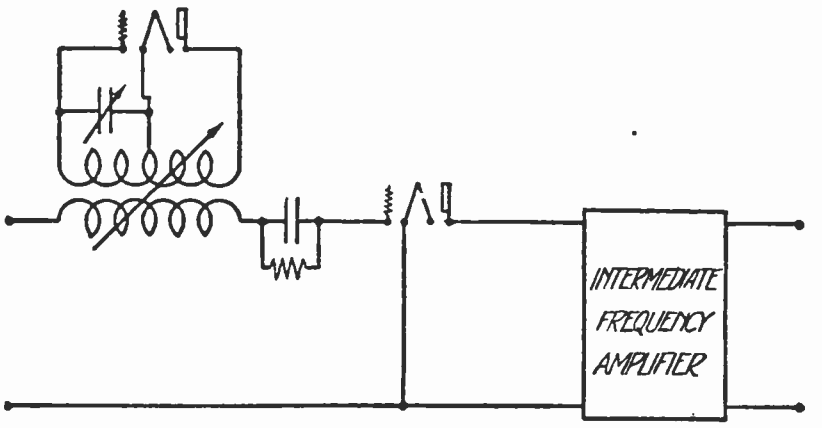


FIG. 4

The circuit of the frequency changer. The separate oscillator uses the Hartley connection. The output goes to the intermediate-frequency amplifier

Plate-circuit modulation may be used, as in the Ultradyne circuit. The Radio Corporation second harmonic super-heterodyne receiver, however, uses grid-circuit modulation. It may be pointed out here that broadcasting stations use plate-circuit modulation, and there seems to be no evident reason why this method may not be applied to the receiver. Fig. 5 shows a frequency changer of this type.

Another one of the tricks of the super-heterodyne lies in this frequency-changer tube. The output of this tube to the amplifiers that

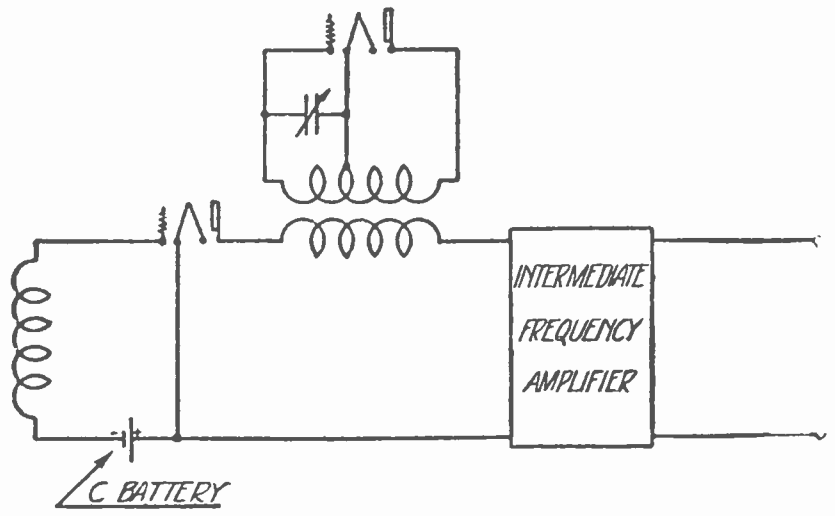


FIG. 5

Showing the frequency changing circuit with plate circuit modulation and C battery detection. In Fig. 4 a grid condenser is used for detection. The oscillator connection is the Hartley

follow, is dependent upon the product of two voltages, namely, the signal or incoming voltage and the oscillator voltage. For this reason it behooves the builder to make his oscillator as good as possible, for much of the efficiency of the entire receiver depends upon the proper functioning of this part.

Since the voltage of the second harmonic is less than that of the fundamental, it seems that the Radio Corporation super-heterodyne might lose some amplification by use of this feature, yet the advantages seem to outweigh the objections. The second harmonic idea was a brilliant one, and credit should be given Houck, its originator, who was one of Armstrong's associates in its development.

This business of multiplying two voltages to get the amplifier input voltage explains in a way why the receiver is so sensitive to weak signals. Suppose a station is tuned-in whose signals are weak, that is, they impress a small voltage on the loop. On an ordinary receiver this voltage is what actually operates the first tube. In the super-heterodyne this small voltage is multiplied by the relatively large one of the oscillator, and the voltage actually applied to the amplifiers is proportional to this product, not merely to the weak incoming signal.

Since the energy fed into the first detector is relatively high, in case of local reception, this detector usually functions with a C battery as shown in Fig. 5 instead of the usual grid condenser and leak. The reason is that the more conventional method may "block" if too strong a signal is applied to the tube. Any one can verify this by trying to receive when a near-by amateur is sending, or when heavy lightning occurs in the vicinity.

THE INTERMEDIATE AMPLIFIERS

CONFUSION seems to reign supreme on the matter of the intermediate-frequency amplifiers. Perhaps it is because they belong to the far-famed "superhet," perhaps it is because it is difficult to buy, or more difficult to build good ones.

Any of the amplifiers described in Haynes' article on page 408 of the September number of this magazine may be used in the super-heterodyne—*provided* that it passes the required band of frequencies.

Now let us see what this signifies.

The usual band of frequencies broadcast extends up to about 5,000 cycles. This means that an amplifier must pass at least twice that band in order that the speech or music be true, that is, without lopping of the high violin harmonics, or the "s's"

In the usual receiver operating at 300 meters,—or 1,000,000 cycles, the band required is $\frac{10,000}{1,000,000}$ or one per cent. of the radio frequency. That is, if the receiver is so sharply tuned that it can differentiate between one million and one million ten-thousand cycles, the reception will be poor. Such sharpness is not attained, and the music and voice frequencies are all received.

In our intermediate amplifiers, however, another story must be told. Here we have a beat radio frequency of 50,000 cycles, or 6,000 meters, and if the usual band of 10,000 cycles is to be faithfully transmitted by each amplifier, they must be comparatively broadly tuned. In this case the band is $\frac{10,000}{50,000}$ or twenty per cent. of the beat frequency.

In other words, the usual type of resonant circuit will not suffice, for it is too sharply tuned and part of the speech band will be chopped off. This will result in distortion. Transformers with flat characteristics are

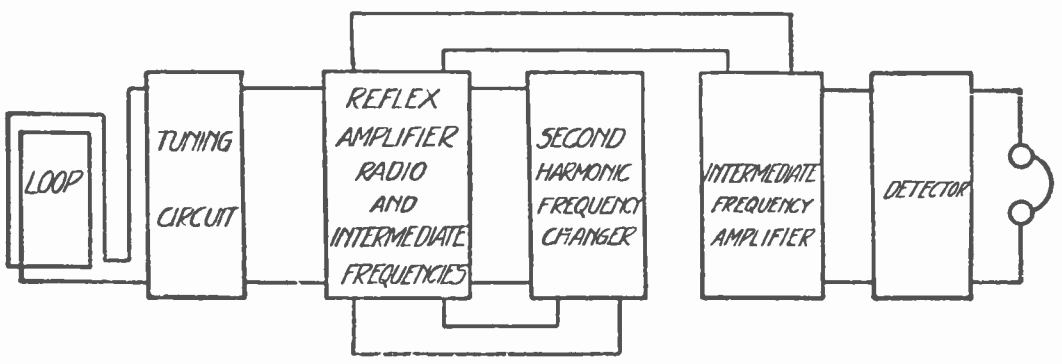


FIG. 6

The scheme of connections for the second harmonic super-heterodyne developed by Armstrong and Houck. Reflexing is employed in the first intermediate-frequency stage, which saves one tube.

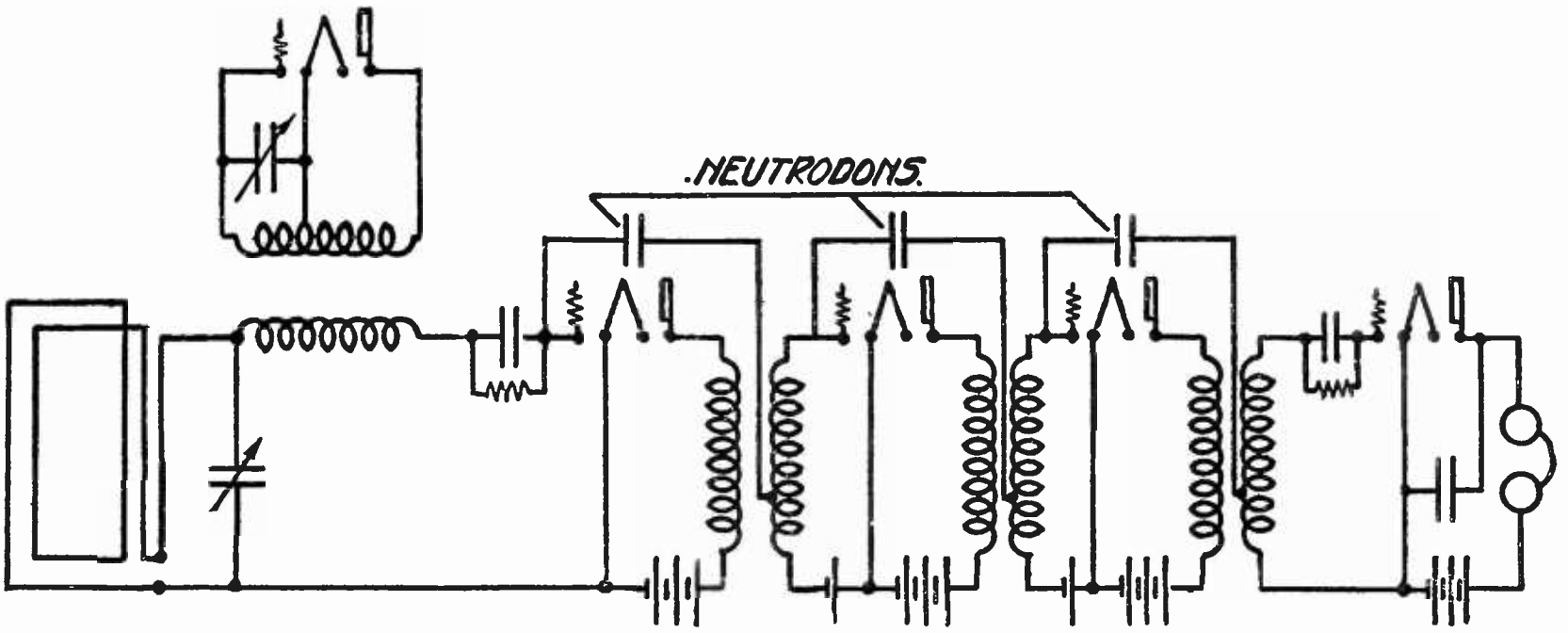


FIG. 7

Diagram of a two-control super-heterodyne showing the principles described in the accompanying article. There is a loop for receiving, tuned by a condenser, and the Hartley oscillator circuit is used. Grid condenser modulation is employed. The intermediate-frequency amplifier is coupled by untuned transformers, and the tubes are neutralized. Detection is accomplished in the last stage by the usual grid condenser method. No audio amplifiers are shown, but would be connected where the telephones are indicated

usually best for the interstage coupling. Such transformers should be paired so that they work together properly. This is a matter for the laboratory-equipped engineer.

THE SECOND DETECTOR

FOLLOWING two or more stages of intermediate or beat-frequency amplification, the signals are fed into a second detector from which they pass to the output circuit as usual. This detector tube operates by means of the usual grid condenser leak method. It may or may not be regenerative, but if so, it must oscillate at the beat frequency.

There is really no object in making this detector oscillate, provided that the remainder of the outfit is made properly. All the signal strength that one can stand will be attained before the second detector is reached, so there is little use in making the apparatus more complicated than necessary. If the intermediate amplifiers are giving enough gain that they have to be neutralized to keep them from howling, one may rest assured that he is getting all possible out of the equipment.

In one of the Radio Corporation models, one of the intermediate amplifiers is reflexed, thereby eliminating one vacuum tube and bringing the total number down to six.

If a loud speaker is to be run from this receiver—and it is not wise to try a pair of phones on a strong and healthy "superhet"—a stage or two of audio-frequency amplification may be added. If the intermediate amplifiers pass the required band, and if the last detector and the audio-frequency amplifiers are not overloaded, undistorted music and speech should arrive at any part of the country from all other parts of the country, during the winter and at night.

What more could any one ask of any receiver?

How to Build a Knock-Out Amplifier

A Highly Efficient and Easily Built Amplifier Unit Combining Resistance and Transformer Coupling

By ZEH BOUCK

IT IS unfortunate that many radio writers lack experimental data, personally gathered, with which to bolster up their more general theoretical statements. Were such not the case, authors would have been less hasty and definite in the repeated denunciation of resistance-coupled amplification since RADIO BROADCAST introduced this system to the fan a half year ago.

There are few radio possibilities that have been more maligned than this truly meritorious system of radiophone amplification. Its economy of operation has suffered the most relentless criticism which a half hour of actual experiment and a half minute of unclouded thought would have demonstrated to be unjust and without sound foundation.

The sole objection that holds more than a negligible amount of water is the fact that transformer-coupling permits greater amplification per stage than the resistance-coupled system. The resistance-coupled amplifier permits a theoretical maximum intensification equal to the amplification constant of the tube. That is, the potential applied to a succeeding tube is equal to that applied to the preceding tube times the amplifying ability of the repeating bulb. This limit, however, can only be approached—never attained. A transformer-coupled stage permits a greater intensification that is roughly equal to the amplifying ability of a resistance-coupled amplifier multiplied by the turn ratio of the transformer.

The truth is that neither resistance coupling nor transformer coupling is in itself perfect, each arrangement being deficient in qualities possessed by the other. A consideration of the characteristics of each amplifier will be enlightening in that it will indicate a method of combining the two systems. The composite arrangement exhibits both the superior amplifying ability of the transformer-coupled amplifier and the perfect quality of the resistor intensifier.

TRANSFORMER DISTORTION

THE only objection to the usual transformer-coupled amplifier is the distortion which is almost invariably evident when amplification is continued to loud-speaker intensity (that is, two or more steps). Assuming the proper operation of a cascade amplifier in respect to the biasing of grids, distortion is promoted in several ways. The first consideration is the ineradicable tendency of the transformer to favor certain frequencies—usually those of a medium high period. In a well designed

Facts and Fancies

The resistance-coupled amplifier has come in for a lot of criticism from many in the radio industry who ought to know better. If the laboratory tests they claim to have made actually were made, there is something radically wrong with their laboratory methods. In this timely article, Mr. Bouck, who is widely known as one of the soundest of radio technicians, describes a unique and very satisfactory amplifier which happily combines the desirable features of resistance- and transformer-coupling. Two other applications of resistance-coupling to an amplifier have been described in this magazine by Mr. Bouck, one in June, 1924, where resistance-coupling was added to the one-tube knock-out reflex and in October, 1924, where a two-stage resistance-coupled amplifier was added to the Roberts circuit. This amplifier unit should not be used with any kind of a reflex receiver, because such an arrangement would bring two stages of transformer coupling into play.

To those who criticize resistance coupling, we wish to extend an invitation to visit our laboratory. If they wish to do so, they may bring any receiver of this type with them for comparative test.—THE EDITOR.

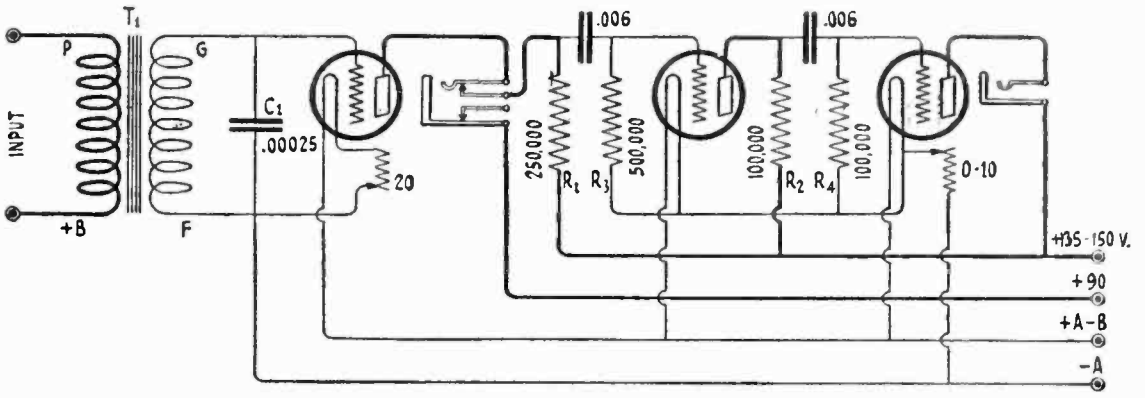


FIG. 1

The circuit of the combination amplifier. In the majority of cases C1 can be eliminated. The detector is coupled to the amplifier in the usual way

transformer, this characteristic is somewhat subdued, to the extent that distortion cannot be discerned even by the trained ear, *in a single stage of intensification.* However, if amplification is continued through additional stages, perhaps only one, repeating through the same general type of transformer, the following transformer will emphasize the distortions originated in the first step. The effect is thus cumulative, and the distortion is finally evident to the average ear.

Another phenomenon which will result in distortion is the non-uniformity of the magnetic action of a transformer when heavily loaded. More technically, in such a case, the inductive effect is no longer proportional to variations in the magnetizing current as the saturation point in the core is approached. Some audio transformers evidence such an action at comparatively small loads. The ounce of prevention is a larger core, which in turn is argued against by its inconvenient size and more worthy theoretical considerations. Distortion from this cause is probably encountered only in cases of excessive amplification, with high plate voltage and little or no bias, in which instances it is merely contributory to the general strain. *It should never be experienced in the first amplifying stage.*

Distortion in the tube itself is a phenomenon of uneven emphasis similarly confined to the last stage of transformer-coupled amplification. For satisfactory amplification, variation in grid potentials is limited to voltages

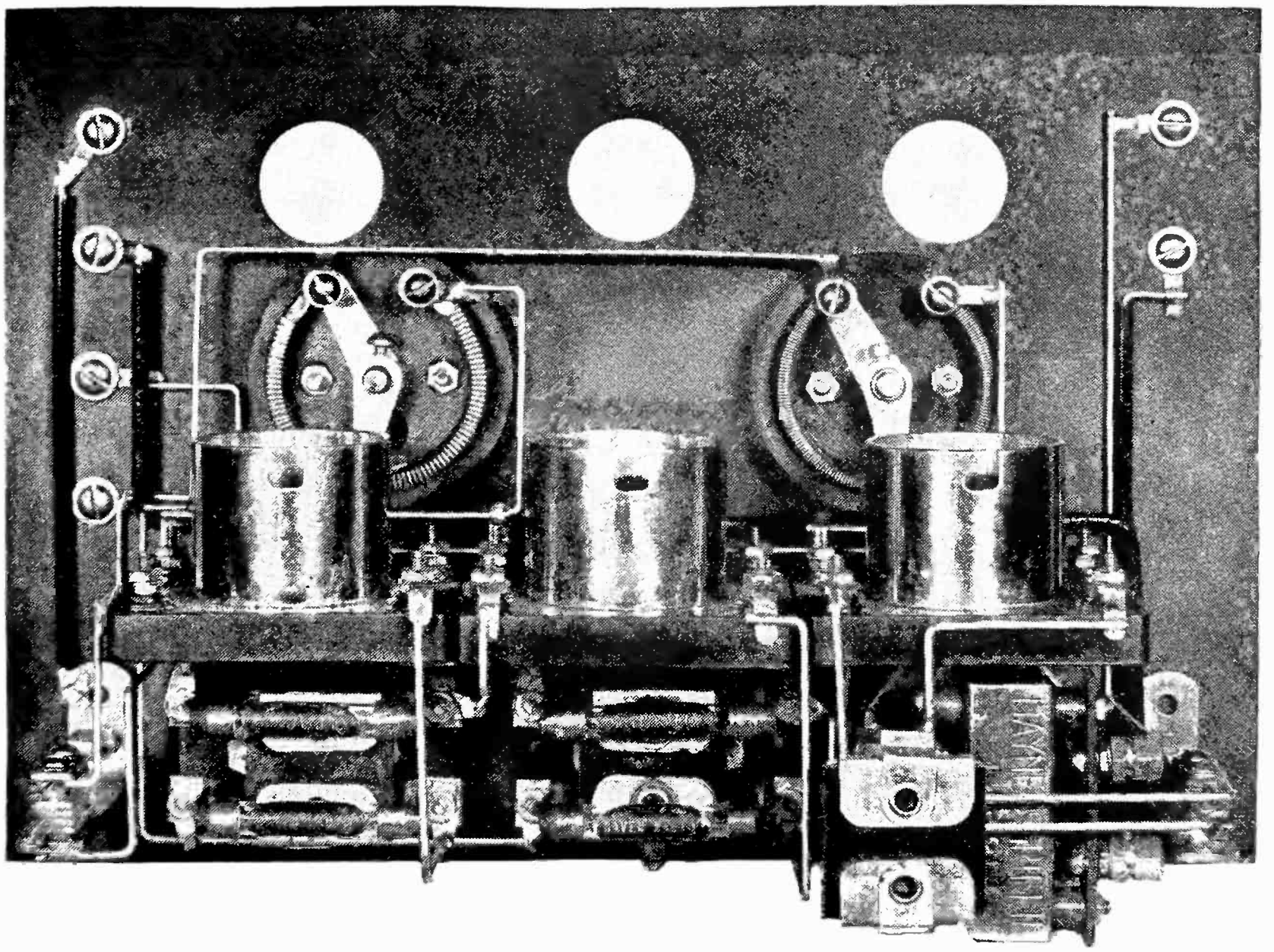


FIG. 2

A rear view of the amplifier. The selection of panel mounting parts makes a particularly compact and neat job

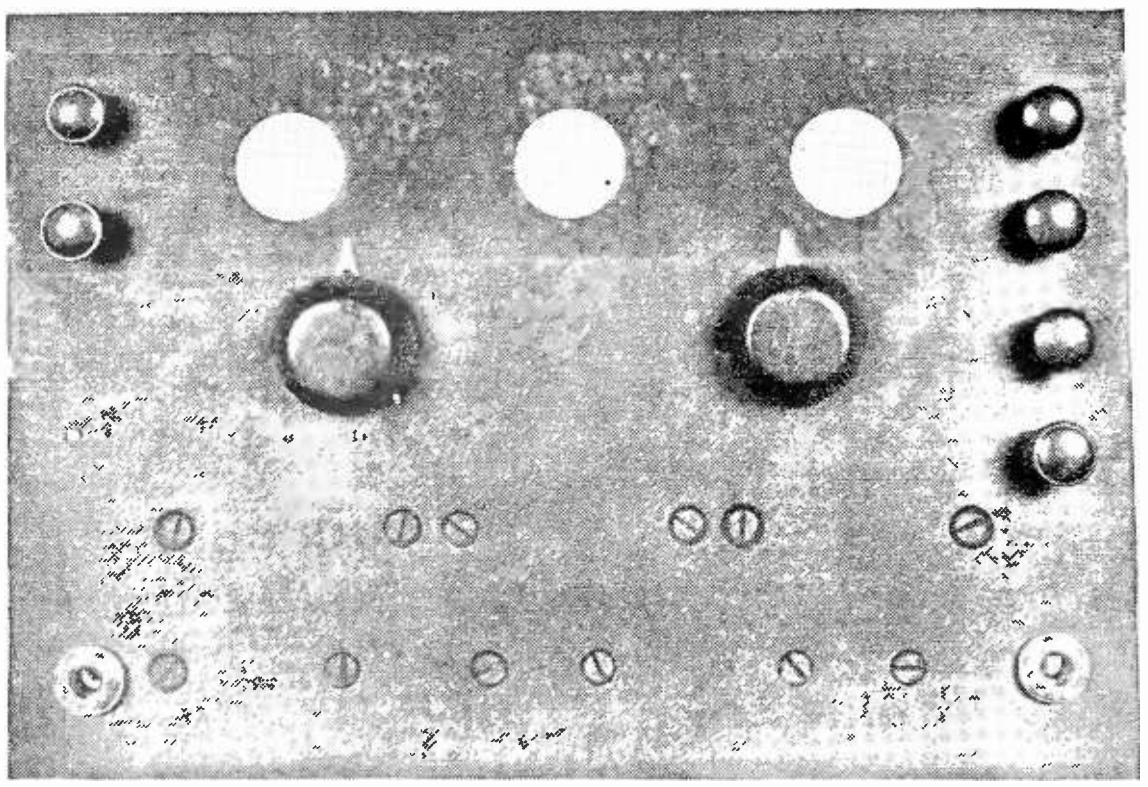


FIG. 3

The panel layout of the amplifier described. The design may be varied in order to maintain a consistent appearance of all receiving apparatus

projected by the straight portion of the usual "characteristic curve." However, in the transformer-coupled system, such variations are additionally confined to about half this workable portion, the negative or lower slope—which limits may be exceeded in the case of a strong signal in the last stage of amplification. Distortion will be the result. The impedance and resistance-coupled amplifiers are less restricted in this manner, for their operating characteristics permit a greater range of grid variations.

THE IDEAL AMPLIFIER AND ITS CIRCUIT

IT IS thus evident that the distortion in the transformer-coupled amplifier may be considered as being totally absent in the first stage. In this position, its superior amplifying ability recommends it as ideal. It is equally obvious that the case of the resistance-coupled amplifier has been similarly well established in the second and third stages where, free from the distorting characteristics of the transformer, it outputs an auditively perfect signal.

The reader will now grasp the possibilities of an amplifier consisting of one stage of transformer amplification followed by two stages of resistance coupling. The accompanying illustrations show such an amplifier, which thoroughly justifies the theoretical considerations outlined above.

Fig. 1 is the circuit of this ideal amplifying arrangement. The various values and connections have been determined experimentally and will give the best results on the average receiver. Transformer T1 is any reliable audio-frequency transformer with a turn ratio no higher than four to one. The .00025 mfd. condenser across the secondary is a Micadon, and connected in this manner it will improve the quality of some transformers. The capacity offers a comparatively low impedance to the high frequencies which may be over emphasized by the transformer—a discriminating "short" that irons out uneven amplification. Its desirability should be determined by experiment.

R1 is the first coupling resistor, having a value of 250,000 ohms. This is considerably in excess of the usual resistance of 100,000 ohms, which is employed in the case of the second resistor, R2. Experiments have determined the higher value as the most satisfactory in the plate circuit of the first tube in this particular amplifier.

C2 and C3 are the isolating condensers of .006 mfd. capacity.

The grid leaks, R3 and R4 have respective values of 500,000 ohms and 100,000 ohms.

The rheostat and jack connections are quite self-explanatory.

THE PARTS

THE following is a list of the exact parts used in the amplifier illustrated and described. Equally reliable makes may, of course, be substituted for the designated apparatus with similarly satisfactory results.

One 7″ by 10″ panel;
One six- or ten- ohm rheostat;
One twenty- or thirty- ohm rheostat;
Three standard sockets;
One Haynes-Griffin audio-frequency amplifying transformer;
Two Daven Resisto-Couplers with necessary grid leaks and coupling resistors;
Two .006 Micadon or New York Coil condensers;
One .00025 mfd. capacity Micadon or New York Coil condenser;
Two Pacent jacks (one open and one closed circuit);
Six binding-posts;
And the necessary tail-washers, busbar wire, etc.

CONSTRUCTION

THOUGH the illustrated mechanical design is suggested to the average builder, the amplifier admits of several minor electrical and mechanical variations, such as a second stage jack, automatic filament control, and constructional changes to adapt the apparatus to a tuner of rather different appearance. It will be observed from the photograph, Fig. 2, that all apparatus, including sockets, are of panel-mounting design, which makes possible an exceedingly neat and efficient construction. The baseboard, may of course be used, if the designated apparatus is inconvenient or unavailable. Fig. 3 shows the panel layout and Fig. 4 is a descriptive drawing of the amplifier described, and recommended.

OPERATION

THE operation of the transformer-resistance-coupled amplifier is identical with that of the more conventional types. The indicated battery connections are made, and the output of the tuner wired to the primary of the amplifying transformer, the plus B battery and plate connections following through to the respective apparatus in the detector circuit. When inputting from the detector of a regenerative receiver, a telephone bypass condenser, which may be a Micadon, .002 mfd., should be shunted across the primary of the transformer, or from the upper (P) side of the primary to the filament battery. In most receivers, this condenser will be found included in the original tuning circuit.

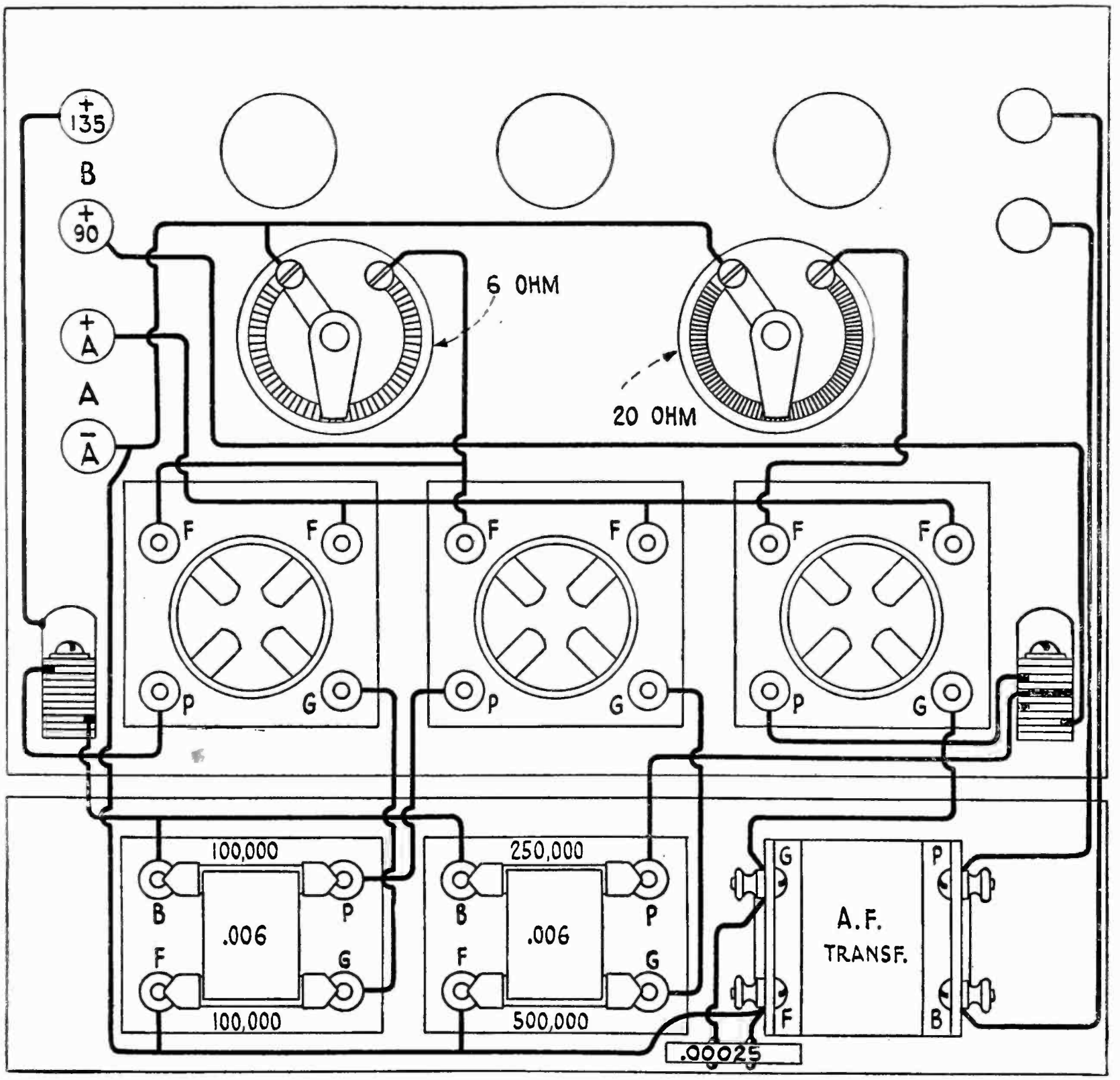


FIG. 4

A picture drawing of the layout and connections. This will be helpful to our less experienced readers, who, however, should train themselves to understand Fig. 1

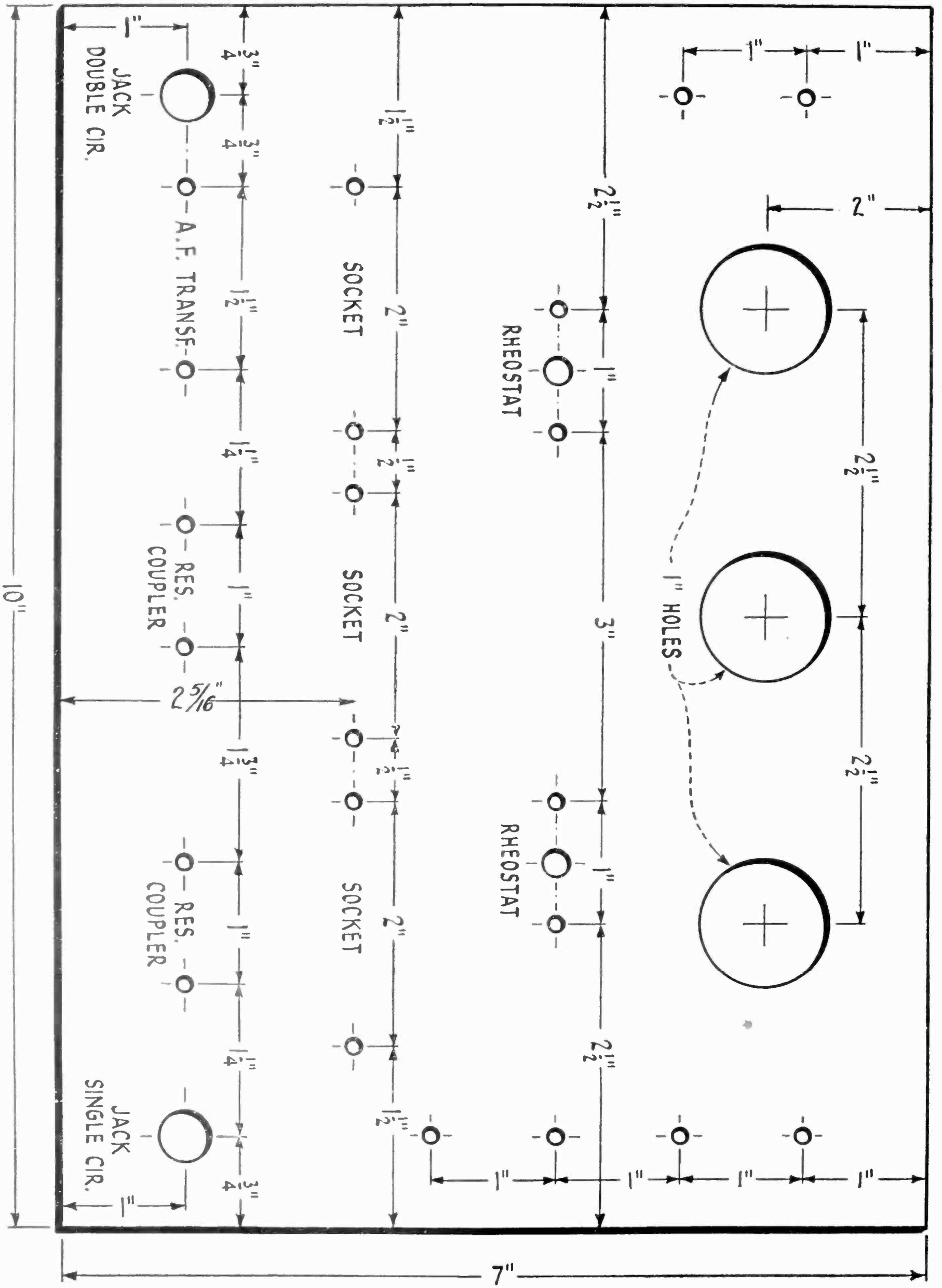


FIG. 5

Front view of the completed amplifier. Only two jacks have been used in the set described, in the first and third stages

Two plate voltage potentials have been indicated and extra posts provided, isolating the higher voltage from telephone receivers plugged into the first jack. However, if an amplifying plate voltage in the neighborhood of one hundred is applied, the two upper right hand binding posts may be shorted over, eliminating the necessity for an additional tap to the B battery.

TUBES

ANY of the standard tubes can be used in the amplifier described. One secures the best volume from the six-volt bulbs. The plate potentials should vary with the type of tube for best results. It is wise to keep close to the upper limit recommended by the manufacturer with the bias in the straight transformer-coupled amplifier. No bias however, should be used with the knock-out amplifier.

DISTORTION

CORRECTLY operated, the output of the amplifier described should be perfect as far as the ear is concerned. On exceptionally loud signals, and with some tubes, the final stage may "choke," which will result in harsh, grating reproduction. This strain can be remedied by lowering the resistance of the last grid leak, R4. Placing the fingers across the leak prongs on the resisto-coupler (lowering the resistance by shunting through the hand) is a simple test to determine if distortion is due to the overloading of the last tube. The UV-201-A is somewhat limited in respect to the power it will handle without distortion: For dance purposes in a large hall, a power tube, such as the Western Electric 216-A, with a separate rheostat, is recommended for the last stage.

Flatness, or loss of the high tones will generally be remedied by eliminating C1 (if used) or by bringing the grid leak of the last tube down to the plus side of the filament-lighting battery. This places a slight positive bias on the tube, operating the bulb a little higher on its characteristic curve. As the resistance-coupled amplifier "modulates down," in fact very emphatically on the higher audio frequencies, more room for a useful grid variation is provided by this connection. It is interesting to note that the writer has operated resistance- and impedance-coupled power amplifiers that were distortionless only when functioning with a *positive* bias, supplied by a C battery.

However, distortion *in* an amplifier built exactly as described will be rare. In the majority of cases, unsatisfactory quality can be traced to either poor tubes (generally bootleg) or the loud speaker, and should the simple remedies suggested in the preceding paragraphs prove of no value, the trouble may be external to the amplifier.

ECONOMY

THE plate-current consumption of the knock-out amplifier is unusually low, with the exception of the last stage, being under that of a well biased transformer-coupled intensifier. With one hundred volts plate potential, across both B battery posts, the first tube, when the amplifier is passing signals, draws about .17 milliampere (seventeen one hundredths of a thousandth of an ampere)! Under similar conditions, tube number two consumes one milliampere, and tube three, five milliamperes. It will be observed that the third tube consumes almost five times as much as the total plate current of the preceding amplifying tubes. This is due, of course, to the substitution of the loud speaker windings for the comparatively high ohmage coupling resistors. The plate current in the last stage can be materially reduced, without appreciably affecting volume, by including a five-thousand-ohm resistance in series with the loud speaker.

A MOTOR GENERATOR FOR BATTERY CHARGING

AN EXCELLENT article, by James Millen will appear in an early number of RADIO BROADCAST, which describes the theory and construction of a motor generator for charging radio storage batteries. The entire unit is not expensive to build and to assemble, and gives a very quick and economical method of charging the storage battery.

Why Don't Great Musicians Aid Radio?

IF A majority of the leading musicians of this country would take a constructive interest in radio music, this particular feature of broadcasting would soon show marked improvement. At present they are a detriment rather than a help to the cause. They are quite willing to concede that there are unlimited possibilities for musical achievements of value through the radio, but they withhold activity in helping toward the development of these possibilities. Yet when radio music does finally attain a level sufficiently high to command the respect of the critical, these musicians, who are waiting for that day the while they are doing nothing to bring it about, will be among the first to seek the microphone for the promulgation of their work.

Perhaps this is only human. For in this commercial age, being a musician is at best a hard job. It may be asking a good deal to expect musicians to give much consideration to the radio as long as the radio does nothing for them in a financial way. But, now and then, one does come across one who is sufficiently interested in radio music to consider it in its relation to humanity rather than to his or her individual career.

ROBERT D. BONIEL

Director and announcer at station WEBH, Edgewater Beach Hotel, Chicago. It was from this station that the delightful surprise commented upon in these columns came not long ago

Such a musician is Mrs. H. H. A. Beach, the only American woman composer who has gained distinguished international recognition, and who, in addition to this, can hold her own among the men composers. An opinion on radio music from such a source is of far more than passing importance.

When asked to give this opinion, Mrs. Beach's reply, although brief, showed broad comprehension of the subject:

I should say that, in the main, its influence has been for good. I know that there are two sides to the question of its value to the composer, but so far as the public is concerned, I feel that much interest must have been aroused, especially in the smaller places, in the hearing of music. I have had personal knowledge of many people who live in remote districts, who have had wonderful happiness in listening to the artists and musical organizations which, otherwise, they would never have had an opportunity to hear. It is not only bringing enjoyment into lonely lives,

© Smith

JOSEPHINE LUCCHESE

—Coloratura soprano. What radio programs will be like when professional musicians are regularly featured, was demonstrated when Miss Lucchese, at present the leading coloratura of the San Carlo Opera Company, was heard from station WIP, Philadelphia. The career of this young American girl is being watched with much interest by connoisseurs of singing. WIP is to be congratulated on making it possible for a large radio audience to hear her.

but, in many instances, positive education as well.

But I acknowledge there is another side to the matter. I wish, of course, that the character of much of the music sent out through the air might be improved. In future this good may be brought about, not only by the improvement in the musical taste of the people, but also by the higher grade of artists performing.

This starts another and very vital question as to the remuneration of the artists. Where they give their time to music as a profession it seems highly unjust that they should not be paid for radio performances as for concert-giving. If such payment be not a regular procedure, then radio concerts will become merely a source of advertising to performers of immaturity or small reputation, who will take this method of making themselves known.

The radio, I believe, is merely at the beginning of its career, and what the future will show it seems impossible to predict. On the whole, I believe that it has already proved itself a blessing to many music lovers. If certain disadvantages have shown themselves, these may be remedied by concerted action on the part of radio stations, artists, managers, and the public itself.

This conclusion to a fair-minded estimate of radio in its relation to music, suggests what many of us believe to be the best method by which the present shortcomings in radio music can be done away with: "concerted action on the part of radio stations, artists, managers, and the public itself."

The only one among these influences that could work this reform, single-handed, is the public. But why wait for the public to take the initiative? Combined action would bring results much quicker.

Mrs. Beach has herself been heard over the radio, having broadcast a group of piano numbers some time ago from station WRC at Washington. Mention of this performance was made in the subsequent number of this magazine. To play for a radio audience was a gracious act on the part of this musician, whose symphonic works have been performed

—Belden, Newark

PERRY AND RUSSELL

If any monologuist of to-day tried to get away with that once popular hit, "You Can't Play Every Instrument in the Band," these clever chaps who are called, "The Two-Man Singing Orchestra" would have the laugh on him. They not only play all those instruments in the picture, but sing while they're doing it. If you happen to have a grouch when you tune-in on them they'll give you a quick hunch toward cheerfulness. They have been making life joyful for listeners-in at station WOR

by every orchestra of importance in this country, and by orchestras in Europe and in England; who has appeared as piano soloist with these same organizations; whose choral compositions have been sung by noted choruses under the direction of the ablest conductors; whose piano works and songs are featured on many concert programs; and who, for many years, has appeared on the concert stage as a professional pianist.

Some radio enthusiasts may think it a bit patronizing to say that it was "gracious" of Mrs. Beach to play for them. But let it be asked of such as these: How many musicians of fame equal to that of Mrs. Beach have you heard over the radio? Of course, you have heard certain celebrated artists when the public concerts in which they appeared happened to be broadcast. But that is quite a different matter from hearing these artists play from a radio studio to which they had gone for the express purpose of broadcasting. We have a notion that you can count the number of such artists on the fingers of one hand and not use all the fingers at that.

ROSE BROWN, LEADING LADY OF THE KGO PLAYERS

That lovely voice of hers prompted a rush request to station KGO for Miss Brown's picture, for we felt sure that anyone with such speaking tones would be good to look upon. A good guess, it proved as all will agree who see the above photograph

Radio Popularity on the Pacific Coast

WHEN E. M. B., of Gold Beach, Oregon, wrote the letter on Pacific coast broadcasting stations which was published in a recent number of this magazine, he probably had little idea of the protests he would arouse. Not that any one has disagreed with the fine things he has to say about KHJ, at Los Angeles, or with his comments regarding his enjoyment of KLK at Oakland, California, and CKCD at Vancouver. It is his estimate of KGO at Oakland that has raised the rumpus. He remarks, with finality:

> KGO is a wonderfully equipped and powerful station with splendid programs of a certain high class, but the people in general do not care for them. They are not interested in cantatas, radio dramas, or operatic singing. When listening-in with me, visitors often ask me to shift from KGO to KHJ, KFI, or KPO, and are better satisfied with what they receive.

Where E. M. B. makes his mistake is in confusing his friends with "people in general." It is, for that matter, a rather large order to utter an *ex cathedra* opinion as to what "people in general," think about anything unless by this term E. M. B. means that large mass of people who do not do much thinking on any subject.

Among those who have entered an objection to this verdict regarding the KGO programs is Mr. H. S. Gibson of Logan, Utah. After stating that, as a constant reader of RADIO BROADCAST and a loyal supporter of KGO he cannot let E. M. B.'s letter go without "considerable protest," he adds:

> In marked contrast to E. M. B., when we tell the neighbors that KGO has a play scheduled, we are forced to get extra chairs. Our children, and also the neighbors', recognize at once music by the Arion Trio or other performers that have been on KGO programs. These kiddies, all under thirteen, base their respective vocal or instrumental abilities largely as they have heard KGO performers. . . . My only regret is that KGO does not have a program every evening.

To which we wish to add personal testi-

mony to the effect that KGO is one of the very few radio stations putting on musical programs sufficiently well-balanced to hold our attention to the end. A good program is generally such throughout, and a popular program is complete in itself.

It is but another case of "many people, many minds." But it is always a bit dangerous to judge many people by a few minds.

Can Radio Artists Play Only Chopin and Liszt?

THERE is scarcely a broadcast station of any importance from which we have not heard times without number the second, sixth and twelfth Rhapsodies of Liszt, and his "Liebesträume." Why do we never hear any of his "Études"? Or the "Années de Pèlerinage"? Or some among his fifty transcriptions of Schubert's songs?

As for Chopin, he is played almost as frequently as Liszt, and represented within an even narrower scope. A few Nocturnes, with the hackneyed one in E flat major far in the lead; a Waltz or two; and those Impromptus of the kind within a conservatory pupil's ability . . . this is the radio Chopin, the petted darling of the Parisian *salon*. Yet he was one of the most superb among the Titans that have put pen to paper to express their thoughts in music.

—T. Kajiwara, St. Louis

MISS V. A. L. JONES

Program director and announcer at station KSD, St. Louis, is praised far and wide for the quality of her work

—Apeda, New York

MRS. H. H. A. BEACH

American composer of international renown who sees great possibilities in radio music

Numbers of pianists have been heard over the radio who seem quite capable of playing some of this composer's Études . . . the "Revolutionary," for instance. Likewise, the "Fantasie Impromptu," and the "A flat Polonaise." The former has been played, to be sure, but all too seldom. Yet many people are hungering for just that sort of music—people who were raised in musical centers and now live far from points where they can hear great music. To them the radio could and should be of a value it does not now fulfill for them.

So, to the pianists who are expecting to broadcast during the coming months, we suggest that they try giving their listeners some of the works by Liszt and Chopin that have not already been presented by radio times without number. Also we would suggest that they give some composers other than Liszt, Chopin, and Rachmaninoff a chance to be heard now and then. For instance, we suggest Mozart, Beethoven, Schubert, Schumann, Brahms—to name but a few.

Musical Parodies Should Be Announced As Such

IF ANY one recited over the radio a parody of a well-known poem it would be announced beforehand as a parody. Were the

changed version given without anything being said either by the announcer or by the one reciting the poem, those who listened would object to hearing the well-known verses given other than as the poet wrote them. Why, then, should such liberties be allowed in music?

The specific instance giving rise to this protest was the performance of a man heard from station WTAM, who was announced as "Our Wandering Musician." If memory serves rightly, he was from Punxsutawney, Pa. Well, he was a wandering musician, all right. He did not jazz the numbers he played, at least not those we heard, but he added to them at his own sweet will. Rubinstein's "Mélodie in F" lost all its simplicity and wandered to the upper keyboard far from the region where the composer placed it. Octaves and chords unknown to the original composition were added.

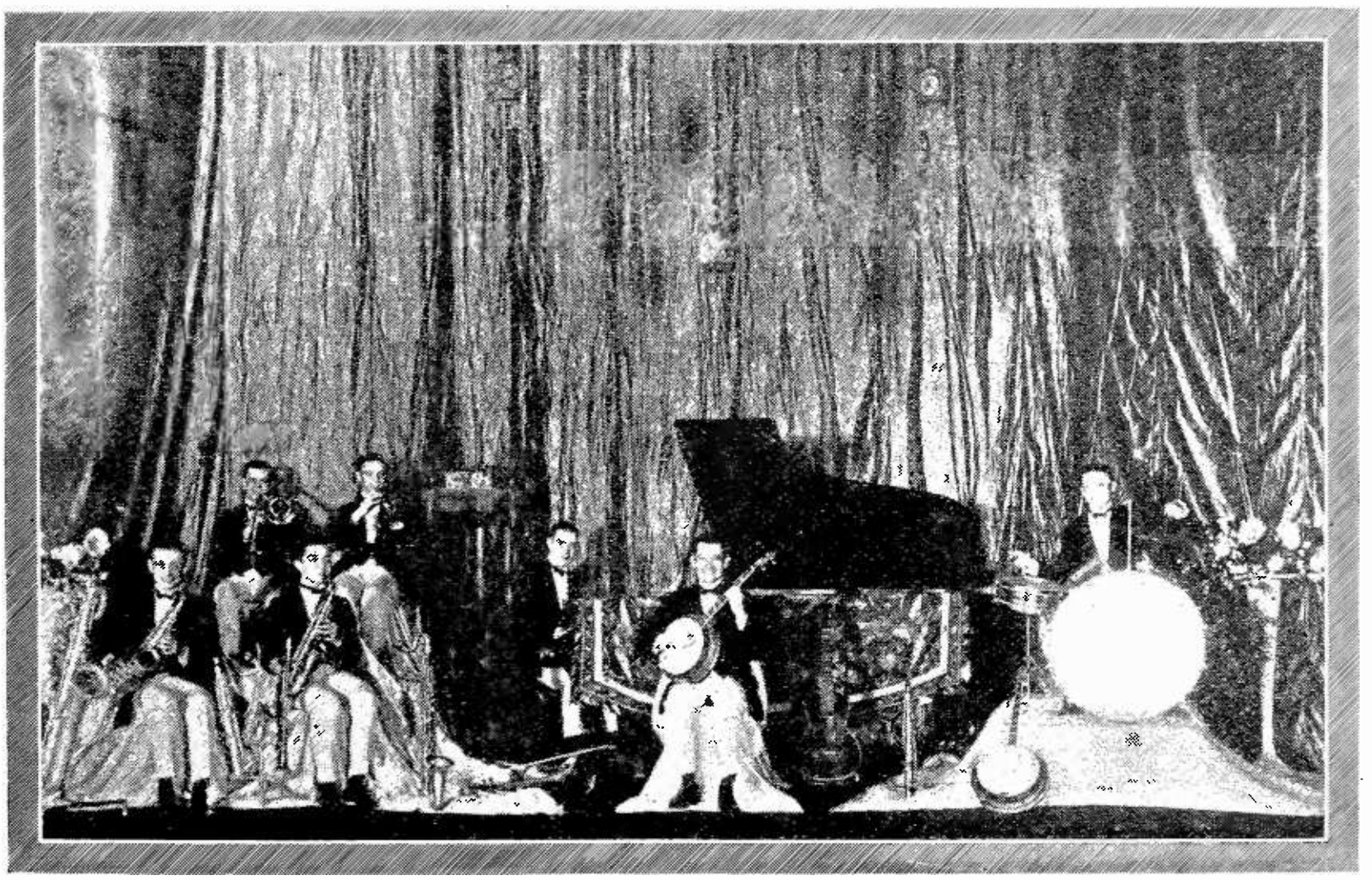
We hold that such performances should be announced as the performers' versions and not as the original compositions. Such versions are not unusual in concert programs, but when did one ever hear of their being played without the program bearing the explanation that they were adaptations?

How Dramatic Readers Are Rated at Station WWJ

IT WILL be recalled by those who read this department regularly, that in the number preceding this one, Mrs. R. J. Quien, dramatic reader of Camden, N. J., objected strongly to Mr. Corley W. Kirby, director of station WWJ, having said that he had never heard a woman reader over the microphone who was not "terrible." And she then and there issued a challenge to compete with any man reader at some leading broadcasting station, that the public might decide between them. She also said that as proof of her success, she would like to have Mr. Kirby see the letters of appreciation she receives after each broadcast performance.

To which comes the following reply from Mr. Kirby:

> I am sure that Mrs. Quien has received many letters from those who have heard her give dramatic readings. You can do anything over the radio and get letters of commendation, because the radio audience represents a better cross section of the American nation than can be obtained in any other way.
>
> The problem of the radio station is to please the



—Strentz, New York

HARVEY MARBURGER AND HIS KEITH VAUDEVILLE ENTERTAINERS

If you have seen the Cafe L'Aiglon in Philadelphia, you'll know that the exotic setting arranged for this orchestra is quite in keeping with the place where they play. And they can make even jazz sound better than it really is, a statement you can prove for yourself by tuning-in WIP

—Krumhar, Cleveland

MAURICE SPITALNY

Director of the Hotel Statler Concert Orchestra at Cleveland, Ohio, heard during the dinner hour through station WTAM. The excellent work of this orchestra under Mr. Spitalny's leadership has been frequently commented upon in this department

greater part of its audience with each concert, and I am sure dramatic readers are not able to measure up to this standard. Whether they are men or women makes no difference. In strengthening my position I ask this question: how many dramatic readers have you heard from any stage? Certainly, if they were a real attraction, the theater managers would have realized it long before this.

As far as the contest proposition is concerned, I would put it in the same class with other contests. In the end they mean little or nothing. If we had a contest calling for an expression on jazz and classical music, jazz would win out, because the people who prefer jazz to all else are just the type who would enter into a contest with gusto, while those who prefer classical music would say little or nothing about it. These people take no interest in contests, but when they like a thing they will write a good constructive letter, where others would fill out a form postal card. Radio contests reflect the opinions of the radio audience to a smaller degree than the straw vote reflects the political tendencies of the country.

I am willing to be convinced as to the value of dramatic readers as entertainers and the value of radio contests. I feel sure that the latter will not be held from the Detroit *News*, station WWJ.

Can't Telegrams Be Original?

HERE is a suggestion for some station that would like to start a competition in which the winner will receive a prize.

Why not give a prize to the first person who, in telegraphing congratulations on a program, says something other than:

"Program coming in fine. Keep it up."
"Program great. Keep it up."
"Everything coming in grand. Keep it up."
"Fine program. Coming in great. Keep it up."

Station WTAS, at Elgin, Ill., recently offered a prize of a $250 Shetland pony to the one who gave them the best suggestion for a new slogan, WTAS having up to that time meant "Willie, Tommy, Annie, Sammy." We missed hearing who won the prize. It was an easy way to earn a pony. For who is there who could not improve on, "Willie, Tommy, Annie, Sammy"?

It would be much more difficult, apparently, to earn a prize through sending telegram containing some original sentiment commenting on the program then being heard. For the present form seems to be firmly fixed in the minds of all and sundry who like to hear their names put on the air as "among those present."

Good Band Music Is Coming from Prisoners through WOS

COMPILERS of musical statistics will tell you that few musicians are found in our prisons in comparison with the number of criminals drawn from other occupations. Yet there is that band heard at stated intervals from station WOS, and whose members are all from the Missouri State Penitentiary. Their numbers never seem to grow smaller, although from time to time the personnel of the band must change owing to this or that member having finished his prison term. The band plays so well that it speaks badly for the morale of the musical profession. It was hoped, until that band was heard many times, that the statisticians were right. But now their authority seems doubtful. There is a psychological aspect of this band's performances about which one might write an entire article. For men who can play with such engaging spirit must have much of good in their natures. To be sure, the public performer who simulates an emotion

for the interpretation of the work he is giving, need not necessarily have experienced that emotion. But he must have the imagination to conceive of himself as having experienced it. In the case of a worthy emotion, the nature is not lost that has sufficient imagination to portray it with the right feeling.

The Dangerous Microphone

SINGERS who present the best songs to the radio audiences are almost without exception the singers who, of all the vocalists heard over the microphone, have the worst diction. They would do well to listen to those who present only popular songs of the day and learn from them something regarding correct enunciation. It is seldom that one word is indistinct when these latter singers are broadcasting, while with the former it is seldom that one word can be understood. In their case the only way one can tell what song is being given is by the melody.

Good songs will be more popular with all classes of radio listeners when those singing them make themselves intelligible. If these singers at present are unappreciated the fault is largely their own.

The microphone never fails to make known to the radio audience when a singer is off the key. Of late, some have been heard who never got the pitch once during an entire song, and were seemingly quite unconscious of this fact, or indifferent to it in the belief that it would not be discovered.

Radio can make a singer's reputation or it can ruin it. The singers of popular songs seem to realize this far more than do those others who are expected to be taken more seriously.

Score One for Women Announcers

THERE is more to be added to the discussion that has been going on in these columns regarding women announcers. Miss V. A. L. Jones, of station KSD, St. Louis, judging from the letters received commending her announcing, is not only in the lead among the women filling this position at broadcasting stations, but ahead of most of the men as well. And ahead of *all* the men, according to Mr. J. C. Porter of Amargura, 23, Havana, Cuba. It is a pleasure to print the following excerpts from his letter.

The object of this letter is to pay a well-deserved compliment to KSD's announcer, Miss Jones. There is much telegraphic interference here as well as the steady grinding static that prevails most of the year, and it requires an exceptional voice to cut through this mess and be intelligible. This, Miss Jones does. I can say as the result of more than a year's experience that there is not a voice coming from the States that we receive better than hers.

In this day, when RADIO BROADCAST is running a series of articles under the heading "Is Woman Desirable—Over Radio?" I feel that such a very fine radio voice as that of Miss Jones deserves a word of appreciation. . . . We are a family of "radio nuts" . . . have six sets, and get the latest thing on the market. There is at least one set going every night, the year round, and this letter in praise of Miss Jones is the combined opinion of our family, based on full three years of dial twisting. . . . Here's hoping that for

CORLEY W. KIRBY

Of station WWJ, Detroit *News*, who started something when he came out in this department against radio dramatic readers. Nor has he backed down an inch, as you will discover when you read what he has to say in this issue

many seasons to come we may enjoy the clear, measured, and cultured voice of the best announcer that we hear from the States.

A charming and intelligent tribute. May it influence some of the patronizing announcers to mend their ways. In particular that one in Chicago who, although he has some excellent points, spoils everything he does when, after saying they are signing off but will be on the air again in an hour, calls out with aggravating cheerfulness: "See you later!"

Pleasure Unique and Unexpected

ONCE in a while something so delightful in its character and in its unexpectedness happens over the radio that one forgets all the recent disappointments after one tunes-in. The most delightful of such experiences came when, upon tuning-in WEBH at Chicago, this was heard:

"We are now about to make a very important announcement although it may result in your missing part of our program. We want all of you who hear this to go to your north windows and look out. You will see the most beautiful aurora borealis that has been seen for many years."

And it was even so. There, in the northern sky, was one of nature's most wonderful miracles. And many, thousands upon thousands, no doubt, would have known nothing about it if it had not been for the announcer at WEBH. Some of us are still thanking him.

An Elephant Dancing Among Daisies

THE old saying about taking a sledge-hammer to drive in a tack was recalled when hearing a short time ago Mendelssohn's fragile, light-footed "Spring Song" played from station KFMX, at Northfield, Minn., on a trombone. Why any trombone player should choose such a number is beyond comprehension. An elephant trying to dance among daisies without touching one . . . that was how it sounded.

But there is no doubt that this particular trombone player could give his listeners much pleasure if he stuck to music that belongs to his instrument. The fact that he managed to cavort through the "Spring Song" proves this.

DURING a visit of the Memphis baseball team to Fort Worth the Rotary Boys' Band of Memphis gave a program from WBAP, the station operated by the Fort Worth *Star-Telegram*. They played better than half of the bands made up of adults, and here's congratulations on their work! Whoever is their director should also be congratulated. It was a real joy to hear such legitimate, sincere playing. And special mention should be made of the tone quality of the various instruments. For that, too, was unusually good.

IF, WHEN tuning-in a station it happens to be the moment when the announcer is speaking, one can tell almost instantly what station it is, provided it has been tuned-in before. For each announcer has a distinct individuality. But it is next to impossible to tell the station if music is going on when it is tuned-in, for the reason that most of the stations play the same things, night after night, week after week, month after month. But this state of things is going to change for the better. Put this down as a prophecy, if you wish. It is a safe prophecy.

THE frequency with which Edward German's "Three Dances from Henry VIII" are broadcast is sufficient testimony of their popularity with radio audiences. These charming pieces are especially well suited for performance by small orchestras, such as are maintained by radio stations; and the art with which they are often played by many of these orchestras speaks well for the performers.

It may interest listeners-in to know that Edward German who was born in England in 1862—was not named German at all, but Smith. It was Sir Alexander Mackensie, the British composer, who told the then young Smith that he could become famous by any other name, but never with the one he bore. As he was of German descent on the maternal side, Smith took the name by which he is now known. While he composed many works, he is now noted chiefly for his incidental music to Shakespeare's plays.

THE Piggly Wiggly Girls who are heard occasionally through KHJ, Los Angeles, can put up a pretty good program when they are so minded. There is an excellent violinist among them; they have some good pianists; and a number of the singers have more than average voices, well trained.

THE men whose broadcasting is confined to humorous monologues, or the telling of a succession of jokes, must have about the most difficult job of any among those who are regularly heard over the microphone. That most of them succeed in landing the point of the humor, shows them to be experts.

Can "Static" Interference be Eliminated?

Fertile Fields for Radio Experiment to Make Receiving Free From Natural Interference—Is Radio Development Tending the Right Way?—Some Concrete Suggestions of Great Interest

By WALTER VAN B. ROBERTS

THE season has just passed when our radio sets frequently produce horrible cracks and frying and tearing and grinding sounds, to the more or less complete destruction of any pleasure in listening to broadcasting. One can scarcely listen to these barrages of noise without trying to figure out some way to eliminate them. It is proposed to consider here just what methods for reducing this type of interference are feasible at present, and also to make a few guesses as to possible future developments.

The most obvious attack upon the problem is the increase of power used by the transmitting stations. If we imagine that on a certain day all broadcasting stations were to increase their power tenfold, what would be the result? Evidently the owners of receiving sets could reduce the size of their antennae very considerably and still get the same loudness of signals as formerly. On the other hand the static noises would be much weaker on account of the smaller antenna. Interference between one station and another would remain the same because the *relative* strengths of the signals would not be changed by increasing the power of all of them proportionally. This increase of power is a very attractive method for reducing static interference and is being made and will very likely continue to be made.

When an Expert Speaks

Walter Van B. Roberts is one of the ablest writers on radio today, as many of the readers of this magazine have often written us. He recently joined the technical research staff of the Radio Corporation of America at their special laboratory at the College of the City of New York. In this article, which is easily one of the most interesting that has appeared in any radio publication for a long time, the author discusses what is truly one of the most serious problems in radio. "Static" is one natural force that the best of radio engineers have had great difficulty in mastering, and the end is not yet. The elimination of static is a problem in which everyone is interested and Mr. Roberts's presentation of the problem and six definite suggestions for development is extremely clear in its technical phase and decidedly thought-provoking.—THE EDITOR.

Meantime there is an independent precaution that can be taken at the receiving end to reduce interference. That is, to use a receiver that has the best possible selectivity. There is a very definite limit to the selectivity allowable in a receiving set used for voice or music, for in order to receive these it is necessary to receive equally well not merely a single wavelength or frequency, while listening to a given station, but a "channel" of frequencies about 10,000 cycles (or 10 kilocycles) wide. For example suppose we wish to listen to station WOO whose frequency is given in the newspapers as 590 kilocycles. A receiving set that is so selective as to receive only this frequency would not be able to pick up voice or music from WOO. The set should be made so as to receive equally well, and all at once, all frequencies from about 585 to 595 kilocycles while listening to WOO. Furthermore if the selectivity of the set is to be the best possible, all frequencies below 585 and all above 595 should, at the same time, be completely rejected.

THE IDEAL RECEIVER

IN OTHER words the ideal receiver should be like a slit or a door that opens only wide enough to let in the desired music. (In order to carry out this simile, we may say that good quality music is about 10 kilocycles

wide, while 4 kilocycles is as wide a range as speech needs to be satisfactorily natural and understandable). If the door is not opened wide enough the "side bands" will be "pinched" and the quality of the received voice or music will suffer. On the other hand, if the door is opened wider than necessary there is just so much more room for the static to get in. The super-heterodyne is the type of receiver best adapted to yield the ideal selectivity defined above, especially at short wavelengths. In fact, practically speaking, it can be said that probably no other type of receiver can be made to come anywhere near this ideal for waves shorter than three or four hundred meters.

In connection with the advantage of the best possible selectivity, it is interesting to note a step taken by the American Telephone and Telegraph Company in their recent experimental transatlantic radio telephone work. By using what is called "single side band" transmission, the width of channel required is cut in half, so that if the selectivity of the receiver is correspondingly increased, only one half as much static can get in as is the case with the ordinary type of transmission. This advantage is not the only one offered by single side band transmission, but the difficulties attendant in producing the single side band, especially at short wavelengths, and the difficulty of receiving music by this method, prevent its general use for broadcasting at present.

GREATER POWER AT THE SENDING END?

THE increase of power of the transmitter and the increase of selectivity of the receiver are unquestionably feasible methods for reducing static interference. There are however many ingenious inventors who will not agree with the following rather sweeping statement: Suppose that a typical broadcasting station is working on a wavelength in the ordinary range. Now suppose that some one using any conventional type of antenna experiences static interference while listening to the broadcasting station. The statement is, that no "filters," "traps," double modulation schemes, or any other arrangements, no matter how complicated, can ever do any more toward reducing the interference than can be done by simply making the selectivity of the receiving set approach the ideal character previously described. This is merely another way of expressing the view that static can be considered to be a mixture of disturbances of identically the same nature as the signals, and hence that the portion of these disturbances that acts like signals lying in a given frequency range will inevitably be received by any set that is receiving signals in this frequency range.

WHY NOT CHANGE THE ANTENNA?

THE above statement might seem to indicate that there can be no cure for the trouble. However, there are several conditions mentioned in the statement that suggest new methods of attack. For instance, why must we receive with a conventional type of antenna? Why not devise a very "directional" antenna, that is, one that has to be accurately pointed in the direction from which the waves are coming? Such an antenna would pick up only the small fraction of static disturbances that acts like signals coming from the same direction as the signals we want to hear. The loop antenna has this directional property to a rudimentary degree and hence gives a slightly better signal-to-static ratio than the usual open antenna. It is hoped that the use of very short waves will make possible antennae having very high "directional selectivity."

Again, why do we have to stick to the ordinary range of wavelengths? It is natural to expect the static interference to be worse in some wavelength ranges than others, and it may well be possible to work down to a wavelength where the interference is negligible.

A NEW TYPE OF WAVE, PERHAPS

SO FAR we have met the enemy face to face and combatted him in a straightforward fashion. It is not impossible however that we might have been able to avoid doing battle at all. For, upon finding that natural causes were already ahead of us in producing a certain type of electromagnetic disturbance, we might have said to ourselves: "Very well then, we will invent for our purpose some other kind of disturbance, one that Nature is not already producing, and thus insure that we receive nothing except what we transmit." As an example of possible experiments along this line, we might try using horizontally polarized waves; that is, waves turned over on their sides, so to speak. Such waves are emitted from a loop with its plane parallel to the earth's surface. Another possibility would be circularly polarized waves. These are a little difficult to describe and it will be enough to say that they are to an ordinary wave what a corkscrew is to a wavy line, or a

curl to a simple "wave" in the hair. In any case the receiving set would have to be designed *not* to receive the ordinary type of wave at all. While the signal-to-static ratio might very likely be improved by the use of these particular types of waves, it is extremely unlikely that complete freedom from static would be attained.

UNDERGROUND TRANSMISSION

UNDER the general head of "avoiding battle" comes the idea of transmitting from one antenna entirely buried under the earth to another similarly buried. Transmission free from static has been reported by some experimenters using this method. The writer does not feel prepared to criticize the possibilities of this method, and only ventures to wonder whether the phenomenon of "total reflection" could play any part in it.

Summing up the whole subject, we do not see much hope of eliminating static absolutely, but believe it to be readily possible to reduce the interference to any desired degree by the use of the methods (no two of which are mutually exclusive) tabulated below in order of practicability and importance:

1. Increase power of all transmitting stations.
2. Increase frequency selectivity of receivers to the limit imposed by quality considerations.
3. Work in region of wavelengths that experiment shall have shown to be freest from interference.
4. Increase directional selectivity of receiving antennae.
5. Decrease necessary channel width by use of single side band transmission.
6. Use some type of electro-magnetic wave that is less used by Nature than the type now used for broadcasting.

LIEUTENANT LOWELL SMITH

Acting Commander of the United States Army World fliers, who recently completed their 'round the world flight. Lieutenant Smith is describing his experiences before the microphone at station WCCO, St. Paul-Minneapolis. WCCO was formerly known as WLAG. At several cities, notably at Boston and New York, when the fliers arrived, greetings and speeches were broadcast to them in the air, and the answers picked up by the microphones of a broadcasting station on the ground and rebroadcast to radio listeners

INDIRECT ADVERTISING

By radio is regularly achieved by this orchestra which plays popular and semi-classical numbers from station WEAF, New York. It is the B. Fischer and Company Astor Coffee Orchestra. This company, one of a considerable number now doing indirect advertising "on the air" pays a fee of a certain sum per minute for the use of the broadcasting station as well as the salaries of the orchestra. Radio advertising is a new field about which very little is known

How Will You Have Your Advertising?

The Radio Advertising Problem is Similar to the Newspaper's—Should Advertising Be Permitted on the Air?—How Does the Public Like Ether Publicity

BY JAMES C. YOUNG

WHEN Mr. Householder hurries home in the evening from a day's work and sits down beside his receiving set, his face does not always reflect that peace and pleasure that passeth all understanding, usually associated with radio. He is likely to get in touch with a station which has just announced that, "Mr. Albert Wagh of the Baked Bean Corporation of America will now describe the scientific preparation of the bean, from pod to pot."

This is publicity. Radio users throughout the nation, a large percentage of American advertisers, and all who come in contact with the public mind, are wondering just how far publicity can be carried in the field of radio. On that question will depend the future development of broadcasting, perhaps in a broader measure than any other one consideration. It is undeniable, of course, that no particular reasons exist why broadcasting stations should furnish a daily program of entertainment to the American public without any kind of compensation. Naturally these stations derive a reflective prestige which frequently is sufficient to warrant their maintenance, as in the case of department stores and similar establishments. But the fact remains undisputed that the man with a $5 receiving set is the one who enjoys the greatest benefit.

How can the broadcaster be paid? So far but one dependable method of return has been evolved, and that method is publicity. There are many shades of opinion as to what the public thinks about this intimate association of advertising and radio entertainment. A majority of the men who have studied the matter from the broadcaster's point of view assume to believe that the American radio audience, represented by three to five million receiving sets, does not particularly care whether the programs it enjoys are made available by direct or indirect advertising. But the statements of radio followers themselves show that there is a considerable and growing prejudice against the type of program in which the genesis and descent of that baked bean are discussed too extensively.

One large station that has broadcast publicity with marked success recently took a poll on the problem of publicity among 25,000 persons owning radio sets. The directors of this station concluded that the quality of entertainment was the determining factor in bidding for the radio public's favor, rather than the question of publicity. Just how far that conclusion can be trusted is a matter not easy to decide.

Advt.

Of late, there has been considerable discussion among radio listeners about advertising on the air. We have heard much that is pro and much con. There is a great group of the radio audience who contend that if radio programs are good in both content and execution, it doesn't make any difference to them if they are an advertising feature for some firm or other. Others feel, among them, the powerful American Radio Association representing many listeners, that the air should be free of all advertising. For many years all periodicals have been required to indicate that material appearing in news columns which is advertising must be so labelled. "Advt." has so become a very familiar abbreviation to newspaper readers. We think the question should be thoroughly discussed, and the opinions of listeners clarified and expressed, for that will make it easier for all. RADIO BROADCAST will publish some of the best letters received from readers on this subject.—THE EDITOR.

IS PUBLICITY ALL RIGHT IF VERY GOOD?

WITH a numerous group of broadcasters accepting pay for the privileges of their stations it is not difficult for them to become convinced that the public has no strong objections to this practice. It even seems reasonably true that an excellent quality of entertainment will go far to neutralize opposition from listeners. If these matters are granted, we still may doubt that the great average of American radio followers will be content with programs in which the flavor of advertising is becoming steadily more perceptible.

The broadcaster may well ask how he can obtain revenue by other means. That is a phase of the situation closely allied with publicity, but it is not the immediate subject under discussion, nor can it be looked upon as the weightiest factor in broadcasting. This great enterprise has assumed a semi-public character and the stations of the nation are regarded as semi-public institutions, in the same way that newspapers and periodicals often become a vital part in the life of the times. If a newspaper or magazine, honored with the respect and confidence of the public, should so far misconceive its mission as some radio stations have been known to do, the result could not be long if it is a doubt. Broadcasters of trained perceptions admit this view, and maintain that every station must stand or fall by the rule of its own conduct. That is an excellent answer and not improbably the solution of publicity in the air.

It is not an easy matter to conduct a broadcasting station. Judging from the number of those who rush in where the initiated tread with care, a wide impression exists that the only requirements for success are represented by a microphone and a few entertainers. But the record of survival indicates that broadcasting requires something more. That something might be called a large endowment of ingenuity, because the typical program director must be ingenious indeed—if not a genius.

Within the last two years more than 1,000 government licenses have been issued to broadcasting stations. At this moment but 535 are in operation, surely a prodigious number, but still these are a mere half of those established in this short span of twenty-four months.

What became of the others? That is one of the unwritten chapters of radio, which might afford much profit to those who contemplate entering upon the high adventure of broadcasting. About sixty of the 535 surviving stations are now interlarding pub-

licity with their usual programs. These sixty stations are among the largest and best organized in the country, so it is a fair assumption that the principal support of broadcasting to-day comes from paid publicity.

ESSENTIALLY BROADCASTING IS PUBLICITY

THE definition of paid publicity is used advisedly, for some of the men identified with radio argue that the whole broadcasting activity has been built upon the theory of publicity, and maintain that the question whether this publicity benefits a station or is bought by some one using that station, does not really matter.

But there is a difference between the kind of publicity which a station obtains and the sort that deals with baked beans at so much a minute. The privilege of addressing a radio audience is worth anywhere from $40 to $600 an hour, and the man who buys even ten minutes will strive hard to sell something in his allotted time.

This question of "selling something by radio" is a particularly annoying thorn. No matter how ably theories may be argued, it is past dispute that the man who puts on his slippers and lets his mind drift away with radio, does not want to have a salesman's patter drummed in his ears. The direct sales appeal seldom is permitted by radio. Happily that has been true in a large measure, but selling organizations everywhere are turning intensive attention to the possibilities of radio campaigns. The appeal to buy seeps through the air more clearly every day. The man we have imagined in his slippers always has the opportunity to turn a dial and usher in another thought, a privilege that he undoubtedly uses to excellent advantage, but if there is to be no intelligent check on publicity, the day does not seem far distant when it will be difficult to tune-in a program without unpleasant advertising features.

VARIOUS ARE THE USES OF PUBLICITY

THERE are many sorts of publicity. Every one is familiar with the discourse on baked beans and other subjects of the kind. Then there is the variety of publicity which

THE RADIO STUDIO

May become as much a battleground for advertisers as the pages of the daily newspaper or the magazine. There are those who contend that all broadcasting is advertising for someone, and that it is merely a question of who shall be advertised and in what way. Secretary of Commerce Hoover says "the quickest way to kill broadcasting would be to use it for direct advertising." In any event, it will be the listener who decides whether or no he will countenance radio advertising of any sort. The photograph shows the studio of KGO at Oakland

radio followers themselves do not always recognize. Upon the principle that ignorance is bliss, this particular phase might seem beyond objection. The man with a radio set will not resent an announcement in which the name of some New York hotel is called to his attention by the information that its orchestra will now play for his edification. There has been a lively competition lately among hotel orchestras of the metropolis for this privilege, and some of the big hostelries are paying monumental fees in order that their names may be associated in the public minds with superior musical organizations.

THE HAPPINESS BOYS

Give a weekly program from WEAF, New York, which is an excellent example of what many consider a quite inoffensive form of indirect advertising. The only mention made of Happiness Candy Stores, which they represent, is at the start and finish of their half-hour program

This is publicity in its least objectionable form. Another variety that seems to pass muster is the address by some life insurance executive or banking official who treats of matters which lie close to the public interest. Usually the only advertising consists in the linking of names which join the company and the speaker while thousands of persons pay heed. Many of these radio addresses are so well delivered that they represent a public service rather than a private gain, no matter how large that gain may be. Other addresses are boresome to the point of drowsiness, but it does not take long for the radio follower to apply the proper and inevitable remedy.

