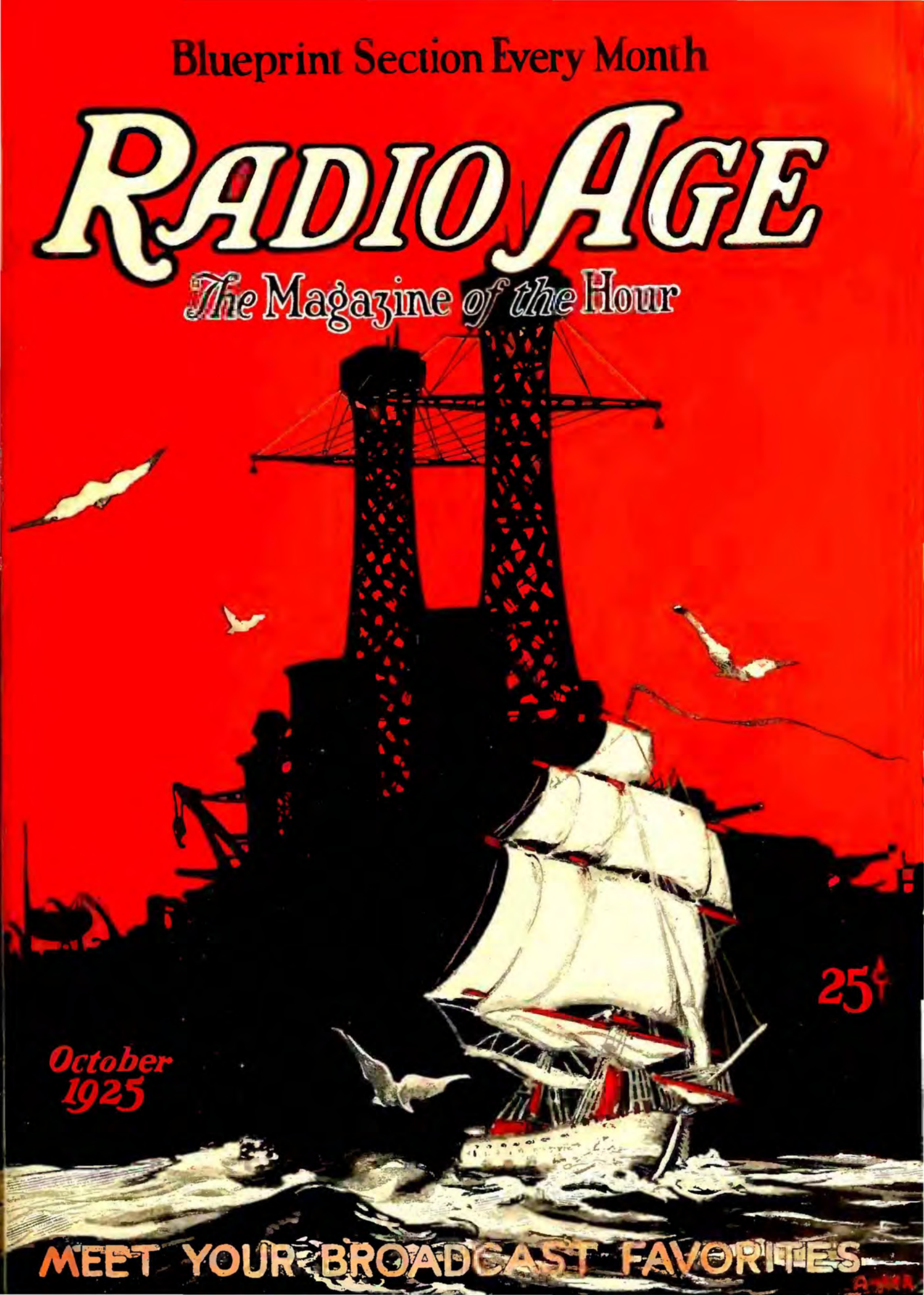
Blueprint Section Every Month

RADIO AGE

The Magazine of the Hour



25¢

October 1925

MEET YOUR BROADCAST FAVORITES

Built As Only B-T Can Build

"No condenser is better than its bearings,"—and no other bearing made today approaches the mechanical efficiency of the B-T "Lifetime" bearing.

You can pay more for condensers but you cannot buy as much. That's why we print on every carton "*If you don't find it better send it back.*"

The B-T Straight Line Frequency Condenser

spaces stations evenly on the dial according to frequencies when used with B-T Inductances. No condenser, regardless of advertising, will give straight line results except with the particular coil for which they are designed.

The B-T S L F follows the design and mechanical construction of the B-T "Lifetime,"—leader of the world for the past eighteen months. In buying a B-T product you know you have an original and not a copy. For your protection we caution you to avoid imitations.

Type S L F—17 plate, .00035, is **$5.75.**

The B-T Universal Socket

eliminates adapters. It takes the present type and the new UX tubes. *You may change to dry cell tubes without changing sockets.*

Positive, side-wiping, spring contacts insure results.

Price—**75c.**

The B-T "Euphonic" Transformer

Euphonic,—"pleasing to the ear,"—is the only term that expresses the matchless qualities of this new product.

Its Universal mounting feature,—exclusively B-T,—is the first real improvement in transformer mechanical construction since broadcasting began.

The mounting legs snap into position readily in either position. Either side may be placed upwards,—the terminals may be brought where you want them and all crossed wiring,—a most frequent cause of howling and distortion, eliminated.

Fully shielded, black enamelled,—Gold and Blue seal.

Two ratios 2.2 to 1 and 5.9 to 1,—small enough to be compact,—

Large enough that adding more iron would be wasted material.

Just as much superior to other transformers as every other B-T product has been. Price, Low ratio **$5.00**; High ratio **$5.75.**

The B-T Tuning Control

is proving to be probably *the most popular item we ever built.* We have been greatly surprised at the number of people who go to the trouble of writing us letters after trying one. Price..... **$2.50**

The 8th edition of "BETTER TUNING" we guarantee to be the biggest 10c worth you ever bought. It covers many live subjects in a way that is peculiarly different. Send the coupon today.

☐ Send circulars on your Audio Transformer, Universal Socket, Tuning Control, High Resistances, "Toro-style" Transformers and all B-T products.

☐ Send "Better Tuning" 8th Ed. 10c enclosed.

☐ I would be interested in a complete set. Send information

Name.....

Address.....

BREMER-TULLY MFG. CO.

"Pioneers of Better Tuning"

CANAL AND HARRISON CHICAGO

Earn $50 to $250 a Week in RADIO

Easy to Become a RADIO EXPERT at Home in Spare Time

Big Jobs Waiting in the Radio Business

IF YOU are making less than $50 a week—if you want to get into the big pay class in the world's fastest growing industry—get into Radio—NOW. Coupon brings you full information.

Big jobs are open for trained men, in every section of the country. Radio manufacturers — distributors — dealers — broadcasting and receiving stations—railroads and steamship companies and branches of the Government, need trained Radio Experts NOW! Opportunities are open everywhere for men to go into business for themselves as Radio Experts. The pay is big. Thousands are now making $50 to $250 a week in Radio. This great industry is making new millionaires almost over night.

Learn Quickly at Home by Tested Method

You can become a Radio Expert quickly, and easily, in your spare time at home, with the help of the National Radio Institute—America's first and largest home study Radio school. This famous, tested course makes Radio as simple as ABC—and so fascinating you will scarcely realize that you are mastering one of the world's most important industries. In a few short months you may become the Radio Expert of your town or wherever you wish to locate. You get the benefit of our years of experience and you learn Radio RIGHT when you learn our way!

This Is The Course That Pays for Itself

We mean every word of it! We have developed the famous method that makes it unnecessary for your training to be an expense. Instead of making any man "scrimp" to get his training, our system makes your course pay you returns practically from the start. When you learn our proven way your course will pay for itself, and more—much more! Get the details of these amazing methods.

Don't Worry About Age or Education

It makes no difference what your age is or what your previous training has been. Radio is a field in itself. It calls men of all ages from youth to settled middle-age. Success does demand training in Radio and the N. R. I. course gives you the training necessary to Success.

Up-to-date Receiving Sets Given with Course

You learn by doing—through the N. R. I. Course. All materials and equipment necessary are furnished you along with your course. You are sent receiving sets to build and install—real sets for experimental work and pleasure. This is a practical course that teaches you to get the practical results that big pay jobs demand.

Helpful Employment Service

We are constantly in touch with openings for trained Radio men. The men we train get first chance at these fine jobs through our Free Employment Department—at no extra cost. When you complete our training we help you until you get the job you want.

Mail Coupon Quick for FREE BOOK and Special Offer

The coupon below will bring you the most amazing book on Radio, ever written. It will open your eyes to the opportunities for you in this established, big pay field and tell you how to become a Radio Expert in your spare time at home. It has helped thousands of men to success in Radio.

Important: We have a Special Limited Offer for those who act quickly. Mail the coupon or write a letter NOW.

National Radio Institute
Dept. 53MB, Washington, D. C.

Get this FREE BOOK

NATIONAL RADIO INSTITUTE, Dept. 53MB, Washington, D. C.

Without obligation send me your book, "Rich Rewards in Radio," which tells all about the opportunities in Radio, how spare time study at home will qualify me quickly as a certified Radio-trician so I can get one of these splendid positions, and how your Employment Service helps me to secure a big pay job.

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

Street .....

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

Proof that Radio Pays

See What These N. R. I. Men Are Doing

Buys New Car With Earnings

Anyone, regardless of age or sex, should have no trouble in mastering Radio from the N. R. I. course. I am at present employed as Service Manager for the Geo. F. Dent Radio Service Co. and I am still taking the course.

I have had great success selling, building, repairing and installing all kinds of Radios. At present I am getting a salary and commission which, although I have only been with the firm for 3 months, has enabled me to purchase a new car.

Richard E. Jones, Bay City, Michigan

Gets Own Manufacturing Business

As you can see by our letterhead, Mr. Bartlet (one of your graduates) and I are in business for ourselves. We build 6-tube radio frequency sets and have a ready market for them. This was only made possible through your course. Your instruction and service is a great help. It is impossible for me to estimate its value in dollars and cents. I think Radio offers better opportunities than any other field.

