

Blueprint Section Every Month

# RADIO AGE

*The Magazine of the Hour*



*July*  
*1926*

The Golden Rule in Shielded  
Form **Ω** A Compact Portable  
Super-Het **Ω** Data on Crystal  
Control **Ω** A Good Short-  
Wave Receiver

25¢

**Complete Broadcast List and Log**  
*In Each Issue*

# SM

## “Plug-In B”

### The 220—

#### The Audio Transformer With a Wallop



—and with as “true to color” tone reproduction as you ever heard. Guaranteed to be superior to anything on the market including impedance and resistance coupling and every transformer or practical audio amplifying device. It is a power job; designed for this fall’s power tubes as well as those now available. It is husky—it’s the biggest transformer built, and is *unconditionally guaranteed* to be better than anything else. The price is \$6.00.

Type 221 output transformer is designed for use between the receiver and loud speaker. It is to be used optionally with 220’s and power tubes for exceptional quality.

With the advent of the 220 transformer comes a revolutionary idea in audio amplification—the falling frequency characteristic at high frequencies. This tends to compensate for actual loud speaker characteristics of a reverse nature. 220’s and 221’s are the only audio transformers ever really *designed* to operate with cone speakers—and to do it with *real* quality from thirty cycles up—and absolutely without hiss.

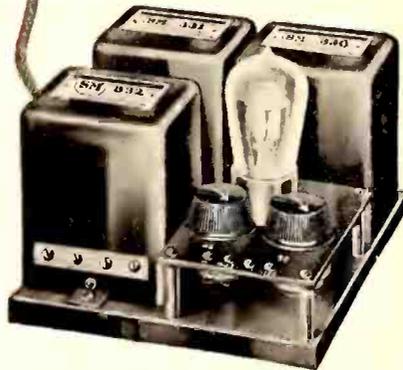
THE Silver-Marshall “Plug-In B” power supply is by far the most outstanding “B” eliminator on the market. It is as steady and constant as your electric light current. It has better voltage regulation and a higher power output than any similar product. It will not heat or distort on the heaviest continuous load. There is less of even a semblance of a hum than in any other “B” eliminator. No “static-like” distortion due to run down “B” batteries.

Attach it and forget it. It is an economy and a necessity on every good receiver. \$35.00.



### New Filter Design

“Plug-In B” is conservatively rated at 85 milliamperes and can be operated at 100% overload. This 650-B kit has incorporated in it an absolutely new principle in filter design, developed in the Silver-Marshall laboratories and fully covered by patents. This is the greatest single advance made in “B” eliminator construction and places the assembly above all competition for power—constant power—and all around efficiency. Compact and small in size  $6\frac{1}{2} \times 7\frac{1}{2}$ ". Fully mounted on metal base—all that is needed are a few wires to complete it.



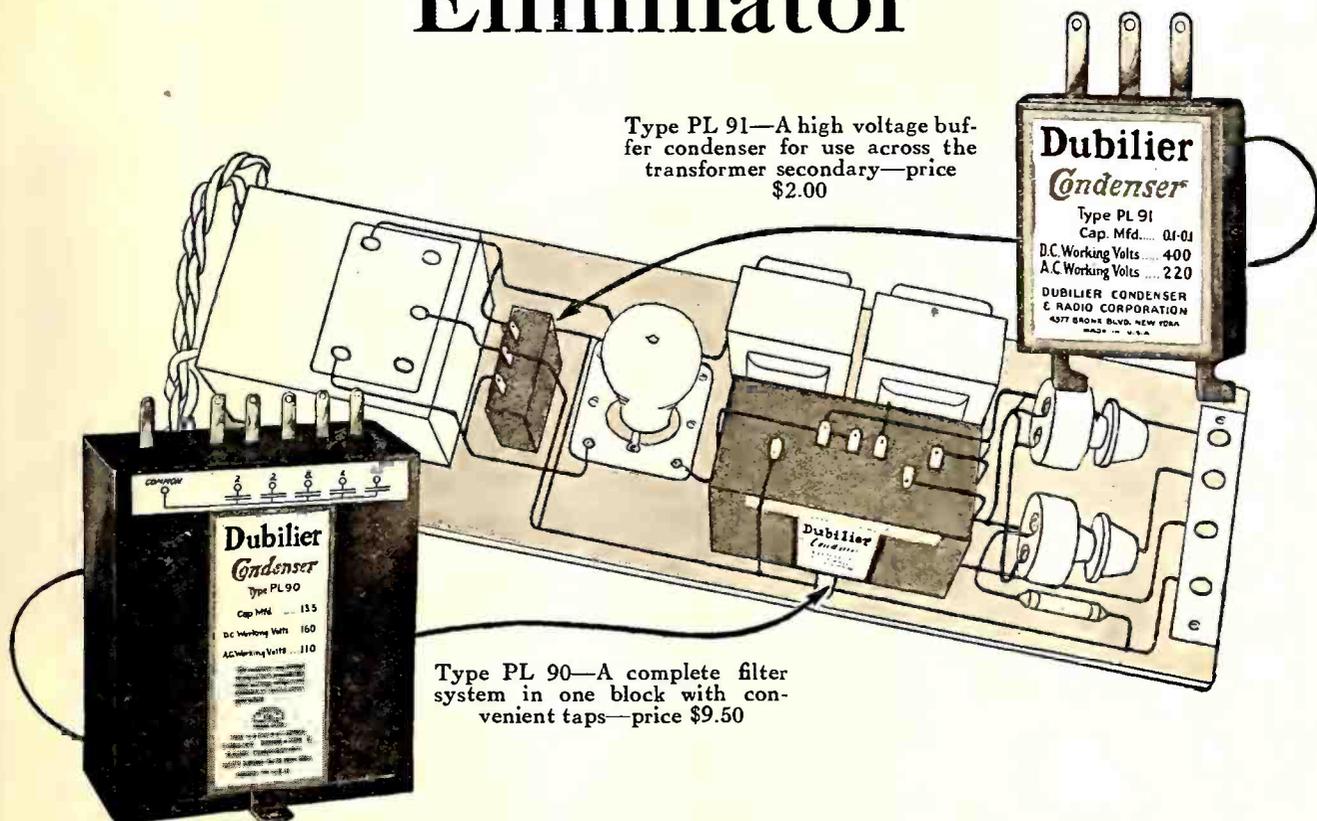
*To be found wherever good radio  
equipment is carried*

## Silver-Marshall, Inc.

850 West Jackson Boulevard

Chicago, U. S. A.

# Use Dubilier Condensers in your Raytheon Eliminator



Type PL 91—A high voltage buffer condenser for use across the transformer secondary—price \$2.00

Type PL 90—A complete filter system in one block with convenient taps—price \$9.50

These new Dubilier condensers will make your Raytheon "B" battery eliminator better.

Type PL 91, is a .1—.1 buffer condenser to be used across the secondary of the 110 volt input transformer.

Type PL 90, contains all condensers needed in the filter circuit, and is tapped at 2, 2, 8, 1 and .5 mfd.

Dubilier condensers are specially designed and constructed to withstand the high voltages used in "B" battery eliminators. They are the finest condensers obtainable for this purpose.

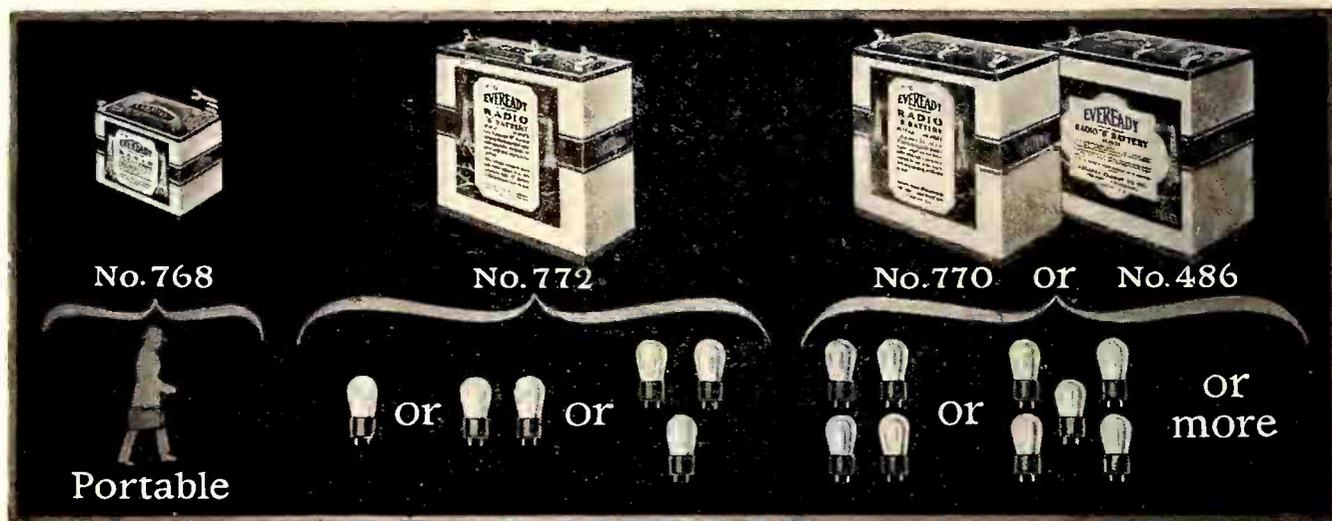
Send 10c for our booklet which shows fourteen ways in which you can improve your set by simple application of Dubilier condensers.

4377 Bronx Blvd., New York, N. Y.

# Dubilier

**CONDENSER AND RADIO CORPORATION**

Perhaps you, too, can cut your "B" battery costs in half. Just follow the chart. It gives you the secret of "B" battery economy.



THOUSANDS of people have made the discovery that Eveready "B" Batteries, when used in the proper size, and on sets equipped with a "C" battery\*, are a most economical, reliable and satisfactory source of radio current.

Here is the secret of "B" battery economy, reliability and satisfaction:

*On all but single tube sets—Connect a "C" battery\*. The length of service given below is based on its use.*

*On 1 to 3 tubes—Use Eveready No. 772. Listening in on the average of 2 hours daily, it will last a year or more.*

*On 4 or more tubes—*

\*NOTE: A "C" battery greatly increases the life of your "B" batteries and gives a quality of reception unobtainable without it. Radio sets may easily be changed by any competent radio service man to permit the use of a "C" battery.

*Use the Heavy-Duty "B" Batteries, either No. 770 or the even longer-lived Eveready Layer-built No. 486. Used on the average of 2 hours daily, these will last 8 months or longer.*

These figures are based on the average use of receivers, which a country-wide survey has shown to be two hours daily throughout the year. If you listen longer, of course, your batteries will have a somewhat shorter life, and if you listen less, they will last longer.

Evereadys give you their remarkable service to the full only when they are correctly matched in capacity to the demands made upon them by your receiver. It is wasteful

to buy batteries that are too small. Follow the chart.

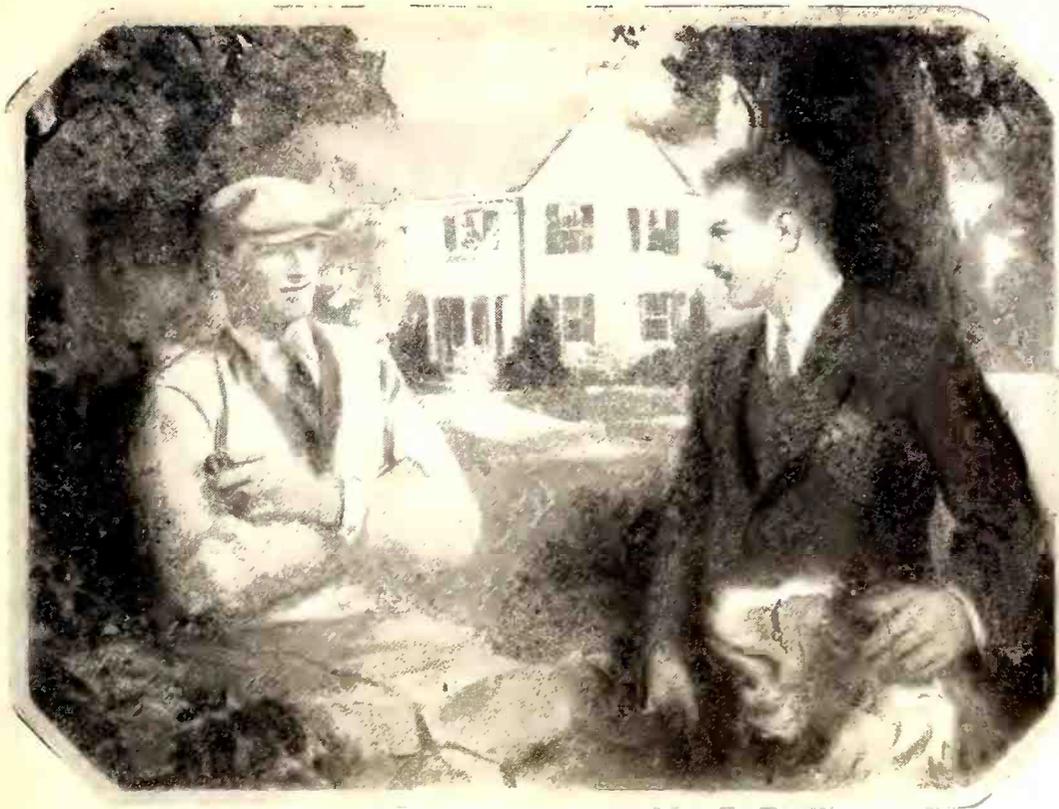
In addition to the batteries illustrated, which fit practically all the receivers in use, we also make a number of other types for special purposes. There is an Eveready Radio Battery for every radio use. To learn more about the entire Eveready line, write for the booklet, "Choosing and Using the Right Radio Batteries," which we will be glad to send you on request. There is an Eveready dealer nearby.

Manufactured and guaranteed by  
**NATIONAL CARBON CO., INC.**  
 New York San Francisco  
 Canadian National Carbon Co., Limited  
 Toronto, Ontario

Tuesday night means Eveready Hour—8 P. M., Eastern Standard Time, through the following stations:

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

**EVEREADY**  
**Radio Batteries**  
*—they last longer*



“We give our sets about the same amount of use, but your ‘B’ batteries always last longer than mine. What’s your secret?”

“WHY, there’s really no deep, dark secret about it. It’s simply knowing what are the right size batteries to buy for your set.”

“Yes, but what do you mean by right size?”

“The right size depends on the number of tubes in your set. The more tubes you have, the bigger the ‘B’ battery you need to give you long, economical service. Just follow the rules laid down by Eveready and you can’t make a mistake.” These are the rules and the results:

*On all but single tube sets—connect a “C” battery\*. The length of service given below is based on its use.*

*On 1 to 3 tubes—use Eveready No. 772. Listening in on the average of 2 hours daily, it will last a year or more.*

\*NOTE: A “C” battery greatly increases the life of your “B” batteries and gives a quality of reception unobtainable without it. Radio sets may easily be changed by any competent radio service man to permit the use of a “C” battery.

*On 4 or more tubes — use the Heavy-Duty “B” Batteries, either No. 770 or the even longer-lived Eveready Layerbilt No. 486. Used on the average of 2 hours daily, these will last 8 months or longer.*

The above rules will give you the maximum of “B” battery life and

economy. Of course, if you listen in more than 2 hours a day, which is the universal year-round average, your “B” batteries will not last quite so long, and if you listen less they will last longer. Eveready “B” Batteries give a pure, steady, noiseless current, the kind of current that is absolutely essential if you prize pure tone.

Send for booklet, “Choosing and Using the Right Radio Batteries,” sent free on request. There is an Eveready dealer nearby.

Manufactured and guaranteed by  
**NATIONAL CARBON CO., INC.**  
 New York San Francisco  
 Canadian National Carbon Co., Limited  
 Toronto, Ontario



LEFT - No. 486, for 4, 5 or more tubes. \$5.50.

RIGHT - Eveready Dry Cell Radio “A” Battery, 1½ volts.



# EVEREADY

## Radio Batteries

—they last longer

Tuesday night means Eveready Hour—8 P. M., Eastern Standard Time, through the following stations:

WEAF—New York	WSAI—Cincinnati
WJAR—Providence	WTAM—Cleveland
WEEL—Boston	WWJ—Detroit
WTAC—Worcester	WGN—Chicago
WFI—Philadelphia	woc—Davenport
WGR—Buffalo	wcco { Minneapolis
WCAE—Pittsburgh	{ St. Paul

KSD—St. Louis

# RADIO AGE

The Magazine of the Hour

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## CONTENTS

### FOR JULY ISSUE

Cover insert by A. P. Mehlum

Zenith Radio Corporation Described.....	7
By F. A. Hill	
Really Compact Portable Super.....	10
Short Wave Receiver.....	13
By Willis L. Nye	
Quartz Crystals for Radio Control.....	17
By S. R. Winters and Geo. S. Turner	
Tube Rejuvenation.....	23
By Armstrong Perry	
A Theory for Mr. Humphrey.....	24
By H. M. Bishop	
Edison Studio Stars.....	25
What the Broadcasters Are Doing.....	26
Porto Rico—the Enchanted Isle.....	28
By E. D. Cahn	
Aerial Night's Entertainment.....	30
By Dorothy B. Stafford	
Golden Rule in Shielded Form—Blueprints.....	33
By F. A. Hill	
Pickups and Hookups by Our Readers.....	40
With the Manufacturers.....	44
Correct List of Broadcasters.....	54-56-58-60-62
Classified Advertisements.....	63
Log-a-wave Chart.....	64

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## Chats With the Editor

BROADCAST fans who desire to make the transition from the ranks of the listeners to that of the telegraphing amateurs will find much of interest in the blueprint section of the August issue of Radio Age. A low power, short wave telegraph transmitter has been made, is operated frequently during the evening hours under the call 9BHX and is fully described in the blueprint section with enough data to enable any prospective amateur to duplicate the set and get on the air. Of course the aspirant must have a license from the Department of Commerce, but the amateur field is different from that of the broadcasters; on the lower waves there is no waiting list. All you have to do is demonstrate you can copy ten words a minute and have a rudimentary knowledge of transmission and reception and you secure an amateur operator's license. Then to get your transmitting license, build the set first, describe it in your application for a license, and if everything is all right your amateur transmitting license will follow shortly. Then you can go ahead and work. Many of the amateurs one hears on the air were formerly BCL's but they had to have an outlet for their excess energy and amateurism was the next step.

Beautification of radio sets is the keynote of the leading article in this month's issue. Then there is an article on a seven tube super that is portable and compact. The receiver may be used either at home in a console or spirited away in a carrying case on your vacation. It uses either 199 or 201-A tubes and controls are down to a minimum.

Short wave enthusiasts will find good meat in the story by Willis L. Nye covering the low wave receiver he constructed.

A great deal of interesting matter is uncovered on crystals by R. S. Winters and George S. Turner, while Armstrong Perry takes a fling at tube rejuvenation. Porto Rico is described as the home of WKAQ by E. D. Cahn while Dorothy B. Stafford gives us an idea of aerial night's entertainment.

The Golden Rule receiver shielded form is shown in the blueprint section.

*Frederick Smith*

Editor of RADIO AGE.

# Why the Zenith "B" Battery Eliminator is different and better!



The Highest Type "B" Eliminator  
for All Receivers



How It Fits the Zenith Cabinet

In the few weeks since we announced the Zenith "B" Battery Eliminator, the demand has been literally astounding—once more confirming the basic policy on which we have founded and built our business. The people *do* want the better thing in radio, and are willing to pay for quality merchandise.

Here are three reasons why this new Zenith product is different—and better:

- 1—The transformers used in this Eliminator are specially wound and are tested to a much higher voltage than those in the average Eliminator. They have a greater margin of safety, so that the danger of burning out is eliminated.
- 2—The condensers are of an extra heavy capacity, for this same reason. They will take care of a greater variance of line voltage and still maintain the required voltage output—will deliver more milliamps and still not have the voltage drop, a thing a great many Eliminators cannot produce. Many Eliminators are using a Hollowax condenser. Although this possesses ability to withstand flashes of high voltage, it is a known fact that the great weakness with the Hollowax condenser is that if subjected to a moderately high voltage continuously, an ageing process takes place and the condenser deteriorates rapidly. With voltage around 100, this period of deterioration is about three months, at the end of which time more than 90% of the condensers blow. The Zenith employs a Parrafin condenser, which will stand its rated voltage steadily year in and year out. Parrafin condensers cost almost twice as much as Hollowax. Zenith considers service and performance before cost.
- 3—Most Eliminators are built with an adjustable resistance. The Zenith Eliminator has a *fixed resistance* on both amplifier and detector. The 22½-volt tap will always deliver 22½ volts; the 100 intermediate tap, 100 volts; the amplifying tap, 135 volts. The operator need make no adjustments.

The Zenith "B" Battery Eliminator is specially designed to fit all Zenith models, but it may be used equally well with other makes of receivers requiring the same voltage. It is built to stand up under the most severe usage, over a long period of time.

The coupon will bring you a descriptive circular about this new and remarkable product—show you how you can maintain your radio set at the highest degree of efficiency, at a minimum cost. Ask for it *today*.

*Obtained only thru authorized Zenith Dealers and Distributors*

Zenith Radio Corporation, Straus Building, Chicago

Tune in on WJAZ

Dance Orchestras on Tuesday, Wednesday, Friday and Saturday Nights from 8:00 P. M. until 1 A. M.

Musical Program from the Zenith Spanish Garden Studio 8:00 until 11:00 o'clock Thursday Nights and Special Programs 6:00 until 8:00 Sunday Nights.

Central Standard Time. Authorized Wave Length, 329.5 Meters.

INQUIRY COUPON

ZENITH RADIO CORPORATION,  
310 South Michigan Ave., Chicago

Gentlemen: Please send me full particulars of the Zenith "B" Battery Eliminator. Show me how I can increase the efficiency of my radio set.

I own a.....tube .....  
(Name of make)

Name .....

Address .....

# RADIO EDITORIALS

A RECENT letter from an English reader tells us that he finds our magazine quite the best thing he has encountered in his search for information on home set-building. Our London friend supplies the interesting information that American parts are now available in the English shops. This leads him to the further comment that the American parts are rather more up-to-date than those manufactured by our English cousins. It appears that the effort to restrict the English fans to the use of English sets, parts and accessories has not been successful. It is a good thing for the fans over there. The wider the field of selection open to the builder of sets the more satisfaction he may derive from his experiments. In some respects the English have managed their broadcasting on a better plan than have we here in the United States. But we do not believe that the British manufacturers have enjoyed the same stimulating spirit of competition that has caused the American makers of sets and parts to literally fight for the latest and best.

THE Englishman referred to in the foregoing paragraphs also made known his approval of the blueprints which are a part of each issue of this magazine. He likes these so well that when he is unable to obtain this magazine in the London bookstalls he has the magazine mailed from America by his brother, who is resident here.

Those blueprints have been a distinguishing mark for the magazine for twenty-two issues. They have attracted so much favorable attention that our book has come to be known generally as "The Magazine with Blueprints." An application for a patent on the special method of incorporating such prints into the magazine has been pending for almost two years. The publishers believed if this idea were of any merit at all it was good enough to deserve protection.

We observe that another radio publication, after successively borrowing other good ideas originating in this magazine, has laid hold of the blueprint method of producing diagrams. The editor of the other magazine does not take this step joyously, with a proud announcement to his readers that he is giving them something fine and new. He merely prints the prints, presumably deferring until a later date his announcement that his magazine is "The Blueprint Magazine." Meanwhile we hope our readers will remember that we have been publishing the blueprints in every issue for practically two years. We also hope that our readers will agree that the incident of the blueprints proves that it is best in the long run to remain loyal to the leader. If we were the first to use isometric drawings of hook-ups and the first to publish corrected complete broadcast lists with a log chart each month and the first to print blueprints of our hook-ups it probably is not too much to expect that we shall continue to be the first as new conditions demand new methods. After so many readers have complimented us upon the blueprints we are now especially gratified that a competing publisher, by imitating us, has also placed the stamp of his approval upon our technical service.

DOWN east, where we have many thousands of readers, certain irresponsibles have been circulating a report that RADIO AGE is to be sold to a combination of other radio publications. The report is entirely baseless. At no time has a suggestion been made to or by the corporation which publishes this magazine contemplating a sale of RADIO AGE. As a matter of fact we have just begun to enjoy ourselves. After almost five years of the business we feel that we may fairly claim to be pretty well established in the field. We have absorbed two other radio publications since we started and we venture the prediction if there is any further absorption we will not be the absorbees.

RADIO AGE has subscribers and newsstand sales in the British Isles, Germany, France, South Africa, Porto Rico, Australia, Japan, Austria and in South American countries. At a fair estimate 150,000 technical radio fans study our pages each month. We have not that many individual subscribers or newsstand buyers but our readers pass the magazine from one to the other, either inside the family or within the neighborhood, so that we have an impressive circle of readers. To one and all of these RADIO AGE friends we wish to say that we are still here at the old stand and expect to be here for many years to come.

SEVERAL of the leading radio manufacturers are proving their faith in the excellence of summer radio transmission and reception by advertising their wares in the summer issues of the radio publications. It is a good sign. We believe, as we always have believed, that the radio business during the hot months can be made comparatively as good as the automobile business in the winter time. In olden days it was the theory on gasoline row that it was little use trying to sell cars in the oyster period. Closed cars came along and winter sales are now enormous. Better radio receivers and better radio stations have come along and radio is losing its seasonal handicaps.

THAT "chaos of the air," which was promised as a result of the victory of the Zenith Radio Corporation, has not materialized. The only effect of the United States Court's decision against the Department of Commerce appears to be a more generally understood necessity for legislation that will cover the intricate aspects of broadcasting. It appears, therefore, that the Zenith Corporation, instead of deserving censure as the first "pirate of the air" is entitled to approbation for waking up congress. Still we do not hope for legislation this year. A lot of people are still five years behind the times insofar as radio is concerned. We know of one editor of a big newspaper who got along for many years without radio and when it burst into his ken he would have none of it. It was decided by the publishers nevertheless that the paper would have to have a radio section. The editor yielded, perforce, but he ruled that the radio editor could not have his desk on the same floor as that occupied by other sub-editors. So the radio department was shunted off somewhere upstairs. That will be a good one to tell our grandchildren.

# RADIO AGE

## The Magazine of the Hour

M. B. Smith  
Business Manager

A Monthly Publication  
Devoted to Practical  
Radio

Frederick A. Smith  
Editor

# Zenith Doing Much to Make Radios Beautiful

*New Models of This Line Show  
Trend of Receiver Design*

By F. A. HILL  
*Associate Editor*

ALMOST every one of the larger radio organizations in the field today, regardless of whether parts manufacturers or complete set builders, have a background of previous experience that goes back a bit further than the dawn of the broadcast craze. The Zenith Radio Corporation, of Chicago, Ill., of which Eugene F. McDonald, Jr., is president, is no exception to this rule. In this article we will therefore review some of the early history of the present Zenith corporation as well as present a few ideas as to what may be expected in future radio manufacturing.

Zenith's beginning can be traced to the days shortly after the Armistice in 1918 when two young Chicagoans, Carl E. Hassel and R. H. G. Matthews, possessors of one of the first Armstrong regenerative licenses, designed, manufactured and sold what was then known as a "ham tuner" which is the amateur term for a receiver to cover amateur wave bands. This set was manufactured under the name "CRL Paragon" and made by the Chicago Radio Laboratory in which Hassel and Matthews were partners. Later on the trademark Paragon was sold to the Adams-Morgan Co., in New Jersey and the name of the receiver changed to the Zenith.

During the useful life of the Armstrong regenerative license the sets were manufactured by the Chicago Radio Laboratory while the sales were handled by the Zenith Radio Corporation. Now the Armstrong regenerative license is not used so extensively; all the manufacturing and sales is carried on by the Zenith Radio Corporation. The engineering and production departments are all under the supervision of the plant superintendent, C. E. Mead, who personally conducted the writer through the various departments.

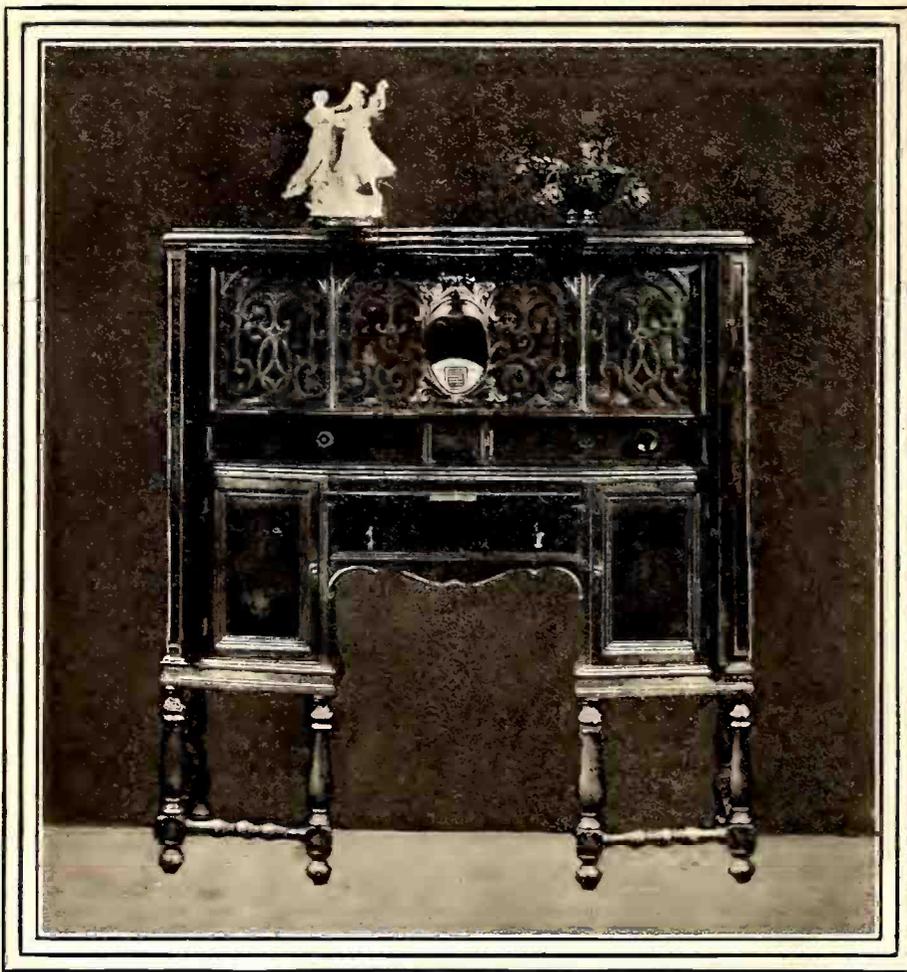
### Quality Sets

ZENITH has occupied a definite place in the radio industry through an early choice of its destiny. If there was to be a good market for quality parts, then of necessity there would likewise be an excellent market for the quality receivers which would go to a public quite able to afford the best in receiving equipment as well as its housing. That such a policy has been the correct one has been borne out by the volume of business done by the Zenith corporation. Further evidence of a desire on the part of the public for beautiful cabinets and consoles is also reflected in

the latest models which Zenith has produced and which will be their standards for the years 1926 and 1927.

Taking advantage of centralized manufacturing facilities the Zenith factory was located at 1620 Iron St., where it is housed in a four story building having team tracks and railroad sidings, the location being in that section of Chicago known as the Central Manufacturing District. Through use of these and other factory facilities at their disposal Zenith is able to handle large shipments in an orderly manner without the necessity for additional switching and other industrial lost motions.

Taking a leaf from the experience book of the automobile and other large industries, the factory itself has been arranged so that maximum production may be attained economically and with celerity. For example in the assembly of the receivers instead of the workers being arranged in tables so they sit side by side, the space has been fitted so tables of workers are in progression, with each worker facing in the same direction, each one behind another operator. Thus when the work is laid out, each table with its worker has a definite, prescribed function to perform. The amount of time involved in performing a particular function is pre-arranged; the load on each



Here we have both a beautiful piece of furniture and a quality radio receiver represented in the English model made by Zenith

table is altered to a point where all tables have the same amount of work to perform. Then when a set is started through at the assembly stage the work progresses by orderly steps. A delay in one of the tables causes a piling up of work from tables behind and as a result the worker who is not able to meet the pace is eliminated. In setting the pace the speed is determined by what is considered good production per man per day, and since all tables have an equal amount of work to perform, the load is evenly distributed and none is given a heavier burden than others. This feature has much to recommend it from the standpoint of satisfaction on the part of the worker. Naturally a contented worker can turn out more material than a grumbler and chronic kicker.

#### Inspect Raw Materials

AS is to be expected from an organization that goes into heavy production, the matter of inspection of raw materials is a

very important one. Any production schedule can easily be slowed down through rejections. The way to maintain the production schedule is to inspect the raw material before it ever goes into the various parts used in the manufacture of a receiver. Then if all material passes rigid tests it is sent into the department requiring it where it is made into the parts desired. But even this inspection could not be depended

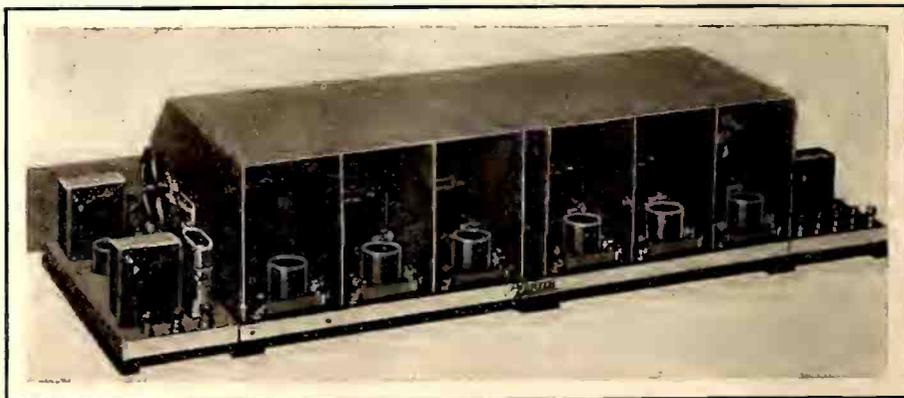
upon entirely by such an organization. So there are other inspections; one while the set is in the chassis form when it is tested for electrical accuracy and perfection. Then again it is given a test when in the completely assembled state in the console or the cabinet. The individual condensers, (and they are beauties) are all measured by a capacity bridge so their capacities are equal and within the tolerances allowed by the engineering department.

In the drilling of holes in bakelite, instead of single holes being drilled, four are drilled at a time. A master gauge, milled down to a thousandth, is used to see that all four holes are always accurately placed. The worker on a drill press has this master gauge beside him during his work and frequently uses it to determine the fact that none of the apertures are being drilled off center.

#### Drilling Chassis

OVERHEAD is of vital importance and wherever possible machinery is relied upon to give uniform accurate work. In the case of holes drilled through the metal portion of the chassis of the sets, templates are provided and power drills used. Thus drilling can only be done in one way and that is the right way. The writer was informed that shortly the Zenith factory will have three separate drills for the chassis work so that drilling that section of the receiver can be confined to three operations, all of which further speeds up production.

Going into the engineering fea-



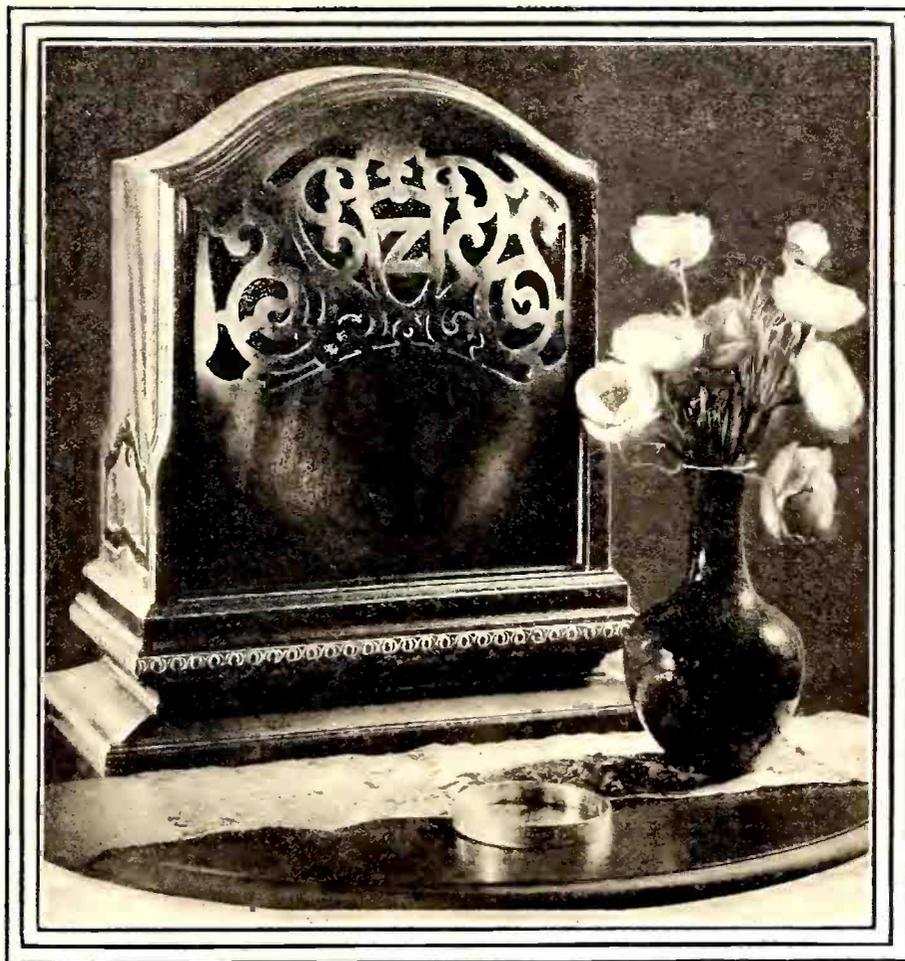
Inside the Zenith sets the curious will find many desirable features as are explained in the article

tures of the organization we find the single control, together with A, B and C battery elimination, the latest development. The single control is achieved through the gang condensers so arranged that with one knob working through a worm and gear, the entire set of condensers is turned. Since all inductances are of an exact size and since the condensers are of a predetermined accurate capacity there is no necessity for later trimming. All leads are the same length in every set too. This ideal can only be attained when all parts are machined, all coils exactly the same inductive value, all connecting wires the same size. Here again Zenith has succeeded in matching all parts to a nicety and the result is a smooth acting, simple, single control receiver.