Publicity falls into a third classification, which is insiduous and subject to criticism, the kind of publicity where the object of the speaker is withheld, seeking by adroit means to inveigle the public mind. An illustration might be found in a number of addresses delivered not long ago on the subject of a great water power development, for which public support was needed. It may be questioned whether some of the stations concerned recognized this theme as publicity, because it bore none of the usual ear marks. Program directors are ever on the alert against the man who endeavors to use their stations for publicity without pay. Perhaps some of these water power addresses were paid material; others were not. But the way in which they cropped up across the country left little doubt in the minds of shrewd observers that interest in water power served a broader purpose.

With the development of publicity we also have had the introduction and rapid advance of the radio publicity agent. He is now an established institution and likely to become as colorful a personality in the field of radio as he long since became in the domain of the press. Indications are that he will not have a higher repute in his new vocation than he has had in his old.

There is another side to radio publicity which deals frankly and wholly with advertising in its customary and recognized forms. It is said that some twenty or twenty-five of the principal advertising agencies now maintain departments which deal exclusively with the sale of merchandise by radio. Their methods are less subtle than those of the publicity agent who organizes a campaign which evolves around some public question, such as the water power rights. But let us assume that an advertising agent is retained to make popular a particular kind of silk. His first step would be to copyright some attractive name for his merchandise. Then he might send out a recognized fashion designer, delivering talks across the country on the charm of the season's new styles in silks, particularly that silk into which had been woven the skillful threads of advertising.

It is within reason to believe that all of the women who listened to one of these fashion chats would find no fault with the advertising flavor. One trained observer of public inclinations pointed out that women read the daily bargain advertisements with as much or more interest than any other section of the daily press. Therefore, why not an equal interest in styles by air?

If the answer be affirmative, it is only another step to conclude that bargains by air might be acceptable to a numerous section of radio followers. This same man, who knows all about the minds of women, even ventured the suggestion that a time would come when broadcasting stations could be operated solely for the purpose of announcing sales and fashions and such things.

Endeavoring for a moment to look down the opening vista of time with the eyes of this commercial prophet it is interesting to follow up the suggestion. If a mail order concern in Chicago made a regular Monday night announcement of special buying opportunities, it would be able to reach a multitude in ten states around, accomplishing in ten or fifteen minutes with the voice of one man what would require great organization and the applied efforts of many workers, by any other means. Although we may safely conclude that this broadcasting of bargains lies somewhat in the future, it is a possibility not to be lightly dismissed.

Broadcasting is such a comparatively new field of endeavor that its principles remain undefined and its development must be yet measured. Much of the uncertainty and many of the objectionable qualities which characterize radio were present in equal or greater measure when the automobile and moving picture industries first began their amazing expansion. Wherever there is haste and stress, there also must be growing pains. But the lusty vigor of radio and its broad application furnish abundant guarantees that its difficulties will be solved.

In the meanwhile the publicity agent is busily engaged at his task. At least two or three radio booking agencies have come into existence which undertake to obtain a hearing for any particular kind of baked beans or some new fabric, by addresses and other devices employed from station to station. These booking agencies have worked out a schedule on much the same principle as theatrical agencies. A speaker leaving New York, let us say, will travel to Cleveland, then Chicago, perhaps Omaha, and so on to the Coast, returning by the Southern route. He will "play one night stands" and allow a few days between each address so that the tenor of his arguments do not become too familiar.

This fall has witnessed an interest in radio never before approached. It is not so long ago that observers asked if radio had come to stay and could maintain itself as an entertainment against the many other forms of appeal for public attention. That question seems trite now, although it involved serious consideration but a short while ago. With the new assurance that radio has become a definite part of American activity, men who study publicity and advertising in its varied phases have centered their efforts upon reaching the public mind by means of the microphone. And they are succeeding in a degree which opens to the broadcasters an immediate and incalculably rich source of revenue. Shall we blame the broadcaster for extending his hand to those who urge pay upon him when he has no other means of obtaining a return? Certainly this presents a case where the broadcaster must be more than human to decline. Once more the ethical and the practical clash.

The American newspapers formerly were blighted with the same sort of shadow that hangs over radio. Almost any average newspaper of fifteen or twenty years ago was

Herbert Hoover Says—

I believe that the quickest way to kill broadcasting would be to use it for direct advertising. The reader of the newspaper has an option whether he will read an ad or not, but if a speech by the President is to be used as the meat in a sandwich of two patent medicine advertisements, there will be no radio left. To what extent it may be employed for what we now call indirect advertising, I do not know, and only the experience with the reactions of listeners can tell. I do not believe there is any practical method of payment from the receivers. I wish to suggest for consideration the possibility of mutual organization by broadcasters of a service for themselves similar to that which the newspapers have for their use in the press associations, which would furnish programs of national events and arrange for their transmission and distribution on some sort of a financial basis, just as the press associations gather and distribute news among their members.

It may be that we cannot find a solution at this moment, but I believe that one result of this conference should not only be the consideration of this question but the establishment of a continuing committee for its consideration."

—Herbert Hoover, Secretary of Commerce, in his opening address to the third annual radio conference in Washington.

crammed with advertisements of patent medicines, liquor of many sorts, and other questionable advertising material. Then public sentiment and the perception of publishers began to raise up a barrier which has become higher than any man might have hoped. Whiskey advertisements were the first to feel this influence. Regardless of the virtues or lack of virtue involved in prohibition, sentiment agreed that the widespread advertising of whiskey was a bad thing. Even before prohibition, it was unusual to find such advertisements in the best papers. Patent medicine advertisements are disappearing. The really representative institutions of the American press exercise a more rigorous censorship over their advertising columns than any public agency could possibly put in effect. The lowly bill-board is hard pressed for its very life.

Along with the change in advertising came a decided improvement in editorial columns. The noxious "reading notice" of yesterday is almost unknown now, not only because of an ethical advance, but for the excellent reason that Congress passed a Federal statute requiring every paid article or card to be plainly marked advertisement. That law, which was stoutly contended against by many publishers, proved one of the wholesome influences brought to bear on American journalism.

To-day the question is asked if radio broadcasters should not be subject to some similar restrictions. What could be lost by a Federal statute that would compel announcers to specify advertising features on their program? This need not take an offensive form, no more than the word advertisement at the top of a newspaper column prevents readers from perusing its contents.

We are a nation of advertisement readers. Advertising long since emerged from the day when it had anything to conceal. Men who value highest the prestige and future of radio have taken note of this similarity and the question is one that will be repeated oftener—why not plainly label each program number that deals with advertising? Then the question of faith between the broadcasters and the public would be effectively settled.

There is distinguished opinion on the side of permitting radio advertising to find its own level. Secretary of Commerce Herbert C. Hoover is one of the men who inclines to this view. In a conversation not long ago with Paul B. Klugh, Executive Chairman of the National Association of Broadcasters, Mr. Hoover repeated previous statements that he saw no reason for a censorship of radio publicity.

QUICK REACTION FROM POOR PROGRAMS

"IT HAS been the experience of broadcasters that the public interest centers on the kind of entertainment provided, regardless of advertising," said Mr. Klugh. "If any station permits an advertiser to broadcast poor entertainment, both the station and the advertiser suffer. There never is much question about the reaction from a campaign of this sort. When uninteresting and badly devised, the station which permits it to go on will not be slow in hearing from followers. Methods of measuring this public reaction to any kind of appeal have become so definitely fixed that we may safely leave the problem of radio publicity in the public's hands.

"Personally I see no reason why radio publicity should be objectionable merely because it is publicity. There may be causes of specific complaint, but it is certain that no worthwhile station would permit questionable material to be radiated, once the character of this material had been established.

"Broadcasting stations are becoming so jealous of their reputation that they closely scan every number on their programs. Should any of these numbers offend public taste, the stations themselves would be the quickest and surest sufferers.

WENDELL HALL

A radio entertainer who is nationally known. He has appeared from many stations in all parts of the country accomplishing "indirect advertising" for the National Carbon Company

PAUL B. KLUGH

Executive Chairman, National Association of Broadcasters. Many of the associated broadcasters of this organization will accept radio bookings of artists or speakers who are employed to appear before the microphone in one of the various forms of indirect advertising now going out on the air. Mr. Klugh believes that a certain form of indirect advertising will be quite acceptable to the listener

"It is not enough to avoid offence; a station must always command the interest of a multitude, and we may be certain that this command is impossible when advertising material becomes uninteresting. There is no audience more exacting than that which sits at home with perhaps a dozen radio stations in easy reach. I think we need have no fear that programs will tend to the boresome or questionable so long as a man need but shift a dial to change his entertainment. It seems to me that the law of preservation and the unfailing exercise of public choice will serve to control radio publicity better than any other means we could devise."

But in any case, the listener-in himself will decide the fate of radio advertising. In this matter as in many others, it takes a considerable time for the feelings of the public to be definitely manifested. It is often difficult even to know exactly what the proper interpretation of "the public reaction" is.

RADIO BROADCAST is interested to know what its readers think of the question Mr. Young has so ably treated. A few of the best letters expressing a reasoned opinion will be published in later numbers of this magazine. Address your letters to THE EDITOR.

PRESIDENT COOLIDGE

And Secretary of Commerce, Herbert Hoover, in the grounds of the White House. President Coolidge is addressing the members of the Third Annual Radio Conference. The President described the advancement of radio as "one of the most astonishing developments in the history of science." He said radio offers the Government one of the greatest problems it has had to face, and that little change would be made in present policies. There would be no monoply of the air, he declared

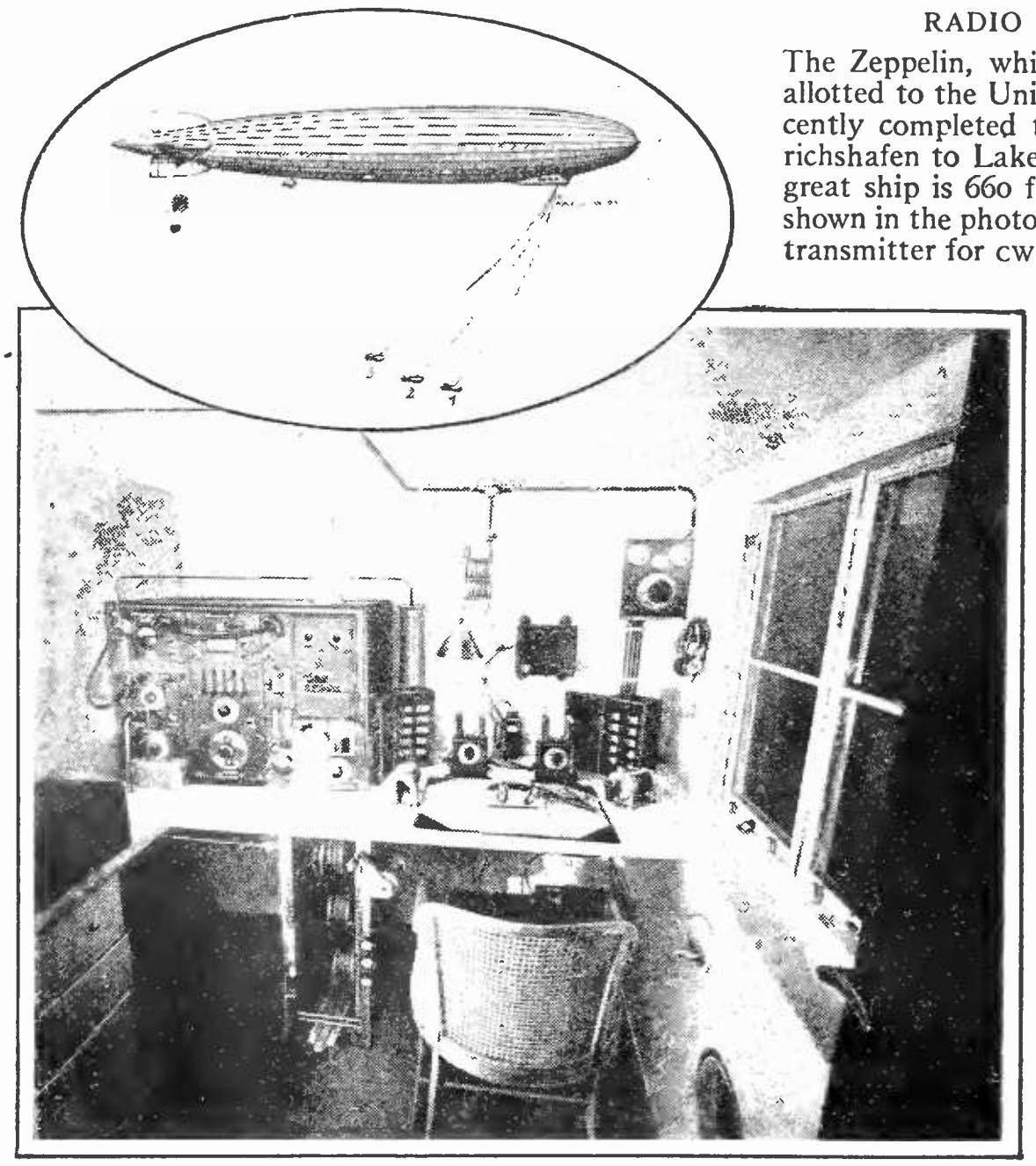
THE MARCH OF RADIO

By J. H. Morecroft

President, Institute of Radio Engineers

What the Hoover Conference Did

THOSE who like to criticize Cabinet officers in the present Republican administration seem to have avoided Herbert Hoover, the able Secretary of Commerce. Almost everyone feels that Secretary Hoover has done an excellent job. And few groups feel that more strongly than the radio folk. Mr. Hoover has been in office during one of the most difficult times possible from the point of view of radio. During the early months of his office, broadcasting began with the licensing of the station of the Detroit *News*, WWJ, and KDKA, the Westinghouse station at East Pittsburgh. Troubles and complications and problems of all kinds descended upon the Department of Commerce thick and fast from then on. The best tribute it is possible to pay Mr. Hoover and his subordinates in office is that they have managed radio affairs with the least possible friction and



RADIO ABOARD THE ZR-3

The Zeppelin, which the Reparations Commission allotted to the United States Government. She recently completed the 5,060 mile flight from Friedrichshafen to Lakehurst in eighty one hours. The great ship is 660 feet long. Her radio equipment, shown in the photograph, consists of a 200 watt tube transmitter for cw and telephone, operating on 1510 meters. The fan antenna is dropped through the deck of the forward gondola, where the radio apparatus is located. The wires, each 400 feet long and weighted at the end, form a fan, as the insert of the ship shows

a great deal of tact. The regulation of radio is a complicated matter indeed.

For the last three years, there has been an annual conference to discuss and make definite recommendations about radio, called under the auspices of the Department of Commerce. Here, the lambs and the wolves have laid down together, bitter enemies have watched each other, pleasantly enough, across the quieting green baize of the conference table, and progress in the radio field has been constructively guided. The Department of Commerce radio regulations have very largely been formed from the wise suggestions of these conferences.

The Third Annual Radio Conference at Washington this year was as widely attended as those which preceded it, and although it is a bit early to draw conclusions, we think it accomplished quite as much if not more than the first two.

A brief summary of the recommendations of the Conference follows:

The amateurs are to be given a new series of wave bands, somewhat lower than those to which they are at present entitled. They are to be permitted to operate continuously, for it is believed that such operation will in no way interfere with other services. The amateur showed his willingness to coöperate by volunteering to abolish the use of spark transmitters and discouraging the use of oscillating receivers within the broadcast range. The latter is particularly important because it means that interference from squealing receivers will not exist so far as the amateur is concerned on the short waves to be used for rebroadcasting.

Ship transmitting waves are to be pushed up beyond the broadcast zone, and thus another form of severe interference has been greatly reduced. A general revision of the licenses for various types of broadcasting stations will, it is believed, result in a great improvement in broadcasting conditions.

Perhaps no one decision of the conference was more important, or considered more thoroughly, than the proposal to establish super-power broadcasting stations in several parts of the country which should be capable of broadcasting important events to all parts of the country simultaneously. There was so much feeling in favor and so much opposition to this proposal that a compromise was effected. This provided that any individual or company may apply for a license for such a station. The license will be an experimental one and is immediately revocable by the Department of Commerce if such a station interferes with any service already existing.

Such an experiment is of great importance. Several companies are ready to undertake it at once. Super-power and the victory or defeat of a group of influential radio men now hangs

in the balance. By all means let us have a fair trial and judgment of the case on its merit alone.

These are the most important recommendations of the Conference. Their crystallization and enforcement now lies with the radio service of the Department of Commerce. Most of the detail work yet remains to be done. And it is left to a pitifully undermanned and pitifully underpaid department to do. The radio service of the Department of Commerce has done marvels when one considers the handicaps under which they have always worked. Congress has steadily refused to make any appropriations other than those covering the bare necessities of operation. The entire personnel of the radio service has been for a period of years taxed beyond its strength.

If no other good results from this latest conference, it is to be hoped that there will have been spread about a greater appreciation for the level-headed, highly conscientious, far sighted men in the Department of Commerce and the Bureau of Standards.

Aside from the technical findings of the Conference, which were much more involved than those considered at any previous conference, there was one outstanding beneficial result. Radio men and women from all sections of the land met and ironed out their difficulties and got away to a new start. In this respect, the Third Radio Conference was strikingly successful.

amateurs who have been experimenting with short waves agree that we know but little about their proper use. One of the principal reasons for the increasing popularity of such experimenting is unquestionably due to the fact that much publicity has resulted from the experimental broadcasting on the shorter waves by the Westinghouse and the General Electric Companies. As a result of this publicity there has been a demand on the part of listeners-in to procure receivers capable of receiving these broadcasts for which many startling claims have been made.

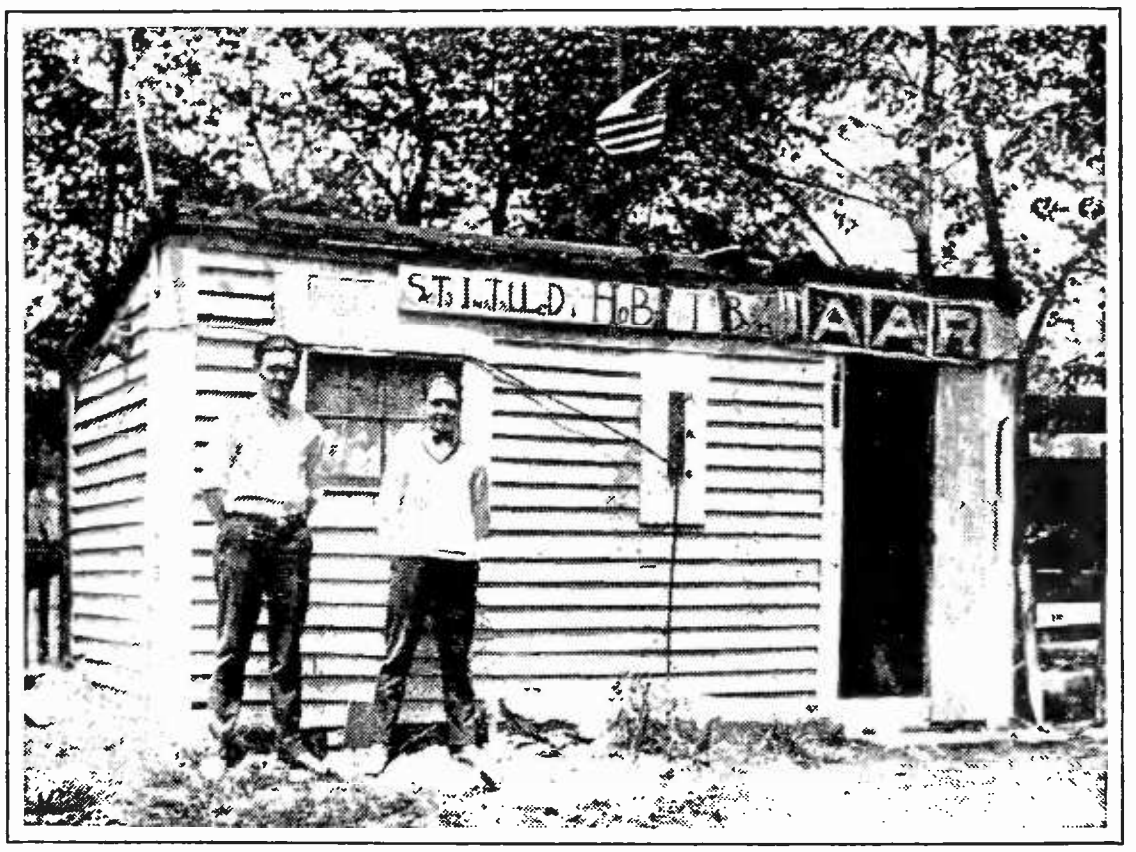
Following this demand there has been the usual group of short-sighted manufacturers who have endeavored to "cash in" upon the demand. The simplest form of receiver for such operation is the common regenerator—with a few slight alterations—which has come in for so much condemnation in these columns because it not only is a receiver, but a very good transmitter when operated in its most sensitive condition.

In short wave broadcasting, we saw a means of sending programs to a group of stations, if proper facilities could be arranged. These broadcasts could then be picked up and rebroadcast on the waves we are accustomed to employ. Indeed, the experiments conducted by the two corporations to which we have referred have proved this to be so. But we foresaw in the ordinary type of regenerative receiver a menace even greater than when used on the regular broadcast waves. For this

Short Waves Should Be Conserved

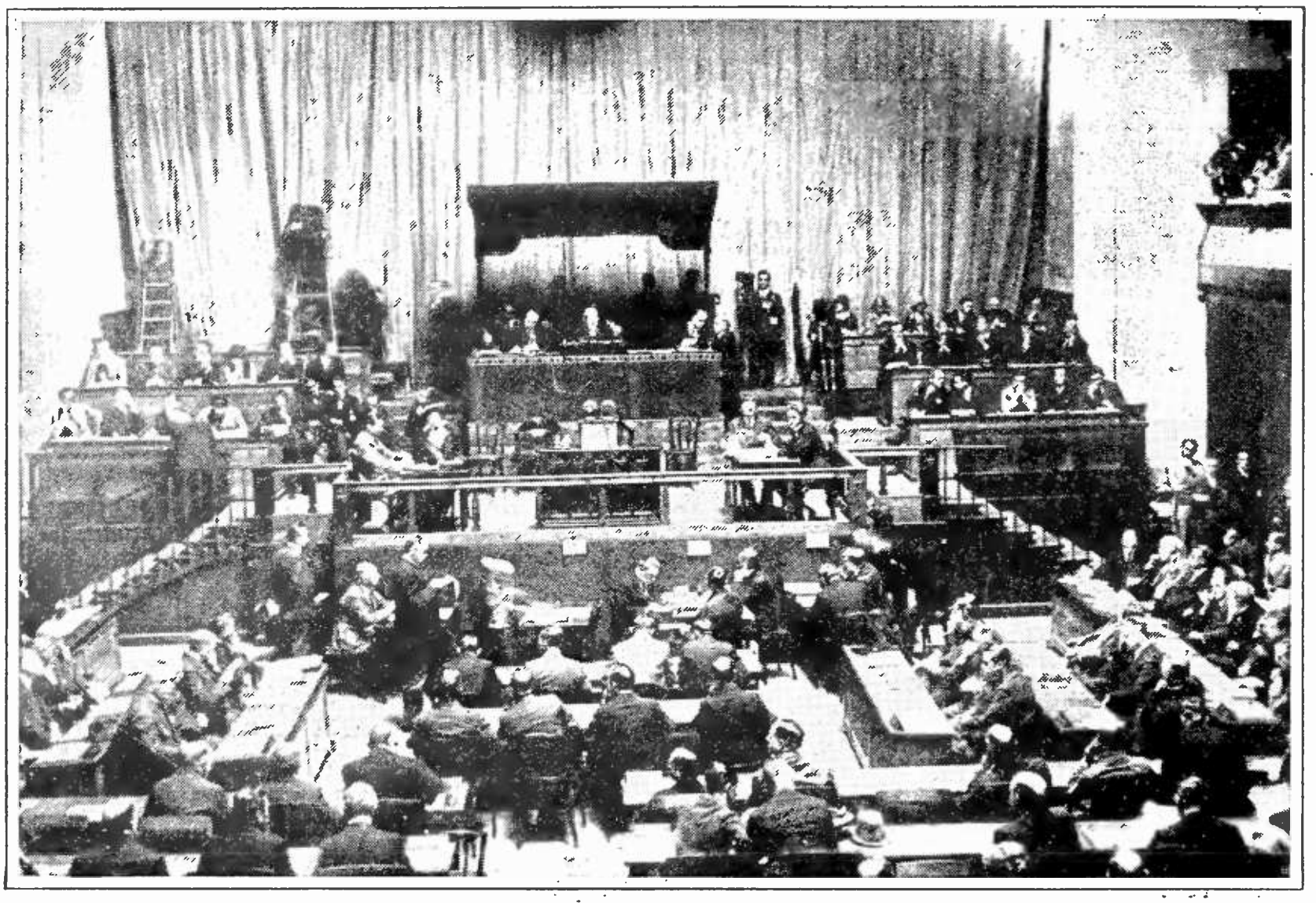
THE world's record for long distance communication was broken by a pair of amateurs, a Californian and a New Zealander, a short time ago. They carried on intercommunication at a distance of 6,900 miles for more than an hour employing short waves. There is something of more importance in the accomplishment of this remarkable feat than appears on the surface—something more than the mere fact that a new record has been set up.

Most engineers and most of the experienced



RUSSELL AND STUART HOBART

Of Roslindale, Massachusetts, outside of their amateur station 1 AAR from which they recently communicated with amateurs in the Netherlands.



THE LEAGUE OF NATIONS IN SESSION

At Geneva. The President of the Swiss Federated Republic is presiding over the meeting of the General Assembly. Four microphones can be distinctly seen on the rostrum from which the proceedings were sent out for the first time

reason no "how-to-make-it" articles in RADIO BROADCAST describing one of these abominations appear.

Let us be more explicit. Nearly everyone who has listened-in on a radio receiver has at one time or another had a good concert ruined by some improperly operated oscillating receiver, operated in his vicinity. In this case the interference from the offending receiver is confined to the neighborhood in which it is operated, which is bad enough. Where short waves are used in place of wires to carry a concert from one point to another where it is to be rebroadcast, it is but necessary to have one such improperly operated receiver completely to ruin reception for those, not only in the immediate vicinity of the offender, but for all served by the station doing the rebroadcasting.

It was not until we could perfect a receiver capable of efficient operation on short waves without causing interference that we would publish any instructions for building receivers with which the short wave broadcasts could be picked up. It is particularly gratifying to us, therefore to have designed the receiver with which this remarkable record was made. Perhaps some of those readers who were somewhat disgruntled at our deliberate refusals to give them the information on such receivers they sought most diligently will now appreciate the reason for our stand. If they do not, we feel perfectly happy in having endeavored to serve the greatest number to the best of our ability. Needless to say we are deeply grateful to Mr. W. B. Magner, the Californian who made the record with the Roberts short wave two-tube receiver described by Zeh Bouck in our August number.

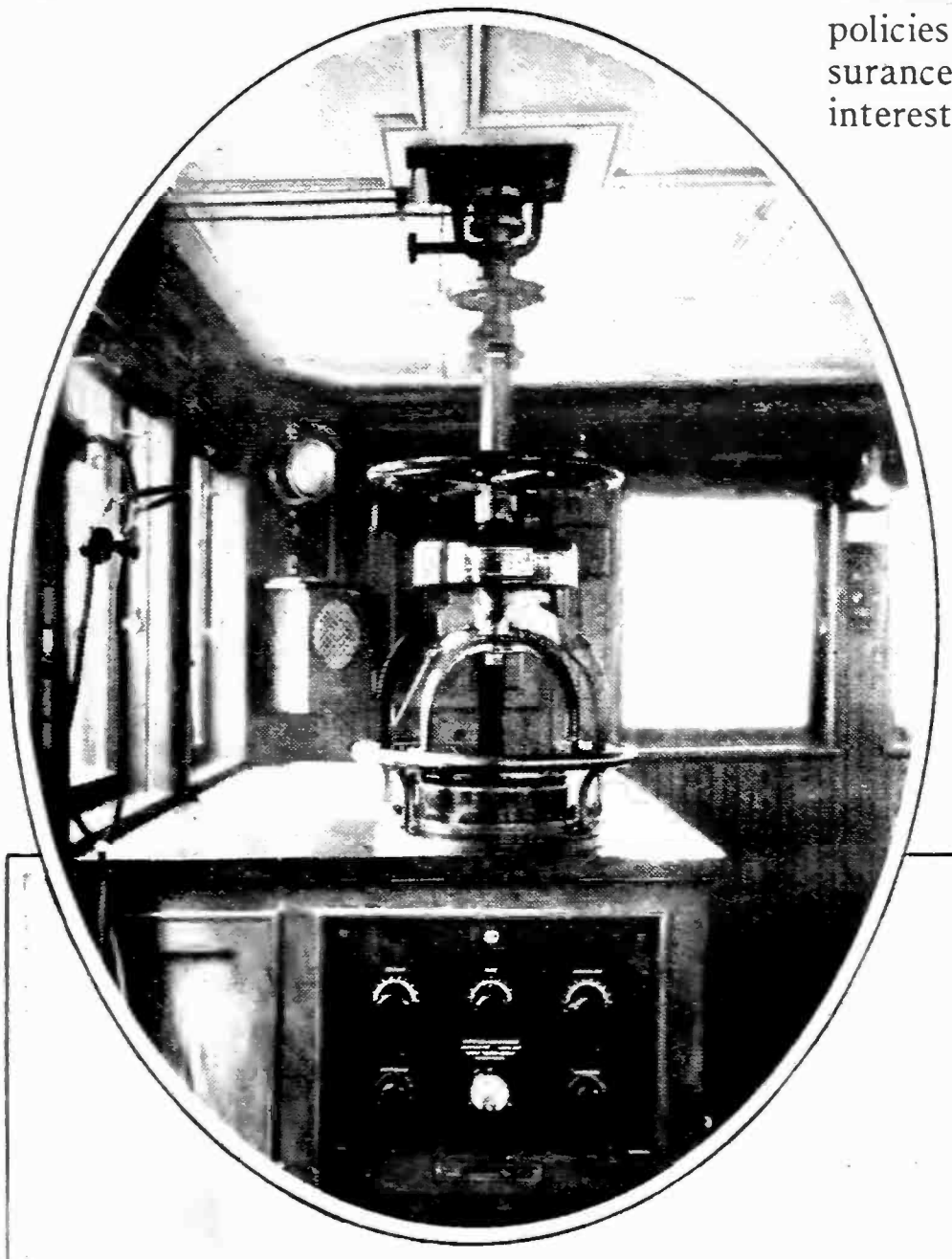
Farmers Really Use Radio

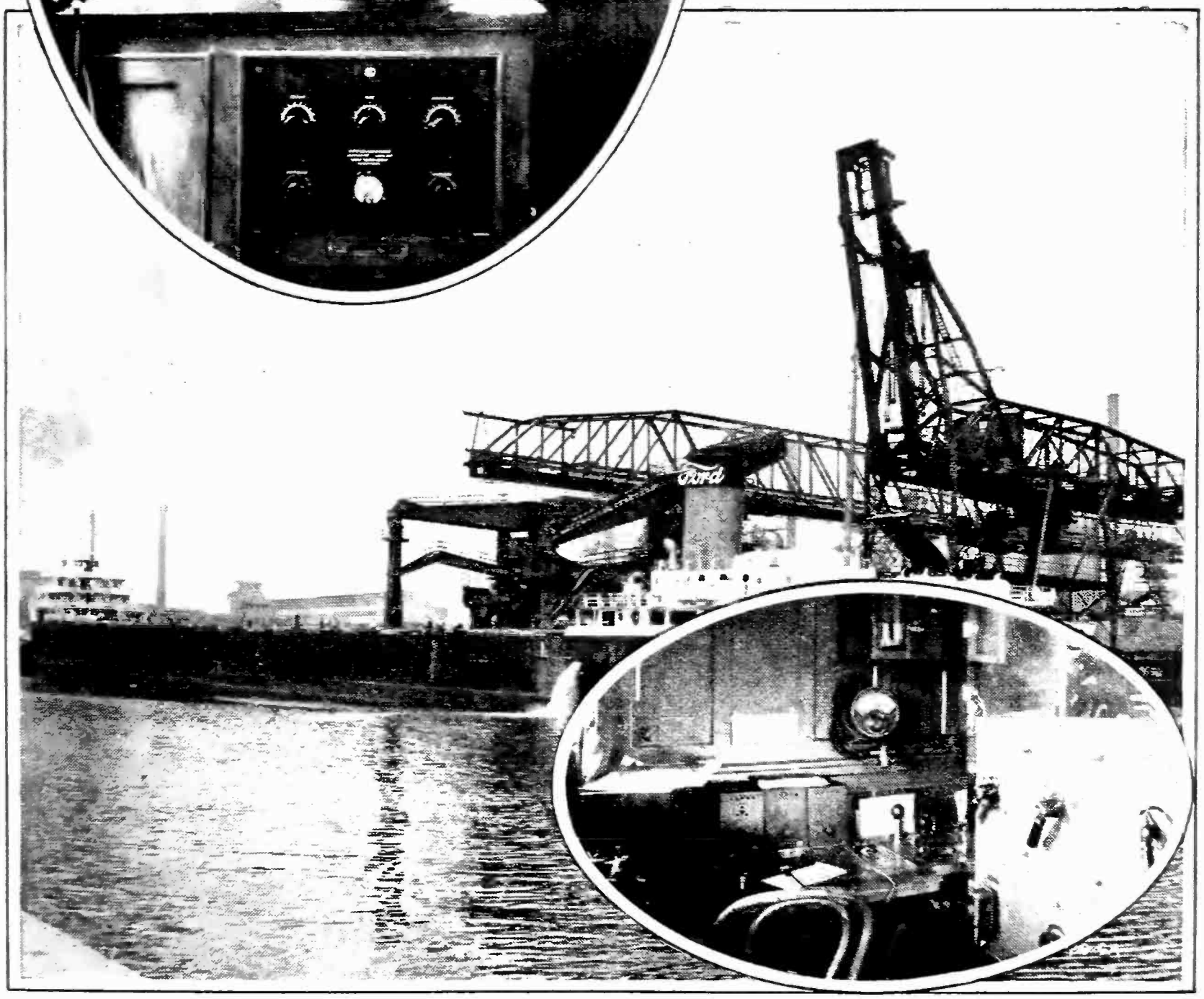
WE HAVE often speculated on the farmer's use of radio, assuming that market reports and similar news items over the radio channel must be of real value to him. Thus far the farmer has not been very effusive in expressing his appreciation of the "farmer's radio channel." A news item from Milwaukee states that the farmers in the neighboring section have banded together to prevent the erection of electric power lines through their property, claiming that the presence of the high power wires "would make

it almost impossible for them to receive market reports and other news by radio because of interference." One must certainly conclude from this apparently dependable report that the farmers in this section at least are making real use of the news which radio is disseminating.

The Narrow Radio Ruling of the Insurance Companies

THE fire insurance companies have taken cognizance of radio installations by attaching a radio permit to their policies. We have just received the one attached to policies issued under the New York Fire Insurance Rating Organization, and note with interest one of its clauses. After stipulating





HENRY FORD'S MARINE RADIO EQUIPMENT

Aboard the SS. *Benson Ford* at dock in River Rouge, Michigan. The ship is one of two, built to carry bulk cargo to and from the Ford Detroit plants. Onthe dock can be seen gondola freight cars of the D. T. & I., the Ford railroad. The *Benson Ford* is equipped with a 500 watt RCA cw transmitter, operating on 600, 706, 909, and 1875 meters. KFTC is also equipped with a radio compass which the photograph shows installed on the bridge. Both the new Ford ships use radio telephone as well as the telegraph. The master of either ship can talk directly from his cabin to any other ship within range by telephone

—Nicholas Muray

KARL BICKEL

New York City; President, the United Press

"Inch by inch radio is edging into the business of news distribution. This was never so graphically illustrated as in connection with the Democratic National Convention. Extra editions rushed from New York to suburban towns carrying the 71st ballot would reach the newsstand just as the complete report of the 80th ballot was coming over the loud speaker. The editions were old before they arrived.

"The results of big sports contests are now known instantaneously via radio. However, in spite of these instances, I do not believe the newspapers have much to fear. But radio can never give the complete news report of the day as the newspapers can give it.

"Radio is an imperative thing. Unlike the newspaper, it cannot be laid aside and picked up in a moment of leisure. You miss the event if you are not at the loud speaker as it is being broadcast. And even then you get only the fact. The newspapers are read for color and interpretation. With big news being flashed by radio, newspaper publishers will no longer have the obligation of going extra to give the public the news. More time and effort can be spent on improving details and interpreting the facts.

"Press associations will not enter the radio field by erecting their own broadcasting stations for the distribution of news in the immediate future. Popular radio telephony is still an infant industry of only three years' growth and has by no means exhausted the possibilities of its development."

that the policy does not cover personal injury from electrical apparatus, etc., a warranty states that "the source of energy shall be only from primary or storage batteries."

One could almost believe that this clause was written at the request of the battery manufacturers. We are extremely irritated by this clause, for it seems to penalize advances in the art. The idea of depending upon batteries for the power to run a radio receiver when electric power is used in a house for lighting, is really very absurd from the engineering point of view. We have continually advocated the use of suitable rectifying outfits so that the power may be obtained from the light socket, with the view of stimulating the inventive genius of the country along these lines, and now the insurance companies have put themselves in the position of penalizing such devices!

There is no reason in the world why these rectifying outfits, properly designed, built, and installed, should be discriminated against. We certainly hope the ill-advised insurance companies will eliminate the progress-impeding clause from their policies.

The Chicago Municipal Radio Commission

FEELING that the conditions in the broadcasting game in Chicago were not as satisfactory to the average listener as they should, and might, be, Chicago's mayor has appointed a committee of representative technical and business men to study the problem and hand in to him their findings and recommendations. The idea of forming such a commission belongs to Frank Reichmann, president of the Reichmann Co. He has felt that such a commission might do much to control the possible censoring of broadcast stations, and to arouse and crystalize public opinion against oppressive local legislation having to do with radio matters. Of course no real power can be assumed by such a commission. Its function is entirely advisory. The control of radio must necessarily come under the Federal Government, as it surely is "interstate traffic." Some municipalities have enacted statutes which purport to dictate on radio matters insofar as their community is concerned, but such statutes are probably of no real importance.

Speaking of the work this Chicago commission will undertake, the minutes of its first meeting conclude "Another important reason for a radio commission is the fact that in the last few years practically every form of popular entertainment enjoyed by the people has been subject to attack from small minority groups, who seek to regulate by sumptuary law every minute of our lives from the

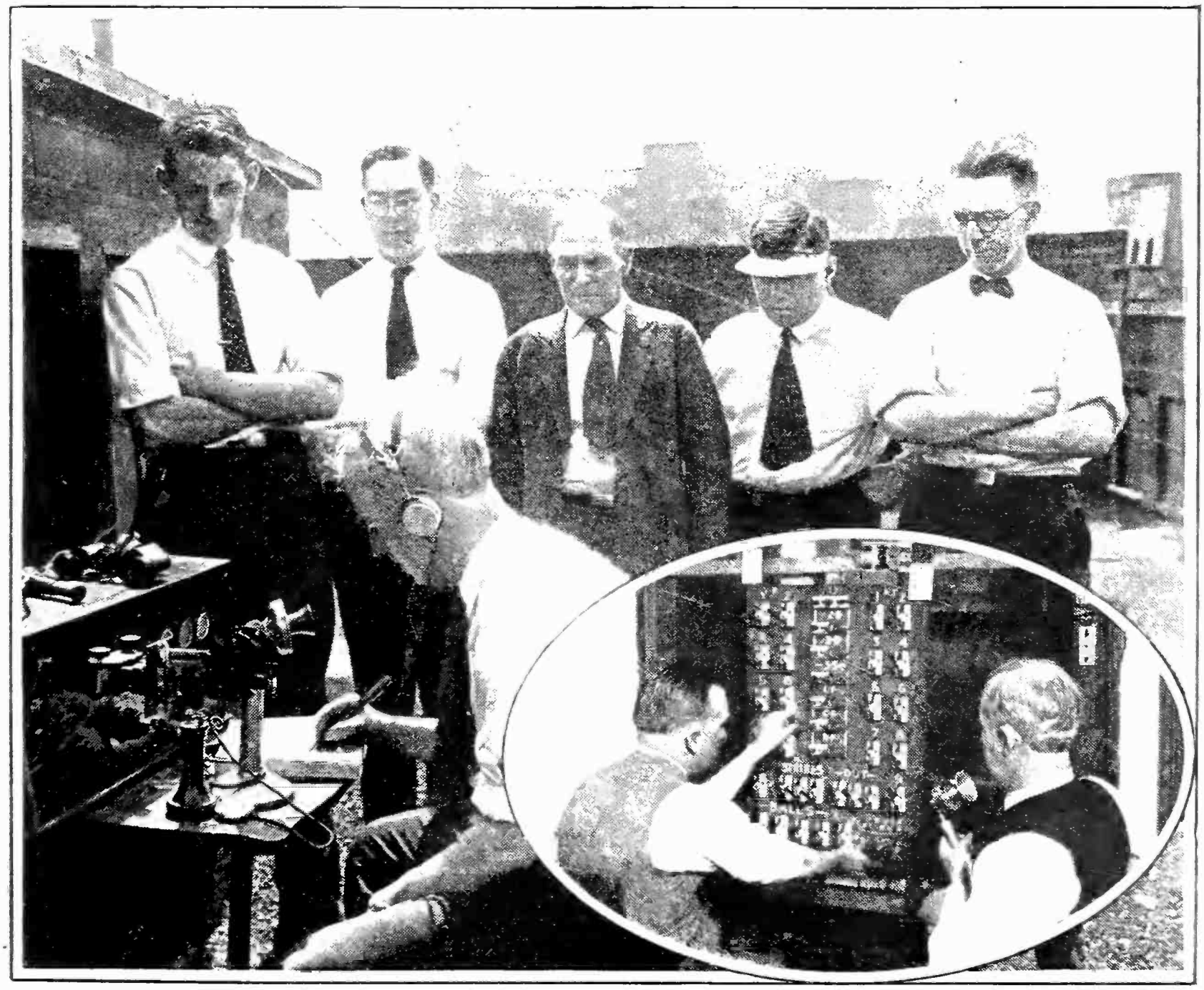
cradle to the grave. A commission operating efficiently can shield the radio listener and the broadcaster from these attacks and can do a great deal to prevent oppressive legislation."

Broadcasting is Publishing

MUCH has been said lately about the use of a broadcasting station for advertising purposes. The majority of listeners, we think, vehemently protest against listening to purely advertising programs. It seems as though advertising in some form or other must be indulged in by broadcasting stations until some better method of raising an income is devised. Looking for an analagous situation, the newspaper at once appeals to us as having a similar problem. We buy a newspaper primarily to get the news, but unless the paper carries a great deal of advertising we would have to pay probably ten times the present price to get the news The advertising of any paper or magazine pays for a very large share of its operating expense and unless a broadcasting station is suitably endowed we must naturally expect to get quite a lot of advertising in its programs.

The listener however, isn't really as badly off as the last sentence might lead one to believe, because radio advertising must be of a high order of merit, for otherwise no one will listen to the station. The reaction is sure to be just the same as was exhibited by a motorist whose view of a beautiful wooded valley was completely shut off by a glaring sign purporting to give the merits of Pinnacle Oil for engines. "Damn the company that puts up signs like that to cut off such beautiful landscapes, said he. "I'll never buy any of their oil, no matter how good it is."

It sometimes happens, however, that one has to listen-in to a program which is quite

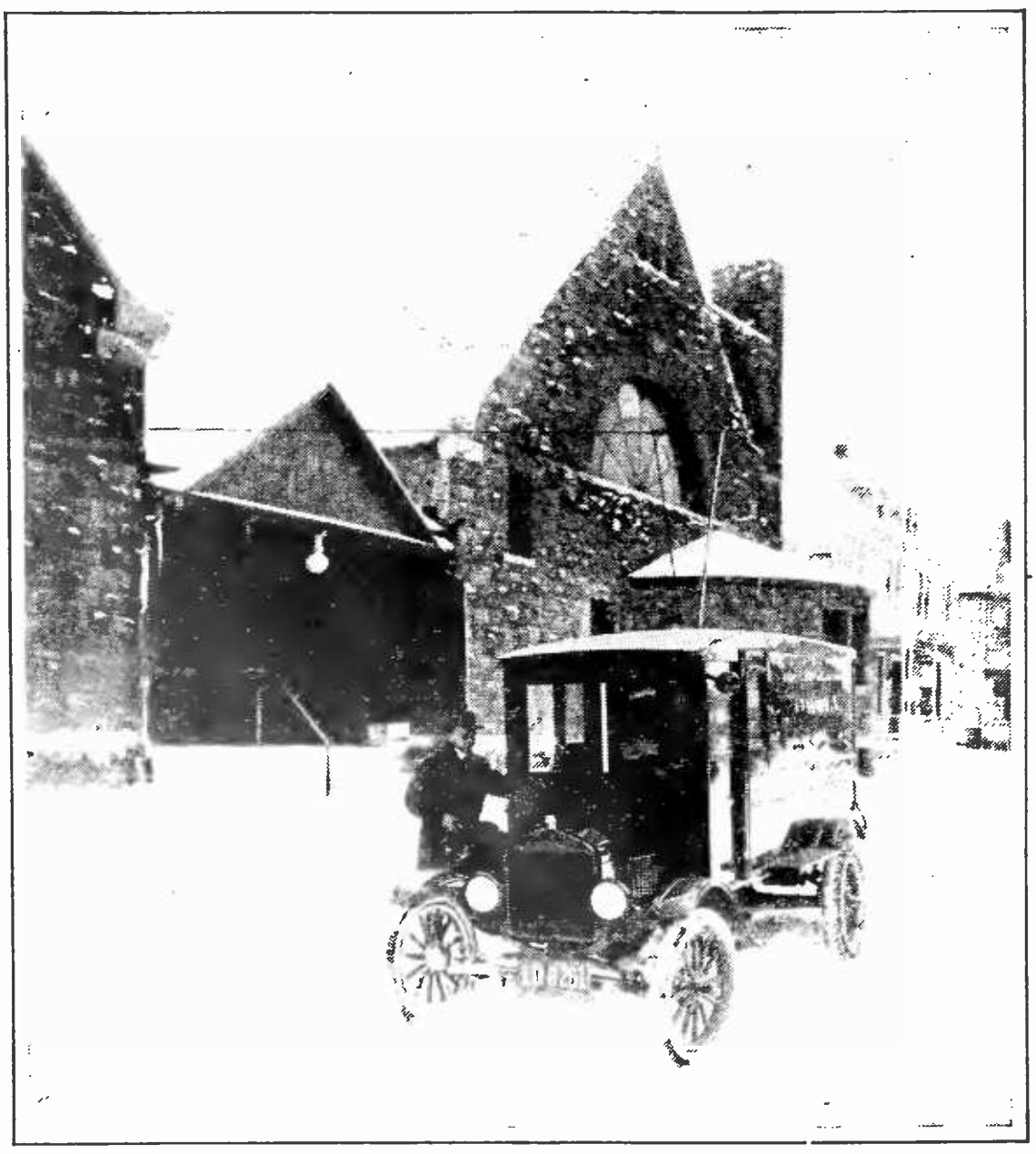


RADIO WITH THE SCRANTON "TIMES"

During the World's Series games. The insert shows the electric scoreboard which was operated simultaneously with the radio loud speakers. When the Navy dirigible *Shenandoah* flew over Scranton recently, the *Times* radio station, WQAN, was in communication with the ship for more than two hours

evidently advertising matter, yet the announcer has said nothing to that effect in introducing the number. One at once feels he is being hoodwinked—something is being "put over." The reaction of the listener to such material is just opposite to that which the advertiser is endeavoring to arouse, so that advertising of this nature is likely to be practised to an ever diminishing extent. The listeners themselves, we think, are apt to be the court of last resort.

Another phase of the question is however brought to the front by a paragraph in the "Topics of the Times" in New York *Times*, drawing an analogy between advertising over the radio channel and by means of the press. It is illegal for a newspaper to put advertising material in its columns without so designating it, and there is no reason at all why the same rule could not apply to radio. In the words of the editorial writer, "Broadcasting certainly is publishing, and all publishing should be honest. Newspapers, or at any rate some newspapers, including one which modesty prevents mentioning, did not wait for the law to speak on this subject but put "advertisement" over all advertisements not obviously that, to every eye. That virtuous example, the broadcasters would do well to imitate voluntarily. The sooner they do it, the less likely will they be to suffer later from regulations that will be really burdensome.



WGY ON WHEELS

This small truck is equipped with a low powered short wave transmitter which picks up programs from churches and public halls. The main station at WGY picks up these signals and they are radiated in the regular manner. The small transmitter takes the place of the usual telephone line connection between the outside hall and the broadcasting station

Bureau of Standards Finishes Tests

THE Bureau of Standards has just brought to a close a series of tests which it organized with the idea of ascertaining as much as possible about fading, interference, effects of weather, etc. Some 200 observers located at varying distances, from the two stations chosen for transmitting (KDKA and WLAG, now WCCO) turned into the Bureau about 50,000 observations. These observations are to be tabulated and classified, and it is hoped they will throw some light on the complex problem of radio transmission.

A task of this kind entails a tremendous amount of work on the small and hard working radio staff of the Bureau, and we cannot but express our appreciation of their work in the interests of radio progress. The standard frequency transmission schedules inaugurated and carried out by the Bureau are, in our opinion, a genuine contribution to radio developments and we are glad to voice the thanks of the millions of BCL's for that useful service.

Radio and the World Flight

OUR world encircling planes have recently completed their 27,000 mile flight and are receiving the congratulations they so well deserve. Besides the intrepidity of the air men themselves, many factors contributed greatly to the success of the experiment, not

the least of which was the radio channels with which the airmen were continually in touch. When crossing the northern part of the Pacific, the radio problem was of extreme importance. As almost everyone knows, the weather conditions here are continually unsettled and the danger threatening a lost aviator is very imminent. In just this part of the world, there is precious little radio equipment, for between Dutch Harbor in America, and Japan, there is not a single radio station.

To the Coast Guard cutter *Haida*, and her radio staff fell the burden of carrying on the radio traffic required by the planes during this, the most perilous part, of their route. In a recent report from the radio officer of the *Haida*, we read a fascinating story of the technical difficulties which the task entailed, and of the great importance of the radio channels he maintained in operation. As he says:

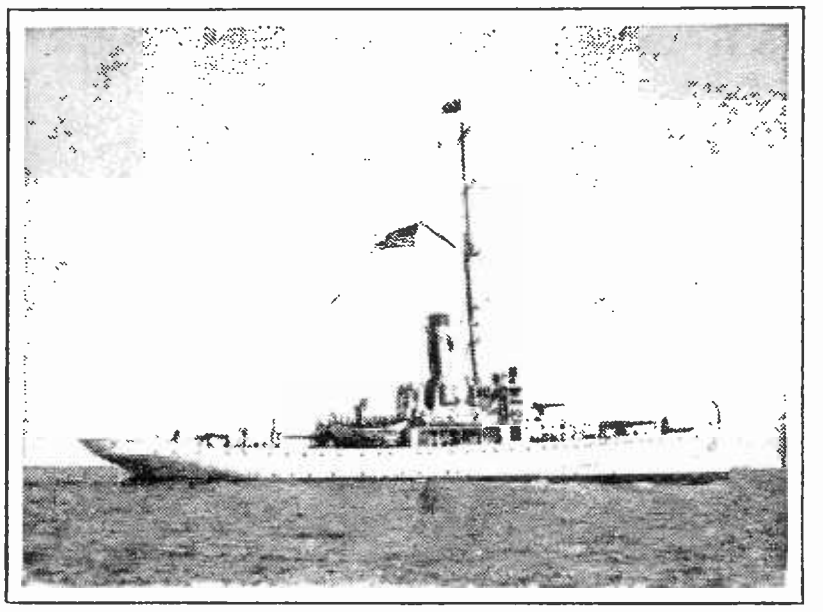
> Radio was imperative and vital to the success of the flight. There were three principal reasons.
>
> First, the planes were hopping from 300 to 700 miles in a jump. It was necessary to know the weather conditions along the line of flight. These conditions had to be known early in the morning so that the flight could start as soon as possible.
>
> Second, if one plane fell during a hop, the other planes were to proceed to the nearest radio station and drop a note telling about the accident. This made it possible to send assistance within a very short time.
>
> Third, publicity. The flight would have been of little value if the people of the United States were not informed of its progress. This news was wanted by all the various news organizations of the country. Radio was the means of getting the news over.

The log of the *Haida* graphically relates how well these three ends were met, and reflects great credit upon her staff.

Radio Movies Are Not Yet

IF WE can believe some of the news items dealing with station WMAF, operated as a pastime by Col. Green, remarkable developments are being carried on there. More than $500,000, we learn, has been spent by the Colonel on his radio hobby, and that he is riding it hard at present is indicated by the fact that he has borrowed three radio experts from the Massachusetts Institute of Technology to experiment for him at his South Dartmouth station.

According to his secretary, this wealthy radio amateur is working on the problem of projecting moving pictures by radio. It is only a few weeks past that we were congratulating those inventors who have succeeded in transmitting still pictures by radio, but even so, the transmission is still far from perfect. It takes several minutes now to transmit a "still." How, then, can the Colonel project moving pictures, which must flash on and off the screen about twenty times a second? With lots of experts and lots of money to buy apparatus and facilities, the Colonel may go far in the experimental game; that he is even attempting movies by radio would lead one to conjecture that his workers have discovered a process a thousand times as rapid and effective as that announced by the press with glee only a short time past. As no details of the scheme were given out, in the interview reported, we can make no judgment at all regarding its reliability.



U.S.C.G. "HAIDA"

In the Bering Sea service, whose radio equipment, ably operated, was of enormous service to the Army World Fliers when they crossed to Japan

Interesting Things Interesting People Say

ARTHUR CAPPER (United States Senator from Nebraska; in an interview in *Printer's Ink*): "It seems almost superfluous to comment on the obviously demoralizing and deceptive practise of broadcasting disguised indirect advertising for which the radio station has received a fee. For some years now it has been illegal for a newspaper or magazine to publish anything in paid-for space without indicating unmistakably that the matter is paid advertising. The laws were passed because the practise of disguising advertising as "reading notices" or news matter was considered an imposition on the public and a deception. And the broadcasting of paid-for indirect advertising without a clear statement of the fact at the beginning of every

© Henry Miller

HERBERT HOOVER

Washington; Secretary of Commerce

"In the whole history of scientific discovery there has never been a translation into popular use so rapid as radio telephony. So late as the year before I became Secretary of Commerce there were no broadcasting stations. At the end of four years, 530 are in operation, making radio available to every home in the country. The sales of radio apparatus have increased from a million dollars a year to a million dollars a day. It is estimated that more than 200,000 men are now employed in the industry, and the radio audience probably exceeds twenty millions of people.

"Let us not forget that the value of this great system does not lie primarily in its extent or even in its efficiency. Its worth depends on the use that is made of it. It is not the ability to transmit but the character of what is transmitted that really counts. Our telephone and telegraph systems are valuable only insofar as the messages sent from them contribute to the business and social intercourse of our people. For the first time in human history we have available to us the ability to communicate simultaneously with millions of our fellowmen, to furnish entertainment, instruction, widening vision of national problems and national events. An obligation rests on us to see that it is devoted to real service and to develop the material that is transmitted into that which is really worth while. For it is only by this that the mission of this latest blessing to humanity may be rightly fulfilled."

message that the speaker has paid for the privilege of broadcasting, is no less a deception and an imposition as far as the public is concerned."

HERBERT H. FROST (Chicago; President, the Radio Manufacturers' Association): "Between the time we first decided on the Association and the time we had effected the permanent organization, we had to go through the tax fight in Washington. The proposed tax of ten per cent., collected at the source, would have meant an increase of more than twenty per cent. to the consumer and would have cost the manufacturers many thousands of dollars in accounting, etc. That fight taught us that the interests of the manufacturer, the listener, and the broadcaster are identical. We are organized, the listeners are organizing, and so will the broadcasters. Then all can work together with the other elements in the industry to prevent these attacks."

JOSEPH M. LEVINE (New York City; President, the Hunts Point Hospital): "We have spent a half million dollars in making this institution the most modern of its kind in the Bronx district. Its equipment, from the operating rooms down through the entire plant, is the most modern and scientifically perfect obtainable. And yet, I do not believe that there is a single modern feature that can compare, in its ultimate effects for good upon the patients, with the radio installation."

FEDERAL JUDGE KNOX (New York City; in his decision in the case of Jerome H. Remick Co., vs. the General Electric Co.): "So far as the practical results are concerned, the broadcaster of the authorized performance of a copyrighted musical selection does little more than the mechanic who rigs an amplifier or loud speaker in a large auditorium to the end that persons in remote sections of the hall may hear what transpires on its stage. Such broadcasting merely gives the performer a larger audience and is not to be regarded as a separate and distinct performance of the copyrighted composition on the part of the broadcaster.

"When allowance is made for the shrieks, howls, and sibilant noises attributable to static and interference, the possessor of a radio receiving set attuned to the station of the broadcaster of an authorized performance hears only the selection as it is rendered by the performer. The performance is one and the same whether the listener-in be at the elbow of the leader of the orchestra playing the selection, or at a distance of a thousand miles."

DAVID SARNOFF (New York City; Vice-President and General Manager, Radio Corporation of America): "There is not to be found abroad the same freedom from censorship and restriction which exists here. For example, in England, where freedom of speech has been such a heralded tradition, political broadcasting is forbidden over the radio stations, which are all controlled by the British Post Office. In other European countries, Governmental regulations and restrictions are even more severe. Radio freedom . . . enjoyment, and instructive information is available to all in the United States. "I endeavored to interest the British, French, and German broadcasters in the idea of increasing the power of their sending stations, so that the programs of London, Paris, and Berlin might be easily heard by the American listening public. . . Much interest was shown in these proposals, and I believe that an era of transoceanic broadcasting is near at hand."

STABILIZING THE THREE-TUBE KNOCK-OUT

THE multi-tube reflex receiver, while opening unusual possibilities in efficiency per tube, unfortunately increases the tendency toward instability and howling. This tendency is noticeable in the three-tube knock-out receiver described in the February, 1924, issue of RADIO BROADCAST which is fundamentally the one-tube knock-out reflex plus two stages of transformer-coupled audio amplification. In the original set, a stabilizing condenser and shielding were resorted to in an endeavor to eliminate the squealing that was particularly evident when the dials were approached for tuning. Though these precautions are effective when the adjustments are made by an expert, many of our less experienced readers were unsuccessful in their efforts to stabilize the set.

More recent experiments in the R. B. LAB have efficiently stabilized this three-tube arrangement by substituting one stage of resistance-coupled amplification for the final step of transformer coupling. Non-inductive resistance-coupled amplification is fundamentally more stable than either transformer or impedance coupled intensification owing to the practical elimination of inductance (the many turn iron core windings) which is directly and indirectly responsible for most of the feedback and resulting howling in the two last named systems of amplification.

The substitution of resistance-coupled amplification also results in noticeably improved quality. Volume, though still very satisfactory, is naturally less than the output of a straight transformer-coupled amplifier.

The circuit of the improved arrangement is shown in Fig. 1. The inductances T1 and T2 are those described many times and recommended for single-tube reflex receivers. Briefly, they consist of secondaries wound with sixty-two turns of about No. 22 wire on a two and a half inch form. The primaries are wound over the secondaries with an insulating layer of paper between. The primary of T1 is wound with sixteen turns of No. 22 wire, and that of T2 with thirty-six turns of the same conductor. T3 and T4 is any efficient amplifying transformer, preferably of a medium ratio, such as four to one. A C or bias battery of one and a half to three volts is recommended in the grid return of the first stage of external audio amplification.

The crystal detector used in the set under discussion is a Pyratek fixed crystal, but may be any other reliable make.

The coupling condenser C4 is a .006 mfd. Micadon, and the coupling-resistor has a resistance of one hundred thousand ohms. This last may conveniently be either

What the Lab Offers You This Month

Hints on Stabilizing the Three-Tube Knock-Out Receiver.

A Soldering Iron for Delicate Work.

An Example of De Luxe Cabinet Construction.

Light on an Electrical Puzzle in the Filament Circuit.

Some New Ideas in Spider Web Coil Construction.

Building Your Own Lab.

Other Items of Laboratory Interest.

a Daven resistor, or a Crescent Lavite. With almost all tubes the grid leak should have a value of fifty thousand ohms.

In the set illustrated in Fig. 2, a Daven resisto-coupler was employed in rebuilding the final stage. The resisto-coupler clips the two resistances and the coupling condenser into a single unit which is connected exactly in the same manner as the transformer, the posts being marked P, B, G and F—thus permitting the change to be made in less than five minutes.

A potential of 135 volts was used, in the R. B. Lab, on the plates of the UV-201-A tubes. If the voltage is under one hundred, an additional 45 volt battery is recommended to be included in the plate circuit of the resistance-coupled amplifier at X.

Panel layouts and a more detailed exposition of constructional data on this receiver will be found in past numbers of Radio Broadcast—particularly the February issue.

At the same time the experiments described were being made, a final stage of impedance-coupled amplification was also attempted with similar hopes of eliminating feedback and squeal. These last experiments, however, were unsuccessful, for resistance-coupling proved the more effective prevention.

SOME POINTS ON DELICATE SOLDERING

DELICATE soldering, and soldering in places inaccessible to a large iron are trying feats that continually confront the radio experimenter, and are best accomplished with a small, specially designed light iron. Figs. 3 and 4 illustrate a soldering finesse which Raymond B. Wailes has found to facilitate delicate work. Fig. 3 shows the construction of a small iron that can be put together in a few minutes. The "iron" itself is an eight- to ten-inch length of copper or brass rod, thrust into four corks as a heat resisting handle. The tip of the iron should be filed into a square point. In the R. B. Lab, the rod was a piece of number four copper wire.

Owing to its smallness, an iron of this type will not hold its heat for any length of time. If the job is one that demands a continued application of a hot iron, it is best accomplished by applying the heat continually to the rod from a small alcohol lamp as suggested in Fig. 4.

In delicate soldering, such as the terminal wires of amplifying transformer windings and jack connections, it is essential that a non-acid flux be used. Soldering flux made by neutralizing hydrochloric acid with zinc is conductive and occasionally corrosive, as are most commercial fluxes. Mr. Wailes, and radio experts in general, recommend a flux made by dissolving rosin in denatured alcohol.

THE RADIO SET AS A WORK OF ART

THE more bona fide broadcast receivers—to discriminate from the sets purchased or built by experimenters—are slowly drawing away from the old wireless traditions of business-like switchboards and death-chamber control panels. The cabinet maker and artist

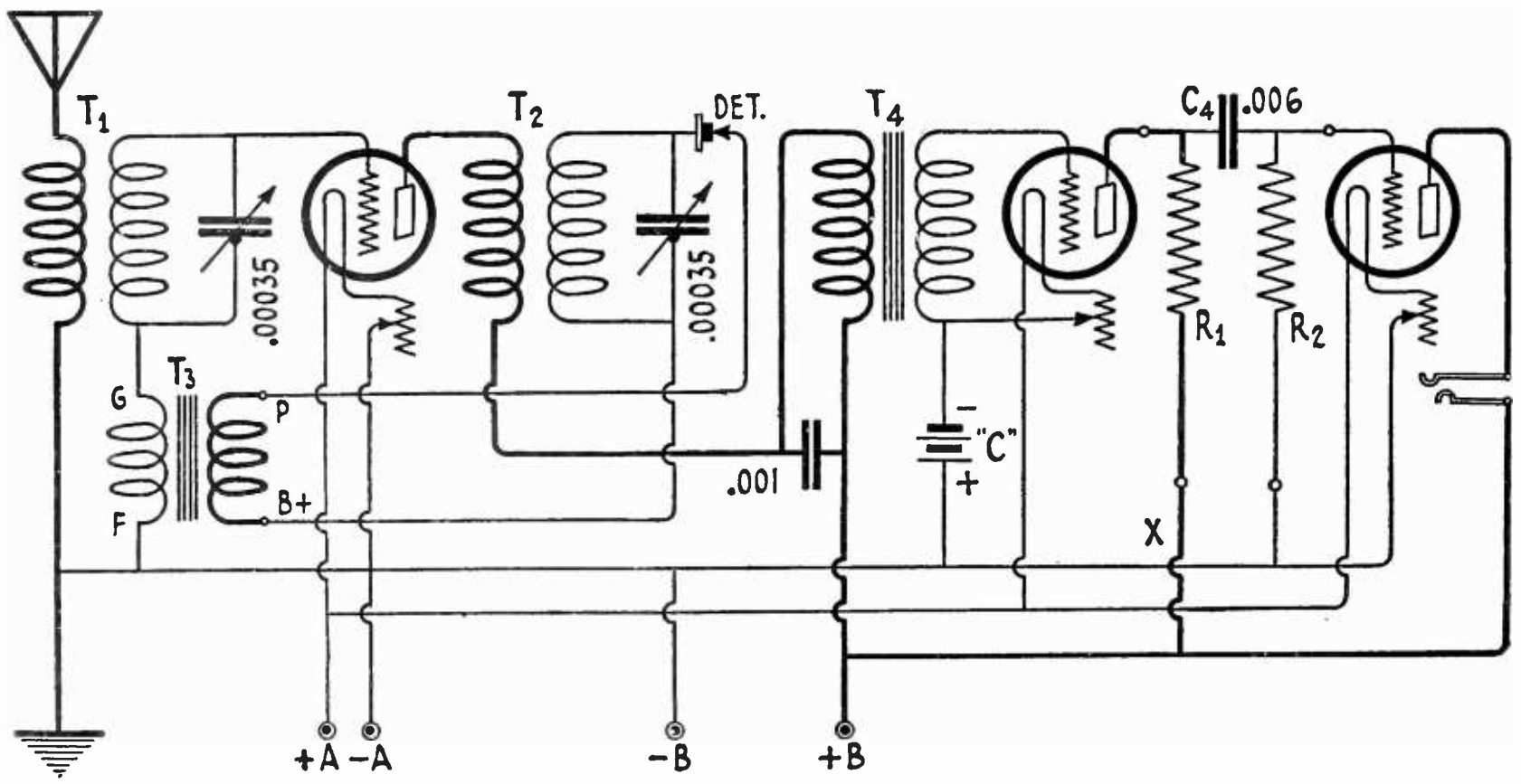


FIG. 1

The stabilized three-tube receiver. Resistance-coupled amplification has been substituted for the final stage of transformer audio

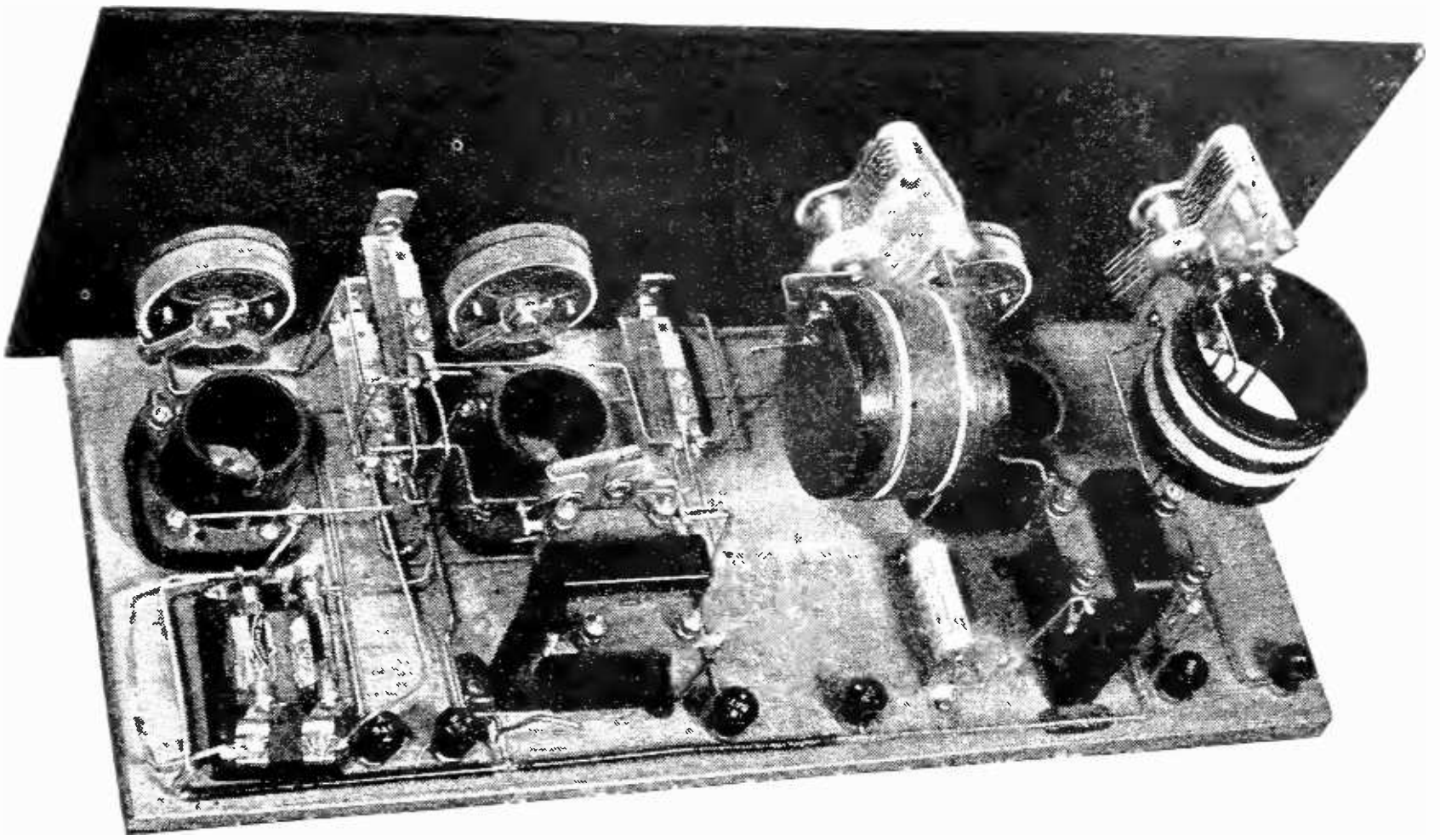


FIG. 2
Showing the change that can be made in five minutes

has come into his own, and our parlor radio sets are to-day as unlike their war-time prototypes as an expensive Victrola is unlike Edison's early machines.

A beautiful bit of furniture built about a neutrodyne receiver is shown in Figs. 5 and 6. The electrical and mechanical details were supervised by Hugh B. Downy, the owner of this work of art. The set itself is constructed with Workrite De Luxe parts. The cabinet is of solid figured oak especially selected from the stocks of the Frank Purcell Walnut Lumber Company, and built to order by the International Equipment Company of Kansas City, Mo.

It is seldom that the construction of even a de luxe radio set is subject to such painstaking care. It is a most modern example of doing a worth-while thing well.

ONE SWITCH IS NOT ENOUGH

AN INTERESTING circuit condition has been brought to our attention by Mr. James C. Millen, which at first glance seems to defy the electrical axiom that only one switch is required to break a circuit. This momentary puzzle is encountered whenever two tubes of dissimilar filament potentials are operated from a common A battery, the lower filament voltage being secured by tapping. Such a circuit is shown in Fig. 7, in which the tubes are a WD–11 (detector) and a UV–199 (audio amplifier), operating respectively from filament battery potentials of three and four and a half volts. This is a common and desirable combination. A single A battery switch has been included in the common lead, which at first glance seems adequate. Such, however, is not the case, as careful tracing of the filament circuit will disclose.

When switch S is open that portion of the filament battery bracketed by A will still discharge through the filaments connected in series—a continuous drain that will rapidly deplete that portion of the battery. No variation of similar connections (even separate A batteries) can get away from this unsuspected and doubtless very prevalent leakage.

There are three possible solutions to the puzzle. The most desirable is the use of a

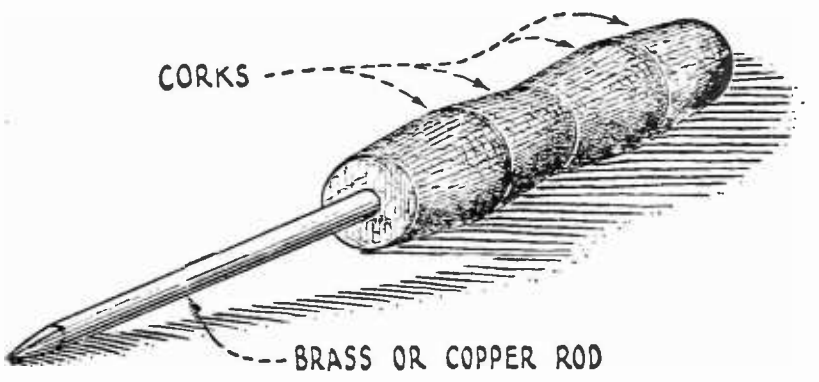


FIG. 3
A simple soldering iron for delicate work

FIG. 4
Applying heat continually to a small iron

high ohmage rheostat in series with the filament of the lower voltage tube, thus permitting it to be lighted from the entire battery. A second possibility is to turn *off* one of the rheostats when the battery switch is open. The last consideration is to include an additional switch at some point such as X.

This little problem will doubtless locate the mysterious drainage in hundreds of cases of short-lived A batteries.

SOME NEW IDEAS ON SPIDER-WEBS

IN THE majority of spider-web inductances where two windings such as primary and secondary are incorporated on a single winding form, the upper winding is wound directly over the lower coil. This necessarily results in tight coupling which is often undesirable. In many cases the spider-webs are substituted for the more conventional tubular or solenoid inductances in which spacing between the windings has effected a looseness in coupling that was more or less essential in the circuit for which they were designed. This is especially true of single-tube reflex circuits, and any other systems in which selectivity is not a predominant characteristic.

In such circuits, the primary and secondary windings should be separated as far as is consistent with a negligible loss in signal strength. This loosening of coupling is quite as easily effected in spider-webs, merely by winding a dozen or so turns of string between the primary and secondary. Figs. 8 and 9 show coils in which the adjacent windings have been separated in this manner.

In Fig. 9 the primary has been wound between halves of the secondary—a procedure which tends to tighten coupling. However the placing of the primary in this manner is desirable, particularly in an endeavor to duplicate the inductance of a known solenoid without recourse to formulas and mathematics.

Referring to Fig. 9, the average radius, R, should be the radius of the solenoid or single-layer inductance that it is desired to duplicate. The primary and secondary should be evenly distributed on each side of this radius—as illustrated in the photograph—winding to the same number of turns as were on the tubular coil. The finished spider-web will, for all practical tuning purposes, be equivalent to the original solenoid.

LIGHTING THE ROBERTS SET FROM A. C.