Allen N. Birteil, Knox, Pa

Makes $50 to $80 a Week More

Your course leads so much further ahead than practical electricity that there is nothing left to say. Since I took your course I have earned from $50 to $80 a week more.

Preston Fowler, Gordon, Neb.

Increases Pay 160 Per Cent

I was just receiving $3.00 per 8 hours when I enrolled with N. R. I. and now I am receiving $1.00 an hour (160 per cent increase). That is where N. R. I. put me. The course has been worth $2500 a year to me and in another year it will be worth $3500 a year.

Andrew M. Shurie, Latrobe, Pa.

Earn $50 to $250 a week in Radio

RADIO AGE

The Magazine of the Hour

Established March, 1922

WITH WHICH IS COMBINED RADIO TOPICS

Volume 4 *October, 1925* *Number 10*

CONTENTS

Radio Age is published monthly by RADIO AGE, Inc.
Member: Audit Bureau of Circulations.

Publication Office, Mount Morris, Ill.
Address all communications to RADIO AGE, INC.
Executive, Editorial and Advertising Offices
500 N. Dearborn Street, Chicago, Ill.

FREDERICK A. SMITH, *Editor*
FRANK D. PEARNE, *Technical Editor*
M. B. SMITH, *Business Manager*

Advertising Director
HARRY A. ACKERBURG
500 N. Dearborn St., Chicago, Ill.

Eastern Representative
DAVIDSON & HEVEY, 17 West 42nd St., New York City

Pacific Coast Representative
V. M. DEPUTY & ASSOCIATES, 515 F. W. Braun Bldg., Los Angeles, Cal.

Final Advertising forms close on the 20th of the 2nd month preceding date of issue

Vol. 4, No. 10. Issued monthly. Subscription price $2.50 a year. October, 1925. Entered as second-class matter at post office at Mount Morris, Illinois, under the Act of March 3, 1879.

A Chat With the Editor

BIRDS in our temperate zones are breaking up housekeeping and preparing for their annual flight southward. Hollyhocks are flamboyant along the garden walls, like glowing, dying embers. There is a flaw of wind at sunset which breathes cool oxygen into fragrant bonfires. Soon the frost will be on the pumpkin and the maples will be ablaze.

Long evenings are coming, when the fireplace will call again and there will be mulling cider and beckoning book shelves.

And radio.

That is what we were coming to. What joy of listening this fall and winter! More powerful stations, better broadcasting technique, improved programs, superior receiving apparatus. It has been the busiest of summers on the air and it is to be an epochal 1925-1926 season. The radio industry has found itself. Radio listeners have thrust aside the doubt and inexperience of another day. The listening millions know exactly what they want and how to get it.

This magazine of ours has been on the sentinel line watching four such seasons of good reception send forward their outposts to prepare for a new drive against dull care in radio time. Our modest sixteen-page pamphlet in the early spring of 1922, in keeping step with the march of radio, has moved forward to an enviable position among publications.

We believe you will like this October number of RADIO AGE. We assure you that it is our sole aim to make each succeeding number more helpful and more interesting. Judging from the public's generous support, we have not labored in vain. We hope the magazine will be your companion these long evenings to come and that it will continue to be a constructive factor in the magnificent destiny which awaits the most popular of all sciences.

Frederick Smith

Editor of Radio Age.

RADIO EDITORIALS

HEREWITH are some facts about the radio gyps. A gyp is a price-cutting sharp shooter who fires broadsides of sensational advertising at the radio public, offering a standard product at less than the regular retail price. When a customer is attracted to the gyp's store by such advertising, the customer finds that the gyp has sold out his advertised line and proposes to sell the customer something else, equally as attractive in character or price. Or the gyp may sell him the standard product advertised, at the same time neglecting to inform the customer that it is an obsolete model or type, and is worth far less than the amount, that even the gyp is charging for it.

Your gyp will announce in his advertisement that he has 500 Excella Loud Speakers for sale at one half the regular price. Investigation will show that he actually has perhaps a dozen Excella Loud Speakers for sale. He probably has had a lot of trouble in getting his hands on that many. But he announces a large stock so that customers will come to him with confidence that they will be able to get the Excella, no matter though they may arrive several hours after the doors open on the "great sale." Failing to get the Excella, the customer looks around. Probably he buys something else. He has been confidenced into the store and there are plenty of high pressure clerks in the place to see that he does not get out before he is sold.

Gyps are not peculiar to the radio business. They have been blow-torching their way into legitimate lines of trade ever since the time of Tubal Cain. They come and go like the oily gentleman who manipulates the three shells and the pea at county fairs. They rent cheap store locations and decorate their windows with enough astonishing price propaganda to make even a wary man stop and look. They are not welcomed into chambers of commerce, business clubs or dealers' associations. Much of the merchandise that is actually what they represent it to be is obtained by them through secret sources. It bears the finger prints of unethical business.

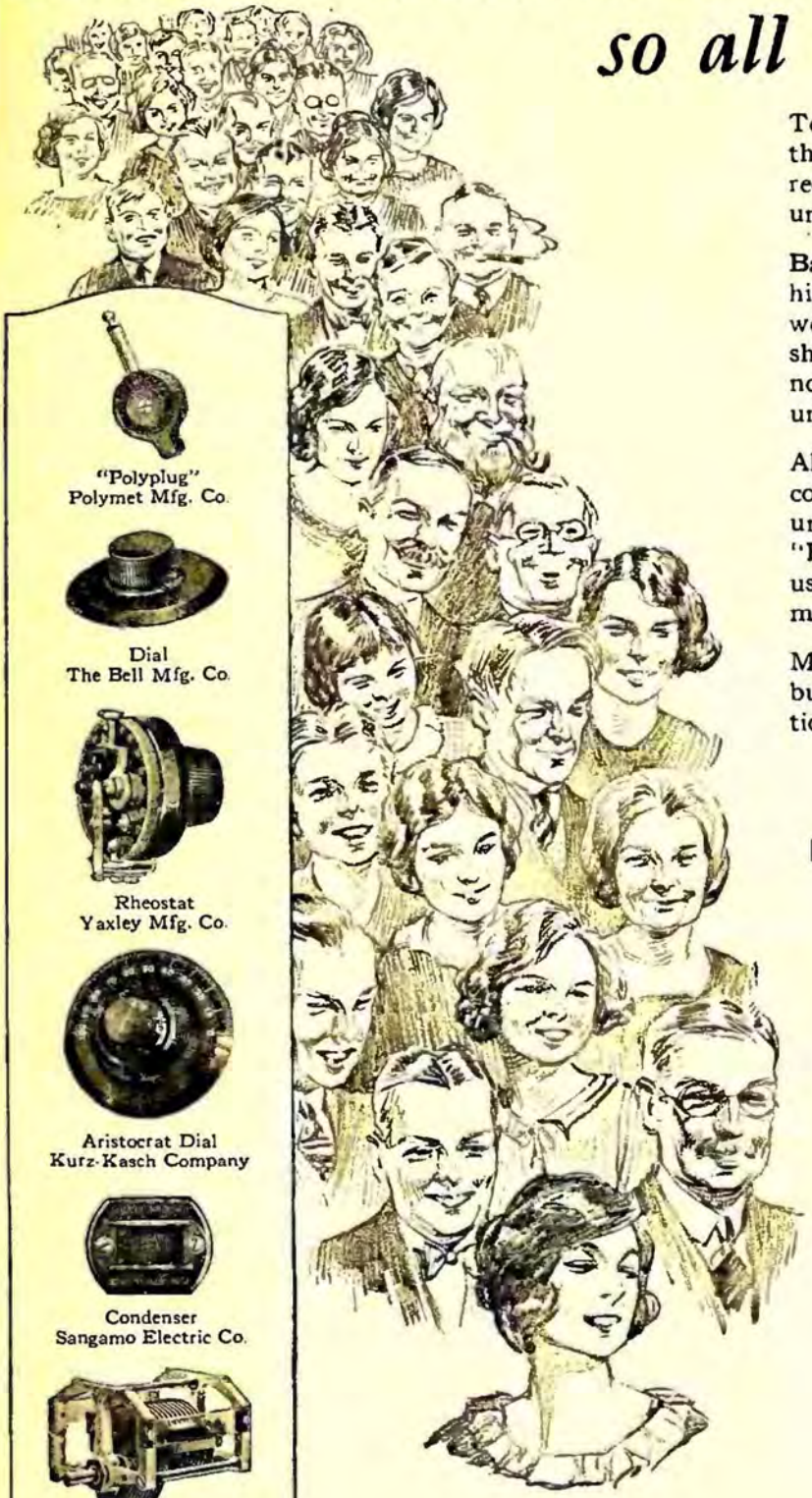
One might suspect that after a few lessons the public would become educated to such an extent that the gyp would have to go out of business. Not so. Barnum said there was one sucker born every minute and one time or another each one of them lines up at the counter of the gyp. The best that can be done for the situation is a continuous presentation of the facts, showing the advantage in dealing with radio merchandisers who buy honestly, advertise frankly and sell fairly.

The radio experimenter or complete set buyer may establish himself in a safe policy by adopting a rule that he will buy only from those whose advertisements appear in reputable periodicals. He may be sure that if the periodical is of good character and is building for a long pull, its publishers are bound to carefully scrutinize the advertisements as well as the editorial material which is submitted for publication.

At the same time, manufacturers and dealers necessarily use care in the selection of the periodicals in which their advertising appears. What would you, as one of the buyers who are turning $400,000,000 into the coffers of the radio industry this year, think of the advertiser who would permit his selling message to appear in a magazine which, for example, was notoriously competing with its own advertisers by establishing manufacturing or retailing enterprises and publishing advertisements of those enterprises under names which attempted to conceal the magazine's connection with the advertiser? Or what would you think of the sagacity of a manufacturer who would advertise his products in a magazine, which in a single issue would print page after page of advertising announcing cut prices on standard products which established and reputable manufacturers were advertising in the same magazine at higher, though perfectly fair and reasonable prices? What would you think of a manufacturer who permitted himself to be tempted away from reputable, honest-dealing magazines by the gyp lure of a publisher who slashed advertising rates for certain accounts and misrepresented circulation figures in order to get the customer in? Sagacious advertisers do not fall into such traps. Buyers of radio equipment may profit by their example.