For B elimination the problem has never been very difficult, but A elimination presented another problem. To try to rectify and choke out from 2 to 4 amperes at 6 volts is a problem that has staggered many an engineering organization. Instead of wasting time on this, the Zenith interests attacked the problem from another angle. They put all filaments (199's) in series (for the RF and detector stages) and then used a Raytheon tube which would pass sufficient milliamperes to light all the filaments. For the power stage raw alternating current is fed to the UX171 tube and in this section there is no need for A battery elimination.

#### Series Filaments

**T**O make certain that tube filaments will not be run at an excessive value there is provided a zero to sixty milliamper



This is one of the first pictures of the new Zenith reproducer which will take in from the highest to the lowest notes of orchestra, organ and symphony music

meter, with a red danger mark set at the figure 60. On account of series filaments a filament voltmeter would not be advisable so the milliammeter was adopted instead.

Three stages of audio frequency amplification, using low ratio transformers, give all the volume necessary to bring the music above the noise level. Further amplification would not be possible or advisable. The C

bias for the grids of the RF tubes is secured through voltage drop across the filaments.

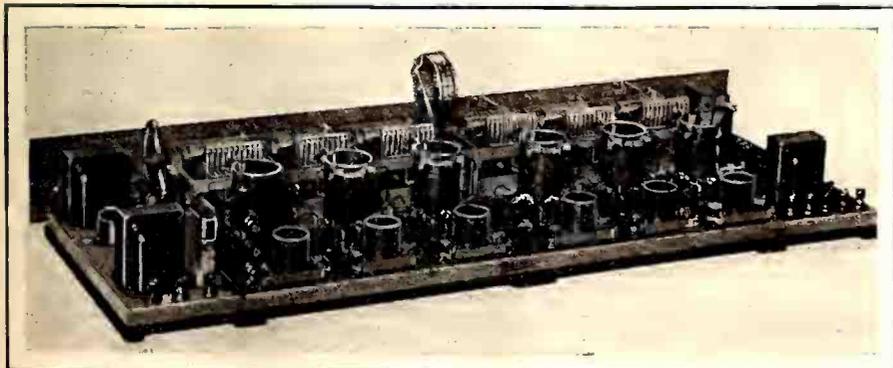
To obtain greatest selectivity and to confine each coil's respective field to its own domain, shielding is carried out to an extensive degree as will be seen by referring to one of the photographs supplied with this article.

In the bigger models there is a drum on which are shown the degrees representing various wavelengths. This is for the single control. The circuits of the new models are the same as previous ones except further simplified.

#### New Models

**S**IX and eight tube receivers are the two major types, the latter being batteryless and arranged for either indoor or outdoor antenna. The self-contained antenna is placed inside the console. Means of preventing oscillation of the RF stages is provided in the primaries of the RF

(Please turn to page 53)



This is the Zenith set before the shielding is applied

# Two Purpose Super-Het IS Easy to Construct

*Seven Tubes May be Used  
Either at Home or on Vacation*

By F. A. HILL

**A**DAPTABILITY of a super-heterodyne to home usage as well as use while on a vacation is an objective which will probably be considered favorably by all experimenters who like to make up their own receivers.

In years past the term portable was hardly proper for the amount of apparatus necessary to build up a super that would deliver good results was so great that portability was no longer a feature. However as is the case in other radio lines the super has been subjected to the simplification process and as a result we now have a portable that is *really* portable. In addition to this fact the receiver is so constructed that it may occupy a place in your cabinet or console at home, and then when you decide to go on your annual vacation the set may be removed from its permanent location, placed in a travelling case and you can have your entertainment wherever you go.

In the receiver to be described the design was based on the desire to be able to use storage battery tubes of the quarter ampere type while the set is at home, and then without any changes other than the substitution of tubes and dry cells, use the set while out in the country, or at the seashore, with the 199 tubes. A single rheostat located in the positive side of the A battery takes care of the difference in tubes, this rheostat being turned seven-eighths of the way on for the 201-A type tubes and only a two-thirds of the way on for the 199 tubes.

## Super Not Wrong

**B**ASICALLY there has never been anything wrong with the super-het, although many of the component parts that go to

make up a receiver of that type have been open to criticism for various reasons. But with the increased interest in the super there have been many advances made in the construction of the integral parts. One of the best changes was noted in the more careful manufacture and charting of the long wave transformers. In the beginning with a limited number of stations the charting of long wave transformers was not so highly necessary, but with over 500 stations pouring their power into the air, the poor chap who had a poorly designed and none-too-sharply-peaked set of transformers and as a consequence picked up all types of beat notes and interference created within his own set, laid all of the blame at the door of the super-het principle instead of going into his receiver and remedying the trouble.

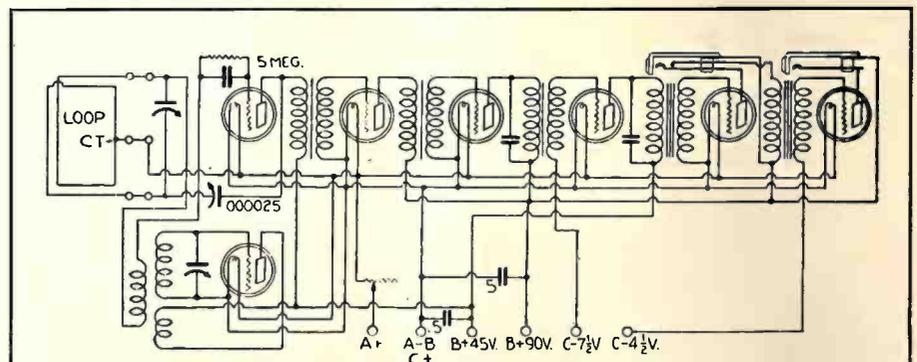
Today, however, much greater care in design, better inspection after manufacture, and ac-

curate matching of the frequency for which the long wave transformers and the long wave filter are to be used, has brought about the possibility of good reception on the super with its ability to pick up long distance signals. Added to that you have the feature of being able to use a loop with much better effect than a loop on another type of receiving set.

## Better Peak Value

**W**ITH the hit-or-miss peaking it was natural that some of the distant strong stations would beat with either the fundamental of a local station, or, perhaps, its third harmonic. But with the long wave transformers being peaked at a frequency that would not fall on a half of either 100,90,80,70,60 or 50 kilocycles the greatest amount of locally created interference has disappeared, leaving only that created by stations which do not maintain their ten kilocycle separation, and these are mighty few.

But transformers are now available for use by the experi-



This schematic diagram, Figure 1, shows the simplicity of the wiring in the portable super described in this article. Only two plus B voltages are provided, one combined for the oscillator, second detector, and the long wave transformers at 45 volts, and the other for the audio stages consisting of 90 volts. In the case of the C battery, 7.5 volts are provided for the second detector biasing scheme (for 199 tubes), and 4.5 volts for the two audio transformer secondaries. Bias for the long wave transformers is provided by the grid return to the negative filament

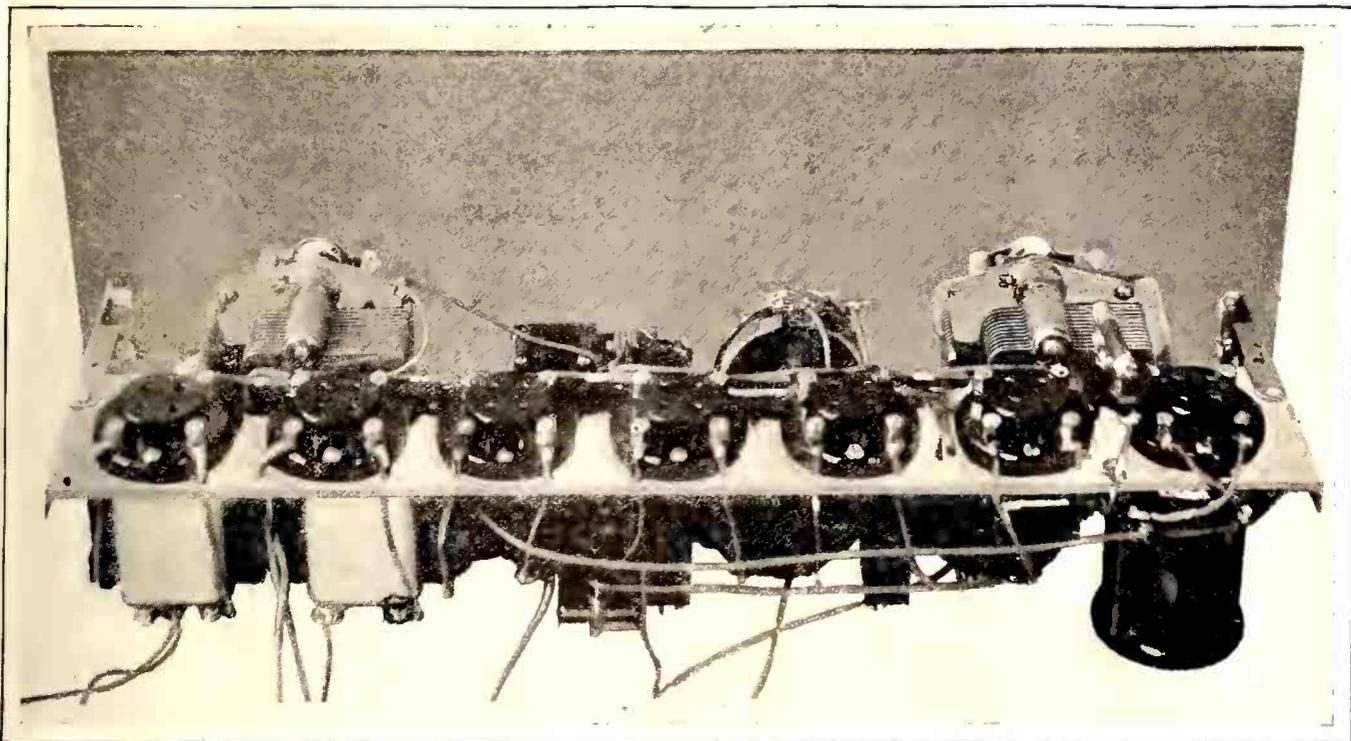


Figure 2 is the rear view of the seven tube portable showing the socket mountings all arranged in a line. The oscillator coil of the plug-in type is shown under the subpanel at the extreme right. All the long wave transformers are mounted underneath the subpanel as are the two audio transformers, the latter seen at the left of the picture

menter and set builder, which are matched for either 201-A tubes or the 199's. Improved methods of capacity measurements have permitted far greater accuracy in transformer peaking than before and today the experimenter gets the benefit of such progress.

We recently noted curves on a number of long wave transformers, the type being used in this receiver having their peak at about 42.5 kilocycles, with a gain per stage of approximately 13 as contrasted to a few other commercial types in which the gain ran from 7.5 to 12. While the gain of the filter was only 7.5 compared to gain of 13 for the iron core long wave transformer, nevertheless it was much sharper than any of the other filters, and this particular quality is desired in a filter rather than its amplification factor, since this feature permits far greater selectivity, the preceding long wave transformers having taken care of the desired amplification at intermediate frequencies.

#### Matched For Tubes

**I**N using the long wave transformers for this super the units were matched first for 199

tubes and then for 201-A's. The operating frequency for the 201-A tubes will be somewhere between 42.5 and 45 kilocycles (preferably the former) while the peak for the 199's will be approximately 62 kilocycles due to the difference in the load imposed on the iron core transformers which changes the inductance value. However the air core transformers are supplied tuned to frequencies to match the iron core stages, but do not change their value under load, and consequently their peak frequency will be the same regardless of whether used with 199 or 201-A tubes.

Grid condenser and leak method of detection is much more sensitive than other forms, so it is used for the first detector, while in the second detector where the signal is already highly amplified and sensitivity need not concern us, we have used the grid bias method of detection, a tap from the C battery at a value of 7.5 volts (for 199 tubes) being utilized for this purpose. As a means of controlling the volume a midget condenser having a small capacity is connected from one end of the loop to the plate of the first detector and

serves to sharpen the loop tuning and give either more or less volume as desired.

To eliminate body capacity through hand tuning of the oscillator condenser the grid-to-filament span of the variable was adopted since under these conditions the rotor is always at a nodal point as regards potential and of necessity not subject to body capacity. This also permits of the plate section of the oscillator being of a fixed value and using series feed instead of parallel feed as in the case of a number of other methods.

#### Negative Grid Returns

**N**O oscillation control is provided for the long wave transformers other than that provided partly by use of the rheostat in the filament circuit. The return from the grids of the long wave transformers go direct to the negative filament. If difficulty should develop it can be easily remedied by placing a Clarostat or some other high resistance (variable) across the secondary of the first intermediate, allowing the operator to alter the load on that stage and thus control oscillation. Under test we did not find this necessary, but mention

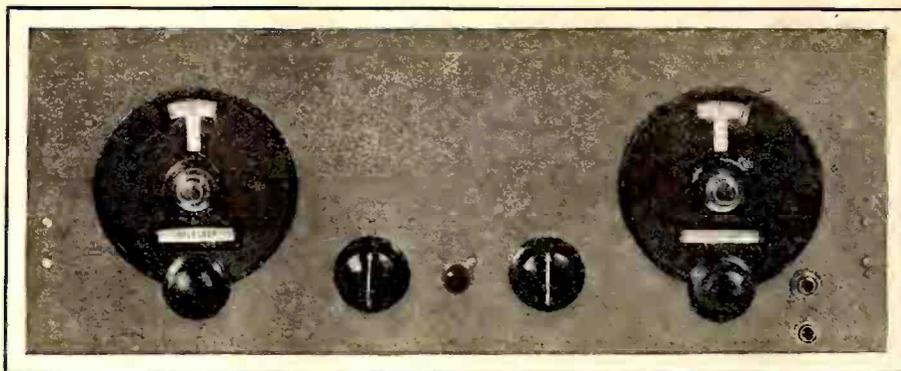


Figure 3 shows the front panel view of the seven tube portable described in this article. The number of controls has been cut to a minimum

it in the event an experimenter does encounter instability of this character.

Filters are best operated with a C bias in series instead of using the conventional grid condenser and leak with the grid return to the positive terminal of the filament. So in this set the C bias was used, there being no current in the grid circuit and better results being attained. In most cases it has been determined that a bias of from 3 to 4.5 volts will do for the bias on the 201-A detector tube, whereas for the 199 tube the value may range from 6 to 8 volts. Individual experimentation on the part of the builder will show the best value for a particular set of tubes and receiver.

Small sized audio transformers were used in order to gain in the saving of weight while at the same time holding constant the quality of output. Larger and heavier types of audio transformers may be used if desired, but greater space allowances will have to be made.

#### The Carrying Case

**T**HERE are numerous "ready-made" carrying cases that would be satisfactory for use with this receiver but the final choice should be made after the speaker and type of loop have been chosen. Of course, it would be possible to have one made to order by a trunk manufacturer, in that case we would suggest one with a front and back hinged removable door. A small cone speaker could be mounted in the rear door and the front door should contain a loop. The receiver itself should be mounted directly above the

battery compartment. In a case like the one described above the outside dimensions of the case would probably be about 16x18x9 inches.

#### LIST OF PARTS

- 1 7"x18"x3-16" Bakelite panel
- 1 2 1-8x17x3-16" Bakelite sub-panel
- 1 Pr. S-M 540 Mounting brackets
- 2 S-M No. 316 Condensers .00035 MFD variable
- 7 S-M 511 UX Sockets
- 1 S-M 340 .000025 MFD Condenser
- 2 S-M 210 Long Wave Transformers
- 1 S-M 211 Long Wave Filter
- 1 S-M 111A Oscillator Coil, Plug-in type
- 1 S-M 515 Coil socket
- 2 S-M 801 Vernier dials
- 1 Yaxley 6 Ohm Rheostat
- 1 Yaxley No. 10 Jack Switch
- 2 No. 1 Yaxley Jacks
- 1 No. 2A Yaxley Jack
- 1 .00025 Grid Condenser with clips
- 1 Meg. Grid Leak
- 2 .5 MFD By pass condensers
- 1 .002 MFD condenser

#### ACCESSORIES

- 1 Carrying Case with arrangements for loop and speaker
- 7 UX 199 Tubes
- 3 4½ Volt "C" Batteries (1 for audio, 2 for second detector)
- 2 45V B Batteries (small size preferred)
- 3 No. 6 Dry cells

#### Instructions

**F**OLLOWING are instructions which have been given in previous articles but their importance justifies repetition. The first step after getting the

material together is to lay out and drill the panel. It may then be sanded by rubbing in one direction only with fine sandpaper and oil until all of the original bright finish has disappeared.

Each part should be examined and all screws, nuts and springs tightened up. Lugs should be placed on all binding posts. Transformers should be clicked out with head-phones and a battery for continuity of windings.

In connecting up the set, as much wiring should be put on the panel and sub-base separately as is possible, using a well tinned iron. Then the panel is screwed to the baseboard again, and the few remaining leads run between the two.

The set is now ready for test. The "A" battery should be connected to the two "A" posts, and the tubes inserted. When the on-off switch is turned and the rheostats turned on, the tubes should light. The "A" plus battery wire should then be connected to, first the "B" 45, and then the "B" 90 post. The tubes should not light—if they do there is an error in connection which should be corrected before proceeding further. One 45 volt battery is then connected with its negative lead to the "A" minus post and its plus to the 45 volt post. The other is connected with its minus lead to the 45 volt post and its plus to the 90 volt post. Both "C" batteries have their plus lead to the negative filament line. One has the minus to the F posts of the audio transformers. The other has its minus (approximately 6 to 9 volts) to the "A" minus posts of the long wave transformers.

#### The Loop

**T**HE loop is now connected with its outside end to the top loop post, its center tap to the center post, and its inside lead to the lower post. If it is of the solenoid type, either end may go to top or bottom post.

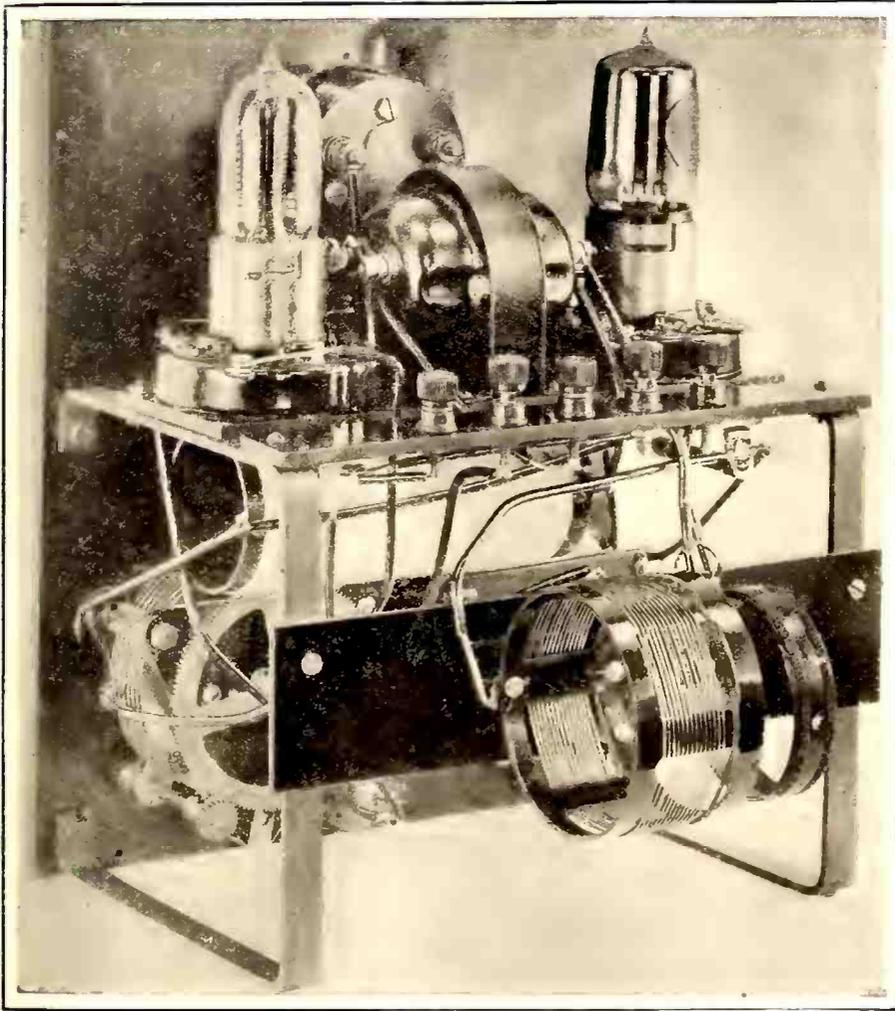
The tubes being put in place, the rheostat should be turned seven-eighths on for storage battery tubes or two-thirds on for dry cell tubes. The balancing

(Please turn to page 55)

# Receiver for Short Wave Telephone and Telegraph Work

By WILLIS L. NYE

(Radio 6DDN)



Here is Mr. Nye's receiver which he describes in this article. It certainly should appeal to the builder of sets for its neat construction

FOR the reception of the shorter waves (i. e. below 200 meters), the radio enthusiast requires a receiver that differs in many respects from those which the average listener is used to or familiar with. It is customary to employ radio frequency amplification in broadcast work and it seems that the good old regenerative receiver is fading into the past when it comes to comparison with the more modern receiver employing radio frequency amplification. However many are in use yet but they are few and far between if the

listener wants real performance and satisfaction in radio such as is required by the broadcast fan of the present moment. However, the old stand-by regenerative is still performing miracles in reception on the high frequency wave bands and in this field it is unsurpassed for short wave work in receiving. The supers and neutrodynes simply cannot compete here and it will be a long time before the multi-tube receivers are going to give the results that the two tube regenerative receiver has given tube for tube. No doubt that the

great satisfaction that the regenerative receiver has given in this field is due to the excellence of design employed in their construction and the development of good parts. However, the opinions of the reader may be adverse but the convictions stated are to be found true wherever short wave reception is being tried out.

The main feature of the receiver described is the use of a condenser to control the feedback and oscillation. The advantages of such a system is obvious to the builder. Along with the novel idea of controlling the feed-

back is the design of the tuning circuits that allow the inter-changement of the inductances. In this way the inductances can be changed and the wavelength altered. This allows reception on all waves below 200 meters except those perhaps below 20 meters.

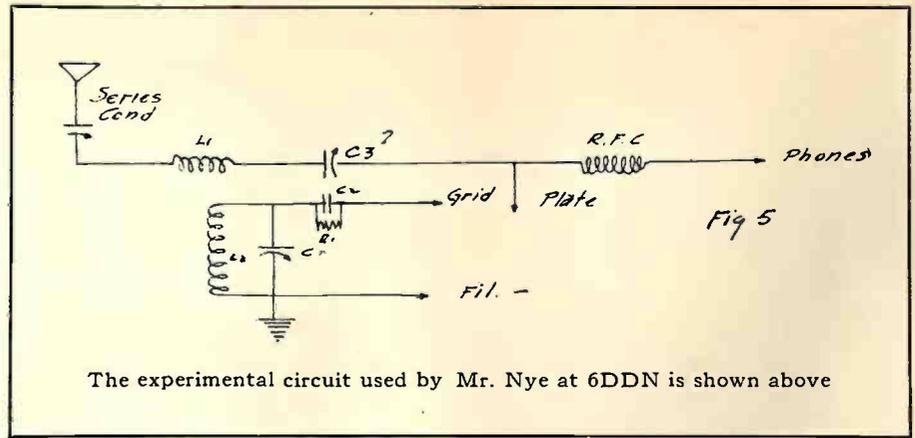
The apparatus is mounted directly on a 1/4" bakelite panel 9"x12". The panel will be made to rest on the short side. This makes the receiver of upright design and saves table space. The panel is finished in the usual manner. The large hole for the voltmeter is cut by means of a keyhole saw.

The secondary tuning condenser is of minimum number of plates to just cover the bands that we wish to receive on. The original condenser used in the set employed but 5 plates. This gave a capacity of 100 mmfds. The condenser is moved by the vernier dial shown. The ratio of the vernier should not be less than 20 to 1. With the small capacity shown the signals will be spread out on the dial and not cramped together. This feature permits easy tuning.

The feedback condenser is is of 250 mmfds. maximum capacity and even larger in size. The setting on this control is not critical. It should be mounted as shown.

**Mounted As Shown**

ALL the apparatus is mounted as shown in the detail with the condensers at the bottom of the panel and spaced equally. Right above the condensers is



mounted the rheostat. Above the rheostat is mounted the voltmeter. This combination presents a panel that is attractive and yet consistent with good electrical design. Note the way in which the brass straps are bent to make a square joint. The sockets and the audio frequency transformer are mounted on the sub-panel as shown. The sub-panel carries the binding posts also at its extreme edge. The choke coil is mounted beneath the sub-panel.

The hard rubber strip that carries the terminals for the inductance coils is mounted 2/3 up from the bottom of the brass straps in the rear. The coil terminals are mounted directly on this strip.

The coils themselves may be made by the builder or purchased. A good set of coils that works very efficiently are the Bremer-Tully short wave coils. They are admirably suited for the purpose in this receiver and the original set designed used them. If

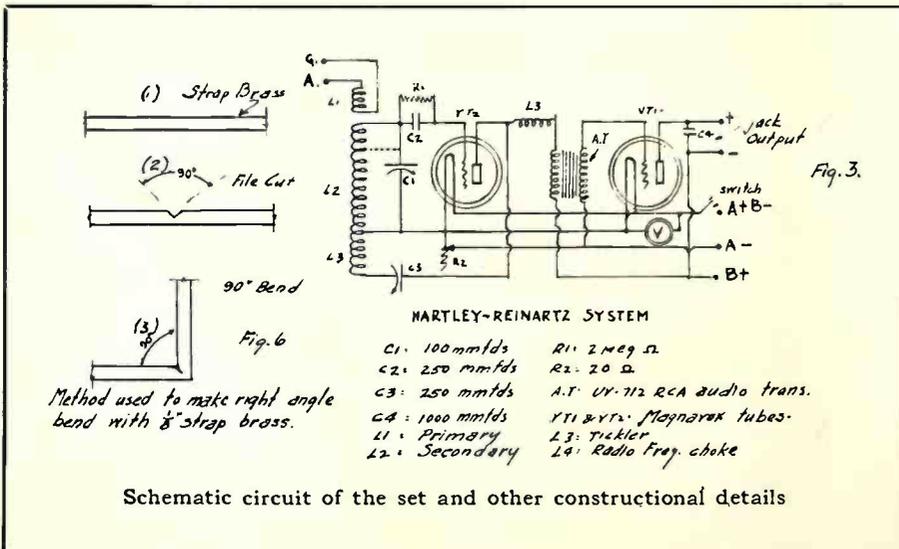
the coils are purchased they are mounted the same identical way as described. The range of the Bremer-Tully coils allows one to tune to 121 1/2 meters with the secondary condenser of 100 mmfds. capacity. The four coils provided allow one to go up to 200 meters in four steps. Surely this allows one a very selective receiver if built as shown. The Bremer-Tully coil set includes an antenna coupling coil also. If the coils are built by the builder they should be of the basketweave style. See table for correct sizes.

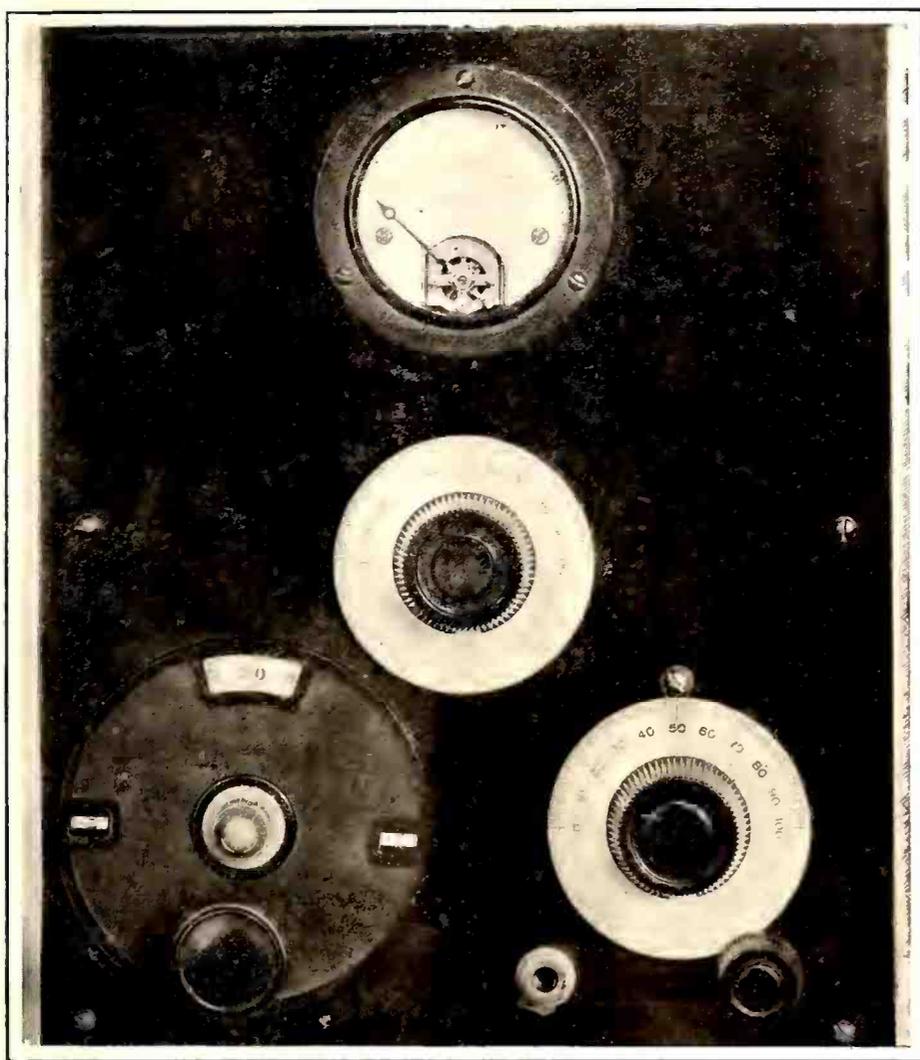
The choke coil should be wound with No. 28 s. c. c. wire and single layer wound on a 2" diameter form; 250 turns will be required although sometimes less turns will suffice.

**Flexible In Design**

THIS receiver is very flexible in design and with the mere substitution of a coil of 59 turns shunted by a 250 mmfds. maximum capacity condenser the range will be from 200 to nearly 600 meters for the secondary. The feedback will need to be increased some in its inductance. This receiver really is two purpose and can be readily used for either range of waves. A Bremer-Tully broadcast tuner may also be used in place of the coil given with excellent results.

The set as a whole if built according to these directions will be very rigid and solid on its base. The center of gravity will be very low if the apparatus is mounted as shown. The design was so chosen after numerous ideas were tried out and a departure was then tried from





Front panel view of the short wave receiver

the usual style of panel and a baseboard. The set is not very bulky if built as shown. The receiver when it is designed this way allows the panel to be easily removed without taking the cabinet to pieces.

The cost of this receiver will be very moderate when compared to the usual tuner. It is very pleasing to the eye in its unique arrangement. With the voltmeter in this receiver the filament voltage is accurately controlled. This may seem a luxury at first but one of the secrets of good consistent results is to keep a steady temperature on the filament and just enough so that good reception is assured. It is a good plan to set the rheostat and connect the filament to a switch which allows the filament to be controlled steadily. The result of good filament control is that the tubes remain

very sensitive and are always operating at their maximum efficiency. For short wave work it is advisable to use a tube with minimum internal capacity. The only 6 volt tube that has this feature is the Magnavox tube. With this receiver the writer has used these tubes and found excellent operation attributable to them.

The circuits that the builder of this receiver may use are shown in Figures 3, 4, and 5. Figure 6 shows the method used to bend heavy strap brass  $\frac{1}{8}$ " thick easily making a corner that has sharp lines in it. This lends a good artistic touch to the receiver. The idea is used in the brass straps that hold the sub-panel. In this way one does not need to use any other tools to bend the brass except to file it as shown and bend it by hand.

The following parts are required in this receiver.

### Parts Needed

- One 5 plate condenser 100 mmfds. max. cap.
- One 13 plate condenser 250 mmfds. max. cap.
- One 20 ohm rheostat.
- One Jewell voltmeter.
- One phone jack.
- One audio freq. transformer
- Five binding posts.
- One sub-panel  $4\frac{1}{2}$ "x9".
- One panel 9"x12".
- One grid condenser 250 mmfds. cap. (Max.).
- One variable grid leak 2 to 10 meg. ohms.
- 3' of strap brass  $\frac{1}{8}$ "x $\frac{1}{2}$ ".
- One strip of hard rubber 9" x1" long.
- One 3" dial.
- One vernier dial 20-1 ratio.

The filament type jack that controls the filament may be substituted in place of a separate switch. However, this will make the wiring more difficult.

**Schematic Figures**

In figure 3 the proper wiring circuit for the receiver is shown. This is a Hartly-Reinartz affair and has been found to be best suited for short wave work.

Figure 4 shows the usual scheme of controlling the feedback by the throttling condenser. This is nothing unusual except that it eliminates the use of a by-pass condenser across the phone terminals. The tickler is fixed here also.

An experimental circuit somewhat similar to the Reinartz transmitting circuit is shown in figure 5. It was first used in France and was found to work well on the shorter wavelengths. It has been tried by the author for the 100 to 200 meter waves but not below that region. It would be well to try it and make a comparison with our standard circuits. From the results obtained by the author it ought to be fine business for the ultra-short waves.

With this receiver it has been possible to hear out here on the west coast in full daylight WGY, KFKX, KDKA on their short

**The Following Tables Are For the Coils**

Meters	Pri.	Grid	Plate	Turns	Approximate Range
20 Band	3	3½	4	"	(16 to 25 Meters)
40 "	3	7½	6	"	(25 to 50 Meters)
80 "	6	14	8	"	(50 to 100 Meters)
200 "	15	28	14	"	(100 to 200 Meters)

All coils are wound basketweave on 11 pegs and are 3 inches diameter tied together with thread and wound with number 16 D. C. C. wire.

wave bands on voice transmission.

This is phenomenal and speaks well for the receiver design as it does also of short wave transmission. Amateur transmission in 15 foreign countries was also logged here.

periment with the different sizes of tickler coils for proper control of oscillation.

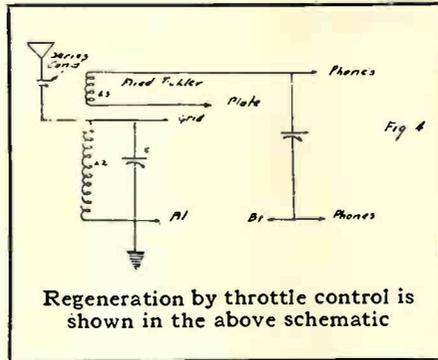
**Antenna Coupling**

For the shorter waves it will not be necessary to cut down your present antenna, although the coupling between the aerial and the secondary will have to be cut down to some extent. One of the popular methods of coupling the antenna to the secondary is through a small capacity, metal plates about an inch square being mounted on a small bakelite block so one of the plates may be moved closer to the other, or further away.

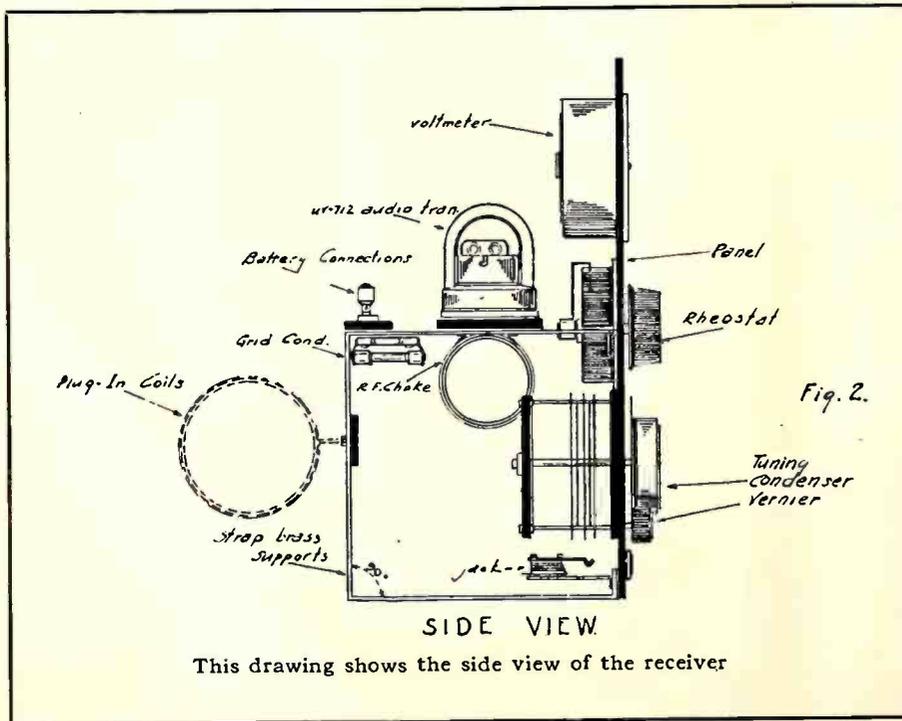
In getting the best out of short wave receivers the vertical height of your antenna will be much more important than the horizontal. If you are going to have an antenna especially for use on the short waves (20 and 40 meters) then it would be best to limit its length to not more than 40 feet and take advantage of all the vertical height possible.