DESPITE the fact that the UV-201-A tube consumes only one quarter of an ampere, the more enthusiastic operators of the Roberts

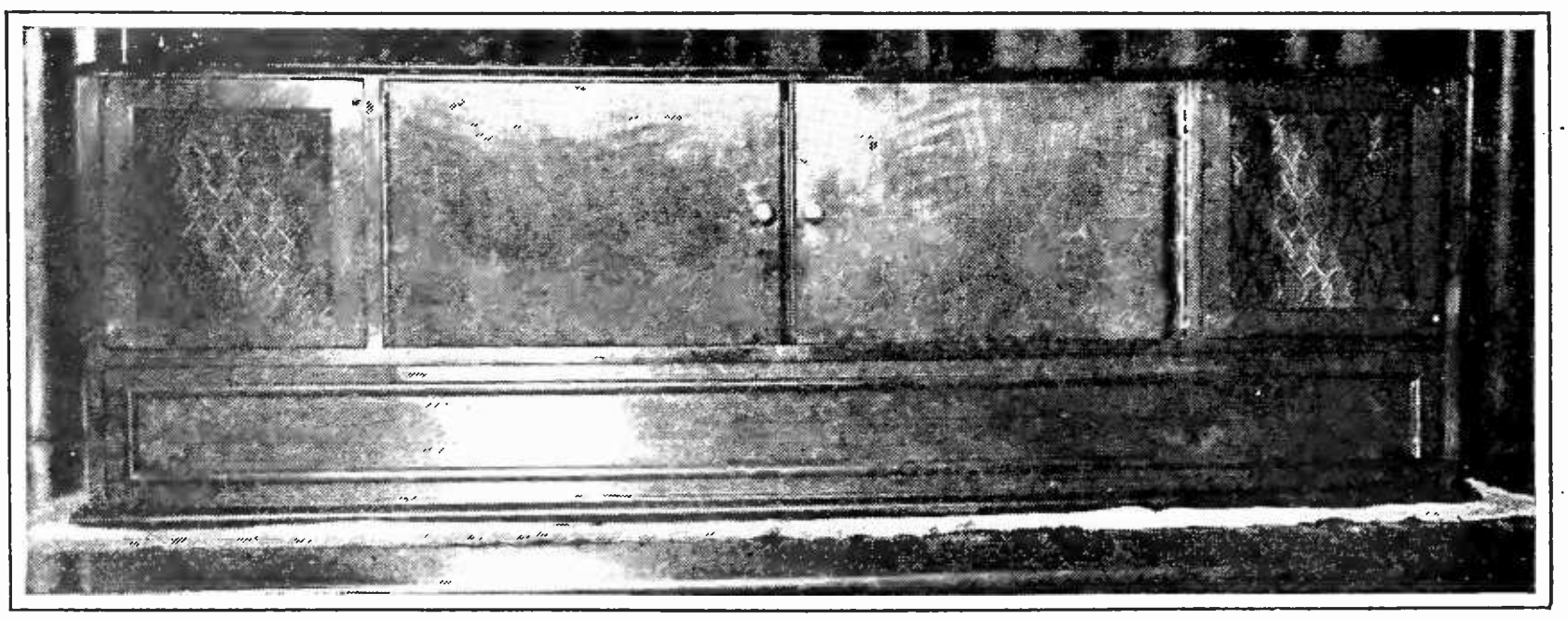


FIG. 5
An aristocratic bit of parlor furniture

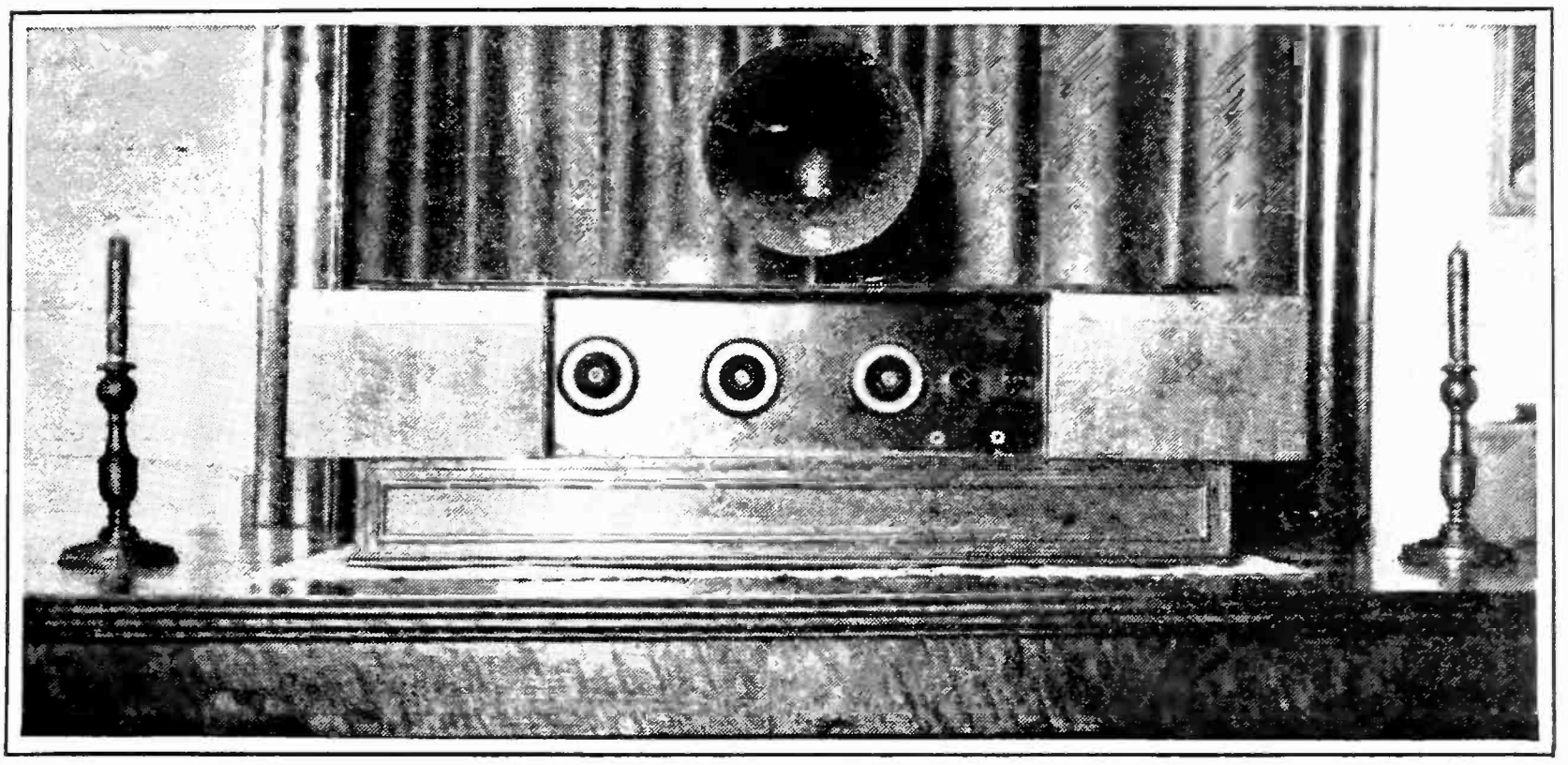


FIG. 6
The work of art open

set, inveigled by its excellence into running it five or six hours a day, find the A battery expense far from negligible. The short life of the amplifying A battery suggests the possibilities of A. C., and Fig. 10 shows the system evolved by George B. Larkin. Similar arrangements have been employed in this laboratory at various times, and confident of the possibilities and success of the system, we recommend it to our interested readers.

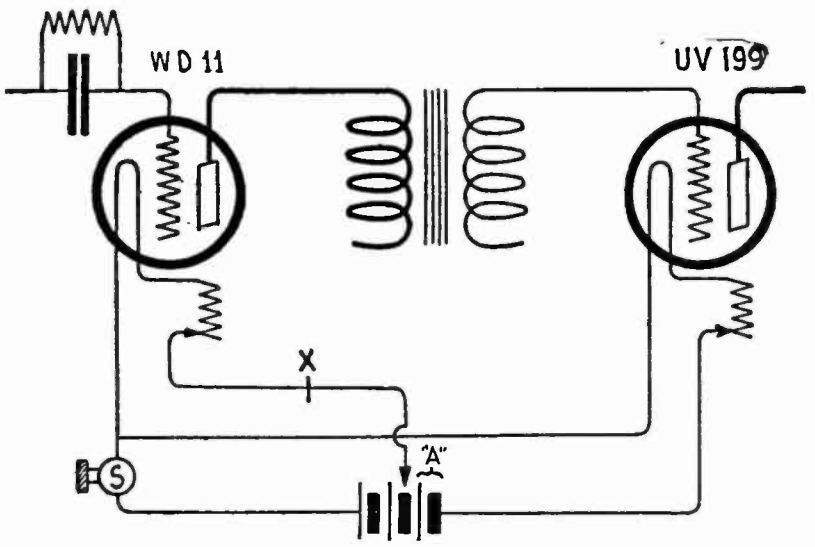


FIG. 7
This circuit will drain your A battery in a day or so if the filaments are turned "off" merely by opening the single switch

Inspection of the diagram discloses no fundamental variation from the original two-tube Roberts circuit, and for constructional details, the reader is referred to the May 1924 issue of RADIO BROADCAST and several subsequent numbers.

The parts required for the change to alternating current are: two twenty-five or thirty ohm rheostats, two six-ohm rheostats (one of which will probably be found in the experimenter's original receiver), and a toy transformer operating from the lighting current and delivering from six to eight volts. A

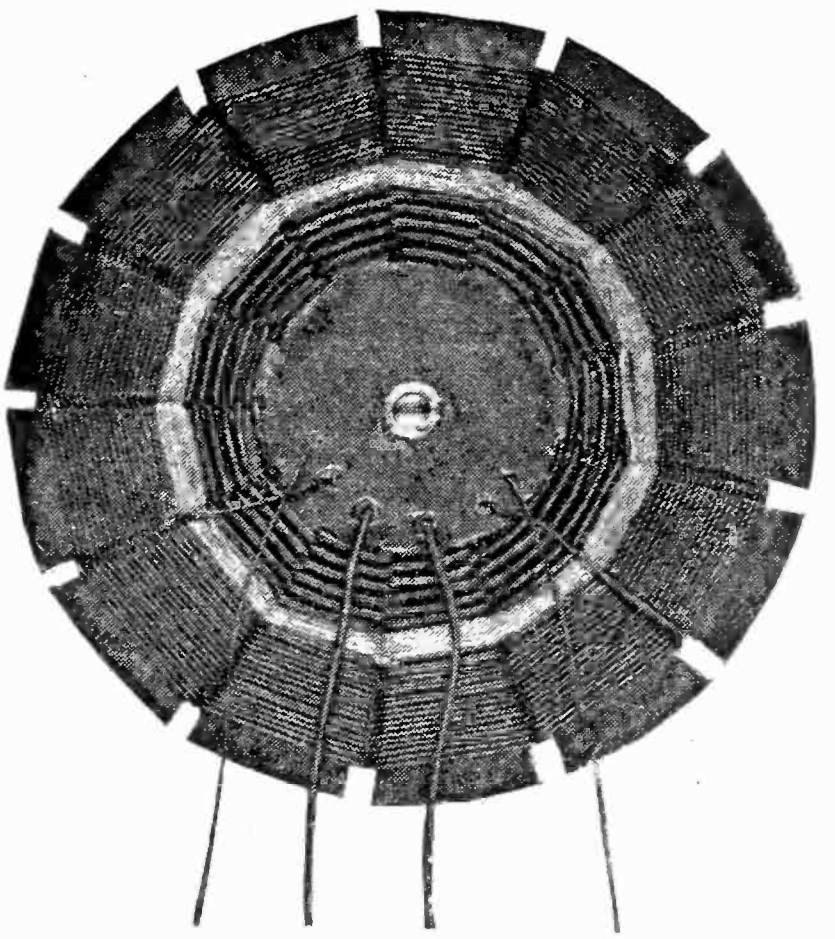


FIG. 8
Coupling is loosened by winding thread between primary and secondary

potentiometer (100 to 400 ohms) may be substituted for the two twenty-five ohm rheostats with improved results.

Balancing out with the two twenty-five ohm resistances as suggested in the diagram re-

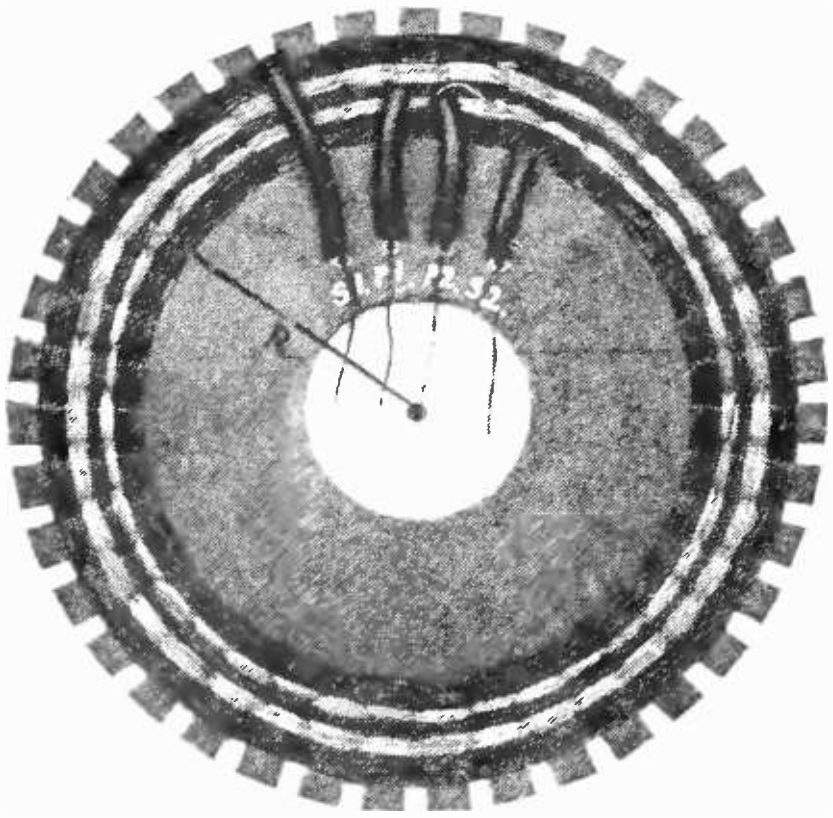


FIG. 9
Duplicating (roughly) a solenoid in a spider-web—coupling again being loosened with thread winding

duces the A.C. hum until it has little or no effect on loud-speaker operation, though it is still audible on head phone reception and interferes slightly with DX signals. This last objection may be done away with, however, by using the potentiometer recommended in place of the two rheostats. The two terminals of the potentiometer are connected respectively to each side of the transformer secondary, Y and Z, while the movable arm connects to X. X is varied until the hum is eliminated or reduced to a negligible minimum.

The action of the receiver can be still further improved by connecting two bypass condensers, of capacities from .006 mfd. to 1.0 mfd., between X and Z and X and Y, as suggested tentatively by the dotted lines.

It will be observed that the UV-199 detector tube is still lighted from a dry cell A battery. The current drawn by this tube is only six one hundredths of an ampere, and such operation is quite economical and more efficient.

BUILDING YOUR OWN LAB

THE R. B. LAB suggestion for this month's addition to the growing radio workshop is a small metal frame plane. This will cost anywhere from $.75 to $1.50. As usual, do not compromise with quality. Since this tool is more or less associated with carpenter work it is seldom thought of as an efficient aid in the radio laboratory. It is nevertheless a very useful all-around tool, and will find a wide application—smoothing the edges of rubber, bakelite and fiber panels, finishing baseboards, refinishing cabinets and producing the desired neatness in board-mounted apparatus. Rough edges on almost any material excepting metal are quickly smoothed away.

The plane should be small, having a blade no wider than an inch and a half, with screw adjustment. Fig. 11 shows a plane that is in constant service at this laboratory.

It is a good idea to obtain an extra blade, using one blade only for wood, and the other for less easily worked materials.

DON'T use enameled wire in winding spider-webs. The construction of these coils imposes a comparatively high mechanical strain on the insulation which often scrapes the enamel on touching portions of adjacent turns. This shorted turn will render the receiver practically inoperative. Double silk-covered wire is recommended for spider-web windings.

If your receiver—a Roberts for instance—is giving results considerably inferior to those you have a right to expect, and careful circuit tests fail to locate the difficulty, change spider-webs, preferably rewinding with the wire suggested.

MANY sets fail to cover the wave range specified by the original builder, and do not tune either to the upper or lower limits

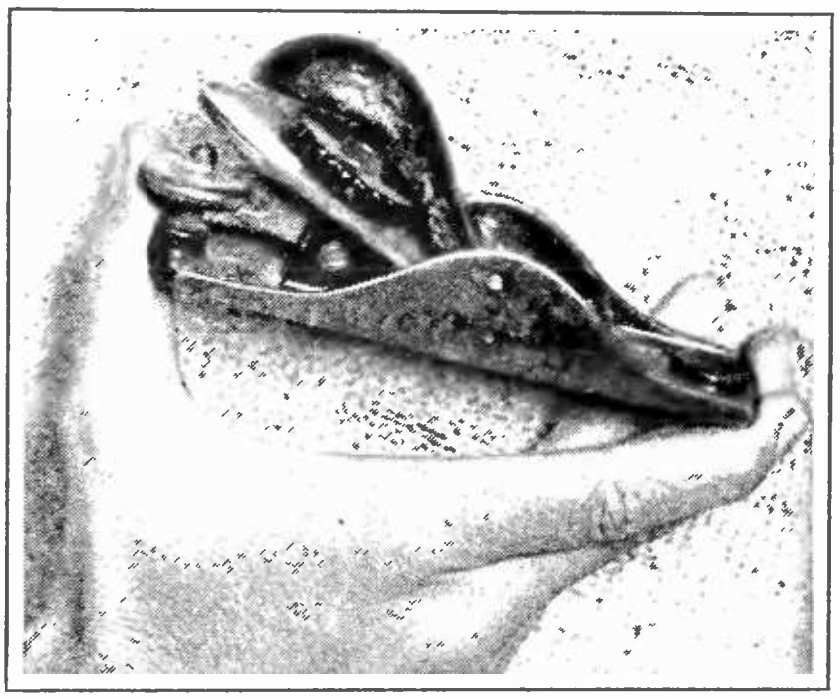


FIG. 11
The small plane has many uses in the radio workshop

or both. When the inductances (coils) are correctly wound, the fault generally lies in the variable condenser. A high minimum capacity makes it impossible to tune low, while a maximum value below the stated capacity of the condenser cuts off the higher wave lengths. Both faults are common in cheap

condensers. Ask for condensers by capacity (not by the number of plates) and accept none but those of reliable make.

THE intermediate frequency amplifier transformer used by Mr. Alan T. Hanscom in his "Six Tube Second Harmonic Super-Heterodyne" may be obtained direct from Harris and Mowry, Woonsocket, Rhode Island. These coils are too intricate and difficult for the average builder to wind, and that is the reason they were not described.

The names of other dealers carrying these coils may be found in our advertising pages.

A SCREW-DRIVER can generally be made into a convenient reamer without affecting its efficiency as a screw driver. It is merely necessary to file the converging edges to scissor edges, finishing with an oil stone. Different sized screw-drivers will be used for larger or smaller reamers—virtually adding tools to the lab equipment without increasing its already rather extensive array.

IT OCCASIONALLY happens that the primary and secondary terminals of an audio-frequency amplifying transformer are reversed in assembly, which in several cases brought to the attention of the R. B. LAB, have been the cause of the non-operation of reflex sets. In shielded transformers, it is impossible to determine the correctness of terminal connections by inspection. Measuring the resistance of the windings however, or merely testing with telephone receivers and a few dry cells, will identify the windings, the lower resistance or louder click indicating the primary.

If careful inspection of wiring of a reflex receiver, and other logical efforts at trouble shooting are without positive result, test the transformers as suggested, before rebuilding.

IN USING tickler regeneration, remember that approaching the tickler coil to the secondary will increase signal strength only when the tickler is connected in the correct direction. If increasing the coupling decreases the strength of the signals, the leads to the tickler should be reversed.

Lack of regeneration on either possible tickler connection generally indicates a partially short-circuited secondary, the lack of a bypass condenser in the regenerating plate circuit (across phones or primary of audio transformer), or a tickler coil of the wrong size, that is, too small or too large.

THE Pyratek fixed crystal detector clips nicely into the standard grid leak mountings. Only one mounting is furnished with each Pyratek detector, and the use of the grid leak holder facilitates experimentation with additional sets without the expense or necessity of extra cartridges.

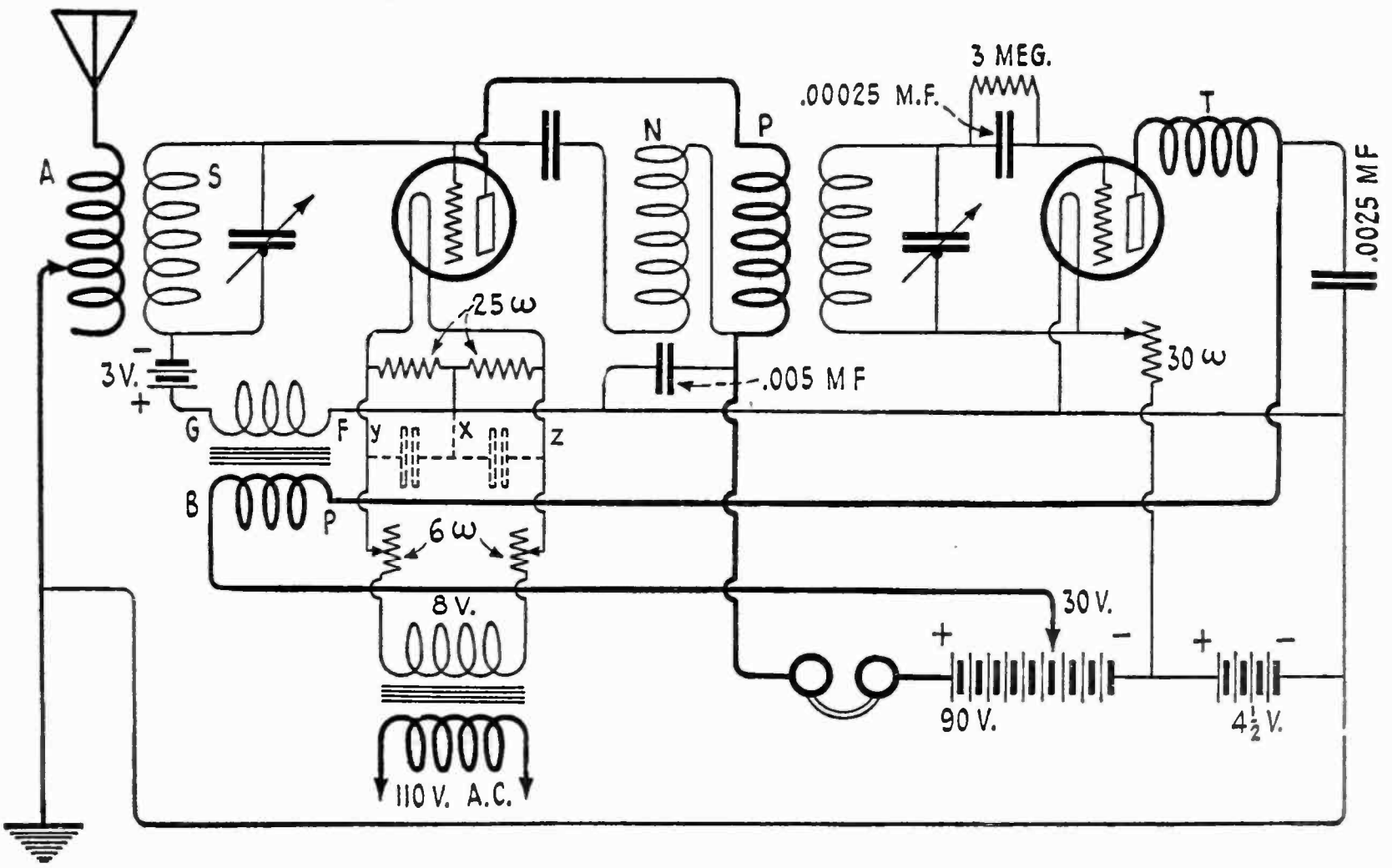
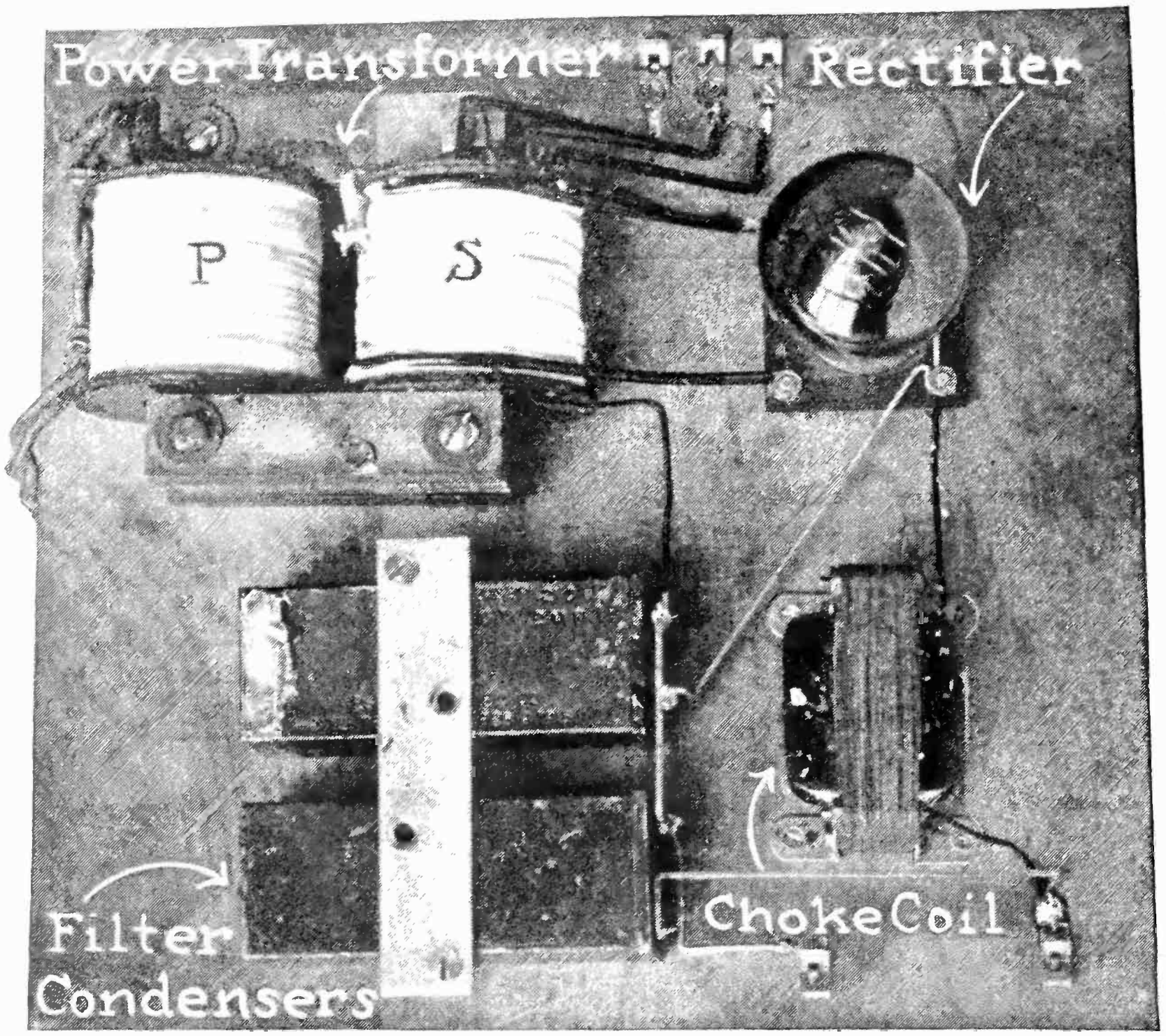


FIG. 10

Operating the amplifying filament in the Roberts set from step down alternating current



How to Make a Plate Supply Unit

A Very Simple and Inexpensive Device Furnishing Up to 200 Volts Without the "Hum"—The Parts Cost about $20 and are Readily Obtainable

BY ROLAND F. BEERS

THE problem of supplying B battery potential for modern multi-tube radio receivers has rapidly become one of importance to every broadcast listener. When the plate current of present-day amplifying tubes attains a value of 12 milliamperes per tube (as in the W. E. 216-A), the current drain imposed by several of these tubes will shorten the life of dry cell B batteries to a few weeks. The cost of replacement alone soon becomes prohibitive.

It is the object of this article to describe in detail a device for supplying B battery voltage for any number of tubes and for any voltages that may be desired. The choice of voltages remains with the builder who can best determine his own requirements. The device is designed to operate from the 110 volt 60 cycle light socket and will deliver up to 100 milliamperes of plate current. In other words, this current supply set will supply plate current for 12 UV-201-A or 8 W. E. 216-A tubes, or

any number of tubes less than this. It will also supply any radio-frequency amplifier and a well-balanced two-stage audio-frequency amplifier with alternating current for heating the filaments. The set may be built by any one who will follow the plans carefully, and the total cost of parts, including the vacuum tube rectifier, should not exceed $20.00.

The general arrangement of the apparatus may be seen on page 268, which is a photograph of one of the sets constructed by the author on a circuit board. Fig. 1A shows the schematic diagram of the parts and the electrical connections. The parts include a power transformer which transforms the 110 volt alternating current from the ordinary light socket to 130 volts alternating current and to 6 volts alternating current for the filament supply of vacuum tubes. The 130 volt alternating current is then changed into a pulsating current which flows in one direction only, by means of the vacuum tube (VT), Fig. 1A. An efficient filter (indicated by dotted lines, and including the choke coil (L) and two filter condensers (C) smooths out the ripples in the unidirectional current, giving an unvarying source of direct current at 120 volts potential, which will operate the receiver in place of the usual batteries without hum. If a crystal detector is used, the entire current supply may be obtained from the light socket. If it is desired, a dry-cell detector may be employed in place of the crystal.

The arrangement illustrated in the photograph need not be followed exactly, but care must be taken in assembling the parts in order to insure short leads in wiring. The necessary parts and their approximate cost are listed below.

Simple, Cheap, and Efficient

In September, RADIO BROADCAST described the LeBel rectifying unit for supplying the plate voltage to radio receivers. The popularity and demand for such a device were manifested in the enormous amount of mail we received.

Mr. Roland Beers developed in his laboratory at Binghamton, New York, the very complete unit here described. Mr. Beers tells us there are seventeen of his units already in use in Binghamton. From our inspection and test of this apparatus we can unequivocally say that it will come up to the expectations of the most exacting of constructors.

Mr. LeBel's device was limited, in construction, to those versed in the art of electrical design or to those who were fortunate enough to order the necessary parts "before the rush."

With Mr. Beers's unit there are no possible restrictions or conditions. Most of the parts for this device may be obtained from the local electrical or hardware store. It is extraordinarily inexpensive to build.

—THE EDITOR.

PRACTICAL AND SPECIFIC DESIGN

THE writer has thought it well to describe in detail a practical and specific design for a complete current supply set, and then to indicate such deviations from this design as may be made for the sake of utilizing whatever spare parts the constructor may have.

We will first consider the construction of the power transformer. Its purpose, as we have indicated before, is to change the 110 volt alternating current to such voltages as we need for our use. For this purpose, we have four separate windings, each easily made. These windings are placed on two of the legs or branches of the core, as illustrated in Fig. 1. The core of the transformer is built up of strips or laminations of silicon steel .014 inches thick. The material for these strips can be bought at electrical supply houses, or it may be obtained from an old pole transformer which can often be had for the asking at the

1 lb. No. 28 double cotton covered wire	$1.50
½ lb. No. 34 black enamel or double silk wire	.90
½ lb. No. 18 double cotton covered wire	.50
½ lb. No. 34 black enamel or double silk	.90
2–No. 21–D Western Electric 2 mfd. condensers or 4–No. 133 Federal 1 mfd. condensers at $1.00	4.00
4 lbs. .014 in. silicon steel for power transformer	1.00
3 lbs. .014 " " for choke coil	.75*
1–V. T. Socket	.50
1–VT–2 or 216–A or UV–201 or UV–201-A or UV-203	4.00
5–8 Fahnestock clips	.15
	$14.20

*May be omitted if the builder desires to buy his choke coil ready-made.

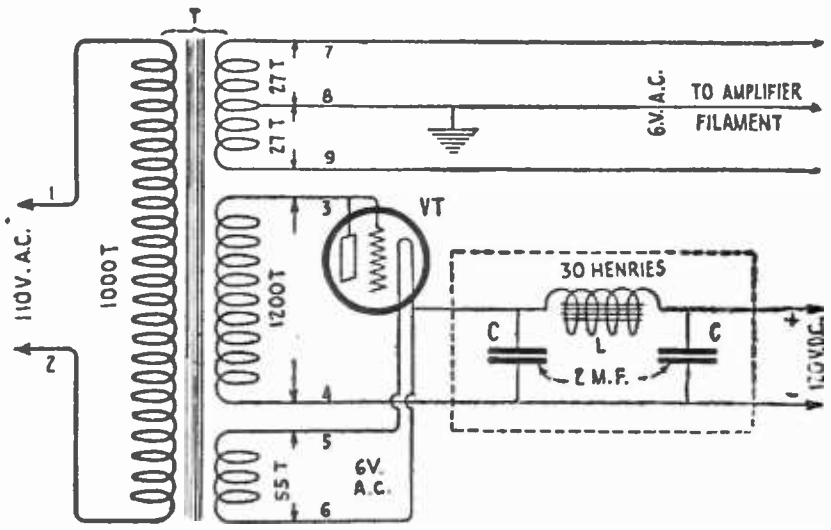


FIG. 1 A

A schematic diagram of the current supply set showing the values of the elements

electric light company's office. The thickness of the steel is not of great importance, although material of much greater thickness than that indicated will cause the transformer to run up the electric light bill rather fast.

Strips 1 inch x $3\frac{1}{2}$ inches are cut from the steel with a pair of tinner's shears to make a pile about 4 inches high when they are pressed together. This pile will require about 300 pieces, which can be assembled in the manner shown in Fig. 2. It may occur that the laminations procured from the old power transformer have dimensions very near to those given here, and in such a case, they may be used as they are. A variation of 10 per cent. plus or minus will not be of consequence. When the strips have been prepared, they are laid aside ready for use after the transformer windings have been completed.

The windings of the transformer consist of the following:

1. Primary—1000 turns No. 28 D. C. C. wire, placed on one leg of the core, as shown at P in photograph. This winding has two ends or terminals, numbered (1) and (2), as shown in Fig. 1A.
2. Secondary—1200 turns No. 34 black enamel or D. S. C. wire, placed next to the core on the opposite leg of the transformer, as shown at S in Fig. 1. Two terminals numbered (3) and (4), Fig. 1A.
3. Secondary—55 turns No. 18 D. C. C. wire, placed over winding No. 2. Two terminals, (5) and (6), Fig. 1A.
4. Secondary—27 turns No. 18 D. C. C. wire, placed over winding No. 3.

This winding is made of 27 turns of a twisted pair, which will be described below. There are three terminals, including the center tap, which are numbered (7), (8) and (9), Fig. 1A.

The writer constructed a spool to contain each set of windings, as shown in the photograph and in Fig. 4. While this construction is not absolutely necessary, it makes a neat job and facilitates the problem of high voltage insulation. Another method of constructing the windings will be given later, for the benefit of those who prefer to make form-wound coils.

MAKING THE TRANSFORMER

FOR the spools, two pieces of micarta or fiber tubing $1\frac{1}{2}$ inches inside diameter and $2\frac{7}{16}$ inches long were fitted with fiber ends $3\frac{1}{4}$ inches outside diameter. (These dimensions correspond to the core described above.) The ends were secured to the tubing with cement, and holes were drilled in them for the lead wires of the various windings, as shown in Fig. 4.

One spool contains the entire primary winding, No. 1. The wire may be wound on by hand, or the spool may be clamped in a drill chuck by means of a long bolt and two large washers. The handle of the drill chuck may be clamped in a vise and the winding is ready to start. If the ratio of turns of the drill chuck to the crank are known, it will reduce the labor of counting turns. Simply count the number of revolutions of the crank and mentally multiply by the ratio every time a multiple of ten is reached. Before actually starting the winding of the fine wire, solder a four foot length of flexible insulated wire to the end of the magnet wire and insulate it well with a short piece of cotton sleeving or spaghetti. Wind at at least one full turn of the heavy wire around the spool, tie it in place with string, and proceed with the rest of the winding. It is not necessary to keep the wire in flat layers provided it is kept tight and free

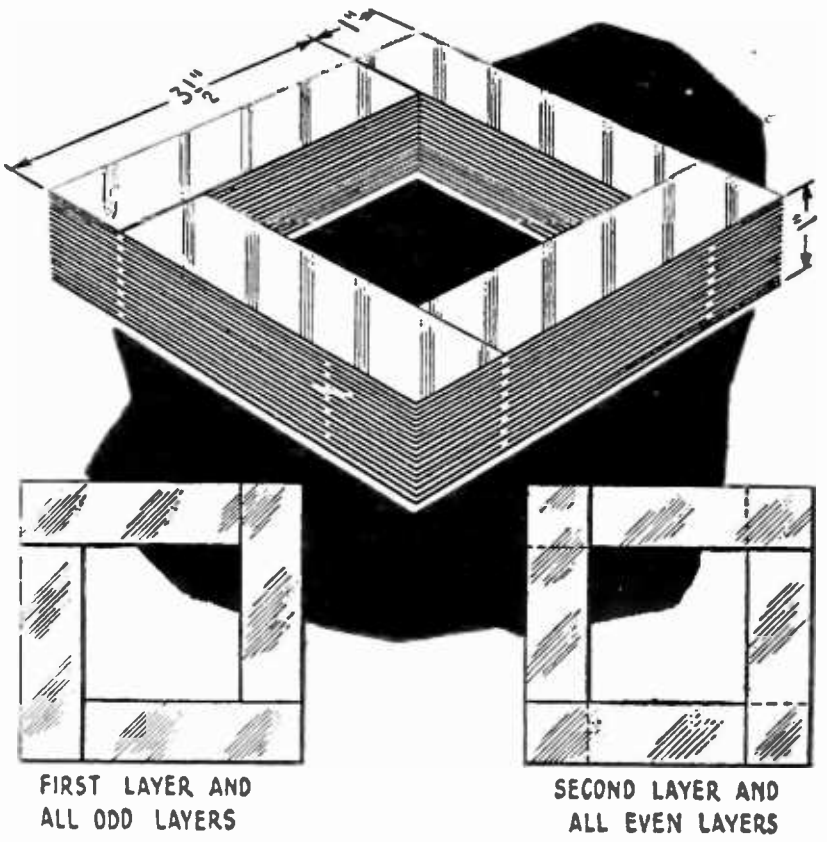


FIG. 2

Which shows the method of assembling the laminations in the core of the power transformer

from loops that are apt to protrude beyond the edge of the spool heads. If the winding gets rough or "bumpy," remove the rough part and wind it over again.

When the required number of turns has been placed on the spool, again solder a flexible lead wire to the end of the fine wire, insulate and tie it in place with string. Now carefully wrap six layers of muslin or three layers of Empire cloth over the winding, and cement the last layer in place with insulating cement. We are now ready to proceed with the second spool, which contains the three secondary windings.

OTHER WINDINGS OF THE TRANSFORMER

WINDING No. 2 is wound exactly as was No. 1, with regard to insulation of the leads. It must be wound in smooth layers, and extra care must be taken to keep layers from overlapping. It may be necessary for the constructor to place thin strips of paper between layers of wire as they are wound, but no more papers should be used than are absolutely necessary. When this winding is completed, six layers of muslin or three layers of Empire cloth are fastened in place over it, and the third winding is started.

The third winding should be wound in two smooth layers without papers between the layers. In case the second layer is not completely full, the remaining space may be used for the fourth winding, which is applied directly over winding No. 3. The leads of the third and fourth windings are brought out at the same side of the spool head, while those

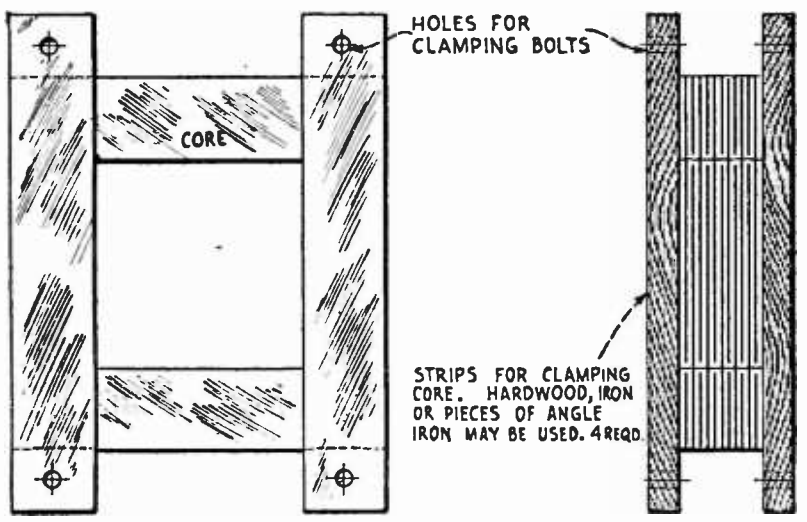


FIG. 3

Detail drawing showing how the clamping plates for the transformer or choke coil are made and attached

of the second winding are brought out at the opposite side of the spool head.

The fourth winding is made of a twisted pair of wires and is used to supply 6 volt alternating current to the filaments of the amplifier tubes. If more than one audio-frequency amplifier tube is supplied with alternating current for heating the filament, the hum will be noticeable, unless special precautions are taken to balance the amplifier

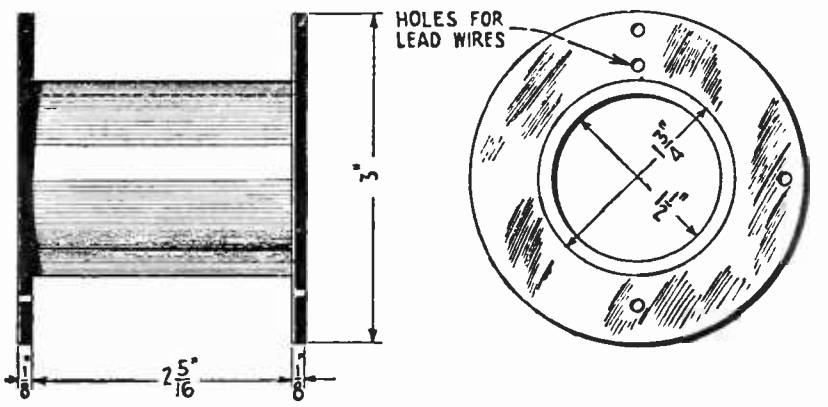


FIG. 4

Detail drawing of the spool for the transformer windings which may be of micarta or phenol fiber. Two are required

for inductance and capacity. Any inherent unbalance or tendency to "howl" will at once produce a loud hum in the loud speaker when all filaments are supplied with alternating current. For that reason, the experimenter should be thoroughly familiar with his audio amplifier before he attempts to supply the filaments with A. C. If this supply is not desired the fourth winding may be omitted. Should the constructor desire to use an Amrad s tube as the rectifier, the third winding will also be unnecessary.

To make the twisted pair, stretch out about $\frac{1}{4}$ lb. No. 18 D. C. C. wire in two strands of equal length. Fasten the looped end over a hook and secure the two loose ends in the chuck of a hand drill. Several turns of the drill will give a neat and uniform twist to the pair, which should be of the order of three twists per inch. The looped end of the twisted pair can now be cut, leaving two separate conductors which have uniform magnetic coupling with respect to each other. Let us call one wire of the pair, wire "A," whose initial and terminal ends are, respectively, (a) and (b). The second wire we shall consider to be wire "B," with corresponding terminals, (c) and (d). The ends, (a) and (c) will be at one end of the twisted pair, and ends (b) and (d) will be together at the other end. By connecting a dry cell and an electric buzzer or doorbell in series, leaving the remaining buzzer circuit open, we can soon determine which wire of the pair is "A" and which is "B." Simply connect terminal (a) to the battery and touch one or the other of the terminals (b) and (d) to the buzzer until the circuit is completed. When the buzzer

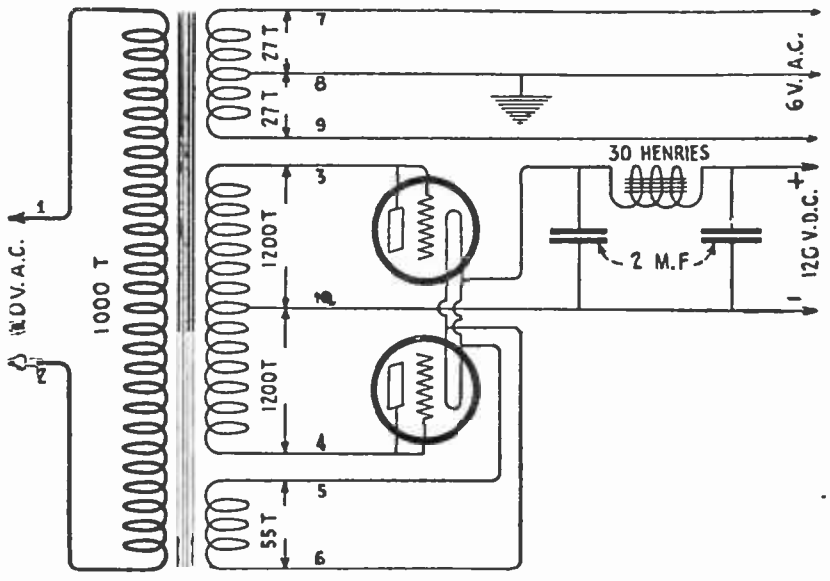


FIG. 5

A diagram showing the schematic layout of the circuit connected as a push pull amplifier using UV–199 tubes where heavy plate current is drawn

operates, the terminal which completed the circuit should be marked with a tag as terminal (b). The remaining terminals are, of course, (c) and (d).

After the twisted pair has been wound on the spool, terminals (b) and (c) are twisted together and soldered. A flexible lead is soldered to the joint, which is conducted to terminal No. 8, Fig. 1A. This point is the zero potential or ground point of the amplifier circuit. All grid return and plate return leads of the amplifier must be connected to this ground, which must also be connected to earth. Terminals (a) and (d) are connected to No. 7 and No. 9, respectively, Fig. 1A, as the 6 volt alternating current supply of the amplifier. The fourth winding is insulated with six layers of muslin or three layers of Empire cloth, as before, and the spools are ready for assembly on the core.

FINAL TRANSFORMER ASSEMBLY

AFTER the windings have been completed and properly numbered with tags, the steel strips may be inserted in the spools and the core clamped together. It will be best to alternate the position of the lapped corner, every time a new layer of laminations is applied, as shown in the small sketches of Fig. 2. When near the top of the pile, compress the core as much as possible, and squeeze in as many strips as can be forced into the spools. After all the laminations have been put in the core, it is ready for the clamping plates. These are made of strap iron or hard wood, as shown in Fig. 3. Four strips are cut to the size required by the core, leaving at least one-half inch at each end for clamping holes. Stove bolts are passed through these holes, which may be drilled with a $\frac{1}{4}$ inch drill, and the clamping plates are screwed down tightly when the core is completely assembled. It is important to clamp every lamination in place as tightly as possible in order to reduce the possibility of mechanical vibration. Such a vibration will often make a very unpleasant hum in the room where the set is being used and will confuse a discriminating observer so that he will believe the hum is produced in the loud speaker.

A physical conception of the action of the filter may be gained from the following explanation. The large capacity condensers (C) in the diagram of Fig. 1A afford a comparatively easy path for alternating current, which is what we are trying to eliminate by the use of our filter. With every change in direction of the alternating current, a certain amount of electricity is carried through the large condensers and back to the system. The choke coil, (L), permits direct current to flow through it with no opposition except the direct current resistance, but offers a large inertia or impedance to the ever-changing alternating current. On account of this opposition to the alternating current, it seeks an easier path through the condensers, and back to the line. The result of our filter action is that we have sifted out, so to speak, the undesirable alternating current, which produces the hum, and have left a pure, uniform direct current, exactly like that delivered by our dry cell B batteries.

The choke coil for the filter may be constructed as indicated below, or it may be purchased from a well-stocked electrical supply house. The value of its inductance should not be less than 30 henries. Values as high as 50 henries may be used with excellent results. The direct current resistance should not exceed 750 ohms, although a value greater than this will only serve to decrease the output voltage.

HOW TO BUILD YOUR OWN CHOKE COIL

THE following dimensions will serve those who wish to build their own choke coil. Strips of .014 ″ silicon steel are cut 1″ x $2\frac{1}{4}$″ to make a pile 4″ high. This will require about 300 pieces. Four hardwood or strap iron strips 1″ x $3\frac{3}{4}$″ are cut and drilled for the mounting holes, as was done in the case of the power transformer. Spools may be constructed for the windings, if desired, or they may be placed directly over the two opposite core legs, after they have been wound with three layers of Empire cloth. The spools may be made of micarta or card-

board tubing $1\frac{1}{2}$" inside diameter and $1\frac{3}{16}$" long. Spool heads are cut to fit the tubing $1\frac{5}{8}$" outside diameter. The coil has two windings, each of 3500 turns of No. 34 black enamel or double silk covered wire, and each wound in the same direction. Flexible leads are provided for the terminals exactly as was done for the power transformer. The inner end of one winding is soldered to the outer end of the other winding, and the joint is insulated with cotton sleeving or "spaghetti." Six layers of muslin or three layers of Empire cloth are wound over the completed windings to protect them from damage. The core pieces are then inserted in the spools, but instead of lapping the corner joints, they are simply butted up against each other as neatly as possible. When the entire core has been assembled into a square form, the clamping plates are put in place and carefully tightened up.

Each of the condensers used in the filter circuit should be of at least 2 mfd. capacity. Larger condensers may be used with some improvement in the efficiency of the filter. It is not necessary to have two condensers of the same capacity, but each must be of at least 2 mfd. As high as 5 mfd. can be used with good results. The condensers should be tested for leaks before placing them in the circuit by charging them with a high voltage B battery and then discharging them after 15 minutes. If they are in good condition, a fat spark will jump when they are discharged. If no spark jumps, they are defective, and will short-circuit the B voltage.

The rectifier tube used most commonly by the writer is the Western Electric E tube or VT-2. This tube is probably as well suited for the purpose as any tube except the special rectifier tubes, such as the G. E. kenotron-UV-216 or the s tube, each of which costs more than a VT-2. Other tubes that have been used with good results are the W. E. 216-A, the UV-202, UV-201, and the UV-201-A. Such changes as are necessitated by the use of a tube other than the VT-2 are indicated below.

MOUNTING

THE apparatus illustrated in the photograph was mounted on a circuit board 12" x 12". Fahnestock clips may be used for terminals, or if it is desired, the conventional type of binding post may be adopted. All wiring should be as short and as direct as possible, and all joints should be soldered butt joints. Wires which carry 60 cycle current may be reduced to their absolute minimum length with considerable improvement in the performance of the set. If difficulty is experienced in reducing 60 cycle hum in the receiver, it may be reduced by wiring all 60 cycle leads with lead covered cable.

The writer has constructed several current supply sets in the usual manner and has had difficulty in obtaining satisfactory operation of them on particular installations, even though they gave perfect satisfaction on his own receiver (super-heterodyne). The difficulty usually lay in one or more places which became conspicuous after several preliminary tests. If the current supply set causes a terrific hum in the loud speaker when it is connected to the radio receiver, several possible errors may exist. We shall assume that the set is wired up correctly and that there are

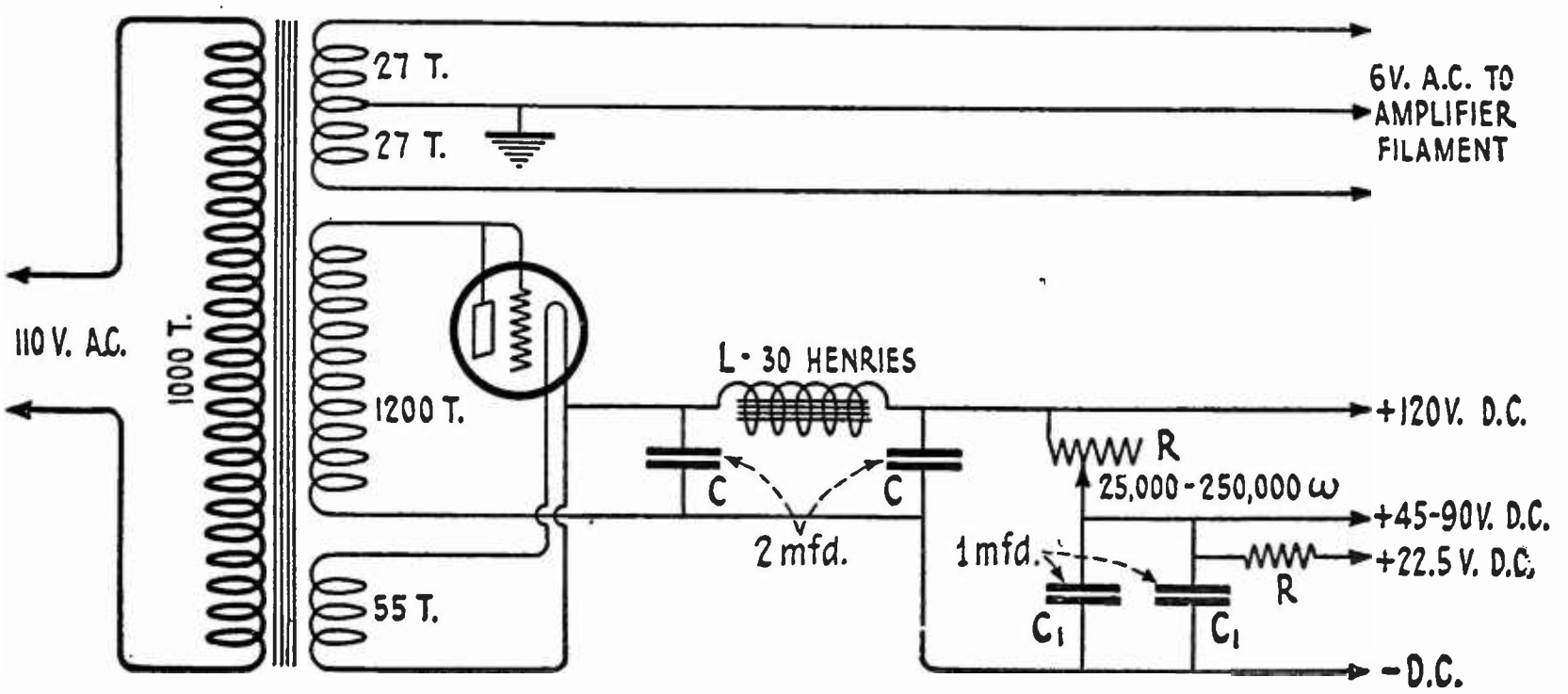


FIG. 6

How variable and multiple voltages may be obtained with the current supply set. The values of the parts are indicated

no open circuits. First of all, it will be necessary to choose both rectifier and amplifier tubes with care. In the writer's experience, bootleg tubes are the most frequent cause of trouble. Some VT-2 tubes will give excellent performance, while others simply will not function. The same applies to the UV type tubes, and in general, relief from the disturbance may be had by testing and finally selecting tubes that will reduce the hum.

Another source of trouble is often found in excessive amplifier or rectifier filament voltage. The number of turns given in the constructional data was correct for a large number of the tubes used by the writer, but frequently it was necessary to add or remove turns from the third or fourth windings in order to obtain good results. A rheostat should *not* be used to regulate these voltages, unless it is a primary rheostat, placed in series with winding No. 1. The proper method of obtaining the correct filament voltage is to alter the number of turns on the respective windings, adding or removing turns one by one until the correct value is found. This change should be made while the set is supplying current to the receiver, if possible, in order to duplicate actual conditions.

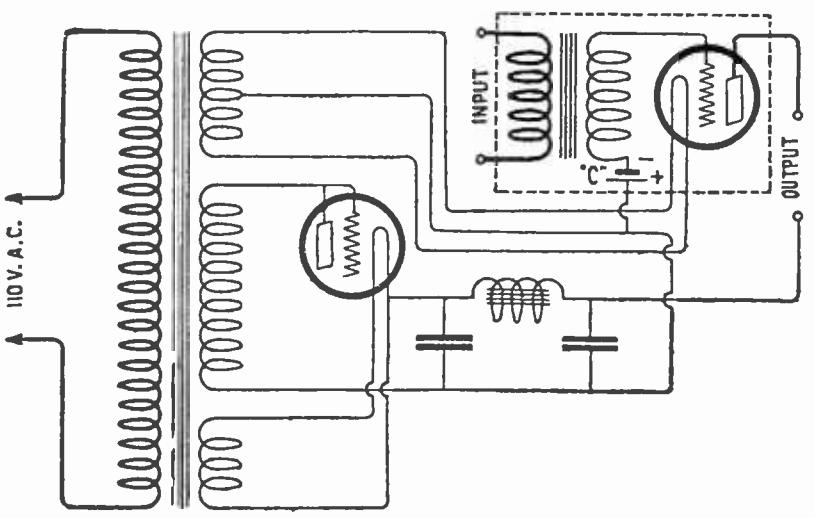
AVOIDING THE HUM

ANOTHER source of hum is frequently found in excessive plate voltage. This trouble may be remedied by the insertion of a lavite or other current-carrying resistance in the plate supply. The writer has used Western Electric No. 38 type and the Bradleyohm with good results. Ward-Leonard resistances are also known to have given good results. The value of the resistance can best be determined by trial with the tubes which are receiving the excessive plate voltage. Another method of reducing the plate voltage is, of course, to remove turns from the high voltage or second winding, until the proper voltage is obtained. Still, another method of reducing the hum caused by excessive plate voltage, and perhaps the most satisfactory one, is to increase the negative C voltage until quiet operation prevails. The writer has used as high as 20 volts negative C battery on a Western Electric tube with 150 volts on the plate. Other tubes will require correspondingly more or less C voltage. It is sufficient to say that under ordinary circumstances it will be very difficult to obtain quiet operation of a radio receiver supplied with alternating current filament supply unless a fairly high C battery is employed.

A fourth source of disturbance is often found in the stray flux or leakage of alternating current magnetism from the cores and wires of the current supply set. An amplifier that has some inherent unbalance or tendency to "howl" will invariably exhibit a loud hum when supplied with alternating current, although it may appear perfectly stable when supplied with direct current. The remedy in such a case is to place the entire current supply set in a tin or iron shield, and to connect the shield to earth. Fig. 7 shows a view of a current supply set connected to a two-stage amplifier, where it was necessary to shield the entire supply set. Here all leads were shielded with lead covered sheath, and the entire shielding system was grounded. Any iron box may be used to contain the set, such as an old panel switch box, biscuit tin or other tin container. Holes may be cut in the box to accommodate the socket and leads, and these should be very well insulated to prevent arcing of the high voltage.

SUGGESTED POSSIBLE ALTERATIONS

IT MAY be that the constructor already has laminations or a core from an old power transformer that he would like to use. In such a case the following remarks will be helpful. The primary requirement is that the inductance of the primary winding shall be not less than one henry. This means that for a 1000 turn winding the ratio of cross-sectional area to length of magnetic circuit ($\frac{A}{e}$) should be not less than 0.6 centimeters, and for normal saturation of the core the cross-sectional area should be not less than 2.5 sq. cms. Values in excess of these will result in good performance. If the values of A and $\frac{A}{e}$ vary greatly from those given above, a new value for the number of turns must be found to give the proper value for the primary



A SCHEMATIC DRAWING

Which shows the connections for the unit when a power amplifier circuit filament is supplied with alternating current

inductance. It will probably be better in such a case to remodel the core to the dimensions given by the writer. Such a problem is best left to the judgment of the constructor.

There are obtainable on the market certain choke coils that could be used in the filter circuit. The Acme Apparatus Company sells a good C. W. choke that gives excellent results in the filter circuits of amateur transmitters. Such a choke will give good performance in the current supply set, but is probably more costly than the builder would wish. A more reasonable choke coil has been recommended by G. M. Best in the June, 1924, Radio. That coil is the General Electric Wayne No. 179,541 Bell Ringing transformer, whose primary winding is said to have a high inductance. The writer strongly recommends building one's own choke coil, in order to obtain sufficient inductance. The coil described above will have an inductance somewhat in excess of 30 henries, depending upon the care with which the core is assembled.

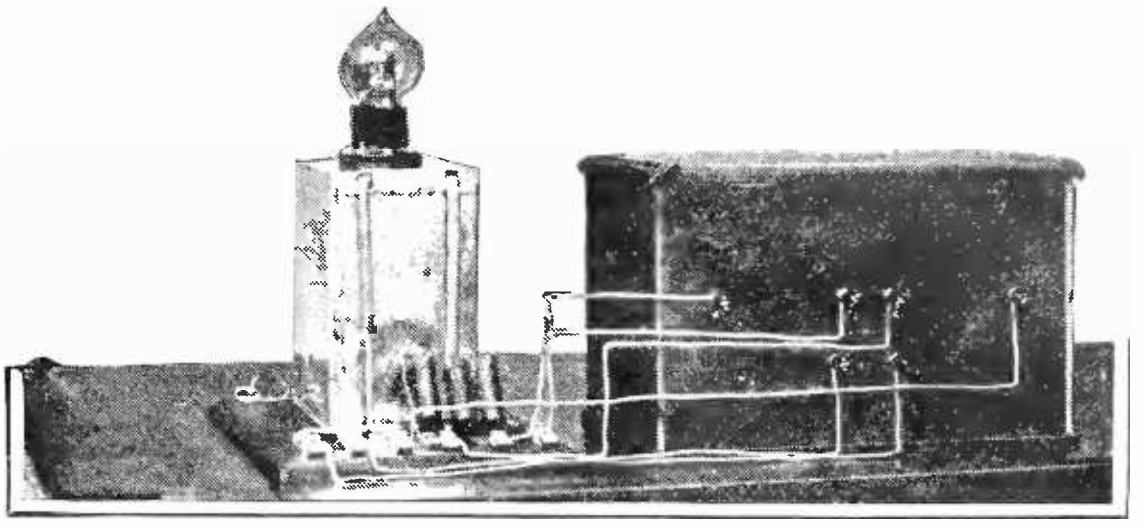


FIG. 7
Another set-up of the current supply set

A WINDING FORM

IF THE experimenter does not want to make spools for the windings, he may make a winding form as follows:

Cut a square block of soft wood the same cross-section as the core leg which is to contain the windings. Save room on each end in which to drive a spike for holding the form and clamping it in the winding rig. Then wrap the wooden form with two layers of heavy string in smooth layers which will extend $\frac{1}{2}''$ beyond the ends of the winding. Over the string wrap two layers of Empire cloth and cement the end in place. Begin the winding with flexible stranded wire (insulated) and continue this heavy wire for one quarter turn. Proceed with the winding of the smaller wire, placing thin papers over each layer until it is completed, and allowing each paper to extend $\frac{1}{8}''$ beyond the edge of the winding. Continue to build up the coil in this manner until the last layer is completed. The outside lead wire should occupy at least one quarter of the last layer of winding and the end should be firmly tied in place with string. Wrap over this layer three layers of Empire cloth and cement the end fast.

The two layers of string underneath the winding may now be carefully unwound, and the coil carefully slipped from the form. *Very carefully* wrap one layer of friction tape around the outside and inside of the entire coil, carrying the end of the tape through the center of the winding each time until the entire coil is made into a firm and substantial structure. The completed coils may be slipped over the legs of the core and the laminations will hold it in place. In this method of winding, it will be necessary to assemble three legs of the core first, leaving the fourth leg open to permit putting the windings in place. The remaining strips may be assembled and the core may be bolted together.

If UV-201 or UV-201-A tubes are used in the rectifier or amplifier circuits, windings No. 3 and No. 4 should consist of 48 and 24 turns, respectively. If 50 milliamperes or more are to be drawn from the set, using UV-201-A or UV-201 tubes, their life will be considerably shortened. It will then be necessary to use two such tubes in parallel, or the full-wave rectification, push-pull circuit may be adopted, as shown in Fig. 5, and the high voltage winding No. 2 must contain twice the number of turns previously specified. Each high voltage winding is wound in exactly the same manner as before, except that each winding occupies but half the spool on which the windings are placed. They are best wound by placing a divider in the middle of the spool, which is the same size and material as the spool heads. Each section of the divided spool will be of the same size and will contain the same number of turns, i. e., 1200. The two windings are wound in opposite directions to each other, bringing the outer end of each winding to the center of the spool, near the divider, when completing the last layer of each winding. The two adjacent ends, each an outer end of its respective winding, are then connected together and soldered, and this point is the

negative terminal of the plate supply system, as shown at (10) in Fig. 5. It is the electrical mid-tap of the secondary winding, provided care has been taken in placing the same number of turns on each half of the spool.

For UV-202 rectifier tubes, winding No. 3 must consist of 68 turns, instead of the number previously specified.

SUBSTITUTING FOR THE ELECTRON TUBE

IF THE builder wishes to use an s tube in place of the electron tube, the third winding may be omitted. It will be necessary to increase the number of turns of the second winding to 4500, and special precaution must be taken to prevent voltage rupture of the coil. In this event, a larger winding spool must be used, and the size of this can be determined by trial after the core has been cut out. Spool heads $3\frac{1}{2}''$ outside diameter will accommodate the increased number of turns, and the winding should be broken up into at least four sections, each separated from the others by a micarta separator, of the same size and shape as the spool heads. With this change, the builder can adapt the s tube to his use. Considerable resistance will necessarily be inserted in the plate supply, which may be determined by trial. Probably a minimum of 20,000 ohms will be required, as suggested by C. J. LeBel in the September RADIO BROADCAST.

THE SET DELIVERS 120 VOLTS

THE writer has indicated a secondary winding No. 2 to give 120 volts direct current, but this value may be altered to suit the builder's particular needs. The set illustrated in the photograph actually delivers 200 volts, which are applied to the plate of a power amplifier tube. Western Electric lavite resistances are inserted in series with the positive plate lead to give lower voltage values. The set illustrated in Fig. 7 delivered 120 volts, 90 volts, 45 volts or 22.5 volts, as might be required.

Multiple voltage may be obtained by the use of the proper resistance inserted in the plate lead. The method indicated on page 371 of the September RADIO BROADCAST by C. J. LeBel will be found to be satisfactory and still another method is shown in Fig. 6, and illustrated in Fig. 7. In this method, high resistances are placed in series with the positive B battery voltage, causing a drop of the desired amount. Fig. 7 show three Western Electric No. 38-B lavite resistances connected in series, with taps taken off at the desired points. The writer has also used the Bradleyohm with good results. The variable control of the Bradleyohm will be found useful in varying the detector plate voltage on soft tubes. Any number of resistances can be connected in series, taking taps off wherever desired, so that the proper voltages can be obtained. If any difficulty is experienced in eliminating hum when multiple voltages are employed, it may be eliminated by the use of proper by-pass condensers of 1 mfd. or 2 mfd. capacity shunted around the various taps. This is illustrated in Fig. 6, at C′, where a 1 mfd. condenser is shown connected across the 45 volt tap.

FOR OTHER SUPPLY FREQUENCIES

IN THIS article, all construction details apply only where the usual 60 cycle A. C. supply is available. The unit described will not function properly in its present form when used on any other frequency. However, the author, in anticipating the demand for details from those fans whose supply is 25 cycle A. C., gives the following constructional changes. The first consideration is that the cross-sectional area of the cores for the transformer and for the choke coil will have to be doubled, while the lengths would remain the same. The detailed changes, including spool dimensions, are as follows:-

Transformer core—600 laminations $1'' \times 3\frac{1}{2}''$ outside measurements $4\frac{1}{2}'' \times 4\frac{1}{2}'' \times 2''$ high cross-section $1'' \times 2''$ high.

Spool made of fiber or red rope paper built up of several layers and cemented together with Ambroid cement—inside measurements $1\frac{1}{16}'' \times 2\frac{1}{16}'' \times 2\frac{7}{16}''$ long.

Rectangular spool heads $3\frac{1}{4}'' \times 4\frac{1}{4}''$ with window to accommodate rectangular spool.

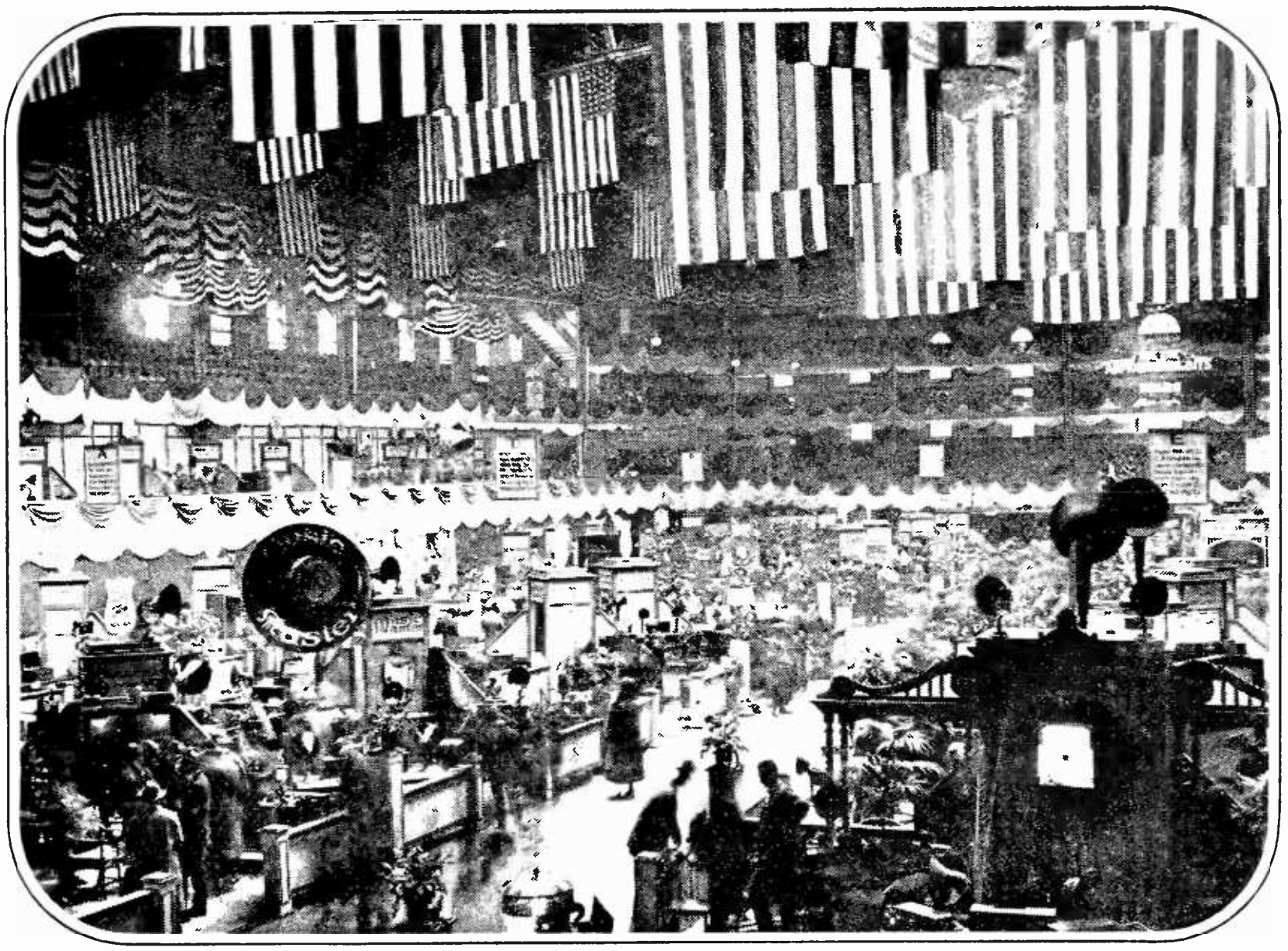
Choke coil core—600 pieces or laminations $1'' \times 2\frac{1}{4}''$
outside measurements $3\frac{1}{4}'' \times 3\frac{1}{4}'' \times 2''$ high cross-section $1'' \times 2''$ high.

Spool made up as above—inside measurements $1\frac{1}{16}'' \times 2\frac{1}{16}'' \times 1\frac{3}{16}''$ long.

Rectangular spool heads $1\frac{5}{8}'' \times 2\frac{5}{8}''$ with window to accommodate spool.

The turns of wire must remain the same as specified in the article, but it will take about thirty per cent. more wire for the windings in each case.

Where a 40 cycle supply is the only available one, it is necessary to increase the cross-sectional area of the cores one-third. Details of core and spool construction would be varied accordingly. —THE EDITOR.



THE FIRST RADIO WORLD'S FAIR

At Madison Square Garden, New York. A large overflow display filled the 69th Regiment Armory across the street. A wealth of new radio apparatus was shown here, including new loud speakers, great numbers of sets with radio-frequency amplification, and reflexing.

A Few Ideas and Ideals

Being a Brief Outline of Our Policies Regarding Some Subjects Heretofore Discussed in Whisper or Behind Closed Doors

By ARTHUR H. LYNCH

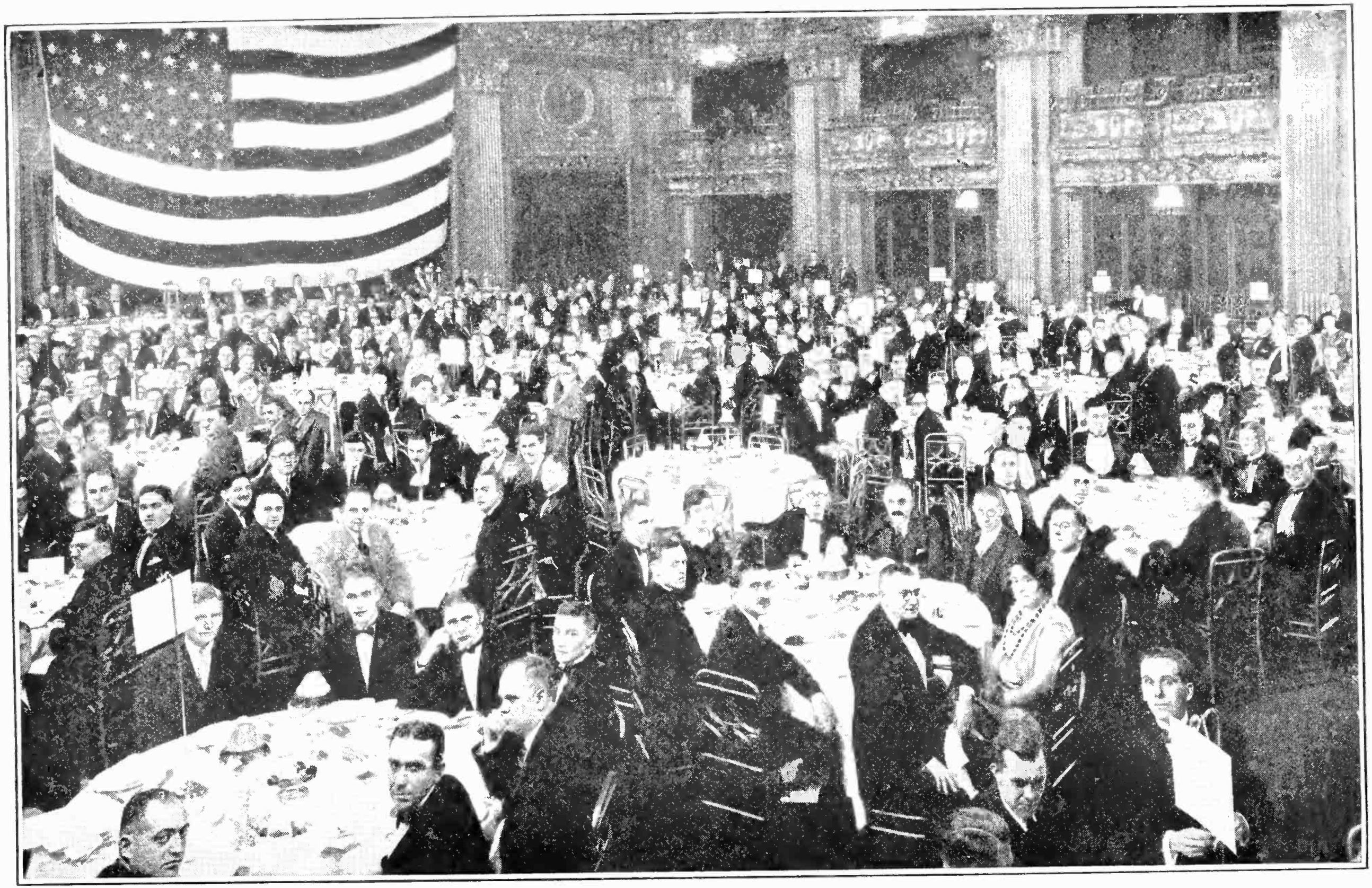
NOT once, but many, many times, have we been asked: "If these receivers that you tell how to make really do the wonderful things you claim for them, how the mischief do you square yourselves with the manufacturers of ready-made receivers who advertise with you?

At first thought that would be a rather difficult question but upon a little serious consideration it isn't. Let us get right at the facts as they are.

There are, at present, more radio publications than at any previous time in the history of the art. In the aggregate, more space is devoted to so-called "how-to-make-it" articles for public consumption than ever before. The proportion of space devoted to such articles as compared to general articles is increasing in most publications.

Many publications have realized the folly of giving space to the description of questionable receiver designs and, for the most part, the man-in-the-street can really build a good receiver from the design he finds in present day publications.

More people are building receivers at home than at any other time in radio's history. Schools are teaching students how to build radio receivers. Boy Scout Camps are doing likewise. The dealers all over the country are doing a tremendous business in parts. And, in the face of all the above *there are*



THE BANQUET OF RADIO DEALERS, MANUFACTURERS, AND JOBBERS AT THE HOTEL WALDORF, NEW YORK

more complete receivers being sold than ever before.

Such a *resumé* might lead to no conclusion, if it were not for the fact that the popularity of radio reception is based almost entirely upon publicity. Judging from the foregoing, the increased sale of complete receivers might be considered as nothing more than a result of the very rapid growth of the entire business were it not for the additional fact—at least most of those in a position to judge believe it a fact—that the proportion of home-made to ready-made receivers is gradually decreasing.

HOME AND FACTORY BUILT SETS

AND, having considered these facts, let us proceed with the explanation of our stand in the matter. Our first argument is that the more home-built receivers there are, the greater will be the demand for those of factory make. Every person who builds a radio receiver that works well is enthusiastic. A thousand people in a small town may see and hear Bill Jones' one-tube bringing in concerts from stations all over the country. They're impressed and many of them will want a receiver of their own. Many of them wouldn't be satisfied with one like Bill Jones'. If he can build one for a few dollars and it works so well, why just imagine what a real set would do, is the way many of them reason. Others wouldn't be bothered making a receiver even if they had the time or were as smart as they figure Bill must be. Still others would like Bill to make a similar receiver for them, but most Bills are too busy with other things to warrant such work. Many manufacturers, who spend thousands of dollars a year advertising their products owe a great deal of their success to the start they got from a how-to-make-it article in some magazine.

Our readers have learned that when we say a receiver is capable of specified performance, our statements are usually very modest. They have learned that we describe only such receivers as we really believe to be good and that we don't care a hoot who manufactures the parts. We believe that the publication of good how-to-make-it articles is of direct benefit to the manufacturer of complete receivers.

THE HOW AND WHY OF THE KNOCK-OUT SERIES

EVER since RADIO BROADCAST came into being, a little more than two and a half years ago, it has waged a relentless war against radiating receivers because its editors as well as it publishers were convinced that the sale of high-grade receivers would ultimately suffer if "birdies", the pipings from such receivers, were allowed to fill the air. There was, we felt sure, plenty of natural interference, without adding more to it with the sale of every receiver.

For many months we searched for a receiver or group of receivers that would perform as well as those against which we were preaching, but the task was a great one. We tried all kinds of circuits, all kinds of tubes, everything we could lay hands on, but found nothing which would compare, let alone prove any better than the squealers, until, in the laboratory of a small radio company in New York we came upon the single-tube reflex receiver which has since become famous as our one-tube Knock-Out Receiver. It has been performing for more than a year now and hardly a mail comes in that fails to carry some commendatory expression upon the results being obtained by some reader who has built it.