Radio drafted Bakelite

so all could listen-in



"Polyplug"
Polymet Mfg. Co.

Dial
The Bell Mfg. Co.

Rheostat
Yaxley Mfg. Co.

Aristocrat Dial
Kurz-Kasch Company

Condenser
Sangamo Electric Co.

Condenser
Bremer-Tully Co

To make available for everyone, everywhere, the marvel of radio reception, radio engineers required an insulating material possessing a unique combination of properties.

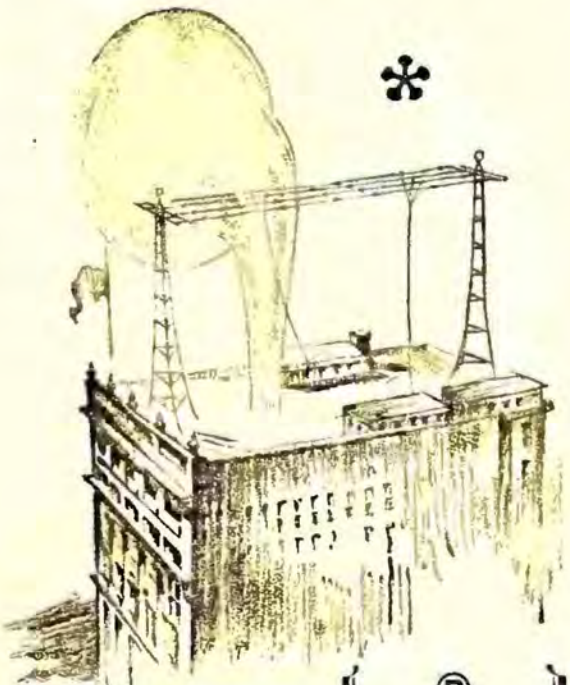
Bakelite alone met the need. It combines high insulation value with strength and light weight. It is easily formed into the many shapes required and will not warp, shrink nor swell. It will not absorb moisture and is unaffected by extremes of heat and cold.

All of these properties and the beautiful color and finish of Bakelite are permanent—unaffected by time, use or climate. So "Radio drafted Bakelite," and today it is used by over 95% of radio set and parts manufacturers.

Make sure that the radio set or parts that you buy are Bakelite insulated, for good insulation is essential to clear reception.

Write for Booklet 31

BAKELITE CORPORATION
247 Park Avenue, New York, N. Y.
Chicago Office: 636 West 22d Street



Bakelite is an exclusive trade mark and can be used only on products made from materials manufactured by the Bakelite Corporation. It is the only material which may bear this famous mark of excellence.

BAKELITE

REG. U.S. PAT. OFF.

BAKELITE
is the registered trade mark for the phenol resin product manufactured under patents owned by the Bakelite Corporation.

THE MATERIAL OF A THOUSAND USES

* *Tested and Approved by* RADIO AGE *

Whether you smile or cuss depends upon the service behind your Radio~

WHAT is this radio service which we claim is so necessary?

Do you drive a car?

Do you ever have little things go wrong with it?

You have become so used to minor troubles that you don't condemn the car on which they occasionally occur.

No—

You go right to a service man—a man who knows your make of car. You don't go to a handy man who claims he can fix any car.

That's automobile service, and is one of the main reasons for the auto being the success it is today.

The same service condition exists in radio—the only difference being that people don't yet understand it.

The radio instrument which never requires service has never been built—it never will be.

Like automobile manufacturers, the better radio manufacturers do all within their power to make their instruments mechanically perfect. Nevertheless, like the auto, little things will sometimes go wrong—they are serious to the radio owner but very simple to a factory trained service man.

The handy man who can fix any radio simply experiments until he locates the trouble—such a method was disastrous to the auto in former days—it is disastrous and expensive in radio today. It is not sound.

Ozarka instruments are sold only by Ozarka factory representatives, men who are factory trained in sales and service, men who sell no other radios but Ozarka.

These men don't pretend to know all about radio but they do know all there is to know about Ozarka—isn't that the kind of radio service you want?

Ozarka instruments are sold under a very definite plan. An Ozarka representative will gladly set up an Oza.ka in your home—he won't tune it—he won't tell you what it will do—you must operate yourself. If the results you receive by your own operating won't convince you that the Ozarka gives you the distance, volume, selectivity, tone and ease of tuning that you demand then don't buy it.

Ozarka instruments are built to sell themselves but no Ozarka is sold without factory-trained service behind it.

Openings for a Few More OZARKA Factory Representatives

OZARKA Incorporated, is now entering its 4th year. From a beginning with one engineer, one stenographer, one salesman–our present president, the Ozarka organization has grown to over 3,100 people. There must be some good reason for this growth.

Ozarka instruments have made good—they have more than met competition. Ozarka representatives have made good not only because Ozarka instruments were right, but because they have been willing to learn what Ozarka engineers were willing and capable to teach them—Ozarka unusual salesmanship and Ozarka service.

There are still openings for the right men in this organization—men who believe in the future of radio—men who are tired of working for some one else—men who want a business of their own. Prove yourself by sales and willingness to learn and exclusive territory will be given you. The man we want has lived in his community for some time. He has the respect of his fellow men because he has never "put anything over" just to make money. He may not have much money, but he is not broke and is, at least, able to purchase one demonstrating instrument.

Send for FREE Book

Radio offers a wonderful opportunity to men who are willing to start at the bottom and build. You need not know salesmanship, but will you learn what we will gladly teach you? You may not know radio, but we can and will teach you if you will do your part. With such knowledge and willingness to work, it doesn't seem possible that you cannot make good. Sign the coupon below, don't fail to give the name of your county. Better still write a letter, tell us about yourself and attach the coupon. If interested in our salesman's plan ask for "Ozarka Plan No. 100."

OZARKA
122 Austin Avenue A
Chicago, Illinois

Gentlemen: Without obligation send book "Ozarka Instruments No. 200" and name of Ozarka representative.
10-25-122A
Name.....
Address..... City.....
County..... State.....

You'll Know the Man Behind This Button!

INCORPORATED
122 Austin Avenue A
Chicago, Illinois

Gentlemen: I am greatly interested in the FREE book "The Ozarka Plan" whereby I can sell your radio instruments.
10-25-122A
Name.....
Address..... City.....
County..... State.....

* *Tested and Approved by* RADIO AGE *

RADIO AGE
The Magazine of the Hour
M. B. Smith, Business Manager
A Monthly Publication Devoted to Practical Radio
Frederick A. Smith, Editor

Handling the Radio Stages with
AUTO-TRANSFORMER Coupling

By ROSCOE BUNDY

Comparing the Many Methods of Coupling

WHILE there are a number of different methods available for coupling the various radio stages, yet the transformer method of coupling has been almost universally adopted for radio frequency receiving sets. This applies to all types of receivers in which radio frequency amplification is used, super-heterodynes as well as reflex circuits and plain five tube sets of the popular "dyne" order. At one time, tuned impedance coupling by means of variometers or else condenser tuned air-core impedances, seemed to be gaining in popular approval, but when the neutrodyne was introduced, the impedance system received a set-back from which it has not yet recovered. Resistance coupling, after the manner of resistance coupling the audio frequency stages, was only efficiently applicable to long wave reception, but even then, the resistor type coupler was seldom encountered, even on the super-heterodyne, where it is at its best.

All modern air-core transformers are essentially the same, no matter how they may differ in the details of the windings or core. They all have a primary coil that is electrically isolated from a secondary coil with a magnetic coupling between the two circuits. The plate current of the first tube in passing through the primary coil of the condenser creates a magnetic field which in turn induces a current in the secondary coil. As the turn ratio between the coils is generally greater than unity, the potential established at the terminals of the secondary, and hence at the grid of the following tube to which they are connected, is greater than the plate potential and hence greater amplification results from the increased voltage. The transformer affords a simple means of increasing the potential at the grid of the tube, and hence the amplification, but it has other characteristics which are not so welcome—the tendency toward the establishment of free oscillations for one thing.

Capacity Coupling

NO matter how carefully the transformer may be designed and constructed, there is always a certain degree of capacity coupling between the primary and secondary coils which causes trouble, and reduces the electrical efficiency below that which would ordinarily be expected from the coil. In the case of tuned radio frequency transformers, the inter-winding capacity seriously affects the selectivity and always has a strong tendency toward setting up free oscillations because of the low resistance of the winding. An electro-static transfer takes place between the two coils regardless of the tuning condenser adjustment; hence the selectivity is not all that could be desired. Signal strength is reduced when the coupling between coils is reduced, so there is a decided limit to the practical utilization of the incoming waves.

With the untuned or "aperiodic" transformer there is less tendency toward uncontrollable oscillations owing to the much greater resistance, but with such transformers there is no selectivity and a very great deal of electrostatic coupling which reduces the effectiveness of the coils. As such transformers are designed primarily with the idea of obtaining uniform amplification over the entire broadcasting wavelength without tuning, the selectivity of the circuit must depend entirely upon the antenna tuning system or upon auxiliary tuned stages which may be introduced. They cannot be "peaked" on a certain definite wave; hence the amplification is never so great as with the tuned secondary transformers. The iron core type of aperiodic radio frequency transformer has a higher amplification than the air core, as a rule, and the wave-band covered with uniform amplification is greater, but still the type has other undesirable characteristics.