Ordinary reception on code may be secured without any antenna or ground, the secondary coil of the receiver acting as a small loop whose pickup is partly enhanced by the presence of an antenna even if the antenna is not directly connected to the set.

Under certain conditions you can make use of a counterpoise instead of a ground, although as a rule the ground is the best except where you are bothered by continuous power discharges from leaky transmission lines. Keep the antenna at right angles to power lines, since power circuits are exceptionally bothersome on the short waves where their disturbing signal volume is generally greatly in excess to that of the desired long distance signal.



This type of receiver has been used by a great many people and it has given much satisfaction due to its excellence in design. It would be well to ex-



# When the Magic Crystal Becomes the Magic Carpet

*Fragile Slab of Quartz Performs Seemingly Impossible Task of Power Control*

**D**R. A. HUND of the Bureau of Standards, who is shown in an accompanying photograph, is not examining samples of eye glasses, as you might surmise from a cursory glance at this picture. Quite to the contrary, he is demonstrating specimens of that recently acclaimed magic mineral known as quartz crystal. More specifically, he is exhibiting a crystal plate holder designed by the Radio Laboratory of the Bureau of Standards.

Like the magic carpet of ancient fable, this frosted-looking glass is in reality credited with many magical properties in its relation to radio. A piece of this crystal which may be ground so fine as to render it extremely fragile, will keep a broadcasting station from straying from its path of rectitude; it will produce audio as well as radio frequencies or wave lengths of very definite value; it will enable radio inspectors to discharge their duties with unerring exactness; and, furthermore, this magic mineral will assist broadcast listeners in making precise settings of their radio receiving sets.

Radio amateurs are combing jewelry and optical establishments for imitations of this precious mineral as a means of precisely controlling the frequency of their transmitting stations. The radio inspectors of the nine radio districts in the United States have been supplied with pieces of quartz crystal by virtue of which the inspectors can rapidly and accurately standardize their wave meters. To broadcast listeners, this means that a close check can be kept on the 560 broadcasting stations and thereby interference with radio reception is minimized. The radio-aircraft section of the United States Navy is adapting

By S. R. WINTERS

and

GEO. S. TURNER

the properties of this mineral to use on aircraft radio installations, thus contributing to the accuracy of transmission and reception of radio communications on board flying machines.

To thoroughly acquaint our readers with all of the popular and semi-technical data on crystal operation, we have combined the two stories in these pages; the first written by S. R. Winters, our Washington correspondent and well-known writer on radio subjects, and the second by George S. Turner, also a writer on radio subjects who handles his topic very interestingly.

In forthcoming issues of Radio Age will try to have articles covering the construction of a crystal wavemeter and also crystal control for short wave telegraph sets.

—The Editor.

## Known for Years

“**P**IEZO-ELECTRICITY is a phenomenon which has been known for many years but which is having some remarkable new applications,” declares Dr. J. H. Dellinger, Chief of the Radio Laboratory of the Bureau of Standards, in contemplating the uses which are unfolding so rapidly and in such great numbers. “Certain crystals,” explains the Chief of the Radio Laboratory, “undergo a slight expansion or contraction when an electrical voltage is applied to them and, vice versa, produce a slight voltage when compressed or pulled. A piece of

quartz crystal one or two inches long has a high natural frequency of the same order as the frequencies of currents used in radio communication.

“It has been found that the frequency of vibration of the piece of quartz is extraordinarily constant and that it is very useful as a radio standard. In association with a small electron tube it acts as an oscillator or generator of a current, the frequency of which is that of mechanical vibration of the piece of crystal. As the frequency thus produced is accompanied by numerous harmonics, the crystal is a standard giving several radio frequencies. It is thus a remarkable supplement to the wave meters which have hitherto been used as standards of radio-frequency.

“A study just completed by the Radio Laboratory of the Bureau of Standards indicates that such a quartz oscillator has many valuable applications in radio work. Means of producing audio as well as radio frequencies were worked out. The crystals can be used to control or determine the frequency of a transmitting station and to hold it strictly constant, which will mean a great advance in radio-transmission technique. The crystals are also useful in accurate setting of receiving apparatus and in controlling the frequency of radio-frequency generators used in laboratory measurement work. The value of these various applications is particularly great at the frequencies above 2,000 kilocycles (150 meters), which are now rapidly coming into use.

## For Standardization Work

“**P**ART of the work resulted in the design of an outfit for use by the Department of Commerce radio inspectors and

adapted to the rapid and accurate standardization of frequency meters. It consists of two instruments, both being simple devices of low power, operated by dry batteries. Persons desiring to construct or procure these instruments can secure copies of specifications therefor from the Bureau of Standards. These specifications are Specifications for Portable Piezo Oscillator, Type N, and Specifications for Portable Auxiliary Generator, Type O.

"The Bureau of Standards has also prepared a set of directions for the use of the two instruments, Letter Circular 183, Directions for Use of the Piezo Oscillator and Auxiliary Generator for Calibration of a Radio-Frequency Meter. It may be obtained upon application addressed to the Bureau of Standards, Washington, D. C., by persons having actual use for it."

I witnessed recently a demonstration of the use of a tiny piece of crystalline substance—resembling a bit of glass, one inch square—in controlling a radio transmitter with the accuracy of one-thousandth of one percent, a negligible quantity. This transparent looking product was connected to the grid element of a transmitting vacuum tube and as the radio waves were propagated into space the operator of this short-wave transmitter confidently realized that the frequency assignment was being adhered to with incredible precision.

### Holds Set to Wave

**Q**UARTZ crystal, or more scientifically speaking, the oscillating properties of the piezo electric crystal, was exercising the seemingly magic wand on this transmitter. In other words, this bit of crystal was, figuratively, acting as a traffic officer on a one-way street, commanding this radio transmitting device to travel unerringly along the 81-meter ether lane. A slight deviation from this ethereal pathway and confusion would be produced, causing a congestion of air lanes and a possible tie-up of traffic in the ether. A burly New

York traffic officer, however, never received more literal obedience to his command than did this quartz crystal receive from this radio transmitter.

The transmitting device used in this particular demonstration employed only a 7½-watt electron tube, with an output of probably 5 watts. This, obviously, was a low-powered set and a low wave length was used, on the order of 81 meters. However, the Naval Research Laboratory, Bellevue, District of Columbia, could have as easily demonstrated a high-powered crystal-controlled transmitter. For, we are told that this government radio research laboratory operates the highest powered crystal-controlled transmitting outfit in the world; the power output being 12.4 kilowatts or more than 12,000 watts. This operates at a wave length of 73.1 meters, and occasionally the power output has approximated 15,000 watts.

More recently, the Naval Research Laboratory put into operation a crystal-controlled transmitter functioning on 25.5 meters, and approximately 10,000 watts are pumped into the antenna. A 24-hour test with this equipment demonstrated that signals from NKF, the call letters of the experimental station at Bellevue, were copied readily at NPU, a station in far-away Samoan Islands. The antenna system thus employed consists of an iron pipe, 30 feet long and one and one-half inches in diameter. This iron rod is insulated from the top of the building by means of a large pyrex bowl, which also supports the antenna.

### Vertical Antenna

**A** CRYSTAL-CONTROLLED transmitter at Bellevue, functioning on a wavelength of 73.1 meters, shoots 10,000 watts into the antenna. According to a claim of the Radio Division of the Bureau of Engineering, United States Navy Department, this is the original high-powered crystal-controlled transmitter in the world. Its performances include many long-distance feats, "working" regularly with radio amateurs in Australia and New

Zealand, between 6,000 and 10,000 miles distant. Moreover, traffic was handled regularly with NBA and NPL, naval stations. This 71.3-meter set has handled traffic ordinarily routed through NSS, the 500-kilowatt arc station at Annapolis. This crystal-controlled equipment makes use of a single upright iron rod as an antenna, which is reinforced by use of a counterpoise.

Other transmitting devices whose frequency assignments are maintained with unflinching precision by means of quartz crystals include outfits operating on 16, 17, 20.8, 32 and 41.7 meters. These for the most part have a power output of only 1,000 watts, with the exception of the 17-meter set which functions with 300 watts. Two crystal-controlled units, designed and built by the Naval Research Laboratory for use by the Marine Corps of the United States Navy, will operate on a wave band between 35 and 70 meters. The crystal controls two UV-210 7½-watt electron tubes.

A radical departure in the use of quartz crystals for radio purposes is that of using them on aircraft for maintaining the wavelength assignments of transmitters on airplanes. The first experiments of this kind were conducted quite recently, the radio transmitting device employing 201-A vacuum tubes and operating on a wave length of 28.3 meters. Signals thus radiated were picked up at distances up to 1,000 miles. Now, the radio-aircraft division of the Bureau of Engineering is making arrangements to install quartz oscillators on spotting aircraft. This will undoubtedly mean a marked improvement in the operation of radio transmitters on aircraft.

### Big D. C. Generator

**I**T is interesting to note that a 12,000-volt direct-current generator, the most powerful ever used for radio purposes and for the first time described by this writer in a recent article, is used in supplying power to the plates of the electron tubes used in the 25.5-meter transmitter.

This powerful generator was designed by the General Electric Company and a bank of six kenetrons deliver a steady power load of 50 kilowatts at 12,000 volts, direct current. Trouble has been experienced in operating this power-supplying unit but eventually the wrinkles will be smoothed out and it will afford a source of energy for the plates of the crystal-controlled vacuum tubes.

Such has been the remarkable development of quartz crystal—pieces of glass, to all appearances—in controlling radio transmitting devices. These tiny shapes of crystal are to the transmitters what the safety valve is to boilers, the damper is to the cookstove, the rudder is to the ship. They are the throttles on radio transmission. And, from a small 5-watt crystal-controlled outfit to a 15,000-watt crystal-controlled transmitter, such is the growth of the application of the oscillating properties of the piezo electric crystal in the hands of the Bellevue Naval Research Laboratory.

#### KDKA Crystal Control

**P**IEZO crystal oscillator control is the solution for one of our main difficulties in radio broadcasting. The Department of Commerce has gradually been compelled to crowd the stations in assigning wavelengths until they are now separated by 10 kilocycles, which, theoretically, is about as close as it is desirable to put them. Practically, however, this assignment plan does not work very well, as it has never been possible to keep all the stations rigidly on their assigned frequencies. Many stations, therefore, have drifted from their proper assignment and are causing interference with other stations. Any owner of a sensitive receiver will bear me out in this.

The piezo crystal, having the property of vibrating at a fixed frequency, depending mainly upon its size, and the added advantage of vibrating in the radio frequency band has been utilized by station KDKA to control several of its transmitters. This

guarantees against any change—in wavelength due to variation of antenna capacity or any other changes on the set. If any change does occur the most that can happen is that the station shuts down but it can never slide off its assigned frequency and interfere with other stations.

A few words concerning the general method of controlling a set by means of a piezo crystal. At KDKA there is a crystal which controls the oscillating



Quartz plate holder for piezo oscillator assembled

circuit of a 5-watt tube. This 5-watt tube is coupled to a 250-watt tube controlling the output of that tube which, in turn, controls the behavior of two 250 watt tubes in parallel. This last unit in the amplifier in turn controls the high power water-cooled transmitting tubes which are coupled to the antenna system. The great difficulty of making a set of this type behave may be realized when we stop to consider the high power in the final stage, the danger of feedback and the extreme care which must be taken to carefully neutralize all circuits to balance out any feedback. Most of us have had experience with audio amplification giving us trouble from feedback when using perhaps from 75 to 100 volts on the plates. Compare this trouble with a transmitting set

which uses, not audio frequencies, but radio frequencies in the neighborhood of 1,000,000, or 5,000,000 cycles in the case of the short wave, and many thousands of volts on the plates of the tubes. That this has been successfully accomplished gives the engineers who were engaged in this work great credit for their ingenuity and ability in overcoming obstacles.

By Geo. S. Turner

**W**HAT is it in radio broadcasting that could possibly deserve such a title? The almighty dollar would probably be the guess of most of us, but as usual our guess would be wrong. Even though it is true the American dollar is today about the *biggest little* thing in existence, in this case it is not applicable nor does it meet the exacting requirements of such a contrasting and at the same time, specific title. Rather consider if you will, a certain something that is just lately becoming a necessity around the modern broadcasting station; something smaller than a silver dollar, being usually more nearly the size of a twenty-five cent piece. It may be round or square but always flat; it is brittle, fragile, something like a diamond, nearly as valuable and much more useful—at least in broadcasting.

If you have as yet failed to guess what the particular thing might be and if you have a curiosity to know, then possibly you are getting ahead of the story and imagining what kind of fool thing these radio fellows have now devised. Before your minds eye come pictures of gold, silver and precious stones. And you guessed it! A precious stone it is—crystalline quartz. Precious not because it is beautiful, for in the rough its many sided chunks of varying sizes, at the best, only resemble glass. Neither is it necessarily precious because of a limited supply even though it was necessary for this country's largest user to import their last collection of crystals from Germany. Briefly, the reason



Fig. 2. Dr. A. Hund, of the Bureau of Standards showing samples of quartz crystal (in right hand) and crystal plate holder (in left hand). The latter has been designed by the Bureau of Standards

is because of its rapidly developing value in radio transmission as a standard for maintaining the assigned frequency (wavelength) within very narrow limits.

#### Their Qualities

IT is probable you have already seen articles of a technical nature in this and other periodicals on the quartz crystal, or piezo-electric crystal as it is sometimes called. You read these articles and no doubt wondered if these small crystals would really amount to as much as was promised for them. However, before attempting to prove or disprove their worth it might be well for us to review briefly, in a non-technical manner, certain peculiar qualities possessed by these magic crystals such as their inherent property when squeezed to become electrified; that is, charged with static electricity as a two plate condenser when placed in a circuit and excited with an electric current. Conversely, by placing the crystal between two plates of a charged condenser the dimension of the crystal will change in a certain plane, for

example, flatten out lengthwise. Removing the charge, the crystal will return to its normal shape. Consequently, if we impress an alternating potential on this condenser, a stable crystal will vibrate or oscillate at a definite and unvarying frequency as determined by its physical dimensions. Usually the thickness or width between the two parallel faces of the crystal disk determines this frequency although certain other factors having to do with the cutting of the disk from the quartz as it is mined has been found to have a marked effect upon its vibrating frequency, some even refusing to vibrate at any frequency. In actual practice therefore, these factors, at present, limit the crystals frequency range for commercial purposes to that portion of the spectrum lying between 1520 and 100 kilocycles.

#### For Broadcast Use

FUNDAMENTAL properties inherent in such crystals were discovered nearly half a century ago and although for some time made use of in other ways with varying degrees of

success, have not until the last year or so become associated with radio. Recent developments have shown the major possibilities of this device are two-fold. The first and more complicated being the incorporation of one of these crystals in an oscillating circuit to provide a fixed frequency oscillator as a nucleus of the modern broadcasting station for the automatic control of the emitted frequency or wave. The second possibility and the one more often taken advantage of, is the use of such a fixed frequency oscillator as a standard to which the frequency of the emitted wave is made to conform. This latter possibility is particularly important in view of the recommendation of The Fourth National Radio Conference, "that the Department of Commerce require all stations to use some means of frequently checking their transmitted frequencies with a properly calibrated instrument."

According to certain authoritative tests conducted over a period of a year, the indication is that interference from other broadcasting stations is one of the greatest obstacles to be overcome before we have satisfactory reception. The reason is obvious—in the past, stations have not been maintaining their assigned frequency. No doubt this is what the Conference had in mind relative to the above mentioned recommendation. In any event, such a condition can surely no longer be tolerated by the listening public.

#### Must Maintain Frequency

WITH the constant improvement of the transmitting and receiving apparatus with particular attention now being given to the development of the entire audio frequency range by engineers trained in telephony as well as radio science, it is necessary now as never before, to give each station every cycle of its available side band in order that no encroachment upon the adjacent station shall result and in order that the radio programs may come through with rich and undistorted reproduction. Such an

accomplishment can only be realized by the wholesale maintaining of the assigned frequencies within narrower limits than the two thousand cycle variation heretofore allowed. Nor is such a thing impossible now that we may obtain the crystal indicator having an accuracy of one-tenth per cent of a given frequency. Let us for a moment visualize what this means in the broadcasting spectrum.

The highest frequency (lowest wave) assigned for broadcasting use is 1470 kilocycles and the lowest frequency (highest wave) 550 kilocycles. An error of one-tenth per cent in each would be 1.47 and .55 kilocycles or 1470 and 550 cycles at the two extremes of the spectrum with proportionate variations in between and it is probable a greater degree of accuracy is being realized. With the broadcasting station operator constantly checking the emitted frequency of the carrier

wave with his fixed frequency oscillator by means of a zero (thirty cycle) beat adjustment between the two waves, the station is assured of maintaining a fixed and unvarying frequency in the assigned channel while the accurately ground crystal ensures the correctness of the emitted wave.

#### Fixed Frequency Oscillator

**N**OW that we know something of the possibilities of this device, it might be well at this time to enlighten the uninitiated regarding such a fixed frequency oscillator with particular reference to its make-up and operation. Therefore, in order to facilitate the explanation, let us forget the crystal for the moment and consider the so called three circuit regenerative receiver having a variometer in the plate circuit instead of electromagnetic (tickler) feedback. You will remember this circuit is capable of producing sustained oscillations when the

plate variometer is brought into resonance or balanced with the grid circuit. These oscillations produce an alternating potential in the grid circuit across the secondary (tuning) condenser, the frequency (wavelength) of which, is determined by the setting of this condenser in relation to its associated coil. As is known, this frequency is not constant but will vary sympathetically with any variations in the constants of the circuit. An attempt will be made in the following paragraph to show how a carefully cut and ground quartz disk can stabilize this frequency.

Again referring to the regenerative circuit, same having been adjusted for oscillation at some wave approximating the natural period of our crystal, if the coil and condenser in the grid circuit are replaced with the crystal in a two plate condenser mounting, we shall find the circuit will continue in oscillation. This is because the am-

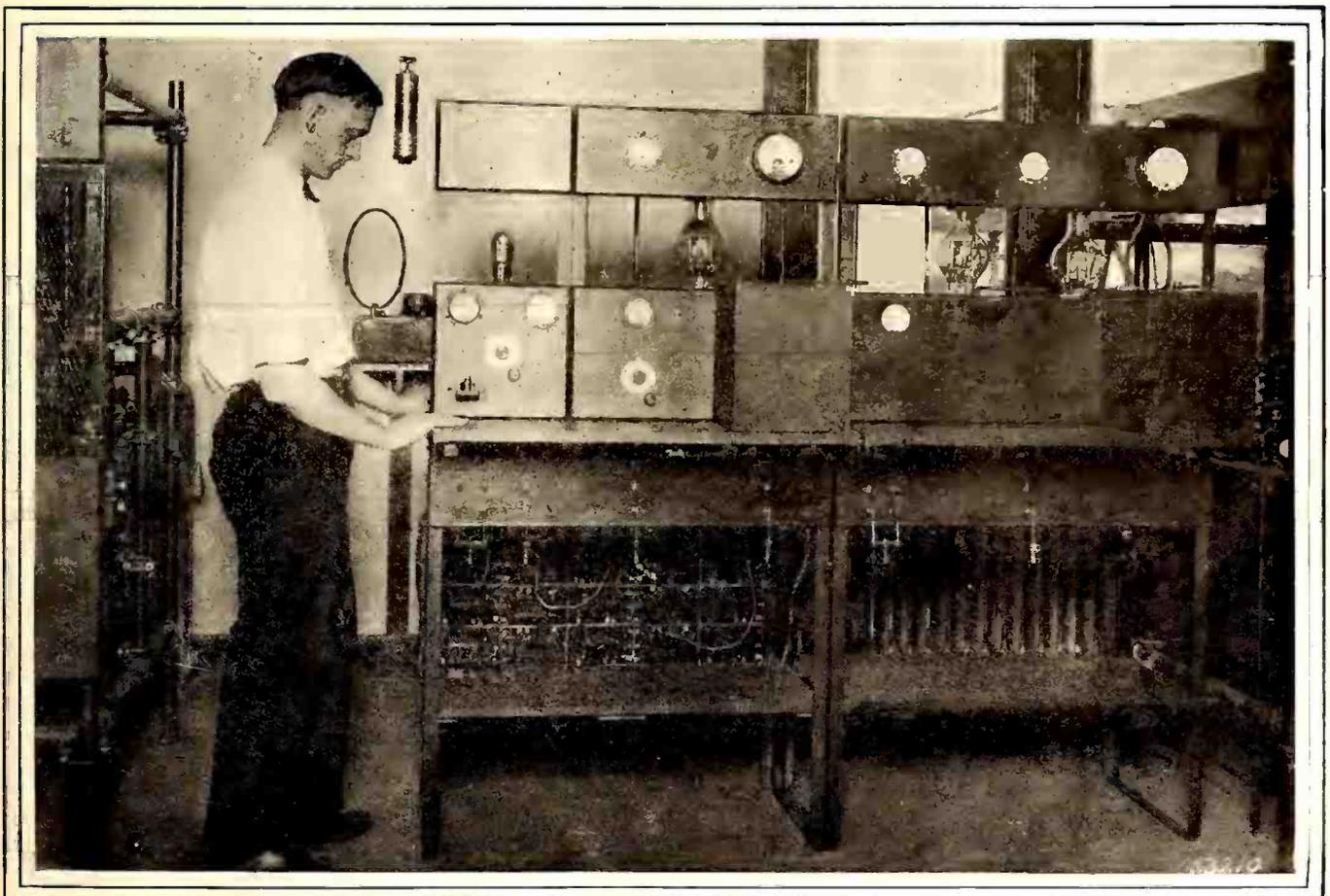


Fig. 3. KDKA controls its vast antenna output by means of the small crystal described by Mr. Winters in this article. The picture shows the crystal oscillator with a 5 watt tube in the panel in front of the operator

plified RF energy in the plate circuit is fed back to the grid circuit through the inter-electrode (grid plate) capacity to excite the crystal into vibration at its own natural period. In vibrating it is expanding and contracting thus producing minute charges of piezo electricity. Same is impressed upon the plates of its condenser mounting which in turn causes constant frequency potential variations upon the grid and in the plate circuit. Thus these two phenomena, when associated with each other work together in combination—a sort of fifty-fifty proposition which reaches a state of equilibrium of oscillation at one definite and unvarying frequency as determined by the period of vibration of the crystal. If the frequency of oscillation in the grid circuit should have a tendency to change, the oscillating crystal will serve to draw them back as a speed governor on an engine controls its speed and insures even running under varying loads. Temperature, atmospheric conditions, varying circuit constants and even rough handling within reasonable limits do not affect the natural period of oscillations. Quite simple isn't it, the way the ordinary three circuit tuner has evolved into a fixed frequency standard.

The beginning of the new year saw the quartz crystal already in use in a few of our more progressive stations. It is not surprising to note that the Westinghouse and General Electric Companies' chain of stations are already making use of the quartz crystal. This is to be expected. However, when stations other than those owned by these concerns purchase them, the indication is that their value is already becoming generally known. In the Ninth Radio District the following stations are now using some form of quartz oscillator as a frequency standard: WLS, WBBM, WEBH, WQJ, KYW, WSBC, WLIB, WGN, WJJD, WOK, KWCR, KFKX and WOC. In addition, the following Ninth District stations advise their orders have been placed and by

this time the majority are using the crystals—WMAQ, WEBW, WMBB, WIBO, WSOE, WBCN, WCCO, WLTS, WCBD, WHA, WORD, WHT, WGES, WJBI, WEBQ, WBNR, and WGWY.

### They Help You

THIS list is being given because it is believed these stations deserve credit. Also, it is well for the broadcast listener to be informed regarding all stations maintaining their assigned frequency within one-tenth per cent, for calibration purposes. The only other list of broadcasting stations maintaining their assigned frequency within narrow limits are those contained in the monthly issue of the Radio Service Bulletin, obtainable from the Superintendent of Documents, care of the Government Printing Office at Washington, D. C. In addition, the signals sent out from WWV at Washington, D. C., and 6XBM at Stanford University, California, at regular intervals are of a known and predetermined frequency. However, in each case the signals from these stations do not satisfactorily serve the listeners of the great middle west because it has been found signals from these stations can only be regularly heard and utilized at distances within about 500 to 1000 miles. Hence, this new group of constant frequency stations should admirably supplement the signals of WWV and 6XBM and thus facilitate the calibration of the experimenters receiver, wave meter or oscillator, specially in the middle west.

Last, but not least, the radio inspection service comes in for its share of the benefits from the use of these crystal oscillators. One of the biggest jobs the inspector has faced in the past, has been the constant checking and readjusting of broadcasting frequencies. This was made necessary by the limited separation of the ten kilocycles between adjacent channels in order that as large a number of stations as possible might broadcast. Experience has proven that this limited separation is sufficient, providing each sta-

tion can be depended upon to keep their assigned frequency.

### Change Calibration

WITH the average wavemeter such as the majority of stations have been using, it has been found this is not possible. Wavemeters, even the best of them, will change their calibration if dropped or handled roughly. Here I might mention for the enlightenment of Pullman car porters, and the like, that is the reason radio inspectors always insist upon carrying that one piece of baggage, even going so far as to hold it upon their lap or sleeping with it in their berth at night. Such care does not guarantee unvarying accuracy over long periods of time. For this reason, the Department of Commerce has provided each of its nine district offices with quartz crystal oscillators for checking their wavemeters and decimeters at frequent intervals. The adoption of these oscillators by the Government surely will prove to the dubious, that they are really worth while. Let us hasten the day when broadcasting stations discard their homemade wavemeters, purchase a quartz crystal and give the inspector more time to be of assistance to those who are experiencing interference from non-radio sources.

Summarizing the quartz crystals' advantages, we find who will benefit through their use:

*The station owner benefits, in that he gets all and no more of his available wave channel than is coming to him. Of equal importance he is assured of a permanent address in the ether.*

*The broadcast listener benefits through a minimizing of heterodyning and overlapping of adjacent side bands.*

*The experimenter benefits in that he is assured of a dependable group of fixed frequency signals for checking purposes over the entire broadcasting spectrum.*

*The radio inspector benefits in that he is able to rely upon a station continuing along the "straight and narrow."*

*Surely, the "biggest little" thing in radio deserves its title.*

# Tube Rejuvenation Is An Attractive Operation

*Same Thing That Shortens Tube Life Lengthens It*

By ARMSTRONG PERRY

**N**OTHING short of a successful monkey-gland operation for rejuvenation could have brought more joy to the human race than the discovery that radio tubes which had ceased to function could have their youth renewed.

Economically, socially and spiritually, there is nothing more depressing than a tube that will light but that shows no other signs of life. When the filament burns off, the ensuing silence gives the same impression of finality as the crash that comes up from the pavement a few seconds after the stenographer's bottle of milk falls out of the tenth-story window, but when the filament lights as usual and still the phones give indubitable evidence that it is only going through the motions without delivering any goods, it is like standing at the bedside of someone who has had a stroke of paralysis just as he was going to tell you where to find Captain Kidd's gold.

The method by which tubes are rejuvenated has none of the delicate implications of the operation for the rejuvenation of human beings. In fact, it is particularly attractive. All you have to do is to burn the tubes. The same thing that shortens their life lengthens it! Oh, for a Steinach or Voronoff to develop some such operation for renewing the youth of human beings. Who that has felt the insidious approach of old age has not wished that he might get all lit up and have the result as permanent as it is, temporarily, exhilarating.

The polite Frenchman who was told that worn-out tubes could be made to function normally by burning the filament brightly for

a time, replied: "No doubt you are right, but God knows eet ees impossible!" Most radio users feel the same way about it at first and look upon the rejuvenators, that are finding their places on the shelves of radio stores, with the eyes of a Doubting Thomas. It is the truth, however, and there is no mystery about it since the metallurgists have revealed the whys and wherefores.

Tube rejuvenation has always been an interesting process. Readers of this story should refer to the article by Mr. Humphrey in the May Radio Age; also to a bit of data furnished by the General Electric tube experts which is printed in the Pickups and Hookups department of the June issue.

Then add to your list this story written by Mr. Perry and you will have a pretty accurate conception of rejuvenation of thoriated filament tubes. —The Editor.

## Only Thoriated Filaments

**T**HEY preface their explanations by a word of caution: rejuvenation is not for the ordinary tungsten-filament tubes but only for those having thoriated filaments. A thoriated filament is one made of tungsten to which a small percentage of thorium has been added.

Thorium emits electrons more readily than other metals, and a comparatively low temperature will cause it to emit the number per second required for the proper action of a radio tube. It was thorium that developed the full possibilities of the dry-cell tube. One and one-half volts from the "A" battery will not

heat pure tungsten to a degree where it will expel electrons in sufficient numbers for radio purposes. But a small percentage of thorium, mixed with the tungsten, will cause the exceedingly small filaments used in dry-cell tubes to emit all the electrons needed, even when the filament is heated only to a dull red.

As the electrons are emitted from the surface of the filament, the surface is where the particles of thorium are needed. The metallurgists tell us that, when a thoriated tungsten filament is heated, the particles of thorium worn out and wasted away at the surface are replaced by particles from the inside of the metal.

The wearing out of the particles of metal at the surface, and their replacement by particles from the interior, continues until thorium particles become scarce. There seems to be a boiling-out process like that which is supposed to eliminate the rheumatism from the folks who take the mud baths at Hot Springs, except that in the case of filaments it is the virtue instead of the dross that is expelled. If an excessive voltage is used on the plate, the supply of thorium in the filament may be exhausted earlier than it would be if the normal plate voltage were employed.

## Tube Goes Dead

**A**S the amount of thorium at the surface of the filament grows less and less, the discharge of electrons becomes correspondingly less. Eventually, the plate, no matter how great its positive attraction for the negative electrons may be, cannot pull enough of them through the vacuum from

(Please turn to page 49)

# Tube Paralysis May Be Cause of Strange Effects

Baltimore Fan Has Theory  
for Mr. Humphrey

By H. M. BISHOP

WITHOUT doing any actual work on the peculiar method of tube rejuvenation propounded by K. B. Humphrey in the May issue of RADIO AGE, other than the considerable amount of thought I have expended on it since reading of it (if that can be called work), I wish to propose a theory of just what occurs and why it successfully reactivates the tube which is in such a bad condition that ordinary "flash" reactivation is impossible, yet it completely paralyzes a "good" tube.

This method, for the benefit of those who did not read Mr. Humphrey's article in the May issue, consists of placing the tube in circuit as shown in Figure No. 1, applying seven volts across the filament, and twenty-two and one-half volts across the filament and the plate and grid, the last two named being tied together by a jumper as shown. The tube is left burning in this circuit until the grid-plate milliammeter shows a normal reading, which is about 25 mils (milliamperes) in the case of a 201A type of tube, at which time it will be found to be as good, or nearly as good as when perfectly new.

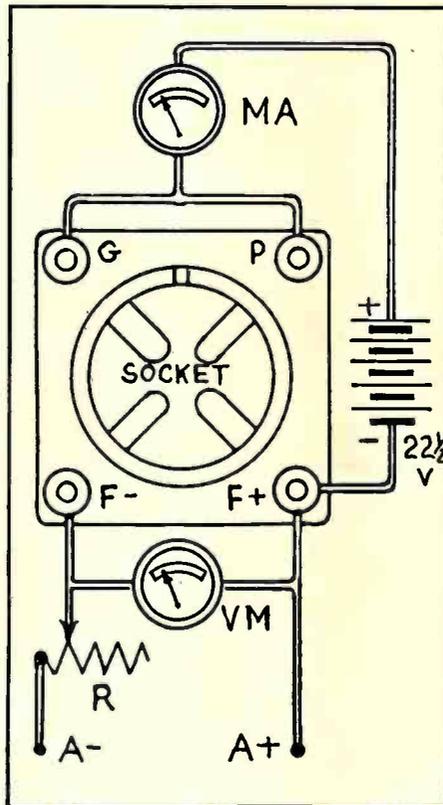
The puzzling thing about this method of reactivation is the fact that it is diametrically opposed to all of the previously conceived notions of tube reactivation. Not only is this so, but it is also true that what is usually considered a "good" tube, that is, one in satisfactorily efficient "light and play" condition, would be completely paralyzed and to all intents and purposes go absolutely dead after a very few moments of this treatment. A most peculiar condition, at least on the surface of it, is it not?

To understand the theory which I am to present on the action of this peculiar method of tube reclamation, it is necessary

to first consider a brief review of the theory of the tube flasher, commonly called a reactivator.

## Thoriated Filaments

ALL of the modern receiving tubes of either the 'A type or the '99 type are equipped with



filaments of thoriated tungsten. This consists of tungsten filament wire which has been impregnated with the rare, and radio active metal, *thorium*, by a secret process.

In the process of manufacture the filament is "flashed" by the method which will be described below, which causes *part* of the thorium to be driven from the interior of the filament wire and deposited on the surface of it, where it forms a layer of thorium approximately one atom thick. Or should we say *one atom thin*?

After this flashing treatment

the filament is in such a condition as to throw off electrons with a high degree of efficiency when only heated to a fair degree of brilliancy, consequently drawing far less battery current than an ordinary tungsten filament. The only fly in the ointment is the fact that after the tube has been in use for some time the filament emission begins to fall off rapidly due to the fact that the thin layer of thorium on the filament is driven off at a greater rate than it is replaced from the interior of the wire.

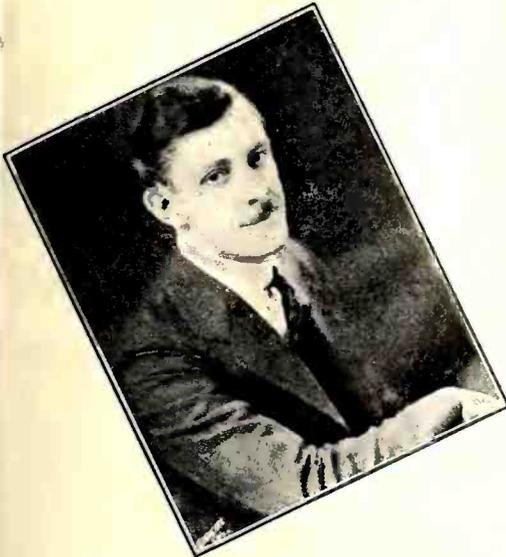
When the filament gets to the point where its electron emission is too low to allow the tube to work with a reasonable amount of efficiency, it is possible to re-perform the "flashing" process which was used in its manufacture, and by this process restore a good part, if not all, of the original sensitivity of the tube.

This process is a very simple one, and is as follows: The tube in question is put into a socket, the filament terminals of which are connected to a variable source of filament voltage, either A. C. or D. C. The grid and plate terminals of the socket are left open. The filament is now given an initial "flash" of 16 volts for exactly one minute, then switched over to 8 volts and allowed to "cook" for about ten or twelve minutes.

The effect of this process is just this: the initial high voltage flash lights the filament to bright incandescence, so that it seems ready to burn out, (once in a while they do "blow"). At this tremendous heat the thorium in the filament tends to "boil out" to the surface, after which the somewhat higher than normal voltage "cooks" or "fixes" the thorium layer. After this treatment, usually called reactivation, the majority of tubes will be to all intents and purposes as good

(Please turn to page 61)

# EDISON STUDIO STARS



Gale Swift, Edison studio director, and librarian of the Edison Symphony Orchestra



Above—Morgan L. Eastman, manager of the Edison Studio of KYW, and also director of the Edison Symphony Orchestra

Above—Sallie Menkes, known to thousands for her bright personality, is the accompanist and pianist at the Edison Studio in the Fine Arts Building



This magnificent salon is the Edison studio in the Fine Arts Building. From here KYW picks up all Edison programs

Below—Lillian Rehberg, cellist, who frequently is heard on Edison studio programs

Below—Lucille Long, contralto, can always be relied upon to please KYW listeners with her songs



E. H. Gager, radio engineer at the Edison studio





# What the Broadcasters are Doing



ABOVE is Arthur Wellington, announcer and baritone, at the Edison studio of KYW. Mr. Wellington has a very pleasing voice both for announcing and singing

## Frequency Stabilizer is added to WLS

**I**NSTALLATION of a new device in the radio transmitter of WLS, the Sears-Roebuck station, has increased its signal strength and vastly improved its tone quality, according to Howard E. Campbell, chief engineer of the station. This is the first device of its kind to be attached to a radio transmitter in Chicago or any other place in this territory and the fifth of its kind in the world.

"Shortly after the construction and installation of the new 5000 watt station at Crete, Ill.," said Mr. Campbell, "there were reports of distortion of signal in parts of the Chicago area. Immediately the engineers of the Western Electric Company, which built the new WLS station, started a series of experiments to find out what was wrong. It was discovered that the same panel arrangement of the transmitter suited to one radio territory was not as effective in another district. The result was the installation of the new panel device now attached to the WLS transmitter. This device stabilizes the frequency whereby the station gets the full power of the transmitter and has high standard of tone quality at the same time. One is not sacrificed at the expense of the other.

"This device is the latest development of the Western Electric Company's radio engineers and gives WLS an increased signal strength which will be plainly noticeable to all listeners-in here in Chicago and at points of greater distance."

## Poor Reception in Parts of California

**A**N ELECTRIC power line carrying 60,000 volts has been found to be the major cause of radio complaints received in the office of the radio supervisor in California. On a trip through twenty-two towns and cities in California, he found that faulty or dirty insulators, power-line substations and equipment, were causing the complete blanketing of reception in four small towns. In these localities satisfactory reception of even the more powerful, nearby stations was impossible.

Road dust and ether dirt, settling on insulators was found not as bad during the winter months when seasonal rains wash the insulators. More serious power-line interference occurs in the summer months when dirt accumulates on the insulators and allows the current to leak.

With the completion of several new substations under construction, most of the troubles will be eliminated, the supervisor believes.

**S**TATION WAIU of Columbus, Ohio, will shortly have the highest broadcasting station in America, when the new American Insurance Union building is completed.

The building, 555.5 feet high, is higher than Washington Monument and the tallest skyscraper outside New York City.

## Bay City Charges Fee for Receiver Licenses

**A**N ordinance to regulate the operation of radio receiving sets and to prevent unnecessary interference to broadcast reception has been enacted by Bay City, Mich., according to Department of Commerce, Radio Supervisor S. W. Edwards at Detroit.