You may be interested in a little story about this receiver. We saw it perform in the laboratory in New York but did not believe it would do as well in Garden City. We made a bet with John Meagher, who built the original model, that he could not make it operate a loud speaker at our plant. The bet was a hat. He brought the receiver out and lost. However, there is a great deal of electrical interference in our plant and we compromised by giving him an opportunity to demonstrate the receiver in our home, increasing the bet to two hats. He came; he did it; we lost two hats.

We would have been satisfied to hear the locals on the loud speaker. You may well imagine our surprise when we were able to hear three stations in Chicago, four in Philadelphia, and two in Cleveland with a single 199 tube on the speaker—not loud enough to dance to, it's true, but with enough volume to be understood thirty feet from the speaker when there was quiet.

Using this circuit, which, by the way, was not new—merely a very clever adaptation of an old idea—we have gone ahead with the development of the Knock-Out receiver idea. There are now one, two, three, and four-tube receivers, which we believe—and no one has ever shown any desire to compete with us—tube for tube and dollar for dollar, better than any receiver described for home construction in any publication up to the time they appeared.

CAN YOU HELP?

WE HAVE spent months improving these receivers; we're working hard on a new one now. Perhaps you can help to solve the problem. We want a three- and a four-tube receiver employing the Roberts circuit with a stage of transformer-coupled audio amplification and one with a stage of push-pull, made with regular cylindrical coils in place of the spiderwebs we are now using. This is due to the fact that our two, three, and four-tube receivers, employing the Roberts circuit are increasing in number so rapidly, that it is difficult to procure the spiderweb units.

This problem is not so easy as it may appear. Substituting the antenna coupling arrangement usually found in a neutrodyne and a rewound vario-coupler, would, it would seem, turn the trick. In fact they do work out quite well, when used in the two-tube circuit, or when resistance-coupled amplification is employed, but with the use of a stage of transformer-coupled audio, there is very noticeable distortion.

Several receivers have been sent us by manufacturers who thought they had solved the problem. They had, to a degree. We have hooked up several such receivers and they worked perfectly. Then we've changed the tubes or made some other changes which would be done in practice. Then the circuit wouldn't work.

But that's more or less in the future. Let's see what the Knock-Outs have done in the past. Briefly we may list their work as follows: They have

Given more satisfaction per tube than any other receivers for home construction.

Overcome the tendency toward the building of radiating receivers by performing better.

Improved the quality of receiver designs offered to the public by setting so high a standard that "trick circuits" could not keep pace.

Stimulated the sale of reliable parts.

Reduced the selling arguments necessary because their performance is internationally recognized.

Because of their excellent tone quality and ease of adjustment, brought radio to the attention of prospective buyers in an entirely new and better light.

Offered the manufacturer, dealer and jobber, a most sound method of sales promotion for the standard parts he has in stock, without favoring any one assisting the entire industry.

COÖPERATIVE COMPETITION

ONE of the outstanding features of the First Radio World's Fair recently held in Madison Square Garden and the 69th Regiment Armory in New York City was the love feast of competitors—a banquet held in the Grand Ball Room of the Waldorf-Astoria Hotel and attended by several hundred manufacturers, jobbers, and dealers. It was a fitting tribute to the advance made during the past few years in the industry at large.

Here, under the same roof—in many instances, at the same table—aye, even at the speakers' table—were the representatives of organizations which have law suits pending between them. When such organizations can, even for a single night, forget their controversies, meet on friendly ground and break bread together, we feel sure that much good may be accomplished.

Nor was the banquet the sole indication of the desire to get together. There were meetings of various trade, publicity, manufacturing, broadcasting and press associations which were conducted on a much more friendly basis than we have ever seen before. With everyone trying to coöperate we feel that the possibility of a huge business this winter is increased immeasurably.

Form 1204

CLASS OF SERVICE	SYMBOL
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Day Letter	Blue
Night Message	Nite
Night Letter	N L

If none of these three symbols appears after the check (number of words) this is a telegram. Otherwise its character is indicated by the symbol appearing after the check.

WESTERN UNION

TELEGRAM

NEWCOMB CARLTON, PRESIDENT GEORGE W. E. ATKINS, FIRST VICE-PRESIDENT

CLASS OF SERVICE	SYMBOL
Telegram	
Day Letter	Blue
Night Message	Nite
Night Letter	N L

If none of these three symbols appears after the check (number of words) this is a telegram. Otherwise its character is indicated by the symbol appearing after the check.

RECEIVED AT

llny sx 4o

SANPEDRO CALIF 12op sept 22 1924

ARTHUR H LYNCH

EDITOR RADIO BROADCAST

RECD CABLE THIS MORNING CONFIRMING TWO WAY COMMUNICATION HELD WITH NEWZEALAND FOUR A A BELL TWELVE TWENTY TO ONE FORTY SUNDAY MORNING RECEIVED ON ROBERTS LOW WAVE RECEIVER AS PER ZEH BOUCK DOES THIS INTEREST YOU SIX B C P

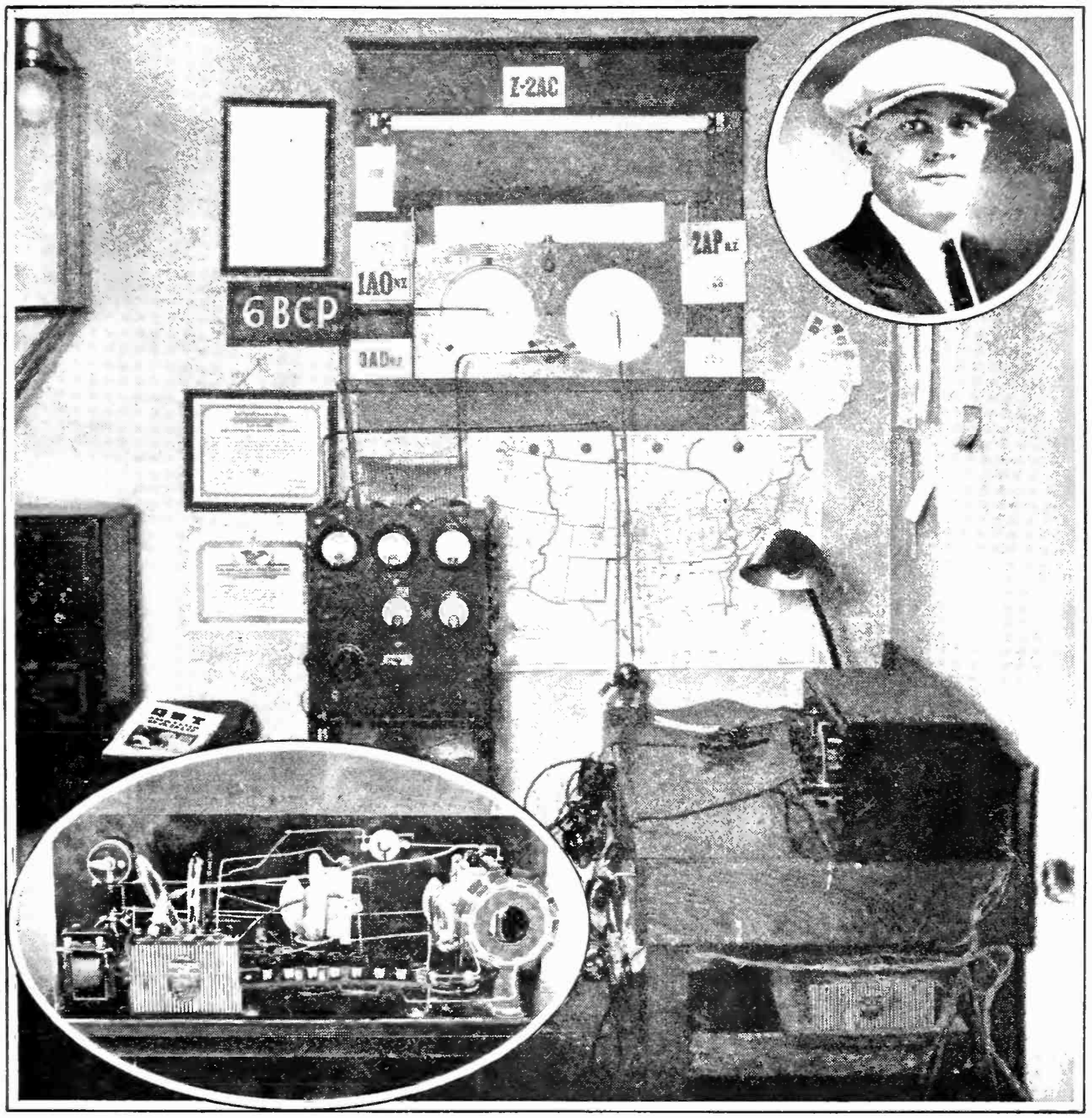
W V MAGNER

836a

REQUIESCAT IN PACE!

TO US, who have labored long in the preaching of the golden rule in radio receiving, no other one thing could be quite as satisfying as witnessing the almost entire absence of squealing receivers at the Radio Fair. At last, the gospel seems to have hit home and many erstwhile sinners have gone and got religion.

All manner of tuned ra



W. V. MAGNER, OF SAN PEDRO CALIFORNIA

And his apparatus at his amateur station 6 BCP, with which he communicated for an hour and a half with New Zealand operator Bell, 4 AA on the night of September 21. The insert shows his receiver, a Roberts short wave Knock-Out, built according to the article by Zeh Bouck in the August RADIO BROADCAST. Mr. Magner established a world's record when his transmission was made, for the distance was 6,900 miles.

frequency receivers, reflexes, super-heterodynes were here and it is safe to say that the number of squealers was in the proportion of less than one to ten and nearly all those in evidence were not in the form of completed receivers, but samples displayed by a few parts manufacturers who have not yet learned that the cutting off of one's nose to spite one's face is a healthy business.

INPUT

THE WORLD'S RECEIVING RECORD

ONE astounding accomplishment following closely on the heels of another is quite vogue in radio. Perhaps no greater evidence of technical advance may be cited than the remarkable feat in long-distance communication with lower power between an amateur in California and another in New Zealand—6,900 miles. Mr. Magner not only established communication, but carried on an uninterrupted conversation for an hour and a half.

The telegram reproduced with this article tells the story completely. We are proud of Bell and proud of Magner. They are *amateurs!* amateurs who are in radio because they love it who are doing the radio field much good and who are getting returns from their work as well.

A Selective High Mu Receiver

This Very Sensitive Receiver Does Not Radiate, Can Be Operated on a Ten-Foot Antenna and Made from Easily Accessible Parts—A Companion Receiver to Those of the Roberts Knock-Out Series

By G. H. BROWNING

EVERYONE is inquiring, "What kind of a set can I build without using six or eight tubes and at the same time get the selectivity and sensitivity of the super-heterodyne?" The set to be described is not claimed to be better than a "super" on a loop, but it is claimed that if rightly constructed and operated it will perform better in many ways than most neutrodynes.

This set is built around an efficient tuned radio-frequency transformer so designed that the theoretical amplification predicted by a mathematical treatment of the circuit is very closely approached. The circuit using the radio-frequency transformer is not new, in fact it is almost the same as that used by Walter Van B. Roberts.

In August of last year, Mr. F. H. Drake suggested that a mathematical consideration of a circuit using a tuned radio-frequency transformer might throw some light on the constants which would give the greatest amplification. Accordingly, he and the author set to work, and by a theoretical treatment not only predicted the amount of amplification which might be expected, but also showed the tendency of the input circuit to break into oscillation when the transformer was tuned. The sharpness of tuning and selectivity were also considered, and a number of interesting points brought out.

Having solved the circuit, the next difficulty encountered was to build a radio-frequency transformer which would measure up to the predicted values. This was not easy, for there were many factors which tended to keep down the efficiency of such an instrument. The most outstanding, however, was early recognized to be capacity coupling between the primary and secondary, for, as this induced a current in the secondary which is not in phase with that induced by means of the magnetic coupling, the resultant transfer of energy is much decreased. The design which minimized this effect is shown in Fig. 1—the primary being wound in a narrow channel cut in a short wooden cylinder, which fitted closely inside the secondary. Laboratory measurements on the transformer when used with a UV-199 tube, as shown in Fig. 2, proved that the actual gain obtained was very close to the theoretical. The curves shown in Fig. 3 represent the measurements, where amplification is plotted against wave-lengths. The amplification is found by measuring both the input and output voltages of the UV-199 tube and transformer combined, and dividing the output by the input.

A shows the theoretical gain of this combination, while B comprises the measured values obtained after the proper design was found. For comparison C is shown, which represents the same tests performed on a UV-201-A tube and a radio-frequency transformer commercially made for a neutrodyne circuit. This last test was made upon request of Mr. Volney D. Hurd, Radio

The Reason Why

This circuit is very similar to the Walter Van B. Roberts Knock-Out described in our September, and previous numbers, with the exception that reflexing is not used. It is, perhaps, somewhat easier to build and spider-web coils are not employed. The High Mu set is not an improvement over those we have described before, but it is a bit simpler in construction. It can be used with a comparatively short antenna, such as a ten foot wire thrown on the ground, and therefore is even more portable than a loop receiver. We have tested several receivers of this type in our laboratory and have found them particularly satisfactory. Associated with Mr. Browning and Mr. Drake in the development of this receiver was Mr. Volney D. Hurd, the radio editor of the Christian Science *Monitor*.—THE EDITOR.

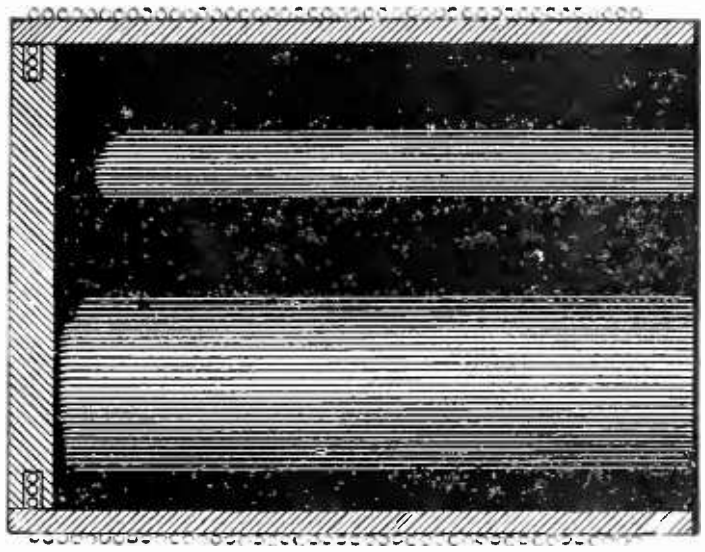


FIG. 1

Editor of the Christian Science *Monitor*, and showed, as we expected, a lack in efficiency.

In developing this transformer without regeneration, the equations obtained indicated that with a "tickler" feed back placed in the plate circuit of the detector tube and coupled to the secondary of the transformer signal strength could be increased three or four times. Accordingly, a set was constructed incorporating this idea with surprising results. Stations 1000 miles or more distant came through with loud speaker volume, using only one stage of audio and an inside antenna about 20 feet long. These results were so gratifying that comparisons were made with several standard make neutrodynes, and it was found that the sensitivity of this set was much greater. It also possesses several distinct advantages which will be taken up after the constructional details have been considered.

DETAILS OF THE CIRCUIT

FIGURE 4 shows the wiring diagram using one stage of audio-frequency amplification which will be found sufficient for most purposes. However, another stage may be added, or, better yet, the output from the first stage may be put into a push-pull amplifier.

C is a .0001 mfd. fixed condenser in series with the antenna, the purpose being to enable long or short antennas to be used. C is connected to the 25th turn of coil Lo.

Lo is a single layered coil wound on a three-inch hard rubber tube, and consists of 50 turns of No. 20 double silk covered wire.

Co and C2 are .0005 mfd. low loss variable air condensers. The ones used in experimenting were made by the National Company and were very good, owing to their extremely low loss and vernier dials. A vernier control is almost necessary as the set tunes very sharply. The rotor plates should be connected to the filament sides of the tubes in order to avoid body capacity when tuning.

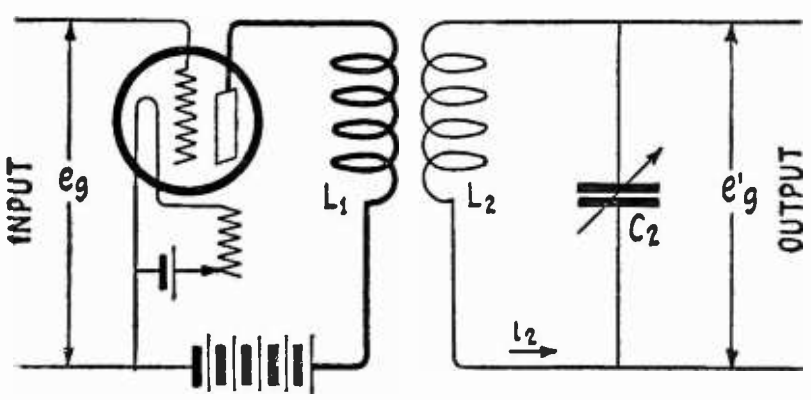


FIG. 2

HOW TO BUILD THE R. F. TRANSFORMER

THE radio-frequency transformer with regeneration, is shown in Fig. 5. A is the flat wooden form which has a groove containing the primary. The groove is about $\frac{1}{8}$ of an inch wide and $\frac{1}{8}$ of an inch deep, in which is wound 24 turns of No. 30 double

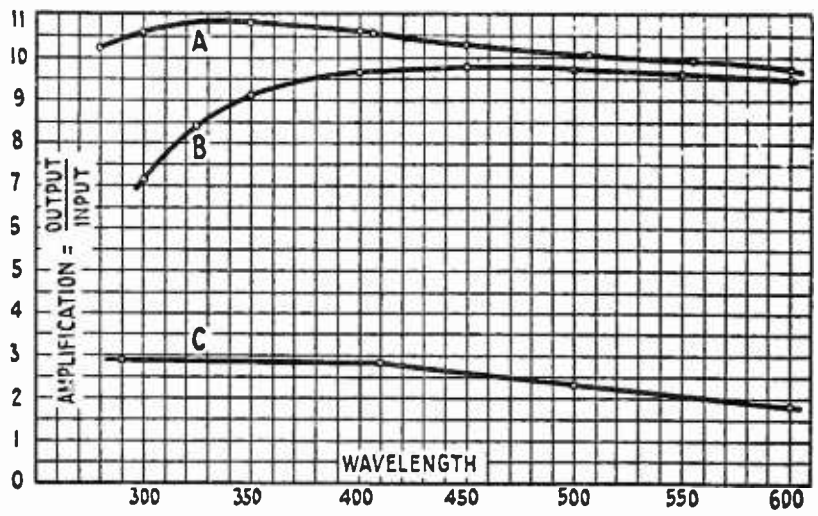


FIG. 3

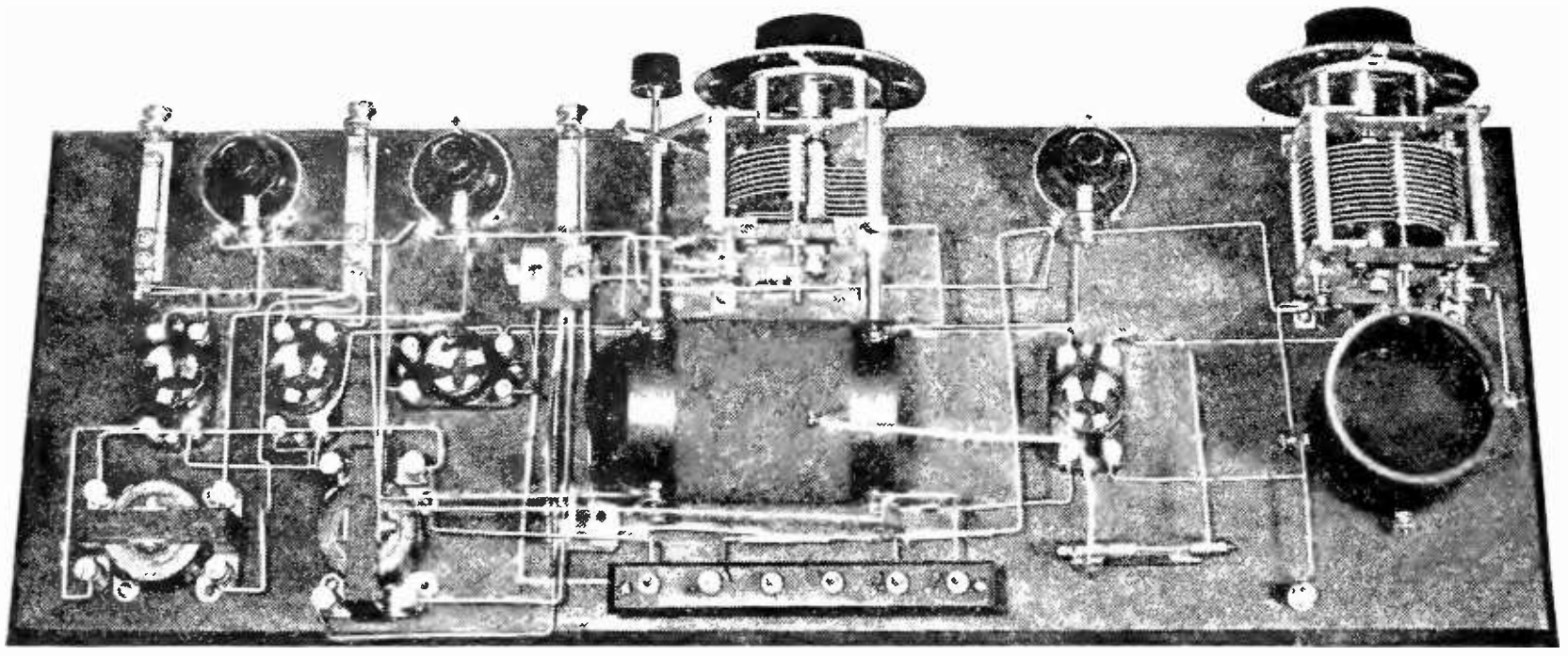
cotton covered wire. B is a 3-inch hard rubber tube wound with 77 turns of No. 20 double silk covered wire. C is the tickler coil. It may either be of the ball rotor type, or may be constructed as shown, from a piece of wood. It is set as close to the end of the secondary as is convenient. On this form is wound 20 turns of No. 28 double silk covered wire.

A patent is pending on the design of this R.F. transformer. Those who manufacture this coil commercially call it a "regenaformer."

L 1 must be placed in the low potential side of L 2 , i.e. the end which is connected to the filament.

Rg , the grid leak is about $2\frac{1}{2}$ megohms, although as tubes vary different values should be tried.

Cg, the grid condenser, has the usual value of .00025 mfd.



A SIMPLE LAYOUT OF THE PARTS

The instruments are spaced generously to allow simplicity in wiring. The constructor can greatly improve on this arrangement

C is a fixed 0.002 mfd. mica condenser used to by-pass the radio frequency.

T is an ordinary audio-frequency transformer of any good standard make.

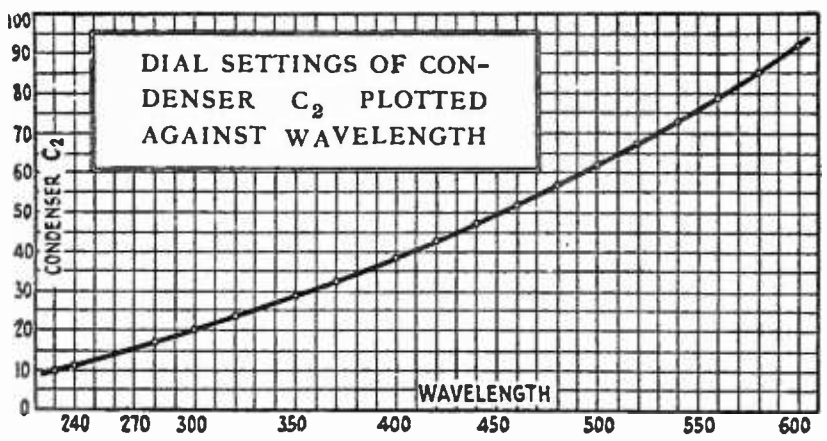
Separate rheostats are shown. However, if UV-199 tubes are used, the radio-frequency amplifier and the audio-frequency amplifier may be operated from the same control.

N.C., the neutralizing capacity, may best be purchased. One plate is connected to the grid of the amplifier, while the other goes to the 18th turn of the secondary of the radio-frequency transformer (18 turns from the end of the coil connected to the filament). This connection may be conveniently made by lifting the 18th turn with a knife, scraping the insulation off, and soldering a lead to it.

DETAILS OF ASSEMBLY

COMMON A and B batteries are used as indicated.

In making connections, the grid leads should be kept short, and well away from plate leads. Be sure that one side of coil Lo goes to the *negative* side of the A battery, while one side of coil L2 goes to the *positive* side of the A battery, as shown. This is important for maximum signal strength.



The curve shows dial settings for various wavelengths of the radio frequency tuning combination when a National .00035 max. mfd. condenser is used

These two coils, Lo and L2, must be mounted at right angles and in such a manner that a line drawn through the axis of one passes through the center of the other. This will be true, if they are both the same distance behind the panel.

The first tube is shown mounted between the two condensers. This is to make the leads carrying the radio-frequency currents as short as possible.

After you have constructed the set according to the directions, the first thing to do is to see whether it is acting normally and is ready to neutralize. Turning the tickler coil should give a "pluck" in the receivers (of course, antenna and ground should be connected, and the tubes lighted to the proper brilliancy.)

LIST OF PARTS

		Approximate Price
2	National condensers with Velvet Vernier dials	$12.00
3	UV-199 tube sockets	2.25
1	Audio transformer	5.00
1	Neutralizing condenser	.25
2	30 ohm rheostats	.60
1	Grid leak and condenser	1.00
3	UV-199 tubes	15.00
2	22½ volt B batteries	3.00
3	Dry cells	1.50
1	.002 mfd. fixed condenser	.40
1	.0001 mfd. fixed condenser	.40
		$41.40

Antenna coil and regenaformer may be constructed, or may be purchased from the National Co.

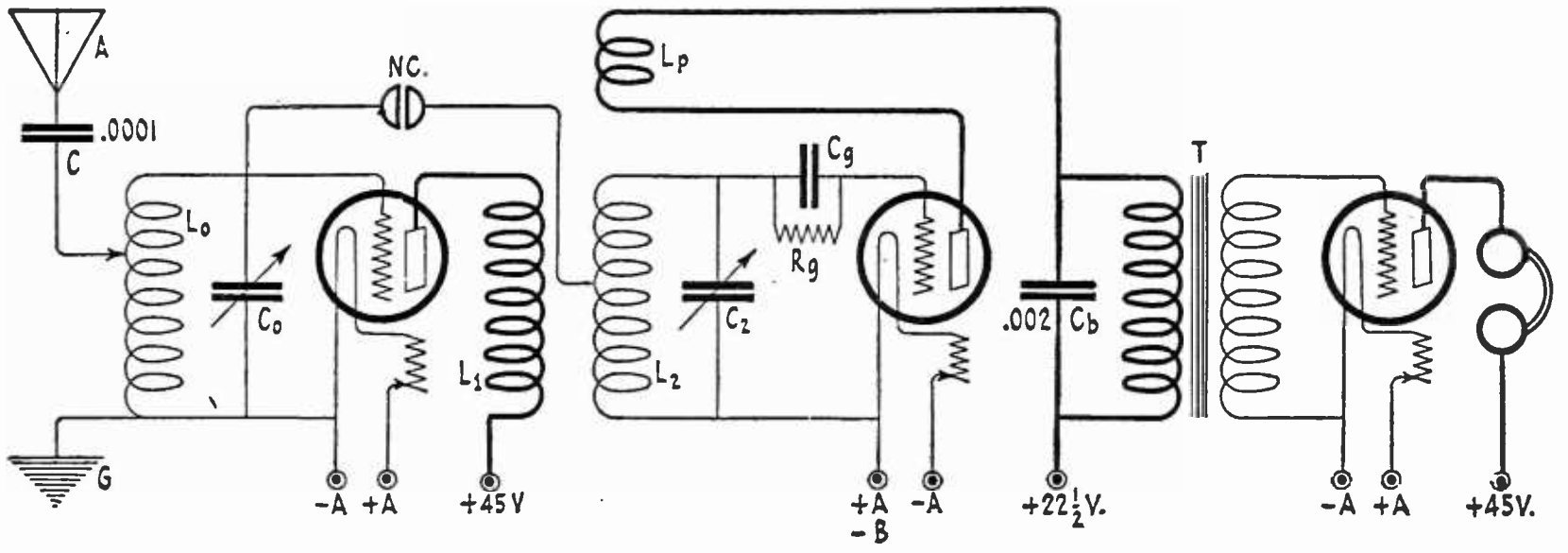


FIG. 4

Circuit diagram of the receiver. One stage of audio is indicated

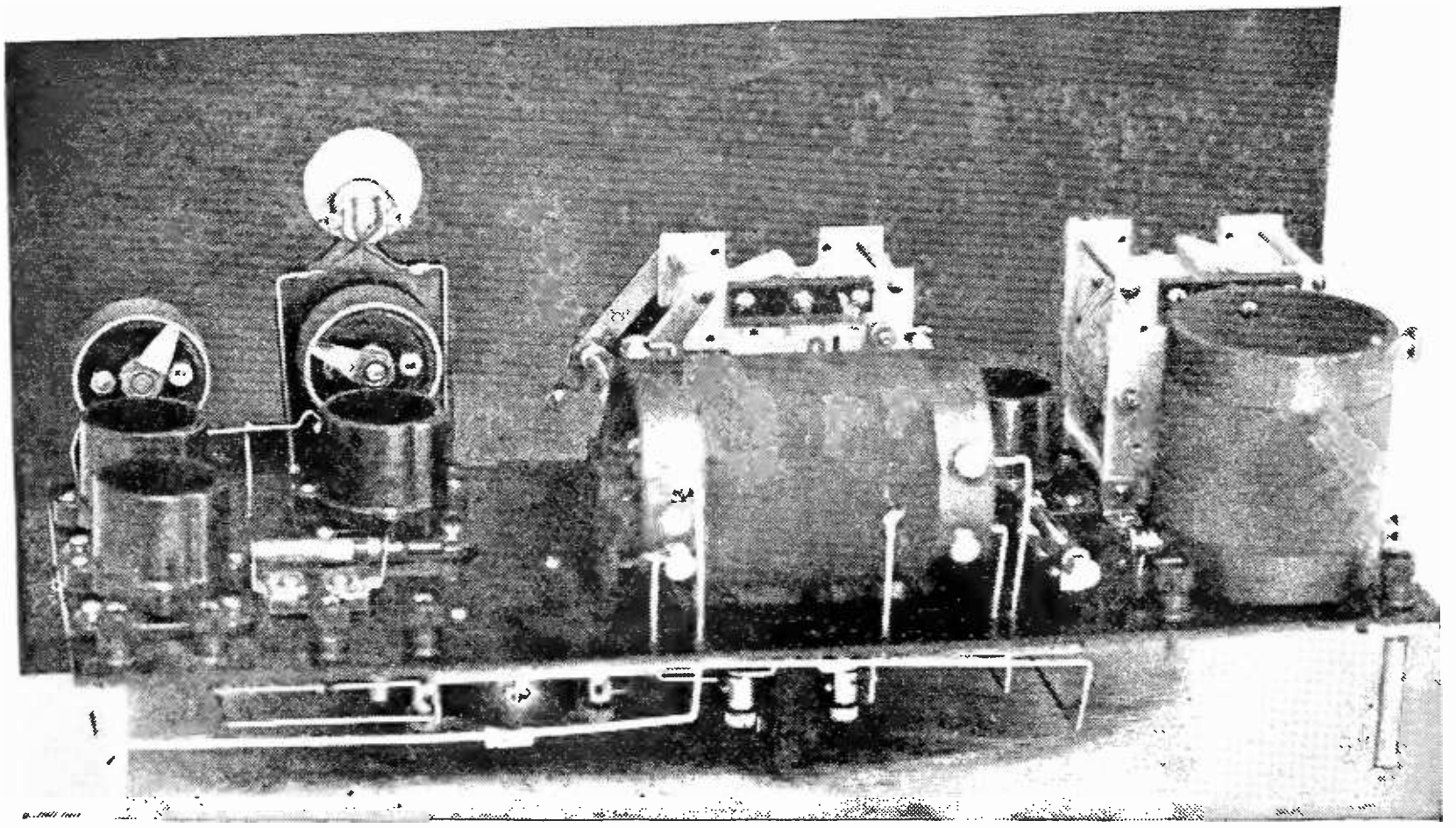
Also, the tickler may be turned to a position where the placing of a moistened finger on the plates of the condenser which go to the grid leak will give the same plucking sound. This is the "finger test" for oscillation. The above tests show that the tickler will perform its function, which is bringing the secondary circuit of the radio-frequency transformer close to the point of oscillation.

When these tests have satisfactorily been performed, the next thing to do is to neutralize the capacity of the first tube so that even if the tickler does make the secondary circuit of the R. F. transformer oscillate, no radiation will be sent out to disturb other listeners.

HOW TO NEUTRALIZE THE SET

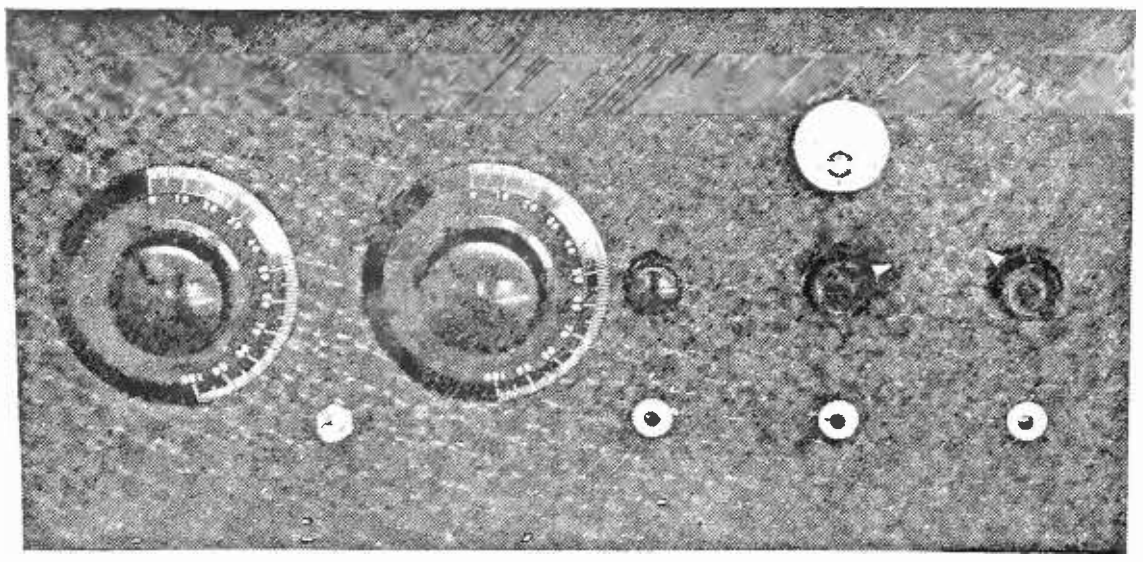
IN ORDER to neutralize the set, a loud signal must be tuned in. Then remove the first tube, stick a piece of paper on one of the filament prongs, and replace it in the socket. An audible signal should be heard when the tube is removed. With the tube in its socket, without the filament lighted, move the neutralizing capacity until the minimum signal is obtained.

In this process, body capacity bothers one considerably, and a stick is very useful in setting the neutralizing condenser to the best value. If no point of minimum signal is found by these adjustments, then the connec-



BEHIND A PANEL

The circuit shown in the diagram above, built behind a panel. This set up uses two stages of audio-frequency amplification



THE PANEL

Of the four tube circuit. A voltmeter to record filament potential is a good addition to the panel equipment

tions of the primary L1 must be reversed and the process repeated. Another method of neutralizing is to set the tickler so that the secondary of the RF. transformer is near the oscillation point, then if turning C to any position gives oscillations the set is *not* neutralized.

The following suggestions as to tuning in distant stations may be helpful. With the tickler coil set at such a position that touching the stationary plates of the condenser marked C2 in the wiring diagram gives a "pluck" in the phones, turn C2 slowly until a whistle is heard. This is the carrier wave of the sending station beating with the wave you are generating in the secondary circuit. Now turn C until the whistle is loudest, adjust Lp, the "tickler," until this beat note disappears, and by very slightly readjusting the two condensers the station will be heard.

THE ADVANTAGES OF THIS RECEIVER

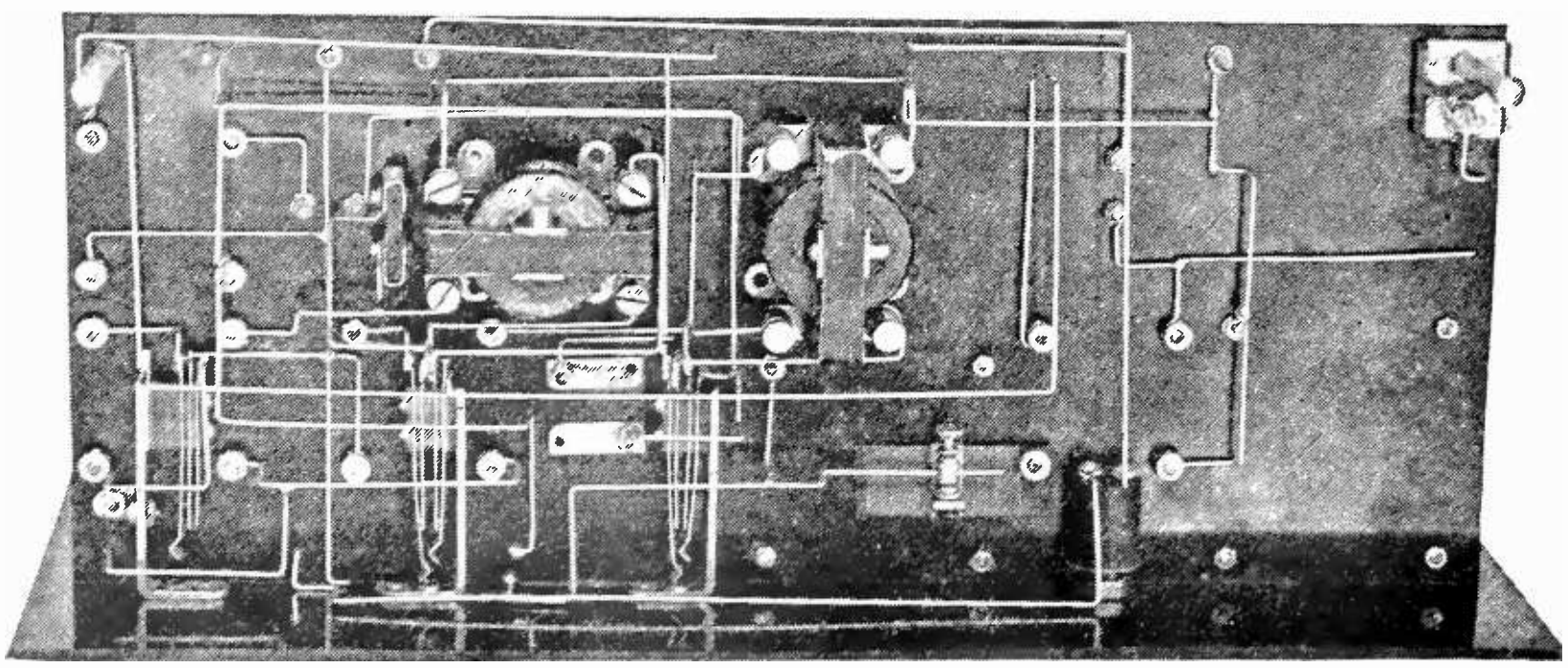
THIS set has several distinct advantages. If it is neutralized at all, there is no radiation whatsoever. This alone is enough to recommend it, as the radiation nuisance at present is sufficient to spoil many excellent concerts.

It is extremely selective, and will bring in distant stations during local broadcasting. One can see how this is possible by referring to Fig. 6, which although it is a resonance curve of the radio-frequency transformer *without* regeneration when C2 only is changed, gives a very good idea of the circuit's selectivity. With regeneration, the set tunes even sharper than is here indicated, and has a much greater amplification, something like 20 or 30 instead of 10.

It is sensitive enough to tune in distant stations which are above the noise level. It should be understood by the readers that when signals get so weak that static and interference are as loud as the signals themselves, no receiver can tune them in.

Tuning is accomplished by obtaining beat notes with the transmitting station, which is much easier and quicker than twisting the dials of a silent set, hoping that the right combination may be found.

The dial readings of condenser C2 may be



UNDERNEATH THE SUB BASE

Is a great part of the wiring in this set up, of which the reverse side is shown on page 285. A much neater wiring job than usual is attained by this method, although it takes some time and care

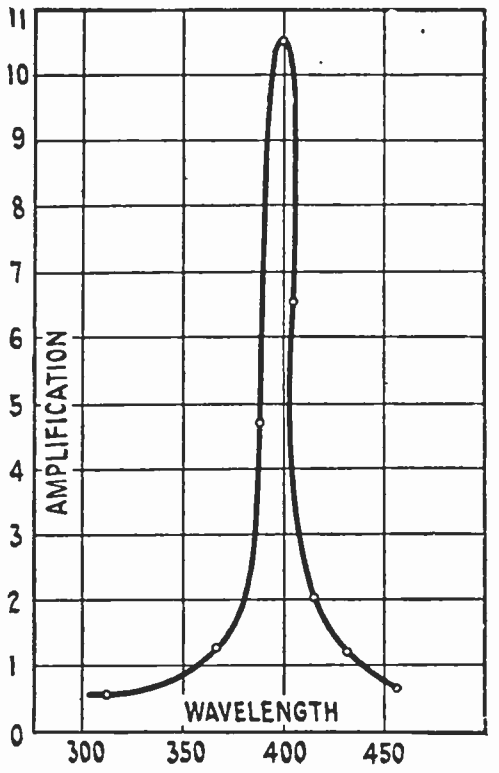


FIG. 6

taken for different stations and will remain the same even though the set is used on different antennas.

In conclusion, it should be stated that the special radio-frequency transformer described is designed for a UV-199 tube, although others whose grid-filament capacity is small may be used. Therefore, the Myers tube should work equally well. However, for the second and third tubes, i.e. the detector and audio frequency amplifier, any good tubes may be used—in fact, more volume can be obtained if a UV-201-A tube is used for the audio-frequency amplifier.

The receiver described is, no doubt, deserving of much more praise than has been given, especially concerning range, non-radiating properties, and quality of signals. However, as hook-ups too highly recommended are almost always looked upon with suspicion, the author hopes that the incentive to construct this set will have resulted from the fact that a design of a tuned radio-frequency has been found which performs as predicted by mathematics.

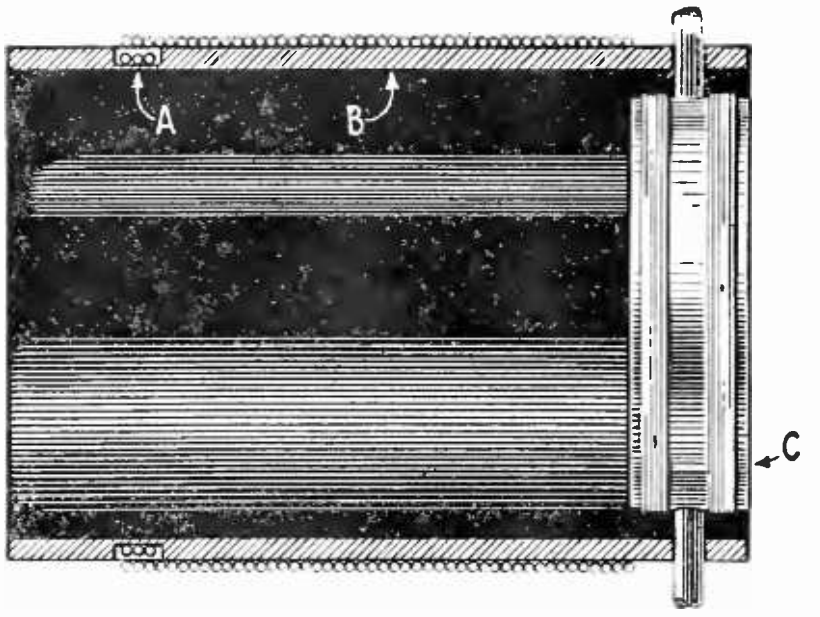


FIG. 5

WHEN YOU HEAR ENGLAND—TELEGRAPH US

DURING the International Radio Broadcast Tests, from November 24th to 30th, a tremendous number of radio enthusiasts are going to be listening for the programs of foreign broadcasting stations. Each evening of the tests, the RADIO BROADCAST LABORATORY at Garden City will be hooked up to London by direct radio connection through the Radio Corporation of America station at Rocky Point, Long Island. We can flash a message to London and have an acknowledgement in less than thirty seconds. When you hear the call letters and program of the foreign broadcasts, step to your telephone and send us a prepaid *telegram with the following particulars: call letters and names of stations heard, degree of audibility, and your own name and address. Both telegraph companies have made special arrangements to rush messages about the tests direct to the LABORATORY at Garden City. Address them RADIO BROADCAST Magazine, Garden City, New York.*

Radio Sets for the Blind

News of a Non-Partisan, Humanitarian Campaign to Put a Radio Receiver in the Hands of Every Blind Person in the United States

BY A MEMBER OF RADIO BROADCAST STAFF

BY THE time this issue of RADIO BROADCAST reaches the reader, the American Radio Association's campaign to put a radio set in every home throughout the United States where there is a blind person who cannot afford to purchase a set, will have gotten well under way. This campaign has the prospect of becoming the biggest beneficial achievement that has crossed the threshold of the radio world. Quick to foresee the immense possibilities for the blind that lay in radio, this young organization rapidly growing in power has stepped to the front and by a touch of the magic wand has actually inaugurated one of the most humane and far-reaching campaigns that has been attempted in some time.

This campaign had its inception in the mind of Alfred M. Caddell, who, when he wrote "A Man Who Built a Set He Has Never Seen," published in the June, 1923, RADIO BROADCAST, determined that he would devote his energy toward bringing radio into the lives of the blind wherever it was possible to do so. As Mr. Caddell aptly put it, the coming of radio meant the dawn of a new found sense for the blind. Later, when he organized the American Radio Association, he saw a means of putting this determination into effect. As secretary of the Association, he invited the coöperation of the American Foundation for the Blind, a national association of associations which minister to the blind, and with that assured, enlisted the coöperation of the New York *Herald-Tribune*, The Chicago *Tribune*, and other newspapers throughout the country in an effort to make the campaign a national success. He formed an Honorary National Committee headed by President Coolidge, and the preliminaries of the campaign began to give way to actual accomplishments.

ALFRED M. CADDELL
Secretary American Radio Association

Inasmuch as the campaign was to be national in scope, it was decided to wait until the Presidential election was out of the air before launching it officially. Therefore the date of opening was set for Thursday, November 6th, when it was launched in the newspapers and by the various broadcasting stations throughout the country. Arrangements have also been made for able speakers to tour the country and appear at the various broadcasting stations.

It is planned that each newspaper participating in the campaign will acknowledge and be responsible for all funds collected by it. The funds will later be grouped into one national total to be spent by the American Foundation for the Blind under the direction of an Advisory Committee, which will in effect be a technical radio committee, on which it is planned the Bureau of Standards will be represented. The money raised will therefore be spent impartially and to the greatest possible advantage. Every dollar that the public subscribes will be spent for the purpose for which the campaign was originated, the administration expenses of the campaign being borne by a man who is thoroughly in sympathy with the undertaking. Moreover, to insure national confidence in the campaign and to account for every dollar turned into the national fund by the newspapers coöperating in the campaign, a well-known firm of public accountants will audit the books and present to the public a detailed certified account of the campaign.

Officially, the name of the campaign will be: "The ARA Radio Fund for the Blind," and the slogan: "Let the sighted help the sightless via radio."

Contributions may be sent directly to the American Radio Association, 50 Union Square, New York City.

Shake Hands With the "R. I."

The Problems, Pleasures, Tribulations, and Experiences of the Department of Commerce Radio Inspector—What Happened During the Years of Radio Growing Pains

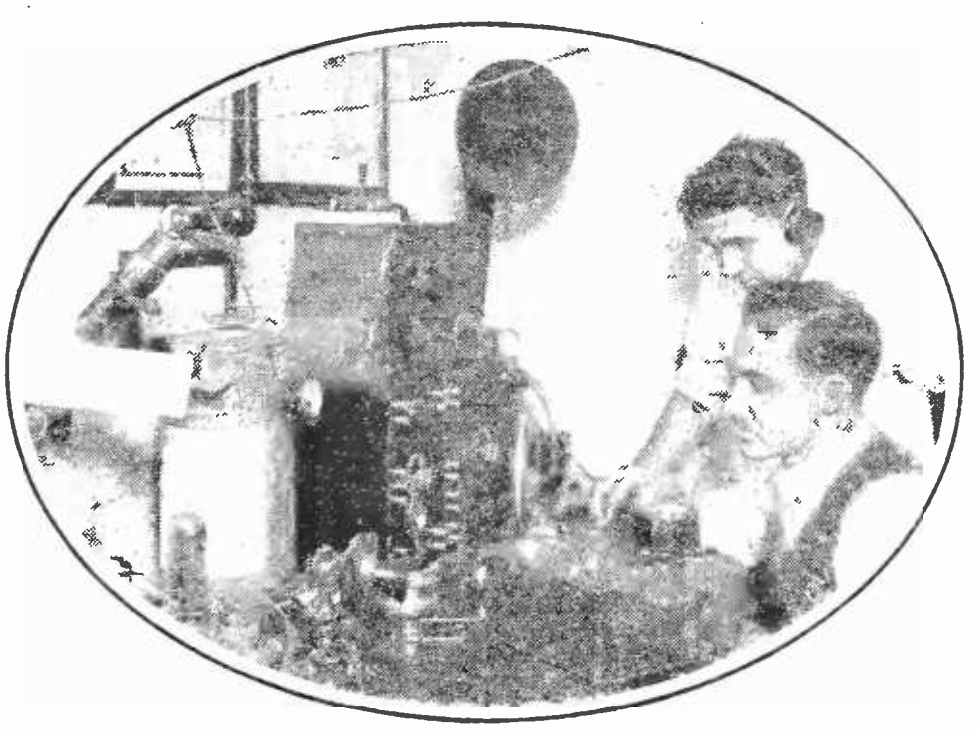
BY HOWARD S. PYLE

DEAR SIR:

I still can obtain no satisfaction from your office in clearing up the radio situation in Podunk. The amateur nuisance is unbearable, and we demand some relief. We urge you to send a man immediately to investigate. You say it is 'ships.' This is preposterous, as reference to your map will show our city to be located twenty miles from the ocean—there are no ships in Podunk.

Yours truly,
GEORGE SMITH.

A PLEASANT start for a rather doubtful day, is it not? Yet this is what the heavy-eyed Radio Supervisor of your district is confronted with as he wearily takes his place at his desk to commence the daily grind. He comes to his office, not refreshed by a restful night's sleep, but dog-tired from a four or five hour vigil the night before, checking the frequencies of the various stations within range of his sensitive receiver. Not once in a while but *every* night, does he do this; not occasionally does he receive an irritating communication such as opens this article, but he gets numbers of them *daily*. And you, in the comfort of your fireside, complain bitterly at a few annoying splashes of static or an occasional ship transmittal which interferes with your pleasure. Maybe you write your district Supervisor, demanding some immediate action, and then grumble at the inefficiency of Governmental services if an inspector does not appear at your home the following evening ready to devote his entire evening to your interests. Suppose you pick a comfortable chair, get a fresh cigar and read on—meet your District Supervisor and his radio inspectors. An insight into the workings of the Radio Inspection Service of the United States Department of Commerce will give you a new respect for the men who are laboring many hours a day that your evening's pleasure may be uninterrupted.



THE RADIO INSPECTOR AT WORK

Emery H. Lee, one of the radio inspectors attached to the New York office is checking up the wavelength of an amateur operator's station, using a standard Department of Commerce wavemeter. The station license is on the wall and the operator's license in the frame to its left, both issued by the Department of Commerce, is next to it. The revealing sign and crêpe on the burned-out transmitting tube tell their own story of the price the amateur pays for his hobby

In 1912, radio communication was limited to communication to and from vessels on the Great Lakes and on the high seas, and between a few points on land. A number of companies controlled this service. When the rapid increase in radio stations came, petty controversies often came up between operators, and in numerous cases these original small arguments grew into serious affairs. A ship of one company, for example, refused to handle business with a ship or shore station of a rival organization. Worse, efforts were often made so to interfere with a competitor's operations to prevent his handling legitimate traffic.

Foreign vessels as well as those of

United States registry were then fast adopting radio telegraphy. No provision for intercommunication with vessels of different nationality existed. Briefly, radio communication up to 1912 was entirely unorganized. The problems presented by the increase in stations and the attitude of competing interests grew so menacing, that the Government found it imperative to interfere in order to protect its military signalling, and to gain some control over commercial traffic. Accordingly, an "Act to Regulate Radio Communication" was introduced and in due course of time became a law, in 1912. Among the various important provisions in this act was an article requiring all stations to intercommunicate regardless of the radio system employed. It was further provided that every radio transmitting station must be licensed by the Secretary of Commerce, and be operated only by operators examined and licensed by him. Certain technical limitations were placed on such stations, and in order that the law might be enforced, it was necessary to create a force of inspectors who would personally inspect each such station. It was found desirable to have these inspectors conduct examinations to determine the qualifications of an applicant for a radio operator license. Nine radio districts were established, with headquarters in the important industrial center nearest the central part of the district.

WHERE THE INSPECTORS ARE

THESE nine districts, with some slight changes of headquarters as demanded by varying conditions, are the same to-day. The present headquarters offices are located in New York City, Boston, Baltimore, Atlanta, New Orleans, San Francisco, Seattle, Chicago, and Detroit. A radio inspector, who was required to be a highly skilled technician, was assigned to each office, and in a few instances, assistants were also provided where the duties were extremely heavy, such as at New York. A Chief Radio Inspector, with offices in Washington, presided over the nine districts, and still does. He acts under the direction of the Secretary of Commerce, through the Commissioner of Navigation.

At the time of the formation of this branch of the Government service, a radio inspector's duties were to inspect each radio transmitting station in his district periodically; hold frequent radio operator license examinations and conduct periodic examinations in the larger cities throughout the district. In 1912 but comparatively few shore stations existed, and not many vessels carried radio apparatus. Since he had a consequently small number of embryo operators to examine, a radio inspectors' duties were not arduous.

Radio has grown steadily since the formation of this service. Just prior to the war, practically every vessel of any size at all carried apparatus. There were numerous shore stations in each district. Thousands of amateur stations existed throughout the country. Many private concerns owned radio stations for communicating only between their various plants and offices. All these stations were required by law to be inspected and licensed, and these tasks fell to the radio inspectors. An increase in the personnel was sadly needed but not forthcoming from Congress. The Department of Commerce Radio Service was forced to struggle along as best it might with the limited funds and personnel at its disposal, while radio was growing in importance and popularity daily. All this was before the inception of radio broadcasting.

AND THEN CAME BROADCASTING

SHORTLY following the new start of commercial radio telegraphy in the United States at the close of the war, the results of experiments made with radio telephone systems for military signalling became public property. It was not long before a few radio broadcast stations appeared. The public were inclined to be a bit dubious at first, but almost overnight, the flame of popularity swept the country and the demand for radio apparatus and broadcasting service was phenomenal. Stations for transmitting entertainment, education, news, etc., sprang up all over the country, and for each such transmitting station, thousands of receiving sets were installed. Under the law of 1912, all transmitting stations must be inspected and licensed. Each must be operated by properly licensed operators. These additional duties were added to the radio inspectors' already heavy burden. No provision was made in the 1912 law to cover radio telephone stations. The Radio Inspection Service had to draft suitable regulations to cover the new situation. A few additional inspectors were obtained through an emergency measure.

No sooner were the enormous problems which the broadcast situation had presented untangled to some degree, than a new menace made itself known in the flood of letters that began to pour into the district inspection offices. The public was becoming educated

in the new science, and had discovered with some surprise and much indignation that there were other signals in the air than those emanating from broadcast stations.

THE PUBLIC DISCOVERS INTERFERENCE

THE new listeners frequently had to contend with the code signals from near-by amateur stations, from ships and shore stations, and from high power transoceanic stations. An amateur radio station owner, was a personality—someone who could be readily visualized, whereas to a large number, the vessels, high power stations and the like were but a dim mental picture. The tide of public opinion turned against the amateur, for it was assumed that all interference from code transmissions must come from him. There were about twenty thousand transmitting amateurs in the country, nearly three thousand radio equipped vessels, and about fifteen hundred commercial shore stations scattered between the coasts. Those with broadcast receivers got a lot of interference. Broadcasting had been assigned wavelengths of 360 and 400 meters. With amateurs on 200 meters, and ships on 300, 450, and 600 meters, and taking into consideration the huge number of non-selective radio receivers (those subject to maximum interference) which were unloaded on an unsuspecting public, it naturally followed that the reception of the radio programs was not all that could be desired. The public was indignant. They did not propose to have their outlay rendered useless if it could be prevented. Accordingly, letters of protest were the first step. The problem of where to direct them was soon solved. Then, such a bulk of mail entered the radio inspectors' offices that it appeared next to impossible even to begin to handle it. But the radio inspectors rolled up their sleeves and "dug into it." It was soon found that by far the majority of letters dealt with interference, real or fancied, from amateur transmitters. This called for individual investigations which entailed an unbelievable amount of work. Due to the insufficient travel appropriation provided, it was necessary to permit such complaints to pile up until those from some certain territory became exceedingly insistent and numerous, and then the radio inspector would proceed to that community, and by working all day and far into the night for several days, would get the tangle somewhat straightened out. Meanwhile, complaints from some other section would pile up and on his return there would be a goodly number of investigations to conduct in other sections. Between trips, and while actually traveling, it was also necessary that he inspect ship and land stations and hold radio operator examinations.

THE AMATEURS' TROUBLES

THE amateur problem finally became so acute, that the amateurs themselves felt they were in danger of extinction, so strong was the flood of public opinion against them. In spite of their splendid war services and other contributions to the art, such powerful influences were brought to bear as to make their position extremely precarious. They accordingly, voluntarily established a "silent period" from seven to ten-thirty P.M. daily, when they would shut down their transmitters to enable the new listeners to receive the broadcast entertainment without interference. This in a way, was successful, but the interference from the few who would not fall in line with their more far-sighted brothers, and from other sources, made it necessary for the Department of Commerce

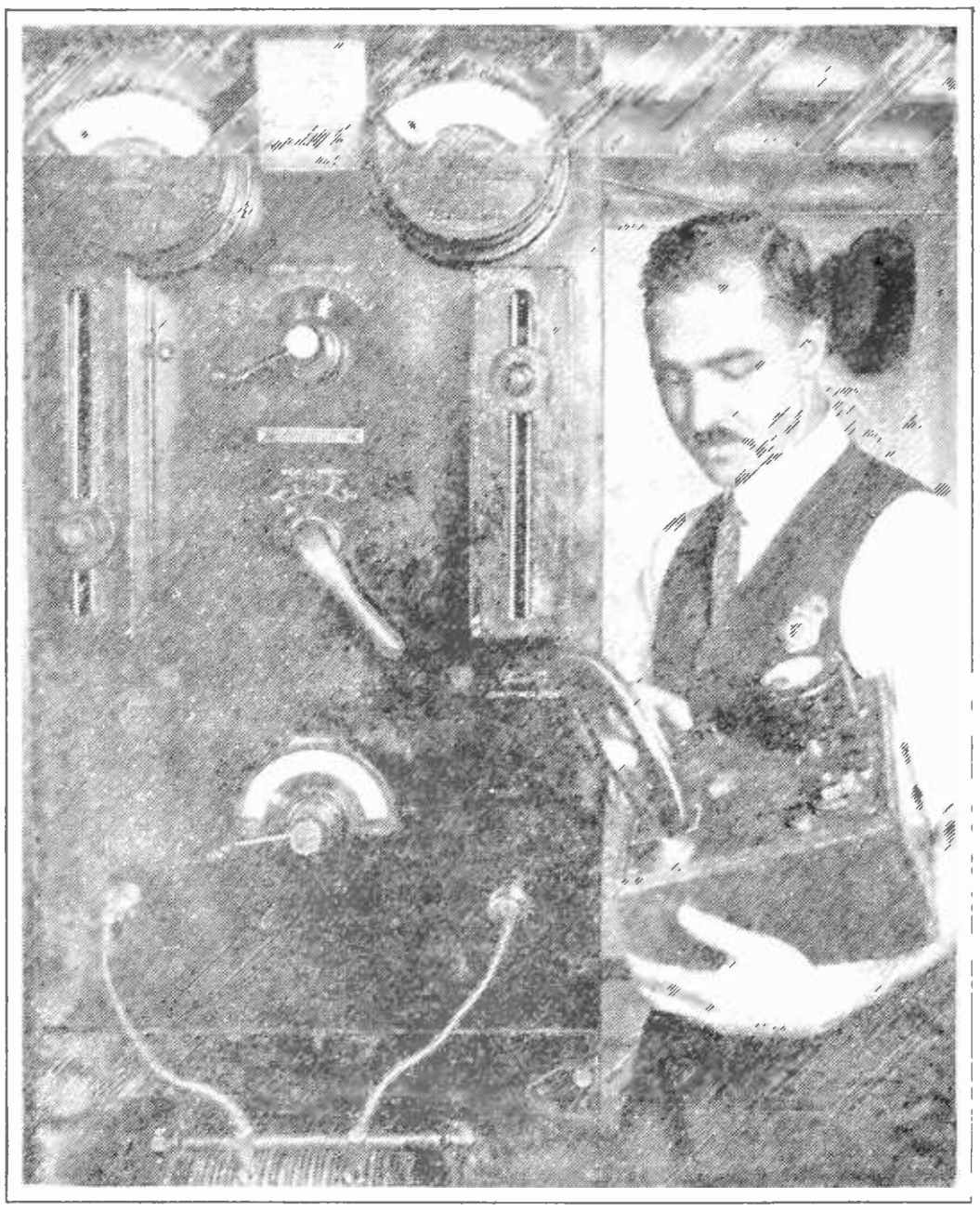
When "Something Ought to be Done About Something"

Radio folk have gotten into the habit of writing to the Radio Supervisor in their district. The broadcast listener may have trouble with an interfering power line near by, or perhaps it is a neighboring code amateur whom they suspect of high radio crimes and misdemeanors. Forthwith, he writes to the Radio Supervisor. If ships pound in over the loud speaker, or if static is excessive, the inspector hears of it. Many there are who have dealings with the inspector, and this article may help to make that person a bit more of an entity. Mr. Pyle has been an inspector himself. He was attached to the Eighth District Headquarters at Detroit for some time. The entire radio staff of the Department of Commerce is rendering yeoman service to the country, and the magnitude of the task they are trying to accomplish with a pitifully small staff is not generally appreciated. The Department needs adequate running and administration appropriations, sufficient to care for the enormous expansion of its tasks. These, Congress has steadily refused.—THE EDITOR.

through regulation, to impose compulsory silent hours of from eight to ten-thirty P.M., local standard time, and during local church services on Sunday mornings, on all amateur stations.

MORE LABORS FOR THE INSPECTORS

IN NO time at all, a new flood of letters poured in. The amateurs were accused of violating the silent period provision of their station licenses, particularly in points remote from radio inspectors where they thought they would not be apprehended. Nothing for it but the radio inspector must extend his day four or five hours more, and arrange to listen in nightly in an endeavor to locate the offenders. Congress would not appropriate funds for the necessary equipment, so, out of his own meager salary, the inspector purchased elaborate receiving equipment—often costing several hundred dollars—in order that he might efficiently serve his public. After a few weeks of such monitoring service it was found that much of the interference came from a number of broadcast stations transmitting on the same wave. Accordingly, Mr. Radio Inspector was called into consultation with his Chief at Washington. New regulations were drafted, providing a re-allocation of wavelength bands for broadcast purposes. These covered the wavelengths from 222 meters to 545 meters, and a zoning system was worked out to provide the minimum interference between stations.



EVERY RADIO STATION ABOARD SHIP

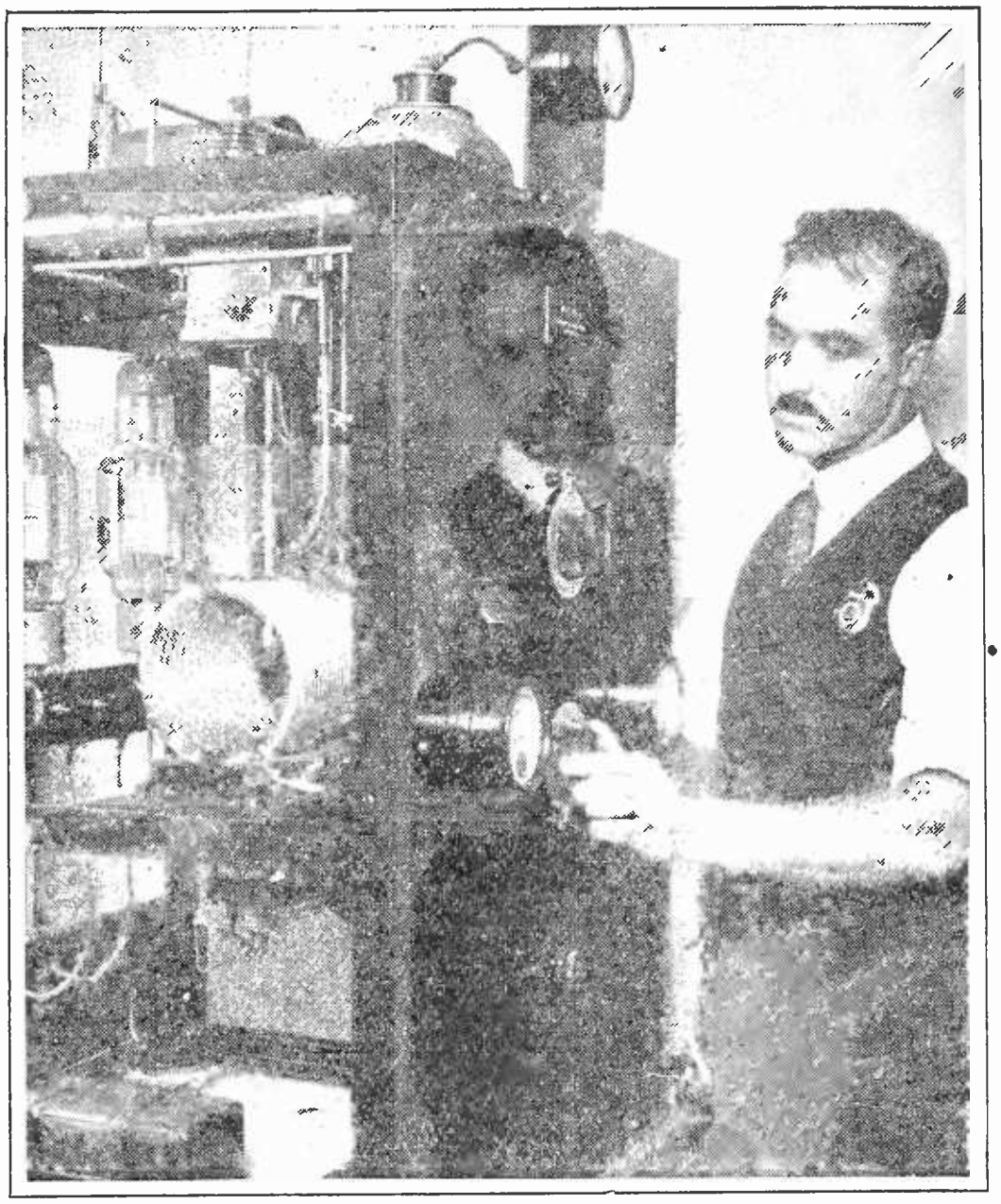
Has regularly to be inspected by the radio service of the Department of Commerce. The inspector checks the wavelength adjustment of the transmitter, and tests the storage batteries which furnish auxiliary power in case of accident to the ship's generators. He also tests the telephone from the radio room to the bridge. At practically all ports of entry in this country, the Department of Commerce inspects each ship each trip it makes into that port. This service alone would keep a large inspecting staff busy, but in addition to ship inspection, the inspectors have to inspect amateur stations of a certain grade, commercial shore stations, broadcasting stations, conduct license examinations for amateur and commercial operators, and investigate violations of the radio laws. The ship being inspected is SS *Maracaibo*

Returning to his office, the radio inspector with his insufficient clerical force, was faced with the task of explaining by letter to each broadcast station in his district the proposed changes, and calling in the numerous licenses for amendment. Relief from inter-station interference was immediate, but still the letters poured in, accusing amateurs of violations of quiet periods. Back to his receiver for Mr. R. I. And this time the problem had taken a new and more serious form. American and foreign ships were causing a tremendous amount of interference, practically blanketing the entire country, with their transmittals on 300, 450 and 600 meters.

REAL CODE INTERFERENCE

THE problem this time was very real. A quiet period could not be imposed upon commercial radio services to accommodate those who wished to be entertained. Furthermore, radio was the only means of communication from shore to a vessel at sea. Recourse to the laws showed that the transmittals were within the requirements in every way. It was then decided to *request* the radio operating companies to have their vessels keep away from 300

and 450 meters, at least between seven and eleven P.M. daily. An additional wavelength of 706 meters was provided for them, away from the broadcast band. Theoretically, this was ideal, the companies expressed their desire to coöperate and—the individual operators going to sea used what they saw fit in regard to wavelengths available. Accordingly, practically no relief was noted. This was communicated to the complaining parties as fast as letters of complaint arrived. It was inconceivable, even to the most intelligent people, that a little vessel, tossing on the waves hundreds—even thousands of miles from their firesides could raise such havoc. It was so much more readily understandable how an amateur in the same town could cause the interference. Accordingly, the radio service was often accused of being in league with the amateurs against the broadcast listeners, or "BCL's" as they grew to be known.



INSPECTING A BROADCASTING STATION

WEBJ, the Third Avenue Railway station in New York, being tested by a radio inspector from the New York, or Second Radio District. The wavelengths of all broadcasters are very carefully watched by the government inspectors

DIPLOMACY AMONG THE INSPECTORS

THE radio inspectors then adopted new tactics. When a complaint against an amateur station was filed, the complainant was requested to furnish the name and address or official radio call letters of the offending station. Where they could do either, the amateur was directed by the inspector to get in touch with the complaining party and endeavor to come to some amicable agreement. Where call letters or names were lacking, the complainant was respectfully requested to get this information before it would be possible to assist him.

Contrary to being a practical solution, letters from the amateur side began to increase. It was claimed that no understanding could be reached with the BCL's; they were for total elimination of the amateur. After such conferences, the amateur naturally went away in a "huff" leaving bad feeling on both sides. This often took more active form and many were the tales of amateur antennae cut down in the dead of night. It was a feud second only to some of the old Kentucky gunfights between the mountaineers. And between them both, fired at from both sides and with no support, stood the radio inspector, sleepless and irritated beyond description, but still struggling to bring peace into this big new family that had been suddenly placed under his wing.

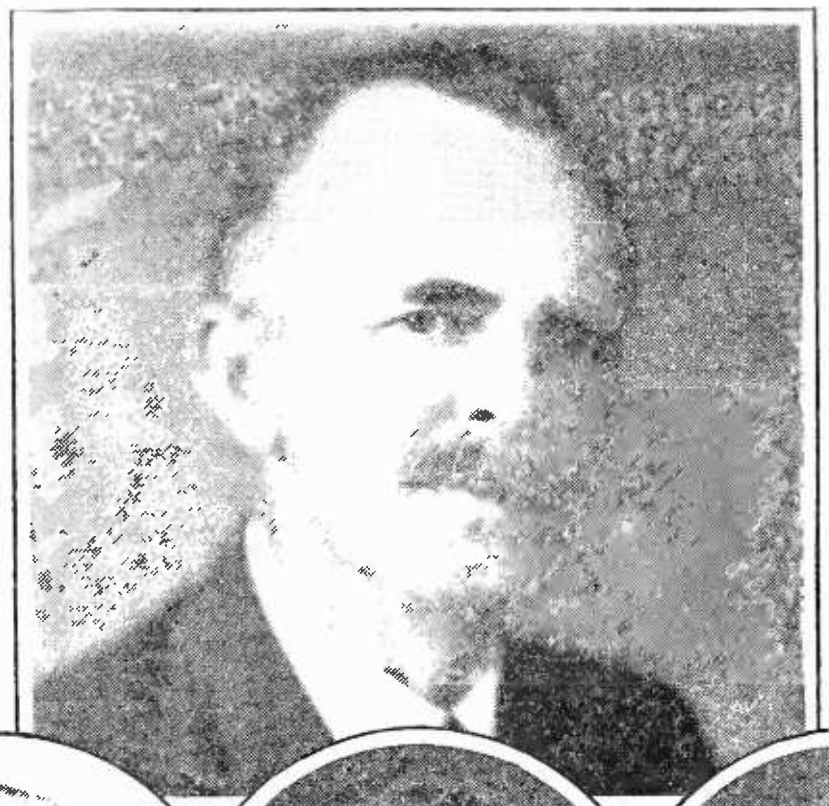
The flood of mail continued. Level headed, clear thinking business men made threats over their signature that they would be ashamed of in any other connection than radio. Fair-minded, ordinarily pleasant people became most selfish and bitter.

When all other methods had been exhausted and still the public clamored for relief, official Washington decided that a general conference of all representative radio interests might solve the problem. Accordingly the Supervisor of Radio at New York was directed to call such a conference. Representative men from the radio operating companies and all those who were so connected were invited. The outcome of such an extended

discussion was an agreement by the radio operating companies, to eliminate the 450 meter wave on their vessels, accept the 706 meter adjustment in its stead, and to use 300 meters only as required by International regulation.

The rest given the inspectors was not for long though, for it was soon seen that in order for the broadcast stations to function properly and with little interference between one another, they must be maintained on their exact wavelength. It again became necessary for the radio inspector to return to his monitoring of the air, this time to check the wavelengths of the broadcast stations and to notify those which had slipped from their assigned frequencies. This service proved so valuable, both to the broadcast stations and the listening public, that it is being maintained voluntarily by the various district Supervisors who are devoting their entire evenings to such work in order that you may have better broadcasting. There is no additional remuneration for this work, it is entirely voluntary. And remember too, that except in rare cases, where sufficient money could be "borrowed" from other office appropriations, the radio inspector has bought and paid for, from *his own pocket*, the receiving equipment which he uses for these measurements, and it is far more selective, far more costly than what you term a "good" broadcast receiver. It has to be.

The devotion to duty of the men in the service is remarkable. The writer will always be grateful for the year which he was privileged to serve among them. The salary is insignificant. Much more has been tendered the inspectors by outside firms, but the majority prefer to stay and conquer your problems and to take such satisfaction as they may find in the fact that they are beyond a doubt doing more to give you better radio than any other individual or group in the art. Think of them as human, and think twice before you write a hastily worded and sarcastic letter.



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W. D. TERRELL

Chief Supervisor of Radio. Mr. Terrell is in direct charge of the inspection activities of the Radio Service, Bureau of Navigation, Department of Commerce. The country is divided into nine radio districts, each with its supervisor and inspectors. The task of administering the radio law has grown to tremendous proportions since the beginning of broadcasting in 1920

O. R. REDFERN

Supervisor of Radio, Seventh District. With headquarters at Seattle, Mr. Redfern has charge of radio affairs in Oregon, Washington, Idaho, Montana, Wyoming, and the Territory of Alaska

R. Y. CADMUS

Supervisor of Radio for the Third Radio District. His office is in Baltimore and with some exceptions he has control of the states of New Jersey, Pennsylvania, Delaware, Maryland, Virginia, and the District of Columbia

CHARLES C. KOLSTER

Supervisor of the First Radio District at Boston, which comprises Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, and Connecticut

The Log of a Radio Hobo

The COVERED WAGON in the Middle West, Which Captain Irwin Calls a Radio Paradise—Radio and the Farmer—The Farm Offers a Great Field for Radio Salesmen—News of the COVERED WAGON on the Radio Circuit

BY CAPTAIN JACK IRWIN

SOMEBODY is asleep at the switch. When I started on my travels in the RADIO BROADCAST COVERED WAGON, one of the objects of the journey was to ascertain first hand from the farmer exactly what radio was doing to assist him in his business and to amuse him in his leisure. I have listened daily to the broadcasting of produce market reports and imagined that the farmers were equipped to receive this information, and the weather forecasts. What do we find? After traversing more than one thousand miles of highway through some of the finest farming districts of the Eastern and Middle Western states we find that less than five per cent. of the farmers are equipped with radio receivers. We looked for mile after mile in vain for the familiar antenna on farm buildings. We stopped frequently at ranches where the fields and buildings indicated prosperity and the outward signs pointed to luxury within, but seldom did we find what we searched for.