Impedance coupling, both tuned and aperiodic, generally gives a lower amplification than the transformer, but in certain other respects it is the superior of the transformer type. It is easier to tune, is not quite so criti-

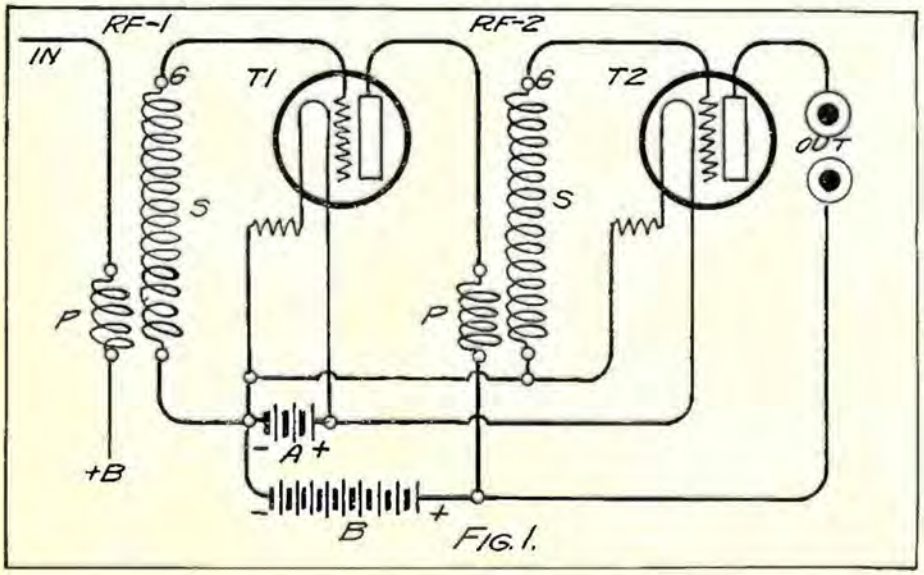


FIG. 1.

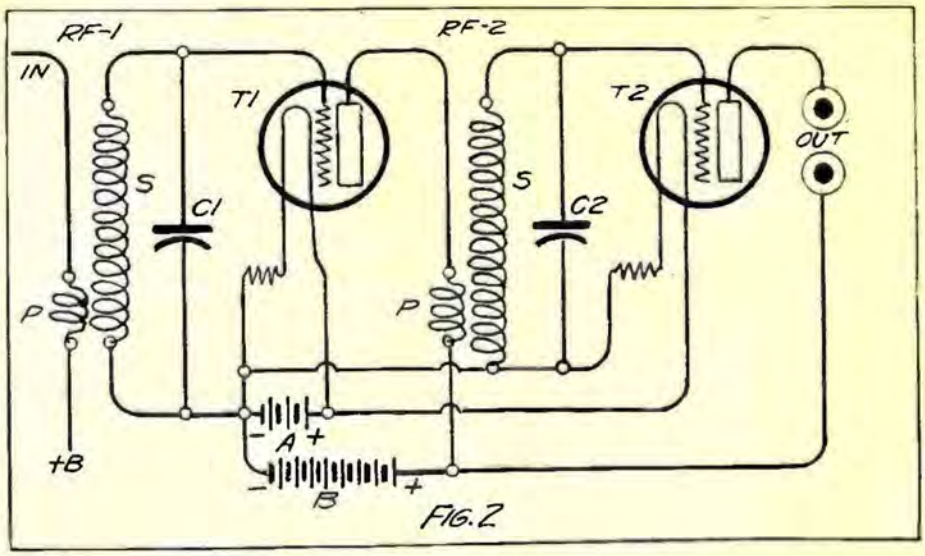


FIG. 2

cal on the controls as the transformer type, and is less likely to cause free oscillations in the radio frequency circuit. However, being a single circuit proposition with no means of controlling the coupling, the tuned impedance type of receiver is rarely so selective as the tuned air-core transformer unless unusual pains are taken in the construction of the coils and in the arrangement of the circuit. Again, there is some loss of plate current through the inductance to the "B" battery, and the ratio is never much greater than unity, so that the voltages impressed on the following tube grid are rather low.

In Fig. 1 is a typical aperiodic transformer coupling, where the output of the tube (T1) is transferred to the grid of tube (T2) through the air-core radio frequency transformer (RF-2); Plate current from (T1) passes from the "B" battery through the primary coil (P) on its way to the plate, hence all pulsations in the coil (P) are inductively transferred to the secondary coil (S) by magnetic linkage. A comparatively high potential is developed at the end of the secondary coil (G), and this acts on the tube (T2) to produce greater amplification. Tube (T1) receives its energy from a tube connected to the input (Primary) of transformer (RF-1) and the same system is carried out with any desired number of "radio stages."

In this sort of transformer, the windings are so proportioned that a fairly uniform coupling is had over a fairly wide range of wavelengths, say from 200 meters to 550 meters. The coils are wound with fine wire and have a considerable resistance, which damps down free oscillations but which equally causes comparatively high ohmic losses and reduced amplification.

Tuned R. F. Transformers

BY tuning the secondary coil to wavelength by means of variable condensers as in Fig. 2, the transformers can be accurately "peaked" at the desired wavelength so that the maximum amplification is secured on any wavelength within the range of the condensers. The variable condensers (C1) and (C2) are connected directly across the secondary coils (S) of the transformers (RF-1) and (RF-2) in the familiar fashion, but the primary coils (P) are not separately tuned and are therefore known as "aperiodic primaries." As few as five or six turns are often used for the primary coils (P) which brings their natural period far below that of any ordinary broadcasting wave and therefore the grid and plate circuits are not so likely to be tuned into resonance and self-oscillation as would be the case with a greater number of turns. The number of turns and length of wire on the secondary coils are determined by the wavelength band and the size of the variable condensers (C1-C2), and the turn ratio between the primary and secondary varies from 6-to-1 to 11-to-1 in commercial types of coils.

Owing to the small amount of wire on the tuned radio frequency transformers, the resistance is very low and the efficiency is correspondingly high. By properly adjusting the distance between the primary and secondary, thus maintaining a proper magnetic coupling, the coils can be made very selective providing that the electrostatic coupling is kept at a minimum at the same time. By having a number of successive tuned radio stages of this type, the total selectivity can be made to reach a high degree, for each successive stage makes it possible to reduce the interference waves passed by the preceding transformer until undesired stations are completely eliminated.

Tuned impedance coupling is really the simplest type, although it does not give quite the amplification given by the transformer. A detail is shown by Fig. 3 where the three tubes (T1-T2-T3) are impedance tuned by the fixed inductances (L1-L2) and the variable condensers (C1-C2) connected across the ends of the inductance coils. Increasing the capacity of the condensers increases the inductance and wavelength of the coils so that they can be peaked on a given wavelength just as with the tuned radio frequency transformers. The positive (+B) current passes from the "B" battery to the plates of the tubes through the inductances, and the inductances are tuned so that the plate output of pulsating current cannot short circuit and pass back to the battery. The condensers are adjusted until the inductance is just sufficient to choke back the radio frequency current at the given wavelength so that it cannot pass through the "B" battery circuit, and at this point a maximum difference of potential is established across the ends of the coils so that the greatest possible potential is brought on the grid of the following tube through the fixed stopping condensers (K1-K2).

Stopping condensers (K1) and (K2) must be provided between the plate and the grid of the following tube to prevent the "B" battery current from reaching the grid and giving it a positive bias. If the positive "B" were to act on the tube, it would be paralyzed and rendered useless as an amplifier, for a negative potential is necessary on the grid for amplification. However, the capacity of the fixed condensers is great enough to pass the radio frequency current freely from plate to grid so that coupling and amplification takes place. Radio frequency oscillating current can pass directly from the plate to the grid of the following tube but the direct battery current cannot pass.

Adjusting the Leaks

AS the grid requires a negative "bias" or a continuous negative charge for amplification, the high resistance grid leaks (R1) and (R2) are connected to the grid side of the coupling condensers with their outer ends connected to the (-A) wire of the filament battery. A small amount of current passes through

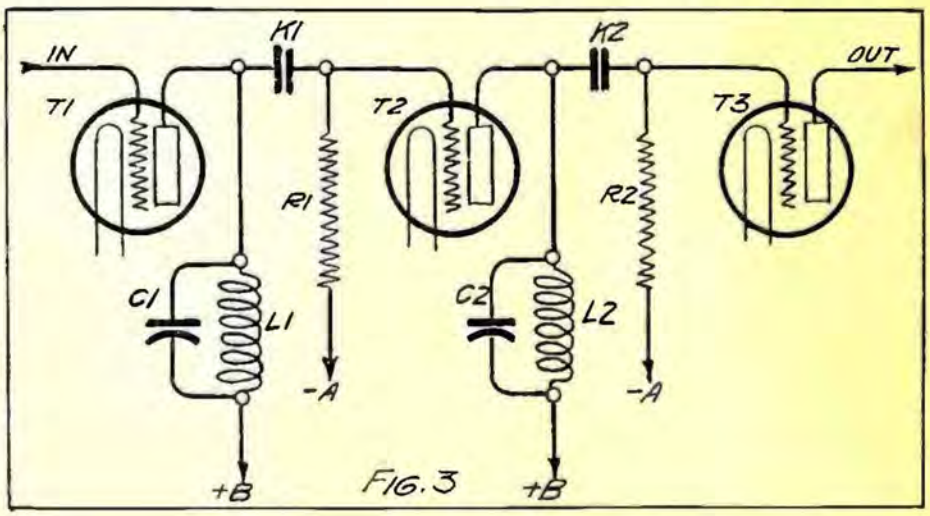


FIG. 3

the leaks to the grid from the negative pole of the "A" battery, and the required amount can be obtained by adjusting the leaks until the proper bias is found by experiment. It should be noted that the leaks are an indispensable proposition in this sort of circuit and that they must be carefully fitted to the tubes for maximum results. The stopping condensers (K1) and (K2) are not critical.

Instead of the simple tuned inductances shown, variometers can be employed, and as a rule the variometers are more efficient than the present scheme although they have practical disadvantages. The introduction of variable condensers causes losses which are avoided by the pure inductance of the variometers.

A coupling of this sort is less critical than a transformer coupling, that is, the peak of amplification is not produced within a fractional part of a dial division, and for this reason, squealing is not so often experienced with the tuned inductances as with transformers. However, it is less selective per stage than the transformer coupling, and even with its purer, cleaner tone it is often supplanted by the transformer for this reason. The impedance gives a wonderfully pure tone when properly constructed with practically no distortion or noise, and this is probably due to the checking of audio frequency currents by the stop condensers in the grid lines.