According to the ordinance no person or organization can operate a receiver in the city until a license has been secured. The operator agrees to be responsible for the apparatus and to permit its inspection. The fee is \$2.00 for a permit, good unless revoked, for violation of regulations. Sets must be operated so they will not cause interference to broadcast reception on nearby receivers. Radio dealers are permitted to demonstrate sets without licenses for a period of only ten days.

## Labor May Go on Air with WCFL

**T**HE Department of Commerce hears unofficially that the Chicago Federation of Labor Radio Broadcasting Association plans to open a station soon, to be known as WCFL and operate on a wavelength of 491.5 meters. This organization together with twenty-three other applicants, has been denied a broadcasting license because of congestion in and around Chicago where some thirty stations now broadcast, and because no additional channels are available.

It is understood, however, that WCFL will go on the air soon, with or without a license and that it will use the channel now shared by KGW, Portland, and WEA, New York.

### Results of 2XAF'S World Spanning Tests

**FIFTY FEET** of wire of little more than pencil thickness, hung vertically from the cross arm of a wooden pole seventy feet high, has been flashing broadcast radio programs from the experimental stations of the General Electric Company at Schenectady to practically every corner of the habitable globe.

Here are some of 2XAF'S achievements on 32.79 meters.

April 3—A special program broadcast by 2XAF for the farmers of South Africa was rebroadcast by JB, the Johannesburg station. Signals received by N. Grant Dalton and passed on by wire to JB. Johannesburg is approximately 8100 miles from Schenectady.

E. C. Cox, an Australian amateur at Elsternwick, Victoria, Australia, heard the entire program to South Africa and gave an accurate log of the performance.

Just to prove that the reception and rebroadcast were not freaky, station JB also rebroadcast 2XAF, March 27 and April 10.

April 12—The British Broadcasting Company received and rebroadcast 2XAF, reporting the quality of the rebroadcast signal as good as though originating in the London studio. The same program was heard direct from 2XAF by radio listeners in Perth, Australia, 11,498 miles from Schenectady.

May 3—Broadcast music of 2XAF was heard by the crew of the Chantier, in King's Bay, Spitzbergen. The Chantier was Commander Richard Byrd's base ship. Shortly after Byrd's successful flight to the Pole a special program was broadcast to him from the office of the New York Times.

Frank Gow Smith, explorer and writer, en route to Brazil, preparatory to making an expedition into the unexplored wilderness of South America, reported picking up 2XAF aboard ship, 1800 miles from Schenectady. Mr. Smith used neither ground nor antenna for reception. He also received

2XAF when 4540 miles away, using aerial and ground. Reception of the long wave signal used by broadcasting stations was impossible because of static, he reported.

A letter from N. Grant Dalton of Johannesburg, dated April 13, contains much material of interest to those interested in the vagaries of radio transmission. Mr. Dalton reports, for example, that "on certain mornings reception of 2XAF operating at 6:30 p. m. E. S. T., has been excellent, whereas at 11 p. m. E. S. T., the signal has dropped to practically nothing."

Mr. Cox, of Elsternwick, Australia, stated by letter, that the transmission of April 3, received between 8:30 and 9:30 on the morning of April 4, was very strong, the words of the announcer being audible three feet from the headphones. He used a two tube receiver of standard design. He reports that the wavelength was perfectly steady and carrier pure.

While at Corumba, Brazil, and prior to his departure into the unexplored country, Frank Gow Smith, invited a few residents of Corumba to listen to United States stations. One of his guests was Simeon Quass, British vice-consul, who reported enjoying the "absolutely unique and unparalleled experience of listening to the broadcast programs of WGY in this remote portion of the globe." R. A. Smith de Vasconcellos, chief of telegraphs of Matto Grosso, heard WGY broadcast the opening baseball game between the Dodgers and the Giants.

2XAF will continue to broadcast programs of WGY, every Tuesday and Saturday evening.

Baltimore Fans will see WBAL pictured in the August Radio Age—Out July 15.

### Beans Burn While Music Broadcast

**HARVEY ENDERS**, of St. Louis, who wrote the music for Vachel Lindsay's "Daniel," has filed a claim for forty cents against the "Eveready Hour", broadcast each Tuesday evening through station WEA, New York, and its network of affiliated stations throughout the East and Middle West.

Added to the normal difference in time between New York and St. Louis, this daylight saving thing brought the "Eveready Hour" and the evening meal into keen competition in the Enders home. For a time Enders and Mrs. Enders entered into the spirit of this competition and made it a game. In each Tuesday evening's race, by agreement, Enders piloted the "Eveready Hour" while Mrs. Enders held the reins in the kitchen.

Then, one evening, Enders was seated at the dials and breezing along into the home stretch when a peculiar odor assailed his nostrils. He turned and saw that Mrs. Enders was leaning on the back of his chair. Somehow he gained the distinct impression that she had been in that position for some minutes. Both made a dash for the kitchen. A pot of beans on the stove was quietly going up in smoke—hideously malodorous smoke.

Mrs. Enders says it wasn't her fault. Enders wants forty cents for that charred pot of beans.

**GENERAL** calls have recently been assigned by the Department of Commerce and should be of interest to amateurs. The call will generally be used on 600 meters, but might also be found on some of the lower waves.

NOB is the general call for any or all warships of the Navy.

NQO is the general call for any or all naval coast stations.

WKW is the general call for any or all merchant vessels of the United States.

WTM is the general call for any or all commercial coast stations in the United States.

# PORTO RICO —

**P**ORTO RICO is the last and smallest of the island group known as the Greater Antilles. It is 1,380 miles from New York—96 hours by steamer—it is 100 miles long and 35 miles wide and is, roughly, the shape of a parallelogram.

It is located like a great stepping-stone between the southeastern tip of North America and the northeastern extremity of South America. In fact it might well be the foundation of some gigantic bridge of the future.

Even today radio has created an aerial bridge between the two and WKAQ, located in San Juan Porto Rico is calling the world's attention to this Island of Enchantment.

Mr. Joaquin Agusty, the Announcer and Program Director,

is known far and wide as the Announcer with the Spanish accent and is not only largely responsible for the attention which radioland is focusing on WKAQ but for the interest of his fellow Porto Ricans in radio itself.

He organized the Radio Club of Porto Rico in 1914 and later on became manager and organizer of WKAQ which is operated by the Radio Corporation of Porto Rico, affiliated with the International Telephone and Telegraph Corporation of New York.

The station, of which Mr. Enrique Camuñas is Operator, is located on the roof of the Porto Rico Telephone building and has a wavelength of 341 meters. Incidentally, it was built in 1922 at the same time as its twin station PWX of Havana.

*WKAQ's  
Prefers  
for Station*

By

It broadcasts Wednesdays and Saturdays from seven to nine p. m. Eastern Standard Time and its programs are musical and educational.

#### Programs by Courtesy

**W**HILE WKAQ has naturally not the array of talent to choose from that is at the disposal of a station on the mainland it is by no means at a loss. Most of its programs are given by courtesy and the Figueroa family is one of its most faithful co-operators.

One of the sons of this family is a violinist who has won the highest honors at the Conservatory of Madrid and his music often delights the audience of WKAQ. Paoli, the well known tenor, was another great friend and favorite.

The station's audience has expressed itself as preferring music to most other radio features and accordingly the greater part of its programs are of this nature.

In spite of the circumstance that a high-powered naval station located nearby frequently interrupts with code messages, reception locally is generally satisfactory. As for its more distant audience WKAQ has been heard by thousands of listeners in all parts of the United States, Canada, Cuba, Santo Domingo, Central America, South America and Europe.

One letter was received from Czechoslovakia and during the recent International radio tests



The white building in the foreground is the Porto Rico Telephone building, atop of which is located WKAQ of the Radio Corporation of Porto Rico. This station's towers can be seen in the photograph. This station is a sister station to PWX at Havana, both being built in 1922 and owned by the same interests

# The Enchanted Isle

*Audience  
Music  
Features*

E. D. CAHN

the station received 1100 cards in one mail. These came from all parts of the world and referred to the first day's program.

So, isolated on the map as the Island of Enchantment may be, it makes itself heard a long way across the ocean and the lands beyond it.

The voice with the Spanish accent is recognized where Mr. Agusty's name has never been heard and quite often mail has reached him addressed simply, "To the Announcer with the Spanish Accent, Island of Enchantment."

## An Enchanted Land

**S**URROUNDED by the warm sapphire seas Porto Rico lies like a gem in undulating folds of velvet, a truly enchanted land.

Its people are of Spanish origin, language and traditions but by virtue of the treaty of Paris 1898 they have come under the influence of the United States and live contentedly under its flag.

Sugar cane, coffee, oranges, tobacco, pineapples, cocoanuts are the principal crops and all add to the indescribably rich and verdant aspect of the island.

The port of San Juan, where WKAQ is located, has been improved during a long period of years by dredging and other operations. The city is proud of its age, having been founded in 1508 by Juan Ponce de Leon not many years after Columbus's discovery of the island on his second voyage in 1493. San Juan likes to

remember that it was making history fifty years before the old Florida city of St. Augustine was thought of.

The bells of its cathedral have been heard ever since 1540 and many of the narrow streets contain mouldering souvenirs of the past when pirates swooped down upon the town every once in awhile and all the turbulent life of the Spanish Main swirled around it. It was sacked by Sir Francis Drake in 1595 and again three years later by the Duke of Cumberland.

Today San Juan displays a fascinating mixture of the old and the picturesque side by side with the modern and utilitarian.

It has fine public buildings, modern suburbs, splendid roads which follow the rising and falling contours of its mountains and valleys and yield a thousand splendid views of beauty from

the cultivated and orderly to the rugged grandeur of its greatest heights.

The Aibonito (Oh, how beautiful) Park is famous for its splendid and far-flung views of mountains, valleys and the Caribbean and Atlantic oceans. At one point on the Carreta Militar twenty towns can be seen. The highest settlement on the island is 2,000 feet above sea level.

The trees of Porto Rico are alone worth a visit, being of many varieties, ranging from the intertwined mangoes, the orange and banana to the fire-trees or "flamboyantes" which at seasons carpet the ground with the flaming color of their fallen blossoms.

In spite of its latitude the average temperature of Porto Rico is 76° in the cool months and 79° in the hot ones. The trade winds temper the humidity and people

*(Please turn to page 48)*



Operator Enrique Camuhnas is shown seated at the control desk of WKAQ. From this vantage point the whole station may be started or stopped at will

# Aerial Night's Entertainment—and Otherwise

*Cleveland's Station WTAM Seems to Fill Need of Radio Public*

By DOROTHY B. STAFFORD

THE Chief Engineer was attempting to discredit our contention that there wasn't a decent detector tube in the entire thirteen he had sold us, when the discussion started. The amateur Engineer, who usually plays the role of innocent bystander in these sometimes hectic exchanges of opinion, suggested that it should be entitled, "Why Is a Radio Station?" and it was brought about by an announcement in a WGY program. The item read,

*"An address on 'The Moral Obligation to be Intelligent,' will be delivered by Dr. John Erskine, of Columbia University, Wednesday night."*

The Chief guffawed. *We* thought it worthy of serious consideration.

"There," we said, "is a station that has some excuse for being. When a broadcaster reaches the point where he has the courage of his convictions,—and it takes some courage to be intelligent these days,—he has gone about as far as he can go. But the standard of Schenectady has always been high. If one heard no other station he would be well entertained by the variety and quality of broadcasting that comes out of WGY."

The Chief has spent several crowded years sailing up and down the seven seas in the wireless cabins of ships, and therefore takes a rather sniffy attitude toward broadcasting stations in general. In fact, he is the only person we know who agrees with the pessimistic violinist in his dire prophecy that in a few years broadcasting is going to die a horrible death from inanition. In vain we

remind him that the same was said of the movies ten years ago, and still they are flickering merrily on their way, becoming more prosperous though more impossible each year.

"Intelligence, piffle!" he now commented, as he industriously



Art Herske is announcer and master of the Saturday night revel at WTAM, Cleveland

switched tubes, "It doesn't matter what they broadcast. People listen to the station that comes in the clearest nowadays, and this trying to do something different is mere wasted effort. You know we are to have a broadcasting plant on the new Superba Hotel, and with a hundred-watt station right here in town they won't listen to anything else."

## What To Do?

WHILE we were wondering how an otherwise logical person could be so obtuse, the Amateur bobbed up.

"We are to have a broadcasting station?" he inquired, "and

what, may I ask, are *we* going to broadcast after we get it?"

The Amateur, we regret to say, has no civic pride, and would be hopeless material for a Rotary or Kiwanis club. But his question was justified. We know of no community of equal population that is so utterly devoid of any outstanding musical organization as this particular city. We haven't even a good hotel or cafe orchestra, not even a "silver cornet band," and while the local saenger-bunds are as fair as the average, there is nothing to distinguish them from the hundred and one similar amateur entertainers that are already cluttering up the air lanes. While the natives storm the concert-halls when anybody of note comes to town, and trying to hear the Philadelphia Symphony is about as strenuous an undertaking as getting on to a foot-ball field when Red Grange is playing, the community seems incapable of producing or supporting anything of outstanding musical excellence within itself.

So what it could possibly have to offer the outside world,—a world already fed to repletion with the best in music,—is something of a mystery. It is all very well to talk about wearing paths to your door for mouse-traps, but if your mouse-traps are constructed along the same mediocre lines as the other fellow's, you'll have to buy a lawn-mower to keep down the grass in the path. And we can't imagine anyone wearing grooves in the air trying to get what is going to come out of this station.

## No Excuse for Existence

IF THE radio commission, or whoever hands out the spe-



Three wielders of the banjo are found in the Dixie Trio who frequently appear over WTAM

cial dispensations permitting communities and individuals to shoot forth their broadsides of Hertzian waves upon a defenseless public, would but ask, "What have you got to tell the world?" there wouldn't be such a crying need for straight-line condensers to sort out the stations. Any of us can mention a score of broadcasters right off the reel who have no legitimate excuse for messing up the atmosphere, and yet, just because some misguided soul has money enough to maintain a plant for the purpose of getting his name upon the air, or whatnot, this small, unimportant fry continues to blatt forth its purposeless programs night after night to the exasperation of the listener, who is trying to get some worthwhile station in clear and clean. About once a week something like the following comes over the telephone.

"Oh, Mrs. Stafford, Lillian is going to broadcast from WJX tonight. She is visiting over there, and they've asked her to sing."

Our subconscious mind always retorts, "Well, what of it?" but the conscious mind, trained by years of polite hypocrisy, murmurs, "How nice! So glad you told me."

Forewarned, we stay away from WJX that night, for why

should we want to hear Lillian? We have had to listen to her since the day she sang her first solo in the Unitarian church, have painfully followed her struggles through the Chimes of Normandy, the Mikado and Elijah; and with the best sopranos of the country at our beck and call by the mere turning of the dial, why waste battery-juice to hear Lillian annihilate the "Shadow Song," (which we feel in our bones

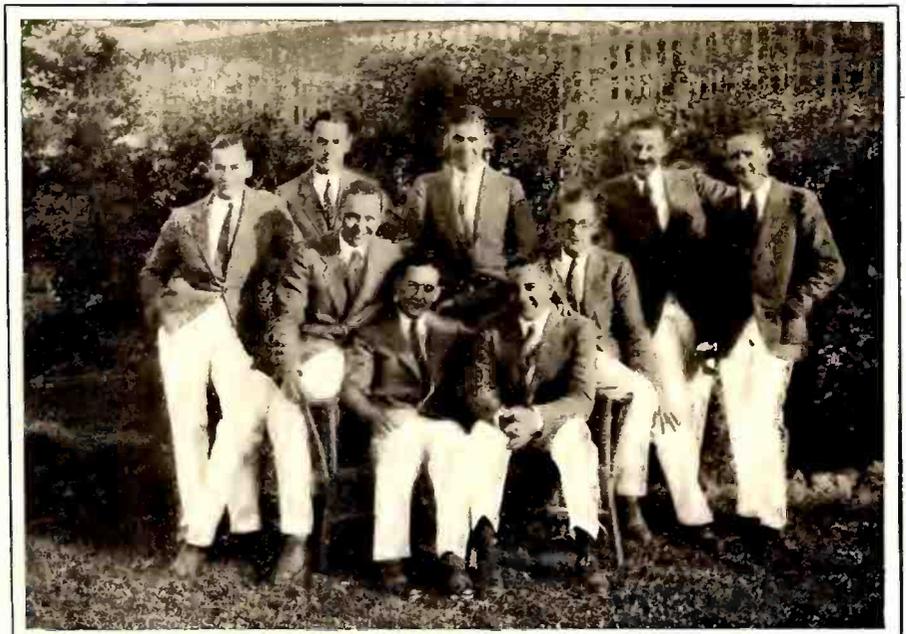
she'll attempt,) just because we went to school with her mother? We firmly believe that a station that has nothing better to perpetrate than Lillian should be put off the air.

"Then," said the Chief, "I suppose your policy would be to eliminate all stations like Tuinucu, Shenandoah and Beaumont, just because they have no grand opera stars and million-dollar jazz-hounds to broadcast. Where are the people, with a range of a couple of hundred miles, in remote districts going to get their radio?"

### Who Have Alibis

OF COURSE our cowardly Opponent was evading the issue. He knew perfectly well our argument was applied solely to the over-congested districts of the East and Middle West. And besides we told him we didn't believe there were any listeners any more with a radius of only two hundred miles.

And as a result of so much having been said about legitimate broadcasting, and it being the time of year when a review of the season seemed in order, we went into executive session with half a dozen other seasoned listeners and began checking up the stations in this crowded area that *had good alibis*. We elim-



These gentlemen, attired so nattily, belong to Guy Lombardo's Royal Canadians and furnish much of the high class jazz music broadcast from the Willard Storage Battery's Cleveland station



In this photograph may be seen the members of the Willard Symphony. Walter Logan is the director of this ensemble

inated most of the stations with eastern hook-ups, for they were supposed to furnish the best.

And after the smoke had cleared away,—for general all-around popularity with all kinds of listeners, for a six days a week diet,—lo WTAM led all the rest.

Write ups of radio stations, as a rule, intrigue us about as much as the canned reviews on the covers of books. Usually the fine Italian hand of the press agent is plainly discernible, or it is apparent that the reviewer has visited the studio, and been so royally received and entertained by the gracious hostesses and announcers that he can, in decency, write nothing but the most glowing praise.

#### Not a Clevelander

WHEREFORE, we conscientiously disclaim acquaintance with anyone connected with the Cleveland station, and solemnly affirm that we haven't been in that city since the war. Our viewpoint is entirely that of the listener, and while we hesitate to trust the judgment of our best friends in anything connected with the musical arts, from our own observation and that of various curious scouts, who spend half their waking hours with pricked-up ears,—WTAM seems to stack up as a mighty satisfactory radio station.

Situated in the largest city in Ohio, it naturally has much to draw on; the hotel and cafe orchestras broadcast are the equal of anything similar that comes out of the east, the special concerts of high-class music present artists of reputation and distinction, and the mechanical performance of the station leaves little to be desired. One thing we like about WTAM is, that contrary to the course pursued by many Middle Western stations, it doesn't wait until night to wake up. It is on the job every noon

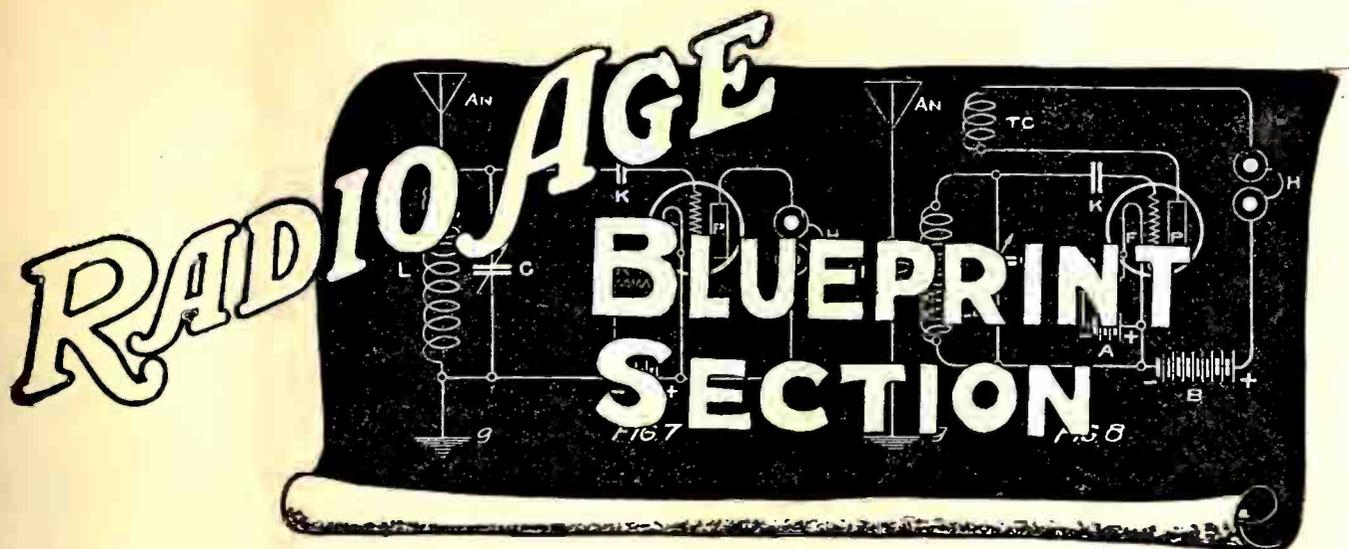
with a lively cafe orchestra, and a couple of times a week puts on a morning lesson in Music Appreciation.

While comparisons are odious, personally, we regard the gay Lombardos,—more properly known as Guy Lombardo and his Royal Canadians—as having little competition on the air in their particular line, with the possible exception of the few Meyer Davis orchestras that still broadcast. There is a rhythm and lilt to their dance orchestrations that we haven't heard since the famous Lido-Venice faded from the air by reason of one of Mr. Buckner's padlocks. And despite all ridicule to the contrary, dance orchestras do have a definite place to fill in radio, particularly since program directors seem prone to fall victims to classical epidemics.

We recall one night last winter when there was an appalling Dvorak outbreak. We don't know whether or not it was the composer's birthday,—but north, south, east and west everybody seemed to be "Goin' Home," and it was with a feeling of genuine relief that we turned to WTAM and the Lombardos. Apropos of these strange epidemics a musician inquired not long since if the radio stations were having "a 'Glow Worm' week." He complained



Louis Rich and the Blue Room orchestra, in the public auditorium in Cleveland. They are frequent broadcasters at WTAM



## Radio Age's Golden Rule Receiver Is Completely Shielded

*Audio Transformers are Changed  
to Gain Better Tonal Quality*

**W**HILE the preceding model, described and illustrated in the June issue as the Golden Rule receiver, was a very simple receiver in itself, in the July model of the Golden Rule which we are about to describe, simplification has been carried still further through the elimination of the wave filter and the use of a metal panel and complete metal shield for the set. The latter course was decided upon for all-around work since so many of the set builders live in the congested areas, and even those who do not are occasionally confronted with extraneous interference which at times is bothersome.

Because of the height of the panel it became necessary to use the baseboard construction inside the set instead of making up a sub-panel arrangement. With the sub-panel the socket height and that of the tubes would have allowed the latter to touch the metal cover for the shield which was not desirable. So the wooden baseboard was

By F. A. HILL

Associate Editor  
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decided upon and all the apparatus mounted on it.

### Metal Panel Used

**H**AVING the four walls of the metal shield to contend with made it advisable in the beginning to mount all of the various units on the board while the board was affixed to the floor of the shield. The metal panel was first prepared by drilling it for the various controls such as the variable condensers, filament switch and telephone jack; the parts assembled on the panel and attached to the baseboard. Then the baseboard was placed on the floor of the shield and the screws holding the sides together removed from the bottom and wood screws inserted instead so the bottom of the shield and the faces of the baseboard could be drawn together. In doing this it was necessary to have the baseboard cut to barely slip into the shield without allowing too

much space between the baseboard faces and the bottom portion of the two end pieces of metal and the metallic back wall of the shield.

Under these conditions all the soldering and wiring was done while the set was inside the shield, and it appeared at first somewhat of a job, but by properly cutting the wire lengths, attaching the soldering lugs loosely to the wire and then laying the wire alongside the filament connections on the socket line, it was possible to do just as good a job as if the lugs had been placed on first, the screws run up, and the wire then fed through the eyes in the end of the lugs. This practice applies principally to the two filament lines, the negative one on the left of the sockets and the positive side of the A battery on the right side of the sockets. This was the only long set of wires which had to be placed on the set, all of the others being more or less of short length so it was not necessary to give much thought to their placement.

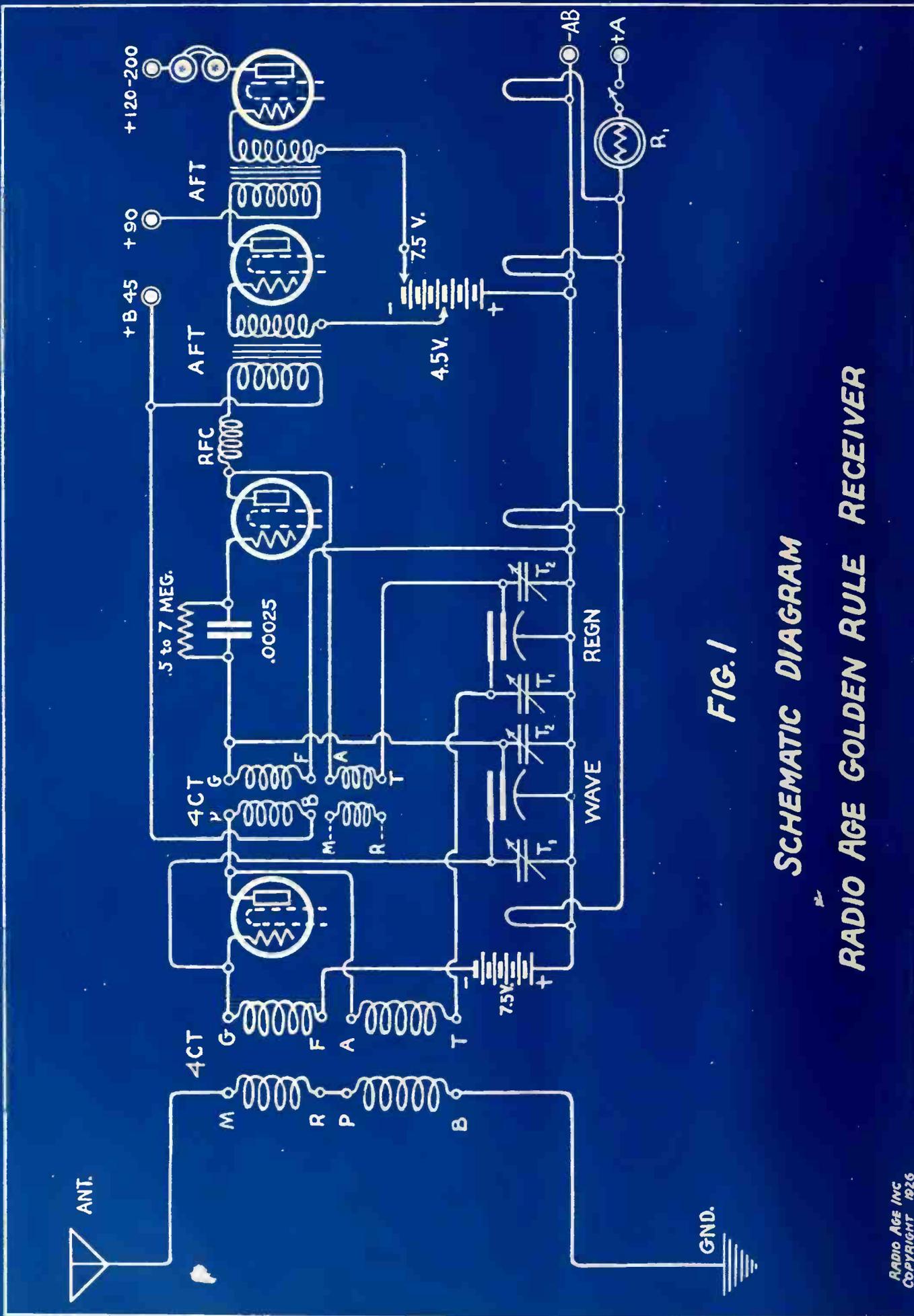


FIG. 1

**SCHEMATIC DIAGRAM  
RADIO AGE GOLDEN RULE RECEIVER**

25"

9"

7"

26"

**FIG. 2**

FRONT PANEL VIEW OF  
**GOLDEN RULE RECEIVER**  
IN SHIELDED FORM-

**Newer Transformers**

**I**N ORDER to get better results from the audio end we changed over from the old style Thordarson transformers, 2 to 1 ratio to their newer model, R200, which has more of a straight line amplification characteristic while not greatly increasing the bulk of the transformer. We thus found it possible to make use of the R200 without having to allow more space than convenient in the back end of the baseboard. The terminals on these audio transformers are about level with the socket terminals which meant easier wiring and all wires close down by the baseboard instead of being carried at a higher level.

In the previous model the toroid coils were placed so they had their flat surfaces facing each other, but in this case in order to keep the ends of the coil farthest from the shield it was arranged so the coils were lined up at the angle shown in the blueprint reproductions.

Two C batteries were used instead of a single one, the C battery for biasing the grid of the r. f. tube being located flat on the baseboard underneath the left-hand tandem variable condenser, with a clip and short length of flexible wire so the bias voltage may be altered as desired. If higher voltages are wanted another 7.5 volt section can be placed in series with the one shown so the total voltage will be 15 volts.

**Two Bias Values**

**F**OR the audio stages the second C battery is laid on its side on the baseboard, with two taps for grid bias, one for the first audio transformer and the other for the second. This is because a different B battery voltage is applied to the first audio than is given the second. For the first audio 90 volts are applied to the plate, for which about a 4.5 volt negative bias is allowed, while the second audio transformer has a 6 or 7.5 volt negative bias on account of the 140 volt B potential applied.

As in previous cases a single filament resistor, the Daven No. 5 with mounting, was attached

to the baseboard in the positive side of the A battery wiring. This resistor was large enough to take three quarter ampere tubes and one half ampere tube,

the metal panel was not very difficult since all the rotors are common with the shield and the negative filament. Position for the dial holding holes was marked, the hole drilled and the dials attached, these being the National type B with scale running from 0 to 200, clockwise. By means of the governor on the front of the dials the ratio can be varied from slow to fast, slow being used on the left hand wavelength control while the rapid motion was allowed for the regeneration condenser on the right.

**Mount Carefully**

**O**N ACCOUNT of the filament switch and pilot light being connected in the positive leg of the A battery, it was necessary to insulate it from the panel, this being accomplished by means of the insulating washers furnished by the Crowe Nameplate Co., with the panel and shield. The same held true for the phone jack which would be at maximum B potential and which had to be insulated properly to prevent a short circuit between the total of the B battery and the negative of the A battery. A simple means of testing for shorts in this case, and others too, is merely to take a C battery and a small range voltmeter and put it across from the panel or shield to the terminals of the jack. If any reading is found on the voltmeter it is an indication that the jack and the panel are common. The washer should be juggled around and carefully placed so the jack does not come in contact with the metal of the panel.

A base mounting Jones multi-plug was anchored to the baseboard somewhat farther back than we are accustomed to since it was desired to allow clearance for the cable head to go through the real wall of the shield. There are four holes there provided with insulating bushings, but we only used one hole and covered the others up in order to have as holeproof a job as was possible. Leaving several half inch holes in a shield does not help matters much and does allow radio en-

LOG		
Wave	Station	Dial
209.7	WSBC	12½
217.3	WOK	14
225.4	WBBM	15½
241.8	KSO	18½
249.9	WMBB	20
258.5	WRNY	21½
265.3	WBCN	23
275.1	WORD	26
282.8	WSM	27
288.3	KFKX	28
293.9	WEAO	29
296.9	KPRC	30
302.8	WGN	31½
309.1	KDKA	32½
312.3	CNRR	33
315.6	KFDM	33½
319.0	WSMB	34
322.4	KOA	35
325.9	WSAI	36½
329.5	WJAZ	37
333.1	WBZ	38
336.9	WJAX	38½
340.7	WKAQ	39
344.6	WLS	40
348.6	WEEI	41
352.7	WWJ	42
356.9	CFCA	43
361.2	KGO	44
365.6	WDAF	45
370.2	WEBH	46
374.8	KTHS	47
379.5	WGY	48
384.4	WMBF	49
389.4	WTAM	50
394.5	WOAI	51
399.8	WHAS	53½
405.2	KHJ	55
410.7	PWX	56
416.4	WCCO	57½
422.3	WLW	59
428.3	WSB	61
434.5	NAA	62½
440.9	WOS	64
447.5	WQJ	66½
454.3	WJZ	68
468.5	KFI	71½
475.9	WBAP	73
483.6	WOC	75
491.5	WEAF	77½
516.9	WCX	85½
526.0	WHO	87½
535.4	KYW	90½
545.1	KSD	93

the former being 201-A's and the latter a UX-112 for maximum volume on the loud speaker.

Attaching the condensers to

ergy to enter which is not desired.

### R. F. Choke Used

**F**OR KEEPING the r. f. out of the primary of the first audio transformer we used a Samson r. f. choke, such as was used in the June model.

Grid condenser mounting was simplified with the use of the Sangamo .00025 type furnished with clips for holding the grid leak, the latter being a "no-noise" variable grid leak made by the Radio Foundation, Inc. We have used the Sangamo receiving condensers in amateur transmitting circuits without disastrous results so we felt sure of their action in a receiver.

In operation the receiver gave better tonal quality on both a Western Electric cone and a Model 100 Radiola cone, this increase in quality being brought about by the use of the Thordarson R200 audio transformers which have a good flat curve covering a wide range of frequencies. (Perhaps the R200 is not quite as good in tone quality as the autoformers made by the same people, but we were interested in transformer coupling in this instance and did not have room for additional stages of impedance coupling.)

Various combinations of tubes were tried in the r. f. end of the set. First we used a UV 201-A, then a Perryman

quarter ampere tube, then a Magnavox quarter ampere tube. All worked well if different grid biases were applied so as to bring down the tube to an anti-radiative condition. For the detector the Magnavox and the UV201-A were tried, and found successful. In the first audio a Perryman tube (amplifier) was used while in the last stage we used a UX-112 with 140 volts

### LIST OF PARTS

- 2 Bremer-Tully 4 circuit toro-styles
- 2 Bremer-Tully tandem variable condensers (.00035 mfd.)
- 4 Benjamin cushion sockets
- 2 Thordarson R200 audio transformers, 2 to 1 ratio
- 2 National type B vernier dials
- 1 Sangamo .00025 grid condenser and clips for leak
- 1 Radio Foundation no-noise variable grid leak
- 1 Jones base-mounting multi-plug
- 1 Yaxley panel light and switch
- 1 Yaxley telephone jack
- 1 Daven No. 5 ballast resistor and mounting
- 1 Samson radio frequency choke
- 2 C batteries 7.5 volts
- 1 Weston phone plug
- 1 Crowe metal panel 7 by 26
- 1 Crowe metal shield for above panel.

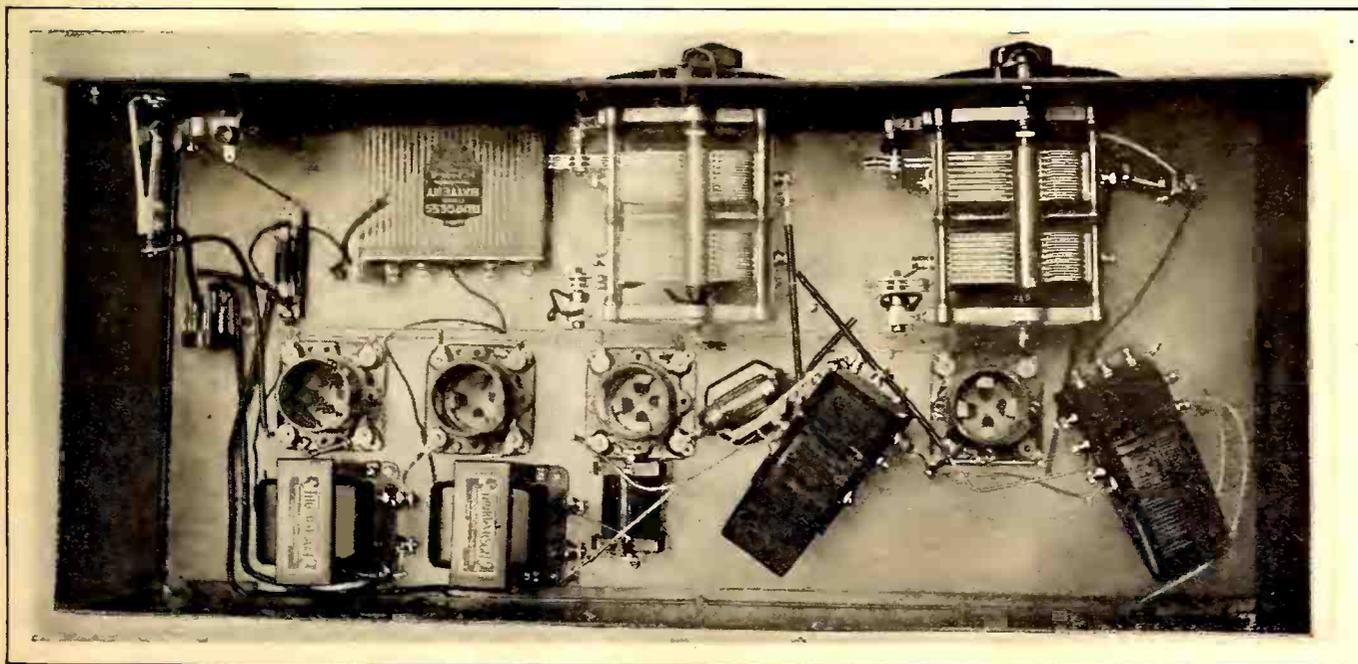
on the plate. We believe a voltage of about 250 would be better on the UX112 with a proper grid bias. Eveready and Burgers can furnish good biasing batteries.