PREPARING A "MULLIGAN"

Better known in the army as "slumgullion." Captain Irwin and the WAGON at the side of a road in Kansas on his transcontinental trip

Inquiries made during these visits proved that it was not lack of interest in radio matters that led to the absence of radio facilities. In almost every case great interest was shown and a keen desire expressed by both old and young for a broadcast receiver. We have been asked over and over again what receiver was best adapted for a particular need. Fortunately, with the complete equipment we carry on the COVERED WAGON, we were able to make suggestions based in many cases upon results obtained on the premises of the people interested. Unlike many of the fans in the towns and cities, the rural prospective radio owner is not inclined to interest himself in assembling a receiver from parts made by himself or purchased. He prefers to learn of a complete manufactured receiver that will bring in reasonably distant stations. To such interested persons I have always put the same question. Have they searched for their requirements in the pages of radio magazines, or have they shopped for radio receivers in their visits to town? The answer has always been invariably the same. They felt that what they had read about radio only left them confused, and their visits to dealers made them more so, as the latter claimed such extraordinary receptive qualities for their product that the farmer was skeptical. In other cases we found prospective purchasers waiting for some immediate neighbor to install a set, which "he would do this fall" and if he was successful, well, "I guess we will get one like it." The army is not the only place they "pass the buck!"

THESE FARMERS SHOULD HAVE BUSY ANTENNAS

IT IS reasonable to expect that the conditions that I have found on the main traveled highways must prevail in less settled byways to which my limited itinerary does not permit a visit. I think that both the manufacturer and the retailer are overlooking one of the most promising fields in the radio business. Farmers are almost waiting to be convinced that the set offered to them is the one that will produce the results that they anticipate for their money. From the expe-

rience of the writer it would seem that the old itinerant tinware peddler with his wagon could be resurrected to advantage in the retailing of radio apparatus in rural communities. Without exaggeration, we could have sold our sets on our WAGON dozens of times after giving demonstrations in farmyards. It is my personal opinion that the dealer must devise other methods than those now prevailing to reach one of the most receptive markets open to the radio industry. The farmer may purchase almost every other commodity he equires by mail, but when it comes to a radio receiver he must be shown.

MUNICIPALLY OPERATED RADIO

I DISCOVERED in Detroit to what extent broadcasting was employed as a public utility. The COVERED WAGON arrived in that city on the eve of the annual international motor boat races. The evening before the opening day, several mysterious looking wagons were drawn up along the river bank, each shrouded in coverings that hid the contents. Subsequently we learned that these wagons were owned by the Detroit Parks and Boulevards Department and contained broadcast receivers, each with a huge wooden horn to be used in announcing the results of the races to the assembled spectators. We found that every public park in the city would be similarly furnished with such receivers. They had not been especially installed for the important motor boat events, but had been designed and installed by the municipal authorities to broadcast the band concerts from Belle Isle, one of the largest and most beautiful city parks in the world. By means of these mobile receivers and giant loud speakers, citizens of the city in every park or public gathering place in Detroit could enjoy the band concert. This utilization of radio saved the city the expense of furnishing several bands for its parks. The idea originated with General Heckle, Commissioner of Parks and Boulevards, who had learned from practical experience during his service in the war of the advantages of radio.

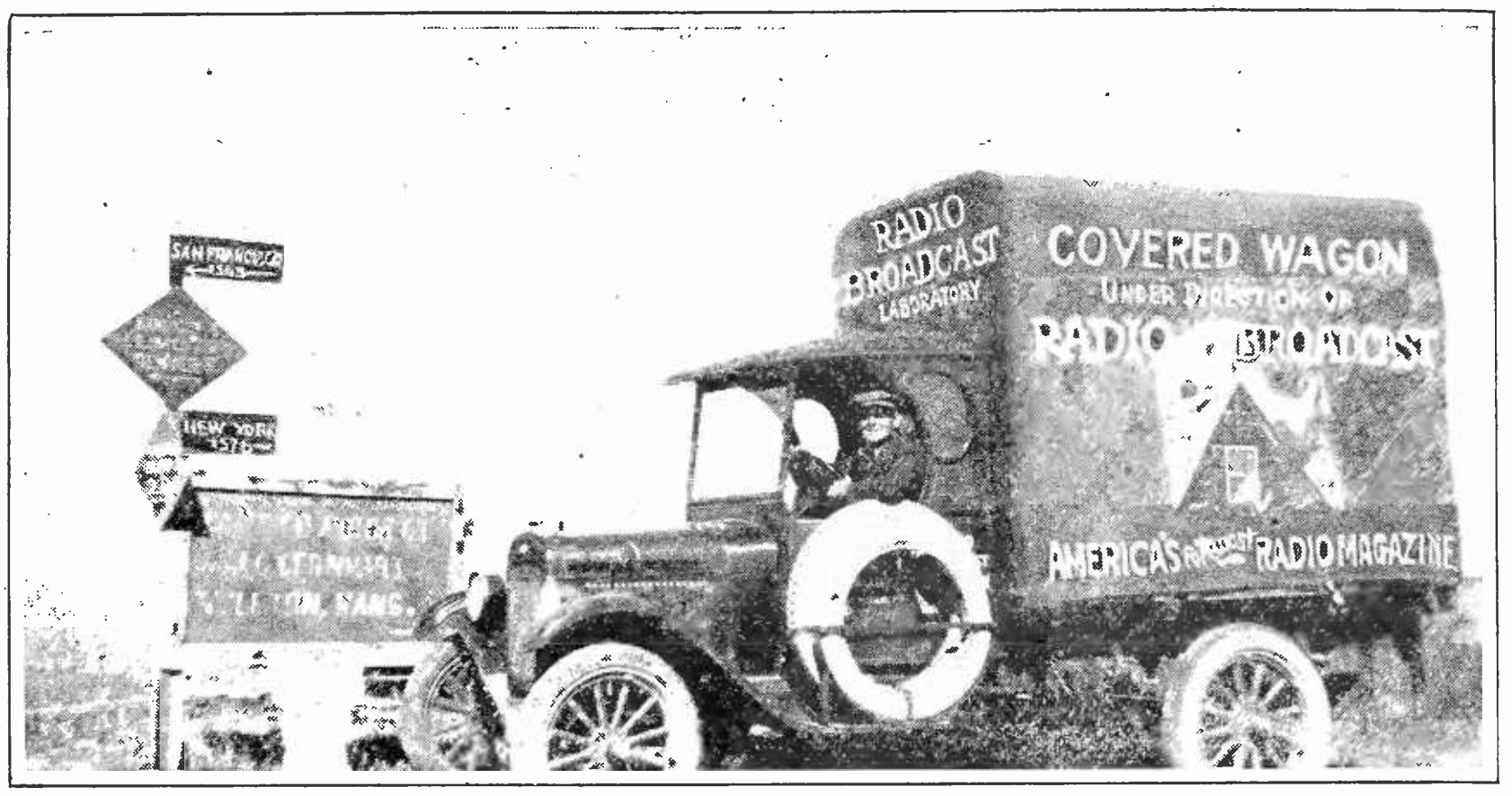
THE POLICE "STATION"

THE city owns and operates a transmitting station at police headquarters. From this station was broadcast frequently particulars of any crime. Every precinct station throughout the city was equipped with a receiver and loud speaker, thus enabling the officers on duty in each station simultaneously to learn of the details of newly reported crimes as they were filed at headquarters. For instance, as each stolen automobile was reported, the number of the license, engine, and the make of the car was broadcast with other essential information that would lead to its recovery. Officials assured me that a very large percentage of stolen cars had been recovered as a result of this up to date method. This station has the most appropriate call letters of KOP!

Another excellent use the city finds for this municipal station is in connection with the city owned street cars. The repair trucks and cars of the railroad are equipped with receivers operated with a loop. When a breakdown in the system occurs, the broadcast station calls the number of the repair crew responsible for that section of the road and supplies the particulars of the trouble and the locality. The police department has equipped several speedy patrol automobiles for rapidly transporting police reserves to the scene of such hold-ups. These fliers, as they are called, are also equipped with radio receivers that enable the crew to keep in constant touch with headquarters. Radio has been so successful in solving communication problems in the city management in Detroit that it is planned further to utilize the new system by extending its use to the public schools.

THE GREAT LAKES ARE A RADIO PARADISE

OUR journey has progressed as far as the Great Lakes, and we envy the diversified programs that citizens of this region of the Middle West enjoy. Not only are they plentifully supplied with excellent broadcasting stations in their own particular zone, but their central locality enables them, with even small receiving units, to bring in programs from the Atlantic and far West stations. While listening in for a couple of hours each evening, a fan can gather in a dozen or more excellent stations. The fact that the division of times also adds to their advantage enables the Great Lakes fan to obtain DX without sitting up until the wee sma' hours, as his brother fan in the East must do. While the night is yet young he can hear the Atlantic stations sign off and turn his dials for Western stations working, say, on mountain time. At this time I am particularly enjoying these advantages. We have been most anxious ever since commencing this trip to obtain distant stations in the particular spot we happened to be each night. Prior to our arrival in the Great Lakes district this entailed much hardship in the loss of sleep, which we particularly needed after driving all



HALF WAY POINT

The COVERED WAGON on the Liberty Highway, 1,576 miles from New York and 1,563 miles from San Francisco. It was in the Middle West and West that Captain Irwin found the farmers so very much interested in radio, but so poorly supplied with sets.

day in the exhilarating country air, and even when we succeeded in warding off friend Morpheus we feared to disturb our temporary neighbors should there be fellow tourists near us. Excellent as broadcast music may be, there is a time and place for the best things, and a tired tourist camp is certainly not that place.

THE AUTOMOBILE TOURISTS

SPEAKING of our audiences, although the weather for the last two weeks (I am writing in early September), has been very chilly, we continue to meet thousands of automobile tourists. Some are *en route* home, but many are still touring. Each night as we camp in a new locality, each farther west, we are surrounded by a number of tourists whose license plates indicate that they are from north, south, east, and west. Wonderful companions on the trail they are. As I remarked in another article, I find it hard to write only of radio topics. The intensely interesting personalities we meet will long be remembered. Before I began this tour, I had read in a magazine devoted to outdoor life that in 1923 the estimated number of automobile tourists numbered several hundred thousand. I remember that the actual number seemed incredibly large and I made a mental note at the time that the writer had exaggerated, but my personal experience to date indicates that 1924 will exceed that estimate of last year. Now of the thousands we have met, we have not encountered a dozen carrying radio receivers. Even those who do possess receivers in their touring equipment do not use them often. A very large number are ardent fans and speak enthusiastically of their receptive feats at home. These tourists are very substantial citizens and the equipments are marvelous in ingenuity.

Some of the cars resemble furniture moving vans. Heads of happy smiling youngsters may often be seen protruding from an automobile load of camping equipment. Mr. Ford, if he could take such an extended trip as we now are enjoying, would have food for thought if he could but see what his efforts have led to! So far I seem to have encountered two outstanding classes of tourists. One is the substantial citizen already alluded to, the other is the itinerant worker who travels in the lowly, often ancient and dilapidated Ford, works for a period in one place, accumulates enough capital to carry on to his next objective point, and then repeats the process. Both are well informed, not on world topics perhaps, but upon American national problems.

In every tourist camp men and women foregather from every state and exchange amicable notes upon their diversified experiences. Two great inventions have brought Americans together, the automobile and radio.

The International Broadcasting Tests

Last-Minute Facts About the Plans for International Broadcasting During the Week of November 24th to 30th in the Tests Conducted by RADIO BROADCAST

BY WILLIS K. WING

BY THE time this copy of RADIO BROADCAST reaches the hands of the reader, the International Radio Broadcast Tests will be ready to start. The week of November 24th to 30th is destined to remain long in the minds of radio fans because the plans this year insure thrills for the listener that can be secured in no other way. Every important broadcasting station in the United States, Cuba, Porto Rico, Hawaii,. Canada, and Great Britain will be "on the air" during their allotted time in the test week.

We have often been asked exactly what the purpose of these tests is. Last year, the transatlantic test was primarily to find out whether or not the ordinary super-sensitive receiver could bring in the English broadcasters, if American transmitters on the same wavelengths were silent. We purposed also to allow the English listeners to hear American broadcasting under the most favorable conditions of time and atmosphere. Both aims were achieved, as radio folk on both sides of the water will assure you. American broadcasting was heard in England very generally during the tests last year. It was about one month after that that the British broadcasting company successfuly rebroadcast the programs of KDKA over their own circuits.

© *Life;* from a recent issue

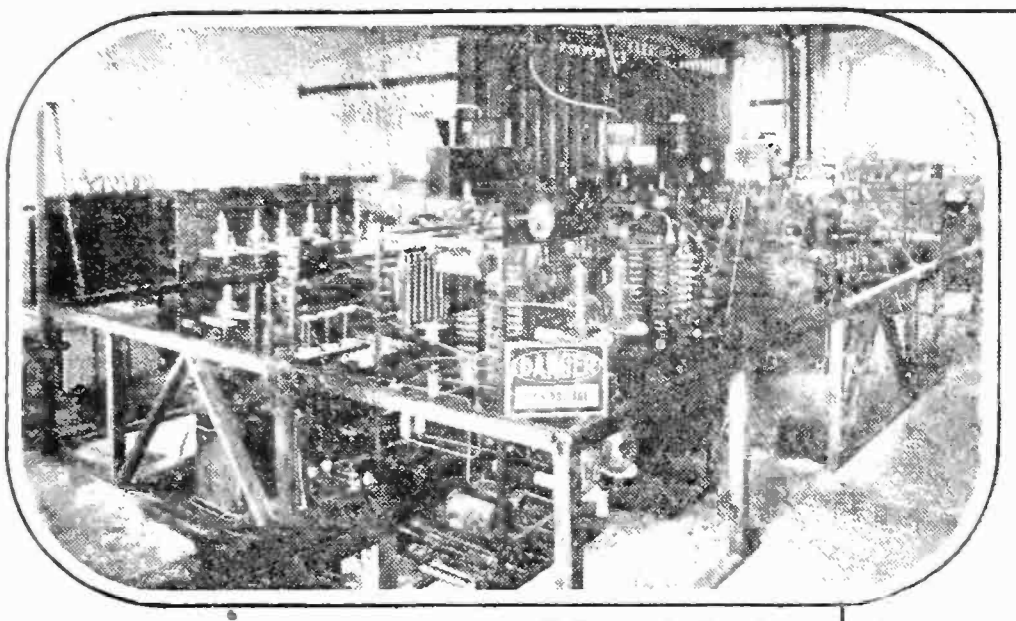
"OH BOY! I'VE GOT SCOTLAND"

It is an established fact that listeners on each side of the Atlantic can hear the other, given highly sensitive receivers and favorable conditions. But those conditions have to be supplied. American listeners cannot hear English and Continental stations while their own broadcasting stations are sending on about the same waves. So, during an hour each evening of the tests, American listeners can tune-in on the foreign broadcasts unhampered by interference from United States stations. Listeners will have another opportunity to try their sets under conditions which could be found at no other time. After all, it is an experience for a listener in an isolated spot in Oregon to hear a program direct from London. That is just what happened in the tests last year. All the thrilled listeners were not in Oregon, either, for our reports, tabulated after the tests were over, showed there were great numbers of successful listeners in every state in the Union, and all the provinces of Canada.

FEATURES OF THE TEST THIS YEAR

THE International Esperanto Society is deeply interested in the potentialities of the International Tests and they have arranged to put on a brief program in Esperanto from at least ten important American and Canadian stations.

The proponents of this language feel that the tests will give them an unusual opportunity to put their international language to a



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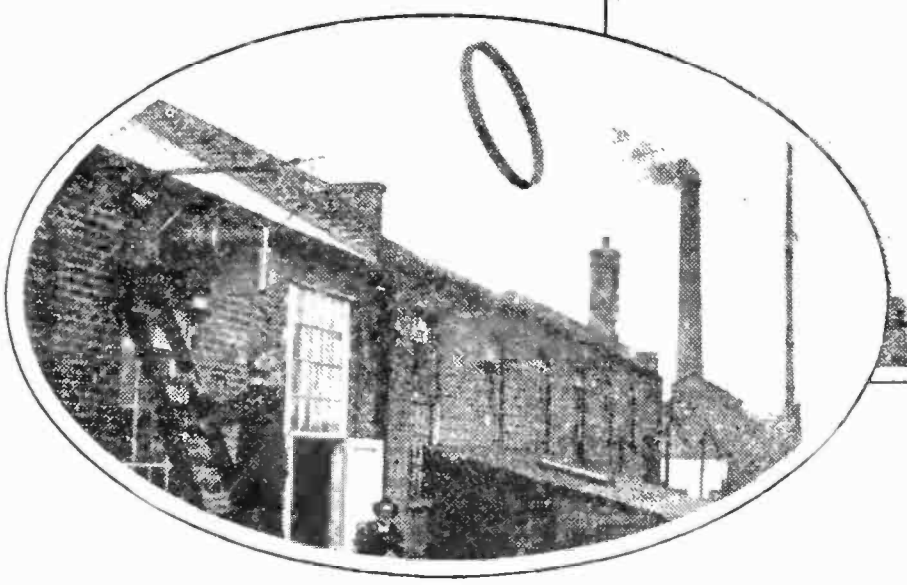
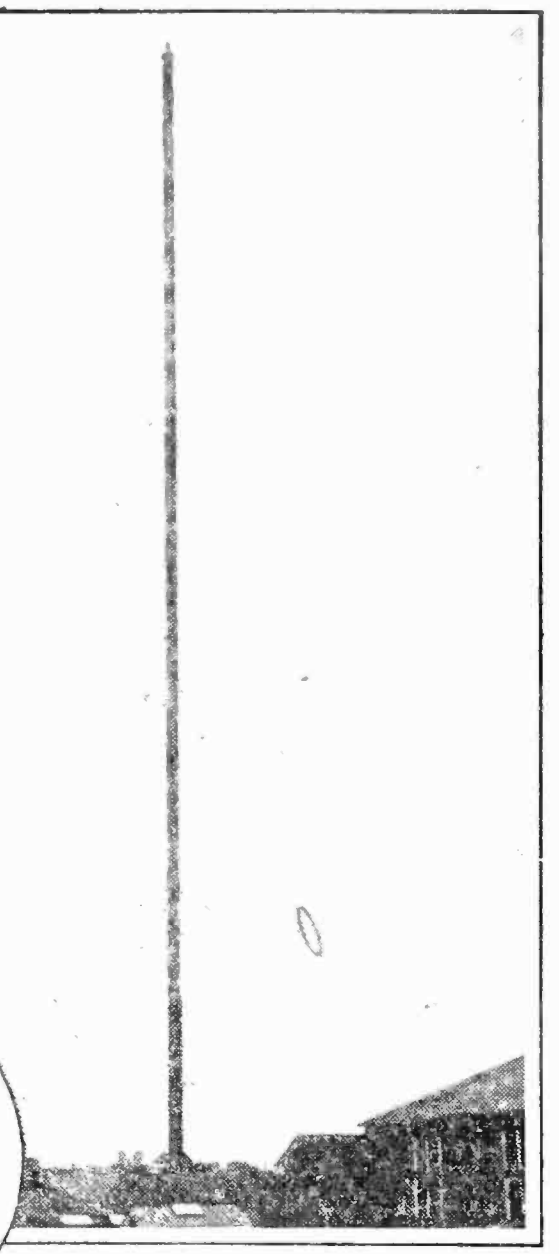
COÖPERATING IN THE TESTS

Is the new Chelmsford station (5XX) of the British Broadcasting Company. The power is a maximum of twenty-five kilowatts, sent out on a wavelength of 1600 meters. The mast is 400 feet high. The oval shows the large lead-in insulator. The other insert shows a portion of the transmitting apparatus. Listeners here whose receivers will tune up to 1600 meters should hear 5XX





practical test. They have arranged that members of their society in foreign countries will listen for the programs. Many who have given thought to radio problems have felt that with the increase in international broadcasting, it might soon become a serious question whether or not an international language were not a necessity.

Program directors of all the stations have been hard at work making a special effort to have the best talent they can muster before the microphone during this week. Last year, it will be remembered that such persons of importance as Secretary of State Charles E. Hughes, Owen D. Young, General James G. Harbord, Henry Ford, and others spoke to the British listeners. Similar events of importance will take place this year. Marconi himself spoke in England last year.

The staff of this magazine has visited broadcasting stations personally in the eastern part of the country. The editor, Arthur H. Lynch, recently completed a trip which included the Marconi and *La Presse* stations at Montreal, CKCO at Ottawa, CKAC at Toronto, and WGY, Schenectady. The writer visited, among others, WGR at Buffalo, one of the stations which was successful in getting its signals to England last year, WWJ, at Detroit, WJAX, and WTAM at Cleveland. Short addresses were made over the air at most of these stations, telling of the plans for the test.

DETAILS ABOUT THE TEST

AMERICAN stations will open the test, beginning their transmissions at ten o'clock, eastern standard time on the night of November 24th. Promptly at eleven P. M., eastern standard time, they will all close down, and the foreign stations will send. The Pacific Coast broadcasters, then, will begin their programs at seven o'clock, local time, which corresponds to the Atlantic Coast stations' start at ten. American stations will send for an hour and remain silent for the hours specified each evening.

On the next page are the call letters and wavelengths of the English stations. American stations whose wavelengths are nearest to that of the English station are indicated in the last column.

When you know the dial adjustment of your receiver for the American station whose

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AT THE WASHINGTON RADIO CONFERENCE
Commander E. C. Edwards, Supervisor of Canadian Radio, Captain P. P. Eckersley, Chief Engineer of the British Broadcasting Company, and Arthur H. Lynch, Editor of this magazine, and organizer of the International Radio Broadcast Tests. Mr. Edwards, Captain Eckersley, and Mr. Lynch completed arrangements for the November tests at a recent conference in Washington

wavelength is nearest that of the foreign station, a minimum of time will be lost in adjusting your receiver to the foreign stations.

WHEN YOU HEAR THE FOREIGN STATIONS

ELABORATE plans have been made at Garden City, at the RADIO BROADCAST Laboratory to receive the foreign programs. Another special receiving laboratory has been set up on the seashore, away from all radiating receivers and power-line noises, so the programs can be received and accurately checked. Direct radio connection with London will be possible through a control key at the Laboratory connected to the high-power transmitter of the Radio Corporation of America at New York. Each evening, we shall make up a report of those listeners in all parts of the country who report to us that they heard the foreign programs. These will be quickly tabulated and rushed by radio across the Atlantic.

Every listener, no matter where he is, is asked to send a prepaid telegram to RADIO BROADCAST magazine when he hears a foreign program. The telegram should contain the name and address of the sender, the name and call letter of the sending station, and any necessary facts about the program heard. Those who live near enough may telephone their reports to the office of the magazine at Garden City 800. We shall also be glad to have reports by letter when you receive the test programs. All communications will be acknowledged.

WHOLESALE COÖPERATION

THESE tests have been made possible by the coöperation of the American, Canadian, and English broadcasters, the Radio Corporation, the General Electric, the Westinghouse Company, and the London *Wireless World*.

STATION	CALL	WAVELENGTH	AMERICAN STN.	WAVELENGTH
Paris	PTT	450	WMAQ	448
London	2 LO	365	WEBH	370
Chelmsford	5 XX	1600		
Aberdeen	2 BD	405	WOR	405
Birmingham	5 IT	475	WFAA	476
Bournemouth	6 BM	385	WGY	380
Cardiff	5 WA	351	WCBD	345
Edinburgh	2 EH	325	KDKA	326
Manchester	2 ZY	375	WEBH	370
Liverpool	6 LV	318	WGR	319
Newcastle	5 NO	400	WHAS	400
Sheffield	6 FL	303	WEEI	303
Plymouth	5 PY	335	WBZ	337
Leeds	2 LS	346	WLS	345
Brussels		265	KFNF	266

WHEN YOU WRITE THE GRID . . .

Don't fail to enclose a stamped, self-addressed envelope with your inquiry if you expect a personal reply.

Don't be impatient if you do not receive an immediate answer. Every letter is answered in the order of its receipt. Do not send a second letter asking about the first.

Look over your files of RADIO BROADCAST *before asking a question which might have been covered in a previous issue.*

Don't ask for a comparison between manufactured apparatus. The addresses of manufacturers of articles used in the construction of apparatus described in RADIO BROADCAST *will be given on request.*

Don't include questions on subscription orders or inquiries to other departments of Doubleday, Page & Co. Address a separate inquiry to the Grid.

Don't send us a fee for answering your questions. The Grid Department is maintained for the aid and convenience of readers of RADIO BROADCAST *and there is no charge for the service.*

QUERIES ANSWERED

WHAT IS THE CORRECT VALUE OF RHEOSTAT TO USE WITH A UV-201-A TUBE?

G. M. F. Tulsa, Okla.

HOW MAY I APPLY A FINELY VARIABLE NEGATIVE POTENTIAL TO THE GRID OF A VACUUM TUBE?

D. McG. Philadelphia, Pa.

DO GRID LEAKS AFFECT THE SENSITIVITY OF MY RECEIVER?

A. J. N. Keyport, N. J.

THE VOLUME OUTPUT OF MY RECEIVER IS DISTORTED. HOW MAY I CONTROL IT?

C. D. M. Waco, Texas.

HOW IS A C BATTERY INSERTED IN AN AUDIO-FREQUENCY AMPLIFIER CIRCUIT?

R. T. L. Augusta, Maine.

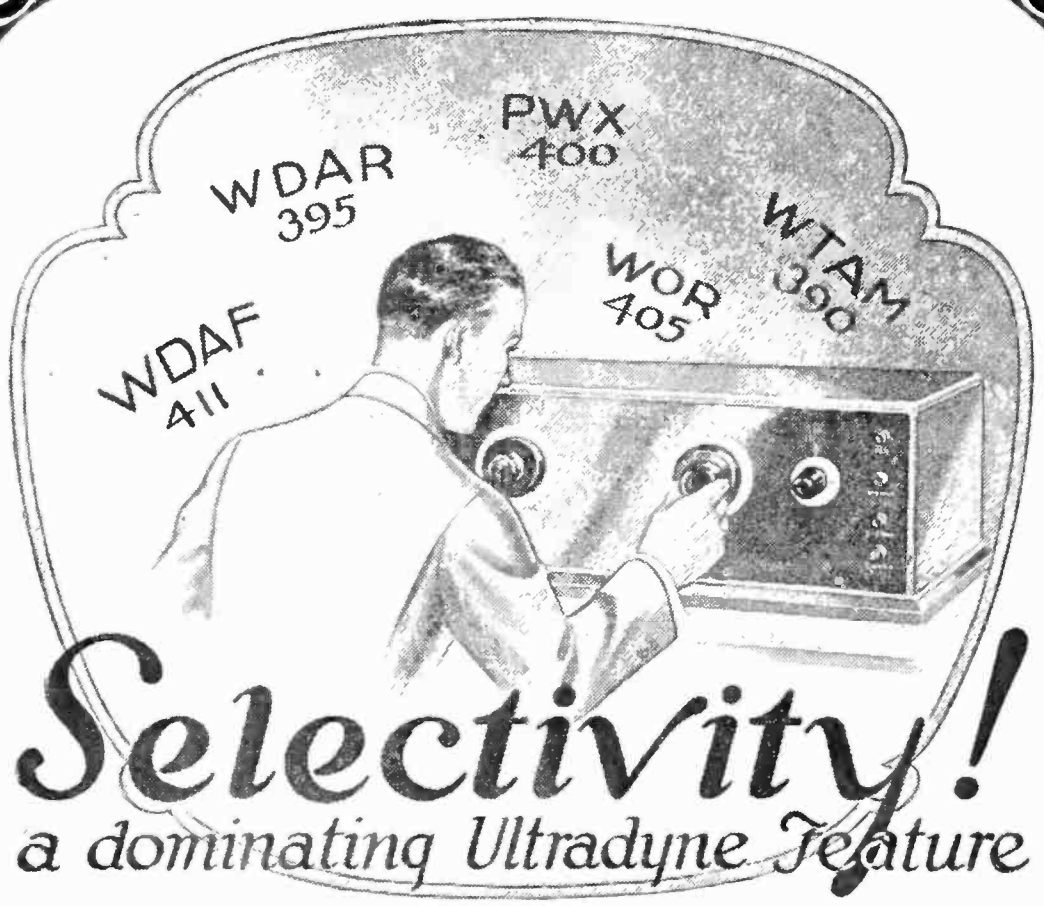
PROPER RESISTANCES FOR TUBES

WE HAVE been asked numerous times why 15- and 20-ohm rheostats are recommended for use with UV-201-A tubes. Likewise we ask, why, too. According to Ohm's Law R equals $\frac{E}{I}$, that is the resistance of a circuit is equal to the voltage supplied, divided by the current in amperes flowing through it.

According to the data supplied by the tube manufacturer, the resistance of the UV-201-A is 20 ohms. This figure is arrived at by dividing 5, the operating voltage of the tube, by .25 the current at which it is operated.

By applying the same formula we find that with a 6-volt storage battery the resistance of the circuit is 24 ohms. Since 20 ohms of this is to be attributed to the tube, the rheostat will necessarily have to take care of the extra 4 ohms. Therefore a 4-, 6-, or 10-ohm rheostat will be ample for controlling the tube filament.

In general, to find the resistance for any rheostat,



Selectivity!
a dominating Ultradyne Feature

AN Ultradyne receiver operating in New York City easily tunes out the powerful broadcasting of WOR, Newark, N. J.—405 meters and brings in WDAR, Philadelphia—395 meters; PWX Havana, Cuba—400 meters; WDAF Kansas City—411 meters.

Regardless of close similarity in wave-length, the Ultradyne selects any station within range—brings in broadcasting clearly, distinctly, faithfully.

In addition to this Ultra-selectivity, the Ultradyne is the most sensitive receiver known. It employs the "Modulation System" of radio reception, the achievement of Mr. R. E. Lacault, EE., A.M.I.R.E., Consulting Engineer of this company and formerly Radio Research Engineer with the French Signal Corps Research Laboratories.

The "Modulation System" responds to weaker signals than the conventional method of detection—because it provides greater rectification. Weakest signals are made to operate the loud speaker.

Ultradyne performance is the envy of the radio industry.

Write for descriptive circular

PHENIX RADIO CORPORATION

5-7 Beekman Street **NEW YORK**

ULTRADYNE

MODEL L-2 ★

Modulation Plus Regeneration in the New Ultradyne

To the "Modulation System" of radio reception, R. E. Lacault has successfully applied the use of regeneration in the new Model L-2 ULTRADYNE.

The result is ultra-sensitivity never before thought possible. The use of regeneration produces tremendous amplification which is more noticeable when receiving weak signals.

The Radio Section of the U. S. Bureau of Standards has proven by actual measurement that regeneration becomes more effective as the received signal diminishes in strength.

Regeneration applied to the "Modulation System" allows the ULTRADYNE to respond to an extremely small amount of energy. This energy is further amplified thousands of times by the intermediate frequency amplifier before it is detected and made audible. This amplifier is designed for maximum efficiency without decreasing the tone or quality of music and speech.

The reception of distant stations is only limited by atmospheric conditions and causes beyond the control of Model L-2 ULTRADYNE.

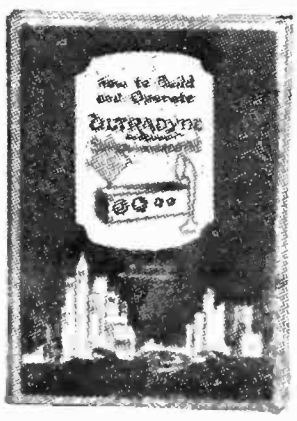
Loud Speaker Reception Using LOOP Aerial

Efficient loud speaker reception using a loop aerial is possible with the Model L-2 ULTRADYNE. Ordinarily loop reception is considerably less efficient than an outside aerial. However, the application of regeneration to the "Modulation System" reduces the resistance of the loop circuit, thereby allowing the loop to pick up infinitely weak signals.

The use of a loop also increases selectivity and decreases static and other interference.

How to Build the New Model L-2 ULTRADYNE

This 32-page illustrated book gives latest authentic information on drilling, wiring, assembling, and tuning the new Model L-2 Ultradyne. This book explains the "Modulation System" in detail and also deals with the application of regeneration to this new system of radio reception.



It is edited by R. E. Lacault, inventor of the Ultradyne Receiver. Price, 50c.

Model L-2 ULTRADNE Kit Is Ready

This is the new Model L-2 Ultradyne Kit which contains one low loss tuning coil, one low loss Oscillator Coil, one special low loss Coupler, one type "A" Ultraformer, three type "B" Ultraformers, four matched fixed Condensers.

$30.00

The Ultraformers are new improved long wave radio frequency transformers, especially designed by R. E. Lacault, inventor of the Ultradyne. As a precaution against substitution, R. E. Lacault's personal monogram seal (R.E.L.) is placed on all genuine Ultraformers. All Ultraformers are guaranteed as long as this seal remains unbroken.

★ Tested and approved by RADIO BROADCAST ★

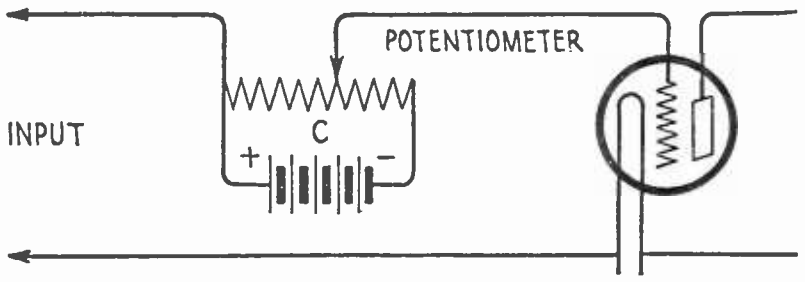


FIG. 1

substitute in the equation the voltage of the battery and the current rating of the tube. From the quotient derived, which is the total resistance of the circuit, subtract the resistance of the filament of the tube. The filament resistance of a tube may be ascertained by applying the equation to the operating characteristics of the tube, usually supplied upon the wrapper or tube carton by the manufacturer.

FINELY VARIABLE BIAS VOLTAGE

FOR applying a finely variable voltage to the grid of an amplifying tube or for controlling the voltage of a C battery similar to the method employed by Mr. Silver in his seven-tube super-heterodyne, we recommend the circuit shown in Fig. 1. The C battery is of the standard $4\frac{1}{2}$-volt type, the potentiometer 150, 200 or 400 ohms.

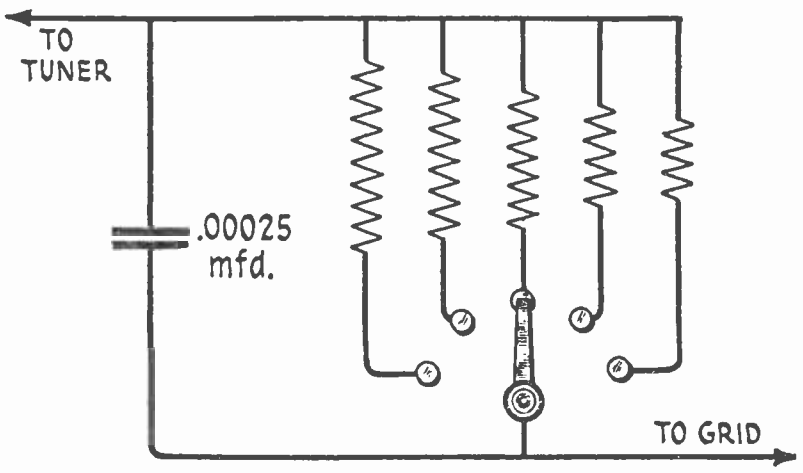


FIG. 2

GRID LEAKS

THE selection of a grid leak for your receiver requires care and judgment. Not all the variable grid leaks now on the market may be depended upon to give reliable service.

The importance of the grid leak may be understood when it is explained that the value of the leak controls to a large degree your distance reaching qualities. Strong, loud signals from local stations require a greater leakage to prevent the grid of the tube from becoming blocked.

Now, then, if this same large value of leak is used for the reception of weak, distant signals it is fair to assume that the signals will also be leaked out through the comparatively easy path the large grid leak offers. Therefore a variable leak, positive in its action, is necessary. We offer the suggestion as shown in Figs. 2 and 3 to this end. While the arrangement is not entirely economical, it is nevertheless efficient. Several grid leaks of various values are mounted as shown. The tap switch arrangement allows the proper selection of leak value for the station being received.

AVOIDING DISTORTION IN THE AUDIO OUTPUT

THE same device shown in Figs. 2 and 3 for a variable grid leak may be arranged to control the volume output of a receiver. For the values of leak shown, substitute resistance between 25,000 and 100,000 ohms (.025 to .1 megs). These are placed in the audio frequency amplifier circuit across the secondary of the transformer of the last stage. Overloading and distortion may be controlled with this unit. Any good continuously variable resistance may be substituted.

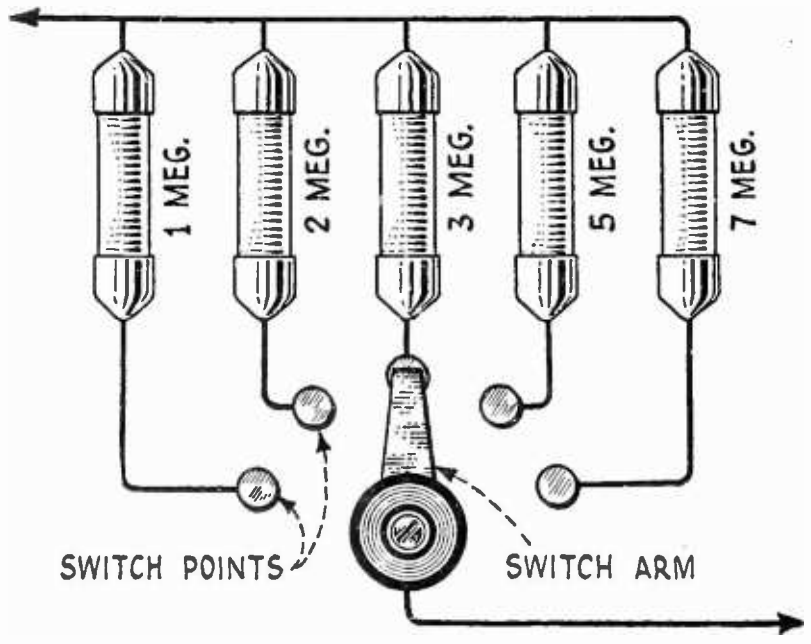


FIG. 3

THE C BATTERY

A METHOD for employing a C battery in a standard two-stage audio-frequency amplifier is depicted in Fig. 4. Ordinarily, the lower side or grid return of the secondary is connected directly to the negative side of the filament supply. But to insert the C battery, the lower side of the secondary is connected and then

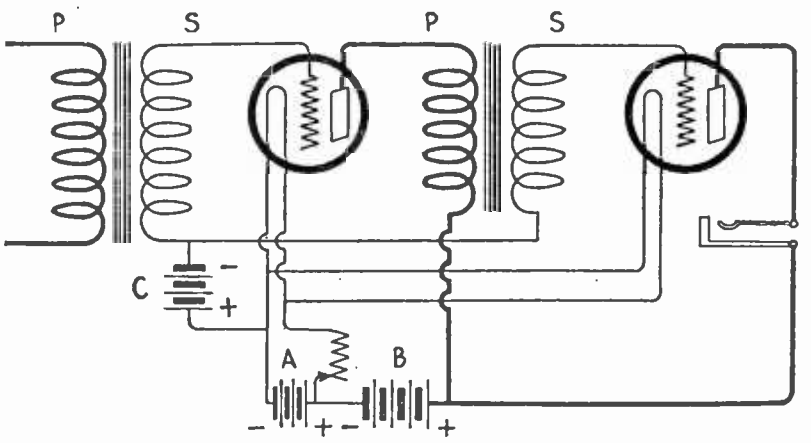


FIG. 4

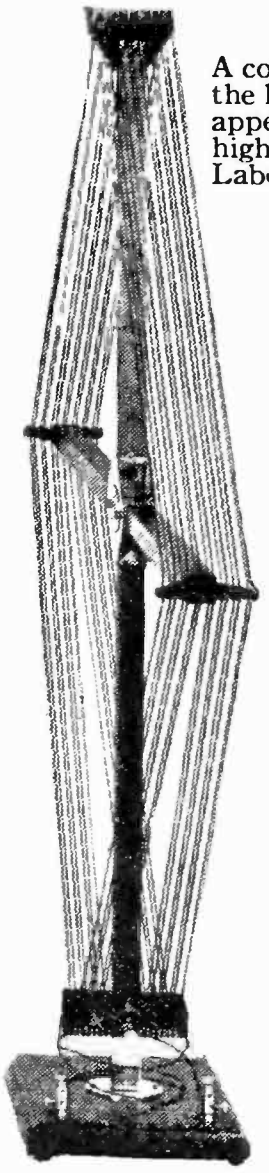
brought to the negative side of the C battery. The positive side of the C battery is then connected to the negative side of the A battery.

It will be seen that instead of directly bringing the grid return to the negative A lead it is first brought to the C battery which is inserted in its position between the negative A and the lower side of the secondaries.

New Equipment

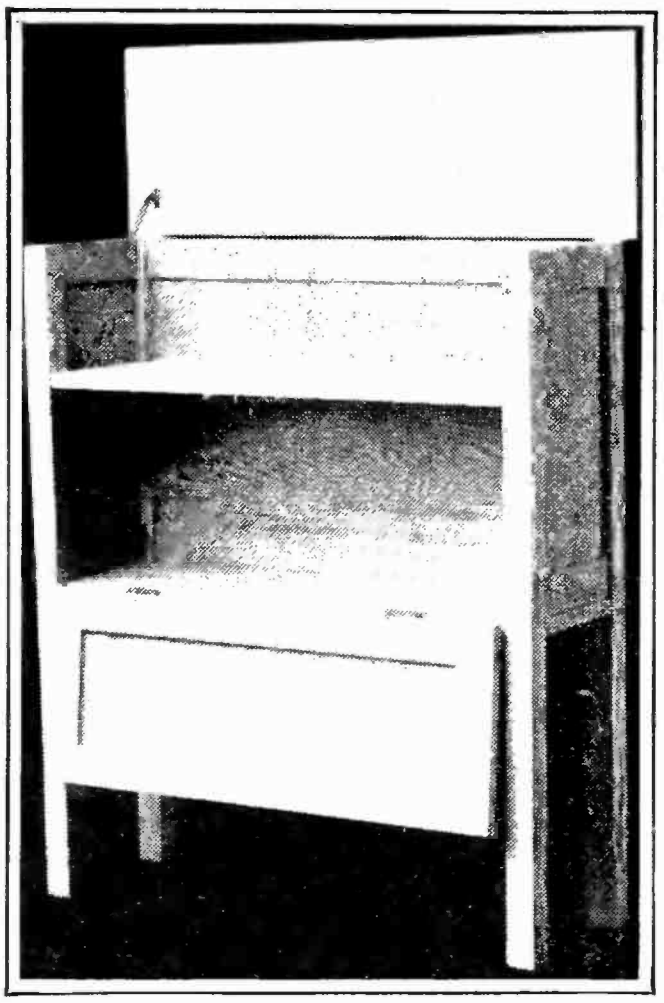
A LOUD SPEAKING TELEPHONE

Which gives exceptionally fine reproduction, is the Western Electric No. 540-AW. The projector consists of two cones of specially selected material resembling parchment. The apex of one cone is connected by a driving rod to an electro magnetic unit that responds to current impulses from the receiver thereby causing the cones to vibrate and reproduce the received signals. Made by the Western Electric Company, 195 Broadway, New York City. Price $35



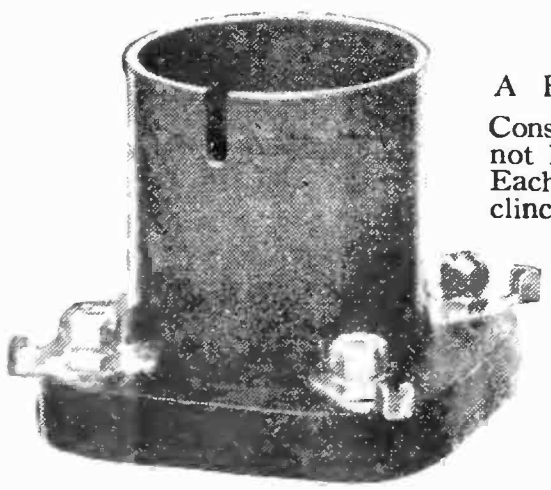
"FIAT" BANK–WOUND LOOP

A collapsible loop antenna of merit. The manner in which the loop is held rigid is very satisfactory. It is neat in appearance and of sturdy construction. The wood is highly polished mahogany. Made by the Radio Appliance Laboratory, 1529 Howard Ave., Chicago, Ill. Price $15



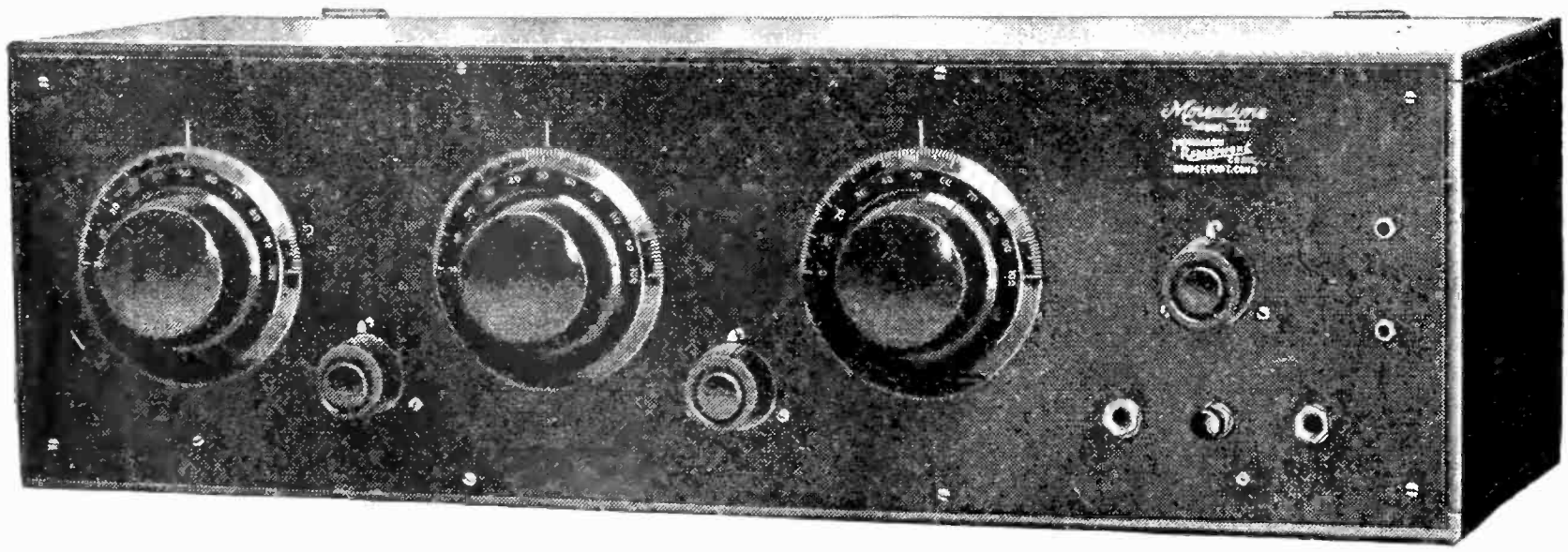
M–B–G RADIO CABINET

A moderate priced combination cabinet table with battery compartment. This arrangement is ideal for eliminating the confusion of batteries and wires in the radio corner. The manufacturer also makes a plain table and one with battery compartment. The purchaser can finish the table as he wishes. Made by the Express Body Corporation, 44 Lake St., Crystal Lake, Ill.



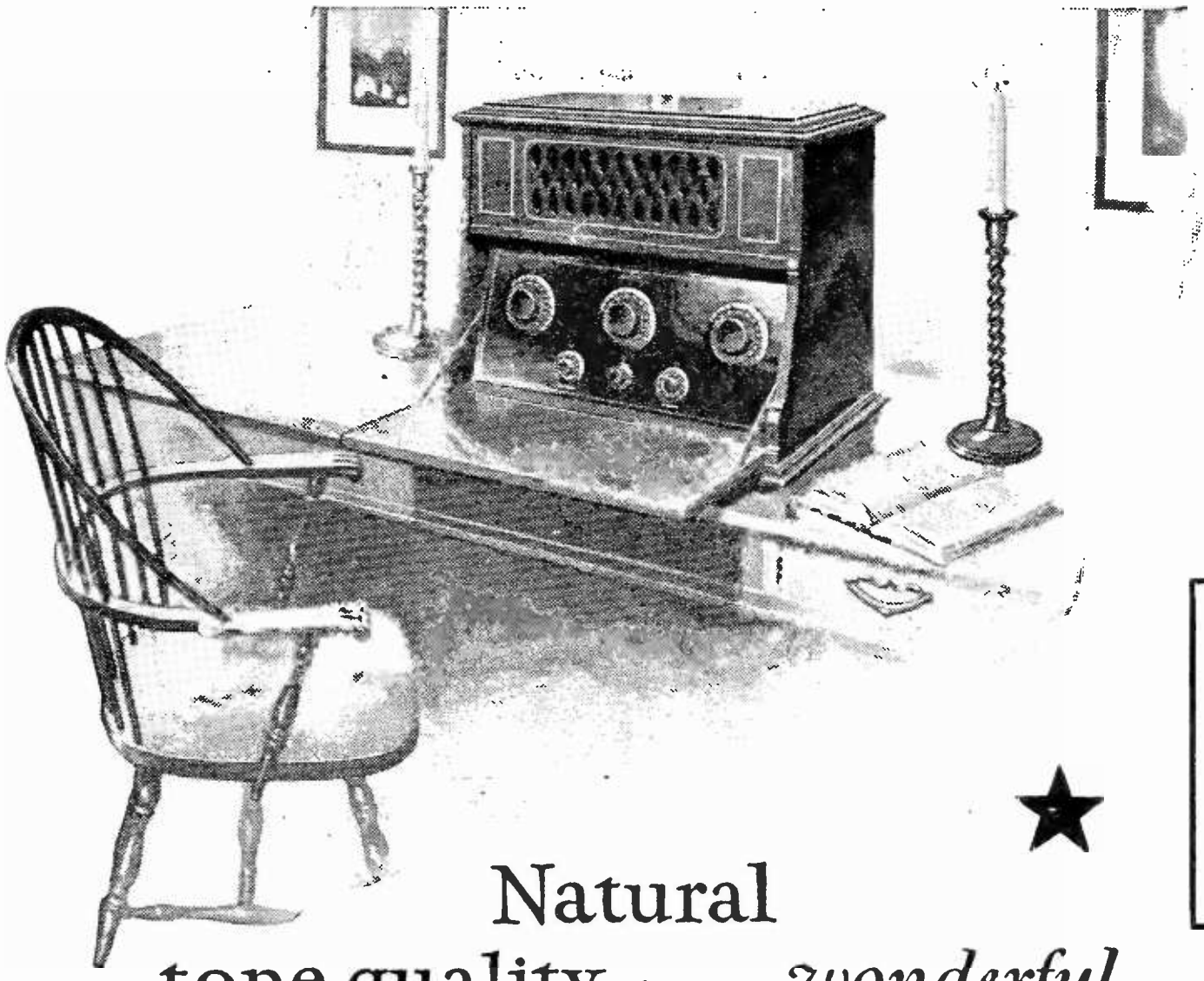
A RADIO TUBE SOCKET

Constructed so that the tube does not have to be twisted into place. Each contact is a spring clip that clinches the tube prong without strain. The silver plated contact and respective lug is one continuous piece, doing away with binding post connections. Made by The Cutler-Hammer Mfg. Co., Milwaukee, Wis.



MORRADYNE RECEIVER

A five-tube receiver employing two stages of radio-frequency, detector and two stages of audio-frequency amplification. It delivers very good volume with fidelity. Tuning is sharp yet not critical. Made by the Morrison Radiophone Co., Inc. Bridgeport, Conn.



FADA Neutrola

Five-tube FADA Neutrodyne, with self-contained loud speaker. Genuine mahogany, artistically decorated with wooden inlay. Ample space for all batteries and charger. Drop when not in use. Price (exclusive of tubes and batteries), $220.

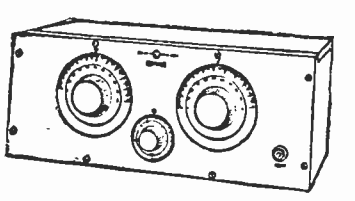
Natural tone quality - - - *wonderful volume with a* FADA Neutrola

In the "Neutrola," FADA has produced a radio receiver that possesses every essential to your complete enjoyment of radio. It is a new and better designed five-tube Neutrodyne set, refined to give the most faultless reproduction of music and voice. You can, without exaggeration, imagine yourself in the very presence of the musicians and artists. Selectivity is but one remarkable feature of the "Neutrola." With powerful local broadcasting stations operating, the "Neutrola" cuts through them and brings in outside stations, hundreds of miles away, on the loud speaker with minimum interference.

The "Neutrola" cabinet is of genuine mahogany, inlaid with a lighter wood. A decorative grill covers the built-in loud speaker, and a drop desk lid hides the panel when the set is not in use. The "Neutrola," is fitting company to the finest furniture in the home.

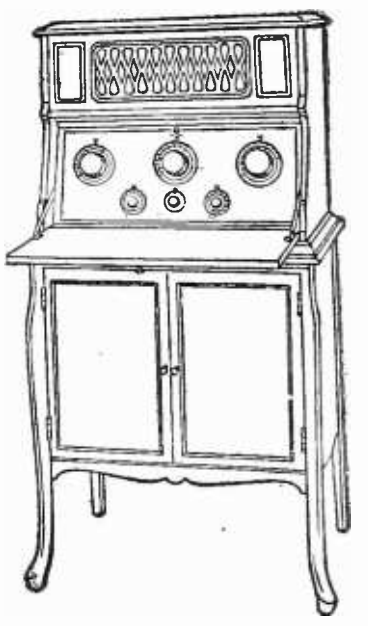
In adition to the "Neutrola" there are other FADA Neutrodyne receivers in sizes and styles to meet every desire; three, four, and five tube receivers in plain and art cabinets at prices ranging from $75 to $295, each extraordinary in results; each a remarkable value.

LICENSED BY INDEPENDENT RADIO MANUFACTURERS, INC. NEUTRODYNE PAT MARCH 27, 1923 AND APRIL 1, 1924 HAZELTINE PATS. NOS. 1450 080 AND 1489 228 OTHER PATENTS PENDING F A D ANDREA INC., 1581 JEROME AVE., N.Y.C.



FADA Neutro Junior No. 195

Three-tube Neutrodyne. A wonderful performer. Price (less tubes batteries etc.) $75.



FADA Neutrola Grand No. 185-90-A

The five-tube Neutrola 185-A mounted on FADA Cabinet Table No. 190-A. Price (less tubes, batteries, etc.) $295.

F. A. D. ANDREA, Inc., 1581 Jerome Avenue, New York

FADA *Radio*

★ Tested and approved by RADIO BROADCAST ★

Among Our Authors

FRANK E. BUTLER, whose story "Making Wireless History With De Forest" forms the leading article for this month, is now radio expert for La Salle & Koch in Toledo, Ohio. It is quite true, we think, that radio men up to the present have been far too busy making radio history to take much time to write it. There are a number of other articles in this series which will appear in later numbers of this magazine in which Mr. Butler relates facts about early wireless struggles which are fully as interesting as any fiction.

JULIAN KAY is at present continuing his research work at Harvard University, and absorbing, so he admits, much of the good Boston atmosphere. He has written several more of his excellent explanatory articles which we hope to print in later numbers of the magazine.

AN EXTREMELY busy person these days is Zeh Bouck, whose constructional article on "A Knock-Out Amplifier" appears on page 226. For what with devising ways and means to escape hearing the flood of last-minute political radio oratory and doing his reulgar research and design at his New York laboratory, he asks us to judge if his time is not rather well filled. It is.

ZEH BOUCK

ANOTHER of James C. Young's interesting articles appears in RADIO BROADCAST this month. In the current WORLD'S WORK he has a story called "Breaking Into the United States." Most of Mr. Young's work appears in various New York newspapers.

SHORTLY after he graduated from Rensselaer Polytechnic Institute, Roland F. Beers, taught electrical engineering at his alma mater. He then went into the transformer design department of the Western Electric Company. He is now a consulting engineer in Binghampton, New York, where he manages to find some extra time for radio.

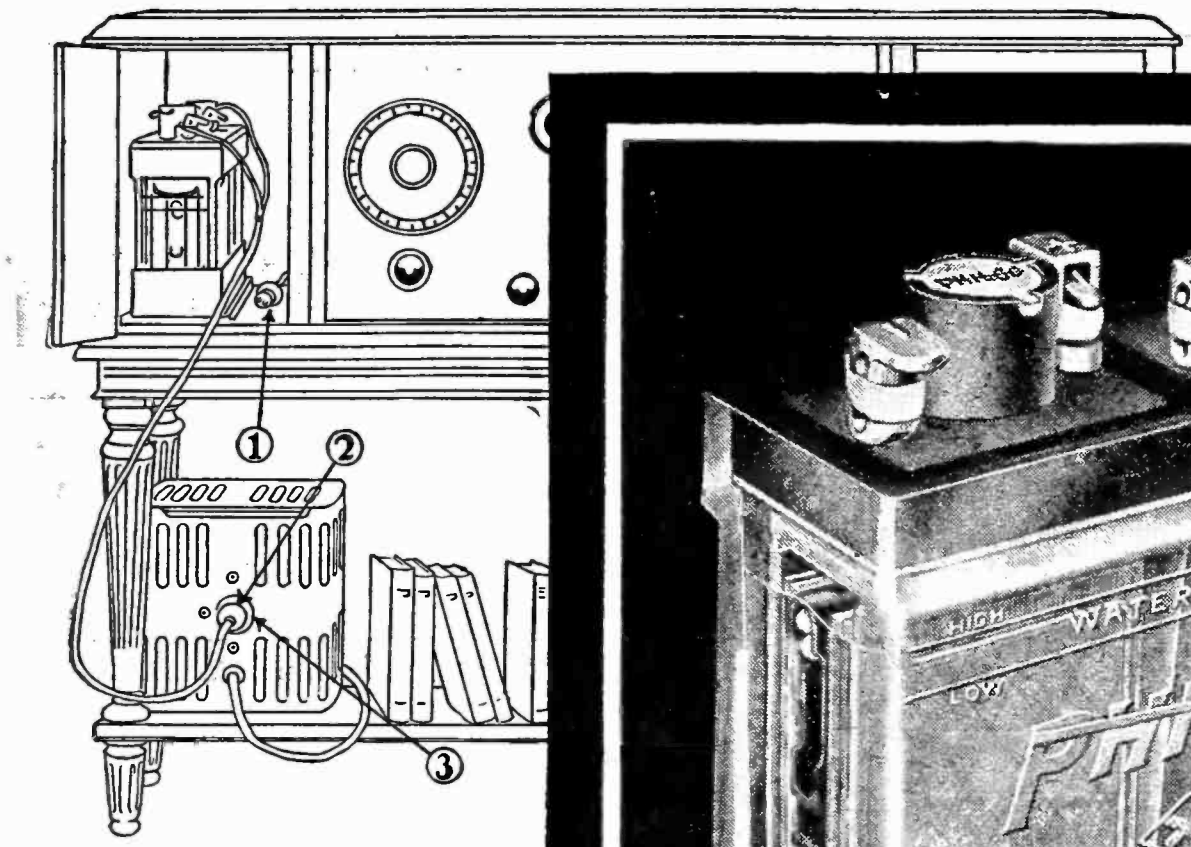
ROLAND F. BEERS

G. H. BROWNING, who with Mr. F. H. Drake, and Mr. Volney D. Hurd, produced the set which he describes on page 282, is in Cambridge, Massachusetts at the Harvard School of Engineering.

HOWARD S. PYLE

HOWARD S. PYLE, recently resigned from the Radio Service of the Department of Commerce and after several months spent as a radio consulting engineer is now one of the operators attached to the new Radio Corporation of America coast station WGO at Chicago.

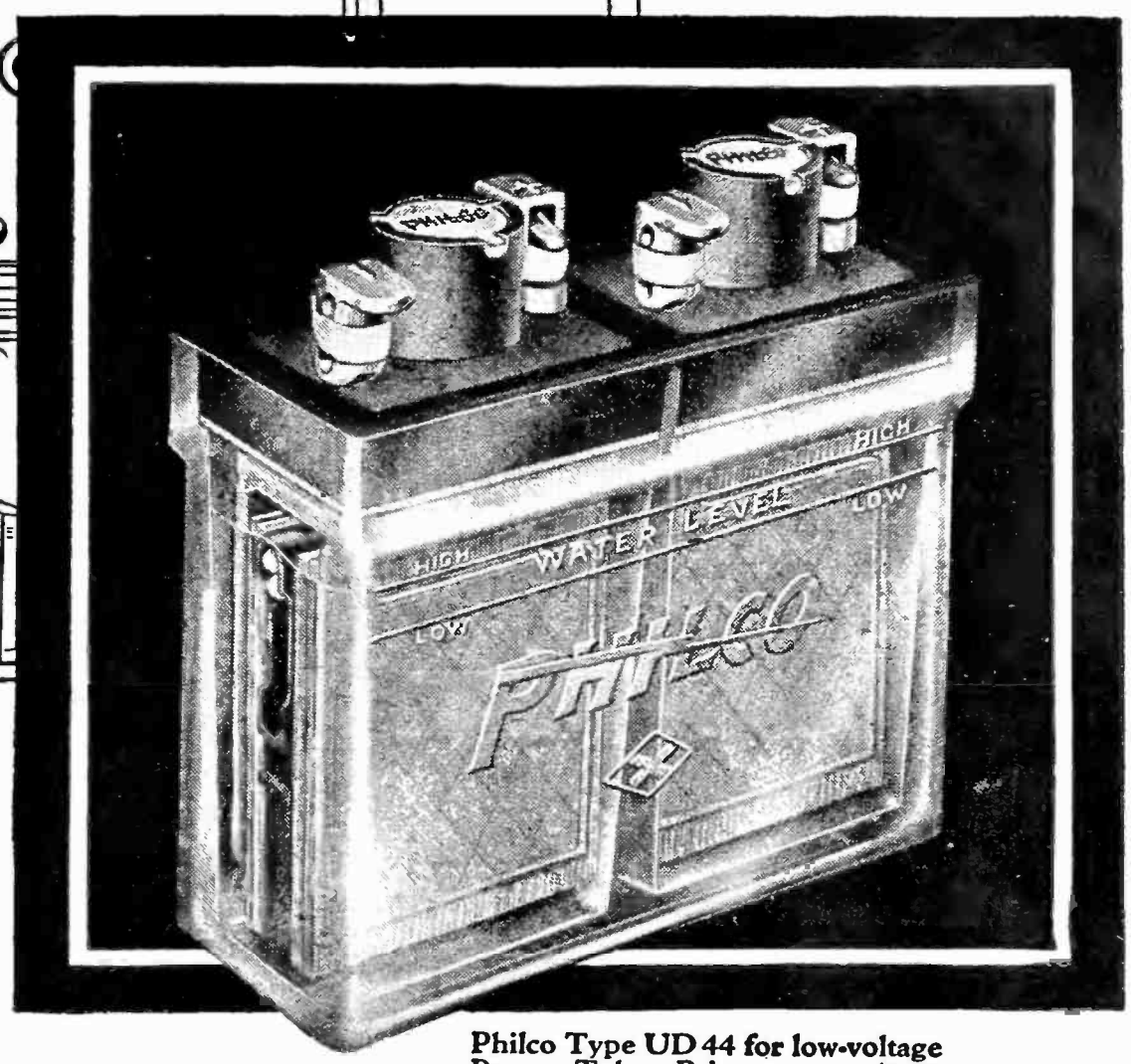
THE article by Dr. W. H. Eccles on "The Importance of the Radio Amateur" which appeared on page 83 of RADIO BROADCAST for November, was reprinted through the courtesy of the *Wireless World and Radio Review* (London). We regret that a credit line to that effect was inadvertently omitted from the article.



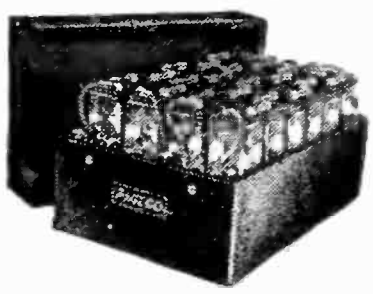
Philco "A" Battery on Charge

To connect the battery to your receiving set just pull out plug (2) from receptacle (3) of the Philco NOISELESS Charger and push into receptacle (1). (You can operate Philco "B" Batteries in the same convenient fashion.)

Philco Double Charger for 6-volt "A" batteries and all "B" batteries $15.00
Philco Single Charger for dry-cell tube "A" batteries and all "B" batteries $9.75
Prices include plugs and receptacles (1), (2) & (3)



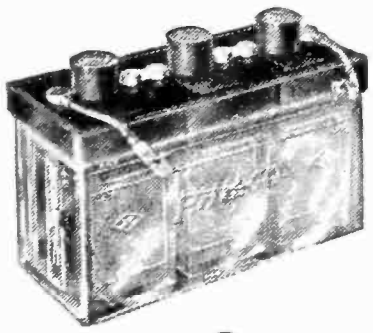
Philco Type UD 44 for low-voltage Peanut Tubes, Price . . . $8.00



Philco "B" Battery

Storage "B" batteries are essential for clear and distant reception. Philco "B" batteries stay clean and dry.

With de luxe mahogany-finish case with cover (48 volts) $20.00
With handsome mahoganized case without cover (48 volts) $16.50



Philco "A" Battery

For standard 6-volt tubes. Acid-tight glass case. Built-in Charge Indicator.
Price . . $16.00

Philco "A" Battery

Mahoganized case type for standard 6-volt tubes.
Price . . . . . $14.50 up.
Charge tester—permanently mounted in filler cap—$1 extra. Avoids fussing with a hydrometer.

A Philco Rechargeable *"Dry-Cell Replacement"* Battery

A PHILCO "dry-cell replacement" storage battery gives better reception at much less expense than dry cells even on dry cell tubes. There is no appreciable drooping in reception from the start to finish of a discharge.

Dry-cell voltage falls continuously from the very day the cell is manufactured, whether it is used or not.

Storage battery voltage stays within 12% of maximum at all times and can be restored to maximum at any time by recharging.

Recharging with a Philco NOISELESS charger means merely pulling a plug from the radio socket and pushing it into the charger socket. No wires to change. No getting positive and negative mixed.

This Philco "dry-cell replacement" battery has other big advantages. It has a built-in Charge Indicator that tells you at a glance how far the battery is charged or discharged. It delivers strong, non-rippling current without hum, roar or buzz.

Like all Philco Rechargeable Radio Batteries, it is Drynamic (shipped by the factory dry but charged). Its life doesn't start until you or your dealer pours in the electrolyte. You are sure to get a new, fresh battery.

This Philco Type UD44 operates either UV199 or WD11 type tubes. It occupies only the same space as three dry cells but easily replaces six dry cells as used on multi-tube receivers. Exclusive acid-tight sealing makes it practical for use inside radio cabinets. Philco makes batteries of similar convenience and economy for storage battery tubes and for your automobile.

PHILCO DRYNAMIC RADIO BATTERIES

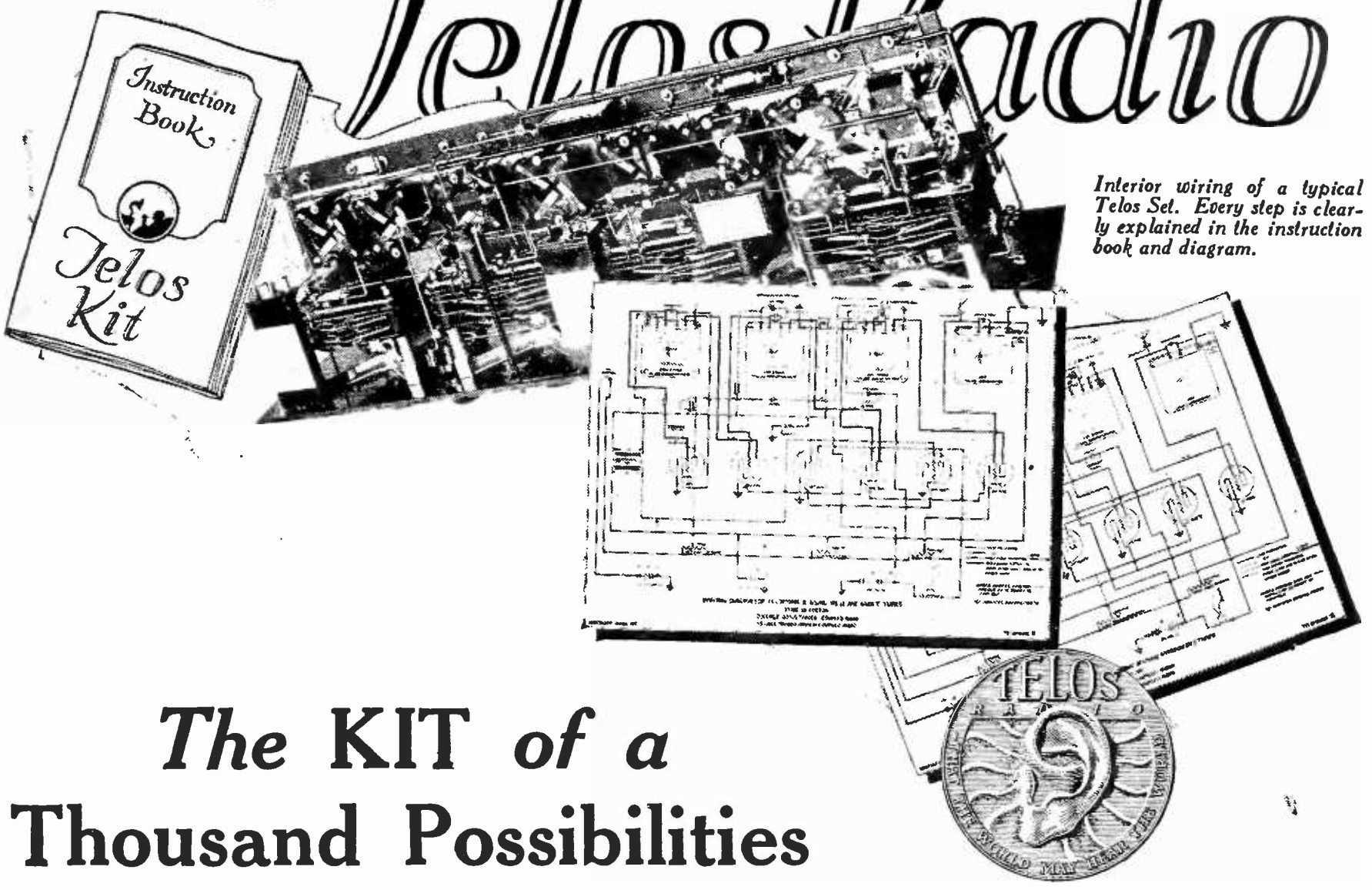
Philadelphia Storage Battery Co.
Ontario and C Sts., Philadelphia

Jobbers *and* Dealers—Philco has brought radio batteries out of the cellar and put them in the living room. Our new Radio Manual tells how. Fill out coupon below and we will mail you a copy.

Name _____
Street _____ *City* _____
State _____ *Jobber* ☐ *Dealer* ☐

★ Tested and approved by RADIO BROADCAST ★

Telos Radio



Interior wiring of a typical Telos Set. Every step is clearly explained in the instruction book and diagram.

The KIT *of a* Thousand Possibilities

WHEN, up to now, have you heard of *three* stages of tuned R.F.—perfectly and automatically stabilized! When, up to now, have you heard of 2, or even 3, stages of resistance-coupled A.F. — superimposed (reflexed) on the radio frequency tubes? Yet you won't have the slightest difficulty in accomplishing this with the equipment in the Telos Kit.

And you can do it with dry cell tubes—U.V. 199's or D.V. 3's throughout.

But you're not limited to that combination either. Truly, Telos is the KIT of a thousand possibilities! You can introduce a crystal detector if desired. You can use one, two or three stages of transformer A.F.; you can use W.D. 12 tubes for the R.F., with filaments connected in series, and 201 A's for the Detector and A.F.

These, and countless other combinations you'll want to try, are fully covered in the handsome instruction book and detailed blue-prints that come with every KIT.

You'll also be interested in "Unicontrol," the clever device whereby all dials turn together for rough tuning, then separately for the finer adjustment. It's in the KIT, too!

But get the full story! Use the coupon *now!* Every real fan will want a copy of the new Telos booklet!

DANZIGER-JONES, Inc.
Dept. B
25 Waverly Place
New York N. Y.

DANZIGER-JONES, Inc.
Dept. B 25 Waverly Place,
New York, N. Y.

Send me at once your booklet "The KIT of a Thousand Possibilities."

Name .....

Address .....

.....

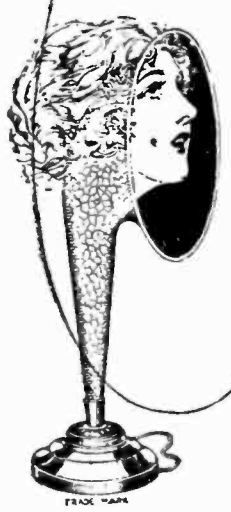
★ Tested and approved by RADIO BROADCAST ★

Atlas

TRADE MARK

RADIO REPRODUCTION

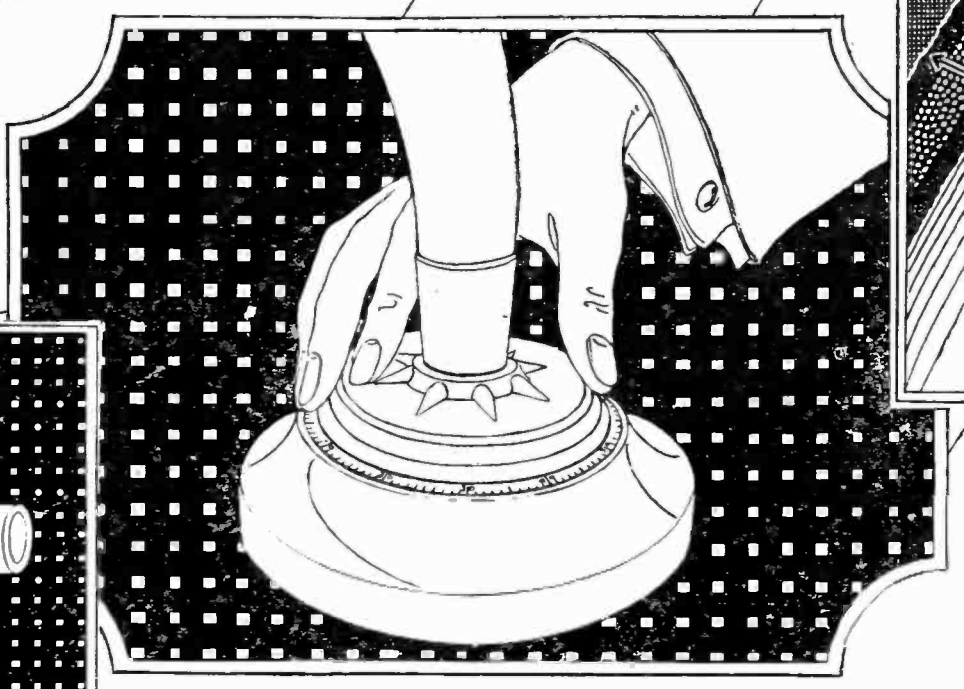
speaker

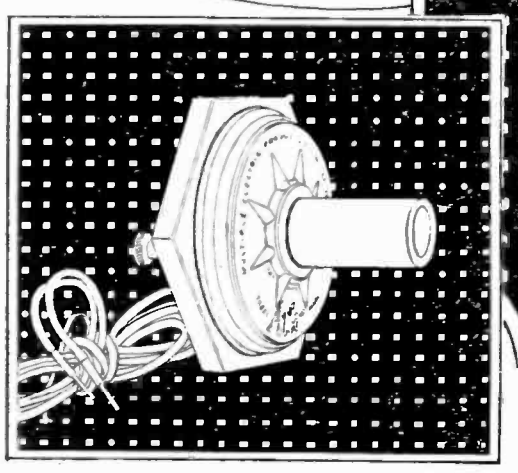


Radio . . as you *ought* to hear it!

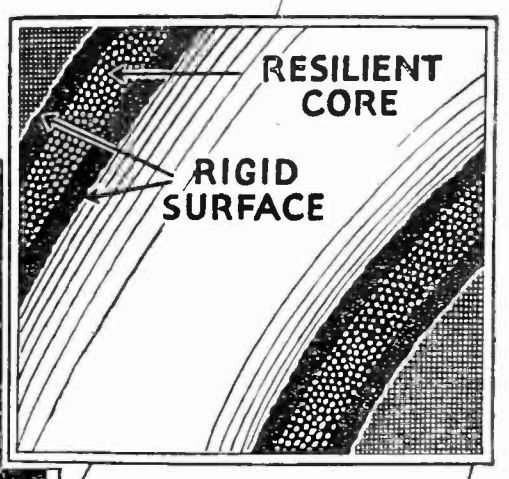
ATLAS Radio Reproduction is *harmonized* Radio Reproduction–a speaker in harmony with your receiving conditions. A slight turn of the *harmonizer** gives you radio as you *ought* to hear it–from near and distant stations–with 3 tubes or 8–on speech, or song, or instrumental music.

**Patent Applied for*





Atlas unit, complete with attachment couplings for all standard Phonographs.



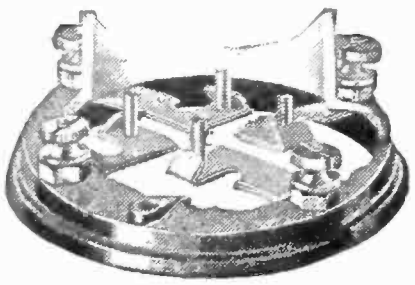
Cross-section of an Atlas horn—
—resilient in the center to absorb vibrations of the material,
—rigid at the surface to conserve the pure tones of the compound diaphragm.