Many experiments have been made by the writer in the attempt to combine the advantages of the transformer and tuned impedance, and out of these experiments the "auto-transformer" type of inductance has proved the most successful. It avoids the noise and critical adjustments so often in evidence with straight transformer coupling and at the same time, the degree of amplification is much better than with the tuned impedance type. So far as selectivity and distance are concerned, the auto-transformer coupling has been found eminently satisfactory in the vicinity of Chicago where interference from local broadcasting stations is at a maximum. The volume is slightly less than with the transformers but the tone is so wonderfully improved that it more than compensates for the lost amplification.

An auto-transformer consists of a single continuous tapped coil which serves both as a primary and secondary. In Fig. 4 is the complete coil (A-B) tapped at the point (t), the latter being the input for the plate current. In passing from (+B) to (t) through a small portion of the coil, the turns in the distance (m) become the virtual primary of the auto-transformer, while the total length (n) forms the secondary although all parts of the circuit are electrically connected. Both the virtual primary section (m) and the secondary section (n) are threaded through by the same magnetic flux and are magnetically as well as electrically coupled. Therefore, with a given ratio of turns between (m) and (n), we can correspondingly build up the potential at (B) just as in the transformer secondary coil. The voltage between the ends (a) and (b) is now much higher than between the primary terminal (m), and greater amplification can be had than with a simple tuned inductance. The coil is tuned by the variable condenser (C1).

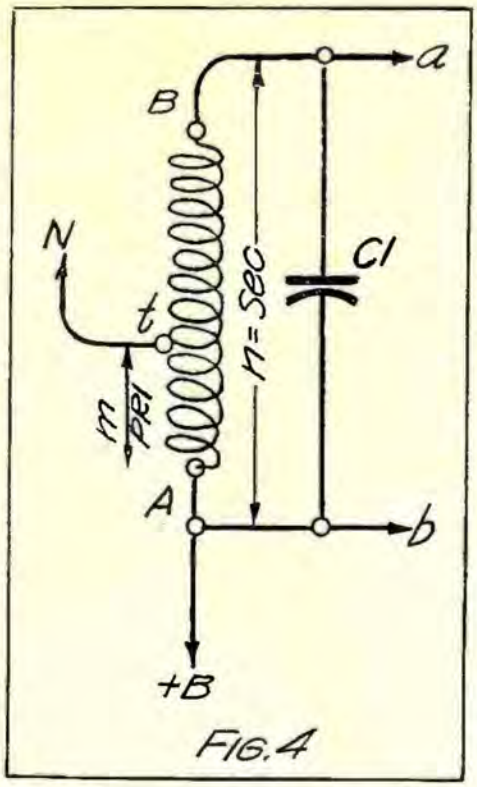


FIG. 4

In Fig. 5 we have a detail of the application of the auto-transformer to the receiving set. The output (plate current) of the first tube (T1) passes through the virtual primary (P) to the battery at (+B). The position of the tap point (t) determines the ratio of the primary to secondary turns or the "ratio" of the transformer. The total result is a greatly increased potential in the grid line at the stopping condenser (K1) that gives high amplification in the second tube (T2). As before explained, the stopping condenser (K1) prevents the "B" battery from putting a positive bias on the grid of tube (T2).

A grid leak (R1) is placed on the grid side of the stopping condenser (K1), and by connecting the other end of the grid leak to the negative filament line (-A), a negative potential can be established on the grid of (T2). The plate output of (T2) is then led through the tap point (t) of the second auto-transformer (L2), and further amplification is attained in the third tube by the same method. The variable condenser (C1) is used to tune the system to wavelength in the usual manner. We really have a transformer, but it is a special form of transformer that performs exceedingly well in regard to tone and freedom from self-oscillations.

As the tubes are somewhat critical to the resistance of the leaks, an adjustable resistance is best at this point so that the resistance can be just right for the individual tubes with maximum volume. After once adjusted, the leaks need no further care until the tubes are changed or replaced by new. It is not necessary to mount the grid leak controls on the front panel.

Complete Auto-Transformer Circuit

FIG. 6 shows the complete circuit for use with auto transformers, two stages of radio frequency amplification and detector. Audio amplification can be added to the output as with any other radio frequency set, but is not shown here as it is considered desirable to concentrate our attention upon the inductances and other details of the radio frequency stages. After the previous description it should not be difficult to understand the principles of operation.

It should be particularly noted that the two radio frequency tubes (T1) and (T2) are given a negative bias by connecting the ends of the leaks (R) to the (-A) line. On the other hand, the detector tube (T3) is given a positive (+) bias by connecting the leak (R3) to the positive (+A) side of the filament battery line. This change in biasing polarity is most important, and if it is not observed, the set will be inoperative or at least greatly weakened. All of the constants given for the units on the drawing will be found correct for the majority of cases, although there is considerable development work yet to be done before the circuit reaches its

(Turn the page)

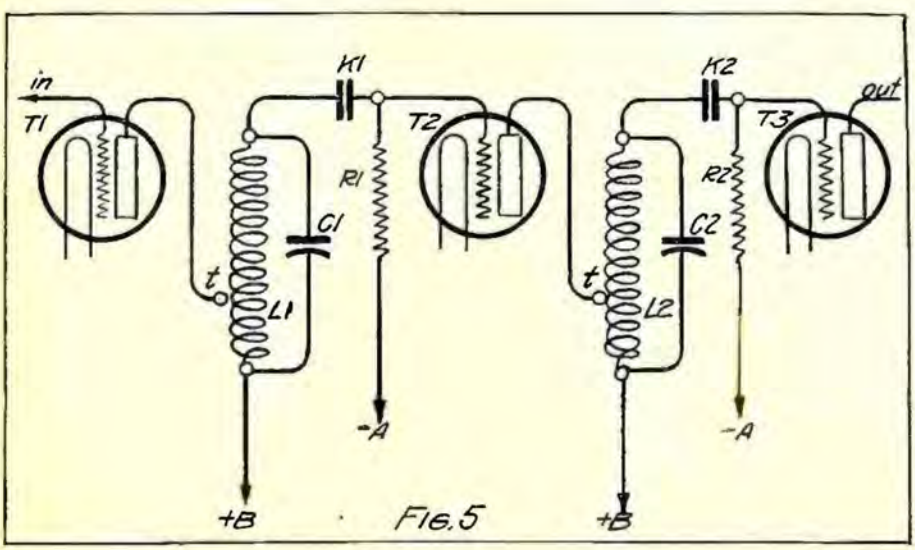


FIG. 5

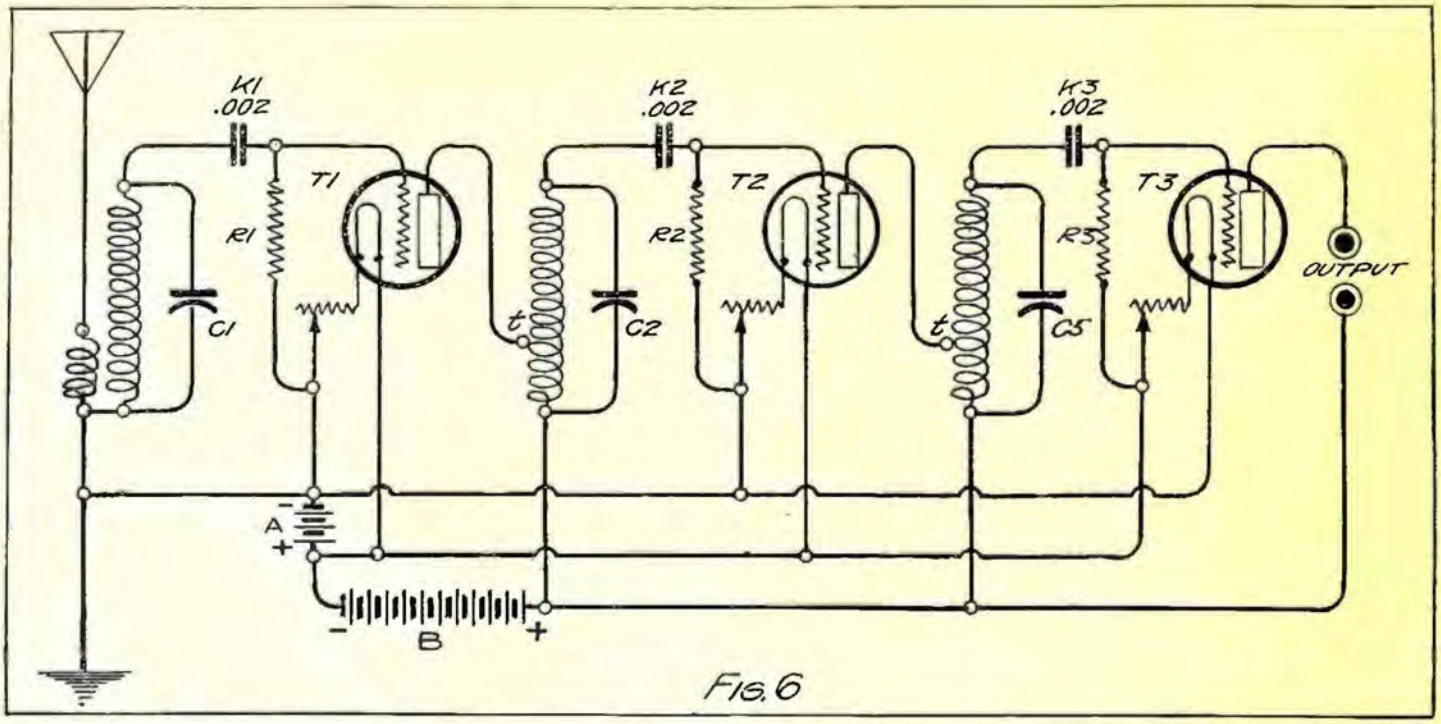


FIG. 6

highest efficiency. It is a brand new type so far as I am aware, and promises much with further experimental work in regard to details. It is intended as a suggestion for the more experienced fans who find pleasure in experimenting with novel circuit combinations and is not particularly advised for the beginner.