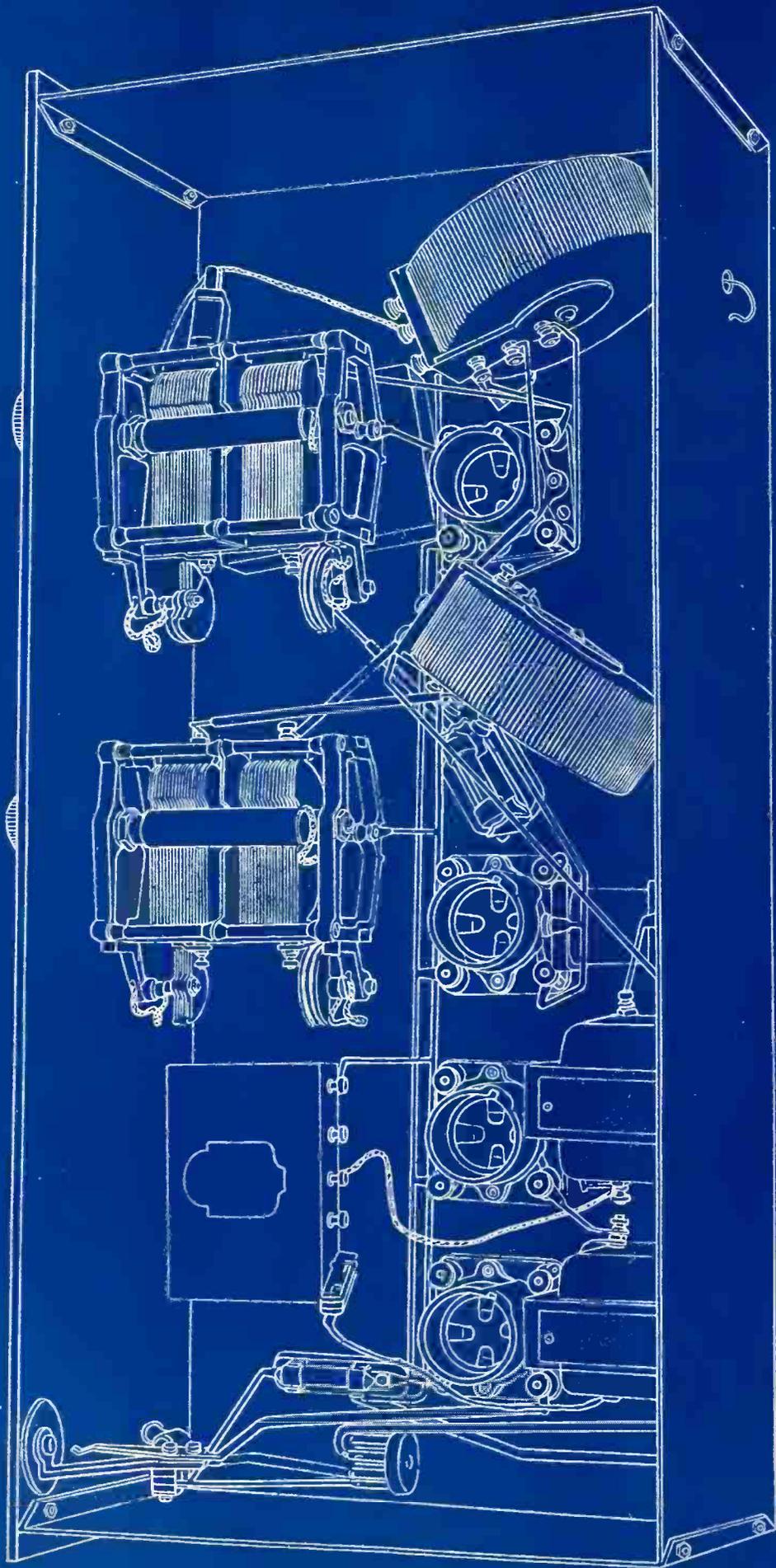
### Tuning Qualities

**T**UNING qualities of the Golden Rule were just about the same as the preceding model, except perhaps a little sharper on locals on account of the shield effectively barring signals from the coils themselves, for after all there is no such thing as a fieldless coil. When we find a fieldless coil there will be no energy in the coil and it will be worthless from a radio standpoint. The front trimmer on the left hand condenser, which controls the wave, was set while in operation on stations around 322 or 328 meters and once this adjustment was made it remained so for the balance of the range, both up and down the wavelength scale.

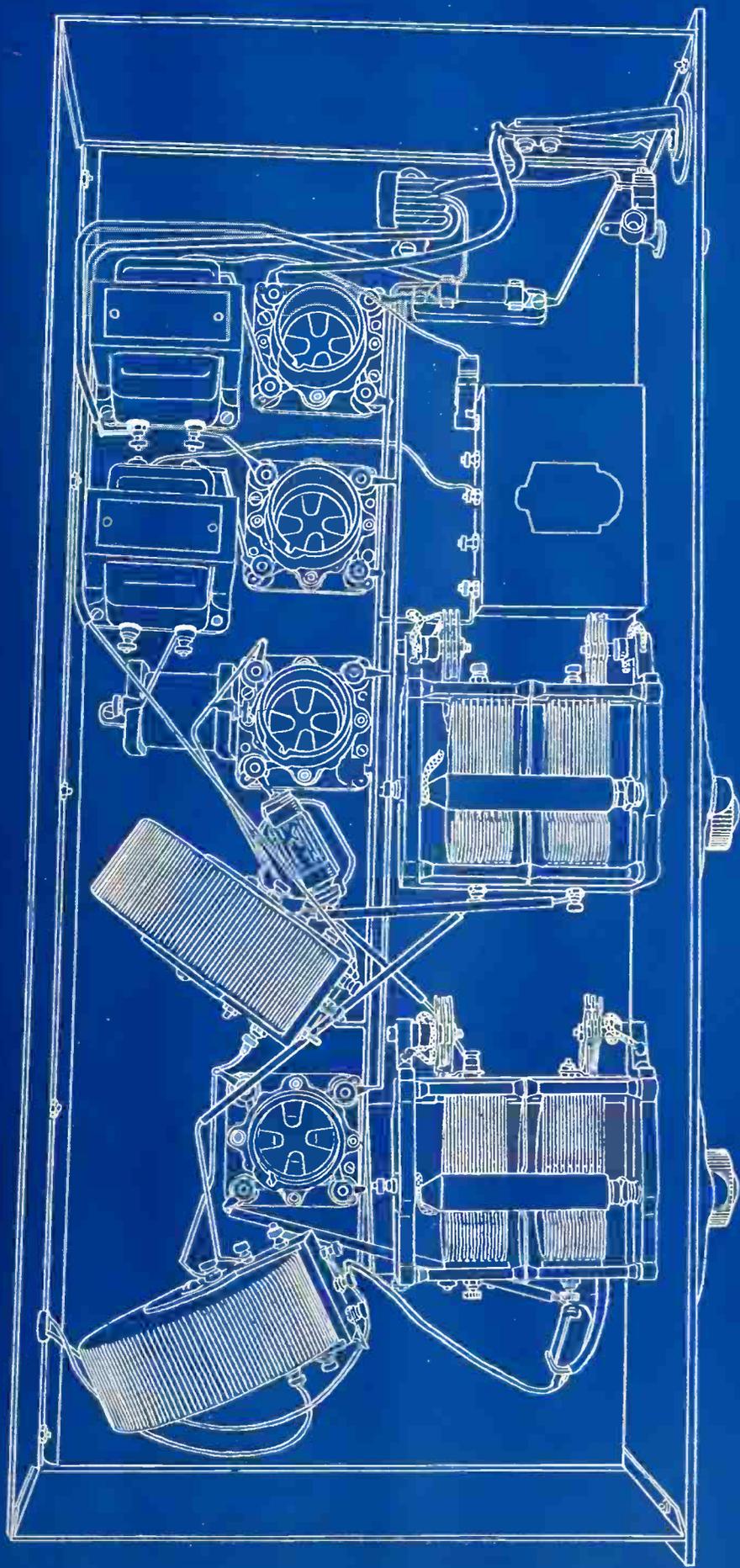
Ability of the receiver to pick up out-of-town stations while the locals boomed on was a bit better than the June model of the Golden Rule, although we could not tell whether this was to be attributed to altered conditions in weather which might have permitted greater signal volume on distant stuff than was found during the test and oper-

(Please turn to page 59)





**FIG. 3**  
REAR PANEL AND BASEBOARD VIEW OF  
**GOLDEN RULE RECEIVER**  
IN SHIELDED FORM—



**FIG. 4**  
TOP VIEW OF  
**GOLDEN RULE RECEIVER**



# Pick-ups and Hook-ups by our Readers



Conducted by F. A. Hill

THE material appearing under the title "Pickups and Hookups by Our Readers" in RADIO AGE, is contributed by our readers. It is a department wherein our readers exchange views on various circuits and the construction and operation thereof. Many times our readers disagree on technical points, and it should be understood that RADIO AGE is not responsible for the views presented herein by contributors, but publishes the letters and drawings merely as a means of permitting the fans to know what the other fellow is doing and thinking.

**S**HORT wave enthusiasts who have perhaps not found all of the high frequency phone circuits now in operation, will note we are printing at the bottom of page 62 a list which will enable many readers to have good summer reception when some of the distant stations on the normal broadcast channels would hardly be audible.

In the case of the two General Electric stations, 2XAF and 2XK, the wavelengths given are correct for the time being. In the last few months these channels have been shifted somewhat but according to latest advices from that company they will remain as indicated for some time, since most of the desired experimental work on higher waves has been finished.

It will be noted that all of the stations are crystal controlled and this should be an excellent means of calibrating your receiver.

**G**EORGE S. RICHARDSON, 604 King St., London, Ont., Canada, carries out his dial twisting propensities to the point where he gets an eighth of a column in the local newspaper, recounting his success in bringing in PTT (Toulouse) during the recent International tests with a five tube Atwater-Kent. If we had a special DT button we would certainly award it to Mr. Richardson. The reception was formally verified by PTT on April 5. Mr. Richardson is an old DT member so we really are not surprised as his good work.

**L**OUIS J. ANDREATTA, 48 Lake Ave., Clifton, N. J.,

## DIAL TWISTERS

F. E. Filies, Jr.	702 Ocean Ave.	Portland, Me.
Jack Berscheid	408 Wood St.	Aurora, Ill.
Louis J. Andreatta	48 Lake Ave.	Clifton, N. J.
George S. Richardson	604 King St.	London, Ont., Can.
John Scott		Union Furnace, Ohio
Elmer W. Schmidt	3108 N. Christiana Ave.	Chicago, Ill.

liked the tube tester by Brainard Foote in the April (1926) Radio Age so well he made it up, and now spends a good portion of his time testing tubes for his friends. He is also interested in short wave transmission and reception so he looks like a prospect for the ranks of the amateurs.

**J**OHAN SCOTT, Union Furnace, Ohio (sounds rather warm, doesn't it?) must have spent hours over the typewriter in making up a list of some 150 stations which he picked up on a three tube receiver. In addition to the eastern, western, northern and southern broadcasters, including Cuba, he also logged a goodly number of amateur stations, all of which shows considerable application. A single wire about 70 feet long was used with a driven ground. He wants his DT emblem *pronto*, so by this time he will have received it, we trust.

**W**E have received an interesting letter from Joseph H. O'Connor, a radio engineer at the Public Service Co. of Colorado, at Denver, in which he calls our attention to a slight error in a statement made by Armstrong Perry in the April

number of RADIO AGE on the subject of interference. Mr. O'Connor says: "When receiving signals from a radio station a coil antenna (loop) will point in the general direction of the station, but when attempting to take compass bearings to determine the source of an inductive interference the antenna will show a maximum signal parallel to any power circuit. In many cases it will point parallel to the nearest telephone or telegraph circuit, or a wire fence, showing the direct radiation from the source is very small, and that r. f. currents are being carried over these circuits. The effect of a filter proves this, for the filter does not affect the direct radiation but keeps the RF currents from traveling back over the distribution system." Readers of this department should remember the above and when shooting trouble not be led into believing that every street lamp is the cause of trouble, when the source may be at another spot miles away. We remember with some chargin (a few years ago) galloping all over town with a loop and a receiver to hunt down an especially pernicious power leak, tearing out all our hair on finding that every arc light in a radius of five miles gave a direc-

tional effect. We finally started at the central station and following the high tension line found the trouble in one of the oil switches which was getting ready to let go. The following day it did, with a vengeance—the company had to buy a new one and the radio community breathed in peace thereafter. Incidentally we are very pleased at the entirely new attitude which power companies take towards radio trouble shooting, for often it gives them a clue to prospective trouble not apparent on indicating devices at the central station.

**JACK BERSCHIED**, 408 Wood St., Aurora, Ill., sends in a good-sized list of results from a three-tube set, in which both coasts and the north and south are well represented with good distance.

**FANS** who use Amperites instead of filament rheostats will be interested in knowing the Radiall Co., (makers of Amperites) have issued a fixed resistance known as No. 112 which is to be used for the RCA UX-112 power tubes (also any other tube which takes a half ampere at 5 volts (from a 6 volt source). It will also do for the UX-171.

**AT** the right of this paragraph we are printing a view of the short wave transmitter in operation at 4BY, owned and operated by John E. Hodge at Savannah, Ga. It is crystal controlled on 37.9 meters and puts a healthy amateur signal into Italy, England and other foreign countries (which are no longer foreign by radio).

In the picture the small tube on the right is a UX-210 (or a VT-2) this being the master oscillator with a crystal in its grid circuit, the crystal being ground by the owner who is an optometrist by profession, and who also designed the type of holder used for housing the quartz slab. The crystal oscillator circuit has 350 volts DC applied to the plate with a grid bias voltage of 45 volts negative. The first power amplifier is an old UV-204 which has weathered many

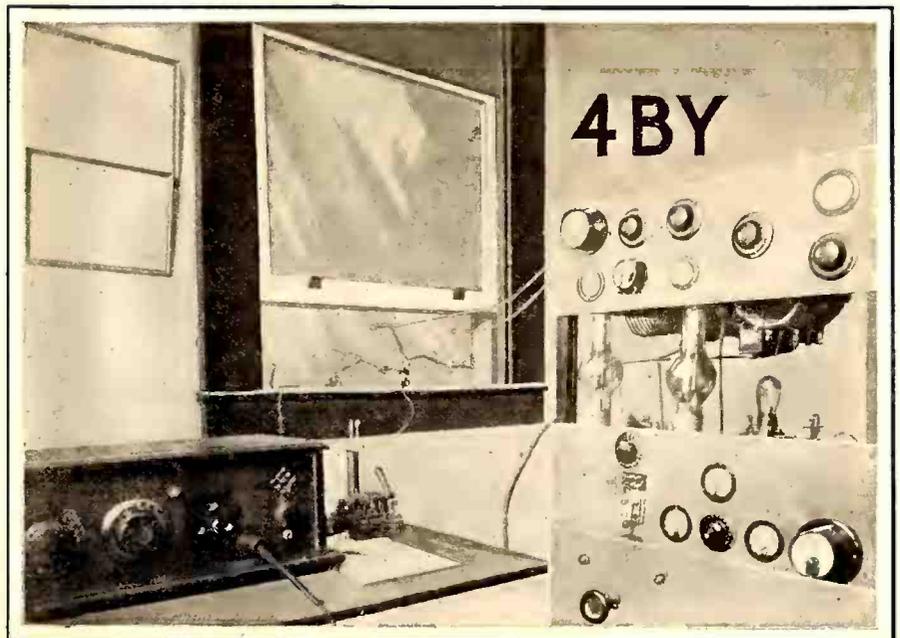
a radio storm and on which is used 1000 volts with a 65 volt grid bias, the plate drawing 110 milliamperes. The first power amplifier is tuned to the same wave as the crystal oscillator, 75.8 meters, while the second power amplifier is another UV-204 with 1700 on the plate, a grid bias of 112 volts and a plate current of 175 milliamperes. The second power amplifier is tuned to twice the frequency of the first (half the wavelength) and puts from 2 to 3 amperes in the antenna circuit. The antenna is a single No. 10 wire with a counterpoise of the same length (34 ft.) The note is DC, R6-8, and very steady under normal weather conditions. 4BY is now engaged in conducting tests with 9BHX at the Radio Age laboratory to determine the best input value in order to put a reliable signal into Chicago. Other amateurs who desire to test with 9BHX may do so and we will be glad to help.

**WILLIS L. NYE**, 1344 Bernal Ave., Burlingame, Calif., who writes of a short wave receiver in this issue, is an amateur, owning station 6DDN. Arthur A. Collins, Cedar Rapids, Iowa, who has written previous short wave articles, is also an amateur, having station 9CXX. Quite frequently you will find articles in Radio Age by amateurs who

like to help out the coming radio telegraphic generation with hints and suggestions on receiving and transmitting circuits.

**A** TUBE to take the place of the UX-112 and for use as a heavy duty power amplifier tube is the UX-171 recently released by the Radio Corporation. Maximum plate potential is 180 volts with a 40.5 grid bias voltage and 20 mills current drawn. For 90 volts the 171 takes 16.5 volts and draws 10 mills. When operating tube at full voltage and mill capacity a choke and bypass should be placed between the tube's plate and the loud speaker to isolate the DC component from the loud speaker. The choke may run from 10 to 30 henrys while the bypass should be from 2 to 6 microfarads. The secondary of an ordinary audio transformer will make a good choke. Or the output may be delivered to a 1 to 1 output transformer, the secondary of which is connected to the speaker. In either event the current from the tube will not flow the windings of the loud speaker.

**DONALD S. ROSE**, supervisor of interference of the Radio Listeners Club at Evansville, Ind., thanks RADIO AGE for help given in making up a small



portable set with which to run down power line interference. The club has organized a campaign against radiative receivers and power leaks and is meeting with success in both lines of endeavor due to the civic spirit of the owners of radiative receivers as well as the cooperative spirit of the local power company.

**D**ISTANCE seekers, or even those who are casually interested in the air-line mileage between cities may secure a government table, made up by the Department of Commerce. This table shows the distance between fifty leading broadcast centers of the country. It is published by the government printing office and sells for five cents a copy.

**W**E are advised by the Engineer in charge of WJZ at New York at the present time that station is not operating any short wave telephone channels. For a time WJZ was to be heard on the short waves but apparently work on that band has been discontinued.

**F.** E. FILIES, Jr., 702 Ocean Ave., Portland, Me., must have been a cow puncher in his youth for the manner in which he has rounded up 353 broadcasting stations and logged them all. In the list is included a large number of amateurs. It's hard enough to have to listen on that many stations, but to log them on paper is still harder. Here's your button, Mr. Filies!

**O**NE of the hardest tests that can be imposed upon a B-eliminator is to use it on a short wave receiver in handling amateur traffic on 40 or 80 meters. In this case the operator must wear headphones and if there is any discernible ripple it will be evident.

Recently at the Radio Age laboratory we had an opportunity of testing the Mayolian B supply unit which in addition to the conventional detector, r. f. and audio voltage taps, has a

high tap for a maximum of 180 volts. The unit uses a Raytheon tube. Hooking up the eliminator to the short wave receiver at the station we operated the set for six hours handling traffic and getting even the faintest signals on the dial without ever knowing we had an eliminator hooked up. If any eliminator passes such a test you can *know* it is an eliminator.

**T**WO interesting patents were recently granted A. H. Taylor of Washington, D. C. The first one was for the operation of a number of quartz crystals in series in the grid circuit of a crystal oscillator, and the other one the operation of a number of crystals in parallel in the grid circuit of the crystal oscillator.

The latter patent interested us most, and will interest many amateurs, on account of the higher power which can be put on a single oscillator when two or more crystals are used in parallel. In these cases, however, the crystals must be one thousandth of one per cent accurate, so as to permit their oscillation in parallel. Hodge of 4BY, referred to elsewhere in these columns, is now doing some work along that line and we expect to be able to chronicle his results in a later issue of Radio Age.

**R**EPLYING to a recent letter from RADIO AGE covering the subject of keying at high power, C. W. Horn, superintendent of radio operations of the Westinghouse interests at Pittsburgh, has the following to say:

"The question of keying a transmitter does not hinge so much on the question of wavelength as the type of transmitter. Where high power is used and in congested centers it is necessary that no disturbance be created which will interfere with traffic or reception on other wavelengths. This particularly holds true as regards interference with broadcast frequencies. Any method which causes the energy to start and stop suddenly in the an-

tenna system will cause key clicks. Therefore the only method now available for keying which will prevent such disturbances is that of shifting the wavelength, which has the objectionable feature of utilizing two wave bands instead of one authorized by the license. This can be minimized by shifting the wave but a few hundred cycles, thus using a band no wider than that which would be used if the transmitter was modulated as in broadcasting. The Westinghouse Company has been doing this to some extent successfully, but it requires especially fine receiving equipment with careful adjustment on the part of the operator.

"The matter of varying the load on the rectifiers is one that can be taken care of in several ways. One is to use no chokes and another is to provide an artificial load when the key is up. Another way is to provide a modulating system and to key in that manner, but this is somewhat inefficient for the reason it requires more equipment such as tubes, etc.

"Of the several factors above I consider the matter of preventing interference to broadcast listeners the most important one. Amateurs who desire to make use of transmitting equipment should be careful to refrain from using unrectified current and to cause no key clicks. They should also provide proper equipment across the power supply lines to drain that system of any high frequency energy, which is probably the way most of the interference is caused to neighbors, as in many sections large areas are connected to the same low tension side of the transformer that the amateur is using. In some localities all secondaries of distribution transformers are tied together, thus increasing the possibility of this sort of interference."

We believe Mr. Horn's statements, particularly about draining your power supply so as to curb RF pickup going out onto your neighbors' line, are quite apt and could be followed with good results by all amateurs using alternating current as original supply.

**R**EPORTS received regarding 2XAF just before publication date state voice transmission from that station is being regularly heard in South Africa and Australia. The transmitter used at 2XAF (Schenectady, General Electric Co.) is crystal controlled and uses a vertical antenna hardly fifty feet long, suspended from the cross arm of a wooden pole seventy feet high. The aerial is a single wire about the thickness of a lead pencil. The wave used is 32.79 meters. Reception of this wave at the RADIO AGE laboratory for the past few weeks has been extremely consistent and loud using only a detector and one stage receiver. We have no data as to the antenna current at 2XAF but imagine it is of rather high value on account of the large input.

**E**LMER W. SCHMIDT, 3108 N. Christiana Ave., Chicago, Ill., in addition to being a dial twister, is a candidate for the amateur game. His log includes many of the worth while broadcast stations and a number of amateur stations. The August number of RADIO AGE will have some interesting matter for the telegraphic fraternity.

## U. S. Naval Frequency Assignments

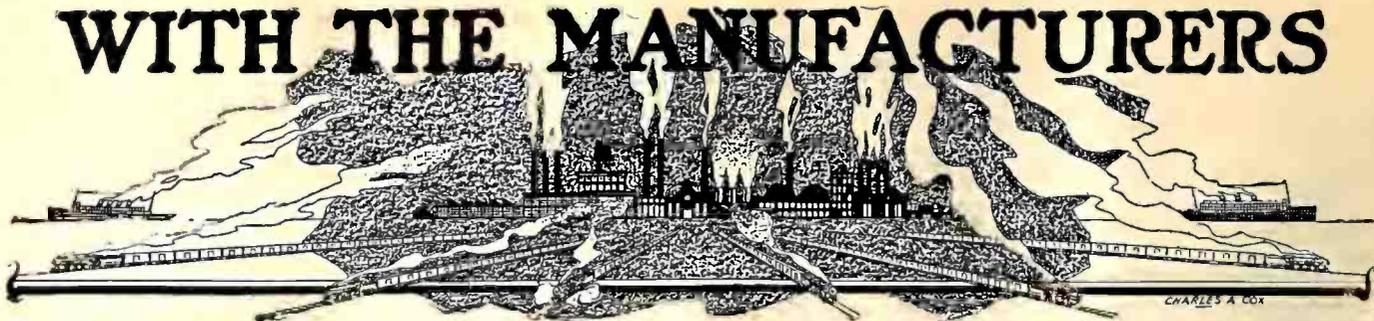
KC	Meters	Stations
17620	17.01	Charleston, S. C., training
17420	17.21	Key West, Fla., training
17300	17.33	New Orleans, La., training
17260	17.37	Great Lakes, Ill., training
16980	17.65	San Diego, Calif., training
16860	17.72	Cavite, P. I., training
16820	17.82	USS Henderson (NOH) for training (NLE, NEZB, NITZ)
16700	17.89	San Francisco, Calif., training
16300	18.38	Honolulu, T. H., training
16220	18.42	Norfolk, Va., training, Puget Sound, Wash.
13215	22.68	Charleston, S. C., training
13065	22.94	Key West, Fla., training
12975	23.10	New Orleans, La., training
12945	23.17	Great Lakes, Ill., training
12735	23.54	San Diego, Calif., training
12645	23.71	Cavite, P. I., training
12615	23.76	USS Henderson (NOH) for training
12525	23.93	San Francisco, Calif., training
12435	24.11	Boston, Mass., training
12225	24.52	Honolulu, T. H. training
12165	24.64	Puget Sound, Wash., and Norfolk, Va., training
8810	34.03	Charleston, S. C., training
8710	34.42	Key West, Fla., training
8650	34.66	New Orleans, La., training
8630	34.74	Great Lakes, Ill., training
8490	35.31	San Diego, Calif., training (NQG)
8430	35.57	Cavite, P. I., training
8410	35.65	USS Henderson (NOH) for training
8350	35.91	San Francisco, Calif., training
8290	36.17	Boston, Mass., training
8150	36.79	Honolulu, T. H., training
8110	36.97	Puget Sound, Wash., Norfolk, Va., training
6972	43.11	San Francisco, Calif., (NPG)
6118	49.00	Honolulu, T. H. (NPM)
6000	49.97	San Francisco, Calif., (NPG)
5657	53.00	Samoa (NPU)
4405	68.10	Charleston, S. C., training
4355	68.80	Key West, Fla., training
4325	69.30	New Orleans, La., training
4315	69.50	Great Lakes, Ill., training
4245	70.60	San Diego, Calif., training
4215	71.10	Cavite, P. I., training
4205	71.30	USS Henderson (NOH) for training
4193	71.50	Washington, D. C. (NKF)
4175	71.80	San Francisco, Calif., training
4145	72.30	Boston, Mass., training
4075	73.60	Honolulu, T. H., training
4055	73.90	Puget Sound, Wash., Norfolk, Va., training
3475	86.30	Naval air stations Lakehurst (NEL) Hampton Roads (NAM) Anacostia (NSF) Pensacola (NAS) Dahlgren (NDY) San Diego (NPL) Quantico (NFV)
3005	99.80	Same as above paragraph

### WORKED 9BHX

Following are amateurs reported as having worked 9BHX during the month of May:

8CJM	5ARH
9ACL	6CUW
4PF	2FR
4JR	9CJQ
9AHM	4VQ
5AQT	8APM
4BY	4BK
4QE	5ACY
4SC	5LS
3BNR	9DOO
5AUZ	2KG
9BFK	

# WITH THE MANUFACTURERS



## Clapp-Eastham Company Moves to New York

**C**LAPP-EASTHAM Company, located for many years at Cambridge, Mass., has moved their whole plant to Long Island City, N. Y., according to announcement of Verner A. Hendrickson, the president. This move marks the passing of the world's oldest exclusive radio manufacturer from New England.

For over twenty years the Clapp-Eastham Company has been located at 139 Main St., Cambridge. Its new quarters are in the Chicle Bldg., Thompson Ave., Long Island City. This location was made necessary to obtain larger quarters, particularly for space and to secure a national distributing point. The new factory is modern and up-to-date in every respect.

An entire new line will be brought out. One of the receivers is designed either for "A" or "B" eliminators.

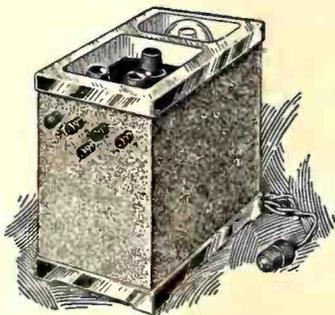
Both sets will utilize the time-tested radio frequency circuit with controlled regeneration added. The receiver will be wholly "squealless."

The company has been re-organized on a large scale and will go into volume production. It will continue under the direction of Hendrickson, who is a well-known pioneer in the industry.

## Los Angeles Show

**T**HE exposition committee of the Radio Trades Association of Southern California under whose guidance the successful 1925 Radio Show was held, announces September 5 to 11, inclusive, as the dates for the 1926 Radio Show, which will again be held in the Ambassador Auditorium at Los Angeles.

## Mayolian B Supply



**T**HE Mayolian "B" supply shown above is encased in a beautiful mottled blue gray metal cabinet, with a satin finish aluminum base and top, and engraved Bakelite panel.

As a full wave rectifier, it employs the Raytheon long life rectifier.

It is equipped with three separate and variable voltage taps; one for the detector tube, one for the radio frequency tubes, and one for the audio frequency tubes. When these taps are adjusted to the set, the eliminator requires no further attention.

The detector voltage is variable from 0 to 60 volts, and is controlled by a specially constructed resistance which is noiseless.

The radio frequency or medium voltage is controlled by a variable resistance and will supply to the receiver any voltage from 40 to 110 volts.

The total output or amplifier voltage is controlled by a panel switch, which has three positions and can be set to supply the correct voltage necessary to obtain the best results.

With the Mayolian one can obtain a high "B" voltage up to 180 volts, which is quite desirable for power amplification.

## Abandon KOP

**D**ETROIT police recently abandoned their broadcasting station, KOP, to operate a station known as WCK on 144.8 meters.

## Leaks in Vacuum

**T**HE TOBE Deutschmann Company, Cornhill, Boston, Mass., has secured the contract as sole representatives in the United States for the Loewe leaks. These are metallic resistors in a vacuum tube, designed and developed by Doctor Siegmund Loewe of Berlin.

## St. Louis Radio Show

**T**HE ST. LOUIS Radio Trades Association will hold its second show October 18 to 23, inclusive. It is known as the second annual southwest national radio exposition, at the Coliseum. Wm. P. Mackle is executive secretary, 1207 Syndicate Trust Bldg., St. Louis, Mo.

## New Models of Burns Speakers

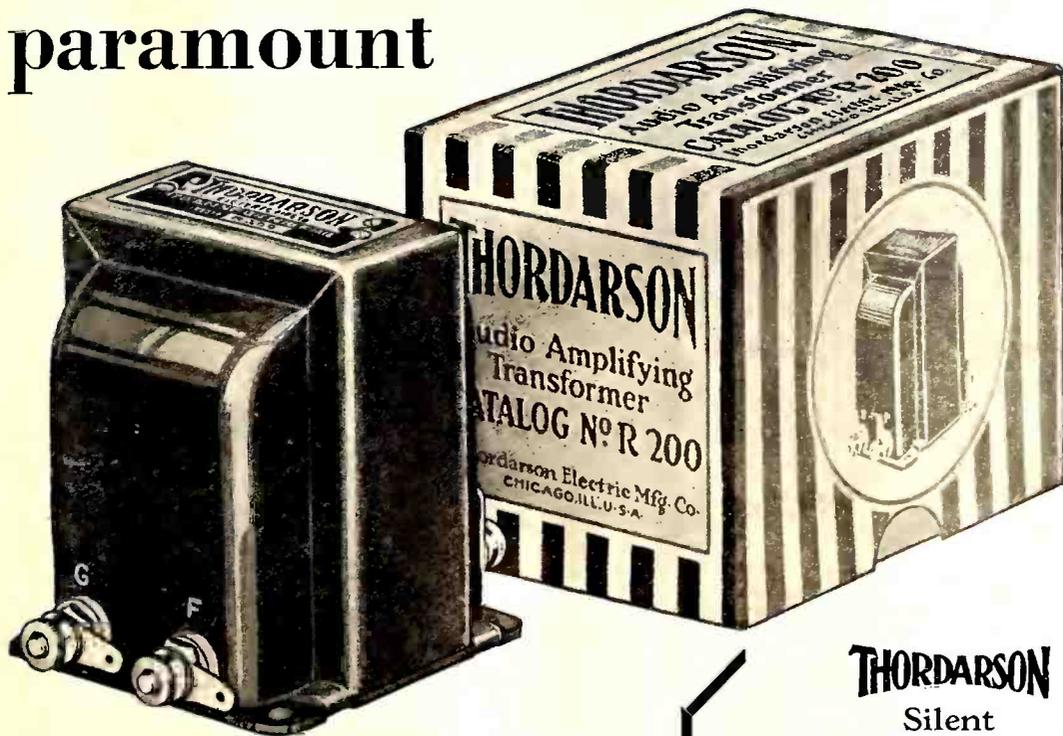
**T**HE American Electric Company of Chicago are announcing new models in their Burns loud speakers for the coming season. They will have something particularly attractive in the new floor cabinet speaker—the Burns Ortho-Harmonic. Some rather original features have been worked out in this speaker, embodying the latest developments in acoustics.

Included in these new developments by the American Electric Company will be the Burns Hi-Lo Speaker Unit. The reproducing qualities of this unit will certainly prove a revelation as to what is possible in this type of equipment—the range of tone, the volume, and above all else the remarkable timbre.

## New Code Channel

**T**HE Radio Corporation has just opened a new short-wave commercial radio telegraph station at Rocky Point, N. Y. It will carry on a continuous service on 18 meters. The call is WLL.

# Specified wherever tone quality is paramount



**THORDARSON**  
R-200

The proof of the pudding is in the eating.

The satisfaction you derive from your radio set depends upon its fidelity of reproduction.

Since the institution of broadcasting, Thordarson transformers have been the great outstanding factor of faithful reproduction in a multitude of receivers.

That is why to-day you find more Thordarson transformers in the receivers of leading manufacturers than all competitive transformer combined.

The Thordarson R-200 is available at reliable dealers everywhere at a cost of eight dollars.

## THORDARSON

Silent  
B-eliminator  
Transformers and Chokes

We unhesitatingly recommend the Raytheon type B-eliminator for quiet and efficient operation on all types of receivers. Thordarson transformers and chokes are available for this circuit.

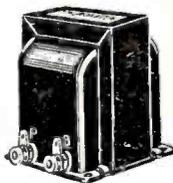


**Transformer R-195**

Larger in capacity — Will not heat up in continuous service. Separable plug, 6 foot cord attached. At reliable dealers everywhere, price \$7.00.

**Choke R-196**

Completely shielded and mounted in steel case. Binding posts at base for neat assembly. Capacity 60 milliamperes. 30 henries inductance. Price \$5.00.



Write for assembly instructions

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

### Aerial Night's Entertainment —and Otherwise

(Continued from page 32)

plaintively that in every home he had visited where they owned a radio set, the old familiar air was rolling forth from some point of the compass. The reason for the occasional renaissance of some forgotten composition by a score of stations on the same night must be added to the ever-growing list of broadcast mysteries.

### Jazz To Stay

TO RETURN to our Lombardos,—they sing as well as play,—or almost as well as they play,—and one of the brothers, Carmen, we believe, has a voice which he uses to advantage in the popular numbers which make up the orchestra's repertoire. One's impression of this organization is that it symbolizes youth,—yet that may be said of all jazz. Some one asked the other day where jazz musicians go when they get old, and the reply, "Into the symphonies," can scarcely be correct, for so many of them come from there. The more we listen to orchestras of this character the more we agree with Paul Whiteman that jazz, carefully and conscientiously executed, has come to stay. In the case of the Lombardo outfit, there is scarcely a home with dancing feet that does not know their music.

Another WTAM feature along this same line is Austin Wylie's Vocalion Recording Orchestra, which alternates with the Lombardos in the noon-day and evening dance programs. The outstanding feature of this organization seems to be one Jack Rose, who performs on a variety of instruments that embraces almost everything but our pet aversion, the vibraphone.

Carl Rupp and his Hollenden Hotel Orchestra have done much to add to the prestige of WTAM. Aside from the dinner-hour concerts from the hotel, they put on an hour Saturday night that is always worth waiting for. Occasionally they turn themselves into a symphony and do some exquisite bit, again they cater to the popular taste, but

all their performances are conscientious and show careful conducting. Mr. Rupp is a composer of reputation,—his chief claim to fame the past winter being the melodious "Love Bound." We've liked especially his arrangements of old musical comedies and hits of former years, a class of music that has a wide appeal, and to date has not been overdone.

When WTAM wants to be really serious and produce music of the highest order it puts on the Willard Symphony, under the able direction of Walter Logan. We have heard some very fine concerts and operatic productions the past winter from this organization and assisting vocalists.

And then there are the broadcasts from Cleveland's great public Auditorium, which embrace a wide range of subjects, and it is on these programs that Louis Rich and his Blue Room Orchestra are heard. In fact an attempt to catalog all the many features this station has at its disposal is somewhat bewildering. While WTAM is essentially a cheerful station, and most of its broadcasts are designed to chase away the blues rather than disseminate heavy culture, there is a fine balance to its programs that makes them acceptable to all classes.

### Saturday Night Session

WE KNOW not what embryonic Earl Carroll conceived the idea that it was fitting and proper for radio stations to have a mental lapse one night in the week, and stage what is commonly known as a "nutty" program, (and it is possibly well for the genius that he is unknown to posterity) but the idea caught on to a deplorable extent, and in the average case has done more to injure broadcasting with intelligent listeners than any other single phase of radio. The "clubs," the "gangs," the "owls," and other multitudinous organizations, that through poor direction, indifferent talent, and in many cases, flagrant bad combine to make night hideous, have discouraged many a listener. Too often the humor

(Please turn to page 57)

**FREE!**

To Each Purchaser of a **WORLD 6V. Auto or Radio BATTERY**

**12-Cell — 24-Volt Storage 'B' Battery**

Positively given free with each purchase of a **WORLD "A" Storage Battery**. You must send this ad with your order. **WORLD Batteries** are famous for their guaranteed quality and service. Backed by years of successful manufacture and thousands of satisfied users. Equipped with **Solid Rubber Case**, an insurance against acid and leakage. You save 60 per cent and get a **2-Year Guarantee Bond in Writing**.