Multiple Electric Products Co., Inc.
365 Ogden St., Newark, N. J. Dept. A
New York, Boston, Philadelphia, Baltimore, Pittsburgh, Detroit, Chicago, St. Louis, Denver, Rialto Bldg. San Francisco.

Marconi Wireless Telegraph Co. of Canada, Ltd.
Sole Canadian Distributors

★ Tested and approved by RADIO BROADCAST ★

If you want clear radio, you must have perfect contact



"It's the contact that counts"

Exacting test prove efficiency of Na-Ald Sockets

CLEAR contact between socket and tube is necessary, above all, to insure clear radio reception. This contact is the important point to watch in all sets.

Perfect contact assured with Na-Ald De Luxe Sockets. Broad wiping surface of four special dipped phosphor bronze socket clips press both on sides and ends of tube terminals, making constant clean bright contacts.

Clean Easy Feature. The two to eight tubes do not have to be removed and sandpaper used to scrape contact surfaces bare. Duo-contacts easily cleaned and film of oxide between tube and socket, better known as corrosion, which can ruin contact, is quickly removed by twisting each tube back and forth in its socket two or three times. This feature of Na-Ald Sockets saves trouble and time.

Socket instantly cleaned by twisting tube

Highest insulating qualities. Na-Ald Sockets are genuine bakelite Alden processed. This gives a socket of well-cured not-too-heavy bakelite of even cross-section throughout.

Thus Alden Processed construction insures highest insulating qualities and lowest loss. All possible current is carried from socket clips to tube terminals. This is most essential as current flow is so minute, any loss is noticeable in efficiency results.

Na-Ald Sockets are easy to mount. Sockets equipped with slotted knurled nuts. Tightened with ordinary screw-driver.

You can obtain Na-Ald Sockets at radio, electrical and hardware stores everywhere. Be sure you have Na-Ald Sockets in the set you build or buy. Sockets for all tubes. DeLuxe 75c; others 35c, 50c, 75c.

Send for free copy of radio booklet—"What to build,"—giving a number of the best selected and tested circuits.

ALDEN MANUFACTURING COMPANY

Also makers of the famous Na-Ald Dials

Dept. B-1 **Springfield, Mass.**

ALDEN PROCESSED

NA-ALD

SOCKETS AND DIALS

★ Tested and approved by RADIO BROADCAST ★

Dear Jim:

You asked me what caused the noises in your radio set.

Here's a diagram that will help you. The dotted line tells the story. B Batteries connected right to your phones. *All radio sets are built this way.*

When B's start to run down their current gets jumpy, and there's a crash or a sizzle in every jump.

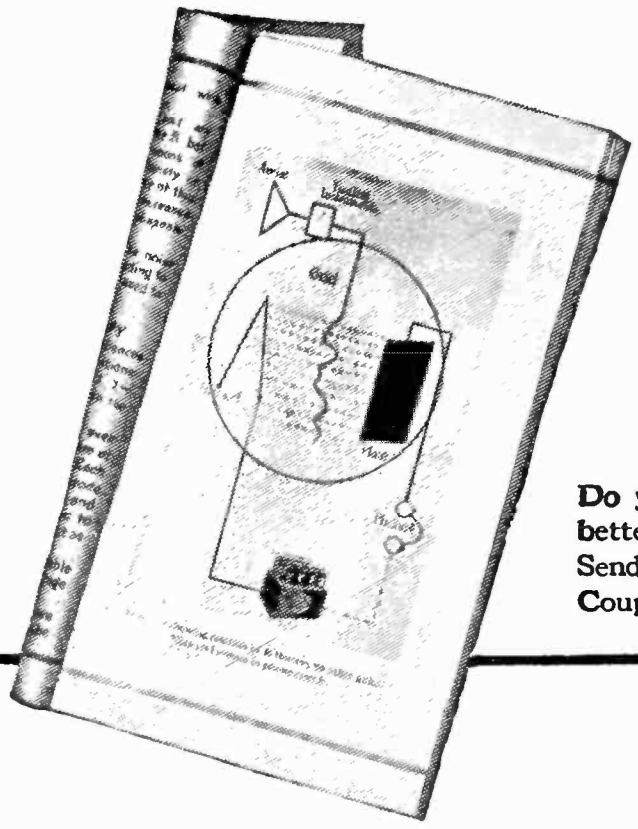
I used to think that Old Man Static made these noises until I got my Willards and listened to the difference.

Take my advice, Jim. Get Willards. You can depend upon *them* to give steady current for a long, long time. Willards require very little recharging, and you can do that right at home with an inexpensive little rectifier in circuit with an ordinary light bulb.

Why keep buying batteries when Willards *last for years,* and give better results.

Yours noiselessly,

Sam.



Do you want better results? Send in the Coupon.

WILLARD RADIO BATTERIES

FOR SALE AT WILLARD SERVICE STATIONS AND RADIO DEALERS

★

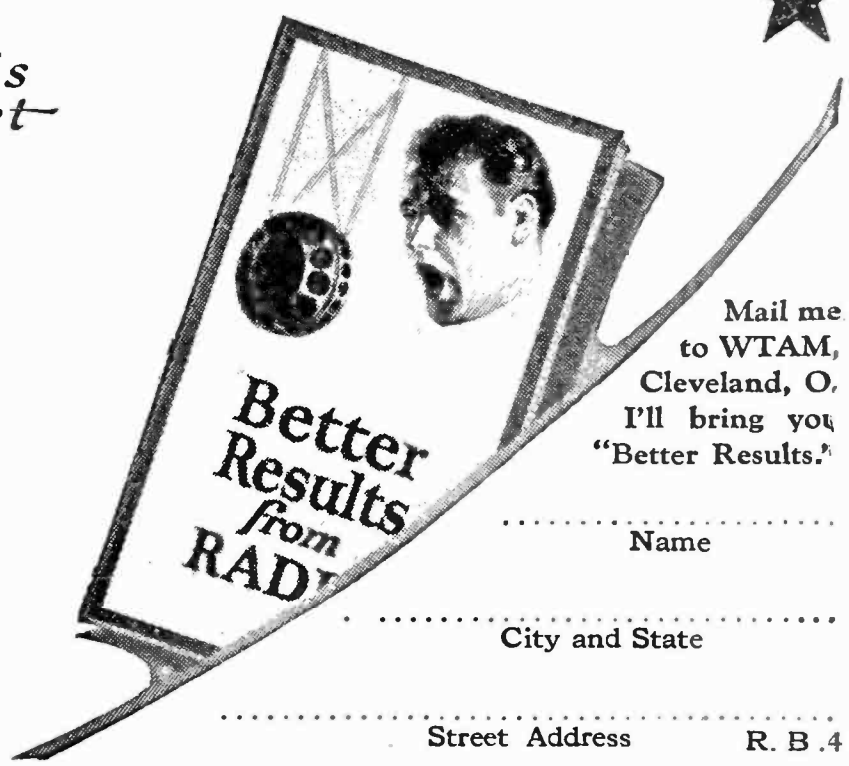
Write to **WTAM** *for this booklet—*

[The Voice of the Storage Battery]

WTAM is the Radio Research Laboratory and Broadcasting Station of the Willard Storage Battery Company, Cleveland, Ohio.

Its function consists of research which is being done to improve the quality of radio reception and the broadcasting of radio programs for your entertainment.

Write for WTAM's own booklet, "Better Results from Radio." Most interesting booklet ever published on this subject. Mailed to you with our compliments.



Mail me to WTAM, Cleveland, O. I'll bring you "Better Results."

..... Name

..... City and State

..... Street Address R. B .4

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All Parts Complete for the Series of Wonderful "KNOCK-OUT" RECEIVERS

Know the Joy of Radio! **Build a "Knock-Out" at Home!**

Save Time! Save Patience! Deal with a house which specializes in what you want. Get the parts complete for the One, Two, or Three Tube "Knock-Out" Receivers, including the R. B. Booklet of instructions, **described by *Radio Broadcast,*** (price 50c or free with order,) from

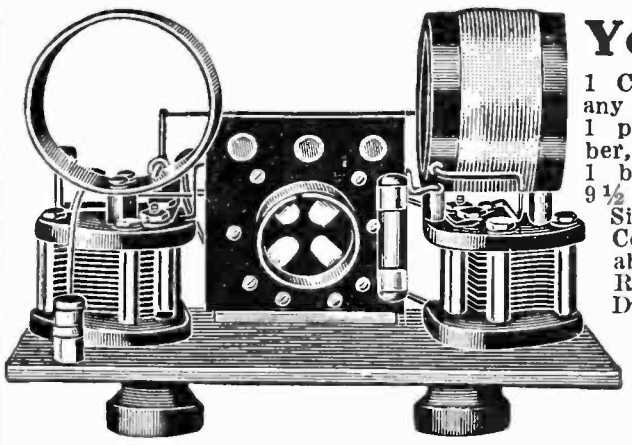
"The Radio House of Friendly Service"

Headquarters for Everything Needed for the Entire Series—

and anything else usually wanted to build or equip any other set

One-Tube "Knock-Out"

"I have received KFI, Los Angeles, five nights in succession, understanding every word spoken and the music with extra good volume. On two occasions, have been able to use the loud speaker." B. R. LINTON, HAPEVILLE, GA.



You Get—

1 Cabinet, mahogany finish, 7x10; 1 panel, hard rubber, 7x10 drilled; 1 baseboard, 6½x9½; 1 set coils, Sickles Reflex; 2 Condensers, variable, 23 plate, R. C. Co.; 1 Detector Crystal, Harco; 1 Rheostat and mounting, Amperite; 1 Socket, panel type, Federal; 1 Transformer, 5-1 Sherma-tran; 1 Jack, filament control, Millimeter; 2 Dials, black, 3 in.; 6 Binding Posts, moulded; 2 lengths of tubing, varnished; 1 doz. lengths wire bus bar.

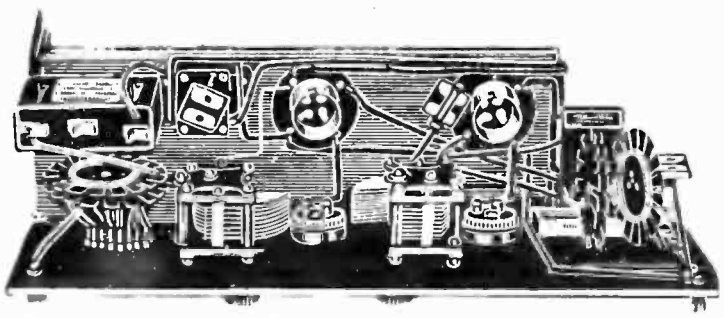
14S93 Regular Price $26.40 **Postpaid $20.92**

Accessories — 1 Battery, B, 22½ v.*, Eveready; 4 Batteries, A, drycells, Ray-O-Vac; 1 pair head phones, Little Tattler; 1 phone plug, Pacent; 1 tube, U. V.-201-A; 1 Antenna Equipment. *We strongly recommend 45 or 90 volts.

14S95 Regular Price $16.55 **Postpaid $11.87**

Two-Tube "Knock-Out"

"I have very distinctly heard on the 'phones the program of KGO, Oakland, California. My log shows many stations of 1,000 miles or more." J. P. CHARBONNEAU, MONTREAL, CANADA.



1 Cabinet, mahogany finish, 7x14; 1 Panel, hard rubber, 7x14, drilled; 1 Baseboard, 6½x13½; 1 Set coils, Roberts; 2 Condensers, variable, 23 plate, R. C. Co.; 1 Grid condenser, micadon, .00025; 1 Grid leak, 2 megohm, Daven; 1 Condenser, fixed, micadon, .0025; 1 Condenser, fixed micadon, .005; 1 Condenser, neutralizing; 1 Rheostat, 60 ohm, Tillman; 2 Resistance units, 25 ohm, Cutler Hammer; 1 Socket, Federal; 1 Socket, Federal, UV-199; 1 Transformer, 5-1 Sherma-tran; 2 Dials, black, 3 in.; 1 Switch, inductance, Fada type; 7 Switch points; 2 Switch stops; 8 Binding posts, moulded; 1 Battery, C, Eveready, type 771; 2 Lengths tubing, varnished; 1 doz. lengths wire, bus bar.

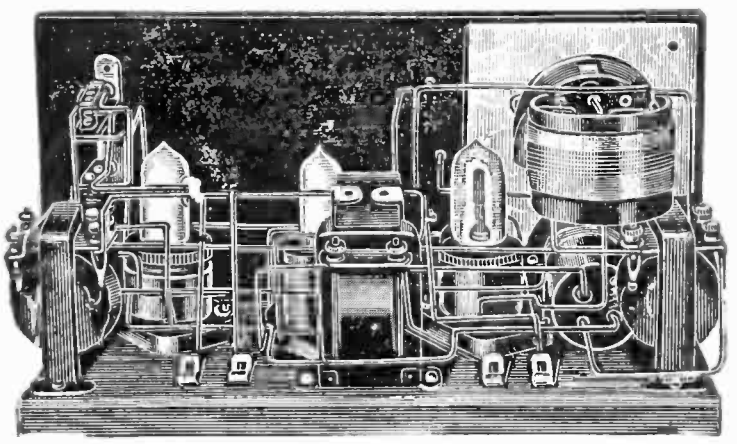
14S95 Regular Price $35.45 **Postpaid $26.71**

Accessories — 2 Batteries, B, Eveready, 45v.; 1 Battery, A, storage, 70 a.h., Westinghouse; 1 pair head phones, Little Tattler; 1 phone plug, Comsco; 1 Tube UV-199; 1 Tube, UV-201-A; 1 Antenna Equipment.

14S101 Regular Price $40.00 **Postpaid $31.44**

Three-Tube "Knock-Out"

"It is very satisfactory; in fact, it has greater volume than 6 or 7-tube heterodyne." C. W. TOLLNER, NEW YORK.



1 Cabinet, mahogany finish, 7x14; 1 Panel, hard rubber, 7x14, drilled; 1 Baseboard, 6½x13½; 1 Set coils, Sickles Reflex; 2 Condensers, variable, 23 plate, R. C. Co.,; 1 Detector, crystal, Harco; 1 Grid leak, 50,000 ohm; 1 Rheostat, 20 ohm, Tillman; 3 Sockets, Federal; 1 Resisto coupler, Daven; 1 Resister, Special, 100.000 ohm, 2 Transformers, 5-1 Sherma-tran; 3 Jacks. Filament control, Millimeter; 1 Micadon, .0005; 2 Dials, black, 3 in.; 6 Binding posts, moulded; 3 Lengths tubing, varnished; 1 Doz. lengths wire, bus bar.

14S96 Regular Price $40.40 **Postpaid $31.74**

Accessories — 2 Batteries, B, Eveready, 45v; 1 Battery, A, storage, 70 a.h., Westinghouse; 1 Pair head phones, Little Tattler; 1 Phone plug, Comsco; 3 Tubes, UV-201-A; 1 Antenna Equipment.

14S97 Regular Price $44.00 **Postpaid $34.79**

Read What This Expert Says:

"I have built about 60 sets of all types. Have built four Knock-Out Sets and with nine sets now, in the presence of super-heterodyne, neutrodyne, 6-tube R. F. and others of the best types, I truly think the Knock-Out is the most satisfactory all around set I have ever built or tried." SPENCER CARLTON, M. D., NEW YORK.

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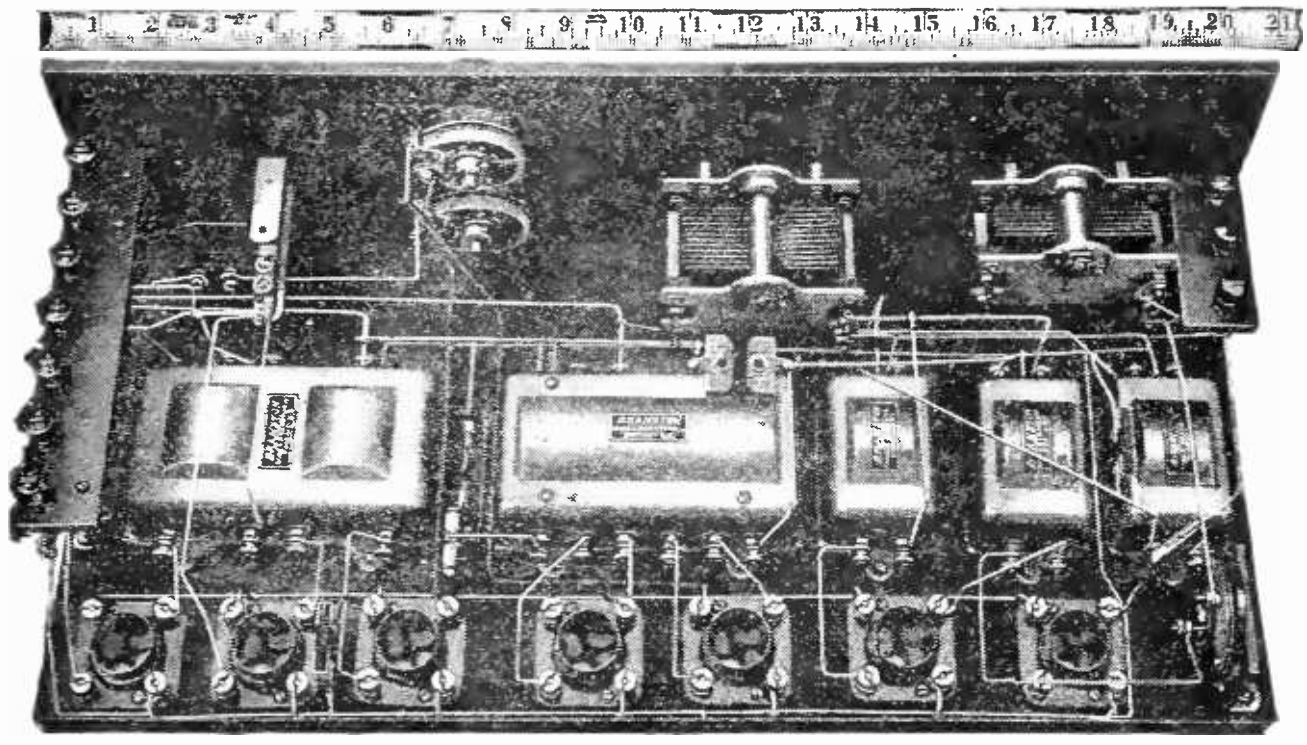
You can examine at your express office without obligation to accept. If you accept and within a reasonable time you do not get satisfactory results, we will take back anything or everything undamaged and willingly refund your money.



Just a Suggestion—Here's One of Several Circuits in Which Branston Transformers can be Used. This one is a Super-Heterodyne in which 7 Dry Battery Tubes do the Work of 10 or 12; A Strictly Loop Set. Panel 7″x21″, 2 controls. Built by a Buffalo, N. Y., Radio Fan.

Increase Your Range by Adding Short Wave Radio Frequency

If you own a Super-Heterodyne, use Branston Matched Transformers to replace inefficient transformers in your receiver and make seven tubes do the work of ten by reflexing. Use them to make your "Super-Heterodyne" a strictly loop set of great volume and range and remarkable selectivity. Non-reradiating. Their extreme compactness will enable you to reduce the size and improve its appearance.

8 Matched Transformers $35

Branston Super Transformers, Kit No. R-199. Contains three-stage long wave R. F. Transformers No. R-200 ($13.50), Twin A. F. Transformers No. R-204 ($8.00), Single Stage Long Wave R. F. Transformers No. R-205 ($4.50), Long Wave Tuned R. F. Transformers No. R-201 ($4.50), Special Tuned Coupling Transformer No. R-203 ($4.50), Short Wave R. F. Transformer No. R-202 ($4.50).

Every Transformer Perfectly Matched and Given an Operation Test

These are precision-built instruments, guaranteed to handle the radio energy with superior accuracy and extraordinary efficiency. They give all possible amplification without distortion. Useful in the building of sets using various circuits. They give remarkable results in Super-Heterodyne Circuits.

Send for Blue-Prints and Catalogue

Complete blue-prints and layout covering Super-Heterodyne, Radio Frequency, and Honeycomb Coil circuits sent for 25c in coin or stamps. Also complete catalogue of BRANSTON QUALITY RADIO PRODUCTS.

Your Dealer has Branston Kits or can get them for you.

CHAS. A. BRANSTON, Inc.
813 Main Street Buffalo, N. Y.

Manufacturers of Branston Violet Ray High Frequency Generators

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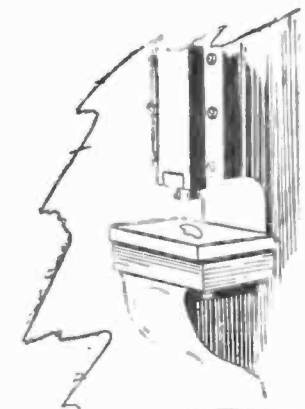
HEATH



Permanently FLAT Plates

The well-known Heath process of stamping rotor plates to lasting flatness, makes the new HEATH a permanently satisfactory instrument.

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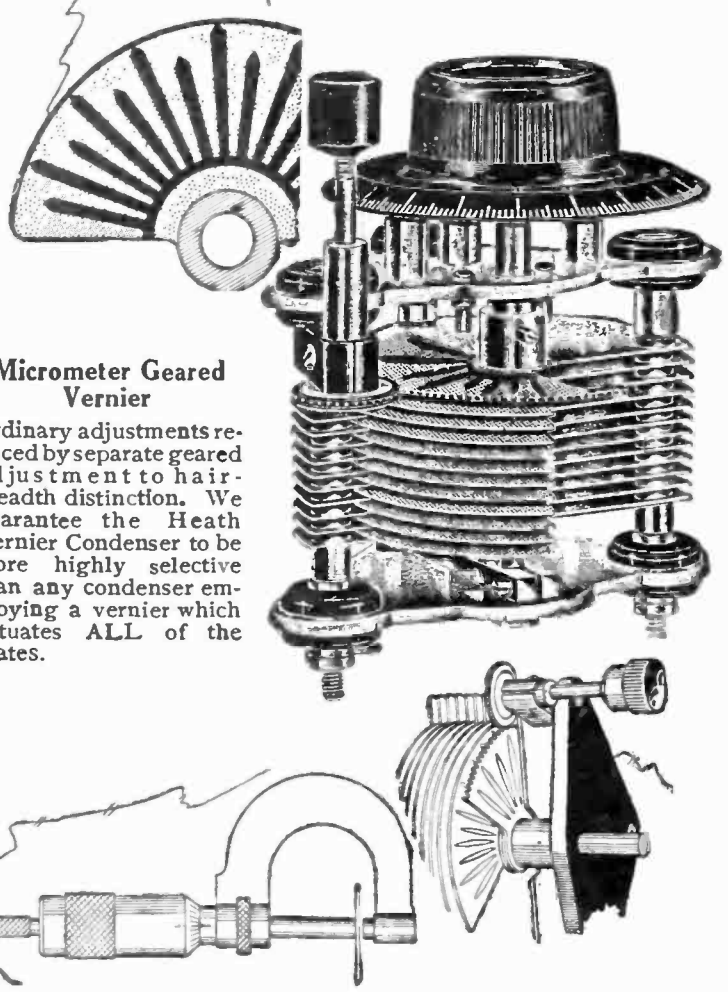

Micrometer Geared Vernier

Ordinary adjustments reduced by separate geared adjustment to hair-breadth distinction. We guarantee the Heath Vernier Condenser to be more highly selective than any condenser employing a vernier which actuates ALL of the plates.

Heath Radiant NON-DIELECTRIC Condensers

A new type of end plate which banishes leakage and capacity effects, added to the popular Heath features of permanently FLAT Plates and the most perfect type of vernier. These advantages of Heath condensers are the best guarantee of lasting satisfaction.

PRICES FOR VERNIER CONDENSERS

	With Dial	Without Dial
No. 12AV 12 plate	$5.00	$4.35
No. 24AV 24 plate	5.50	4.85
No. 44AV 44 plate	6.50	5.85

Plain types in all sizes

HEATH Sockets with the Exclusive Shock Absorber Feature

Bakelite base into which re-enforced phosphor bronze, self cleaning contacts are securely embedded. HEATH Standards of material and workmanship. **Price 75c.**

HEATH BAKELITE DIALS IN THREE SIZES

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The original and correct design and superior construction of Yaxley Approved Radio Products guarantee the best results for you. ★

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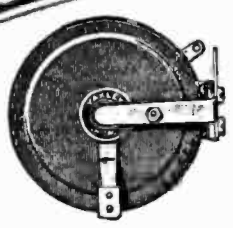

Rheostat

Gives fine tuning without use of vernier attachments. Has one nut mounting in single panel hole. Can be turned in any position to suit your wiring layout. You will like these and the other features of this new efficient rheostat. Fully guaranteed.

6, 20 or 30 ohm, with knob, $1.35
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Potentiometer
Same construction as Rheostat
200 or 400 ohm, $1.85.

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FIXED Crystal Rectifier

Guaranteed to give utmost sensitive reception with absolute stability. Especially designed for REFLEX work.

Tested and recommended for the "Knock-out" Reflex by "Radio Broadcast" Laboratory.

WITH MOUNTING CLIPS $1.25

At your dealers or sent direct upon receipt of purchase price

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containing a thousand bargains of everything on radio—parts, supplies, complete parts for sets, complete sets, etc., also a mine of very latest information on all different circuits, complete list of broadcasting stations, and other valuable, up-to-the-minute radio data. Send your name and address on a card or letter. We will send catalog free.

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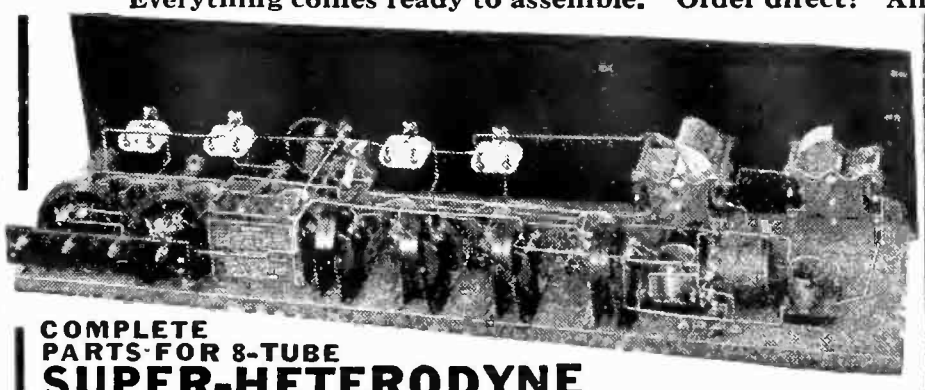
Our radio engineers will help you solve all your radio problems, and furnish up-to-date information on set construction, operation and improvement. This service is **free** to customers.



COMPLETE PARTS FOR 8-TUBE

SUPER-HETERODYNE

2 23 Plate Bremer-Tully or Duplex Low Loss Condensers.
3 Remler or Columbia Intermediate Frequency Transformers.
1 Remler or Columbia Tuned Circuit Transformer.
1 Special Oscillator Coupler.
1 Midget Condenser.
8 Bakelite Sockets.
2 Thordarson or Columbia A. F. Transformers.
1 Connecticut Filament Switch.
2 Bakelite 6-ohm Rheostats.
2 Bakelite 30-ohm. Rheostats
1 Bakelite Terminal Strip for Binding Posts.
1 Multicolucord cable for connecting batteries.
2 4″ Bakelite Dials.
1 Bakelite Potentiometer 400-ohms.
1 Carter Double Circuit Jack.
1 Dubilier 1 mfd. Condenser
1 .006 Mica Condenser.
1 .0005 Mica Condenser and 2 meghom grid leak.
3 .0025 Mica Condenser
1 .00025 Mica Condenser.
9 Binding Posts.
2 4½ Volt C Batteries.
1 7 x 30 x 3-16 Drilled Bakelite Panel. 1 Baseboard.
35 ft. Hook-up wire.

$59.75

Complete wiring diagram, baseboard layout, and blue-print,

Our Guarantee

Every article exactly as represented. Every article is tested before shipping. Complete satisfaction guaranteed or money will be cheerfully refunded.

Our Catalog Is Filled With Bargains Like These

CONDENSERS	
23-plate plain Condenser.	$1.29
23-plate Vernier Condens'r	2.59
RHEOSTATS and POTENTIOMETERS	
Bakelite Rheostat, 6-ohm.	.38
Bakelite Rheostat, 30-ohm.	.59
Bakelite Vernier Rheostat	1.15
Bakelite Potentiometer, 200-ohm.	.59
TRANSFORMERS	
Randolph Special, 6 to 1; 2.16; 3½ to 1.	1.89
Sinclair Special, 3 to 1, 2.55; 3½ to 1.	2.24
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4″ Hygrade Dial.	.29
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With adjustable loud speaker unit.	6.95
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180° Variocouplers.	.95
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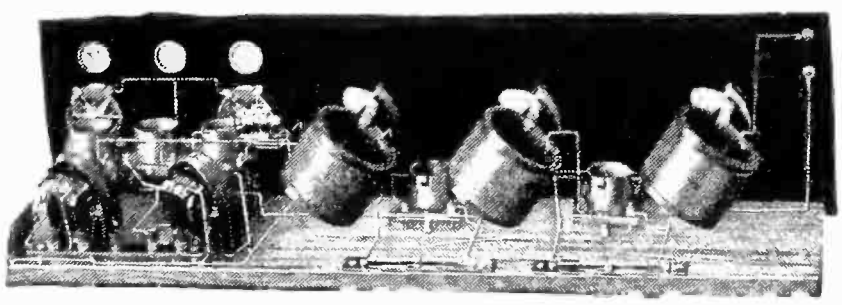
Cockaday Coil.	1.65
Three-Circuit Tuner.	2.95

Complete parts for the IMPROVED FOUR CIRCUIT TUNER as designed by L. M. COCKADAY

$39.65



COMPLETE PARTS FOR 5-TUBE

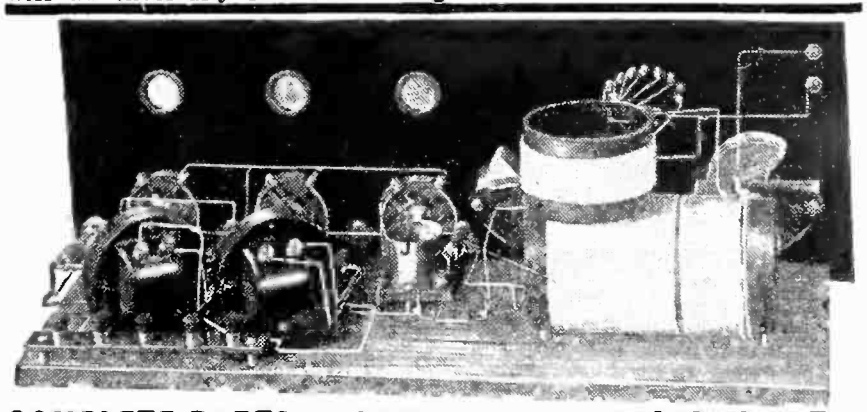
NEUTRODYNE RECEIVING SET

Genuine Hazeltine Licensed Neutrodyne Parts Furnished

PARTS FOR 5-TUBE SET:

1 7x24x3-16 Drilled Panel.
2 Thordarson or Columbia Audio Transformers.
3 4″ Bakelite Dials.
2 Precision Jacks.
1 Bakelite Rheostat—30-ohm.
1 Bakelite Rheostat—6-ohm.
1 Bakelite Binding Post Strip.
7 Marked Binding Posts.
1 Grid Leak and Condenser.
5 Bakelite Sockets.
1 .001 Condenser.
1 .006 Mica Condenser.
35 feet Hook-up Wire.
1 Kit consisting of 3 Hazeltine Licensed Neutroformers and 2 Neutrodons.
1 Baseboard.
2 Bezels.
Complete blue-prints working diagrams and instructions.

$33.75



COMPLETE PARTS FOR 3-TUBE

COCKADAY RECEIVING SET

1 Cockaday Coil.
2 23-Plate Hy-Grade Cond.
2 Bakelite Rheostats, 30-ohm.
1 Bakelite Rheostat, 6-ohm.
3 Bakelite Sockets.
1 high ratio Columbia or Thordarson Transformer.
1 Single Circuit Jack.
1 low ratio Columbia or Thordarson Transformer.
2 Double Circuit Jacks.
2 3″ Bakelite Dials.
2 Grid Leak and Mica Con.
7 Switch Points, 2 stops.
1 Bakelite Binding Post Strip.
7 Binding Posts.
1 Switch Lever.
24 ft. Hook-up Wire.
1 7x21x3-16″ Drilled Bakelite Panel.
3 Bezels.
1 Baseboard.
Complete blue-prints and wiring diagrams.

3-TUBE SET

$19.59

1-Tube Set.....$10.45

Complete Parts for 2-Tube

Harkness Set

7 x 14 Drilled Bakelite Panel, 2 Harkness Reflex Transformers with Condensers, 2 Dials, 2 Bakelite Sockets, 2 American Bell Transformers, 1 Single Circuit Jack, 1 R. W. Crystal Detector, 1 Bakelite Rheostat 6-ohm, 7 Binding Posts, Baseboard and Busbar Wire, Blue-print to complete wiring..... **$17.95**

Acme 1 Tube Reflex set **$17.45**

Acme 4 Tube Reflex set **$39.85**

RANDOLPH RADIO CORPORATION

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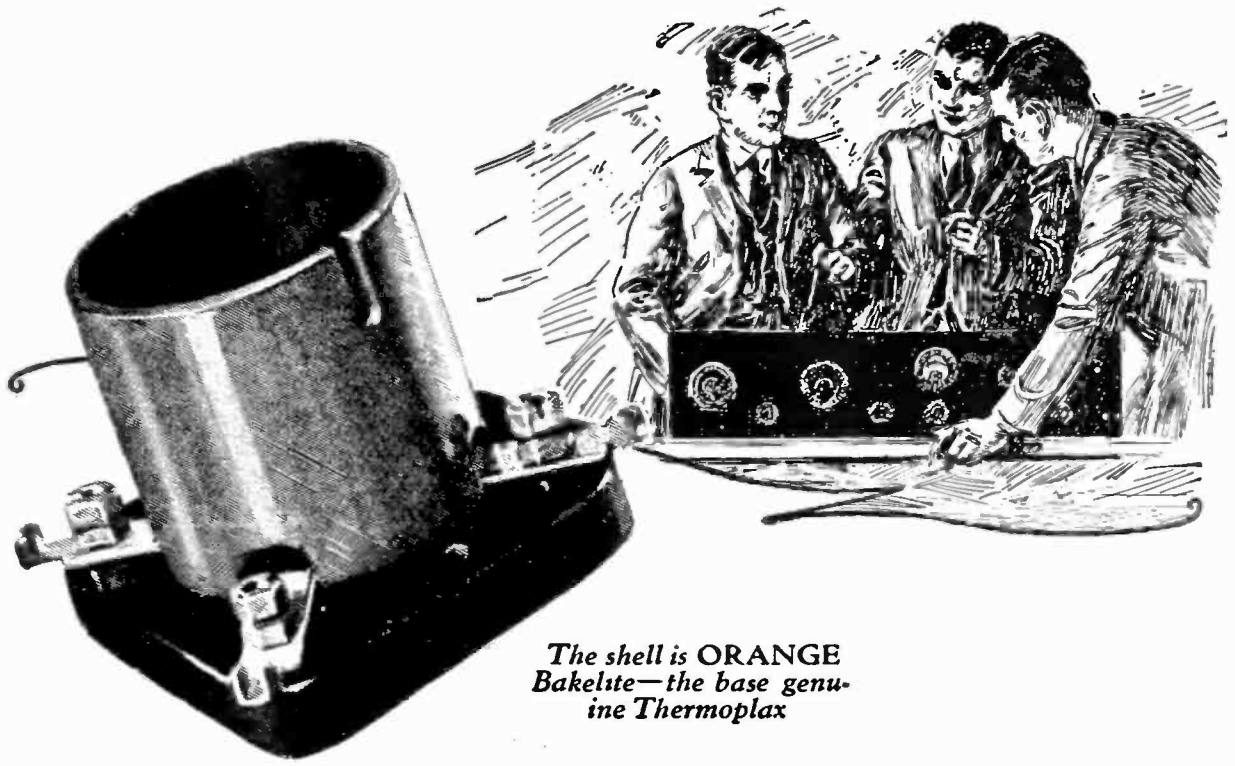


The shell is ORANGE
Bakelite—the base genuine Thermoplax

The More You Know About Radio the Better You Will Like This Socket

If ever a device were designed to increase the efficiency of all receiving sets, it was this new socket by the Master Builder. Radio Engineers praise it—new set builders marvel at its ease of installation and the clear, loud reception obtained that bespeaks the absence of losses—many old-timers have even rewired their sets to establish new distance records and enjoy clearer reception with this better socket.

You'll like its construction, embodying a minimum of both insulation and metal—capacity absolutely minimized *without sacrifice of mechanical strength.* And its base of ebony Thermoplax in beautiful color contrast with the thin shell of orange Bakelite adds greatly to the appearance of any set as the construction does to its efficiency.

You'll like its contacts (the source of losses and noise in most sockets); they are radically new in design, formed of phosphor bronze and *silver* plated—because the contact resistance of silver does not increase as it stands exposed to air. Then, too, electrical losses are minimized by providing maximum spacing between terminals, both in insulation and in the air.

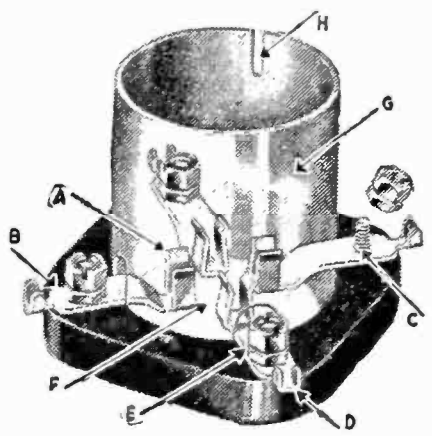
You will like the way the tube is inserted and removed without turning—which prevents twisting the bulb from its base. You will like its appearance—its small size—its neatness. You will like its silvered posts with slotted nuts that are fastened *well* with either screw driver or wrench. You will like the way these terminals are arranged for soldering—extra long so that they may be bent down where under-wiring is desired—and provided with ears to hold the wire in place for soldering. And best of all you will like the price, 90c. *This socket that meets the specifications of the most exacting radio engineer costs no more than most of those on the market today!* If your dealer has not yet been stocked, you can be supplied direct from factory at regular price plus 10c for packing and postage.

THE CUTLER-HAMMER MFG. CO.
Member Radio Section, Associated Manufacturers of Electrical Supplies
Works: MILWAUKEE and NEW YORK

"Built By The Master Builder"

C-H

These Exclusive Features Assure Better Reception



A
Perfect contact. Both sides of tube prong cleaned when inserted—no contact or wear on soldered end.

B
All metal parts *silver* plated—perfect contact for the life of the set. Silver may tarnish but its contact resistance does not change.

C
One piece contact construction. The binding post is NOT a part of the circuit—the wire to the socket always touches the contact strip which carries the current direct to the tube prong—no joints to cause losses.

D
Convenient terminals for soldering—full length to allow bending down for under-wiring. Ears hold wire in place for soldering.

E
Extra handy binding posts—tight connections with either wrench or screw-driver. Lock washers hold terminals rigid.

F
Wide spacing of current carrying parts both in air and insulation—true low-loss construction.

G
A minimum of both metal and insulation for low capacity. Shell of thin Bakelite—the base of genuine Thermoplax.

H
The tube is held in place by merely a vertical motion—no twisting to separate bulb from base.

The attractive orange shell helps identify this better socket, but the famous C-H *trade mark both on the socket and on the orange and blue box is your genuine protection.*

C-H **RADIO SOCKET**

★ Tested and approved by RADIO BROADCAST ★

Spintite
WRENCHES

Why not have a gift that you *want and really need* in your radio work! Ask "the folks" to include Spintites in your Christmas list this year. Or, if you have a friend who is a fan, surprise him with a set of these handy little wrenches that make the hardest hook-ups easy.

Clumsy pliers simply can't do the work of Spintites. Pliers *slip;* Spintites *grip*. Yes, even in the closest quarters Spintites reach right down and take hold of the smallest nuts, enabling you to spin them on *as tight as if soldered*, in less time than it takes to tell it. Tight joints, as you know, put an end to losses and noises due to leaky connections.

Spintites are appreciated as Christmas gifts because they are *real tools*, drop forged in *one piece* for long wear and quicker action. No separate parts to get lost. The other Stevens "Speed-Up" Tools for radio fans also make ideal holiday gifts. Write for Booklet 22 describing all the tools.

Set of 3 Spintites in most popular sizes (round or hex, as desired)

$1.00

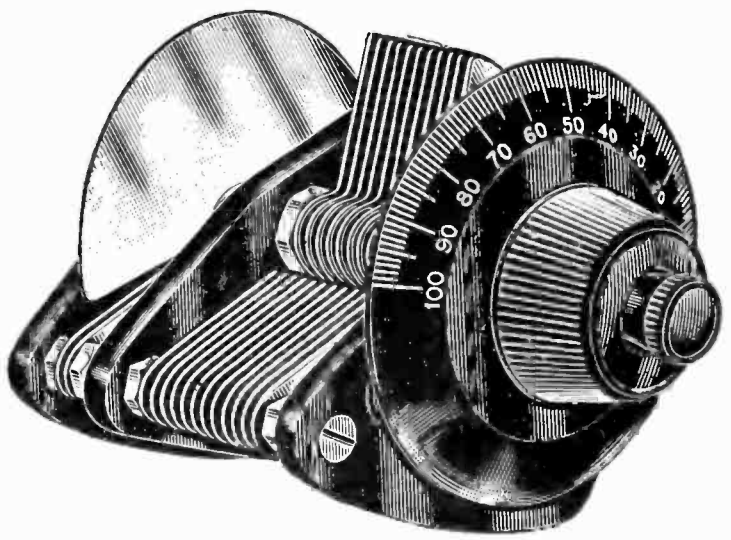
If your dealer can't supply Spintites, order direct from us. Don't take a substitute.

STEVENS & CO.
375 Broadway New York

Toolsmiths since 1899

ON APPROVAL!

Examine it in your express office—No money in advance.



No Sherman Kant-Short Vernier Condenser
ever returned to us as unsatistactory

Think what this means to *you*. Built with brass plates and bakelite ends, designed by radio engineers of ability and made by mechanics who know their business, the Sherman Kant-short Vernier Condenser offers to radio builders an excellent radio unit. Its sturdy construction coupled with brass plate design which protects against short circuits (fatal to perfect reception) insures you many years of satisfactory condenser service. Price includes dials. Furthermore it is fully guaranteed.

Satisfaction or Money Back

26-plate.....$3.50 **46-plate.....$3.95**

LIBERTY MAIL ORDER HOUSE
"The Radio House of Friendly Service"
Dept. 683Z 106 Liberty St., New York City

Get the program you want *when* you want it!

The Singer Compendyne will do it!

The Compendyne* five tube tuned R.F. low loss receiver has brought in sixty-seven distant stations on the loud speaker, within two and a quarter hours, while powerful local stations were broadcasting. Cabinet and panel are matched in mahogany, engraving and panel parts are gold finish.

The price is $95.00. *Write for descriptive literature.*

E. SINGER COMPANY, 40 Hudson St., N. Y.

**Patents pending*

★ Tested and approved by RADIO BROADCAST ★

ADLER-ROYAL 199
Designed and built to operate on dry cells
Price $165.00

A 5 tube Dry Cell Neutrodyne—
all batteries within the cabinet

YOU may have your choice of two different styles of Adler-Royal Neutrodyne. Set 201 A operates with the usual storage battery. Set 199 operates on dry cells. This is an achievement that has baffled radio engineers since the introduction of Neutrodyne.

Adler-Royal Neutrodyne also has separated the control for radio frequency and audio frequency. In simple language this means that with Adler-Royal, when a station is amplified, the desired tone quality and volume is controlled without detuning or distortion.

Not only their beauty of cabinet design but the workmanship and simplicity of the sets themselves are outstanding features of Adler-Royal.

Adler-Royal is on exhibit only at the higher class stores whose reputation is an additional guarantee of the quality of the Royal line.

★ **ADLER MANUFACTURING COMPANY, Inc.**
General Sales Office: **881 Broadway, New York City**
Factories: **Louisville, Ky.**

ONE *of the three cabinet designs of Adler-Royal Combination Radio and Phonograph Cabriole Model 10*
Price $300.00

Licensed by Independent Radio Manufacturers, Inc.
Reg. U.S. Pat. Off. NEUTRODYNE Reg. U.S. Pat. Off.
Pat. March 27, 1923 and April 1, 1924
Hazeltine Pats. Nos. 1,450,080 and 1,489,228
Other Patents Pending

The Adler-Royal Neutrodyne is licensed under the Hazeltine Neutrodyne patents and manufactured for us by King-Hinners Radio Co.

ADLER-ROYAL *Elizabethan Floor Type Neutrodyne No. 1 in figured walnut or mahogany finish; storage battery or dry cell equipment*
Price $350.00

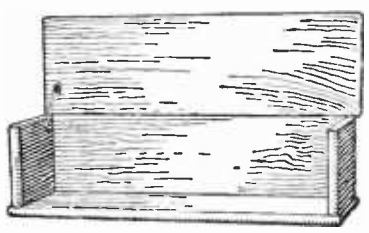
Adler-Royal
NEUTRODYNE

Send for an attractive booklet describing the complete Royal line of phonographs, radio sets and combinations.

★ Tested and approved by RADIO BROADCAST ★

TABLE NO. 31

Substantial table 15″x31″ x29″. Packed 1 each in carton, $3.50.



SPECIFICATIONS AND PRICES

Panel 7x9″ 7″ deep	$1.80
Panel 7x12″ 7″ deep	2.00
Panel 7x14″ 7″ deep	2.25
Panel 7x16″ 7″ deep	2.30
Panel 7x18″ 7″ deep	2.40
Panel 7x21″ 7″ deep	2.50
Panel 7x24″ 7″ deep	2.60
Panel 7x26″ 7″ deep	2.70
Panel 7x28″ 7″ deep	2.80
Panel 7x30″ 7″ deep	3.25
Panel 7x36″ 7″ deep	4.75
Panel 7x40″ 7″ deep	5.25
Panel 8x40″ 8″ deep	5.75

8 or 9″ deep add 30%
8 or 9″ Panels add 30%

MBG RADIO CABINETS

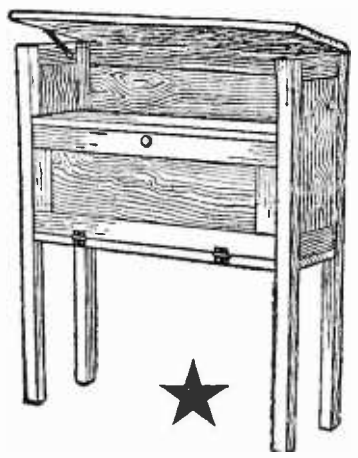
for your Radio Set

Get an MBG Cabinet for your set to-day. Any size you need at ridiculously low prices. All our cabinets are strongly made from beautifully grained Douglas Fir. Shipped in the natural wood with full instructions for staining at home to harmonize with 24 standard wood finishes. Make your radio set into an attractive piece of furniture at low cost.

RADIO CABINET DEPARTMENT
EXPRESS BODY CORPORATION
44 Lake Street **Crystal Lake, Ill.**

CABINET NO. 29

Battery compartment 10″x11″x29″. Open back with shelf compartment for B battery. Paneled front to conceal batteries, over all measurements, 11½″x32″x29″. Set up complete in carton, $7.50, with panel door in rear, $3.00 extra.



CONSOLE CABINET NO. 37

Panel Bat. Comp.
7x18″, 9½″ deep
10″x11″x18″ $10.50
7x24″, 9½″ deep
10″x11″x24″ 11.50
7x26″, 9½″ deep
10″x11″x26″ 11.50
7x28″, 9½″ deep
10″x11″x28″ 11.50
Additional door makes shelf in front of panel when open, extra, $3.00
No. 37 Two-door console for 5-tube Atwater Kent set.
Panel 8x30″, 10½″ deep.
Battery Comp. 10″x11″x 30″ $17.50
To fit 6-tube Atwater Kent
Panel 8x36″, 10½″ deep.
Battery Comp. 10″x11″x 36″ $20.50
Mounting boards, each, $.50
Shipped set up complete, one to a carton.

FARAWAY RADIO

$29.50
Gets stations Far and near Loud and Clear

FARAWAY Radio Sets are amazing values at bargain prices. Users get stations from New York to Frisco—loud and clear. Operate with either dry cells or storage batteries. Beautiful cabinet finished in mahogany with new platinum-finished panel. SATISFACTION GUARANTEED. Don't pay $100 to $150. Write for our *money-saving plan* and literature.

2-Tube Set - $29.50
4-Tube Set - 59.50

Dealers - Agents: Biggest possibilities you ever heard of. Write for plan and territory quickly.

THE FARAWAY RADIO CO., 655 W. THIRD ST., CINCINNATI, O.

RADIO

Big, complete stock. Standard prices. And you're sure it's reliable if it comes from Andrae.

Send for our catalogue

JULIUS ANDRAE & SONS CO.
112 Michigan Street **Milwaukee, Wis.**

ANDRAE *In Business Since 1860*

RADIO ENCYCLOPEDIA

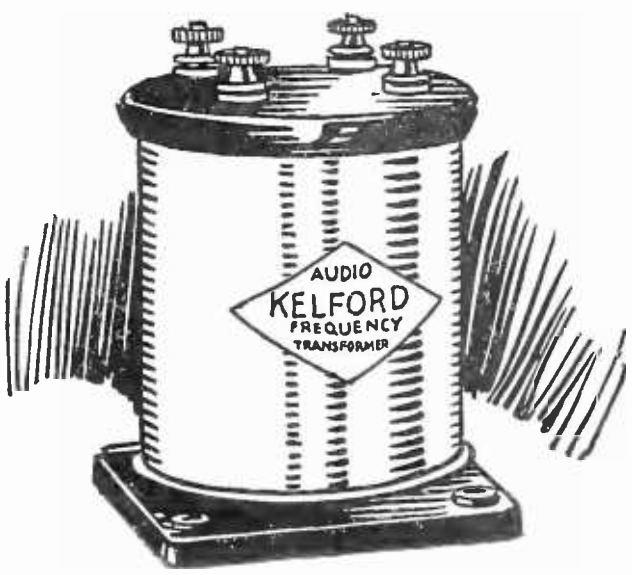
FREE! Thousands of radio bargains; standard sets, standard parts for sets, vacuum tubes, etc., at one-third less than regular prices, also latest information on all circuits, complete list of broadcasting stations and other valuable data. Send name and address, we'll send you 50c book FREE! **FREE SERVICE DEPARTMENT.** Mr Decker of N Y Eve. World will help you solve your radio problems, and furnish up-to-date information on set construction, operation improvement. This service **FREE** to our customers. Write today!

NORWALK RADIO CORP.
Dept. 57 66 READE ST., NEW YORK

Ratios 3½ to 1 and 5 to 1

$4.25 and $4.50

Nickle on brushed brass



KELFORD

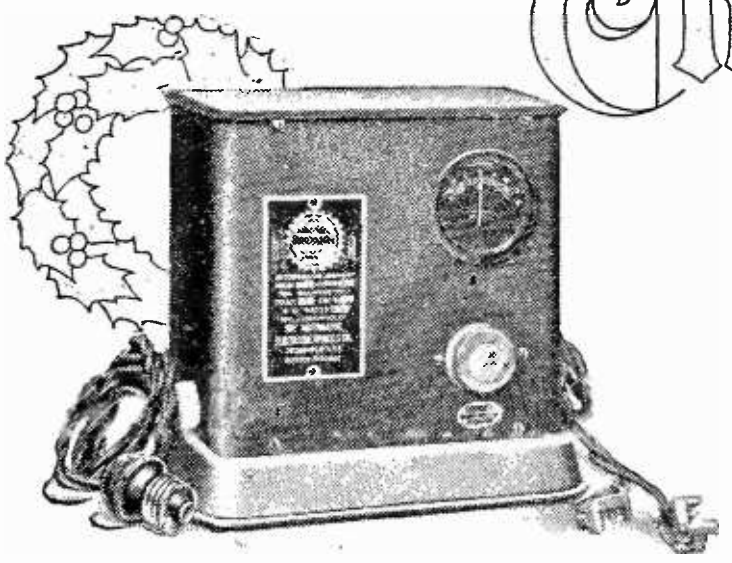
Shielded Audio Frequency Transformer

Considered by experts most perfect transformer ever constructed. Used in many of the world's finest sets. Gives great and clear volume without distortion. Made by America's oldest manufacturers of radio parts. Send post card for full details.

THE AMERICAN SPECIALTY CO.
176 Holland Ave. Bridgeport, Conn.

★ Tested and approved by RADIO BROADCAST ★

HOMCHARGER and Christmas



Give the Gift of Distance and Volume

YOU can give the most welcome gift of radio—increased distance and volume. This is the gift to be used and cherished for years to come.

14 GOLD SEAL HOMCHARGER features

1—Simple; needs no care.
2—Efficient; costs about 5c to charge the average battery, much less than bulb or liquid types of charger.
3—Quick; brings battery up to full charge overnight.
4—Tapers charge; cannot injure the battery.
5—Clean; no bulbs to break, no liquids to spill or produce fumes.
6—Dependable; adjusted and sealed at factory.
7—Lasts forever; only one moving part, the Tungsten contact, which can be replaced at $1 after many thousands of hours of use.
8—Fool-proof; charges automatically, no matter which clip is attached to which battery terminal.
9—Safe; approved by Fire Insurance Underwriters. No danger of shock or fire.
10—Beautiful; sturdy metal case finished in mahogany-red and gold.
11—Universal; made in types for all voltages of alternating and direct current. Charges all radio "A" and "B" batteries and automobile batteries.
12—Quiet; its faint hum cannot be heard in next room.
13—Unqualifiedly guaranteed.
14—Popular price; sold everywhere for $18.50; in Canada $26. Complete, no extras to buy.

The New Silent GOLD SEAL HOMCHARGER ★

Anyone who can operate a radio set can use the new silent GOLD SEAL HOMCHARGER.

More than 200,000 satisfied users of the HOMCHARGER are doing this today. Give your family, your friends, everybody, the gift of better radio, resulting from the great advantages of storage battery tubes.

So "Christmassy"! Finished in handsome bright mahogany-red and gold, the new silent GOLD SEAL HOMCHARGER makes a happy, brilliant display de luxe. It has rubber feet, too, and can't mar polished tables or floors.

FREE! Get the interesting booklet, "The Secret of Distance and Volume in Radio," containing valuable information on radio at its best, and fully describing the new silent GOLD SEAL HOMCHARGER. Your dealer has it; if not, send us his name and we will mail you a copy post-paid.

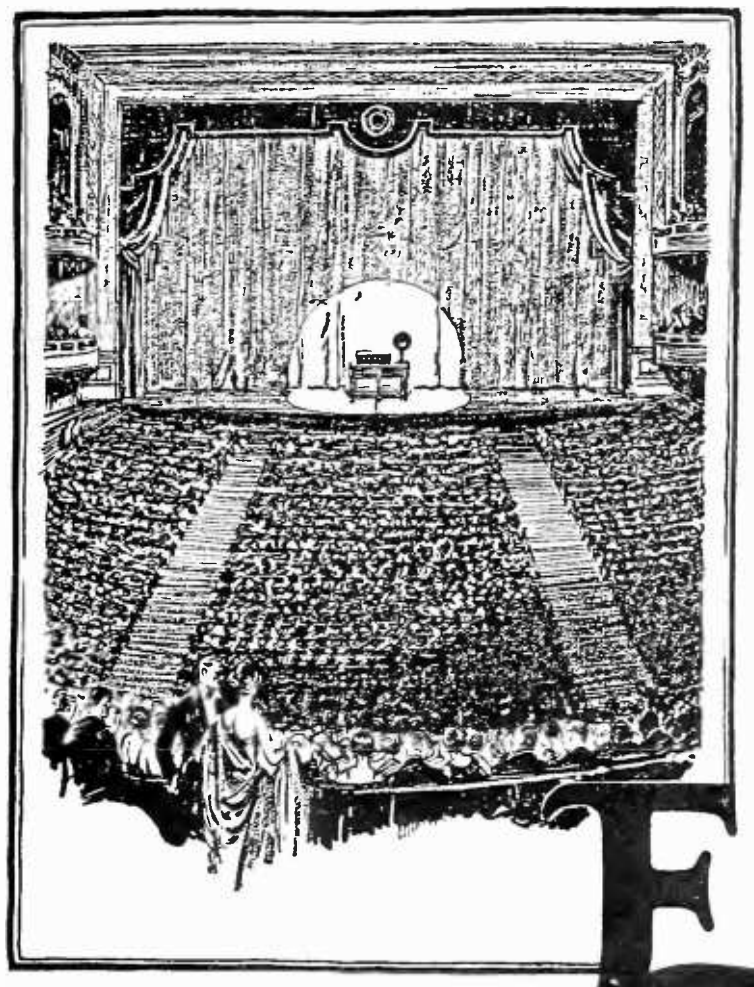
THE AUTOMATIC ELECTRICAL DEVICES COMPANY

Largest Manufacturers of Vibrating Rectifiers in the World

128 West Third Street, Cincinnati, Ohio

Under the same management as the Kodel Mfg. Co.

★ Tested and approved by RADIO BROADCAST ★



—and then we heard Electrola

The Musical Instrument of Radio

SUCH volume that it is necessary to warn users not to turn it on full—lest the loud speakers be thrown out of adjustment. A new five tube tuned radio circuit—developed by the pioneer makers of radio parts in this country. Batteries and tubes will last from twice to three times as long. Marvelous selectivity. These are the high spots. The whole story in a booklet. It will pay you to send for it so we can give you the nearest dealer's name and you can have the joy of your Electrola for Christmas.

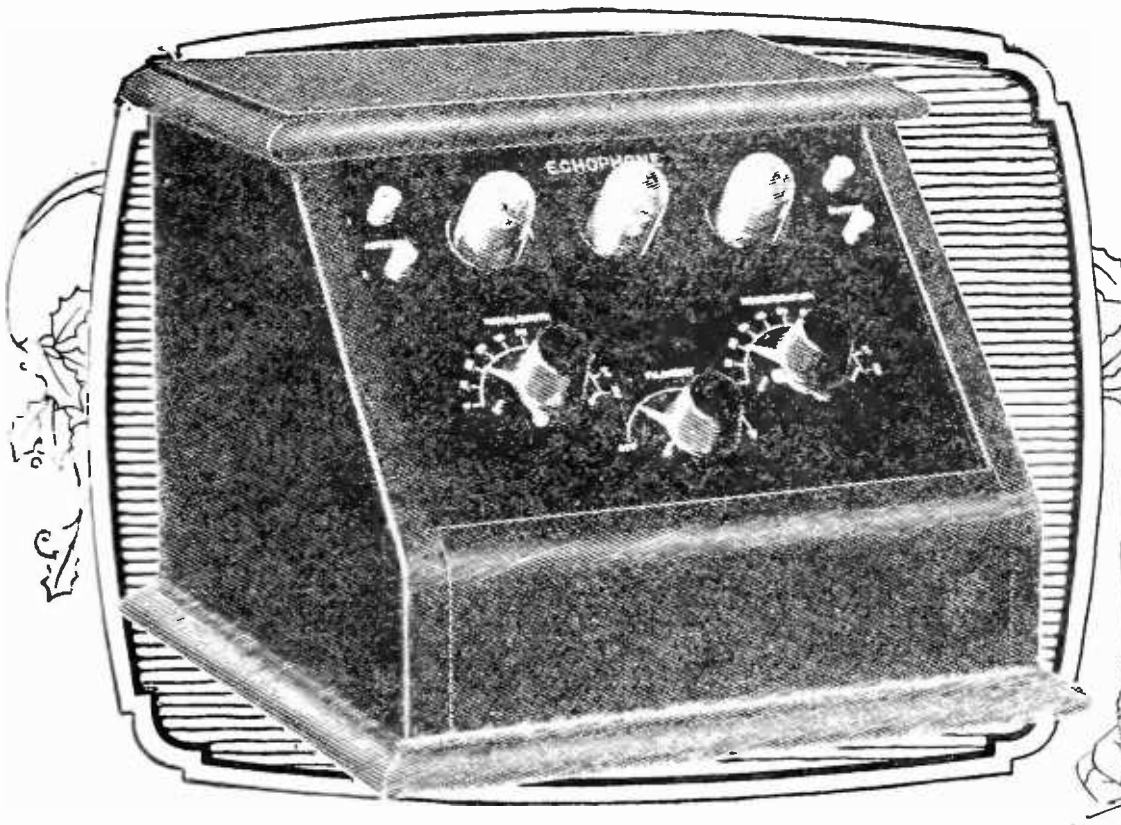
The Famous Line of Kelford Radio Parts include a remarkable low loss variable condenser, laboratory precision rheostats and potentiometers and a new shielded audio frequency transformer acknowledged by radio experts to be the most perfectly constructed transformer made. These parts are more efficient because of our long experience—and at lower prices because of our facilities. Send for catalog if you know that a set is only as good as its parts.

THE · AMERICAN · SPECIALTY · COMPANY

172 Holland Avenue, Bridgeport, Connecticut

America's Oldest Manufacturers of Radio Parts

Exclusive territory for jobbers. Community agency plan for dealers. For both jobbers and dealers the highest quality merchandise and discounts worth investigating



The ECHOPHONE "V-3"
The Super-Volume 3-Tube Regenerative
Without Tubes and Batteries

$50.00

The Ideal Gift
Distinctively Superior Yet Moderately Priced

WHEN you give your family the Echophone "V-3" for Christmas you are giving them radio entertainment of a noticeably finer quality than is afforded by any other three tube receiver on the market.

For here is a machine that brings "real music" into your home—that reproduces even on a loud speaker all high and low pitch tones, all voice modulations exactly as they are when they enter the microphone a half mile or eighteen hundred miles away. The Echophone "V-3" is a receiving set any novice can operate. It has only two tuning controls which once set bring in *only* the stations *wanted*. Operates with dry cell batteries, which fit into the handsome Adam Brown finished self contained cabinet.

As comparison readily reveals, such performance is available at moderate cost only in the Echophone "V-3." It is the result of special construction features and the use (through license obtained under U. S. Patent No. 1,113,149) of Armstrong's famous regenerative circuit.

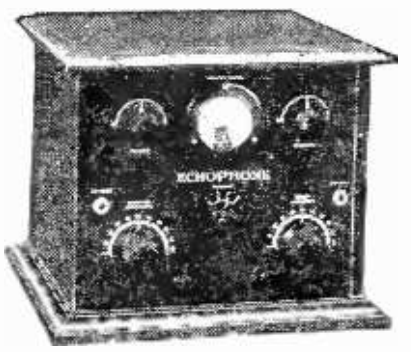
For those who want the ultimate in radio reception there is the Echophone "F-5." The 5-tube combined radio and audio frequency set that assures loud speaker reception of distant stations from either loop, indoor or outdoor aerial.

Ask your dealer about these sets today. Meantime send for our descriptive folder. Address

The Armac Radio Company, Agents
1120 N. Ashland Ave., Chicago, Ill.

Manufactured by THE RADIO SHOP, 1120 N. Ashland Ave., Chicago, Ill.
Long Beach, Cal. Sunnyvale, Cal.

ECHOPHONE



ECHOPHONE "F-5"
Without Tubes and Batteries
$110.00

ECHOPHONE
Storage Battery Results at Dry Cell Cost

Dealers: Get in Touch With Your Jobbers.

THE ARMAC RADIO CO.
1120 N. Ashland Ave., Chicago, Ill.

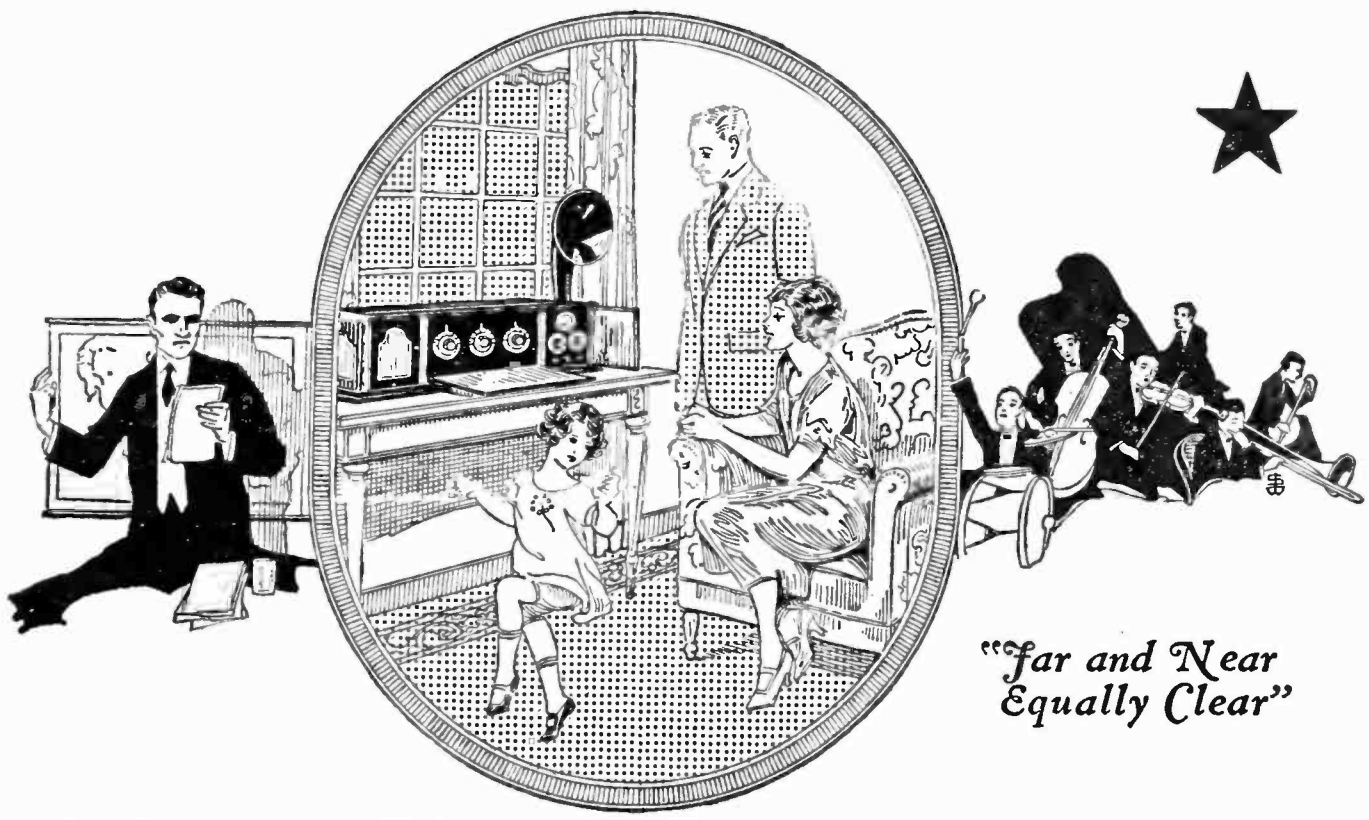
Please send folder describing fully the Echophone "V-3" and the Echophone "F-5." My Radio dealer is

.....

Name.....

Address.....

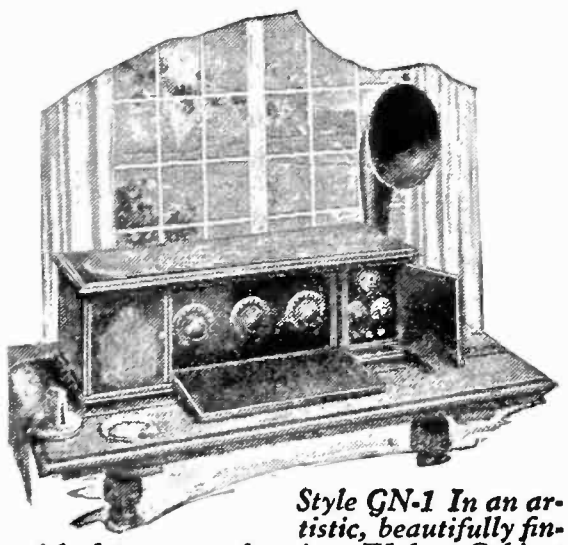
GILFILLAN NEUTRODYNE



"Far and Near Equally Clear"

A Christmas Gift of Permanent Satisfaction

PROOF of the superior performance of the Gilfillan Neutrodyne is coming in from every section of the country. Users everywhere tell us of their long distance feats and the wonderful clarity of tone with which stations far and near are reproduced. Convenient to install and simple to operate.



Style GN-1 In an artistic, beautifully finished two-tone American Walnut Cabinet of three panels, without accessories **$175**

These sets are manufactured in our three factories, supervised by a corps of Radio Engineers of national reputation. Each set must pass a rigid test so that it reaches you ready for instant service.

Buy a Gilfillan Neutrodyne for your Christmas gift and you will have a set that is in the first rank of Radio Improvement and Achievement.

Ask your dealer for demonstration and send to our nearest office for literature.

Style GN-2 Same Neutrodyne construction and features in smaller cabinet made of American walnut, finished in two tones; without accessories **$140**

GILFILLAN BROS. INC.

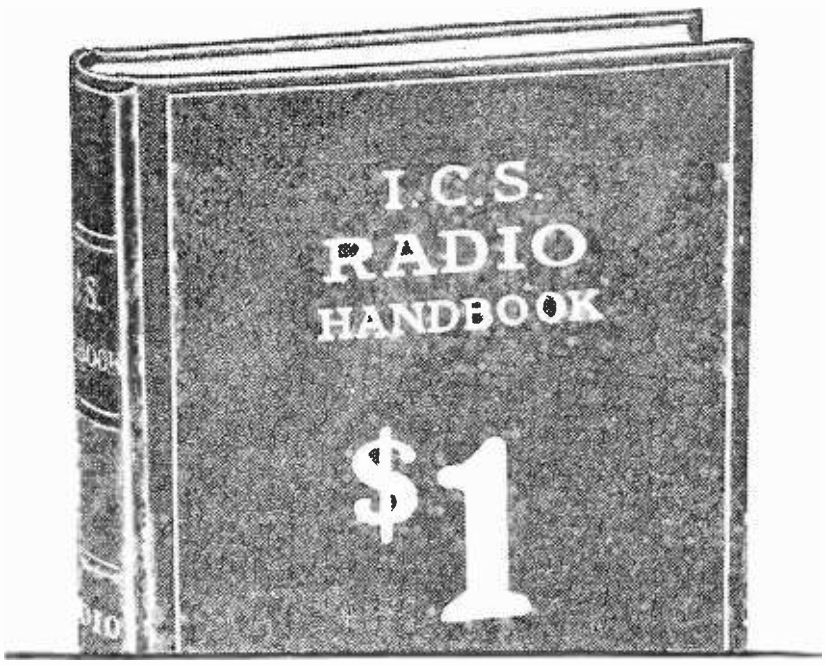
KANSAS CITY
2525 W. Penn Way

1815 W. 16th St., LOS ANGELES

NEW YORK CITY
225 W. 57th Stteet

GILFILLAN RADIO CORPORATION
LICENSED BY
Independent Radio Manufacturers INC
Reg. U.S. Pat. Off.
NEUTRODYNE
Reg. U.S. Pat. Off.
Pat. Mar. 27, 1923 and April 4, 1924
Hazeltine Pats. NOS 1,450,060-1,489,228
Other Patents Pending

★ Tested and approved by RADIO BROADCAST ★



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**

NEW edition off the press! The greatest book on radio ever written. Price only $1. Filled with sound, practical, tested information for every radio fan, from beginner to hard-boiled owl. Written, compiled and edited by radio experts of national reputation.

Every page tells you something useful. And there are 514 pages! More than 150 illustrations and diagrams!

You may dip into this I. C. S. Radio Handbook at random, or hunt up special information you want, or read it right through. Different types of receiving and sending hook-ups are explained; interesting experiments; definitions; codes and symbols; technical data and thousands of suggestions for .getting more pleasure out of radio. Will save you from wasting money on things that won't work. 100,000 already sold.

Send $1 today and get this 514-page I. C. S. Radio Handbook before you spend another cent on parts. Money back if not satisfied.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
Box 8297-C, Scranton, Penna.

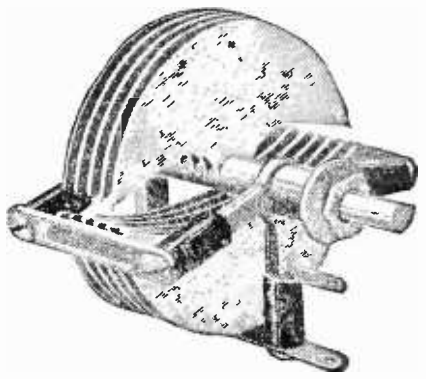
I enclose One Dollar. Please send me—post-paid—the 514-page I. C. S. Radio Handbook. It is understood that if I am not entirely satisfied I may return this book within five days and you will refund my money.

Name.....

Address.....

Check here ☐ and enclose $1.50 if you wish the de luxe edition, bound in Leatheroid.

Premier "CROFOOT" Vario Condenser



"Look for the condenser with the Red Stripe"

1 to 74 Tuning Ratio!

So great a ratio in a standard variable condenser is no accident. It is the result of careful engineering, radically different design and painstaking manufacture.

These facts are convincing evidence of superiority. "CROFOOT" has the lowest minimum capacity yet attained, therefore the greatest tuning ratio and widest tuning range. Extremely low phase angle loss, low insulation leakage and low skin resistance. Made entirely from brass and hard rubber, semi-straight line construction. All plates soldered. Grounded rotor. Lacquered rotor and stator plates. One hole mounting.

Min. Capacity	Max. Capacity	Tuning Ratio	List Price
.000005 M. F.	.0001 M. F.	1 to 19	$2.75
.000006 M. F.	.00025 M. F.	1 to 42	3.25
.000007 M. F.	.00035 M. F.	1 to 53	3.50
.000007 M. F.	.0005 M. F.	1 to 74	3.75

Complete with "E-Z-Toon" Vernier Dial 75 cents additional
Write for Free Bulletin No. 94 showing complete line of Premier Quality Radio Parts. Ask your dealer if he has Premier free hook ups. If not, send his name and receive a set free.

Premier Electric Company ★

3812 Ravenswood Avenue Chicago

PREMIER
Quality Radio Parts

POSITIVELY SENSATIONAL!

The Fixed Detector Marvel

Radio's Latest Scientific Triumph

The most sensitive fixed detector known for Reflex and Crystal sets.

★

Lego Wonder Fixed Detector

100% sensitive. Not so long ago many dealers believed the Reflex and Crystal Set to be a thing of the past, but that was before **LEGO** began to show them new tricks.

BUY A LEGO TO-DAY
Note the difference

For Sale by All Dealers, 90c., or Sent Postpaid Insured, $1.00

LEGO CORP. 225 W. 77th St., N. Y. C.

★ Tested and approved by RADIO BROADCAST ★

The Greater NEUTRODYNE EAGLE

★ Balanced Receiver

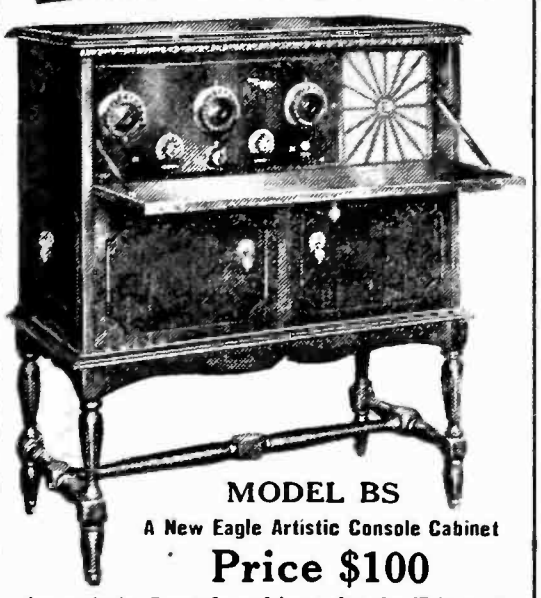
"My Choice this Christmas"

MODEL B 5 TUBES

Price $175

Eagle Guarantee

The Guarantee that accompanies every EAGLE Receiver Fully Protects You!



MODEL BS

A New Eagle Artistic Console Cabinet

Price $100

An artistic Console cabinet, for the EAGLE in American Walnut or Mahogany, with fume-proof compartments for battery and charger.

Licensed by Independent Radio Manufacturers, Inc., under Hazeltine Patents Nos. 1,450,080, dated March 27, 1923, and 1,489,228, dated April 1. 1924. Other patents pending.

EAGLE RADIO CO.

WE SOAR ABOVE
EAGLE RADIO COMPANY
NEWARK NEW JERSEY

19 Boyden Place, Newark, N. J.

Dear Mother:—

Merry Christmas! You see Santa Clause did remember what you said about wishing you had a radio set like ours, didn't he?

In fact, Mother, this is even a better Eagle Receiver. It's what is known as the New Model B Eagle. Your Eagle is even simpler to operate than ours. All you have to do to locate the different stations is turn the dials to certain numbers, which are always the same.

Another thing: you don't have to bother with plugs any more. You switch on the different stages and batteries just by a turn of the center knob, which operates a multiple (filament control) switch. Your Eagle has a number of important refinements — instruments which are exclusive Eagle features, among them a ball-bearing die-cast condenser and a new design rheostat.