The total number of turns on the auto-transformer from end to end of the coil will be from 55 to 60 on a three inch tube. Generally, the tap point (t) for the connection of the plate circuit works out best at 8 turns from the end, but it will be safest to provide at least three taps at 8, 12 and 15 turns so that the optimum ratio can be easily determined by experimental means. With 55 turns total, a 0.00035 mf. variable condenser connected across the ends of the coil will tune it through the broadcast range of wavelengths. As explained before, the circuit is rather critical to the grid-leak value and for this reason variable resistances are the best. The approximate value of fixed leaks is shown on the drawing, and with the tubes used in the experiments this resistance value gave very good results.

The capacity of the stopping condensers is not critical and almost any capacity that will freely pass radio frequency currents will be satisfactory. Values ranging from 0.0005 mf. to 0.005 mf. were tried, but above 0.002 mf. there did not seem to be much increase noticeable. Below 0.001 mf. there was some falling off in volume, but not a great deal of loss. The ordinary 45 to 90 volts can be applied to the grids of the tubes, although the lower voltage probably brings in distance better than the 90 volts which gives the greatest volume on local stations.

If more radio frequency stages are desired, they can be added by repeating the auto-transformer and leak arrangement shown for the first two stages. Four and five stages have been used without difficulty in the way of critical tuning, and the quality was little affected.

U. S. Radio Representatives Sail for Paris

WASHINGTON.—America's three unofficial observers to the International Telegraph Conference at Paris sailed from New York on the S. S. America last month. The delegation was headed by John Beaver White, a retired engineer of Philadelphia, and included Honorable Wallace H. White, Jr., Congressman of Maine, and Maj. Gen. Charles McK. Saltzman, Chief Army Signal Officer.

Although the United States is not a party to the International Telegraph convention, the Senate never having acted on it, it is understood, its representatives will be seated as unofficial delegates and granted all privileges except the right to vote. In this capacity the U. S. delegation will present the views of the U. S. Government and probably also the attitude of the private interests which own and operate the commercial telegraph, cable and radio services, as to the desirability of incorporating the field of radio in the international regulations prescribed by the telegraph convention.

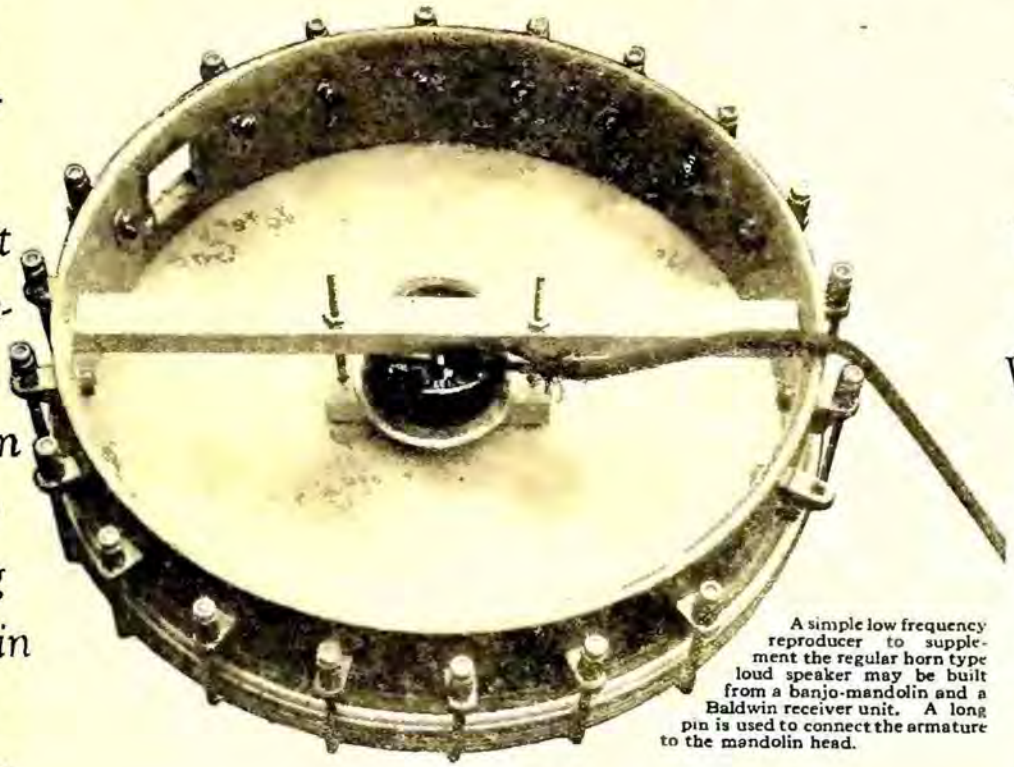
For the past month, representatives of the several government departments interested in radio have met daily in the State Department. This body, known as the Interdepartmental Committee on Electrical Comm., has discussed the proposals submitted to this government some time ago by the International Telegraph Bureau at Berne, together with the agenda of the international sessions which opened in Paris on September 1st. One of the many suggestions made by the European Governments is that the subject of radio be considered at the conference. To this it is believed the American government will object, in view of the special world conference on radio to be held in Washington in the near future. At least, the delegates will express a hope that any changes made in the present telegraph convention, will be such as would be acceptable to the radio conference when it meets here. Obviously, it would not be desirable to have matters pertaining to radio threshed out in detail prior to the regular radio sessions. On the other hand, assurance is given by the Berne Bureau that only the international radio policy with its commercial and business angles would be included if this subject is injected into the telegraphic sessions at Paris. That is, the technical side and service regulation affecting wavelengths, power, schedules, etc., probably will not be considered. The U. S. Interdepartmental Committee has analyzed the voluminous report from Berne, to see how it affects the interest of the United States, where all communication systems are privately owned. It has filed its report with Secretary of State, Kellogg, who, it is understood has prepared letters of instructions to the American delegates as to this government's policy. This policy has not been released by the State Department, and may not be made public, but it is said to express a desire on the part of the Government and the private commercial radio interests, that, if possible, radio be kept out of the general telegraph discussions and that this subject in its many phases be left for the world radio conference.

The Chairman of the Interdepartmental committee, Leland Harrison of the State Department, has not attended the sessions here. In his absence, J. B. White, a friend of Secretary Hoover, has acted as chairman of the special committee on Paris conference. The personnel of the committee includes Maj. Gen. Saltzman, and Major J. O. Mauborgne of the Signal Corps; Captain Ridley McLean, Director of Naval Communications; Asst. Secretary of Commerce Stephen Davis, and P. E. D. Nagle and W. D. Terrell of the communications and radio sections of the Commerce Department; H. C. Moore of the Shipping Board; E. M. Webster of the Treasury, and W. R. Valance and W. M. Greene of the State Department.

Technical aides who accompanied the American Delegation included W. D. Terrell, Chief Supervisor of Radio of the Department of Commerce and Maj. J. O. Mauborgne, of the Signal Corps

Some Facts About QUALITY

Loud Speaker Music Without Troublesome Distortion Is Now The Big Problem in Radio Reception



A simple low frequency reproducer to supplement the regular horn type loud speaker may be built from a banjo-mandolin and a Baldwin receiver unit. A long pin is used to connect the armature to the mandolin head.

Expert Tells How Use of Two Loud Speakers Will Enable Listener to Receive Pure High and Low Notes Faultlessly

By BRAINARD FOOTE

THE general problem in connection with entertainment with a loud speaker is, briefly, to reproduce music and voice just as it sounds in the broadcast-station's studio. This resolves itself at once into three separate departments of radio reception, as follows:—

1. Faithful detection
2. Undistorted amplification
3. Clear reproduction

Thus we must start with a comparatively weak impulse, in itself true to the original, make it stronger without accentuating any part of it over and above the rest, and then employ a reproducing device that doesn't render our earlier efforts fruitless.

If we attack the problem of undistorted entertainment with a clear recognition of the various portions of the radio set wherein the faults are likely to be situated, we are in a better position to rectify them. Let's try it in this way.

The Detector

USUALLY, the reproduction by the detector is perfect. Headphones are plugged into the detector jack by way of verification. However, trouble is sometimes met because of

1. Over-sharp tuning.
2. Bad grid leak and grid condenser.

Over-sharpness of tuning can seldom be found with multi-tube sets having three tuned circuits, nor indeed with single tube sets unless regeneration is too prominent. In tuned R. F. amplifiers that are on the verge of oscillation, due to inter-stage feed-back or to the use of primary windings that are too large, the sharpness of tuning is extremely pronounced. The "side-bands" or slightly different frequencies which convey the overtones of music or speech are cut off thereby. These side-bands are nothing but wavelengths just a bit different from the stated wavelength of the station and are directly due to the fact that the imposition of voice frequencies on the carrier wave not only has a modulation effect but a HETERODYNING effect as well.

In one-tube sets, the quality may be ruined in the same way, merely by turning the tickler coil a little too close to the oscillation point. In this case, it's a question of operation, however.

If the grid condenser is not perfectly insulated, interfering noises may start in it. The grid leak, even more often, is responsible for hissing and sizzling sounds, so that it is always wise to test three or four of them, as well as two or three grid condensers to get a good combination. A weak station should be listened to during this process and the combination yielding the quietest operation chosen.

Outside of these two sources of trouble, and assuming a good tube and batteries, the headphones should respond with good clear music, in which the soprano's voice is sweet and pure and in which the low thud of the drums and the bass chords of the piano come through with equal effectiveness.

Audio Amplification

PASSING now to the next department of our research, we tackle the audio amplifier. The loud speaker is left disconnected, but otherwise the amplifier is turned on, ready to work. The headphones are connected across the primary winding of the first audio transformer. Do the drums and piano chords still stand out? If so, that stage is operating satisfactorily and the transformer handles the lower frequencies quite well. However, the higher notes will be slightly more pronounced in this stage. If there is any sudden crackling or surging of the volume, something is wrong with the tube's functioning. Probably a "C" battery of 3 volts is needed in that stage to maintain the grid's potential at a negative value. Usually, though, the first stage gives a fine account of itself.