**WORLD Battery owners!** That's our best proof of performance. Send your order in today.

**Solid Rubber Case Radio Batteries**

6-Volt, 100-Amperes	\$11.25
6-Volt, 120-Amperes	13.25
6-Volt, 140-Amperes	14.00

**Solid Rubber Case Auto Batteries**

6-Volt, 11-Plate	\$11.25
6-Volt, 13-Plate	13.25
12-Volt, 7-Plate	16.00

**Send No Money** Just state hatery wanted and we will ship day order in received, by Express C. O. D. subject to your examination on arrival. **FREE "B" Battery** included. Extra Offer: 5 per cent discount for cash in full with order. Buy now and get a guaranteed battery at 50 per cent saving to you.

**WORLD BATTERY COMPANY**  
1219 So. Wabash Ave., Dept. 36 CHICAGO, ILL.

**World STORAGE BATTERIES**

ROKA - WFAF - WGN - WJS - KRLJ - KGO - KFAP - WJY - KOB

Set your Radio Dials at 210 meters for the new 1000 watt World Storage Battery Station, WSHC, Chicago. Watch for announcements.

**Be A RADIO EXPERT**

**STUDY at HOME**

Radio, the wonder of all ages, has grown with gigantic strides. Radio experts are needed to keep pace with the growth. Thousands of good-paying positions are open to trained men. Be a radio expert—earn big money—travel—get into the limelight. There's romance, power and fortune ahead for men with vision now just as there was when Henry Ford got started on his auto. The ground-floor opportunity is here.

**YOU EARN WHILE YOU LEARN**

Our home-study course in practical radio can be mastered by you in 3 months. Become a radio engineer. Write for free booklet, "Millions Untouched."

**FREE—TWIN** if you enroll now. Send 6 UPERDON letter or postal to **RADIO SET** I. J. Mendels.

**AMERICAN RADIO ENGINEERS,**  
Dept. 315 Hearst Bldg., Chicago, U. S. A.

\$50-\$200 a week

millions untouched

**RADIO** We want to hear from hard-hitting radio dealers operating live-wire stores who want to make the best jobber connection in America.

**DEALERS**

Our eight big warehouses furnish you with the finest products in radio. And we ship fast.

**WANTED**

Write today on your letterhead for big catalog of nationally advertised lines. Ask for L 1006

**WAKEM & McLAUGHLIN, Inc.**  
225 E. ILLINOIS STREET, CHICAGO, ILL.

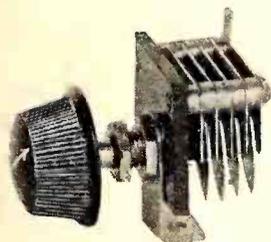
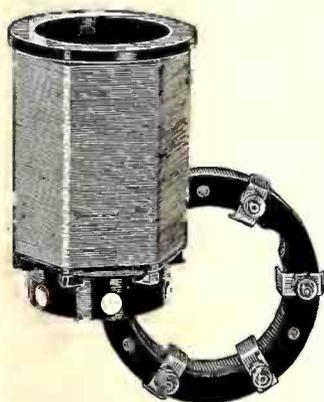
**AMSCO RADIO PARTS**

CONDENSERS  
VERNIERS  
RHEOSTATS

**AMSCO PRODUCTS, Inc. New York City**

# SM

## Products of a Laboratory



**S**ILVER-MARSHALL products first of all are built to perform. The most delicate and up to date sensitivity measuring equipment is employed to insure the operation of all radio units sold to the consumer. In every sense of the word they are products of a laboratory and not merely thrown together to sell—they are built to give satisfaction.

### Long Wave Transformers

The 210 and 211 long wave transformers are measured and guaranteed. They are tested with equipment approximating actual receiving conditions and actual amplification to the fraction of one per cent is predicted in tests that these transformers have to pass. The 210 is an untuned iron core transformer and the 211 is a sharply tuned air core filter. Supplied, measured in any quantity for 199 or 201A tubes. \$6.00 each.

### Interchangeable Coils

These uniformly interchangeable inductances are made in ranges from 30 meters up. They are space wound with enameled wire and the uniformity is better than one-fourth of one per cent. This makes them ideal for gang condenser design. Suitable for all standard circuits wherever the finest is required. They will increase the scope of your receiver more than 100%. "A" type, 30 to 75 meters; "B" type, 70 to 200 meters; "C" type, 190 to 550 meters, \$2.50 each. No. 515 Universal Socket \$1.00 each.

### 340 Compensating Condenser

The 340 condenser is a small .000025 mfd. adjustable condenser designed for compensating, balancing, or neutralizing. Its sphere of usefulness is not limited to these purposes, however. Supplied with brass plates, mounted on a bakelite head. Size, 1 1/8" wide, 1" deep and 1 1/2" high. Furnished with control knob for single-hole panel mounting, and also with bracket for base mounting. The price is \$1.50.

### Universal Vernier Dial

The Silver-Marshall type 801 vernier dial is composed of a black bakelite dial housing enclosing a reversible celluloid-finished indicator plate marked off to half-degree divisions, controlled by a knurled tapered knob. The reduction ratio is 14.5 to 1, and the dial, due to an automatic friction take-up, is absolutely without backlash. It is provided with logging space. The dial will fit any condenser, either left or right, or half or full turn movement. Price \$2.50.

## Silver-Marshall, Inc.

850 West Jackson Blvd.

Chicago, U. S. A.

# A new-type radio offers 4 great advantages

- 1 **Greater distance.** Coast to coast in winter. 1000 miles in summer.
- 2 **Finer tone.** No distortion. All tones crystal clear.
- 3 **Better selectivity.** Find any station already logged in 20 seconds.
- 4 **Increased volume.** Brings in distant stations with volume enough to fill an auditorium.

# ERLA

FOR CLEAR, QUIET "B" POWER



**25** RADIO Storage "B" Battery

**12 Cells 24 Volts** Lasts Indefinitely—Pays for Itself  
 Economy and performance unheard of before. Recharged at a negligible cost. Delivers unfatiguing power that is clear, pure and quiet. Approved and listed as Standard by leading Radio Authorities, including Pop. Radio Laboratories, Pop. Sci. Inst., Standard, Radio News Lab., Lofox, Inc., and other important institutions. Equipped with Solid Rubber Case, an insurance against acid leakage. Extra heavy glass jars. Heavy rugged plates. Order yours today!  
**SEND NO MONEY** wanted and we will ship day order received. Extra offer: 4 batteries in series (96 volts), \$10.60. Pay expressman after examining batteries. 5 percent discount for cash with order. Mail your order now!

**WORLD BATTERY COMPANY**  
 1219 So. Wabash Ave., Dept. 81 Chicago, Ill.  
 Makers of the Famous World Radio "A" Storage Battery.  
 Prices: 6-volt, 100 Amp. \$11.25; 120 Amp. \$12.85; 140 Amp. \$14.00.  
 All equipped with Solid Rubber Case.

**World STORAGE BATTERIES**  
 Set your Radio Dial at 210 meters for the new 1000 watt World Storage Battery Station, W.S.B.C., Chicago. Watch for announcements.

## EVERYTHING IN RADIO AT BARGAIN PRICES

Just hot off the press—1926 Radio Catalog & Guide brimful of latest ideas, newest hookups—all free. Shows savings as high as 50% on standard guaranteed radio parts, sets, kits. Be sure to get this thrifty book before you buy. It puts money in your pocket. Unusual? You'll say so when you get it. Also please send name of radio friend. Write today.

**THE BARAWIK COMPANY**  
 102 126 S. Canal St., Chicago, U. S. A.

## Porto Rico—The Enchanted Isle

(Continued from page 29)

sleep under blankets in the high lands.

The island has been called Uncle Sam's Tropical Garden and truly, with its flowers, its gorgeous sunsets and its leisurely life it merits the description.

### Porto Rico Booster

**T**HOUGH Mr. Agusty's enthusiasm for radio is keen he is an even greater booster for Porto Rico. And he knows how, for he began to hustle at the age of fourteen, when his parents died and he found himself at the head of the family with brothers to support.

His first job was watchmaking. Later he was employed in the printing department of the Insular Government and after his interest in radio developed finally found himself in his present happy niche with WKAQ.

He will tell you that it was at Arroyo, Porto Rico, that Morse tried out his telegraph invention and he can see no reason why equally important developments in radio should not also take place in the beloved isle.

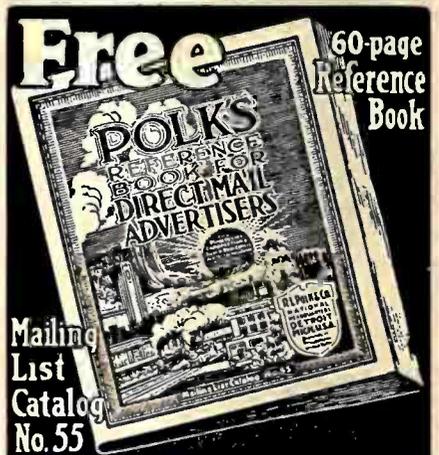
In the twelve months ending June, 1925, the United States exports of radio supplies amounted to \$13,642 and the difficulty of obtaining receiving sets locally is one of the reasons that the estimated number of radio listeners in the island is about 2,500.

The remnants of the peculiar living conditions of Spanish days still linger in the roots of the common people. The *jibaro*, (mountain dweller) comes slowly under the influence of modernity; but he is coming; and a great and wonderful future is opening before his eyes.

In the meantime massive machinery goes on crushing sugar cane. There is horse racing and baseball. Evening concerts are given in the Plaza Principal in front of a City Hall built in 1799; the fort of San Cristobal frowns down upon the doings of tamarindo vendors and palm leaf hat merchants. The Ballaja Barracks, built for 2,000 Spanish soldiers and now occupied by Porto Rican members of Uncle

Sam's army, floats the Stars and Stripes above.

In San Juan the clubs and varied women's activities advance the cause of civilization in their own ways while on top of the telephone building Mr. Agusty stands before the microphone of WKAQ, the living voice of Porto Rico—with its Spanish accent—alive, enthusiastic, full of hope and promise and vibrant with the romance of the Enchanted Island.



Mailing List Catalog No. 55

### POLK'S REFERENCE BOOK

FOR DIRECT MAIL ADVERTISERS

Shows how to increase your business by the use of Direct Mail Advertising, 60 pages full of vital business facts and figures. Who, where and how many prospects you have. Over 8,000 lines of business covered.

Write for your FREE copy.

**R. L. POLK & CO., Detroit, Mich.**  
 599 POLK DIRECTORY BUILDING  
 Branches in principal cities of U. S.

## PATENTS

### To the Man with an Idea

I offer a comprehensive, experienced efficient service for his prompt, legal protection and the development of his proposition.

Send sketch of model and description, for advice as to cost, search through prior United States patents, etc. Preliminary advice gladly furnished without charge.

My experience and familiarity with various arts frequently enable me to accurately advise clients as to probable patentability before they go to any expense.

Booklet of valuable information and form for properly disclosing your idea free on request. Write today.

**RICHARD B. OWEN, Patent Lawyer**  
 81 Owen Bldg., Washington, D. C.  
 41-M Park Row, N. Y. City

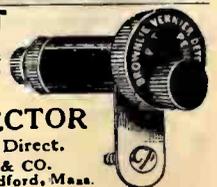
### YOU CAN GET

Greater reflex or crystal set reception if you use the

### BROWNLIE VERNIER DETECTOR

\$2.00 At your dealer or Direct.

**ROLAND BROWNLIE & CO.**  
 21 Sanders St. Medford, Mass.



Use the Log-a-Wave Chart  
 Page 64

### Tube Rejuvenation Is An Attractive Operation

(Continued from page 23)

the filament to produce the plate current necessary to impress the characteristics of the received radio waves upon the diaphragm of the phone or loud speaker. At this point the tube is "dead," though its filament may burn as gaily as before.

The thorium in the filament, however, may not be completely exhausted. In the deeper strata of the metal there may be lurking particles that can be coaxed to the surface and made to function. Some scientist discovered that the way to bring them out was to keep the filament heated but prevent the escape of electrons from the tube.

#### Hastening Process

IF more than the voltage usually delivered by the radio storage battery is available, the process of rejuvenation may be hastened. Sixteen to eighteen volts, applied for thirty seconds, then ten volts applied for about ten minutes, are the doses for 6-volt tubes, according to a recent radio text book. For the low-voltage tubes it is better to apply not more than twelve volts for the first half-minute period, and the eight volts for ten minutes. These figures do not agree exact-

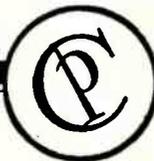
ly with the recommendations of some manufacturers concerning tubes of their own manufacture. Alternating current appears to work as well as direct current, as it heats the filament equally well. There is no sixty-cycle hum because there are no phones or loud speaker in the circuit to hum it. Transformers that will step down the voltage of the house lighting circuit to that required for the rejuvenating process may be found in toy shops.

The tube rejuvenators now on the market enable the user to make his methods more exact. Some of them are designed for use with alternating current. These contain transformers to reduce the voltage so as to regulate the voltage applied to the filament. Those designed for use with direct current need no trans-

formers, of course, but do have resistances. The directions furnished with these devices tell just what treatment to give each type of tube. Some of the rejuvenators have meters, so that the result of the rejuvenation may be measured before the tube is returned to its socket in the radio set.

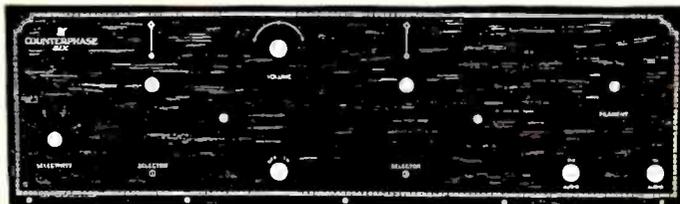
With the prices of tubes reduced as they have been, and with these processes of rejuvenation demonstrated to be practical, there are now no reasons why we should not play with radio all we want to, except those that wife enumerates along about 3 a. m. as she leans over the banister in her nightie and inquires, with quinine-coated sarcasm, why, since we can sit up all night listening for Europe, we cannot keep awake one hour in church!

Look for this Mark



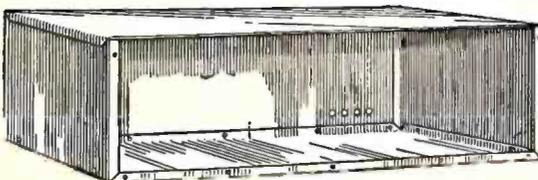
It Denotes the Genuine

## Crowe Metal Panels and Shields



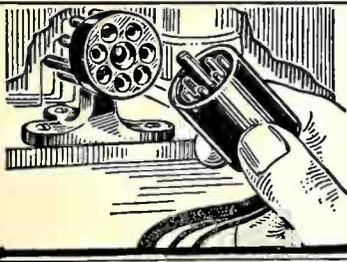
solve shielding problems for the home set builder. Q Insure maximum selectivity in congested districts. Q Write for bulletin giving latest list of available panels and shields for popular circuits.

Address  
**Crowe Mfg. Co.**  
1749  
Grace St.  
Chicago



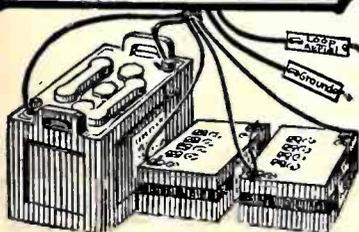
Leading Dealers Sell Them

Dealers—Crowe products are supplied by responsible distributors from coast to coast. Write for list.



### ON YOUR SET Jones MULTI-PLUG THE STANDARD SET CONNECTOR

Get a Multi-Plug for your present set—or the one you're building. A single plug connects your batteries, ground and aerial to a socket on the set. Ask your radio dealer.



# BIG MONEY!

\$3,000 to \$10,000 a year

Want to make big, easy money? Learn how to install, operate, repair, construct and sell Radios. Write now for facts about the amazing opportunities for Radio experts, and our special offer of a FREE 1000-mile receiving set, and how you can quickly train at home by mail.

## Be a Radio Expert

No previous experience necessary. Anyone with ordinary education can now learn Radio quickly under our simplified home-study plan. We need men right now to represent our Association. Be the Radio expert in your neighborhood. Get your share of the big profits. Hundreds about you want Radios and advice how to operate. You can earn enough money right from the start to pay for course. Nothing difficult about it. Low cost and easy terms.

## FREE 1,000-MILE Receiving Set

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

Radio Association of America  
4513 Ravenswood Ave., Dept. 1347 Chicago, Ill.

First with the Blueprints—Radio Age still leads the field. Watch for the August Blueprint Section!



## Bradleyunit PERFECT FIXED RESISTOR

WHETHER you build a resistance-coupled audio amplifier or a B-battery eliminator, be sure to ask your dealer for Bradleyunits. These perfect fixed resistors are made of solid molded material and cannot deteriorate with age. Bradleyunits are accurately calibrated and fitted with silver-plated caps which permit soldering without injury to the Bradleyunit. Ask your dealer for Bradleyunits, today.



ALLEN-BRADLEY CO.,  
289 Greenfield Ave., Milwaukee, Wis.  
Please send me your latest literature on Bradleyunits and Bradleyunit Amplifier Resistors.

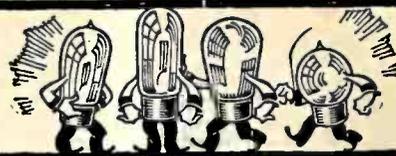
Name .....  
Address .....

## Ground and Sky Waves Subjects Tests

**S**UBSTANTIATION of the theory that radio waves split into a ground wave and a sky wave in passage from transmitter to receiver, has been found in preliminary compilation of data secured by radio engineers of the General Electric Company in broadcast wave propagation tests conducted from January 1 to May 8.

According to the split wave theory, one wave passes along the earth and the other, passing into the air probably about 100 miles or so above the earth, continues until reflected down upon the receiver by a semi-conducting layer in the atmosphere. The ground wave weakens rapidly and becomes negligible about 200 miles from the broadcasting station and reception at greater distance is due entirely to the sky wave.

In conducting propagation tests with the cooperation of radio listeners in every part of the country, the engineers were seeking, among other things, the possible relation of radio reception and the condition of the weather. The weather condition is known to depend largely on the barometric pressure over various parts of the country and radio engineers endeavored to find a relation between reception records and the barometric pressure through which the waves had passed. From present analysis of data it seems probable that barometer and weather have only a minor effect on radio conditions. The data do show that signals received at short distances are stronger when they have come along a region of even pressure than when they have come from a low pressure area to a high pressure area, or vice versa. At distances of more than 400 miles, however, the conditions on the surface of the earth seem to have little or no effect. On the basis of the split wave theory of transmission, it becomes obvious that if the sky wave goes through an arc reaching 100 miles or more above the earth, weather conditions, which are known to go up less than ten miles, can have but little effect upon it.



## Use any tubes

**A**NY TYPE or combination of Tubes can be used with AMPERITE. Insures filament regulation to meet each tubes' individual needs. Specified in all popular construction sets.

Price \$1.10

Dept. R. A. 7 Radiall Company  
50 Franklin Street, New York City

Write for FREE Hook-ups

# AMPERITE

REG. U.S. PAT. OFF.

The "SELF-ADJUSTING" Rheostat

WRITTEN 2-YEAR GUARANTEE

## Arrow Battery

### Battery Prices SMASHED!

**To Consumers Only**  
Here is a real battery quality, guaranteed to you at prices that will astound the entire battery-buying public. Order Direct From Factory. Put the Dealer's Profit in your own pocket. You actually save much more than half, and so that you can be convinced of true quality and performance, we give a *Written 2-Year Guarantee*. Here is your protection! No need to take a chance. Our battery is right—and the price is lowest ever made. Convince yourself. Read the prices!

<b>Auto Batteries</b>	<b>Radio Batteries</b>
6 Volt, 11 Plate, \$8.50	6 Volt, 100 Amp, \$8.50
6 Volt, 13 Plate, 10.25	6 Volt, 120 Amp, 10.25
12 Volt, 7 Plate, 11.75	6 Volt, 140 Amp, 11.75

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

ARROW BATTERY CO.,  
Dept. 12, 1215 So. Wabash Ave., Chicago

"Banjo Plunker"



Uncle Dave Macon

WHOOOP 'em up Cindy, and cook that possum brown, 'cause Old Dan Tucker is comin' to the log cabin in the lane, and we'll bile the cabbage down."

Uncle Dave Macon has been pickin' the banjo for nearly a half-century. His programs in the studio of WSM, The National Life and Accident Insurance Company's station, Nashville, Tennessee, include the old time songs of the South, still very much beloved by the older generation, and interesting to the younger people who listen to the barn dance programs on Saturday night. Uncle Dave is one of the many picturesque characters of the Tennessee hills.

**A&B Battery Charger ONLY \$2**

SATISFACTION GUARANTEED



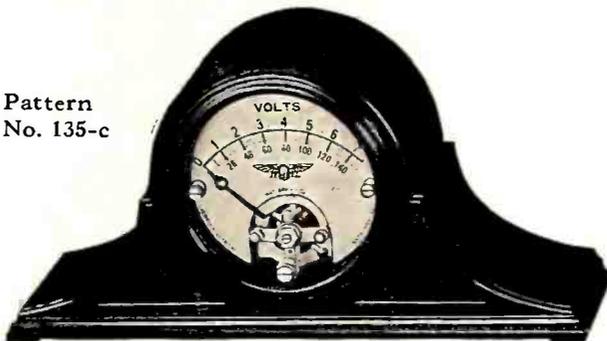
Charges any type of storage A or B battery, using a few cents worth of ordinary house current, either alternating or direct. Cannot injure battery. Complete directions enclosed. Anyone can operate. No expensive "extras" to buy. Why pay

\$10.00 to \$15.00 for a charger when you can get this splendid GUARANTEED R. B. Charger by mailing us two dollars (bills, money-order, check or stamps) plus ten cents in stamps or coin to pay mailing costs. Charger will be sent postpaid. If you are not satisfied, return within five days and we will refund your money. Order at once—TODAY.

R. B. SPECIALTY COMPANY  
Dept. 1020, 308 East Third St., Cincinnati, Ohio



Pattern No. 135-c



**Radio Voltmeter  
"De Luxe"**

The Jewell No. 135-C Portable Voltmeter is not only the most serviceable radio instrument made, but it is also the most beautiful. The entire case holding the movement is made of moulded genuine black Bakelite. The metal scale is silver etched with black characters and all visible parts of the movement are silvered to prevent corrosion.

Two cords with phone tips are furnished for plugging into the jacks on panels of Radiola, Victor, Brunswick and other sets.

The 7 1-2 volt scale is used for adjusting filament voltage and by changing the connections the 150 volt scale may be used for checking "B" batteries.

*"Don't make the mistake of guessing—it is costly. Save your tubes and keep your batteries checked."*



Ask your dealer for our No. 735 and 739 circulars describing the two instruments illustrated in this ad. If you are building a set ask for 15-C Radio Catalog.



**Jewell Electrical Instrument Co.**

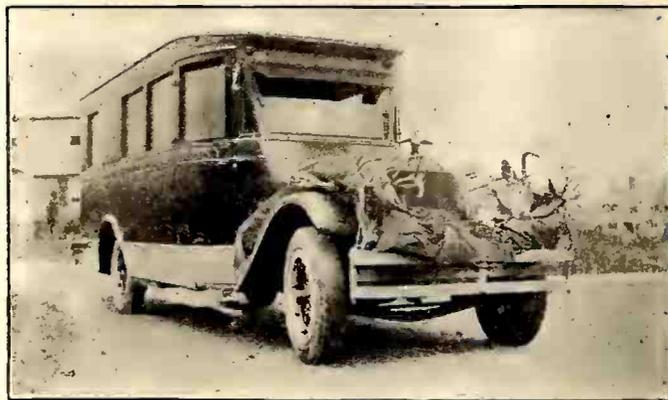
1650 Walnut St.

Chicago

*With a Jewell No. 107 Jr. Tube-Checker it is easy to check a tube at home*

*26 Years Making Good Instruments*

# BUNNY BUS HAS RADIO



THE 'Bunny Bus' shown above is mounted on a special White 15-45 chassis and is a complete home in every detail. It was designed by W. G. Kelly of Fairmont, W. Va. and built to order. Special equipment includes a Zenith radio, ventilators and electric fans, a refrigerating plant, hot and cold running water, shower bath, toilet, cook stove, sink, etc. Sleeping accommodations for four people. The bus carries four large wicker chairs which makes comfortable riding. Special closets are built in to take care of dishes, fishing tackle and other accoutrements of camp life. If there is anything missing which might add to our comfort while on the road, we haven't noticed the lack of it. I might add that while we were touring Florida last year, our Zenith radio was a great pleasure. We could pick up all the northern stations, including Canada, and while in Canada last fall on a shooting trip, we experienced some very rough going, snow, ice, mud and rain, but our Zenith was always on the job to cheer us up of evenings. We gathered up many stations, including Florida.—Excerpts from Mr. Kelly's letter.

**FREE!**

**12-Cell—24-Volt Storage 'B' Battery**

Positively given free with each purchase of a WORLD "A" Storage Battery. You must send this ad with your order. WORLD Batteries are famous for their guaranteed quality and service. Backed by years of successful manufacture and thousands of satisfied users. Equipped with Solid Rubber Case, an insurance against acid and leakage. You save 50 per cent and get a **2-Year Guarantee**

**Bond in Writing**—Very owners "tell their friends." That's our best proof of performance. Send your order in today.

**Solid Rubber Case Radio Batteries**

6-Volt, 100-Amperes . . . . .	\$11.25
6-Volt, 125-Amperes . . . . .	13.25
6-Volt, 140-Amperes . . . . .	14.00

**Solid Rubber Case Auto Batteries**

6-Volt, 11-Plate . . . . .	\$11.25
6-Volt, 13-Plate . . . . .	13.25
12-Volt, 7-Plate . . . . .	16.00

**Send No Money**—Just state battery wanted and we will ship day order is received, by Express C. O. D., subject to your examination upon arrival. **FREE "B"** Battery included. Extra Offer: 5 per cent discount for cash in full with order. Buy now and get a guaranteed battery at 50 per cent saving to you.

**WORLD BATTERY COMPANY**  
1219 So. Wabash Ave., Dept. 36 CHICAGO, ILL.

**World STORAGE BATTERIES**

Set your Radio Dials at 210 meters for the new 1000 watt World Storage Battery Station, WSBG, Chicago. Watch for announcements.

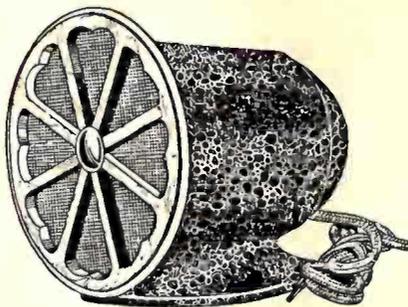
## Freshman Has New Type Loud Speaker

CHAS. FRESHMAN CO., INC., manufacturers of tuned radio frequency receivers and "B" battery eliminators announce the introduction of an entirely new type of loud speaker.

a new development, resembling the old type "leaks" in size only. They are a scientific product from start to finish.

The actual resistance element is in chemical form and deposited on the inner surface of a high grade glass tube. The process then involves the use of high temperature heat treatments with the final result that the resistance becomes an integral part of the glass section.

Manufacturing process and inspection must be highly developed to insure a perfect product. A most scientific calibration method assures a resistance well within 10% of its rated value.



The speaker is of a very novel construction and incorporates a special reflexed resonating air chamber which affords wonderful volume and most realistic quality reproduction. It is but six inches high and is readily adaptable for placing in any nook, corner or on top of or alongside the radio receiver.



Amsco Socket

AMSCO'S plug receptacle is shown above which, through its mechanical isolation and accompanying reduction of vibratory feedback, contributes to the overall efficiency of receiving circuits. It is particularly recommended for receivers incorporating built-in speakers.

## Daven Has New Type of Resistor

DAVEN has recently placed on the market a new resistor called "Glastor." It is a radical departure in the art of grid and plate resistor manufacture. "Glastors" are entirely

**POOR SUMMER RECEPTION**

is overcome when you install a set of our perfectly matched

**COILS**

\$1.00 each for any standard size or style. Machine wound and tested. All kinds of inductance made to order.

**KISSEL-CARMAN LABORATORY**  
4905 Lake Park Ave., Chicago, Ill.

**Free Mailing Lists**

Will help you increase sales. Send for FREE catalog giving counts and prices on thousands of classified names of your best prospective customers—National, State and Local—Individuals, Professionals, Business Concerns.

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**ROSS-Gould Co., 4339 St. Louis**

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**RANDOLPH RADIO CORP.**  
159 N. UNION AV. Dept. 4 CHICAGO, ILL.

**PATENTS**

PROMPTLY PROCURED SEND A SKETCH OF YOUR INVENTION FREE INVENTION RECORDING BLANK

NAME \_\_\_\_\_

ADDRESS \_\_\_\_\_

**MAIL TO-DAY**

**Z. H. POLACHEK**  
PATENT ATTORNEY CONSULTING ENGINEER  
70 WALL ST. NEW YORK

**Zenith Doing Much to Make Radios Beautiful**

(Continued from page 9)

coils being arranged on a shaft which turns in step with the variable condensers and alters the inductive coupling between the RF primaries and the secondaries.

Two control models which have been favorites in the past seasons will still be made, although not in the highest priced consoles.

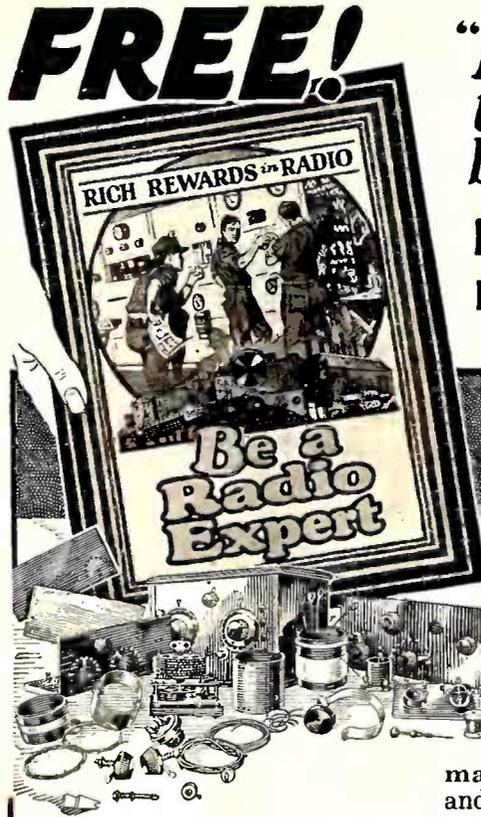
In addition to receivers so far the Zenith organization is manufacturing two accessories. The first is a B eliminator which has been on the market a short while, and the second is the new Zenith reproducer, which is also shown pictorially in these columns. In designing this new reproducer the Zenith engineers have succeeded in getting a much larger resonant surface into a smaller space than it had been thought possible. The range of tone is from that of the shrill notes of the upper register of a pipe organ or a piccolo down to the rumbling notes of the bass.

Radio sets in the past have not been especially beautiful but Zenith is doing much to change that condition so the lady of the house can point with pride to a receiver instead of hiding it in the study or den.

**A new-type radio offers 4 great advantages**

- 1 **Greater distance.** Coast to coast in winter. 1000 miles in summer.
- 2 **Finer tone.** No distortion. All tones crystal clear.
- 3 **Better selectivity.** Find any station already logged in 20 seconds.
- 4 **Increased volume.** Brings in distant stations with volume enough to fill an auditorium.

**ERLA**



**These Instruments FREE of Extra Cost**

All instruments shown here and others—SIX BIG OUTFITS—sent to all our students free of extra cost under short-time special offer. Clip coupon now—find out all about this big unequalled offer while you still have time to take advantage of it. Our training is intensely practical—these instruments help you learn to do the practical work. Receiving sets, from simplest kind to thousand-mile receiver. Many other big features.



J. E. SMITH  
President

**My Radio Training is The Famous "Course That Pays For Itself"**

Spare time earnings are easy in Radio when you know it the way we teach you. Increase your income almost from the start of your course through practical knowledge we give you. We show you how to hold the job, then our Big Free Employment Department helps you get one. Free Book "Rich Rewards in Radio" tells how.

Howard B. Luce of Friedens, Pa., made \$320 in 7 weeks during his spare time. D. H. Suitt of Newport, Ark., writes, "While taking the course I earned in spare time work approximately \$900." Earl Wright of Omaha, reports making \$400 in a short time while taking his course—working at Radio in his spare time only! Sylvester Senso, 207 Elm Street, Kaukauna, Wis., made \$500.

And when your training is completed you're ready to step into a real big Radio job like C. C. Gielow, Chief Operator of the Great Lakes Radio Telegraph Company; E. W. Novy, Chief Operator of Station WRNY; Edward Stanko, Chief Operator of Station WGR; and hundreds of other N. R. I. Trained men. The National Radio Institute, Originator of Radio Home-Study Training, established 1914, today offers you the same opportunity these men had, under a bond that guarantees you full satisfaction or money refunded. It's your big chance to get into Radio—mail coupon for FREE Book and proof!

**"MEN! Here's the 'dope' you've been looking for-**

**How TO GET INTO THE RADIO BUSINESS"**

J.E.S.

**\$50 to \$250 a Week in Work That is Almost Romance**

If you're earning a penny less than \$50 a week, clip coupon now for FREE BOOK! New book, profusely illustrated, tells all about the Radio Profession, thousands of openings—in work that is almost romance! YOU can learn quickly and easily at home, through our tested, improved methods, to take advantage of these great opportunities. Why go along at \$25 or \$35 or \$45 a week, when you can pleasantly and in short time learn to be a Radio Expert, capable of holding the big jobs—paying \$50 to \$250 a week?

**Clip Coupon For Free Cook**

Don't envy the other fellow who's pulling down the big cash! Our proven home-study training methods make it possible for you, too, to get ready for a better job, to earn enough money so you can enjoy all the good things of life: Most amazing book ever written on Radio tells how—thousands of interesting facts about this great field, and how we can prepare you, quickly and easily in your spare time at home, to step into a big pay Radio job. You can do what thousands of others have done through our training. GET THIS NEW FREE BOOK. SEND COUPON TO-DAY.

J. E. Smith, President  
**NATIONAL RADIO INSTITUTE**  
Dept. GU-3 Washington, D. C.

**NOW! Special Short Time Offer 6 BIG OUTFITS**

**Radio Needs Trained Men**

Dept. GU-3 National Radio Institute, Washington, D. C.

Dear Mr. Smith: Without obligating me in any way, send me your big FREE BOOK, "Rich Rewards in Radio" and all information about your practical, home-study Radio Course.

**SEND THIS COUPON TODAY**

Name.....  
Address.....