'Scuse me, Mother, I didn't mean to cover so much good paper with my "radio ravings" but I can't help feeling happy about this new Eagle coming out just in time to send to you for Christmas.

I wanted to be sure I was getting the best receiver, so I tried out all the leading makes. But none of them could compare with the Eagle Model B for real simplicity, quality of reception and appearance. Just one other thing, Mother. You need'n't worry should anything happen to your Eagle as it's absolutely guaranteed.

Now I'll sign off, Mother. Let's hear how you make out with your Eagle. I suppose you'll be as much of a bug as I am, in a month or so.

Lovingly, Bob

Write for Literature

★ Tested and approved by RADIO BROADCAST ★

A Red Seal Headset *Completes* Your Radio Receiver

The best in headsets is none too good for you when you try for long distance. Even if your Loud Speaker *is* a Manhattan, it cannot catch those faint signals from distant stations which a Red Seal Headset pulls in with ease.

It is designed especially to receive broadcasted programmes—quite differently from ordinary phones built primarily for telephone and telegraph reception. Large tungsten steel magnets with silicon steel pole pieces pass on the full strength of incoming signals to the sensitive diaphragm. This and other structural refinements explain its great success in D. X. work.

The Red Seal Headset is comfortable to wear, particularly if you wear glasses. A flexible headband covered with washable, soft moulded rubber lightly holds the phones against your ears with a pressure easily adjustable.

There are no projections on the back of the phones to scratch furniture. There is nothing on the entire headset to catch the hair.

You can not buy a better looking, better working headset at any price. It's a wonderful value at $6.00.

Manhattan Electrical Supply Co., Inc.
New York, Chicago, St. Louis, San Francisco

★ Manhattan RADIO PRODUCTS

Made by the makers of the famous Red Seal Dry Batteries, Manhattan and Red Seal Radio Products

BARGAIN CATALOG

Yours **FREE!** **100 Pages!**

Just Send Your Name

Crammed full of money-saving offers of all kinds of Radio sets complete, from a few dollars up, and parts and accessories including

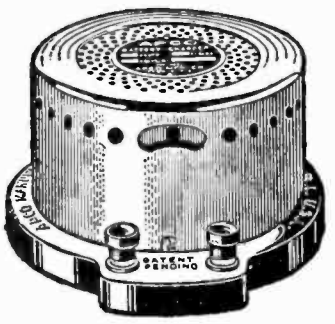
Parts for "KNOCK-OUT" SETS

developed and approved by Radio Broadcast Magazine, published by Doubleday, Page & Co., anything you may need to build or equip any set.

Very interesting

It's easy to do business with us, for this is "The Radio House of Friendly Service." All goods offered subject to examination and approval. No money in advance. Quick shipment. We pay transportation anywhere in U.S. *Satisfaction or money back.* Your questions answered free **Get this wonderful catalog—you need it—don't delay—write today!**

LIBERTY MAIL ORDER HOUSE
Dept. 676Z 106 Liberty St. New York.



Don't Blame Your Set!

If the batteries run down, you're lucky to get anything but "sounds."

APCO Battery Charger keeps radio batteries *alive*. Works noiselessly, efficiently, surely, fully charging any radio battery over-night for a few cents. 7½ ampere capacity. Pays for itself in six months. Guaranteed one year.

Write for circular and dealer's name.

APCO M'F'G. CO. ★

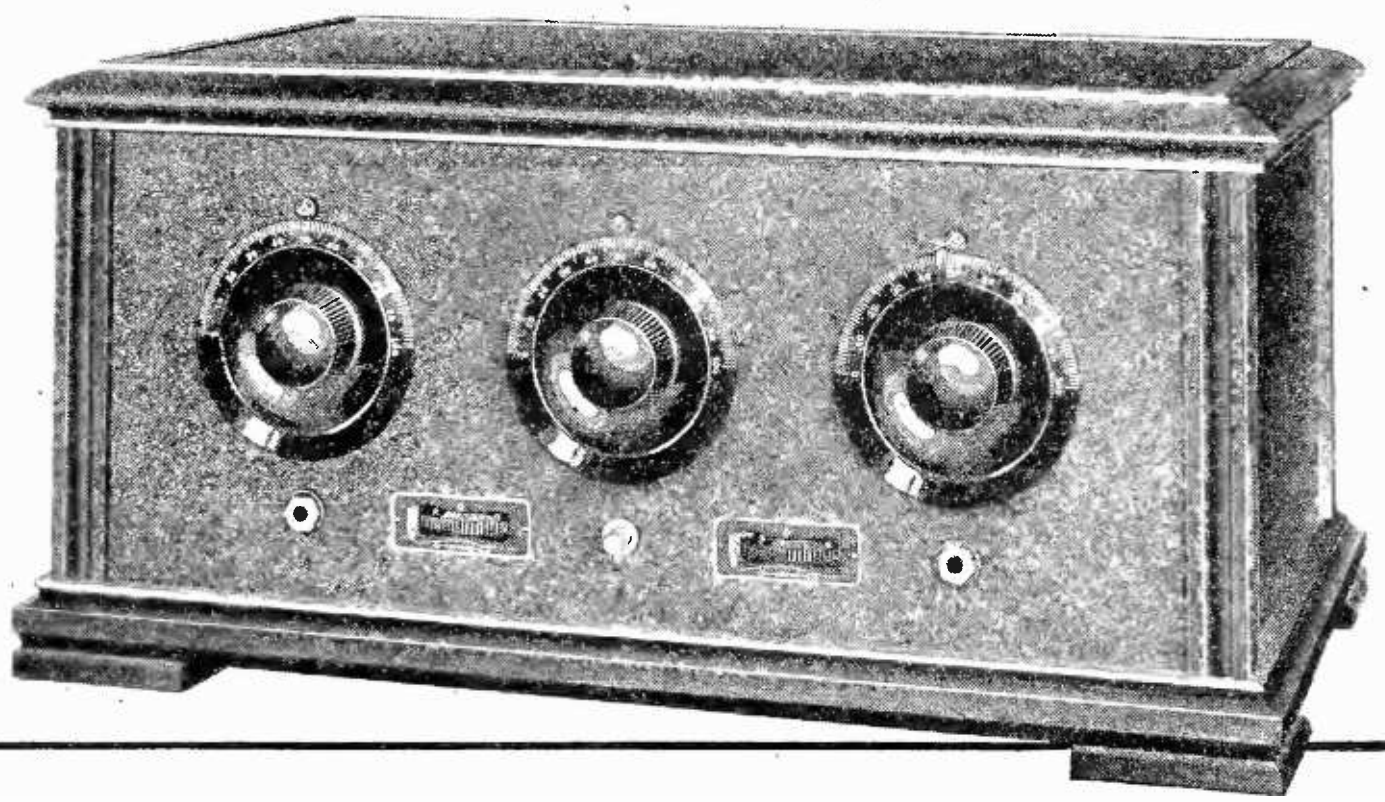
Cavendish St. Providence, R. I.

APCO BATTERY CHARGERS
for "A" and "B" Batteries

★ Tested and approved by RADIO BROADCAST ★

EISEMANN

ELECTRICAL EQUIPMENT



Choose Wisely!

SPECIFICATIONS

Circuit: Two stages of tuned radio frequency amplification, detector and two stages of audio frequency amplification. Non-oscillating. Non-radiating. Astatic transformers used to minimize mutual induction.

Tubes: Five in all. Jacks provided for either five or four tube operation.

Batteries: Either storage or dry cells.

Cables: Complete set supplied for "A" and "B" batteries.

Wave lengths: 200 to 600 meters, with uniform efficiency of reception.

Aerial: 75 to 125 feet, single wire.

Panel: Aluminum, with attractive crystal black finish. A perfect body capacity shield.

Dials: Sunken design. Shaped to fit the hand and permit a natural position in tuning.

Rheostats: Adequate resistance for all standard base commercial tubes.

Condensers: Single bearing, low leakage losses.

Sockets: Suspended on cushion springs which absorb vibrations.

Cabinet: Mahogany, with distinctive lines and high finish. Ample space provided for "B" batteries.

In selecting a broadcast receiver, it is well to distinguish between essential and non-essential considerations.

The circuit is important, insofar as it affects performance, but the mysterious trick names now so much in vogue are not.

Type 6-D combines the only three things that constitute true value—efficient performance, attractive appearance and fair price.

Speech and music are reproduced without distortion. Far distant stations are received with generous volume. The selectivity is extraordinary—even powerful, local broadcasting stations tune sharply. The 6-D is non-oscillating and non-radiating, with unvarying reception efficiency at high and low frequencies.

In appearance, the 6-D is strikingly attractive—a handsome mahogany cabinet, symmetrical panel layout and perfectly proportioned interior construction.

Be sure to examine the Type 6-D Receiver before you make a final selection.

★

For Sale by Reliable Dealers

EISEMANN

Price, without Tubes and Batteries, $125.00

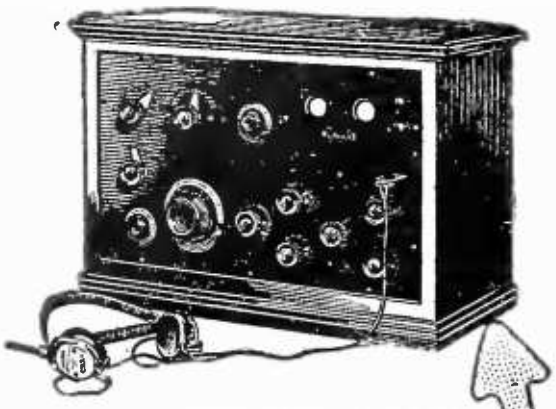
EISEMANN · MAGNETO · CORPORATION

General Offices: 165 Broadway, New York

DETROIT SAN FRANCISCO CHICAGO

★ Tested and approved by RADIO BROADCAST ★

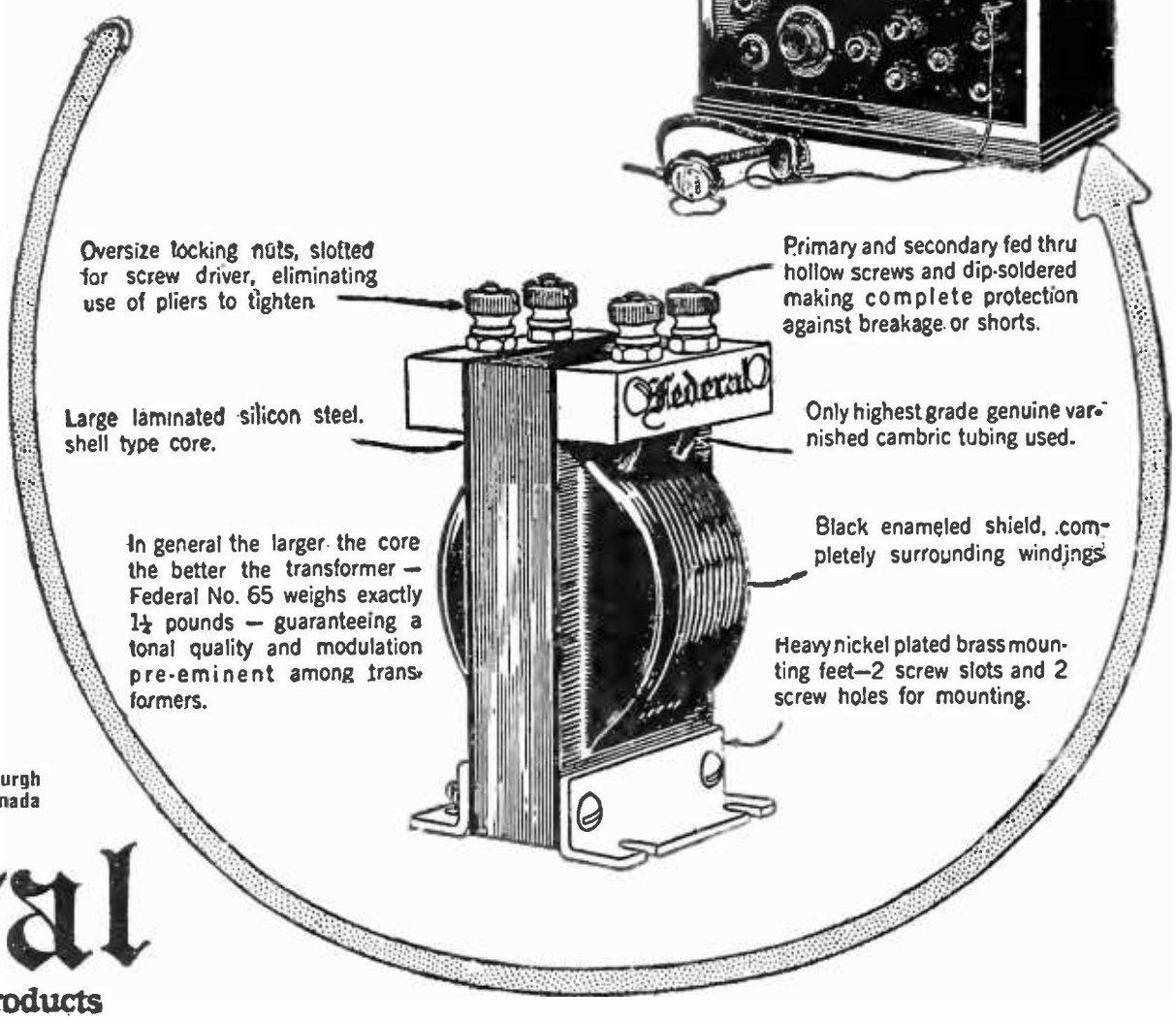
Why it is Better



"MASTER of Every Note in the Orchestral Range" is the *proven* claim of the Federal No. 65 Audio Frequency Transformer! Volume without distortion is the basis for the beauty of Federal Tone.

From its oversize locking nuts to its heavy brass mounting feet the Federal No. 65 Transformer incorporates the same engineering skill that has made Federal the recognized leader in electrical communication apparatus since 1890.

Insist upon Federal parts for your "pet" hook-up. There are over 130 standard parts bearing the Federal iron-clad performance guarantee.

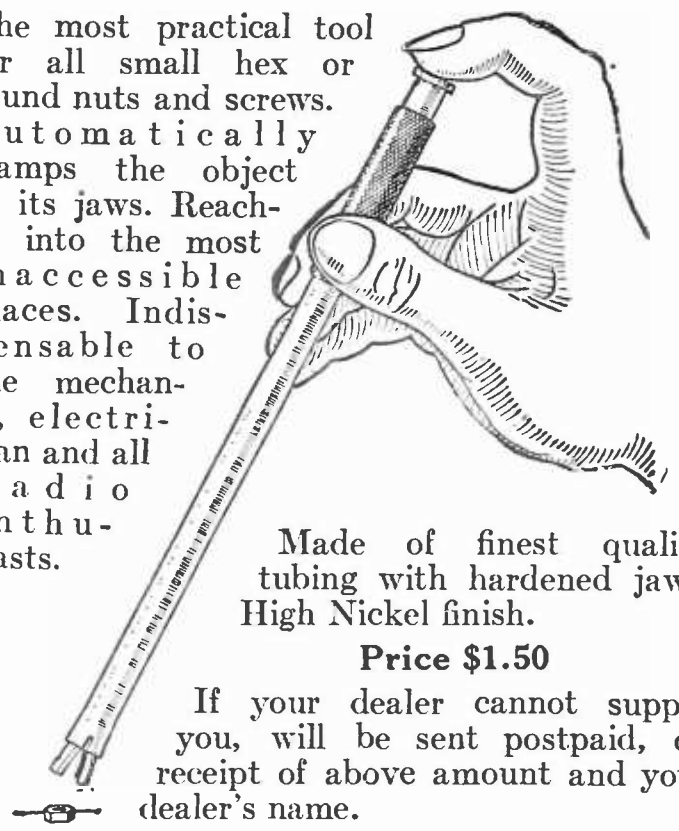


Federal Telephone & Telegraph Co.
Buffalo, N. Y.

Boston New York Philadelphia Pittsburgh
Chicago San Francisco Bridgeburg, Canada

Federal
Standard RADIO Products

YOU'VE ALWAYS NEEDED A C. & C. "Reach It" Wrench



The most practical tool for all small hex or round nuts and screws. Automatically clamps the object in its jaws. Reaches into the most inaccessible places. Indispensable to the mechanic, electrician and all Radio enthusiasts.

Made of finest quality tubing with hardened jaws. High Nickel finish.

Price $1.50

If your dealer cannot supply you, will be sent postpaid, on receipt of above amount and your dealer's name.

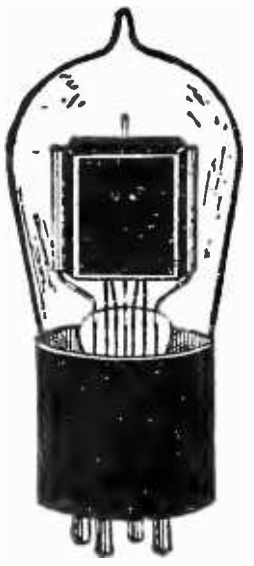
CAUFMAN & CLOUGH CO. WILMINGTON, DELAWARE

Use Repaired Tubes Save 50%

Guaranteed Good as New!

RETURN your old Tube and get any kind or model of standard repaired tube at **$2.00** per tube.

$2.00



These tubes carry an unlimited guarantee. If they prove to be unsatisfactory for any reason, return them and get your money back.

Repaired tubes are carefully packed and mailed to you, C. O. D.

If an old tube is not returned with your order, the standard repaired tubes are **$2.25** per tube.

Jobbers and Dealers
Write for Special Discount

C. F. E. Radio Tube Works
Essex Court **Newark, N. J.**

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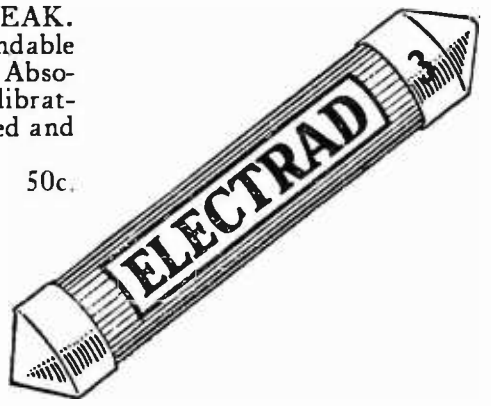
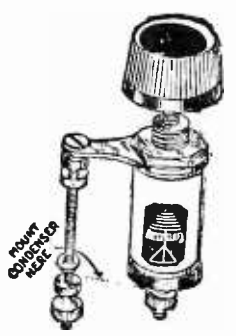
ELECTRAD INC.

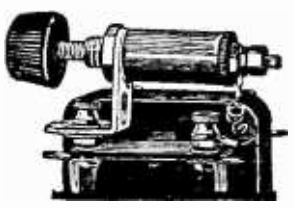
Parts of Guaranteed Dependability

CERTIFIED LEAK. The most dependable grid leak made. Absolutely correctly calibrated. Each one tested and permanently set. Price ..... 50c.



VARIOHM. A scientific variable grid leak. Any resistance from ¼ to 30 megohms by turning the knob. Guaranteed to increase your distance. Price, 75c. Mounted $1.00





AUDIOHM. Just try one across the secondary of your transformer. $1.50 with adjustable bracket.

LIGHTNING ARRESTER. If fire should occur, you can't collect insurance if you haven't a lightning arrester. Get an Electrad. Model passed by the National Board of Fire Underwriters. Price ....50c.

LAMP SOCKET ANTENNA. Simplest, and most effective antenna. Price ..... 75c.

Don't take chances. Insist on getting Electrad parts and protect yourself by using them. They are the trade-marked products of one of the oldest and largest radio laboratories.

Electrad parts are precise, scientific instruments for radio reception, the finest product of skilled craftsmen.

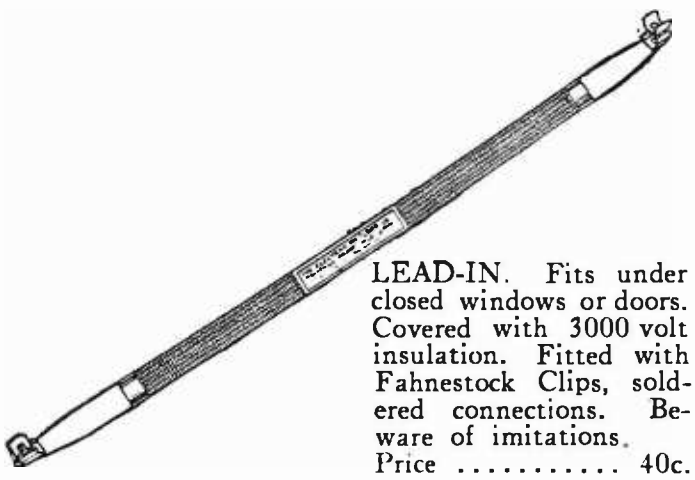
They cost no more, frequently less. If your dealer cannot supply you, send us his name and the purchase price indicated and we will see that you are supplied.

ELECTRAD, Inc. ★

Dept. R., 428 Broadway New York

MAKERS OF

Hydrogrounds, Glass Grid Leaks, Variable Grid Leak and Condenser Combined, Grid Leak Mountings, Aerial Outfits, Fixed Resistance Units, Indorarial, Resistance Coupled Amplifier Kits, Verni Tuner.



LEAD-IN. Fits under closed windows or doors. Covered with 3000 volt insulation. Fitted with Fahnestock Clips, soldered connections. Beware of imitations. Price ..... 40c.

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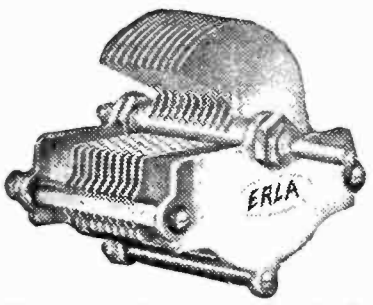
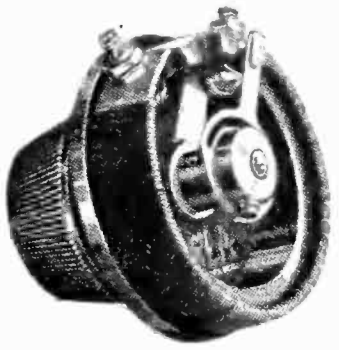
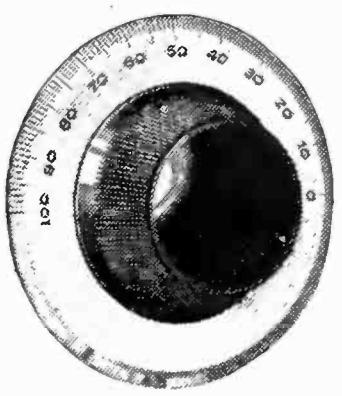


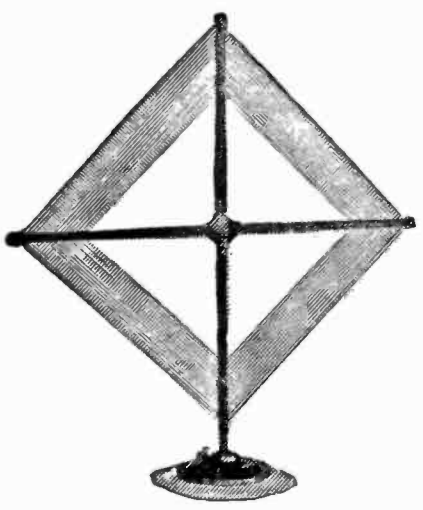
Exclusive features give Erla Miniloss Condensers highest efficiency. Dielectric and resistance losses absolutely minimized. Compensating plate form. 5 to 41 plates, priced $3.50 to $5.50 each.



Uncanny smoothness and sensitiveness bespeak the advanced design of Erla Precision Rheostats. Single hole mounting eliminates need for disassembly. 6, 25, or 40 ohm. Price, $1.10 each.



Built for permanent true running; with Bakelite knob shaped for sensitive touch; and highly artistic calibration, Erla dials better any panel. Three sizes for ¼" shaft. Price, 50c to $1.25.



Adding to receiver efficiency is the advanced Erla Loop. Rigidly erected—compactly folded—easy in rotation—beautifully finished. Standard and De Luxe models, $7.50 and $10 respectively.

CIR-KIT builds new Supereflex—Greatest of Erla Circuits

Erla led the radio amateur out of the wilderness of circuits. Erla initially introduced exclusive circuit ideas which made radio history, particularly because those ideas have uninterruptedly kept Erla circuits in advance of contemporary radio.

Remarkably significant is the fact that so many thousands of seasoned experimenters, once attracted to Erla circuits, consistently adhere to Erla. So there is a note of finality when Erla now announces the new Erla Supereflex Circuits. They represent highest development of the inherently superior Erla principles, acknowledged responsible for the most powerful circuits ever built, tube for tube.

Bringing these latest and finest circuits within the reach of everyone is the Erla *CIR-KIT*, effecting not only extreme economy, but also greatest ease of construction. Only screwdriver and pliers are needed to transform any Erla *CIR-KIT* quickly and skillfully into the most efficient of radio receivers.

CIR-KIT provides you with *everything*, including specially designed Erla Synchronizing Transformers, Erla Certified Capacity Condensers, Erla Cushion Sockets, and finally Erla famous Solderless Connectors, banishing all solder difficulties. Each unit and connection is unerringly located through full-size blue-prints; drilled, lettered panel; and stenciled baseboard.

With Erla *CIR-KIT* you yourself can confidently and proudly put into finished form the highest achievement of Erla radio engineers—Erla Supereflex Circuits. *CIR-KIT* receivers of one to five tubes are available, in loop and antenna types. See the Erla dealer, or write direct, mentioning your dealer.

ELECTRICAL RESEARCH LABORATORIES
Department J, 2500 Cottage Grove Avenue, CHICAGO

ERLA

Circuits of Certainty

★ Tested and approved by RADIO BROADCAST ★

The Concert Model Speaker at $25 is the best radio affords. Easily accessible adjustment regulates tone and volume. This speaker is recommended for multi-tube sets as it will handle all the volume any set can produce.

TRIMM

Superior Reproducers

HEADSETS

Professional - - **$7.50**
Dependable - - **$5.00**

SPEAKERS

Concert Model - **$25.00**
Home Speaker - **$10.00**

PHONODAPTER

GIANT Unit - **$10.00**
Little Wonder - - **$4.50**

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Member Radio Manufacturers' Association

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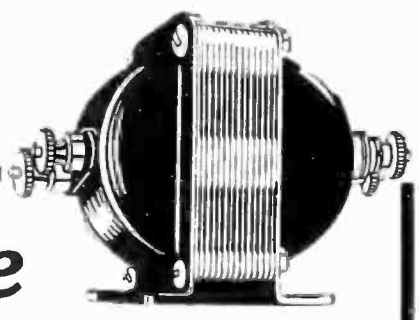

Convince Yourself!

You can now secure the very highest quality

Audio Transformer $ **2.95**
of the very latest design for use in all circuits for only post paid

"Push-Pull" Type $ **8.50**
Price per matched pair, only post paid

Complete information and wiring diagram packed with every Transformer.

Satisfaction guaranteed or money refunded.

Crescent Transformers

CRESCENT MFG. CO.
Box 337 Central Sta.
Toledo Ohio

★ Tested and approved by RADIO BROADCAST ★

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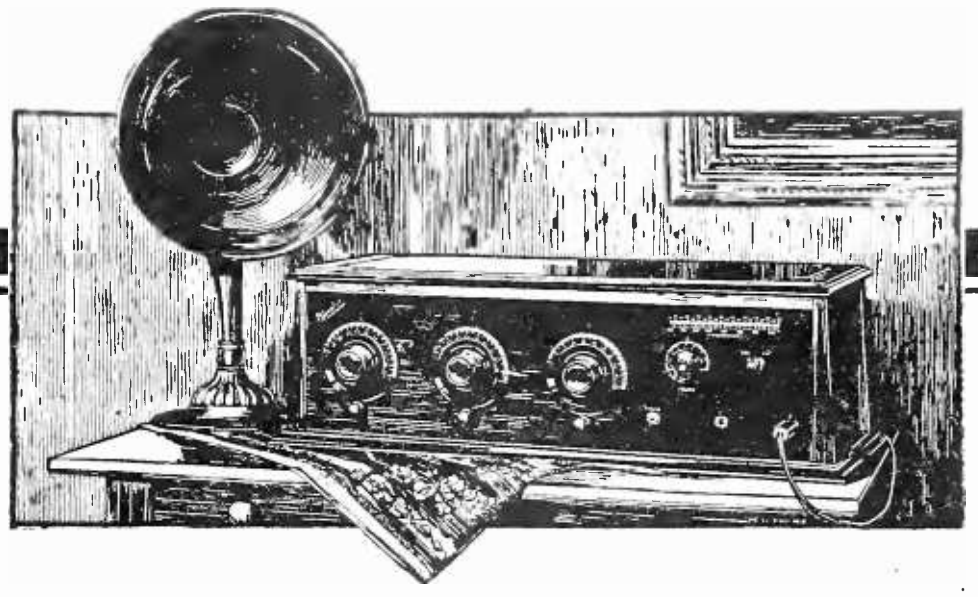


Station Finder Is Unique Feature

in the New

Pfanstiehl Model 7 Receiver

A 5-tube receiver using the new system of tuned radio frequency

A NEW simplicity of tuning is attained by the Pfanstiehl Model 7. There are three large dials, which tune the three successive circuits. Therefore, these dials are turned identically, or to the same number, for any given station. This means that to receive on any one "wave length" you need to know but one number. That number is given by the "Station Finder" on the right-hand upper corner of the panel. On its lower scale, read the "wave length" of the station desired. (This information is obtained from the daily program in the newspaper.) Directly above the "wave length" read the number at which the three large dials are all to be set to secure reception. The Pfanstiehl "Station Finder" takes the guesswork out of tuning.

The Pfanstiehl Non-Oscillating System

Simplicity of operation also is made possible by an entirely new development in circuit design embodied in this receiver, the Pfanstiehl Non-Oscillating System.

Oscillations are the source of internal disturbances in radio frequency receivers. By means of shaping magnetic and electrostatic fields, Pfanstiehl has avoided altogether the generation of these disturbing oscillations. Hence, no devices to choke them down, such as potentiometers or neutralizing condensers, are needed. How much more effective it is, not to misdirect or waste forces, than to suppress them afterwards! It is also more efficient. Hence, the supreme purity of tone and sensitivity to distant signals in the new Pfanstiehl Model 7.

Dealers: Write for the Pfanstiehl Proposition

PFANSTIEHL RADIO COMPANY · 23 S. Second Street, Highland Park, Ill.

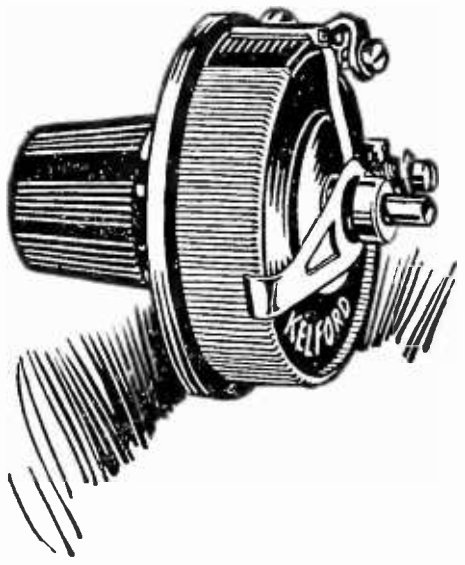
Pfanstiehl

★ Tested and approved by RADIO BROADCAST ★

KELFORD

Rheostats and Potentiometers

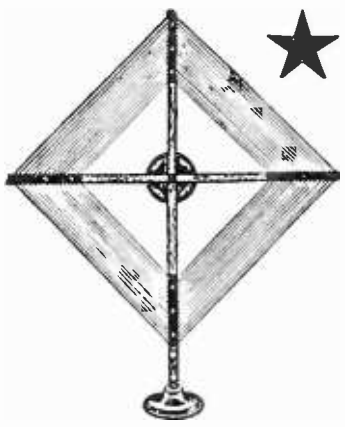
The U. S. Navy standardize on these fine parts, made by America's oldest manufacturers of Radio Parts. High quality and remarkably low prices. Send post-card for particulars.



Rheostats 2 to 30 ohms . . . . . $.75 to $1.50
Potentiometers 200 and 400 ohms $1.50

THE AMERICAN SPECIALTY CO.
176 Holland Ave. Bridgeport, Conn.

Nazeley Folding Loops



★ **Portena** $7.00

Selecto $5.00

The Pioneer Loop Makers Originators of the Folding Type

The experience and skill of our loop makers is demonstrated in the uniform efficiency and service of the product.

We Specialize on Loops of Standard and Special Types

No Other Factory Can Equal Our Equipment

WE ARE HEADQUARTERS

J. NAZELEY COMPANY
571 Hudson St. New York

Poly Plug

is the only phone plug equipped with the wonderful "tension slot" which permits you to pull and tug the cords all you want and still

Positive contact always maintained

★

It's Genuine Bakelite, too

At your dealers or by mail on receipt of purchase price

Polymet Mfg. Corp.
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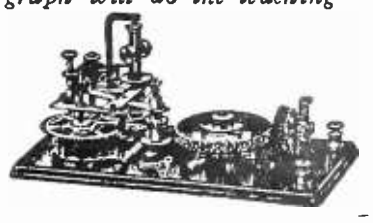
75¢ "WORTH IT"

FAHNESTOCK CLIPS

"Popular Wherever Radio Is Used"
14 Sizes in Beautiful Display Case
Dealers write for big moneymaking proposition
★ **FAHNESTOCK ELECTRIC CO.**
Long Island City, L. I.

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.

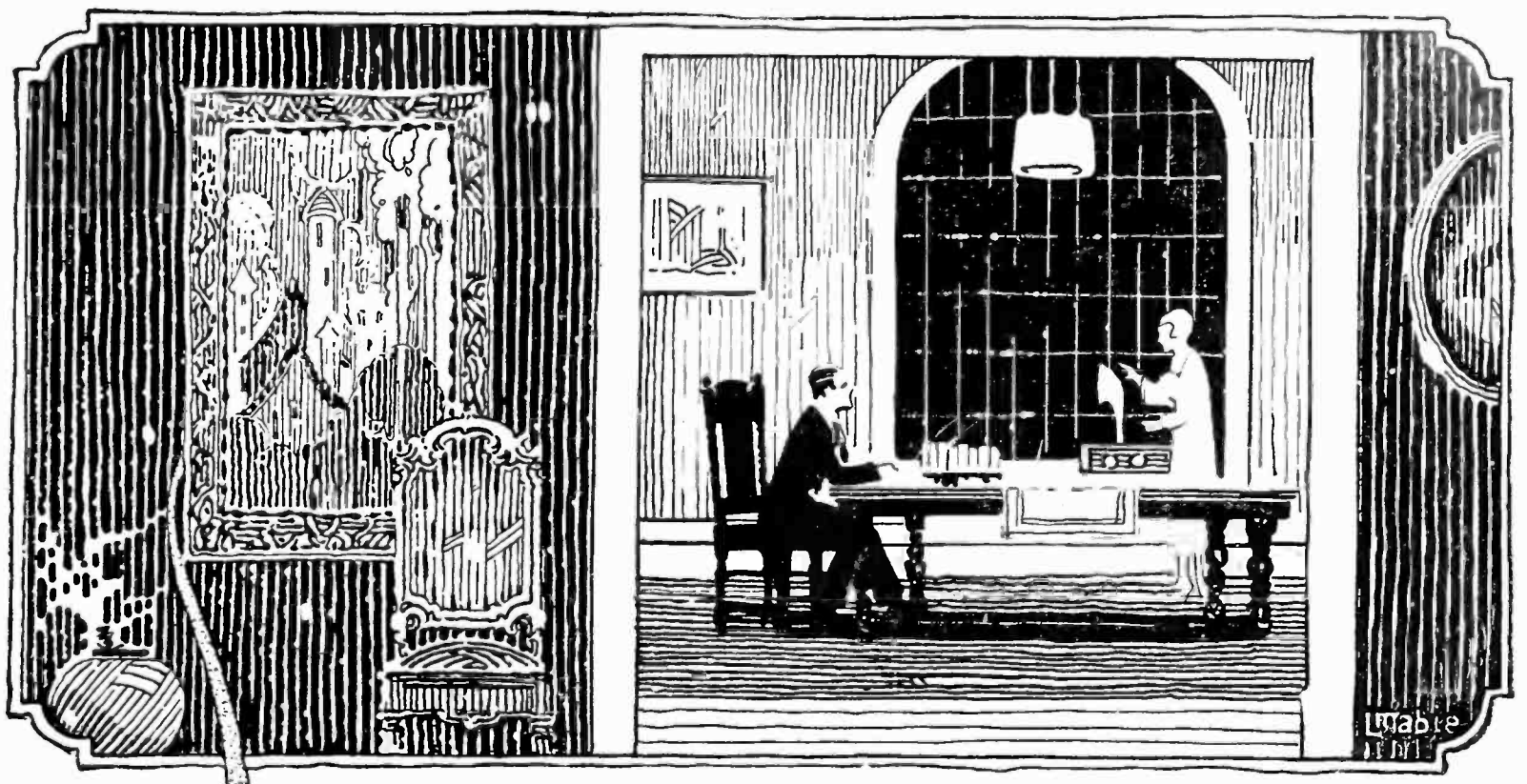
THE **OMNIGRAPH** is not an experiment. For more than 15 years, it has been sold all over the world with a money back guarantee. The **OMNIGRAPH** is used by several Depts. of the U. S. Govt.—in fact, the Dept. of Commerce uses the **OMNIGRAPH** to test all applicants applying for a Radio license. The **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., 16K 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

★ Tested and approved by RADIO BROADCAST ★



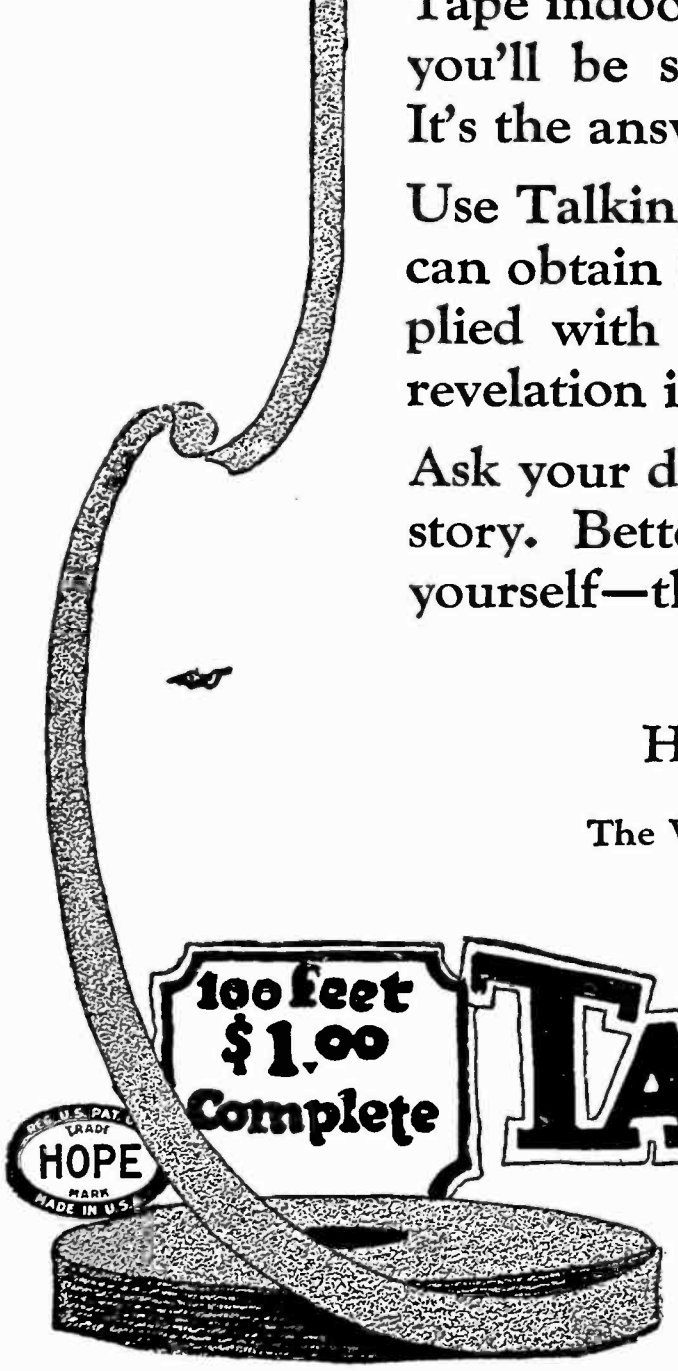
Indoors - Anywhere ! ! !

TALKING TAPE doesn't have to be carefully strung outdoors or on the roof—you don't have to buy lightning arresters, or insulators. Just put Talking Tape indoors—anywhere you find it convenient, and you'll be surprised—and delighted—at the results. It's the answer to indoor reception!

Use Talking Tape instead of a loop—the results you can obtain by following a few simple directions, supplied with each roll of Talking Tape will prove a revelation in Radio entertainment.

Ask your dealer about Talking Tape—he knows the story. Better still, buy a dollar's worth and try it yourself—that's the inexpensive way to better Radio.

Manufactured by
HOPE WEBBING COMPANY
For Forty Years
The World's Largest Manufacturers of Electric Tapes
PROVIDENCE, R. I.



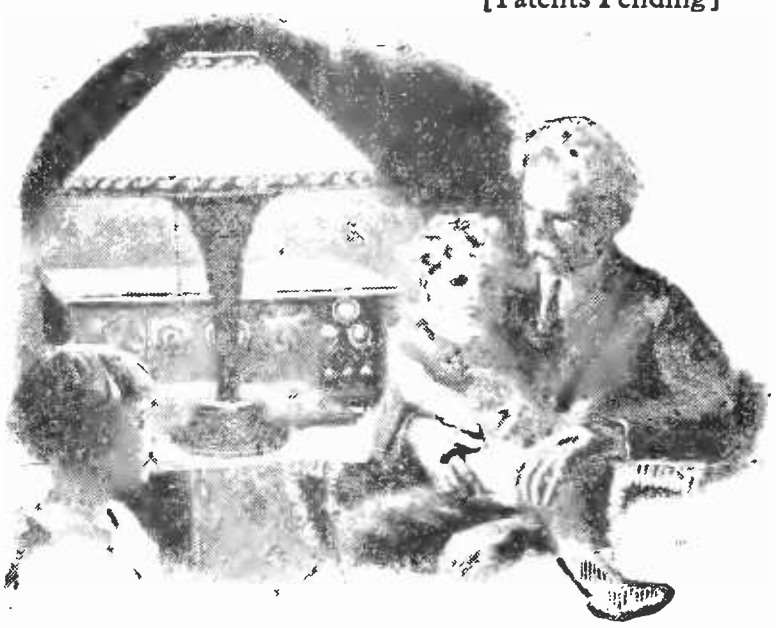
TALKING TAPE

The Perfect Radio Aerial

★ Tested and approved by RADIO BROADCAST ★

Thor Speaker Lamp

[Patents Pending]



—Let this companionable Radio Gift brighten your home Christmas!

IN appearance, Thor Speaker Lamp gives no suggestion that within its bosom is hidden a marvelous speaker unit that reproduces vocal and instrumental tones, as clear, as absolutely true, as if the individual or instrument were in the room.

Thor Speaker Lamp is non-directional and free of guttural, throaty sounds present in all horn-type loud speakers. It distributes its mellow tones to all parts of the room with equal clarity and volume, even as its warm, friendly light radiates cheer.

Price $35 (with parchment or any color silk shade). If your dealer cannot supply you, write direct. We'll ship by prepaid express. Return at our expense if not satisfied.

Franchises in certain territories still open. Dealers and Jobbers are invited to write for full details.

THOR Radio Division

of the GOLDEN GATE
BRASS MANUFACTURING CO.
1239-1243 SUTTER STREET
SAN FRANCISCO

(118)

"Built First- Coto ★ -to Last"

INSIST ON THE SILVER PLATED AIR CONDENSER FOR YOUR RADIO SET.

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Good books with artistic binding

COUNTRY LIFE PRESS *GARDEN CITY, N.Y.*

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LOW LOSS INDUCTANCE ARISTOCRAT OF LOOPS

DISTINCTIVE BEAUTIFUL

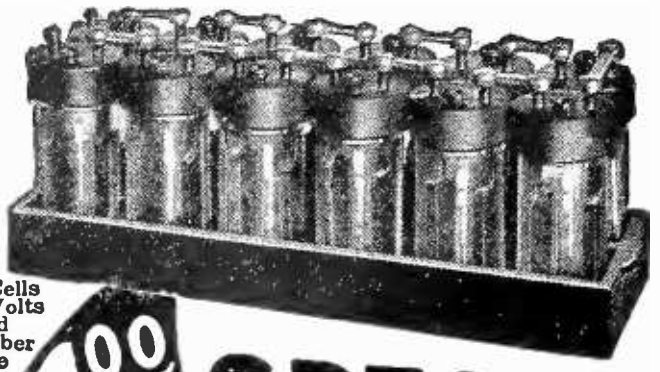
PRICE FIFTEEN DOLLARS

Shipped neatly packed *Completely assembled*

The ULTRA ANTENNA represents a great advance in loop design both from an energy collecting and appearance standpoint. Circular skeleton construction. Maximum Area with minimum conductor. Low capacity losses. Stagger wound on polished black Dupont Pyralin. Low dielectric loss. 16 in. in diameter yet only 6 oz. of dielectric in magnetic field! Axially mounted precision magnetic compass for logging. Practically indestructible. Three types for 31- 23- 11-plate tuning condensers. Literature? ASK YOUR DEALER OR OUR

Sales Office: 4417 Vancouver Ave., DETROIT, MICH.

PHILLIPS LABORATORIES, GRAND RAPIDS, MICH.



12 Cells 24 Volts Solid Rubber Case

$4.00 C.O.D.

SPECIAL

INTRODUCTORY PRICE

For a limited time *only*, and to introduce this new and superior Storage "B" Radio Battery to the Public, we are selling it for $4.00. Regular Retail Price is $6.00. You save $2.00 by ordering NOW. A finer battery cannot be built than the

World Storage "B" Battery

(12 CELLS—24 VOLTS)

To ten million homes with Radio Sets—and to countless millions of prospective buyers—this WORLD Storage "B" Battery brings a new conception of battery economy and performance. Here is a battery that pays for itself in a few weeks—will last for years and can be recharged at a negligible cost. *And you save $2.00 by ordering now.*

A *Superior* Battery Equipped With Solid Rubber Case

Has heavy duty 2 1-8 in. x 1 in. x 1-4 in. plates and plenty of acid circulation. Extra heavy glass jars allow ready observation of charge and prevent leakage and seepage of current. It holds its charge, while idle, at constant voltage.

You will find this battery a boon to long distance reception. It does away with a great many noises so often blamed on "static." Mail your order today.

SEND NO MONEY

Just state number of batteries wanted and we will ship day order is received. EXTRA OFFER: 4 batteries in series (96 volts), $15.00. Pay Expressman after examining batteries. 5 per cent discount for cash in full with order. Send your order NOW and save $2.00.

WORLD BATTERY COMPANY

Makers of the famous World Radio "A" Storage Battery

1219 S. Wabash Ave., Dept. 78, Chicago, Ill.

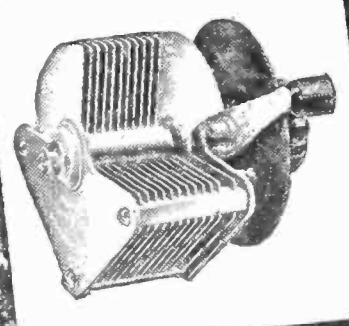
SAVE $2.00 BY ORDERING NOW!

★ Tested and approved by RADIO BROADCAST ★

DUPLEX CONDENSERS

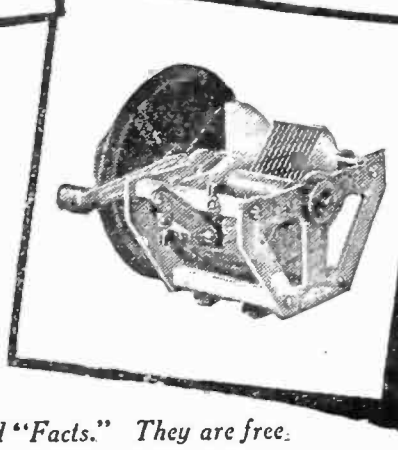
STAND EVERY TEST

For all around efficiency and the micrometer adjustment permitted when unusually accurate tuning is required, DUPLEX CONDENSERS lead the field. Made of only the finest material obtainable under the guidance of foremost radio engineers, they certainly are precision instruments.



"DR" Series

A low loss precision condenser of High value and unusually low price. Great for set builders who want excellent value at low price.



"FR" Series

The highest quality low loss condenser made. Used by foremost set manufacturers. Condenser tests at Yale University in May, 1924, definitely determined its remarkable efficiency.

Write for "Cons" and "Facts." They are free.

The Duplex Engine Governor Co., Inc.
46 Flatbush Ave. Extension Brooklyn, N. Y.

★ TRADE MARK NONE OTHER

USE MAGADYNE REFLEX COILS

manufactured by Coast Coupler Co.

Advantages

The Magadyne Reflex Coils have greater efficiency because they minimize dielectric losses and distributed capacity. No substance is used to distort their operation. Adaptable to practically every radio set.

Enjoy Greater Radio Reception

Mail us check for $2.00 and we will send you a pair of Magadyne Reflex Coils.

COAST COUPLER COMPANY
East Seventh Street
Long Beach, California

FREE

To Each Purchaser of a World Battery

A 24-Volt "B" Storage Battery positively given FREE with each purchase of a WORLD "A" Storage Battery. The WORLD Battery is famous for its guaranteed quality and service. Backed by years of Successful Manufacture and Thousands of Satisfied Users. You save 50%.

Prices That Save and Satisfy

Auto Batteries		Radio Batteries	
6-Volt, 11 Plate	$12.25		
6-Volt, 13 Plate	14.25	6-Volt, 100 Amps.	12.50
12-Volt, 7 Plate	17.00	6-Volt, 120 Amps.	14.50
		6-Volt, 140 Amps.	16.00

Shipment Express C. O. D. subject to examination. 5 per cent discount for cash in full with order.

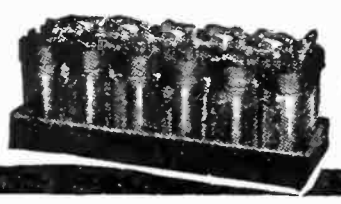
2-Yr. Guarantee Bond in Writing With Each World Storage Battery

proves satisfactory World performance. Mail this ad with your name and address—we will ship battery day order is received; and give you your choice of "B" Storage Battery or a handsome nickle finish Auto Spotlite, **FREE.** Write **TODAY.**

WORLD BATTERY COMPANY
1219 So. Wabash Ave. Dept. 24, CHICAGO, ILL.

This FREE "B" Storage Battery takes the place of dry cell "B" batteries. Can be recharged and will last indefinitely. To be sold retail for $6.00. It is the only battery of its kind equipped with solid rubber case—and insurance against acid and leakage. Take advantage of this remarkable introductory offer NOW. (To those who prefer it, we will send FREE a handsome nickel finish Auto Spotlite, instead of the "B" Battery. Be sure to specify which is wanted.)

GIVEN FREE
To introduce this new and superior World "B" Storage Battery to the Public



B-METAL ★

For tonal purity use B-METAL Crystals. Ask your dealer to order them.

B-METAL REFINING CO.
9th floor
525 Woodward Ave. Detroit, Mich.

The Standard of the World

★

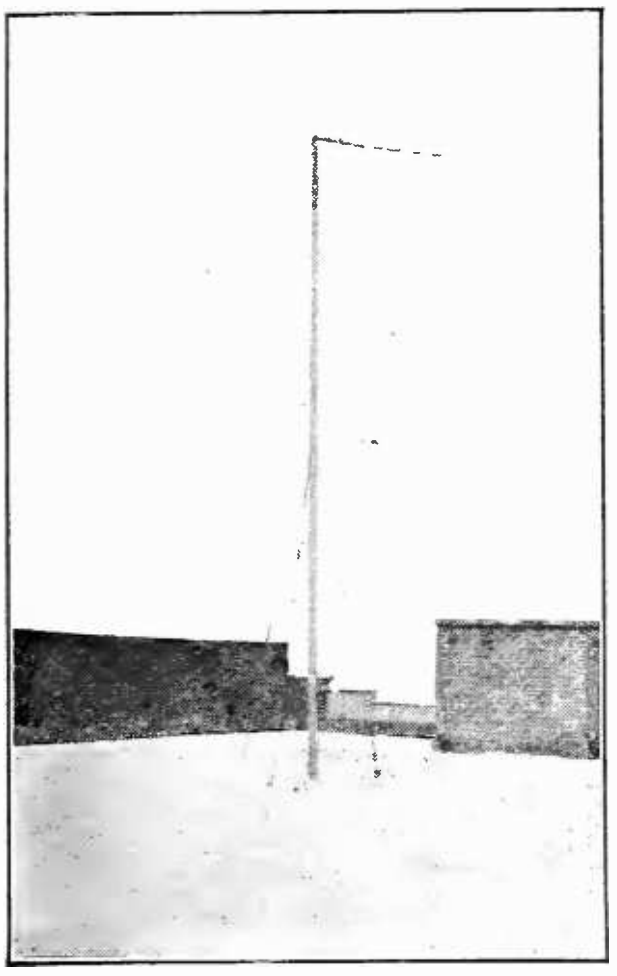
The base-type
Freshman Variable Grid Leak
is the standard for those who build their own sets. It is the most compact and being entirely sealed it always remains unaffected by any climatic conditions.

Complete with either .00025 or .0005 Freshman Condenser— **$1.00**
without condenser..... .75

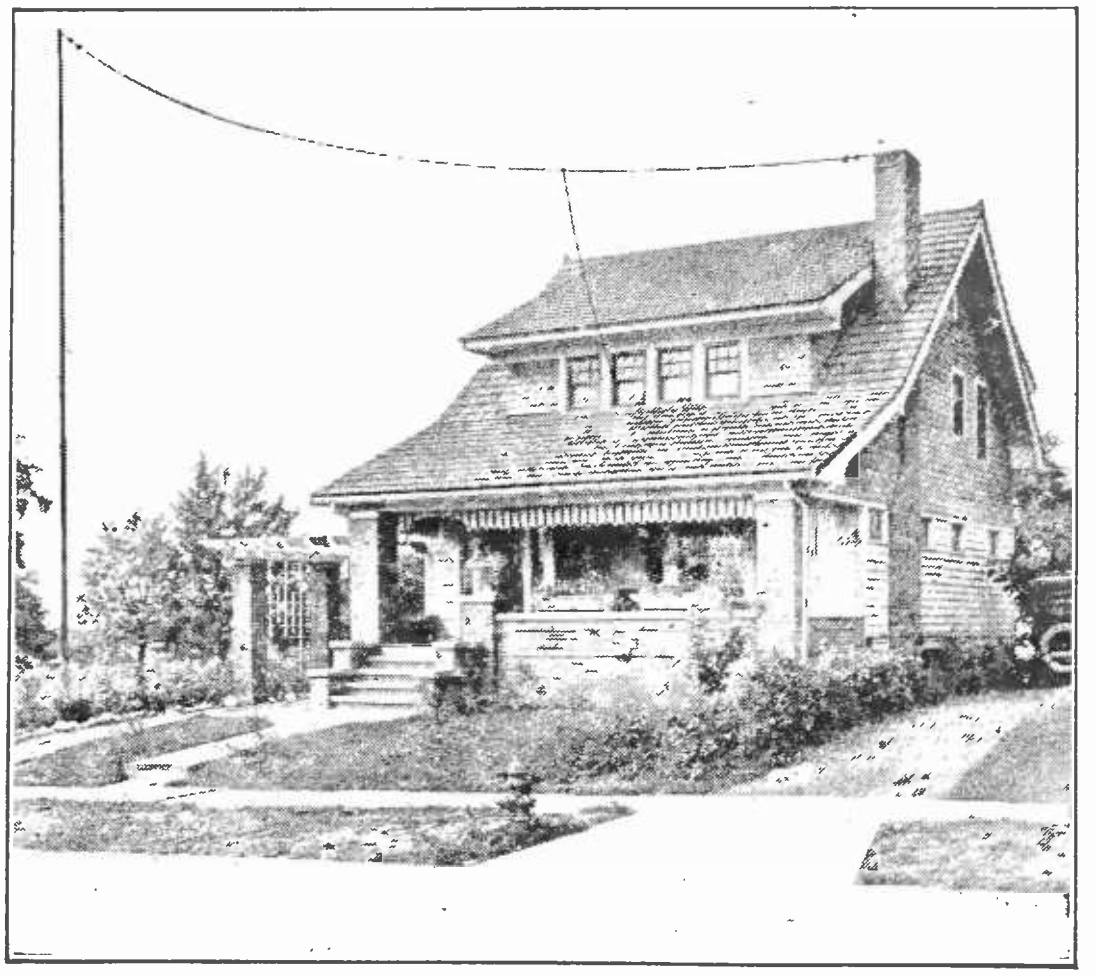
At your dealer's, otherwise send purchase price and you will be supplied postpaid

Chas. Freshman Company, Inc.
106-7th Ave., New York

★ Tested and approved by RADIO BROADCAST ★



20 Foot Mast on Roof of Apartment House



40 Foot Mast in Yard

The HERCULES ★ AERIAL MAST

This mast is made in sizes to get 20 ft., 40 ft., or 60 ft. clearance and is the answer to an efficient aerial system. This graceful mast is an improvement to any property, whether it is installed on the roof or in the yard. A pulley is furnished at the top for raising and lowering the antenna. All parts are made of steel and are light and strong. The mast will safely stand a 500 pound pull at the top and will support a 6 wire cage antenna. We furnish complete blueprint plans for erecting the mast and it can be erected in a few minutes. It is shipped in sections for convenience in handling. The 20 ft. Mast weighs 40 pounds, the 40 ft. Mast weighs 100 pounds, and the 60 ft. Mast weighs 200 pounds. Guy wires are spaced 120 degrees, or three equal spaces, 4 ft. from the base on the 20 ft. Mast; 8 ft. on the 40 ft. Mast, and 10 ft. on the 60 ft. Mast.

20 Foot Mast, $10.00
40 Foot Mast, 25.00
60 Foot Mast, 45.00

Order direct from this Ad. and we will ship FREIGHT PREPAID.

Long Range Radio Reception

It has been said time and again that the best results are obtained only by the intelligent use of the best apparatus procurable. This applies not only to the receiving equipment proper, but also to the antenna system. THE AERIAL MUST BE EFFICIENT if the reception of long distance stations, theoretically within range of the receiver, is desired.

Proper Aerial Clearance

Very few novices realize the importance of a good aerial installation. The feeble currents from long distance stations will never reach the receiving set if the aerial is strung too close to surrounding objects that tend to absorb the energy. It is this interference that we have experimented with for years—and present the answer—THE HERCULES AERIAL MAST.

Have Built Radio Towers for Years

For years we have been building radio towers for important broadcasting stations. Included among the names of our customers is the UNITED STATES GOVERNMENT SIGNAL CORPS. Only after years of experience and development work have we been able to perfect this wonderful steel aerial mast to sell at a price within reach of the amateur.

S. W. HULL & CO., Dept. FI

2048 East 79th Street Cleveland, Ohio

Give Your Set a Chance! Get Results!

Not only will the proper aerial clearance, thus obtained, give you the pleasure of long distance radio reception, but the appearance of this beautiful mast on your property will give you a reputation. This reputation will grow as you bring in stations such as you never hoped for.

Mail Coupon for Literature

S. W. HULL & CO. Dept. FI
2048 E. 79th St. Cleveland, Ohio

Without cost or obligation on my part, send me full particulars of the HERCULES Aerial Mast and your FREE FREIGHT PREPAID offer. I am interested in a (ft. Mast.

Name .....

Address .....

City .....

★ Tested and approved by RADIO BROADCAST ★

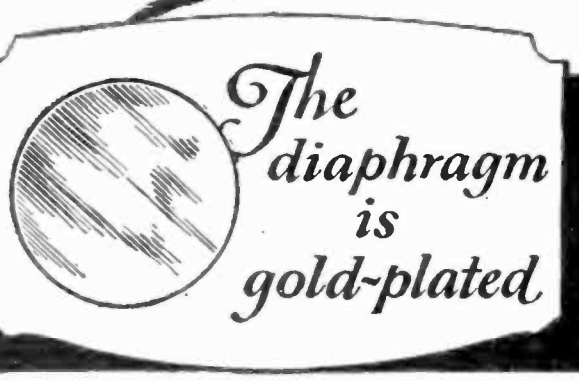
Just a few outstanding features that are definite evidence of the superiority of Bi-Metallic Headphones, the greatest value that money can buy.

Gold Plated Diaphragms
(Gold is one of the best known conductors of sound waves—and assures perfect reception.)

Perfectly Matched and Balanced
Built for Real Comfort
Unusually Durable
Absolutely Guaranteed

The "Gold Plate" Line

Bi-Metallic Gold Plated Bus Bar—Gold Plated Aerial Wire—and the Domino Lead-In, equipped with wing-nuts for easy attachment and Valsparred against all weather conditions. Get the "Gold-Plate" line at your dealer's. Free literature on request.



BI-METALLIC RADIO PARTS CORP.
476-18th Avenue, Newark, N. J.

Up to 120 Volts of "B" Battery IN SERIES

can be easily and quickly charged with the France Multi-Duty Super-Charger. No troublesome wire changing—just leave your batteries wired in series, attach clips, insert ordinary lamp to regulate charging rate and turn on current. Simple—Quick and Convenient.

Two, Four, Six, and Eight volt Radio "A" or Auto batteries can also be charged at a 5 to 7 ampere rate.

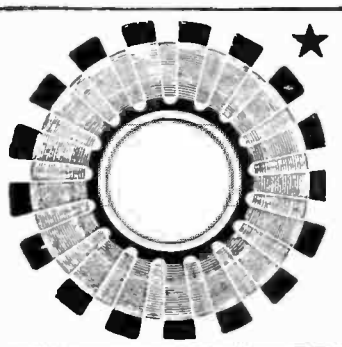
No bulbs or acids, no noise, no sticking or sparking contacts—it embodies every desirable feature.

Price $22.00; West of Rockies, $23.00; Canada—$30.80 F. O. B. Toronto

Dealers and Jobbers—Now is the time to tie up with France and increase your profits. Write us to-day for discounts and details.

The France Mfg. Co.
10327 Berea Road
Cleveland Ohio

Stock carried at convenient points throughout the United States and Canada.



FORMS

Genuine Bakelite Celoron
FOR WINDING COILS
17 Slots—3⅝" Diameter—25 cents each
Regular Discounts to Jobbers and Dealers

We Wind Coils to Order, any Specifications
J. NAZELEY CO., 571 Hudson St., New York

Big Dealer-discounts

IT lists and illustrates absolutely dependable, guaranteed sets and parts. Give your customers what they want—when they want it; but buy it so that you can make a good profit. We're supplying hundreds of radio dealers satisfactorily every day. Write for catalogue and discount sheet. *You'll be astonished at the prices quoted.*

Ask for catalogue No. 8.

★ Tested and approved by RADIO BROADCAST ★

Four Way Company
Springfield, Mass.

QUALITY LOOP

The only folding loop that the wires stay taut when opening and closing. Never become tangled.

Price 50 cts

Simplest, Most Positive Single Radio Plug

The Spring Terminal used in the Single Plug and the Four Way Plug (shown below) is without doubt the surest and best connection, as the tips are gripped all around, insuring a perfect connection with no lost energy.

No tools are needed. Just insert tips by pressing and turning to the right. Fits all standard Jacks; takes all types of tips.

Price $1.00

The New Four Way Switch Plug

is a multiple plug used to connect the head phones and loud speaker to the radio set.

The dial at the base of the plug stem revolves with stops in four positions.

No tools needed. No set screws to get lost. Fits all standard Jacks. Takes all types of tips.

Price $1.00

Licensed under Patent 1,490,003

The Extension Cord Jack

is manufactured to enable those who want to use the loud speaker or phones in other parts of the house without moving set.

No tools or soldering iron needed to make connection.

Takes any standard plug.

Manufactured by

Four Way Company

Myrick Bldg. Springfield, Mass.

SPAULDING
BAKELITE-DURESTO
TUBES

used by

POSTER & CO	(Cut to length for retail trade)
PHENIX RADIO CORP.	(Ultradyne Sets)
WARE RADIO CORP.	(Neutrodyne Sets)
ALLEN D. CARDWELL Mfg. Co.	(Cardwell Sets)

The unqualified endorsement of leading radio manufacturers is the greatest recommendation of Spaulding Bakelite-Duresto quality.

These men know quality depends solely upon manufacture. They know by experience that Spaulding Bakelite-Duresto tubes possess high dielectric properties and great strength; that they will not warp; do not split, and do not laminate.

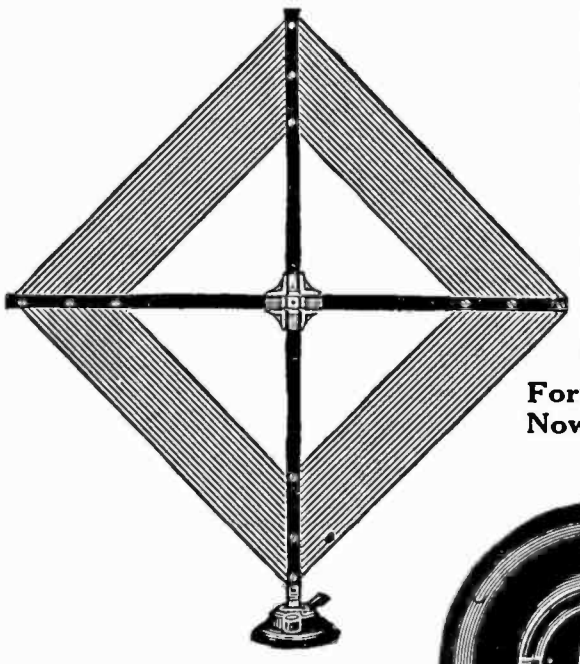
Spaulding BAKELITE-DURESTO

SPAULDING FIBRE COMPANY, Inc., TONAWANDA, N. Y.
Factory: Tonawanda, N, Y.
Sales Offices—Warehouses

484 Broome St., N. Y. C.	141 N. 4th St., Phila.
659 W. Lake St., Chicago	15 Elkins St., Boston
310 E. 4th St., Los Angeles	171 2nd St., San Francisco

509 First National Bank Bldg., Milwaukee

Marion Compass Loop with Center Tap



The Static Dodger

The Real Wave Trap

Opens Instantly

Absolutely Vertical

Unusually Sensitive

Formerly $10.50
Now reduced to
$9.00

The FOLDING loop which RECORDS the proper directional setting for any particular station.

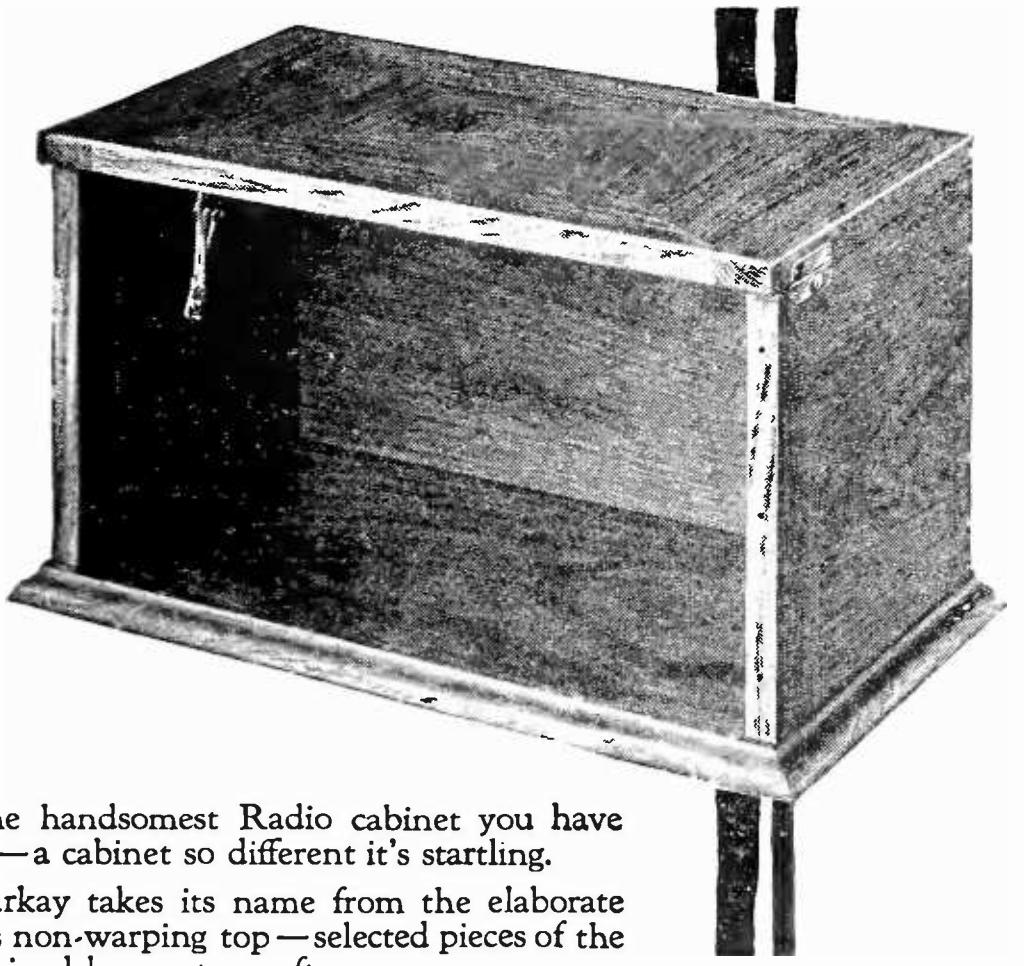
Marion Plain Folding Loop $5.00

MARION ELECTRICAL MFG. CO.
24 CLIFF ST. JERSEY CITY, N. J.
Sales Offices 50 Church St. N. Y. C.

★ Tested and approved by RADIO BROADCAST ★

★ Tested and approved by RADIO BROADCAST ★

The Handsomest Cabinet You Have Ever Seen



JEWETT Quality Products

HERE is the handsomest Radio cabinet you have ever seen—a cabinet so different it's startling.

The Jewett Parkay takes its name from the elaborate parquetry of its non-warping top—selected pieces of the finest woods, joined by master craftsmen.

Other details are in keeping.

Built of the finest walnut, or mahogany—full equipment of nickeled hardware including continuous piano hinge, top prop, and snap locks—finish that emphasizes the fine woods and armors against surface scratches.

With a Parkay you can build a set that simply can't be excelled in appearance—a set which will command a far higher price than anything housed in the ordinary "wood-butcher's delight" type of cabinet.

"Parkay" your next set! Cost will be about the same. But how you will enjoy the difference!

List Prices

7x7x14	$ 8.25
7x7x18	8.75
7x7x21	9.25
7x7x24	9.74
7x7x26	10.25
7x9x27	10.75
8x8x40 (With False Bottom) ..	19.25

All sizes 21 inches and over, fitted with top rail.

★ *If your dealer cannot supply you, we will ship direct to you, charges prepaid, on receipt of list price.*

JEWETT RADIO & PHONOGRAPH CO.
5672 12th Street Detroit, Mich.

Parkay
RADIO CABINET

★ Tested and approved by RADIO BROADCAST ★

★ Tested and approved by RADIO BROADCAST ★

N. B. to Santa— Nothing will bring a family more hours of keen delight than a KENNEDY. It keeps young folks home and older folks happy. KENNEDY models are so troubleproof that even a mechanical enthusiast can find nothing to improve.

In addition to Model VI *(illustrated) there are four other Kennedy models.*

Ask Santa to bring you a KENNEDY

A HINT quietly given to the Right Party is likely to bring you this royal gift. It's worth trying!

When you're out together, lead the way so it takes you past the store where KENNEDY receivers are on display. If you show interest in one, the dealer will demonstrate it. Once a KENNEDY is heard, there is sure to be a strong recommendation to Santa to bring that set on Christmas Eve.

The KENNEDY tone quality is superb; full-rounded, musically pure reproduction of any program within a good long range. No hollow tones or distortion. No fussing or fishing for stations. Simply turn one dial to a certain point, and there is the station you want.

The Royalty of Radio

THE COLIN B. KENNEDY COMPANY, *Saint Louis*

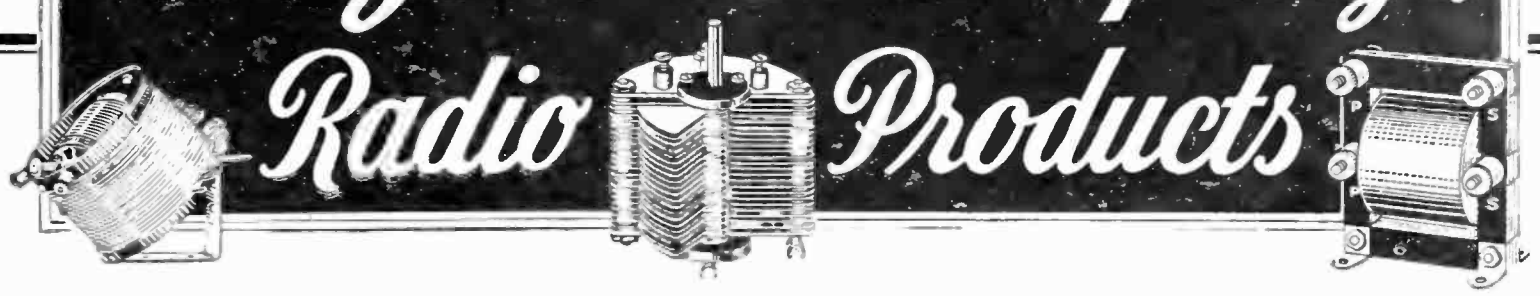
0720-15

★ Tested and approved by RADIO BROADCAST ★

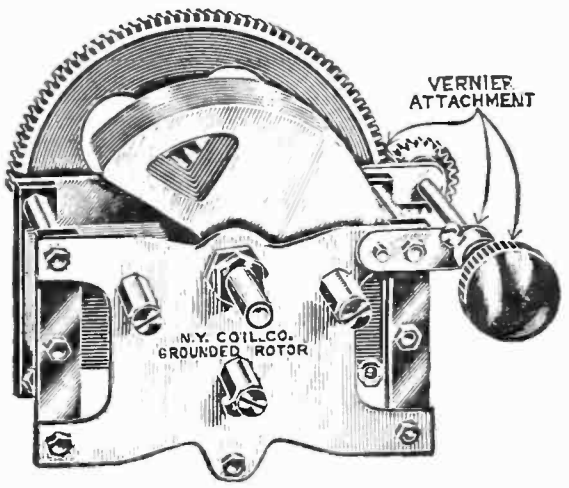
★ Tested and approved by RADIO BROADCAST ★

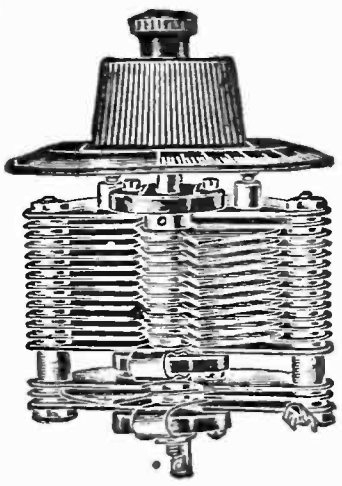
★ Tested and approved by RADIO BROADCAST ★

New York Coil Company's Radio Products



ANY CONDENSER CAN BE *CALLED LOW LOSS*, BUT ONLY ITS PERFORMANCE QUALIFIES THE NAME. In THE NEW YORK GROUNDED ROTOR scientific designing, together with the highest grade of materials and instrument workmanship combine to produce a condenser that is in a class by itself—no other condenser manufactured incorporates so many *actual improvements*.





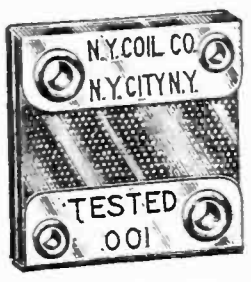
.0005 (23 plate) without Vernier, $4.50.
Geared Vernier attachment complete $1.50.

OUR STANDARD NON-GROUNDED CONDENSERS are made in four sizes with or without vernier, are universally recognized for their efficiency, workmanship and low price,—made possible by large production.

Price with Vernier Knob and Dial

23 Plate . . .	$3.50	17 Plate . . .	$1.80
43 Plate	.$3.00		
Without Vernier, 23 Plate			$2.00

New York Distortionless Audio Amplifying Transformers are the standard by which others are judged. $4\frac{1}{4}$ to 1 ratio correct for all style tubes. Price $4.00.



Type A—No Clips

NEW YORK PRECISION MICA FIXED CONDENSER adds the real undistorted true tone quality to your receiver—the reason they are specified by leading Radio Engineers and used by the most discriminating manufacturers.

Type B

NEW YORK COIL COMPANY

338 Pearl Street, New York City, N. Y.

Pacific Coast—MARSHANK SALES CO., 1240 S. Main St., Los Angeles, Calif.