But how about the second step? Place the headphones there and turn down the volume a little so that the phones aren't overloaded. Now it will probably be found that the lower notes don't come through so well and that when the volume is boosted a little the crashes on the piano are blurred and there is a certain fuzziness about it. Replacing the loud speaker, we shall find very much the same thing. With full volume, the loud speaker does NOT reproduce as clearly as did the phones, although it will do so if it is connected to the first stage (the volume is less, however). What is wrong?

1. The last tube is overloaded and hasn't sufficient undistorted variation of plate current to operate a speaker.
2. The audio amplifier omits the low notes.

Resistance-Coupling

The latter of these two faults found with the transformer-coupled amplifier may be corrected easily by the use of an audio amplifier capable of amplifying all moderate frequencies to the same extent. The audio transformer is inherently a tuning device. We know that the wavelength is equal to the velocity of the radio wave divided by its frequency. Thus, WJZ operates on about

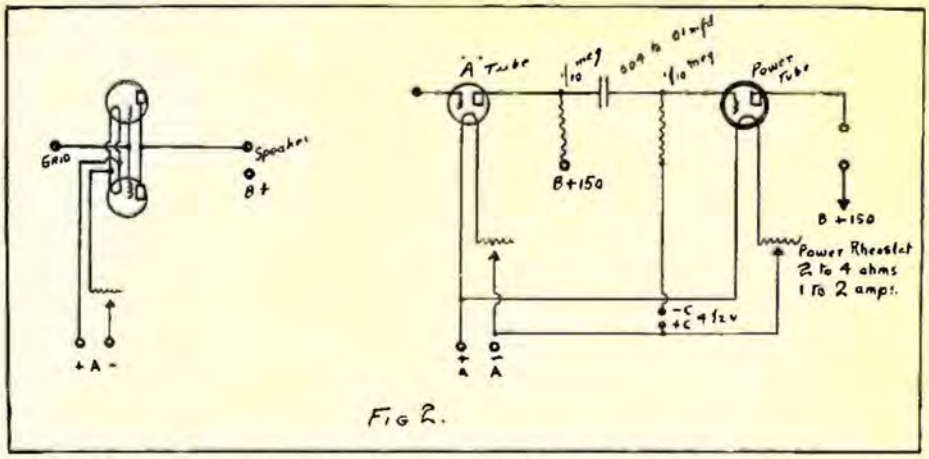


Fig. 2—To prevent overlooding of the lost oudio tube, o heovy power tube moy be employed, or as an alternotive neorly os good, two tubes moy be operoted in porallel.

659,000 cycles, or 455 meters. When we come to the voice frequencies of 100 to perhaps 5,000 cycles, the wavelength is very much longer. Suppose the musical note has a frequency of 1000 cycles. Its wavelength then is 300,000 meters! To amplify at such enormous wavelengths audio transformers have many thousand turns of wire. Small wire is used for compactness and an iron core to still further lower the range and to broaden the tuning. Still, the transformer is a tuned device and just like a radio frequency transformer except that it has more turns of wire and an iron instead of an air core. At best, then, it cannot amplify all frequencies equally. It has a "peak" on either side of which the amplification falls off.

The sort of audio amplifier that handles all audio frequencies impartially doesn't depend on tuning. It uses a resistance and functions on the voltage drop principle. The fact that a resistance-coupled amplifier operates well at a very wide range of frequencies is proven by its use in the super-heterodyne receiver as the long-wave amplifier. In such a case it is amplifying radio frequency currents of perhaps 10,000 cycles. Yet the self-same amplifier will amplify at audio frequency when such energy is fed into it!

The mechanical and electrical drawbacks to the resistance-coupled amplifier lie in the necessity for using 135 to 150 volts of "B" battery and the need for one more tube than required for the transformer amplifier. However, the individual plate current is much less than with a transformer coupled amplifier, so that even with the extra tube and extra "B" battery, the total expense per year of operation is less than with a transformer coupled outfit. The coupling resistances should be of the order of 100,000 ohms (.1 megohm) and the grid leaks of sufficiently low resistance to allow a suitable negative bias of about 3 volts on the grids without causing too much loss of volume. A grid leak resistance of about 2 megohms for the first stage of resistance coupling, and 1 megohm for the second and third stages each. A "C" battery is very helpful in reducing the "B" battery current without causing any loss in volume.

Care must be taken with such an amplifier to use a lower plate voltage for the tube in which the loud speaker is connected. 90 volts is a sufficient potential for the last stage on this account. See Fig. 1.

The quality of amplification may be tested with headphones. First the phones are connected across the GRID LEAK of the first amplifier. The volume, of course, is very low, but the quality may be noted. The phones are not connected across the coupling resistance, for the tube plate voltage would then rise greatly and the detector probably go into oscillation. To observe the quality on the first stage of the resistance amplifier, the phone cords are bridged across the SECOND grid leak. Thus the nature of the input to each successive stage may be listened to and criticized for tonal characteristics. In general, these will be above reproach up to and including the grid leak in the last stage. The loud speaker may still distort, however, even though you may hear the lower notes and the higher notes coming through with much better naturalness than with a transformer-coupled amplifier.

Overloaded Tube

HENCE trouble No. 1 of the transformer-coupled amplifier is still met in the resistance amplifier—that

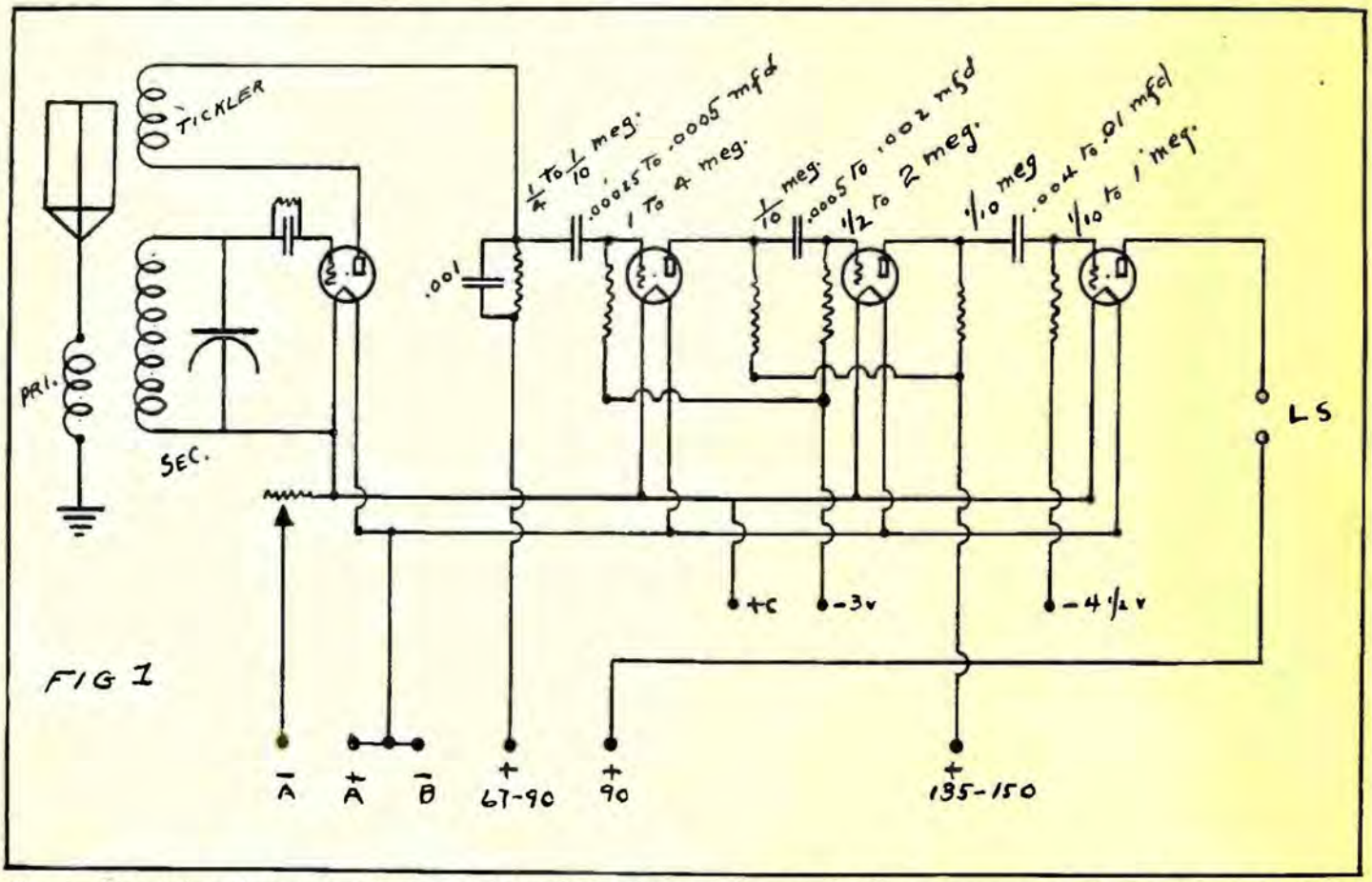


Fig. 1—Circuit for o three-stoge resistonce-coupled oudio omplifier together with the detector connections, showing how three different plote voltoges ore required.

of an overloaded tube. A single 201A or 301A tube does NOT have sufficient variation in plate current to actuate a large loud speaker properly. Of course, almost all sets are built that way, but it is true, nevertheless, that the second audio tube is receiving variations in grid input altogether too great for it to handle. The grid voltage changes NO LONGER control the plate current with perfection.

Therefore, the obvious solution to this part of the problem lies in the use of a heavier tube or in using two or three "A" tubes in parallel to gain the desired effect. The improvement in tone quality found in this way is astonishing. The loud speaker talks up with crispness. There's no "draggy" effect as the tube tries to recover from one shock just as another one comes along. See Fig. 2 for both ways. The heavy tube is to be preferred, in that the parallel operation of tubes is not universally attended with success. A way out of this difficulty is outlined below.