## Correct List of Broadcast Stations

<b>KDKA</b> Westinghouse Electric & Mfg. Co. East Pittsburgh, Pa. 309	<b>KFQD</b> Chovin Supply Co. Anchorage, Alaska 227
<b>KDLR</b> Radio Electric Co. Devils Lake, N. D. 231	<b>KFQP</b> G. S. Carson, Jr. Iowa City, Ia. 224
<b>KDYL</b> Newhouse Hotel. Salt Lake City, Utah 246	<b>KFQU</b> W. Riker. Holy City, Calif. 217
<b>KFAB</b> Nebraska Buick Auto Co. Lincoln, Neb. 341	<b>KFQW</b> C. F. Knierim. North Bend, Wash. 216
<b>KFAD</b> McArthur Bros. Mercantile Co. Phoenix, Ariz. 273	<b>KFQZ</b> Taft Products Co. Hollywood, Calif. 225
<b>KFAF</b> A. E. Fowler. San Jose, Calif. 217	<b>KFRB</b> Hall Bros. Beeville, Texas 248
<b>KFAU</b> Independent School Dist. Boise, Idaho 280	<b>KFRD</b> City of Paris Dry Goods Co. San Francisco, Calif. 268
<b>KFBB</b> F. A. Buttrey & Co. Havre, Mont. 275	<b>KFRU</b> Stephens College. Columbia, Mo. 500
<b>KFBC</b> W. K. Azbill. San Diego, Calif. 216	<b>KFRW</b> United Churches of Olympia. Olympia, Wash. 219
<b>KFBK</b> Kimball-Upson Co. Sacramento, Calif. 248	<b>KFSD</b> Airfan Radio Corp. San Diego, Calif. 246
<b>KFBL</b> Leese Bros. Everett, Wash. 224	<b>KFSG</b> Echo Park Evan. Assn. Los Angeles, Calif. 275
<b>KFBS</b> School District No. One. Trinidad, Colo. 238	<b>KFUL</b> Thomas Groggan & Bros. Music Co. Galveston, Texas 258
<b>KFBU</b> Bishop N. S. Thomas. Laramie, Wyo. 270	<b>KFUM</b> W. D. Corley. Colorado Springs, Colo. 239
<b>KFCB</b> Nielson Radio Supply Co. Phoenix, Ariz. 238	<b>KFUO</b> Concordia Seminary. St. Louis, Mo. 545
<b>KFDD</b> St. Michaels Cathedral. Boise, Idaho 278	<b>KFUP</b> Fitzsimmons General Hospital. Denver, Colo. 234
<b>KFDM</b> Magnolia Petroleum Co. Beaumont, Texas 316	<b>KFUR</b> Peery Bldg. Co. Ogden, Utah 224
<b>KFDX</b> First Baptist Church. Shreveport, La. 250	<b>KFUS</b> Louis L. Sherman. Oakland, Calif. 256
<b>KFDY</b> South Dakota State College. Brookings, S. D. 273	<b>KFUT</b> University of Utah. Salt Lake City, Utah 261
<b>KFDZ</b> Harry O. Iverson. Minneapolis, Minn. 231	<b>KFUV</b> Colburn Radio Labs. San Leandro, Calif. 220
<b>KFEC</b> Meier & Frank Co. Portland, Ore. 248	<b>KFVU</b> McWhinnie Electric Co. San Pedro, Calif. 205
<b>KFEL</b> Winner Radio Corp. Denver, Colo. 254	<b>KFVE</b> Film Corporation of America. St. Louis, Mo. 240
<b>KFEQ</b> J. L. Scroggin. Oak, Neb. 268	<b>KFVG</b> First M. E. Church. Independence, Kans. 236
<b>KFEY</b> Bunker Hill & Sullivan Min. & Con. Co. Kellogg, Idaho 233	<b>KFVI</b> Headquarters Troop, 56th Cavalry. Houston, Texas 240
<b>KFFP</b> First Baptist Church. Moberly, Mo. 242	<b>KFVN</b> Carl E. Bagley. Fairmont, Minn. 227
<b>KFGQ</b> Crary Hardware Co. Boone, Iowa 226	<b>KFVS</b> Hirsch Battery and Radio Co. Cape Girardeau, Mo. 224
<b>KFPH</b> Hotel Lassen. Wichita, Kans. 268	<b>KFVY</b> Radio Supply Co. Albuquerque, N. M. 250
<b>KFHA</b> Western State College of Colo. Gunnison, Colo. 252	<b>KFWA</b> Browning Bros. Co. Ogden, Utah. 261
<b>KFHL</b> Penn. College. Oskaloosa, Iowa 240	<b>KFWB</b> Warner Bros. Hollywood, Calif. 252
<b>KFI</b> E. C. Anthony, Inc. Los Angeles, Calif. 468	<b>KFWC</b> L. E. Wall. San Bernardino, Calif. 211
<b>KFIF</b> Benson Polytechnic Institute. Portland, Ore. 248	<b>KFWF</b> St. Louis Truth Center. St. Louis, Mo. 214
<b>KFIO</b> North Central High School. Spokane, Wash. 265	<b>KFWH</b> F. Wellington Morse, Jr. Chico, Calif. 254
<b>KFIQ</b> First Methodist Church. Yakima, Wash. 256	<b>KFWI</b> Radio Entertainments, Inc. South San Francisco, Calif. 226
<b>KFIU</b> Alaska Electric Light & Power Co. Juneau, Alaska 226	<b>KFWM</b> Oakland Educational Society. Oakland, Calif. 207
<b>KFIZ</b> Daily Commonwealth. Fond du Lac, Wis. 273	<b>KFWO</b> Lawrence Mott. Avalon, Calif. 211
<b>KFJB</b> Marshall Electrical Co. Marshalltown, Iowa 248	<b>KFWU</b> Louisiana College. Pineville, La. 238
<b>KFJC</b> R. B. Fegan (Episcopal Church). Junction City, Kans. 219	<b>KFWV</b> Wilbur Jerman. Portland, Ore. 213
<b>KFJF</b> National Radio Manf. Co. Oklahoma City, Okla. 261	<b>KFXB</b> Bertram O. Heller. Big Bear Lake, Calif. 203
<b>KFJI</b> Liberty Theatre (E. E. Marsh). Astoria, Ore. 246	<b>KFXD</b> Service Radio Co. Logan, Utah 205
<b>KFJM</b> University of North Dakota. Grand Forks, N. D. 278	<b>KFXF</b> Pike's Peak Broadcasting Co. Colorado Springs, Colo. 250
<b>KFJR</b> Ashley C. Dixon & Son. Portland, Ore. 263	<b>KFXH</b> Bledsoe Radio Company. El Paso, Texas 242
<b>KFJY</b> Tunwall Radio Co. Fort Dodge, Iowa 246	<b>KFXJ</b> Mt. States Radio Dist. Inc. (Portable Station). Denver, Colo. 216
<b>KFJZ</b> W. E. Branch. Ft. Worth, Tex. 254	<b>KFXR</b> Classen Film Finishing Co. Oklahoma City, Okla. 214
<b>KFKA</b> Colo. State Teachers College. Greeley, Colo. 273	<b>KFXV</b> Mary M. Costigan. Flagstaff, Ariz. 205
<b>KFKU</b> The University of Kansas. Lawrence, Kans. 275	<b>KFYF</b> Carl's Radio Den. Oxnard, Calif. 205
<b>KFKX</b> Westinghouse Elec. & Mfg. Co. Hastings, Neb. 288	<b>KFYJ</b> Chronicle Publishing Co. Houston, Texas 238
<b>KFKZ</b> F. M. Henry. Kirksville, Mo. 226	<b>KFYO</b> Buchanan-Vaughan Co. Texarkana, Tex. 210
<b>KFLR</b> University of New Mexico. Albuquerque, N. M. 254	<b>KFYR</b> Hoskens-Meyers, Inc. Bismarck, N. Dak. 248
<b>KFLU</b> San Benito Radio Club. San Benito, Texas 236	<b>KGO</b> General Electric Co. Oakland, Calif. 361
<b>KFLV</b> Swedish Evangelical Church. Rockford, Ill. 229	<b>KGTT</b> Glad Tidings Tabernacle. San Francisco, Calif. 207
<b>KFLX</b> George Roy Clough. Galveston, Texas 240	<b>KGU</b> Marion A. Mulrony. Honolulu, Hawaii. 270
<b>KFLZ</b> Atlantic Automobile Co. Anita, Ia. 273	<b>KGW</b> Portland Morning Oregonian. Portland, Ore. 491
<b>KFMR</b> Morningside College. Sioux City, Iowa 261	<b>KGY</b> St. Martins College. Lacy, Wash. 246
<b>KFMW</b> M. G. Sateren. Houghton, Mich. 263	<b>KHJ</b> Times-Mirror Co. Los Angeles, Calif. 405
<b>KFMX</b> Carleton College. Northfield, Minn. 337	<b>KHQ</b> Louis Wasmer. Seattle, Wash. 394
<b>KFNF</b> Henry Field Seed Co. Shenandoah, Iowa 263	<b>KJBS</b> J. Brunton & Sons. San Francisco, Calif. 220
<b>KFOA</b> Rhodes Department Store. Seattle, Wash. 454	<b>KJR</b> Northwest Radio Service Co. Seattle, Wash. 384
<b>KFOB</b> Chamber of Commerce. Burlingame, Calif. 226	<b>KLDS</b> Reorganized Church. Independence, Mo. 441
<b>KFON</b> Echophone Radio Shop. Long Beach, Calif. 233	<b>KLS</b> Warner Brothers Radio Supplies Co. Oakland, Calif. 250
<b>KFOO</b> Latter Day Saints' University. Salt Lake City, Utah 236	<b>KLX</b> Tribune Publishing Co. Oakland, Calif. 508
<b>KFOR</b> David City Tire & Electric Co. David City, Neb. 226	<b>KLZ</b> Reynolds Radio Co. Denver, Colo. 266
<b>KFOT</b> College Hill Radio Club. Wichita, Kans. 231	<b>KMA</b> May Seed & Nursery Co. Shenandoah, Iowa 252
<b>KFOX</b> Board of Education, Tech. High School. Omaha, Nebr. 248	<b>KMJ</b> Fresno Bee. Fresno, Calif. 234
<b>KFOY</b> Beacon Radio Service. St. Paul, Minn. 252	<b>KMMJ</b> M. M. Johnson Co. Clay Center, Nebr. 229
<b>KFPL</b> C. C. Baxter. Dublin, Texas. 252	<b>KMO</b> Love Electric Co. Tacoma, Wash. 250
<b>KFPM</b> The New Furniture Co. Greenville, Texas. 242	<b>KMOX</b> Voice of St. Louis. St. Louis, Mo. 280
<b>KFPR</b> Los Angeles County Forestry Dept. Los Angeles, Calif. 231	<b>KMTR</b> Turner Radio Corp. Los Angeles, Calif. 238
<b>KFPW</b> St. Johns M. E. Church. Cartersville, Mo. 258	<b>KNRC</b> C. B. Juneau. Los Angeles, Calif. 208
<b>KFPY</b> Symons Investment Co. Spokane, Wash. 266	<b>KNX</b> Los Angeles Evening Express. Los Angeles, Calif. 337
<b>KFQA</b> The Principia. St. Louis, Mo. 261	<b>KOA</b> General Electric Co. Denver, Colo. 322
<b>KFQB</b> The Searchlight Publishin Co. Fort Worth, Texas 263	

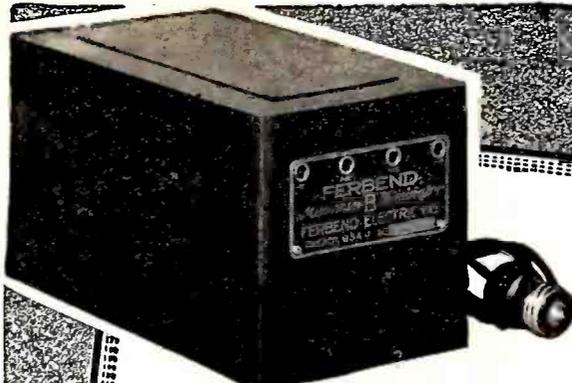
**Two Purpose Super-Het is Easy to Construct**

(Continued from page 12)

condenser should be turned all out, and the two condensers set at about fifty degrees. With the phones plugged in the first audio jack, a click should be heard if the audio or second detector grid post is touched.

To locate a station, the loop dial should be set at twenty, and the oscillator rotated slowly from ten to thirty. A click may be heard, and if so, a station would come in a few degrees either side of this point. If no station is heard, the loop dial should be moved in steps of two degrees over its entire range, the oscillator being rotated through a range of from ten to fifteen degrees below the loop dial to ten to fifteen degrees above it, for each setting of the loop dial.

Once a station is heard, the dial settings may be written down and the station tuned in again later at these same figures. Two points will be found for all stations on the oscillator dial, with one on the loop dial. Rotating the loop will strengthen signals, or help to eliminate unwanted stations, as it is quite directional. It will be difficult at first to tune with a loud-speaker due to the extreme selectivity of the set, and headphones should be used. Loud speaker volume will be obtained from locals on six tubes, and on far distant stations on all seven, or in a few cases, on six tubes. Once a few stations have been heard, the rheostat should be turned down as far as possible to save the tubes and batteries.



Complete, nothing else to buy. Replaces "B" Batteries. Operates Direct from Electric Light Socket. A. C. Model, \$12.50 D. C. Model, 9.75

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City \_\_\_\_\_  
State \_\_\_\_\_

**What Users Say:**

"246 Florence Ave., Highland Park, Mich. April 25, 1926  
Gentlemen: My reception has been easily enhanced at least 50% since the installation of the Ferbend Eliminator and, incidentally I am a very enthusiastic satisfied customer. Performance is far in excess of excellence that I have ever before experienced with the use of batteries. I am using a 5 tube R. F. (Freshman Circuit), employing a "C" battery and am at a loss to know how I can so improve it since using your Eliminator. In fact, I am so pleased that I solicit inquiries from such as may be your prospects. I have compared the performance of the far greater with others of that none produce the clarity of reception as does your instrument.  
(Signed) Wilson E. Rogers"

"San Francisco, April 20, 1926  
Dear Sirs: I have been using my "B" Eliminator steadily since I received it, and must say that it lives up to all the claims you make for it. This letter, I feel in the least I could do to thank you.  
(Signed) Philip A. Reilly  
1167 Valencia St."

"17 Sewall St. Framingham, Mass. April 12, 1926  
Dear Sirs: I have tried the "B" Battery Eliminator which I purchased some time ago and find it works satisfactorily in every way. I have recommended this to several radio friends in this locality. I have had it on two different sets of 5 tubes each. Two of these sets are the used radio frequency and the other is a straight Fred Eisman set fully neutralized.  
(Signed) Edw. A. Browning"



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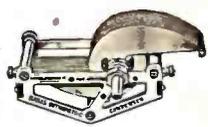


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KOAC	Oregon Agricultural College.....	Corvallis, Ore.	280	WBAP	Wortham-Carter Pub.(Star Telegram)..	Ft. Worth, Texas	476
KOB	N. Mex. College Ag. & Me. Arts..	State College, N. Mex.	349	WBAW	Braid Elec., & Waldrum Drug Co..	Nashville, Tenn.	236
KOCH	Central High School.....	Omaha, Neb.	258	WBAX	John H. Stenger, Jr.....	Wilkes-Barre, Pa.	256
KOCW	Oklahoma College for Women.....	Chickasha, Okla.	252	WBBL	Grace Covenant Presbyterian Church..	Richmond, Va.	229
KOIL	Monarch Manufacturing Co.....	Council Bluffs, Iowa	278	WBBM	Atlas Investment Co.....	Chicago, Ill.	226
KOIN	H. B. Read.....	Portland, Ore.	319	WBBF	Petoskey High School.....	Petoskey, Mich.	238
KOMO	Bert F. Fisher.....	Seattle, Wash.	306	WBBR	People's Pulpit Assoc.....	Rossville, N. Y.	273
KOWW	Blue Mt. Radio Assn.....	Walla Walla, Wash.	256	WBBS	First Baptist Church.....	New Orleans, La.	252
KPO	Hale Bros.....	San Francisco, Calif.	428	WBBW	Ruffner Junior High School.....	Norfolk, Va.	222
KPPC	Pasadena Presbyterian Church.....	Pasadena, Calif.	229	WBBY	Washington Light Inf.Co."B" 118th inf,	Charleston,S.C.	268
KPRC	Houston Post Dispatch.....	Houston, Texas	297	WBBZ	C. L. Carrell.....	Chicago, Ill.	216
KPSN	Star-News Publishing Co.....	Pasadena, Calif.	316	WBCN	Foster & McDonnell.....	Chicago, Ill.	266
KQV	Doubleday-Hill Electric Co.....	Pittsburgh, Pa.	275	WBDC	Baxter Laundry Co.....	Grand Rapids, Mich.	256
KQW	Charles D. Herrold.....	San Jose, Calif.	231	WBES	Bliss Electrical School.....	Takoma Park, Md.	222
KRE	Berkeley Daily Gazette.....	Berkeley, Calif.	256	WBNY	Shirley Katz.....	New York, N. Y.	210
KSAC	Kansas State Agricultural College..	Manhattan, Kans.	341	WBOQ	A. H. Grebe & Co., Inc.....	Richmond Hill, N. Y.	236
KSD	Pulitzer Printing Co.....	St. Louis, Mo.	545	WBPI	I. R. Nelson.....	Newark, N. J.	263
KSL	Radio Service Corp. of Utah.....	Salt Lake City, Utah	300	WBRC	Bell Radio Corporation.....	Birmingham, Ala	248
KSMR	Santa Maria Valley Railroad Co..	Santa Maria, Calif.	210	WBRE	Baltimore Radio Exchange.....	Wilkes-Barre, Pa.	231
KSO	A. A. Berry Seed Co.....	Clarinda, Iowa	242	WBT	Charlotte Chamber of Commerce.....	Charlotte, N. C.	275
KTAB	Associated Broadcasters.....	Oakland, Calif.	240	WBZ	Westinghouse Elect. & Mfg. Co.....	Springfield, Mass.	331
KTBI	Bible Institute.....	Los Angeles, Calif.	294	WBZA	Westinghouse Elect. & Mfg. Co.....	Boston, Mass.	242
KTBR	Brown's Radio Shop.....	Portland, Ore.	263	WCAC	Connecticut Agricultural College.....	Mansfield, Conn.	275
KTHS	New Arlington Hotel Co.....	Hot Springs, Ark.	375	WCAD	St. Lawrence University.....	Canton, N. Y.	263
KTNT	N. Baker.....	Muscatine, Iowa	256	WCAE	Kaufmann & Baer Co. & The Pitts. Pr.	Pittsburgh, Pa.	461
KTW	First Presbyterian Church.....	Seattle, Wash.	454	WCAJ	Nebraska Wesleyan University..	University Place, Nebr.	254
KUOA	University of Arkansas.....	Fayetteville, Ark.	300	WCAL	St. Olaf College.....	Northfield, Minn.	337
KUOM	State University of Montana.....	Missoula, Mont.	244	WCAM	Galvin Radio Supply Co.....	Camden, N. J.	236
KUSD	University of South Dakota.....	Vermillion, S. D.	278	WCAO	A. A. and A. S. Brager.....	Baltimore, Md.	275
KUT	University of Texas.....	Austin, Texas	231	WCAP	Chesapeake & Potomac Tel. Co.....	Washington, D. C.	468
KVOO	The Voice of Oklahoma.....	Bristow, Okla.	375	WCAR	Southern Radio Corp. of Texas.....	San Antonio, Texas	263
KWCR	H. F. Paar.....	Cedar Rapids, Iowa	278	WCAT	State College of Mines.....	Rapid City, S. Dak.	240
KWG	Portable Wireless Telephone Co.....	Stockton, Calif.	248	WCAU	Universal Broadcasting Co.....	Philadelphia, Pa.	278
KWKC	Wilson Duncan Studios.....	Kansas City, Mo.	236	WCAX	University of Vermont.....	Burlington, Vt.	250
KWKH	W. G. Patterson.....	Kennonwood, La.	261	WCBA	Charles W. Heimbach.....	Allentown, Pa.	254
KWSC	State College.....	Pullman, Wash.	349	WCBD	Wilbur C. Voliva.....	Zion, Ill.	345
KWUC	Western Union College.....	Le Mars, Iowa	252	WCBE	Uhalt Radio Co.....	New Orleans, La.	263
KWWG	City of Brownsville.....	Brownsville, Texas	278	WCBH	University of Mississippi.....	Oxford, Miss.	242
KYW	Westinghouse Electric & Mfg. Co.....	Chicago, Ill.	535	WCBM	Charles Swarz.....	Baltimore, Md.	229
KZIB	I. Beck.....	Manila, P. I.	250	WCBR	C. H. Mester.....	Providence, R. I.	210
KZKZ	Electrical Supply Co.....	Manila, P. I.	270	WCCO	Washburn-Crosby Co.....	Anoka, Minn.	416
KZM	Preston D. Allen.....	Oakland, Calif.	240	WCLO	C. E. Whitmore.....	Camp Lake, Wisc.	231
KZRQ	Far Eastern Radio.....	Manila, P. I.	222	WCLS	H. M. Couch.....	Joliet, Ill.	214
KZUY	F. J. Elser.....	Manila, P. I.	360	WCMA	Culver Military Academy.....	Culver, Ind.	222
NAA	U. S. Navy Dept. ....	Arlington, Va.	434	WCOA	City of Pensacola.....	Pensacola, Fla.	222
WAAD	Ohio Mechanics Institute.....	Cincinnati, Ohio	258	WCSH	Henry P. Rines.....	Portland, Maine	256
WAAF	Chicago Daily Drivers Journal.....	Chicago, Ill.	278	WCSO	Wittenberg College.....	Springfield, Ohio	248
WAAW	Omaha Grain Exchange.....	Omaha, Nebr.	278	WCWS	Chas. W. Selene (Portable).....	Providence, R. I.	210
WABB	Harrisburg Radio Co.....	Harrisburg, Pa.	204	WCX	Free Press and Jewett R. & P. Co.....	Detroit, Mich.	517
WABC	Asheville Battery Co., Inc.....	Asheville, N. C.	254	WDAD	Dad's Auto Accessories, Inc.....	Nashville, Tenn.	226
WABI	1st Universalist Church.....	Bangor, Me.	240	WDAE	Tampa Daily Times.....	Tampa, Fla.	273
WABO	Lake Avenue Baptist Church.....	Rochester, N. Y.	278	WDAF	Kansas City Star.....	Kansas City, Mo.	366
WABQ	Haverford College, Radio Club.....	Haverford, Pa.	261	WDAG	J. Laurence Martin.....	Amarillo, Texas	263
WABR	Scott High School.....	Toledo, Ohio	263	WDAH	Trinity Methodist Church.....	El Paso, Texas	268
WABW	College of Wooster.....	Wooster, Ohio	207	WDAY	Radio Equipment Corp.....	Fargo, N. Dak.	261
WABX	Henry B. Joy.....	Mt. Clemens, Mich.	246	WDBE	Gilham-Schoen Elec. Co.....	Atlanta, Ga.	270
WABY	John Magaldi, Jr.....	Philadelphia, Pa.	242	WDBJ	Richardson Wayland Elec. Corp.....	Roanoke, Va.	229
WABZ	Coliseum Place Baptist Church.....	New Orleans, La.	275	WDBK	M. F. Broz.....	Cleveland, Ohio.	227
WADC	Allen T. Simmons (Allen Theatre).....	Akron, Ohio	258	WDBO	Roilins College, Inc.....	Winter Park, Fla.	240
WAFD	Albert B. Parfet Co.....	Port Huron, Mich.	275	WDBZ	Boy Scouts, City Hall.....	Kingston, N. Y.	233
WAGM	R. L. Miller.....	Royal Oak, Mich.	225	WDEL	Wilmington Elec. Specialty Co.....	Wilmington, Del.	266
WAHG	A. H. Grebe & Co.....	Richmond Hill, N. Y.	316	WDGY	Dr. George W. Young.....	Minneapolis, Minn.	263
WAIT	A. H. Waite Co.....	Taunton, Mass.	229	WDOD	Chattanooga Radio Co., Inc.....	Chattanooga, Tenn.	256
WAIU	American Insurance Union.....	Columbus, Ohio	294	WDRG	Doolittle Radio Corp.....	New Haven, Conn.	268
WAMD	Radisson Radio Corp.....	Minneapolis, Minn.	244	WDWF	Dutee Wilcox Flint, Inc.....	Cranston, R. I.	441
WAPI	Alabama Polytechnic Institute.....	Auburn, Ala.	248	WDZ	J. L. Bush.....	Tuscola, Ill.	278
WARC	American Radio & Research Corp.....	Medford, Mass.	261	WEAF	American Telephone & Telegraph Co..	New York, N. Y.	491
WATT	Edison Electric.....	Boston, Mass.	244	WEAI	Cornell University.....	Ithaca, N. Y.	254
WBAA	Purdue University.....	W. Lafayette, Ind.	273	WEAM	Bor. of N. Plainfield.....	North Plainfield, N. J.	261
WBAK	Pennsylvania State Police.....	Harrisburg, Pa.	275	WEAN	Shepard Co.....	Providence, R. I.	270
WBAL	Consolidated Gas & Elec. Co.....	Baltimore, Md.	246	WEAO	Ohio State University.....	Columbus, Ohio	294
WBAO	James Millikan University.....	Decatur, Ill.	270	WEAR	Goodyear Tire and Rubber Co.....	Cleveland, Ohio	389

**Aerial Night's Entertainment  
—and Otherwise**

(Continued from page 46)

is of the "smart-aleck" brand, the lyrics of a type that would not be attempted at any other hour, and the whole affair so common and small-time, that one wonders what manner of mind can possibly be edified by such an exhibition. Here again WTAM has succeeded.

At nine o'clock on Saturday night it turns its microphone over to Everett Jones and his accomplices, and there ensues three hours of absolute irresponsible absurdity, which gets by with some of the most captious listeners simply because it is funny and clever. We don't know where Mr. Jones holds forth the other six nights in the week, but if he is responsible for the programs, he has a genius for clowning that is worthy of wider recognition. Aided and abetted by Art Herske, to whom we have had occasion to refer previously, the versatile Everett guides his crew of really able jazz artists through a vaudeville hodge-podge that we would willingly pay full price plus war tax, to hear across the footlights. Mr. Jones is one of these young men, who can do almost anything with a piano, like Gamby, he "sings," and if you haven't heard him put on "The Three Trees," and "The King With The Terrible Temper," you've missed a lot out of your radio life. Here, again there seems to be a superfluity of talent to draw on, and when some wandering minstrel such as Art Gilliam or Jack Little happens at the station, he fits into the general scheme as "guest artist," and the riot goes on more merrily than before. Mr. Herske uses a Roxy-esque method of presenting the performers, and the whole affair has an intimate flavor that seems to make it a family institution.

It is its wide versatility combined with an abundance of material that makes WTAM a shining example of what a broadcasting station can be.

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"You do still have enthusiasms, don't you?" he grinned. "Now some fair-haired boy will write in and say the worst program he ever heard came out of Cleveland."

"Undoubtedly," we replied, "and New York still says Marian Talley can't sing but what does that matter to Kansas?"

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**ELECTRAD**

WEAU	Davidson Bros. Co.	Sioux City, Iowa	275	WHDI	W. H. Dunwoody Ind. Institute	Minneapolis, Minn.	278
WEBC	Walter Cecil Bridges	Superior, Wisc.	242	WHEC	Hickson Electric Co., Inc.	Rochester, N. Y.	258
WEBD	Electrical Equip. & Service Co.	Anderson, Ind.	246	WHK	The Radio Air Service Corp.	Cleveland, Ohio	273
WEBE	Roy W. Waller	Cambridge, Ohio	234	WHN	George Schubert	New York, N. Y.	361
WEBH	Edgewater B. H. & Herald Examiner	Chicago, Ill.	370	WHO	Banker's Life Co.	Des Moines, Ia.	526
WEBJ	Third Avenue Railway Co.	New York, N. Y.	273	WHT	Radiophone Broadcasting Corp.	Deerfield, Ill.	238
WEBL	Radio Corp. of America (Portable)	New York, N. Y.	226	WHT	Radiophone Broadcasting Corp.	Deerfield, Ill.	400
WEBQ	Tate Radio Corp.	Harrisburg, Ill.	226	WIAD	Howard R. Miller	Philadelphia, Pa.	250
WEBR	H. H. Howell	Buffalo, N. Y.	244	WIAS	Home Electric Co.	Burlington, Iowa	254
WEBW	Beloit College	Beloit, Wisc.	268	WIBA	The Capital-Times Studio	Madison, Wis.	236
WEBZ	Savannah Radio Corp.	Savannah, Ga.	263	WIBG	St. Paul's Protestant E. Church	Elkins Park, Pa.	222
WEEI	The Edison Elec. Illuminating Co.	Boston, Mass.	349	WIBH	Elite-Radio Stores	New Bedford, Mass.	210
WEHS	Robert E. Hughes	Evanston, Ill.	203	WIBI	Frederick B. Zitteli, Jr.	Flushing, N. Y.	219
WEMC	Emanuel Missionary College	Berrien Springs, Mich.	285	WIBJ	C. L. Carrell (Portable)	Chicago, Ill.	216
WENR	All-American Radio Corp.	Chicago, Ill.	266	WIBM	Billy Maine (Portable)	Chicago, Ill.	216
WEW	St. Louis University	St. Louis, Mo.	248	WIBO	Nelson Brothers	Chicago, Ill.	226
WFAA	Dallas News & Dallas Journal	Dallas, Tex.	476	WIBR	Thurman A. Owings	Werton, W. Va.	246
WFAM	Times Publishing Co.	St. Cloud, Minn.	273	WIBS	T. F. Hunter (portable)	Elizabeth, N. J.	203
WFAV	University of Nebraska	Lincoln, Neb.	275	WIBU	The Electric Farm	Poynette, Wis.	222
WFBC	First Baptist Church	Knoxville, Tenn.	250	WIBW	Dr. L. L. Dill	Logansport, Ind.	220
WFBE	John Van De Walle	Seymour, Ind.	226	WIBX	Grid-Leak, Inc.	Utica, N. Y.	205
WFBG	The Wm. F. Gable Co.	Altoona, Pa.	278	WIBZ	A. D. Trum	Montgomery, Ala.	231
WFBH	Concourse Radio Corp.	New York, N. Y.	273	WIL	Benson Radio & The Star	St. Louis, Mo.	273
WFBJ	St. John's University	Collegeville, Minn.	236	WIOD	Wonderful Isle of Dreams	Miami, Fla.	248
WFBK	Onondaga Hotel Co.	Syracuse, N. Y.	252	WIP	Gimbel Bros.	Philadelphia, Pa.	508
WFBM	Merchants Heat & Light Co.	Indianapolis, Ind.	268	WJAD	Jackson's Radio Eng. Laboratories	Waco, Texas	353
WFBR	Fifth Inf. Md. Nat'l Guard	Baltimore, Md.	254	WJAG	Norfolk Daily News	Norfolk, Nebr.	270
WFBZ	Knox College	Galesburg, Ill.	254	WJAK	Clifford L. White	Kokomo, Ind.	254
WFDL	F. D. Fallain	Flint, Mich.	234	WJAM	D. M. Perham	Cedar Rapids, Iowa	268
WFI	Strawbridge and Clothier	Philadelphia, Pa.	394	WJAR	The Outlet Co. (J. Samuels & Bro.)	Providence, R. I.	306
WFKB	F. K. Bridgman	Chicago, Ill.	217	WJAS	Pittsburgh Radio Supply House	Pittsburgh, Pa.	275
WFRL	Robert Morrison Lacey	Brooklyn, N. Y.	205	WJAX	City of Jacksonville	Jacksonville, Fla.	337
WGAL	Lancaster Elec. Supply & Const. Co.	Lancaster, Pa.	248	WJAZ	Zenith Radio Co.	Mt. Prospect, Ill.	322
WGBB	Harry H. Carman	Freeport, N. Y.	244	WJBA	D. H. Lentz, Jr.	Joliet, Ill.	207
WGBG	First Baptist Church	Memphis, Tenn.	278	WJBB	Financial Journal	St. Petersburg, Fla.	254
WGBF	Fink Furniture Co.	Evansville, Ind.	236	WJBC	Hummer Furniture Co.	LaSalle, Ill.	234
WGBI	Scranton Broadcasters, Inc.	Scranton, Pa.	240	WJBI	Robert S. Johnson	Red Bank, N. J.	219
WGBR	George S. Ives	Marshfield, Wis.	229	WJBK	E. F. Goodwin	Ypsilanti, Mich.	233
WGBS	Gimbel Brothers	New York, N. Y.	316	WJBL	Wm. Gushard Dry Goods Co.	Decatur, Ill.	270
WGBU	Florida Cities Finance Co.	Fulford By-The-Sea, Fla.	278	WJBO	Valdeamar Jensen	New Orleans, La.	268
WGBX	University of Maine	Orono, Me.	234	WJBR	Geusch and Stearns	Omro, Wis.	227
WGCP	D. W. May, Inc.	Newark, N. J.	252	WJBU	Bucknell University	Lewisburg, Pa.	211
WGES	Coyne Electrical School	Oak Park, Ill.	250	WJJD	Supreme Lodge, L. O. of Moose	Mooseheart, Ill.	370
WGHB	G. H. Bowles Developments	Clearwater, Fla.	266	WJR	Jewett Radio & Phon. Co. & D. F. P.	Pontiac, Mich.	517
WGHP	G. H. Phelps	Detroit, Mich.	270	WJY	Radio Corp. of America	New York, N. Y.	405
WGMU	A. H. Grebe & Co. Inc., (Portable)	Richmond Hill, N. Y.	236	WJZ	Radio Corp. of America	New York, N. Y.	454
WGN	The Tribune	Chicago, Ill.	303	WKAF	WKAF Broadcasting Co.	Milwaukee, Wis.	261
WGR	Federal T. and T. Co.	Buffalo, N. Y.	319	WKAQ	Radio Corp. of Porto Rico	San Juan, P. R.	341
WGST	Georgia School Technology	Atlanta, Ga.	270	WKAR	Michigan State College	East Lansing, Mich.	285
WGY	General Elec. Co.	Schenectady, N. Y.	379	WKAU	Laconia Radio Club	Laconia, N. H.	224
WHA	University of Wisconsin	Madison, Wis.	535	WKBB	Sanders Bros.	Joliet, Ill.	214
WHAD	Marquett Univ. & Milw. Journal	Milwaukee, Wis.	275	WKBE	K. & B. Electric Co.	Webster, Mass.	231
WHAM	Univ. of Rochester (Eastman S. of M.)	Rochester, N. Y.	278	WKBG	C. L. Carrell (Portable)	Chicago, Ill.	216
WHAP	W. H. Taylor Finance Corp.	Brooklyn, N. Y.	240	WKRC	Kodel Radio Corp.	Cincinnati, Ohio	326
WHAR	Seaside House	Atlantic City, N. J.	275	WKRC	Kodel Radio Corp.	Cincinnati, Ohio	422
WHAS	Courier-Journal & Louisville Times	Louisville, Ky.	400	WKY	WKY Radio Shop	Oklahoma City, Okla.	275
WHAZ	Rensselaer Polytechnic Institute	Troy, N. Y.	379	WLAL	First Christian Church	Tulsa, Okla.	250
WHB	Sweeney School Co.	Kansas City, Mo.	366	WLAP	Wm. V. Jordan	Louisville, Ky.	275
WHBA	C. C. Shaffer	Oil City, Pa.	250	WLAQ	Arthur E. Shilling	Kalamazoo, Mich.	283
WHBC	Rev. E. P. Graham	Canton, Ohio	254	WLB	University of Minnesota	Minneapolis, Minn.	278
WHBD	Chas. W. Howard	Bellfontaine, Ohio	222	WLBL	Bureau of Marketing	Stevens Point, Wis.	278
WHBF	Beardsley Specialty Company	Rock Island, Ill.	222	WLIB	Liberty Magazine	Elgin, Ill.	303
WHBG	John S. Skane	Harrisburg, Pa.	231	WLIT	Lit Bros.	Philadelphia, Pa.	394
WHBJ	Lauer Auto Co.	Ft. Wayne, Ind.	234	WLS	Sears Roebuck & Co.	Crete, Ill.	345
WHBL	C. L. Carrell	Chicago, Ill.	216	WLSI	Lincoln Studios	Cranston, R. I.	441
WHBM	C. L. Carrell, (Portable Station)	Chicago, Ill.	216	WLTS	Lane Technical High School	Chicago, Ill.	258
WHBN	First Ave. Methodist Church	St. Petersburg, Fla.	238	WLW	Crosley Mfg. Co.	Cincinnati, Ohio	422
WHBP	Johnstown Automobile Co.	Johnstown, Pa.	256	WLWL	Miss. Society of St. Paul the Apostle	New York, N. Y.	288
WHBQ	St. John's M. E. Church South	Memphis Tenn.	233	WMAC	C. B. Meredith	Casnovia, N. Y.	275
WHBU	Riviera Theatre & Bing's Clothing	Anderson, Ind.	219	WMAF	Round Hills Radio Corp.	Dartmouth, Mass.	441
WHBW	D. R. Kienzle	Philadelphia, Pa.	216	WMAK	Norton Laboratories	Lockport, N. Y.	266
WHBY	St. Norbert's College	West de Pere, Wis.	250	WMAL	M. A. Lesse Optical Co.	Washington, D. C.	213

### Golden Rule Receiver Is Completely Shielded

(Continued from page 37)

ation of the June set. By making use of the log-a-wave chart found every month on the last page of RADIO AGE the receiver can be logged, starting in at the lowest station on the dial on up to the highest one. The volume can be controlled by means of the regenerative tandem which is turned to zero when minimum volume is desired on the locals.

#### Different Experiments

ANYONE making the receiver can readily compare the difference between the set without the first tube in it and that using the r. f. stage even if it is biased down to a point so as to prevent radiation. As a straight regenerative receiver without the first tube in (and antenna and ground having been transferred to the second coil) there is naturally some increase in volume, but selectivity has departed out of the picture. Putting back the

first tube and coil gives almost as much volume but with a great increase in the selectivity of the receiver. Taking off the wire from the regenerative tandem to the first regenerative coil makes the set more unstable and a trifle broader, so the use of tandem regenerative effects are justified in practice. There are many experiments which the builder may go into if he desires. The vacant coil in the second torostyle can be hooked up with a zero to 200,000 ohm Centralab variable resistor across it to alter the regenerative position of that particular inductance. It can also be bridged with a small condenser and tuned to a higher period than its own fundamental. It can also be hooked in series with the normal primary to allow greater transfer of energy.

By using the R200 audio transformers we found that cone speakers could be operated with excellent quality whereas with the older type of audio transformers the cones did not work at their best value.

### Canadians Do Not Like Interference

OF the seventy-one Canadian broadcasting stations, 23 are operated by amateur clubs and non-commercial organizations, 17 by radio dealers and manufacturers, 14 by railway and commercial houses, 9 by the press, and four each by religious organizations and retail stores, according to Director C. P. Edwards of the Canadian Radio Service.

Actually there are but 59 individual stations broadcasting, the Director explains, but twelve other organizations or individuals hold what are termed "phantom" licenses permitting them to operate from the existing stations under their own call letters which are independent from the regular station call. This reduces the number of stations which ordinarily would be required, and is fortunate in view of the scarcity of broadcast channels in Canada. The Dominion has but six exclusive wave lengths, not used in the United States, and shares eleven other channels with this country.

# Makes a Fair Set Good and a Good Set Better

See That Screw

A screw-driver adjusts an X-L in crowded places.



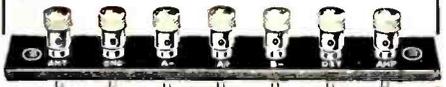
RESULTS in easier tuning, more distance, volume and clarity—greater stability. Indorsed by leading radio authorities. Model "N"—A slight turn obtains correct tube oscillation on all tuned radio frequency circuits. Neutrodyne, Roberts two tube, Browning-Drake, McMurdo Silver's Knockout, etc. Capacity range 1.8 to 20 micro micro farads. Price \$1.20.



Model "G"—as shown above. With grid clip; obtains the proper grid capacity on Cooksday circuits, filter and intermediate frequency tuning in heterodyne and positive grid bias in all sets. Capacity range .00016 to .00055 and .0003 to .001 micro farads. Price \$1.50.

X-L Push Post—Push it down with your thumb, insert wire, remove pressure and wire is firmly held. Releases instantly. Price 15c.