★ Tested and approved by RADIO BROADCAST ★

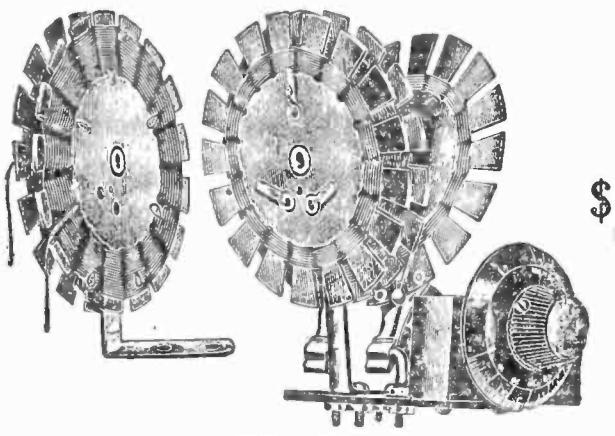
ROBERTS !!!

(TRADE MARK)

Have You Tried That Wonder Circuit Using
REFLEX—REGENERATION AND NEUTRALIZATION

Developed by Walter Van B. Roberts of Princeton

? ? ?



ZIG ZAG
Pat. Aug. 21, 1923

Radio Broadcast says—"It is the Best We Have Ever Seen"

The Boys Are Now Reaching
THE COAST ON THE LOUD SPEAKER
with TWO TUBES

$8.00 **The Roberts Units** (5 coils in two mountings ready for installation) are manufactured exclusively by us according to Mr. Roberts specifications. Packed with complete building instructions, Hookup, schematic, print and all information.

ROBERTS KIT

(TRADE MARK)

COMPLETE EQUIPMENT OF HIGH GRADE PARTS FOR BUILDING

THE ROBERTS TWO TUBE SET

Everything down to the last screw, without cabinet—tubes—batteries—every part standard—complete building instructions by Mr. Roberts.

★ **KIT complete with Portena Loop (for Local Reception) $60.00. Without Loop $53.00**

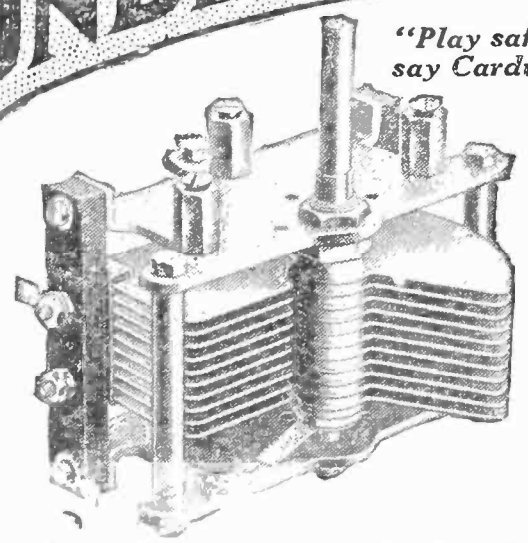
"BUILD A ROBERTS AND REACH THE COAST."

571 Hudson Street **J. NAZELEY COMPANY** **New York**

Sole Manufacturers

CARDWELL
LOW LOSS GROUNDED ROTOR
CONDENSER

"Play safe—say Cardwell"



★

The exclusive choice of Lawrence M. Cockaday for his new Four Circuit Tuner, described in the October Popular Radio. This again emphasises the fact that of all the various kinds of radio apparatus on the market to-day the CARDWELL CONDENSER is the ONLY unit which is recognized by engineers and technical Editors of National prominence as the ONE best.

A Postcard brings you an Education on Condensers.

Allen D. Cardwell Mfg. Corp.
81 Prospect St. Brooklyn, N. Y.

ARROW BATTERY SLASHES Prices TO CONSUMERS ONLY

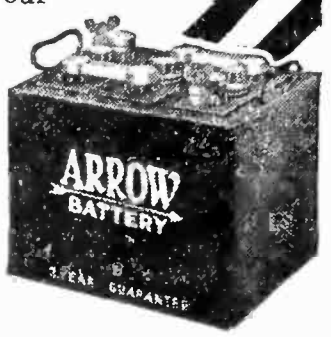
Prices Smashed!
Quality Not Sacrificed

Here is 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 Two-Year Guarantee**

Here is your protection! No need to take a chance. Our battery is right—and the price is the lowest ever made. Convince yourself. Read the prices!

Special 2-Volt Radio Storage Battery,	**$3.75**
Special 4-Volt Radio Storage Battery,	**6.00**
6-Volt, 60 Amp. Radio Storage Battery,	**7.00**
6-Volt, 80 Amp. Radio Storage Battery,	**8.00**
6-Volt, 100 Amp. Radio Storage Battery,	**9.50**
6-Volt, 120 Amp. Radio Storage Battery,	**11.50**
6-Volt, 140 Amp. Radio Storage Battery,	**13.00**

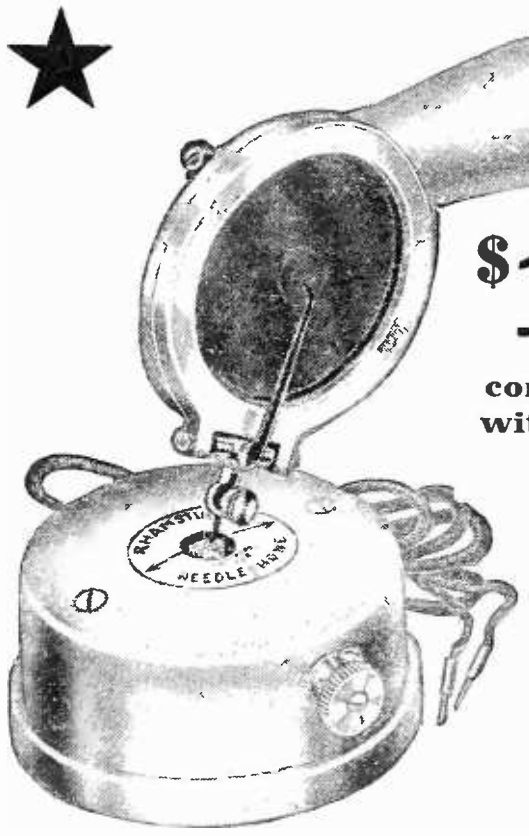
We ask for no deposit. Simply send name and address and style wanted. Battery will be shipped the day we receive your order Express C. O. D., subject to your examination on arrival. Our guarantee accompanies each battery. We allow 5% discount for cash in full with order. You cannot lose! Act quick. Send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



Arrow Battery Co.
1215 South Wabash Ave.
Dept. 10 Chicago, Ill.

★ Tested and approved by RADIO BROADCAST ★

Sweeter Christmas Carols On Your Radio



$10
complete with cord

When the sweet, tender strains of "Silent Night, Holy Night," broadcast by some cathedral choir, come in over your radio Christmas Eve, you will want a Rhamstine* Needlephone to enjoy it to the fullest.

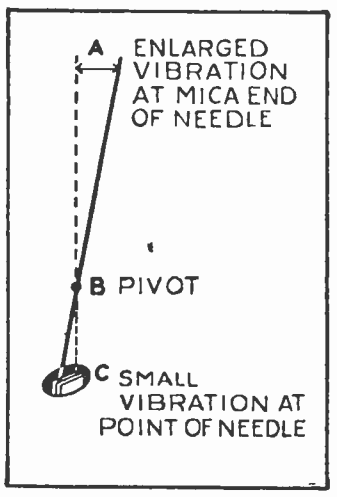
Nothing quite equals the Needlephone for accurate discrimination of tone values, real appreciation of fine music and pleasing reproduction.

It is the principle of "magnified reproduction," an exclusive feature of the Needlephone, that does it. Delicate impulses of high pitched notes, often lost on other types of loudspeakers, that come in over the radio receiver are picked up by the Needlephone and by the vibrations of the reed, are enlarged and transmitted through the pivoted needle of the phonograph to the mica diaphragm of the reproducer where they are transformed into sound.

RHAMSTINE* Needlephone

gives you all the advantages of the phonograph without even removing the needle. It is way ahead of the phonograph loudspeaker, with its metalic diaphragm, that replaces the phonograph reproducer on the tone arm. The Rhamstine* Needlephone gives fuller, sweeter music, better tone reproduction, can be attached more easily and does away with metallic noises. It can be used on any phonograph, including the Edison with Victor adapter.

RHAMSTINE* Needlephone



"Magnified Reproduction" Principle

This diagram illustrates the "magnified reproduction" principle of the Rhamstine* Needlephone. The delicate vibrations of the reed at "C" are transmitted through the pivoted needle and magnified at "A," where it is attached to the mica diaphragm. As a result the most delicate variations of tone are enlarged and given fuller values.

Take No Risk—Send No Money

Send the coupon to-day, pay on delivery, and try the Needlephone with your own set and your own phonograph. Try it with a soft needle on local broadcasting and see what pleasures await you. Try it with a loud needle and enjoy greater volume without metallic noises. Then, if you cannot say you get far greater volume and better reproduction, Rhamstine* does not want you to keep it. Return it and we will gladly refund your money in full.

Send this coupon to-day—there'll be lots of things on the air this Christmas you'll want to get.

J. THOS. RHAMSTINE ★
DETROIT, MICHIGAN

PHILADELPHIA
1220 Vine Street

NEW YORK CITY
652 Broadway

CHICAGO
218 So. Wabash Ave.

Mail This Coupon To-Day

J. THOS. RHAMSTINE* 12
506 E. Woodbridge St., Detroit, Mich.

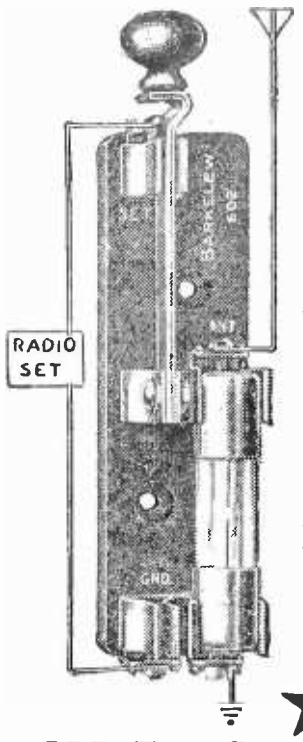
Send me the *Needlephone*. I'll pay the postman $10 upon its arrival. It is distinctly understood I may return it if I desire, within 5 days and receive a refund in full.

Name.....

Address.....

★ Tested and approved by RADIO BROADCAST ★

BARKELEW Lightning Arresters



THE National Electric Code requires an approved protective device (Lightning Arrester) on the lead-in wire of every radio receiving antenna.

Our No. 602 Lightning Arrester Switch is universally recognized as the only device on the market which combines on one base all those functions essential for maximum protection.

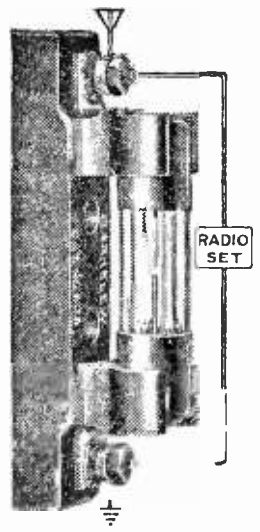
The vacuum tube arrester is permanently in the circuit from antenna to ground, ready to "spill" any overcharge. With the switch blade the antenna may be disconnected from the radio set and thrown directly on ground.

It meets not only the requirements but also the additional recommendations of the National Electric Code.

It is approved by the Underwriters' Laboratories.

Our No. 606 Vacuum Tube Lightning Arrester is less expensive but it meets all the actual requirements of the National Electric Code.

It is approved by the Underwriters' Laboratories.



For full description of each item, see our new Radio Catalog No. 32 at your dealer. If he hasn't his copy, we have one for him.

LIGHTNING ARRESTER SWITCH
No. 602 Price $3.00

The Barkelew Electric Mfg. Co.
Middletown, Ohio, U.S.A.

LIGHTNING ARRESTER
Vacuum Tube Type
No. 606 Price $1.50

NEW YORK 157 Chambers St. | CHICAGO 15 S. Clinton St. | DETROIT McKerchey Bldg.

WASHINGTON, D. C. Mills Building | MINNEAPOLIS 1017 Lumber Exchange | SAN FRANCISCO 75 Fremont St. | LOS ANGELES 443 S. San Pedro St. | SEATTLE 1041 Sixth Ave., S. | DENVER Denham Bldg.

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Send name TODAY for our big, new 84-page catalog. FREE to dealers only. Fully illustrated, with descriptions and special prices on high grade standard sets and supplies.

Unusually attractive discounts to dependable dealers. Orders filled same day received.

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Distributors of High Grade Radio Sets and Supplies
316 So. 19th St. OMAHA, NEBRASKA

ODD FISH

Being a Collection of London Residents described and drawn by

STACY AUMONIER
and
GEORGE BELCHER

Price, $2.00

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

CHASE INDUCTANCE COILS

New—1925—Type — Patent Pending

(Concentrated Magnetic Field)
(The coil guards the pulse of the set)

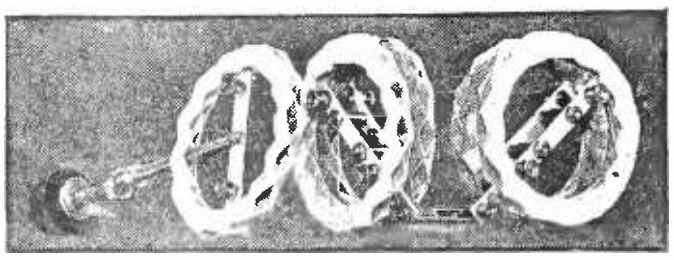
CHASE COILS *and the* ROBERTS CIRCUIT

makes a great two tube set of fine volume and tone, as clear as an "echo"

Immediate attention given all orders

$6.00 per set

ROBERTS



ROBERTS

CHASE COILS for all the best circuits

CHASE RADIO 41 Forest St., Springfield, Mass.

AMERICAN BRAND CONDENSERS

with the ★ ~100 to 1~ Worm Drive Vernier

Finest Condenser Made and the Greatest Radio Value Offered the Public

23 PLATE, only $5.00 In Canada $7.00

AMERICAN BRAND CORPORATION
NEWARK, N.J.

★ Tested and approved by RADIO BROADCAST ★

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, 1924. 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 holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

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, 1924.

[SEAL] (*Signed*) William W. Thornton
(My commission expires March 30, 1925.)

At Last!
Radio That Satisfies
The Music Critic

E. N. Rauland, Pres.
Rauland Manufacturing Co.,
2650 Coyne Street., Chicago, Ill.

THE CHICAGO DAILY NEWS
EDITORIAL ROOMS
August 6, 1924.

My dear Mr. Rauland:

I want to express my great pleasure in witnessing the recent test of amplifying transformers in your laboratory, and in selecting, from different instruments tested, the one which seemed to me to reproduce most exactly the artist's original tones. I was indeed gratified to learn, after the tests, that the instrument which I had repeatedly selected as by far the most successful in reproducing, not alone the music, but even the very personality of the artist, was none other than your own new "Rauland-Lyric" Transformer.

I feel confident that music lovers everywhere will appreciate the contribution you have made to their enjoyment in the creation of this reproducing instrument.

Very truly yours,
Maurice Rosenfeld
Music Critic,
Chicago Daily News

Price, $9.00

In placing his mark of approval upon Rauland-Lyric, Mr. Maurice Rosenfeld has invested Radio with a new beauty and dignity. His words carry positive assurance, to music-lovers and trained musicians, that they can now admit Radio to their field of appreciation and enjoyment, with the certainty that all voices and instruments will be reproduced with their original and distinctive Tone Quality.

Mr. Rosenfeld, a veteran among metropolitan music critics, selected Rauland-Lyric, upon the sole basis of Tone Quality, from a group of the world's best audio transformers.

Karleton Hackett, famous critic of the Chicago Evening Post, pronounced Rauland-Lyric a "distinct advance in the musical quality of radio reproduction."

You can have, in your home, the amplifying instrument which has been commended by eminent critics. Rauland-Lyric can be installed in your present set, or one that you may buy, to replace any ordinary audio transformer.

Ask your dealer.

RAULAND MANUFACTURING COMPANY
Pioneers in the Industry
2652 Coyne St. Chicago, Ill.

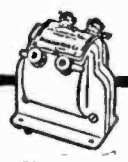
The RADIO KEY BOOK contains the clearest explanation ever given of the nature of audio amplification and equally valuable discussion of many other subjects in Radio. Sent for 10 cents, coin or stamps.

Rauland-Lyric
AN
ALL-AMERICAN
TRADE MARK
TRANSFORMER

The RADIO KEY BOOK
E. N. Rauland

Precision Made for *Reliability*

★



Standard Audio Frequency Transformers
"All-American for Reliability"

Ratio 3 to 1 . . R-12, $4.50 Ratio 5 to 1 . . R-21, $4.75
Ratio 10 to 1 . . R-13, $4.75

Built by precision methods in a modern plant, All-American Standard Audios meet the demand of the public for a dependable, high-quality transformer at a price made possible only by enormous production.

Long Wave Transformer

For highest amplification of intermediate frequencies and perfect reproduction of side bands; 4,000 to 20,000 meters (75 to 15 kilocycles) R-110, $6.00

Power Transformers

For *Tone Quality* in a Third Stage, or for Loud Volume with Clearness.

Input type . . R-30, $6.00 Output type . . R-31, $6.00

Self-Tuned Radio Frequency Transformers
"Wound to Suit the Tube"

Effectively amplifying all frequencies within the radiocast range. For "199" Tubes R-199, $5.00
For "201A" Tubes R-201A, $5.00

10,000 Meter Transformer

(Filter or Input). It gives superior results in beat reception, filtering out a 30 kilocycle frequency with high selectivity and no side-band distortion . . . R-120, $6.00

Radio Frequency Coupler

(Oscillator Coupler). A uniform output at 150 to 650 meters . . . . . R-130, $5.00.

Universal Coupler

Sets a new standard of efficiency as an antenna coupler. As a radio frequency transformer in tuned stages it is unsurpassed R-140, $4.00

Largest Selling Transformers in the World

★ Tested and approved by RADIO BROADCAST ★

Everything You Want In a Radio Set

PERFORMANCE—BEAUTY—AVAILABILITY—the three things you really want in a radio set, are offered to a new degree in the 1925 Operadio.

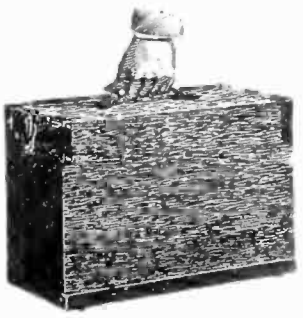
The efficiency of this compact receiver has called forth the highest praise—clear, natural tone, range, volume and selectivity, simplicity of operation and reliability under severe conditions.

In its attractive new case, the Operadio conforms to the most discriminating standards of good taste—harmonizing with the most beautiful surroundings.

And, in addition, the Operadio is so compactly designed that it may be readily carried to any part of the house or easily taken along when traveling or visiting.

The set is entirely self-contained. No aerial, ground or outside connections of any kind required. Loud speaker, six tubes, exceptionally large supply of dry cell batteries and all parts fitted into the cabinet.

Write for an illustrated folder giving complete particulars.



DEALERS: The Operadio Sales Franchise is particularly inviting. Ask for details.

THE OPERADIO CORPORATION
Dept. H, 8 South Dearborn Street, Chicago

OPERADIO

The Original Self-Contained Radio Set

LARGEST RADIO STORES IN AMERIOA

CHICAGO SALVAGE STOCK STORES

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We guarantee RADIO our new 68-page Catalogue will save you money

on brand new fully guaranteed, nationally advertised radio apparatus. We buy up manufacturer's and government surplus stocks, jobber and dealer bankrupt stocks, etc. Our enormous buying power permits us to pay spot cash and get rock-bottom prices—even way below manufacturer's costs. That's why our catalogue is crammed with thousands of wonderful radio bargains. That's why we GUARANTEE to save you money.

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DEALERS WRITE FOR QUICK SELLING KITS RADIO PARTS

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NEW YORK CITY, N. Y.

REDUCE STATIC

by using our super-sensitive

Omni-Directional Aerial

Pat. Pending 690459

Collapsible, Ornamental, Mechanically Perfect

Can be used either as a loop or antennae inside or outside.

A wonderful value featured at a price within the range of all.

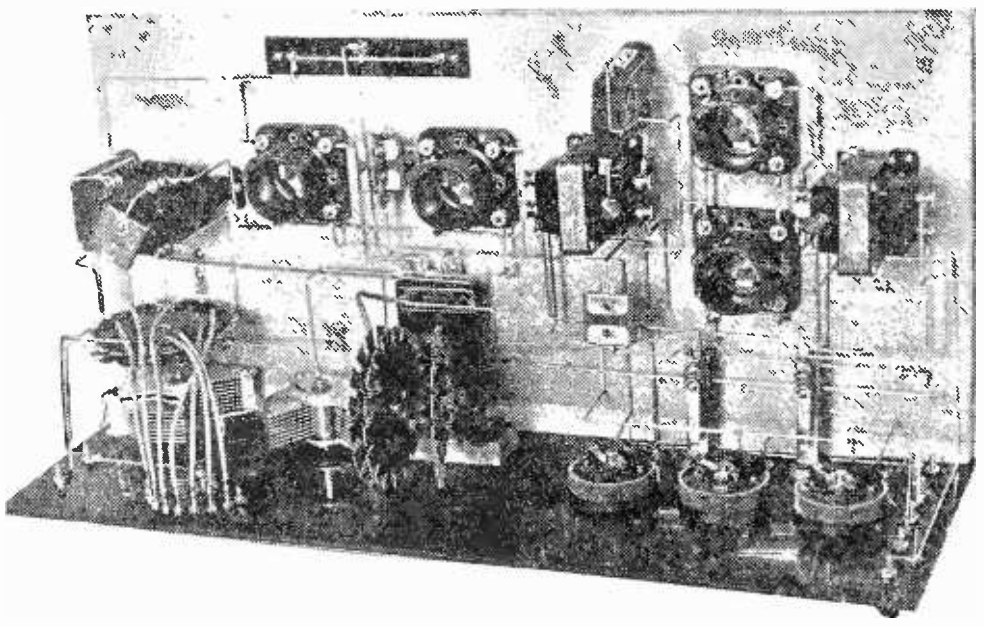
Ask your dealer or send order direct

$10.00 Prepaid in U. S.

The Portable Globe Aerial Co.
1602 Locust Dept. 12 St. Louis

★ Tested and approved by RADIO BROADCAST ★

THE RECEIVER OF THE YEAR



★

¶ For almost a year RADIO BROADCAST has featured the Roberts Circuit. First the two-tube, then the three-tube and now the four-tube receiver. We have positive proof in the form of unsolicited letters from contributors all over the country that it is more than giving satisfaction. Those who have built it feel amply repaid for the time spent in constructing it.

Join the Ranks of These Satisfied Constructors

¶ RADIO BROADCAST'S FOUR-TUBE KNOCK-OUT RECEIVER is ideally suited for receiving the International programs to be broadcast by England, Canada, France, Holland, Hawaii, Germany and other foreign countries during International Radio Broadcast Test Week.

¶ It compares very favorably with any good super-heterodyne.

¶ RADIO BROADCAST'S pattern blue-prints and sixteen-page instruction booklet make it easy for you to construct this receiver.

¶ This circuit combines tuned radio-frequency amplification, push-pull audio-frequency amplification, neutralization, reflexing, regeneration, ease of tuning, super-selectivity, and distortionless loud speaker volume.

FOR YOUR OWN CONVENIENCE IN ORDERING, USE THE ATTACHED COUPON

DEALERS! We have a most attractive proposition for you. Will you let us tell you how we can help you to make sales that STAY SOLD?

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 Knock-out. It is understood that my dollar will be returned if the material sent me does not come up to my expectations.

Name.....

Address.....

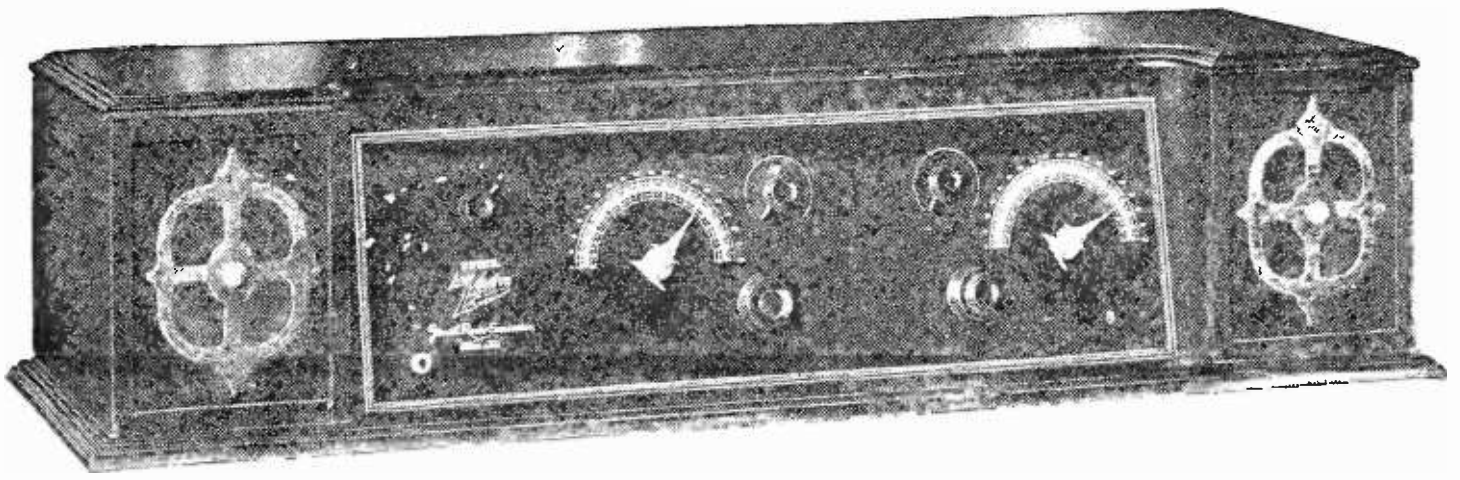
R. B. 12-D

★ Tested and approved by RADIO BROADCAST ★

ZENITH RADIO

TRADE MARK

—it tunes through everything



Super-Zenith VII

The New SUPER-ZENITH

for people who take pride in their homes

ONE glance at the new Super-Zenith and you are instantly impressed with the sheer artistry of its design, the excellence of its craftsmanship, the superb beauty of its finish—you know that within its case is a receiving set capable of the most extraordinary performance—a receiving set entitled to the place of distinction in the finest home.

Radio enthusiasts: Note that the new Super-Zenith is NOT regenerative. It is a six-tube set in four different models ranging from $230 to $550, with a new, unique and really different patented circuit controlled exclusively by the Zenith Radio Corporation. Amplification is always at a maximum in each stage for any wave length. The *Super-Zenith line is not affected by moisture.* For the first time, you have here a set that—

1—tunes through *everything* and selects the station you really want.

2—requires only *two* hands—*not three*—to operate.

3—brings in each station *at only one point on the dial.*

4—affords such mathematical precision and simplicity that you can run over the entire dial in 1½ minutes and pick up *more* stations with greater clarity and volume than any other set on the market. Direct comparisons invited.

Write for the name of the nearest dealer from whom you can obtain a demonstration of this outstanding marvel of the radio world.

★ *Dealers and Jobbers: Write or wire for our exclusive territorial franchise*

Zenith Radio Corporation

332 South Michigan Avenue, CHICAGO

ZENITH—the exclusive choice of MacMillan for his North Pole Expedition—Holder of the Berengaria Record

Super-Zenith VII (Not regenerative)—6 tubes—2 stages tuned frequency amplification—detector and 3 stages audio frequency amplification. Installed in a beautifully finished cabinet of solid mahogany—44⅞ inches long, 16¾ inches wide, 10⅝ inches high. Door panels inlaid. Slanting panel of sheet bronze, mahogany finish, with scales and indicators in metallic relief. Gold plated pointers, to prevent tarnish. Compartments at either end for dry batteries. Can be operated on either wet or dry batteries. Either inside or outside antenna.
Price (exclusive of tubes and batteries).....**$230**

Super-Zenith VIII Same as VII except—built with mahogany legs of well-proportioned appropriate design, converting model into console tvpe.
Price (exclusive of tubes and batteries).....**$250**

Super-Zenith IX Same as VII except—built with legs and additional compartments containing built-in Zenith loud speaker on the one side and generous storage battery space on the other.
Price (exclusive of tubes and batteries).....**$350**

Super-Zenith X Contains two new features superseding all receivers. 1st—Built-in, patented, Super-Zenith Duo-Loud Speakers, (harmonically synchronized *twin* speakers and horns) designed to reproduce both high and low pitch tones otherwise impossible with single-unit speakers. 2nd—Zenith Battery Eliminator, distinctly a Zenith achievement. Requires no A or B batteries or charger.
Price (exclusive of tubes) **$550**
Price (without battery eliminator).....**$450**

Zenith Radio Corporation
Dept. 12-D
332 S. Michigan Ave., Chicago, Ill.

Gentlemen: Please send me illustrated literature giving full details of the Super-Zenith.

Name.....

Address.....

★ Tested and approved by RADIO BROADCAST ★

Sea to Sea—Trouble Free

Easy to Build

THE SILVER SUPER-HETERODYNE

Laboratory Model

McMURDO SILVER

McMurdo Silver, Assoc. I. R. E. designed the 7 Tube Wonder Supers for easy building. All you need is a pair of pliers, a Screw Driver, a Soldering Iron and the book—"THE PORTABLE SUPER-HETERODYNE." This book puts into your hands the results of Mr. Silver's experience with hundreds of Supers—Dope never before available. Detail drawings and photographs show how all the "kinks and twists" have been eliminated; so you can build either model on your kitchen table. Send for your copy to-day.

Price . . 50c.

SEA to SEA

Yes Sir! And Loud Speaker Volume on an 18" Loop—right through the locals—that's what you can expect with the Silver Super—either Portable or Laboratory Model. The Portable described in the October issue satisfies every requirement for a small, self-contained Super. The model illustrated above is just the receiver for the discerning fan who wants and recognizes the best. All parts for the Laboratory Model less Cabinet and Voltmeter cost but $63.60.

Double range Weston Voltmeter for A and B Battery $10.00. 7 x 24 Mahogany Cabinet, $9.85.

All parts for the Portable Model $57.65.

MAIL YOUR ORDER TO-DAY

Silver Super Specials

Bringing Your Old Super Up-to-date

Oscillator Coupler No. 101	$2.50	50 KC RF Transformer Unit No. 401	$14.00
30 KC Tuned Output Transformer No. 201	3.50	5-Gang 199 Socket No. 501	3.00
.0005 Low Loss Condenser No. 301	4.50	Collapsible Center-tapped Loop No. 601	6.50

Circulars Upon Request

DEALERS—Write for our attractive Merchandizing Plan

SHIPMENTS

Prepaid East of the Rockies. Orders filled the same day they are received.

GUARANTEE

S-M Products are sold on a Satisfaction or your Money-back Guarantee.

Eastern Dist. Twentieth Century Radio Corp. 102 Flatbush Ave., Brooklyn, N. Y.

Write for The "WHY" of Silver Supers—It's free!

Silver-Marshall, inc. ★

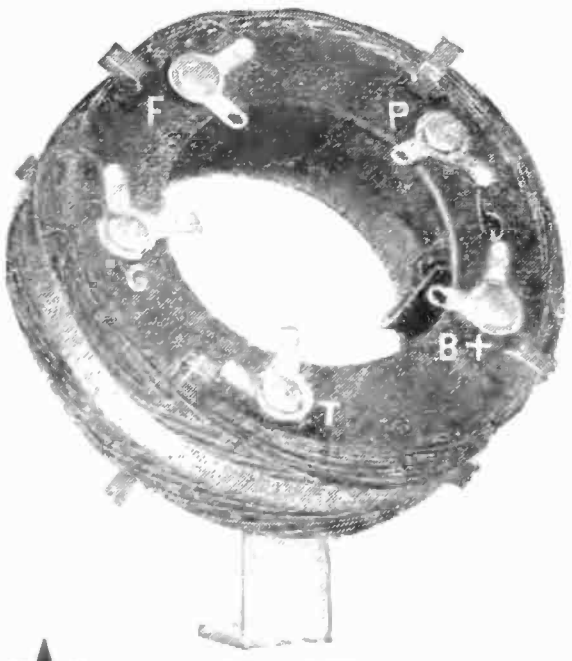
105 S. Wabash Ave. Dept. B. Chicago

Central 3744

★ Tested and approved by RADIO BROADCAST ★

IT'S HERE!

The New Kellogg R.F. Transformer That Brings 'Em In!



No. 602

A radio frequency transformer of the aperiodic type suitable for all sets with which tuned radio frequency is desired. Also used for one stage of audio frequency amplification ahead of regenerative sets to prevent re-radiation.

Consider These Points of Superiority—

No dope to hold windings in place
Soldered connections
Mounting bracket holds coil at correct angle
Minimum rubber used in form
Lowest possible loss
Works with any .0005 condenser
Secondary arranged with suitable taps for biasing features

This transformer makes the construction of a radio frequency set an easy matter, assuring best possible reception with widely varying types of circuits, including reflex.

Built and guaranteed by Kellogg Switchboard and Supply Company

No. 602 Transformer at Your Dealers for $2.35 Each

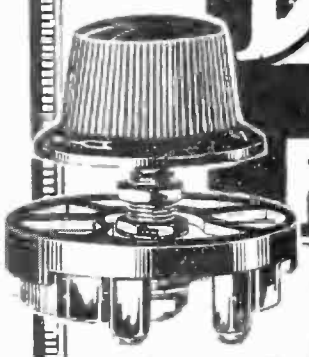
USE—IS THE TEST

KELLOGG SWITCHBOARD & SUPPLY COMPANY

1066 W. Adams Street Chicago, Ill.

DeJUR

ONE HOLE RHEOSTAT



YOU can put this rheostat on your set in less than five minutes. It has everything—fine, clean-cut appearance, will wear for years, and is designed for maximum efficiency.

Consider these exclusive points: Non-corrosive, heat resisting, absolute contact by sliding rod on slide arm. interchangeable resistance element.

Guaranteed—Any part replaced any time.

AT DEALERS EVERYWHERE

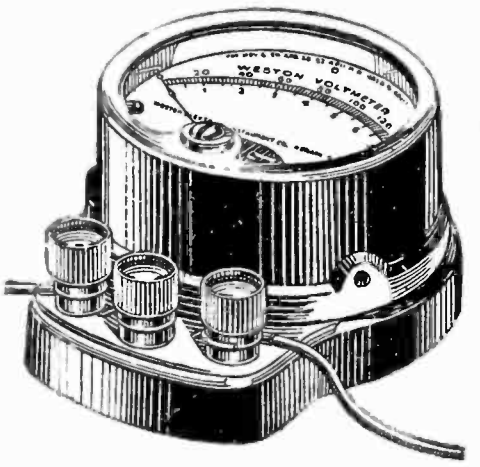
Jobbers and Dealers write for discounts.

DeJUR PRODUCTS CO.

Lafayette and Broome Sts., New York

★

A Handy Table Voltmeter for every Radio Man



TEST your batteries. Tells filament and plate voltages. Enables you to tune in quickly and exactly, duplicating previous results. Invaluable for lengthening tube life by operating at correct filament voltage. Ranges 150 and 7½ volts. Eliminates guessing. Write for Booklet J.

Weston Electrical Instrument Co.

179 Weston Avenue Newark, N. J.

WESTON

Electrical Indicating Instrument Authorities Since 1888

STANDARD-The World Over

★ Tested and approved by RADIO BROADCAST ★

AMRAD

"The Voice of the Air" Presents a New

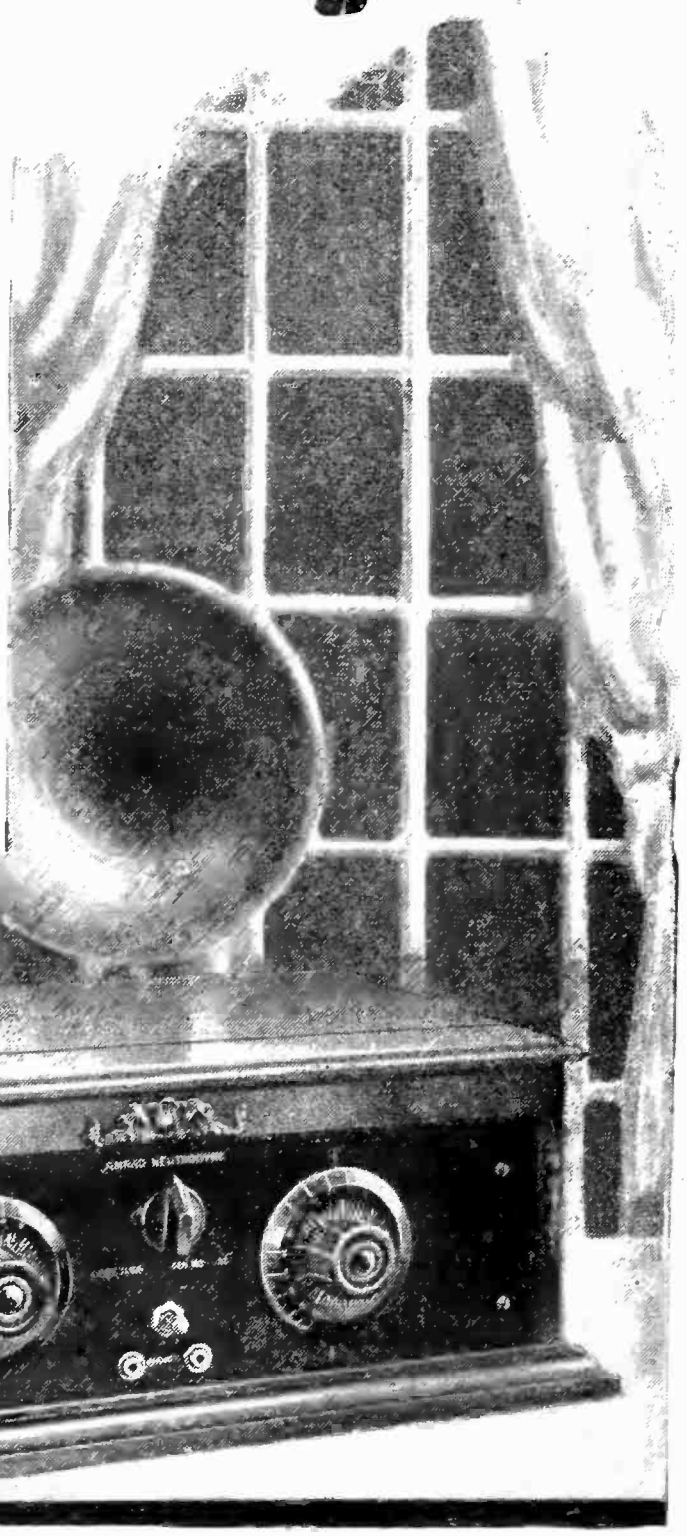
NEUTRODYNE

Two-Dials, Five-Tubes

THE Neutrodyne is the undisputed leader among broadcast receivers. Its one handicap, (shared by other sets) has been that the *powerful* models—capable of producing adequate volume and that fine, clear tone—had to be controlled by *three* tuning dials operated more or less simultaneously,

To meet the demand for simplicity of operation (people have but two hands to use in tuning) the AMRAD Neutrodyne is offered. Here, for the first time, easy control and real power (five tubes, are to be found.

If your dealer cannot demonstrate, send to Dept. B for Folder 520 describing four other outstanding features of this truly wonderful set and why you should have one in your home.



Price Only

$85.

★

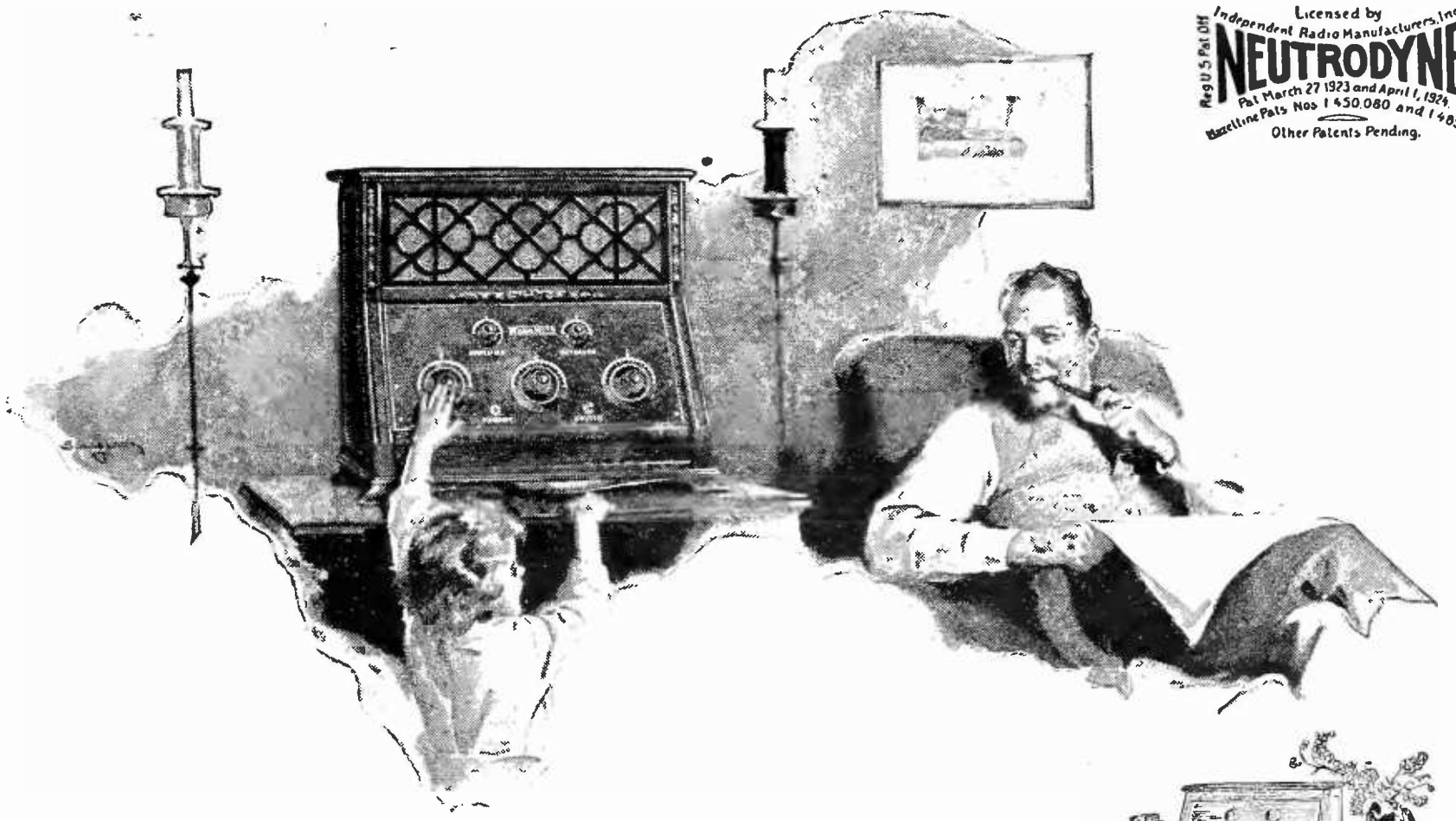
AMERICAN RADIO & RESEARCH CORP.

AMERICAN RADIO & RESEARCH CORPORATION
LICENSED BY
INDEPENDENT RADIO MANUFACTURERS, INC.
NEUTRODYNE
HAZELTINE PATS NOS 1,450,080 AND 1,489,228
OTHER PATENTS PENDING
TRADE MARK REG U.S. PAT OFF

Medford Hillside
Massachusetts

★ Tested and approved by RADIO BROADCAST ★

W O R K R I T E R A D I O S E T S W O R K R I G H T



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Pat March 27 1923 and April 1, 1924.
Marcelline Pats Nos 1 450,080 and 1 489,228
Other Patents Pending.

"Look Daddy!
I can make music, too!"

Anybody can "make music" with WorkRite Super Neutrodyne Receivers. WorkRite is so simple to operate and yet so unerring in results that it is a continuous source of delight and fascination for everyone in the family.

Really, if you've never used a WorkRite set you'll be astonished to learn how easy it is to get—*and hold*—any station you want. You'll find no provoking interruptions, no irritating distortion. And once you have tuned in a station you can get it instantly at any time, simply by using your previous dial settings.

WorkRite positively assures an unusually vigorous reception with all the original depth and clarity of tone—unmarred by howls, whistles, and other disturbing noises.

Another WorkRite superiority that's a revelation even to experienced radio fans, is the astounding selectivity of these superb sets. Just a slight turn of the dials tunes out the most powerful local stations—*and keeps them out.* If you live in a city you know what an advantage that is.

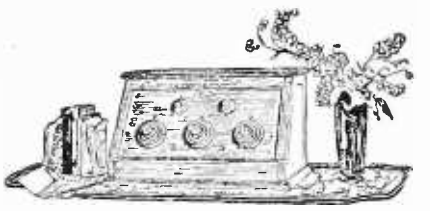
Then there's WorkRite's exceptional range! Under favorable conditions it will easily span the continent for you. Even distant stations come in regularly and distinctly on the loud speaker.

There are other WorkRite advantages, of course. The ingenious super neutrodyne "hook-up"—the fine materials that we use—the painstaking care given to building each individual WorkRite set—all these combine to make receivers that establish a brand new peak in radio performance.

Don't be disappointed if the dealer you visit can't demonstrate WorkRite for you. WorkRite has won such tremendous popularity both among novices and experienced operators that most stores find themselves pressed to meet the demand.

So, if the one you visit hasn't WorkRite in stock, write us and we will send you the name of a store that has. Also, if you want a beautifully illustrated rotogravure folder, giving full information on all WorkRite models, fill in the coupon below and send it to us. You'll get the booklet by return mail.

But above all, know what WorkRite will do before you invest another dollar in radio.



WORKRITE AIR MASTER
A 5-tube Neutrodyne Set

Encased in genuine brown mahogany cabinet with graceful sloping panel. Almost identical with WorkRite Radio King, shown in main illustration, except the latter has a loud speaker built into cabinet.

Prices:
Air Master, without accessories, . . $160
Radio King, without accessories, . . $220

WORKRITE CHUM
A 3-tube Neutrodyne Reflexed Set

Similar to Air Master in appearance. Equal to 4-tube sets in performance. Cabinet provides space for both A and B batteries.
Price, without accessories $75

WORKRITE ARISTOCRAT
A 5-tube Neutrodyne Set

In this beautiful mahogany console, the loud speaker is placed on one side and compartment for A and B batteries on other side. All connections made inside with cable and plug. A set unsurpassed in any respect.
Price, without accessories $350

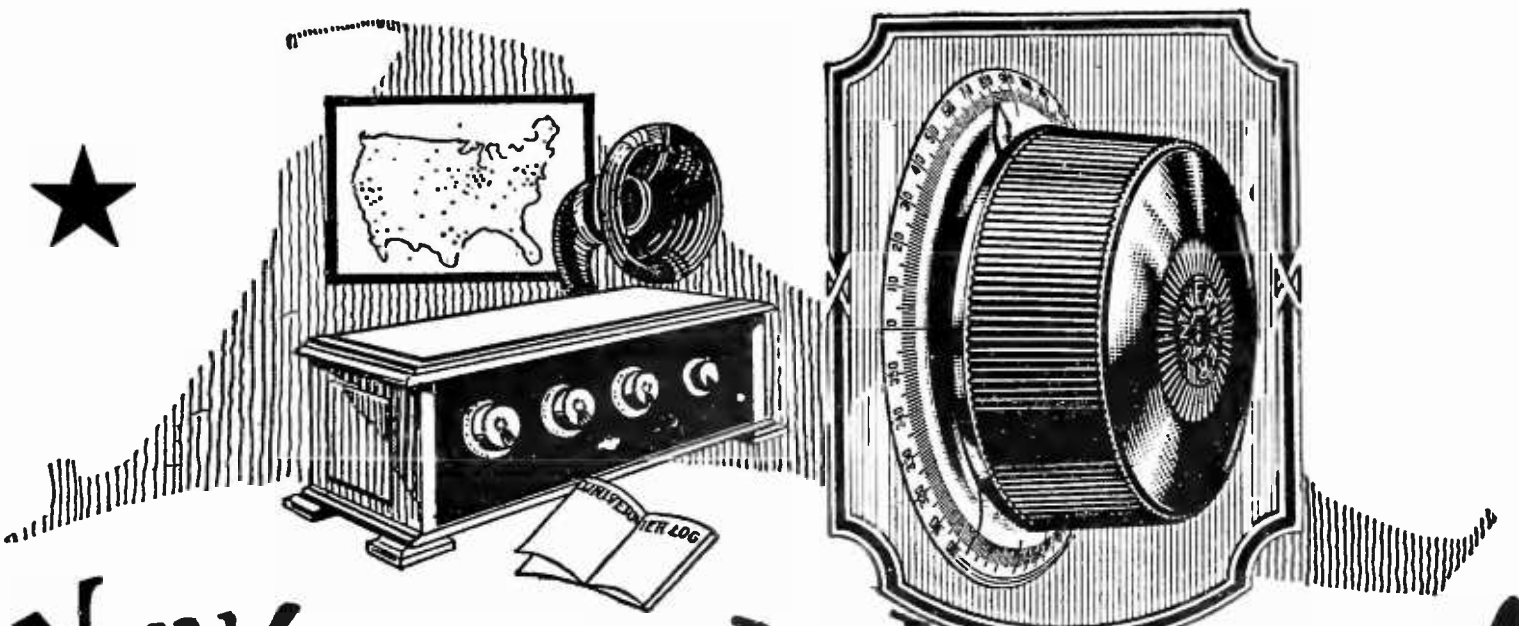
Send Coupon for FREE Rotogravure Booklet

THE WORKRITE MANUFACTURING COMPANY
1810 EAST 30th STREET — CLEVELAND, OHIO
Branches: Chicago, 536 Lake Shore Drive; Los Angeles, 239 South Los Angeles Street

★ WORKRITE
SUPER NEUTRODYNE RADIO SETS

The WorkRite Manufacturing Co.
1810 East 30th Street *Cleveland. Ohio*
Please send me FREE a copy of the Rotogravure booklet which describes WorkRite.
Name.....
Address.....
City .....*State* .....

★ Tested and approved by RADIO BROADCAST ★



New! tripled my log!

of stations "heard" on the second day thru using the

WALBERT UNIVERNIER

Micro-Selective Tuning Control

THAT is what the UNIVERNIER did for A. H. Klingbeil of Ashtabula, O. Tripled his entire log in a single night! "Last night," writes Bishop Francis of Chicago, "I put 3 UNIVERNIERS on my Neutrodyne and got 20 stations I never heard before!"

You can do the same. Tune-in those hard-to-get distant stations quickly, easily, clear and loud. Get the most out of your set. Replace each of your dials with a UNIVERNIER, the *original* 12-to-1 ratio *micro-selective* tuning dial.

WHY A 12-to-1 RATIO IS BEST

Careful tests prove that a lower ratio is inefficient, a higher unnecessary. With higher-ratio dials the actual "searching" for stations is done with the coarse adjustment. The operator finds the vernier adjustment too slow and uses it only for "clearing-up" a station after it has been detected with the coarse adjustment. Many stations are missed entirely with the latter. With the Univernier both "searching" and the final "clearing-up" are done easily and efficiently with the vernier adjustment. And a large knob helps do it!

COSTS NO MORE THAN A GOOD DIAL—

And does away entirely with the need for *vernier* condensers. Very attractive with new "dished" dial. More efficient with heavier gearing. Positive continuous vernier—No slippage! Pointer rigid with shaft. A slight necessary amount of play in the knob prevents involuntary disturbance of vernier adjustments when the hand is removed.

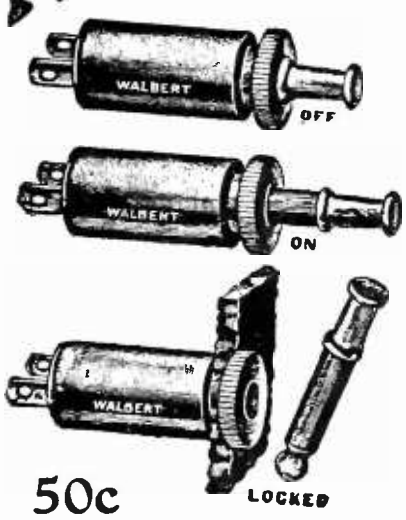
Mahogany Knob and Gold-plated dial . . $1.50

Black Knob and Silver-plated dial $1.25

At your dealer or sent postpaid on receipt of purchase price.
(Please mention dealer's name.)

Jobbers and Dealers: Write for Discounts

THE WALBERT MANUFACTURING COMPANY
927 Wrightwood Avenue Chicago, Illinois



50c

Don't worry any more about someone meddling with your radio set while you are away. Simply remove key from Walbert Filament Lock Switch and take it with you just as you'd take the ignition key from an auto. Sturdy, compact, efficient. Shell and key handle insulated from circuit. No finer switch, and none made with unique lock feature.

75c

The Walbert Safety Rim Socket is guaranteed not to break at the slot. Special heavy bakelite design decreases inter-element capacity thereby utilizing all available grid voltage for producing signals. (New tubes have bakelite bases for same reason.) Soldering lug and double-spring contact integral. The most attractive socket on the market.

Members of R.M.A. and N. R. T. A.

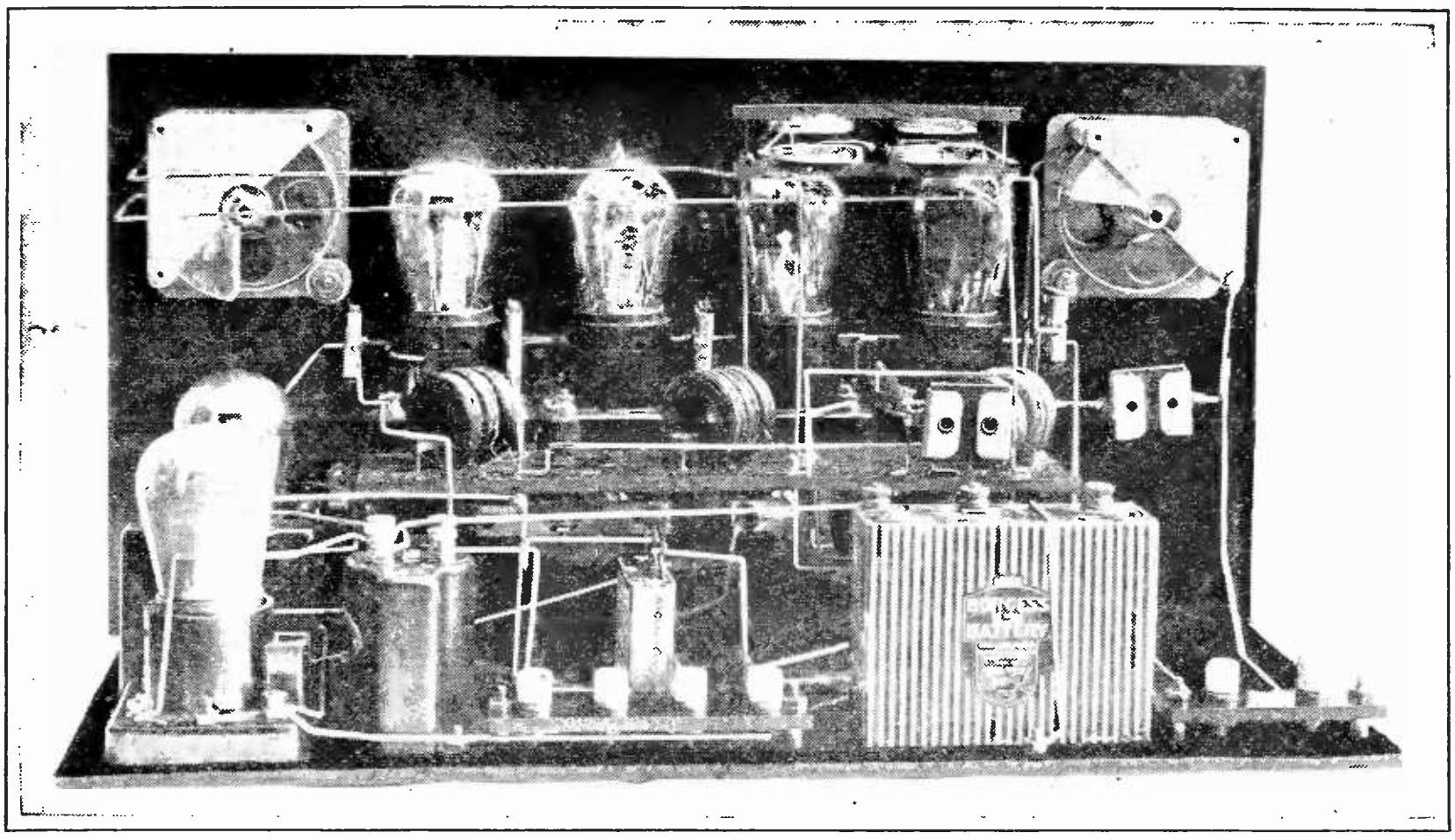
WALBERT

Parts with a Purpose

FREE! Send 2c stamp for FREE copy of UNIVERNIER LOG BOOK.

ALL WALBERT PARTS PROTECTED BY PATS. OR PATS. PEND., U. S. AND FOREIGN.

★ Tested and approved by RADIO BROADCAST ★



Take the "IFS" Away from the Super-Heterodyne

A stable reflexed six-tube receiver that brings KGO into New England with a loop while WSAI is broadcasting.

Coils for the Set

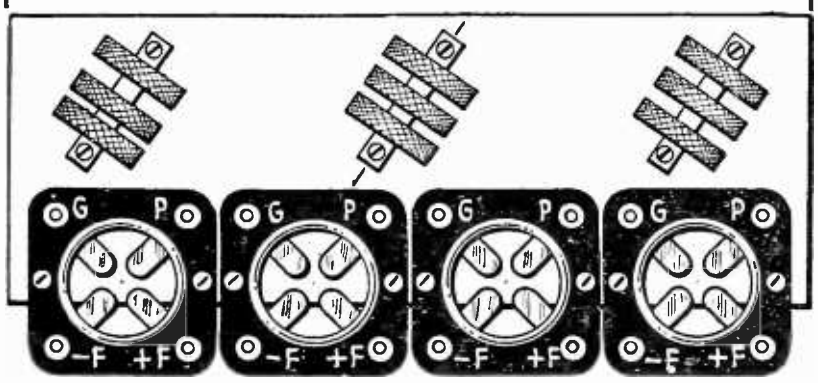
—if you want to build it all yourself, we can furnish you with coils for the I. F. transformers and oscillator with instructions.

$15.00 per set

Can You Mount a Condenser?

If so, you can make this set because we supply the entire four tube unit all wired and tested on a sub-panel, size 10 by 6 inches! Just mount it on a panel with two screws—add two condensers and two rheostats and audio frequency if you want it—and your set is the envy of your neighbors.

Price, $37.50



Full details in November Radio Broadcast ★

ALLAN T. HANSCOM

WOONSOCKET RHODE ISLAND

★ Tested and approved by RADIO BROADCAST ★

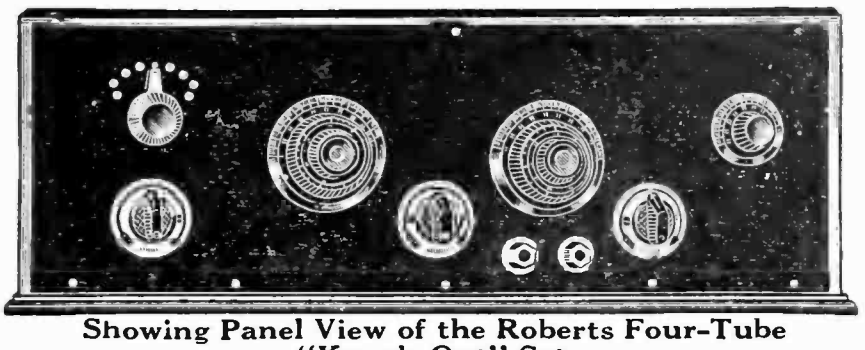
Build At Home Your Own Roberts
FOUR-TUBE "KNOCK-OUT" SET

Get all the parts complete at one time delivered POSTPAID to your door, including booklet, blueprints, and full instructions for building the wonderful Roberts Four-Tube "Knock-Out" Set just as described in the September issue of Radio Broadcast. Shipped on approval—No risk!

Save Time! Save Patience! Save Bother!

Every article and every transaction guaranteed to be satisfactory

Buy all the parts and complete instructions at one transaction. Otherwise you waste time in looking all over town for parts needed. **This saves your time!** You get the complete instructions and exactly the parts you need to build the best radio receiver ever designed for home construction. **This saves your patience!** And you get all the parts, **completely guaranteed,** at one time and in one package, postage prepaid. **This saves you bother!** You also save money by doing business with *The Radio House of Friendly Service* (Headquarters for everything in radio).



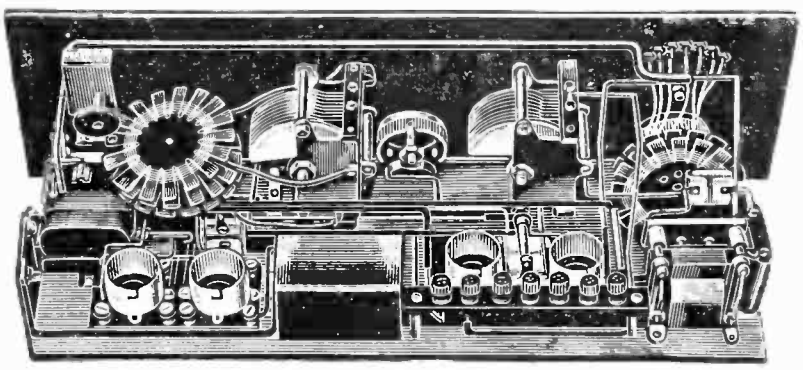
Showing Panel View of the Roberts Four-Tube "Knock-Out" Set

Quick Shipment.
Goods Subject to Examination before acceptance, if desired.
We Pay Transportation to any P.O. or shipping point in the U. S.
No Money in Advance, unless you prefer to send with order.
Letters Answered Quickly and Intelligently.
Radio Questions Answered Free and without obligation.
Interest Your Friends in this Radio offer.

$61.85 in value for Only $48.35

If you have some of the parts listed, tell us what you need, and we will send them only, and charge you for each on the same *basis* as though you ordered all. We guarantee our prices will please you.

		LIST OF PARTS	Quantity	Amount
—	5S5	Cabinet, mahogany-finish, piano polish, 7x21	1	$ 5.00
—	12S26	Panel, hard rubber, 7x21, drilled & engr.	1	4.00
—	5S19	Baseboard, 6½x20½	1	.60
—	6S28	Set coils, Roberts	1	8.00
—	7S64	Condensers, variable, 23-plate, U. S. Tool	2	6.80
—	7S41	Grid condenser, micadon .00025	1	.35
—	12S57	Grid leak, 2 megohm, Daven	1	.50
—	7S45	Condenser, Fixed micadon .0025	1	.40
—	7S48	Condenser, Fixed micadon .005	1	.60
—	7S73	Condenser, Neutralizing	1	2.00
—	16S53	Rheostats, 20-ohm, Tillman	3	2.40
—	16S5	Sockets, Federal	4	4.00
—	19S26	Pair transformers, Como Push-Pull	1	12.00
—	19S4	Transformer, 5-1 Sherma-tran	1	4.65
—	18S17	Switch, Inductance, Fada type	1	.25
—	18S15	Switch, points	7	.10
—	18S16	Switch, stops	2	.05
—	10S17	Dials, Univernier	3	3.75
—	3S16	Binding posts, moulded	7	1.40
—	11S30	Jack, closed circuit, Millimeter	1	.80
—	11S10	Jack, open circuit, Millimeter	1	.70
—	2S85	Batteries, C, Eveready type 771	2	1.20
—	3S8	Doz. lugs, soldering	1	.10
—	21S41	Tubing, varnished, lengths	3	.90
—	21S4	Doz. length wire, bus bar	1	.30
—	4S30	Blue prints and Instructions	1	1.00
		Regular Price		$61.85
		—14S98 Our Price, Postpaid		**$48.35**
		Accessories—		
—	2S70	Batteries, B, Eveready, 45-v.	2	$ 7.50
—	2S79	Battery, A, storage, 70 a.h., Westinghouse	1	15.00
—	13S1	Head phones, Guaranteed	1	4.50
—	11S13	Phone plug, Comsco	1	1.00
—	20S11	Tubes, UV-201-A	4	16.00
—	1S14	Antenna Equipment	1	4.00
		Regular Price		$48.00
		—14S99 Our Price, Postpaid		**$38.14**



An inside view of the Roberts Four-Tube "Knock-Out" Set

Mr. Lynch Says:

Mr. Arthur Lynch, Editor of Radio Broadcast, under whose supervision the Roberts Four-Tube "Knock-Out" Receiver was developed, says in part about this wonderful set:

". . . Tube for tube, dollar for dollar, and result for result, we will stack it up against any receiver for home construction ever described by any radio publication and gamble that it comes out a winner."

We Say:

". . . that we have seen hundreds of letters from radio enthusiasts everywhere who have built this remarkable Roberts Four-Tube "Knock-Out" Set and these letters ranged from conservative expressions of appreciation to wild-eyed enthusiasm. Thousands of others have built this receiver (all with marked success) and so can you. We recommend it unqualifiedly to YOU.

ORDER DIRECT FROM THIS ADVERTISEMENT—QUICK SHIPMENT!

ON APPROVAL!

You can examine at your express office without obligation to accept. If you accept and within a reasonable time you do not get satisfactory results, we will take back anything or everything undamaged and willingly refund your money.

Liberty M. O. House: Please send me all the parts I have listed, subject to your guarantee of satisfaction.

Name .....

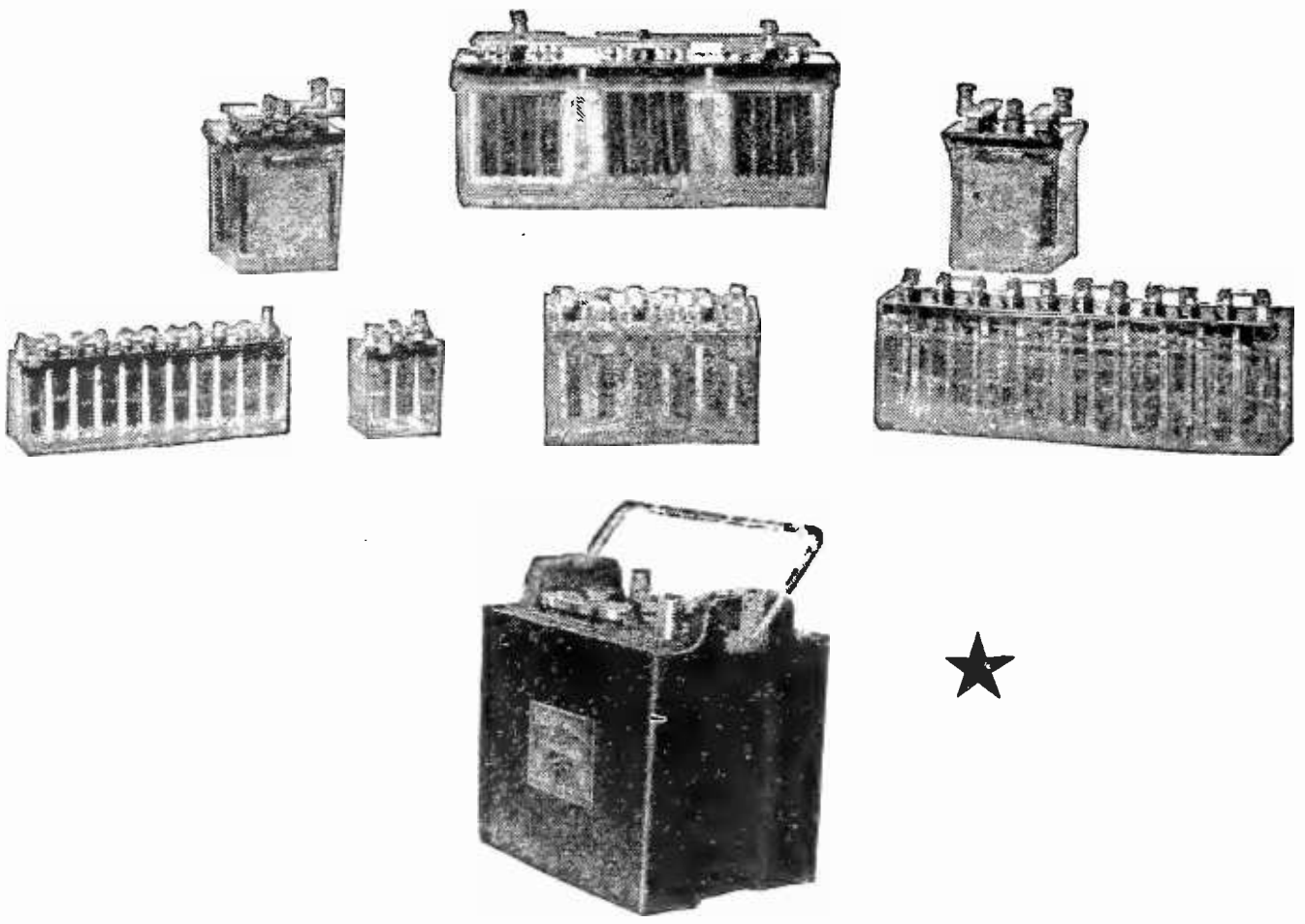
Address .....

Liberty Mail Order House

The Radio House of Friendly Service

Dept. 684Z 106 Liberty St., New York

★ Tested and approved by RADIO BROADCAST ★



A BATTERY FOR EVERY RADIO NEED

It makes no difference what set you are using; whether one or nine tubes, whether two or six volts, single or multiple circuit, regenerative or reflex, or one of the numerous "dynes," there is a Westinghouse battery to fit it.

Furthermore: If you are not already a user of Westinghouse Radio Batteries, you have no idea of the increased economy, reliability and all-around satisfaction to be had by using storage batteries, particularly Westinghouse Batteries, for all receiving sets.

The WESTINGHOUSE UNION BATTERY COMPANY
SWISSVALE, PENNA.

Distributor for Canada
The Canadian Westinghouse Co., Ltd.
Offices in all principal Canadian cities

Distributor for South America, Mexico and Cuba
The Westinghouse Electric International Company
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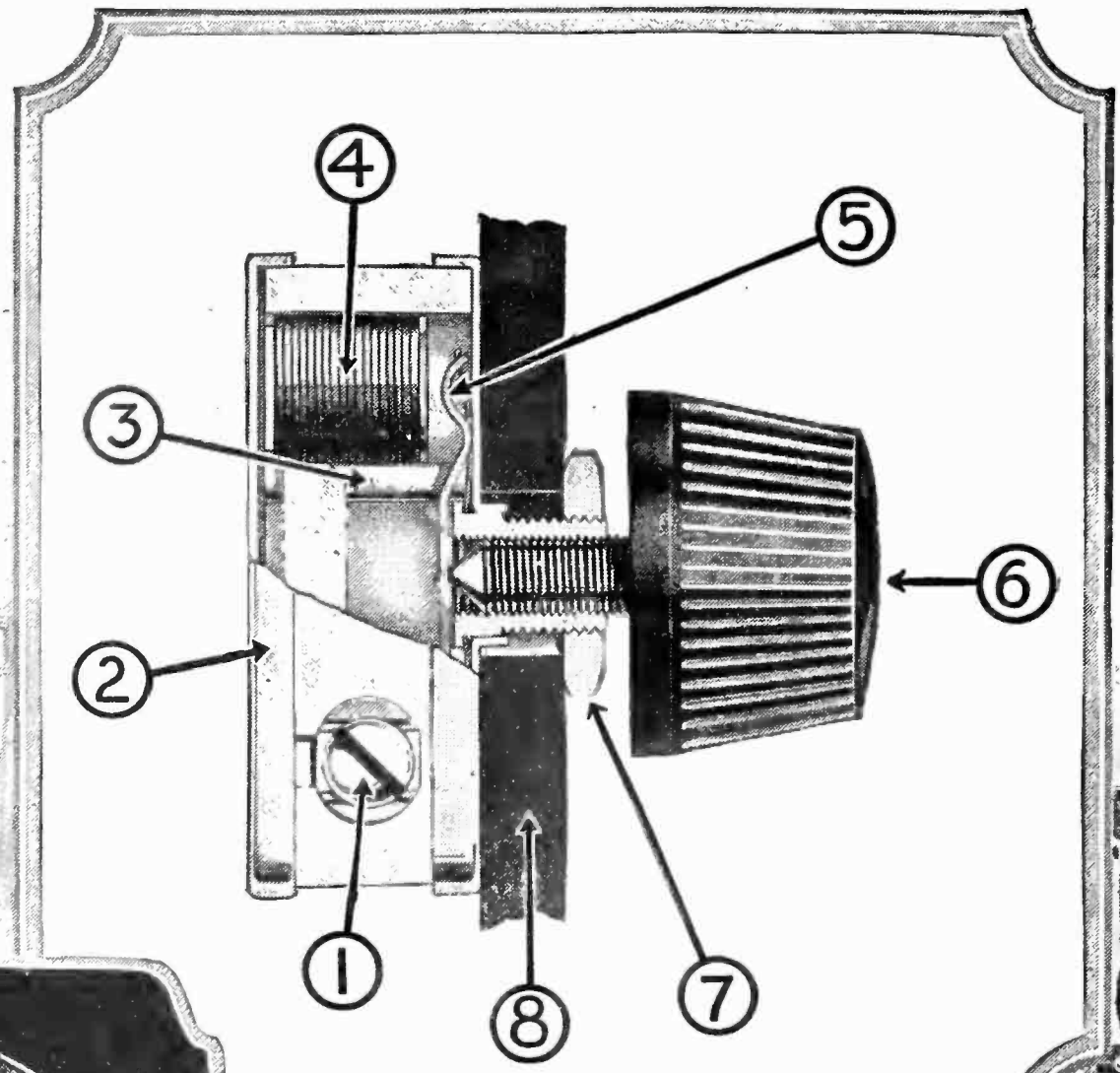
WESTINGHOUSE

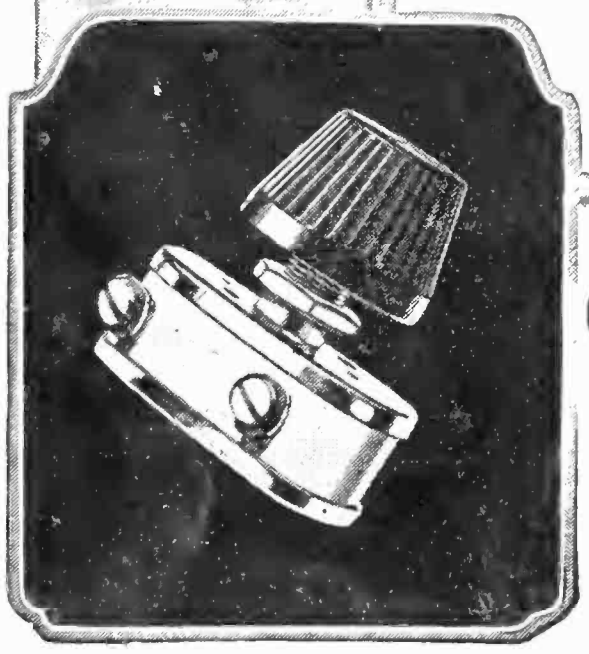
RADIO

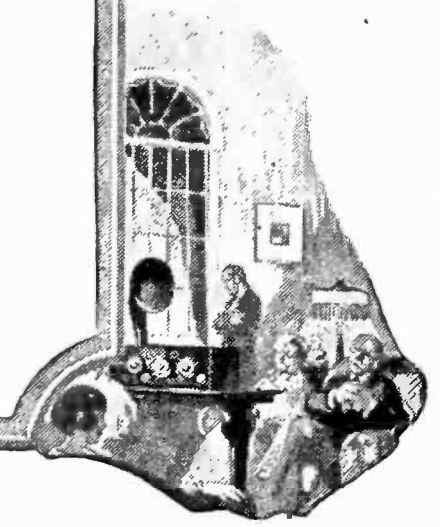
"A," "B" and "C"

BATTERIES

★ Tested and approved by RADIO BROADCAST ★







The New Bradleystat

Supreme in design and performance

ASIDE from the novel "one-hole mounting" that characterizes the Allen-Bradley line of radio devices, the most striking new feature is the extreme compactness of the graphite disc container. When mounted on the panel, the new Bradleystat extends less than three-quarters of an inch behind the panel. The same is true of the Bradleyleak and the Bradleyohm. And the Bradleyometer extends only seven-eighths of an inch.

You can improve your radio set immensely by substituting a Bradleystat for your present wire rheostat or a Bradleyleak for your old grid leak. There's plenty of room. Try it!

Important Features

1. Two terminals suffice for ALL tubes.
2. Back panel extension is 11/16-inch.
3. Holes for table mounting are provided.
4. Graphite discs give stepless, noiseless control.
5. Internal switch opens battery circuit.
6. One knob provides control from ¼ to 100 ohms.
7. One locknut holds Bradleystat securely in position.
8. Drill only one hole in panel

A-B

★

Allen-Bradley Co.

Electric Controlling Apparatus

278 Greenfield Avenue

Milwaukee, Wisconsin

Baltimore	Buffalo	Cleveland	Knoxville	Philadelphia	Saint Paul
Birmingham	Chicago	Denver	Los Angeles	Pittsburgh	San Francisco
Boston	Cincinnati	Detroit	New York	Saint Louis	Seattle

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