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WMAN	First Baptist Church.....	Columbus, Ohio	278	WRBC	Immanuel Lutheran Church.....	Valparaiso, Ind.	278
WMAQ	Chicago Daily News.....	Chicago, Ill.	447	WRC	Radio Corp. of America.....	Washington, D. C.	468
WMAY	Kingshighway Presbyterian Church.....	St. Louis, Mo.	248	WRCO	Wynne Radio Co.....	Raleigh, N. C.	252
WMAZ	Mercer University.....	Macon, Ga.	261	WREC	Wooten's Radio & Electric Co.....	Coldwater, Miss.	254
WMBB	American Bond & Mortgage Co.....	Chicago, Ill.	250	WREO	Reo Motor Car Co.....	Lansing, Mich.	285
WMBC	Michigan Broadcasting Co.....	Detroit, Mich.	256	WRHF	Radio Hospital Fund.....	Washington, D. C.	256
WMBF	Miami Beach Hotel.....	Miami Beach, Fla.	384	WRHM	Rosedale Hospital, Inc.....	Minneapolis, Minn.	252
WMC	Commercial Appeal.....	Memphis, Tenn.	500	WRK	Doron Bros.....	Hamilton, Ohio	270
WMCA	Hotel McAlpin (Greenley Sq. Hotel Co.).....	New York, N.Y.	341	WRM	University of Illinois.....	Urbana, Ill.	273
WNAB	Shepard Stores.....	Boston, Mass.	250	WRMU	A. H. Grebe & Co., Inc., M.Y. "MU-1".....	New York, N.Y.	236
WNAC	Shepard Stores.....	Boston, Mass.	280	WRNY	Experimenter Publishing Co.....	New York, N.Y.	258
WNAD	University of Oklahoma.....	Norman, Okla.	254	WRR	Municipal Station.....	Dallas, Tex.	246
WNAL	Omaha Central High School.....	Omaha, Nebr.	258	WRST	Radiotel Mfg. Co., Inc.....	Bay Shore, N.Y.	216
WNAT	Lenning Bros. Co. (Frederick Lenning).....	Philadelphia, Pa.	250	WRVA	Larus & Brother Co., Inc.....	Richmond, Va.	256
WNAX	Dakota Radio Apparatus Co.....	Yankton, S. Dak.	244	WRW	Tarrytown Radio Res. Labs.....	Tarrytown, N.Y.	273
WNBH	New Bedford Hotel.....	New Bedford, Mass.	248	WSAI	United States Playing Card Co.....	Cincinnati, Ohio	326
WNJ	Radio Shop.....	Newark, N. J.	252	WSAJ	Grove City College.....	Grove City, Pa.	229
WNOX	Peoples Tel. & Tel. Co.....	Knoxville, Tenn.	268	WSAN	Allentown Call Publisher Co.....	Allentown, Pa.	229
WNRG	W. B. Nelson.....	Greensboro, N. C.	224	WSAR	Daughy & Welch Electrical Co.....	Fall River, Mass.	254
WNYC	Dept. of Plant & Structures.....	New York, N.Y.	526	WSAU	Camp Marien.....	Chesham, N. H.	229
WOAI	Southern Equipment Co.....	San Antonio, Texas	394	WSAX	Zenith Radio Corp. (Portable).....	Chicago, Ill.	268
WOAN	Vaughn Con. of Music.....	Lawrenceburg, Tenn.	283	WSAZ	Chase Electric Shop.....	Pomeroy, Ohio	244
WOAW	Woodman of the World.....	Omaha, Nebr.	526	WSB	Atlanta Journal.....	Atlanta, Ga.	428
WOAX	Franklyn J. Wolff.....	Trenton, N. J.	240	WSBC	World Battery Co.....	Chicago, Ill.	210
WOC	Palmer School of Chiropractic.....	Davenport, Iowa	484	WSBF	Stix-Baer-Fuller D. G. Co.....	St. Louis, Mo.	273
WOCL	A. E. Newton.....	Jamestown, N. Y.	275	WSBT	South Bend Tribune.....	South Bend, Ind.	275
WODA	James K. O'Dea.....	Paterson, N. J.	224	WSDA	Seventh Day Adventist Church.....	New York, N.Y.	263
WOI	Iowa State College.....	Ames, Iowa	270	WSKC	World's Star Knitting Co.....	Bay City, Mich.	261
WOK	Neutrowound Radio Mfg. Co.....	Homewood, Ill.	217	WSM	Nashville Life & Accident Ins. Co.....	Nashville, Tenn.	283
WOKO	Otto Baur.....	New York, N.Y.	233	WSMB	Saenger Amuse. Co. & Maison B. Co.....	New Orleans, La.	319
WOO	John Wanamaker.....	Philadelphia, Pa.	508	WSMH	Shattuck Music House.....	Owosso, Mich.	240
WOOD	Grand Rapids Radio Co.....	Grand Rapids, Mich.	242	WSMK	S. M. K. Radio Corp.....	Dayton, Ohio	275
WOQ	Unity School of Christianity.....	Kansas City, Mo.	278	WSOE	School of Engineering.....	Milwaukee, Wisc.	246
WOR	L. Bamberger and Co.....	Newark, N. J.	405	WSRO	Radio Company.....	Hamilton, Ohio	252
WORD	People's Pulpit Assn.....	Batavia, Ill.	275	WSSH	Tremont Temple Bap. Church.....	Boston, Mass.	261
WOS	State Market Bureau.....	Jefferson City, Mo.	441	WSUI	State University of Iowa.....	Iowa City, Iowa	484
WOWL	Owl Battery Company.....	New Orleans, La.	270	WSVS	Seneca Vocational School.....	Buffalo, N.Y.	219
WOWO	Main Auto Supply Co.....	Fort Wayne, Ind.	227	WSWS	Illinois Broadcasting Corp.....	Wooddale, Ill.	275
WPAK	N. D. Ag. College.....	Agricultural College, N. D.	275	WTAB	Fall River Daily Herald Publishing Co.....	Fall River, Mass.	266
WPCC	North Shore Cong. Church.....	Chicago, Ill.	258	WTAD	Robt. E. Compton.....	Carthage, Ill.	236
WPDQ	H. L. Turner.....	Buffalo, N.Y.	205	WTAG	Telegram Pub. Co.....	Worcester, Mass.	268
WPG	The Municipality of Atlantic City.....	Atlantic City, N. J.	300	WTAL	Toledo Radio & Electric Co.....	Toledo, Ohio	252
WPRC	Wilson Printing & Radio Co.....	Harrisburg, Pa.	216	WTAM	Williard Storage Battery Co.....	Cleveland, Ohio	389
WPSC	Pennsylvania State College.....	State College, Pa.	261	WTAP	Cambridge Radio & Electric Co.....	Cambridge, Ill.	242
WQAA	Horace A. Beale, Jr.....	Parkersburg, Pa.	220	WTAQ	C. S. Van Gordon.....	Eau Claire, Wisc.	254
WQAC	Gish Radio Service.....	Amarillo, Tex.	234	WTAR	Reliance Electric Co.....	Norfolk, Va.	261
WQAE	Moore Radio News Station.....	Springfield, Vt.	246	WTAW	Agricultural & Mech. Col. of Texas.....	College Sta., Texas	270
WQAM	Electrical Equipment Co.....	Miami, Fla.	263	WTAX	Williams Hardware Co.....	Streator, Ill.	231
WQAN	Scranton Times.....	Scranton, Pa.	250	WTAZ	Thomas J. McGuire.....	Lambertville, N. J.	261
WQAO	Calvary Baptist Church.....	New York, N.Y.	360	WTIC	Travelers Insurance Co.....	Hartford, Conn.	476
WQJ	Calumet Rainbo Broadcasting Co.....	Chicago, Ill.	447	WWAD	Wright & Wright (Inc.).....	Philadelphia, Pa.	250
WRAF	The Radio Club (Inc.).....	LaPorte, Ind.	224	WWAE	Electric Park.....	Plainfield, Ill.	242
WRAK	Economy Light Co.....	Escanaba, Mich.	256	WWAO	Michigan College of Mines.....	Houghton, Mich.	263
WRAM	Lombard College.....	Galesburg, Ill.	244	WWGL	Radio Engineering Corp.....	Richmond Hill, N.Y.	213
WRAV	Antioch College.....	Yellow Springs, Ohio	263	WWI	Ford Motor Co.....	Dearborn, Mich.	266
WRAW	Horace D. Good.....	Reading, Pa.	238	WWJ	Detroit News.....	Detroit, Mich.	353
WRAX	Berachah Church.....	Philadelphia, Pa.	268	WWL	Loyola University.....	New Orleans, La.	275

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(7-26)

**Use the  
Log-a-Wave  
Chart  
on Page 64**

**Tube Paralysis May Be Cause of Strange Effects**

(Continued from page 24)

as when they were new, except that their life will be somewhat shorter than that of a new tube. In addition, this treatment can often be applied to the same tube several succeeding times. Truly the monkey gland operation of radio, n'est ce pas?

**Sometimes Doesn't Work**

Sometimes, however, for some unexplained reason, the above described reactivation process fails to restore the faulty tube, the plate current reading in the test set being even lower after the attempt at rejuvenation. This has so far been thought to indicate that all the available thorium in the filament has been used.

It is at this juncture that the peculiar process of rejuvenation for these heretofore unreclaimable tubes which has been developed by Mr. Humphrey steps in, seeming to entirely disprove the used up thorium idea, for it brings all these worthless tubes back to normal. Why? Nobody knows, but I have a theory as to what happens which is logical, if nothing else. Only prolonged experimentation can prove or disprove the truth of the following hypothesis, but whether right or wrong, it at least gives a plausible base upon which to make experiments.

To understand this theory, it will perhaps be best to first see why a "good" tube would be paralyzed by the circuit shown in Figure No. 1. This is simply shown. The plate and grid of the tube carry a twenty-two and one-half volt positive charge, which alone would tend to cause a heavy emission of the negatively charged thorium electrons at normal filament voltage. Added to this is the further driving effect of the augmented filament voltage, which is forty per cent above normal. It will readily be seen that with this abnormal demand on the filament the thorium could not possibly replace itself from the interior of the wire at the same rate that it is driven off of the surface, and consequently, it is soon in the state of paralyzation. Ordinary reactivation, however, would in most

cases restore it to perfect condition, because the effect on the tube is the same as if it had been paralyzed by prolonged use in a set.

It is just the above described driving effect of the forty per cent augmented filament voltage coupled with the strong attractive power of the twenty-two and one-half volt positive charge on the plate and grid (which is of course much nearer to the filament than is the plate) that turns the trick!

In the case of the so-called absolutely worthless tube all the thorium which is left is undoubtedly buried deep down at the very heart of the filament wire, hence ordinary methods will not serve to bring it to the surface.

The fact that practically all the thorium has been driven off the surface of the filament undoubtedly slightly changes the skin resistance of the filament and is responsible for the slightly decreased current draw of this member in a "bad" tube. This would also account for the fact that the current draw is brought back to normal when the tube is finally reclaimed.

**MR. HUMPHREY'S** method, as described in his article, is a slow one, and the probable effect is that the combined driving power of the forty per cent higher filament voltage and the heavy positive charge on the plate and grid of the tube cause the deeply buried thorium to gradually be forced to the surface. If the process were to be continued too long, however, (and this agrees with the remark made by Mr. Humphrey in his article that a "so-called good tube would be paralyzed if treated in this manner") it would again become completely paralyzed due to the thorium which had been drawn so forcibly to the surface of the filament being just as forcibly driven from the surface.

It is the fact that a good tube would be ruined by the treatment outlined above that is responsible for the theory which I have just recounted, and which makes that theory plausible.

Should this theory be correct, the process would be undoubtedly

**FOR CLEAR, QUIET "B" POWER**



**RADIO Storage "B" Battery**

**12 Cells 24 Volts Lasts Indefinitely—Pays for Itself**  
Economy and performance unheard of before. Recharged at a negligible cost. Offers unflinching power that is clear, pure and quiet. Approved and listed as Standard by leading Radio Authorities, including Pop. Radio Laboratories, Pop. Sci. Inst. Standards, Radio News Lab., Letax, Inc., and other important institutions. Equipped with Solid Rubber Case, an insurance against acid and leakage. Extra heavy glass jars. Heavy rugged plates. Order yours today!  
**SEND NO MONEY** Just state number of batteries wanted and we will ship day order is received. Extra offer: 4 batteries in series (96 volts), \$10.50. Pay expressman after examining batteries. 6 per cent discount for cash with order. Mail your order now!

**WORLD BATTERY COMPANY**  
1219 So. Wabash Ave., Dept. 81 Chicago, Ill.  
Makers of the Famous World Radio "A" Storage Battery  
Prices: 6-cells, 100 Amp. \$11.25; 12 Amp. \$13.25; 140 Amp. \$14.00.  
All equipped with Solid Rubber Case.

**World STORAGE BATTERIES**  
Set your Radio Dial at 210 meters for the new 1000 watt World Storage Battery Station, W5BC, Chicago. Watch for announcements.

hastened (but made more hazardous and critical) if the positive charge on the plate and grid were made considerably higher in voltage, say forty-five or even ninety volts. The same thing would hold true for a raise in the filament voltage above the recommended seven volts.

As soon as possible I hope to make some experiments along this line, but have manifestly had no time to do so at this date. I am, however, presenting this theory for what it is worth.

**\$75 A WEEK BUILDING RADIO SETS**  
In Your Spare Time

Join the Radio Association of America. Learn how to build and repair sets. The Association will train you—start you out in business, if you wish. Be the radio "doctor" of your community. \$3 an hour upwards easily made.

**Earns \$500 In Spare Hours**

"I have at last found myself," writes Lyle Follick, Lansing Mich. "I have already made over \$500.00." Werner Eichler, Rochester, N. Y., writes, "—have made over \$50 a week in my spare time." Our members are starting radio stores, increasing their salaries, securing better positions, passing radio operator examinations, earning big money in spare time.

**Join Association Now!**

Are you interested in Radio for pleasure or profit? Join now because we have a Special Plan whereby your membership need not cost you a cent. Only limited number of these memberships acceptable. Write now for details—before it is too late.

Mail This Coupon

RADIO ASSOCIATION OF AMERICA.  
Dept. 27—4513 Ravenswood Ave., Chicago.  
Send me details of your Special Association Membership Plan.

Name .....

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**Dominion of Canada**

CFAC	Calgary Herald.....	Calgary, Alta.	434	CJCL	A. Couture.....	Montreal, Que.	279
CFCA	Toronto Star Pub. & Prtg. Co.....	Toronto, Ont.	356	CJGC	London Free Press.....	London, Ont.	329
CFCF	Marconi Wireless Teleg Co., (Ltd.) Can.	Montreal, Que.	411	CKAC	La Presse.....	Montreal, Que.	411
CFCG	Abitibi Power & Paper Co. (Ltd.)	Iroquois Falls, Ont.	500	CKCD	Vancouver Daily Province.....	Vancouver, B. C.	397
CFCK	Radio Supply Co.....	Edmonton, Alta.	517	CKCK	Leader Pub. Co.....	Regina, Sask.	476
CFCN	W. W. Grant (Ltd.).....	Calgary, Alta.	434	CKCL	Dominion Battery Co.....	Toronto.	357
CFCR	Laurentide Air Service.....	Sudbury, Ont.	410	CKCO	Ottawa Radio Association.....	Ottawa, Ont.	434
CFCT	Victoria City Temple.....	Victoria, B. C.	329	CKCX	P. Burns & Co. (Ltd.).....	Calgary, Alta.	434
CFCU	The Jack Elliott (Ltd.).....	Hamilton, Ont.	341	CKFC	First Congregational Church.....	Vancouver, B. C.	411
CFHC	Henry Birks & Sons.....	Calgary, Alta.	434	CKLC	Wilkinson Electric Co. (Ltd.).....	Calgary, Alta.	434
CFKC	Thorold Radio Supply.....	Thorold, Ont.	248	CKNC	Canadian National Carbon Co.....	Toronto, Ont.	357
CFQC	The Electric Shop (Ltd.).....	Saskatoon, Sask.	329	CKOC	Wentworth Radio Supply Co.....	Hamilton, Ont.	341
CFRC	Queens University.....	Kingston, Ont.	450	CKY	Manitoba Tel. System.....	Winnipeg, Man.	384
CFXC	Westminster Trust Co.....	Westminster, B. C.	291	CNRA	Canadian National Railways.....	Moncton, N. B.	312
CFYC	Commercial Radio (Ltd.).....	Vancouver, B. C.	411	CNRC	Canadian National Railways.....	Calgary, Alta.	436
CHBC	The Calgary Albertan.....	Calgary, Alta.	434	CNRE	Canadian National Railways.....	Edmonton, Alta.	517
CHCM	Riley & McCormack (Ltd.).....	Calgary, Alta.	434	CNRM	Canadian National Railways.....	Montreal, Que.	411
CHCS	The Hamilton Spectator.....	Hamilton, Ont.	341	CNRO	Canadian National Railways.....	Ottawa, Ont.	435
CHIC	Northern Electric Co.....	Toronto, Ont.	357	CNRR	Canadian National Railways.....	Regina, Sask.	476
CHNC	Toronto Radio Research Society.....	Toronto, Ont.	357	CNRS	Canadian National Railways.....	Saskatoon, Sask.	329
CHUC	International Bible Ass'n.....	Saskatoon, Sask.	329	CNRT	Canadian National Railways.....	Toronto, Ont.	357
CHXC	R. Booth, Jr.....	Ottawa, Ont.	434	CNRV	Canadian National Railways.....	Vancouver, B. C.	291
CHYC	Northern Electric Co.....	Montreal, Que.	411	CNRW	Canadian National Railways.....	Winnipeg, Man.	384
CJCA	Edmonton Journal.....	Edmonton, Alta.	511				

**Republic of Mexico**

CYB	Mexico City.....	380	CYL	Mexico City.....	400	CZE	Mexico City.....	350
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**Republic of Cuba**

PWX	Cuban Telephone Co.....	Habana	400	2LC	Luis Casas.....	Habana	250	6DW	Eduardo Terry.....	Cienfuegos	225
2BY	Frederick W. Borton.....	Habana	315	2MG	Manuel G. Salas.....	Habana	280	6XJ	Frank H. Jones.....	Tuinucu	275
2CX	Frederick W. Borton.....	Habana	320	2MN	Fausto Simon.....	Habana	270	6KW	Frank H. Jones.....	Tuinucu	340
2EV	Westinghouse Elec. Co.....	Habana	220	2OL	Oscar Collado.....	Habana	300	8BY	Alberto Ravelo.....	Stgo. de Cuba	250
2HC	Heraldo de Cuba.....	Habana	275	2TW	Roberto E. Ramires.....	Habana	230	8DW	Pedro C. Anduz.....	Stgo. de Cuba	275
2HS	Julio Power.....	Habana	180	2WW	Amadeo Saenz.....	Habana	210	8FU	Andres Vinnet.....	Stgo. de Cuba	225
2JD	Raul Perez Falcon.....	Habana	105	5EV	Leopoldo E. Figueroa.....	Colon	360	12AB	Alberto S. de Bustamante.....	Habana	240
2K	Alvara Daza.....	Habana	200	6BY	Jose Ganduxe.....	Cienfuegos	300	16AZ	Valentin Ullivarri.....	Cienfuegos	200
2KD	E. Sanchez de Fuentes.....	Habana	350	6CX	Antonio T. Figueroa.....	Cienfuegos	170	20K	Mario Garcia Velez.....	Habana	360

**Great Britain**

2LO	London.....	365	5XX	Daventry.....	1600	5NO	Newcastle.....	404
5IT	Birmingham.....	479	2RN	Dublin.....	390	5SC	Glasgow.....	422
5WA	Cardiff.....	353	6BM	Bournemouth.....	386	2BD	Aberdeen.....	495
2BE	Belfast.....	440	2ZY	Manchester.....	378			

**France**

YN	Lyons.....	550	8AJ	Paris.....	1,780
FL	Paris (Eiffel Tower).....	2,650	ESP	Paris.....	458

**Short Wave Phone Broadcasting**

		KC	Meters
2XK	Schenectady, N. Y.*	4600	65.16
KDKA	Pittsburgh, Pa.*	4760	63.00
KDKA	Pittsburgh, Pa.*	5100	58.79
2XAF	Schenectady, N. Y.*	9143	32.79

\*Crystal Control

# CLASSIFIED ADVERTISEMENTS

If you have anything to buy or sell, don't overlook the value of RADIO AGE'S classified advertisements. Many such messages have paved the way to independent incomes.

The classified advertising rates are but five cents per word for a single insertion. Liberal discounts are allowed on three, six and twelve-time insertions, making rate of 4 1-2, 4 and 3 cents a word per insertion respectively. Unless placed through an accredited advertising agency, cash should accompany all orders. Name and address must be included at foregoing rates. Minimum contract charge \$1.00.

All classified ads for the August issue must be sent in by June 25.

## AGENTS WANTED

**SELLS at sight.** Prints ad on wrapping paper, envelopes, etc. \$4.00 commission. Send 10c for sample work. Automatic Ad-Stamp, Joplin, Missouri.

**FREE BOOKLET DESCRIBES OVER FIFTY PLANS** for building a business of your own; if interested in making real money, write. Downs Company, 2342 University, St. Paul, Minnesota.

**SELL MARVELOUS NEW RADIO INVENTION THAT IMPROVES** summer reception 100%. Effarsee marvel inside antennae gives better tone, greater selectivity, less static. Sells to every radio owner for only \$4.00. Write today. Fishwick Radio Co., 135 Central Parkway, West, Cincinnati, Ohio.

**Sell Five Tube Radio Sets.** Thirty days free trial. Three sales weekly pays \$90 profit. Experience unnecessary. DIRECT RADIO, 197-FF Fourteenth St., Milwaukee, Wisconsin.

**AGENTS—STEADY INCOME.** LARGE Manufacturer of soaps, perfumes, toilet articles and pure food products, etc., wishes representatives in each locality. Manufacturer direct to consumer. Big profits. Honest goods. Whole or spare time. Cash or credit. Send at once for particulars. American Products Co., 5796 American Bldg., Cincinnati, Ohio.

**Agents Make \$60.00 weekly.** Distribute quality food and toilet preparations among friends and neighbors. No money or experience necessary. Free automobile. Desk BG3. Healtho Products Co., Cincinnati, Ohio.

**Agents Wanted VANCY Guaranteed Radio Tubes** with imported filament all types BEST BY TEST also transmitters. Sample tubes \$1.50 each Post Paid. Send cash or money order. Van Cleef-DeForest Radio Company, Great Kills, S. I., N. Y.

**Man wanted for this territory** to sell wonderful value men's, women's, Children's shoes direct, saving consumer over 40%. Experience unnecessary. Samples supplied. Big weekly permanent income. Write today. Tanners Mfg. Co., 1334C St., Boston, Mass.

**\$50 WEEKLY EVENINGS.** DEMONSTRATING A super selectiva 6-tube radio set. Selectrodyne Radio Co., Dept. M-325 West State, Rockford, Illinois.

**RADIO SALESMEN and SET BUILDERS** in every county write Granzer Radio, 1479 Hodiament, St. Louis, Mo.

## AUTOMOBILES

**Light weight ALOY-NUM pistons** for all cars and trucks, low prices, cast circular. Egge, 7704 South Main Street, Los Angeles, California.

## BOOKS AND MAGAZINES

**Big savings monthly,** exchanging RADIO Magazines. List mailed free. Spencershield Agencies, West Los Angeles, California.

**EXPERIMENTAL RADIO** by R. R. Ramsey, Professor of Physics Indiana University. The only scientific experimental manual. Enthusiastically endorsed by the American Radio Relay League for amateur use. Used in colleges, universities and Government schools. Measure, adjust, and perfect your set. 85 experiments. Price \$2.00 post paid. Hugh Ramsey, Bloomington, Indiana.

**ELECTRICAL MEN! LOCATE TROUBLE ON ELECTRICAL APPARATUS.** PRACTICAL EXPLANATION WITH BLUE PRINT DIAGRAMS OF MOTOR & CONTROLLER CONNECTIONS. GREAT HELP & GUIDE TO MEN IN THE TRADE. COMPLETE BOOK FORM. PRICE \$2.00 POST-PAID. U. S. SALES & TRADING COMPANY, 1457 BROADWAY, NEW YORK, N. Y.

## BUSINESS OPPORTUNITIES

**Drafting, Expert Commercial, Architectural, Licensed, Reasonable.** Union Service, Liberty, Indiana.

**Pecan-Orange-Fig Groves "On the Gulf."** Guaranteed care. Monthly payments. Big quick returns. Suburban Orchards, Dept. K, Biloxi, Mississippi.

**\$100 weekly up.** We want experienced Radio men to operate branch assembling plants. Part or whole time. Barfield Radio Co., 13 Tillary Street, Dept. A. R., Brooklyn, New York.

## CRYSTALS

**Supersensitive Galena Crystals:** Pound 75c prepaid. ALKEMITE. All sensitive Crystals 50c. Buskett, Geologist, Joplin, Missouri.

## DOGS AND BEES

**BEAUTIFUL REGISTERED BULL PUPS \$15.** Bulldogs, 501 Rockwood, Dallas, Texas.

**Beekeeping backyard** among the pets. Breed bees that seldom sting. Build own supplies cheap. Interesting booklet explains how—dharma. Spencergrove Apiaries, West Los Angeles, California.

**WHITE Splz Puppies.** Beautiful, Intelligent, companionable. Fifteen Dollars. Brookwood Kennels, 2626 East 18th Street, Indianapolis.

## HELP WANTED

**RADIO SALESMEN and SET BUILDERS—**We need you and you need us. If you are reliable and well known in your community, we will appoint you our representative and furnish you with standard well advertised sets and parts at prices that will enable you to sell at a handsome profit. Write at once for catalog and sales plan. Waveland Radio Co., Div. 53, 1027 N. State St., Chicago, Ill.

**MEN** wanting forest ranger, railway clerk and other government positions, write for free particulars of exams. Mokane, Dept. B-33, Denver, Colo.

## INVENTIONS

**NEW IDEAS WANTED—**Well known Radio Manufacturer whose products are nationally advertised and sold everywhere wants new Radio device to sell. Will pay outright or royalty for idea or invention which is really new and saleable. Address: Mr. R. F. Davina, Room 1101, 116 West 32nd St., New York, N. Y.

## MUSIC

**SONG Poem Writers—**If you have your words put to music let a gifted Melody Writer do it. Write Francis Conover, (Composer) AVON, New Jersey.

**"MUSIC COMPOSED" TO WORDS.** BAUER BROS., (formerly of Sousa's Band), Oshkosh, Wisconsin.

## PATENTS

**FOR SALE:** U. S. and Canadian Patent on an Attachment for Phonographs; is the most beautiful invention of the age. Address Chas. F. Smith, Huff, N. Dak.

## RADIO

**CHOKES** unmounted 50H. 60MA. \$1.75, 30H. 50MA. \$1.50, 20H. 25MA. \$1.25. **TRANSFORMERS—**420V. from 110, 6V. filament center tap on filament and secondary windings. 70MA. for UX213 tube \$2.75, 280V. from 110V. no tap. 60MA. \$1.75, 190V. from 110V. no tap with 6V. filament for 201A "B" Eliminator \$1.75, AUDIO 5-1 or 3-1 RATIO .90. Write for list of "B" Eliminator parts. Radio Parts Sales Company, Box 24, Orange, N. J.

**NO MORE BATTERIES.** You can eliminate all batteries and operate your set on light current, AC or DC—no hum—any kind of set—any type of tubes. Complete blue prints and instructions, guaranteed \$2. Engineers' Service Company, Suite 203, 15 Park Row, New York.

**A real DX Circuit!** 5 tubes over 3000 miles range with loud speaker volume. Send \$1.00 for circuit and instructions. Tuttle Radio Laboratories, Diamond, Ohio.

**SAVE MONEY** on radio sets and parts. List free. All merchandise guaranteed. GEMRAD COMPANY, 631 E. Okmulgee, Muskogee, Okla.

**"\$1.00 For Your Old Tubes** regardless of make or condition towards the purchase of each new Standard \$2.50 tube. Positively guaranteed. We do not sell rebuilt or bootleg tubes. Order today. Luxem & Davis Mfg. Co., 6229 Broadway, Chicago, Ill. Paste this ad in your set."

**201A and 199 tubes rejuvenated** 30c. Charles Bloedorn, 1394 Detroit Street, Denver, Colorado.

**B BATTERY ELIMINATORS—**BUILD YOUR OWN cheap; no hum; acid or anything to get out of order; blueprint and instructions; 50 cents, money order or cash. Web Radio Co., Dept. A, 5823 Calumet Ave., Chicago, Illinois.

**Standard solderless radio Jacks.** Binding post attachments. Double circuit. One dollar bill. Postpaid. Clinton Seward, Jr., New Paltz, New York, N. Y.

**Three Cosmopolitan Phisiformers,** each \$5.50, book of instructions included. F. A. Mall, Tripoli, Iowa.

## RADIO DEALERS

**DEALERS—**Write for our illustrated catalog of reliable Radio Merchandise. Rositer-Manning Corporation, Dept. D, 1830 Wilson Ave., Chicago, Ill.

## RADIO SUPPLIES

**HAVE YOU SEEN THE NEW DIALITE,** THE UNIQUE lamp that lights up your panel and adds a decorative touch to any radio set? Retail at \$2.75, complete. Send for folder and dealer's proposition on this fast moving article. Also, we are distributors for the famous Knurled Walnut Cabinets, the most beautiful cabinets made. American-Universal Radio Co., 6255 Broadway, Chicago, Ill., Box 11.

## SALESMEN WANTED

**SELLS for \$9.75.** Prints ad on wrapping paper, envelopes, etc. \$4.00 commission. Send 10c for sample work. Automatic Ad-Stamp, Joplin, Missouri.

**Make \$100 WEEKLY** in spare time. Sell what the public wants—long distance radio receiving sets. Two sales weekly pays \$100 profit. No big investment, no canvassing. Sharpe of Colorado made \$935 in one month. Representatives wanted at once. This plan is sweeping the country—write today before your county is gone. OZARKA, INC., 126 F. Austin Ave., Chicago.

**66 MILES ON 1 GALLON—**SCIENTIFIC GAS SAVER. All autos. 1 free to introduce. Critchlow, A-90 Wheaton, Illinois.

## STAMPS

**69 stamps, 4 cents.** Book Stamp Company, 642 Meredith Street, Dayton, Ohio.

**STAMPS, 50 varieties.** Africa, Brazil, Peru, Cuba, Mexico, etc., 10c. 50 different U. S., 25c; 1,000 mixed, 40c; 1,000 hinges, 10c. List free. C. Stegman, 5950 Cote Brillante, St. Louis, Missouri.

## CODE

**Want to Memorize the Wireless Code?** The Coryden Snyder Code Method. Patented is quickest. Send 25c coin, or M. O. to C. C. Snyder, 1423 Elmdale Ave., Chicago, Ill.

**TELEGRAPHY—**Morse and Wireless—taught at home in half usual time and at trifling cost. Omnigraph Automatic Transmitter will send, on Souder or Euzer, unlimited messages, any speed, just as expert operator would. Adopted by U. S. Govt. and used by leading Universities, Colleges, Technical and Telegraph Schools throughout U. S. Catalog free. Omnigraph Mfg. Co., 13 F Hudson St., New York.

*Radio Age Classified Ads Bring Results*

Please mention Radio Age when writing to advertisers

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1430	209.7			
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1400	214.2			
1390	215.7			
1380	217.3			
1370	218.8			
1360	220.4			
1350	222.1			
1340	223.7			
1330	225.4			
1320	227.1			
1310	228.9			
1300	230.6			
1290	232.4			
1280	234.2			
1270	236.1			
1260	238.0			
1250	239.9			
1240	241.8			
1230	243.8			
1220	245.8			
1210	247.8			
1200	249.9			
1190	252.0			
1180	254.1			
1170	256.3			
1160	258.5			
1150	260.7			
1140	263.0			
1130	265.3			
1120	267.7			
1110	270.1			
1100	272.6			
1090	275.1			
1080	277.6			
1070	280.2			
1060	282.8			
1050	285.5			
1040	288.3			
1030	291.1			
1020	293.9			

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KC	Meters	STATIONS		
		1	DIALS 2	3
1010	296.9			
1000	299.8			
990	302.8			
980	305.9			
970	309.1			
960	312.3			
950	315.6			
940	319.0			
930	322.4			
920	325.9			
910	329.5			
900	333.1			
890	336.9			
880	340.7			
870	344.6			
860	348.6			
850	352.7			
840	356.9			
830	361.2			
820	365.6			
810	370.2			
800	374.8			
790	379.5			
780	384.4			
770	389.4			
760	394.5			
750	399.8			
740	405.2			
730	410.7			
720	416.4			
710	422.3			
700	428.3			
690	434.5			
680	440.9			
670	447.5			
660	454.3			
650	461.3			
640	468.5			
630	475.9			
620	483.6			
610	491.5			
600	499.7			
590	508.2			
580	516.9			
570	526.0			
560	535.4			
550	545.1			

# SNUBBED!



Tap the base of a spring-suspended socket and feel the vibrations. Then touch the base with finger and watch them disappear. This explains "snubber" action.

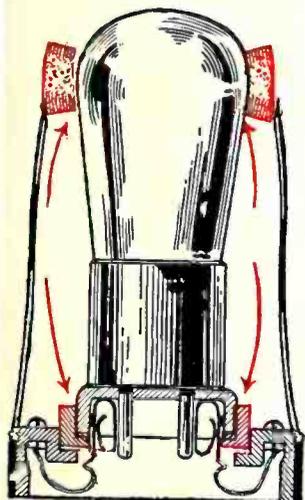
Snubbers on a modern automobile are indispensable. Springs promote riding comfort, but without absorbers the bouncing continues too long after the jolt occurs. Effective snubbers damp out the oscillating spring action.

The delicate elements of a radio tube are in vital need of efficient shock absorption—particularly the detector, where vibration often develops such "microphonics" as to actually ruin reception.



UX Absorber Socket, 75c.

Compact size and neat design permits use where compactness is desired yet superiority is evident.



Showing double absorber for detector tube protection. The arrows point to the absorbing support between the base and the tube holder and to the damping side mufflers. Note the contact springs touch the tube prongs over a large area not making contact at one point only. This is UX Detector \$1.00.

With B-T Sockets vibrations are immediately absorbed. They are not spring suspended. Note the absorbing support between base and tube holder—the damping side mufflers on the detector model,—the long, yielding spring contact,—all designed for one purpose,—**QUIET RECEPTION.**

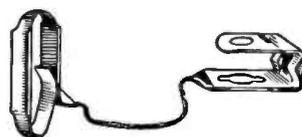
From our experience with the Silent Socket (still available with Universal base \$1.25) we are confident the new type sockets will outsell all other sockets by a big margin.

## Your tubes deserve protection

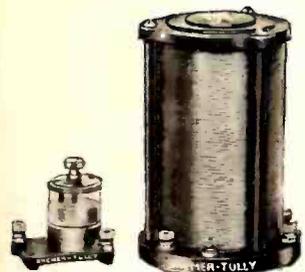
Lengthen their lives and improve reception by treating them fairly. Use B-T sockets if you build. Insist on their use if you buy.

**NO B-T PRODUCT IS EVER OFFERED UNLESS IT HAS FULLY DEMONSTRATED OUT-STANDING SUPERIORITY. THAT'S WHY "EVERY B-T BUYER IS A B-T BOOSTER."**

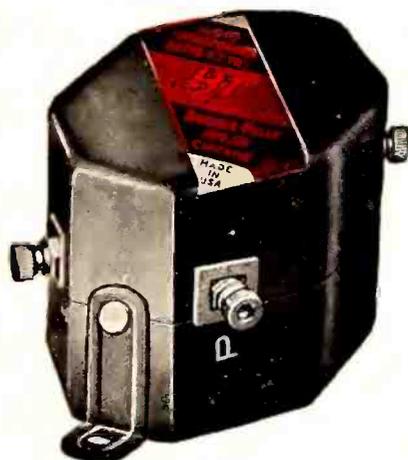
*B-T authorized dealers will soon be able to show you new Beliminators, Counterphase Set models, etc. Watch for them. Write for circulars.*



Showing contact spring and terminal with flexible connecting link, which is for current, not spring tension. The superiority of the spring contact is at once evident. It is positive but causes no undue side strain. The tube slips in place without forcing and is removed easily without sudden and unexpected release.



Radio Frequency Unit and Micro Mike condenser used on the new Counterphase - Seven Shielded stages. M. M. F. condenser alone, \$1.00.



In spite of continued efforts to produce a substitute unbiased experts will agree that there is no amplification method that surpasses good audio transformers.

The Euphonic has proved how good a transformer can be made.

2.2 to 1 \$5.00  
4.7 to 1 5.75

**Premier Tully**  
Manufacturing Company

532 So. Canal St., Chicago, Ill.

# Announcing Zenith's New Reproducer

All who have heard ZENITH RADIO—all who know the high standards of excellence set by Zenith, realize that this simple announcement marks a new step in the faithful rendition of music and voice—the finest of reproducers

You who have listened to radio from "loudspeakers" know that something has been missing. There has been a false quality in the sound, a failure to reproduce all pitches faithfully, and some ranges have been almost totally missing. You have been able to identify radio instantly. You have rarely, if ever, mistaken it for a band or orchestra, or for the human voice.

It has remained for Zenith to solve this difficulty. It has remained for Zenith to design a Reproducer, small enough to be practical, which could still contain all the elements necessary to reproduce faithfully for you the complete range of all instruments from the shrill, sharp notes of the upper register of a Pipe Organ or a Piccolo, to the rumbling Bass.

Zenith has accomplished this. Zenith now offers you a Reproducer that lives up to its name—it reproduces sound.

There is, to all intents and purposes, an oboe in this handsome cabinet. There is also a bassoon, a flute, a clarinet and a bass drum.

From the shrill, piercing notes of the Piccolo to the deep-toned surge of the Double Bass, the notes pour forth until you doubt in spite of your senses that this one Reproducer can thus prove its harmonic kinship with every instrument.

And yet, they are there. They are there together in a realistic burst of harmony, each clear and distinct. Or they are there alone if you wish to single them out—the clash of cymbals, the reedy cry of the saxophone, the rolling wave of sound

from the drums and the heavy brass.

Your first exclamation when you hear the Zenith Reproducer will be: "Why this is MUSIC."

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It required all the ingenuity of Zenith Designers to get all the elements into the compact space occupied by the Reproducer to give you a true reproduction of the complete range of sounds.

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No one would ever mistake the New Zenith Reproducer for anything but a MUSICAL INSTRUMENT. It is dull-rubbed walnut finish, with exquisite carving, both in the relief motifs, and in the gracefully curved fretwork.

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