A suitable power tube for such work is the new 202A tube, ordinarily employed for transmission or speech amplification, or the Western Electric 216A tube as used for power amplification. The latter may be easily adapted to the common amplifier circuit since it calls for no other changes than the use of a 1 ampere filament rheostat and a boost in the plate voltage to about 150. It is easy to get this extra plate voltage, inasmuch as it is needed for the resistance-coupled amplifier anyway.

With a heavier tube in the last stage and with paralleled "A" tubes of the ordinary type, the grid leak resistance must be reduced somewhat. The required leak may be ¼ megohm to .1 megohm—a lower resistance than .1 never being necessary. If a millimeter is at hand, the grid biases and plate voltages can be adjusted to a nicety, so that the plate current is not too high for the tube in use nor so low that it fails to amplify weak impulses as well as strong ones. In general, the grid bias should be made more and more negative until both quality and volume decrease noticeably. The adjustment of grid bias has slight effect in the case of resistance-coupled tubes insofar as quality is concerned, so long as there is sufficient leakage from the grid to prevent the tube from blocking with piled-up negative electric charges. The use of 3 to 4 ½ volts negative is helpful in that it reduces the plate current somewhat, thereby saving the "B" battery. Grid bias adjustment for the last amplifier tube or tubes is very critical, however, and an injudicious biasing may result in a plate current twice normal without much change in quality. The "B" battery won't last very long under such treatment.

About the Speakers

THE use of headphones at various points in the resistance amplifier will show that amplification of all stages is going on undistortedly. And with the last stage properly adjusted and supplied with a heavy tube or paralleled tubes, the output is practically undistorted and contains voice and music frequencies of an extremely wide range, just as put into the transmitting microphone. To take full advantage of this clear output, the reproducer should be capable of reacting to ALL of these frequencies.

Frankly, however, this cannot be done. There is NO ONE loud speaker, so far developed, which does not favor certain frequencies, when pushed to strong volume. Usually, certain frequencies are favored even on weak volume. This is due in the main to the size of the diaphragm, whether it be of metal such as a disc, or a cone of parchment or paper. A small diaphragm favors the high-pitched notes of the soprano, women's voices, the flute, violin and the like. On the other hand, the cone speaker, with its large expanse of vibrating material, delivers the low frequencies with greater vigor, like the bass singer, the violin, the chords on the harp and chords on the piano and so on.

A loud speaker has yet to be developed which does not depend upon some vibrating system by which the sound waves are set in motion. And any such vibrating system, depending upon its magnitude, has more or less of a "natural period" of vibration, at and near which it may be most easily set into vibration. Hence, although the current through the windings of the unit may pulse with frequencies of a very wide range, the diaphragm or reproducing system is more readily set into motion by frequencies near its natural.

Assuming, therefore, that we cannot hear both high and low notes with any single loud speaker—what is the natural recourse in order that we SHALL hear both these frequency ranges? Why—to use TWO loud speakers! This may seem like a radical suggestion and yet anyone willing to try such a combination will be at once convinced of its great value. Take an ordinary horn type of loud speaker, with a diaphragm varying from two to five inches in diameter and connect in parallel with it a cone type of speaker or some other type of speaker having a very large vibrating system. Arrange switches so that either may be heard separately, or both together. It might appear advisable to employ one speaker for high notes and the other for low notes, but such does not prove to be the case. Every frequency is accompanied by "overtones," which are other vibrations that are multiples of that frequency. Thus, if it were no* for the overtones, we should have a ha.d time of it to distinguish one woman's voice from another's or to detect the difference in tone quality between a flute and a fife, or between a trombone and a cello.

Adding the Overtones

By the addition of these overtones the differentiating qualities stand out plainly. Using two loud speakers in this manner, the faint overtones giving richness to the tenor's voice improve the color and depth of reproduction in an almost indescribable fashion, yet are evident to even an inexperienced ear. It is very easy to point out the improvement when the two speakers are connected with switches for quick changes with either or both in circuit. Using the horn speaker, with a jazz band coming in, the melody stands out most promi-

(Turn to page 67)

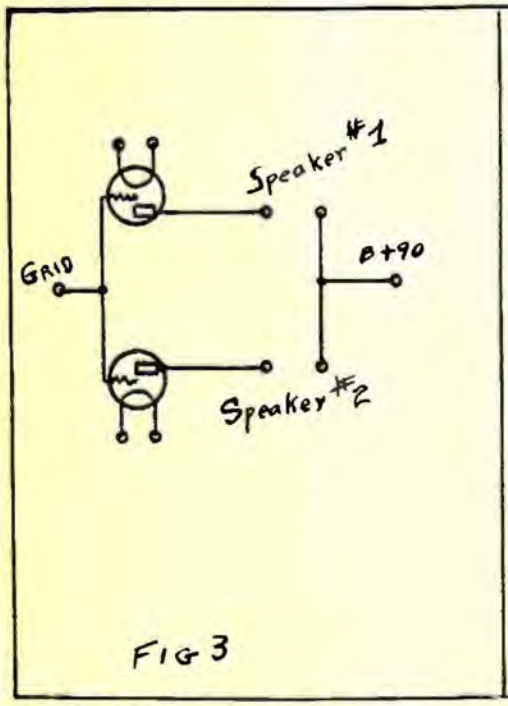


FIG 3

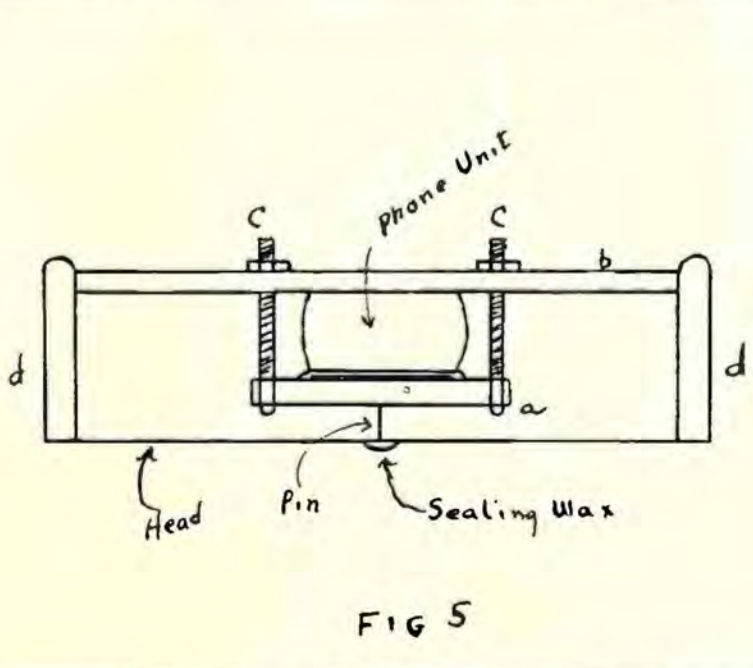


FIG 5

Fig. 3—Using two loud speakers to cover the entire musical range, one for higher frequencies and the other for low; the double tube connection allows a separate tube for each speaker. Fig. 5—Details of the mandolin low-note loud speaker.

Where Does the POWER *for Your* RADIO *Come From?*

Correcting the Erroneous Impression that All the Energy Comes from the Transmitter; Power Creating Sounds in Home Due to 'B' Voltage

By EDGAR H. FELIX

WHEN your loud speaker is reproducing a good program of dance music with sufficient volume for half a dozen couples, an appreciable amount of energy is required to produce such loud signals. Where does that energy come from? How much of it does the transmitter of the distant station contribute?

Actually, a receiving set with 90 volts of "B" battery may pass as much as 6 milli-amperes through the plate circuit of the last tube. This amounts to approximately half a watt. Yet, the power received from the broadcasting station is frequently less than one-millionth of a watt! The power actually creating sound in your home, comes from the faithful, hard-working "B" battery.

Radio transmission and reception require many processes and conversions, all of which can be successively performed without the introduction of any extraneous noises or distortion.

But, unless you understand the many steps which occur from the time the program is rendered in the studio until it is finally re-created in your home, you cannot fully appreciate how anything approaching that fidelity of reproduction is attainable. Numerous explanations of the transmitting and reception process have been written, using freely such terms as "sound waves," "radio frequency," "electro-magnetic waves" and "audio-frequency." Usually these terms convey only a vague meaning to the non-technical reader. But it is not difficult to visualize just what takes place from the time the program is rendered at the studio until it is finally reproduced in your home.

We begin first with sound waves, the result of the artist's performance in the studio. A musical program is a complex combination of different sound waves having various frequencies, between sixteen and five thousand impulses per second. Each individual note emitted by musical instruments consists of a fundamental frequency, determining the pitch of the sound, and a number of harmonics, serving to give each instrument its individual character. You can distinguish whether it is the middle C or any other pitch by the frequency of the fundamental.

The harmonics, consisting of multiples of the fundamental pitch set up by each instrument, enable you to distinguish between the piano, violin, saxaphone or any other instrument. For instance, if the C an octave below the middle C is played on the piano, 129 pulsations per second are set up. This is the fundamental frequency, determining the pitch as that of the C below middle C. Also, there are harmonics of 259, 388, 517, 647, 796 and so on, consisting of multiples of the fundamental. The violin, sounding the same pitch, has the same fundamental and the same harmonics. It is the distribution of the energy on these harmonics which enables you to distinguish whether there is a violin, piano, flute, oboe or clarinet being played.

Tuning Fork Purest

A STUDY of the nature of musical sounds is indeed an interesting one. The tuning fork gives the purest tone because all of its energy is radiated in the fundamental. The flute comes next in purity of tone. When a low tone is played softly on this instrument, 95% of the energy is concentrated in the fundamental, with just a trace of energy in the harmonics: When lower registers are played powerfully, or overblown, the fundamental is weak; being just loud enough to characterize the pitch, the first overtone becomes the most prominent; the second is of the same order of energy as the first; the third is larger than the second. On the other hand, the middle registers of the flute played powerfully are again almost pure tones.

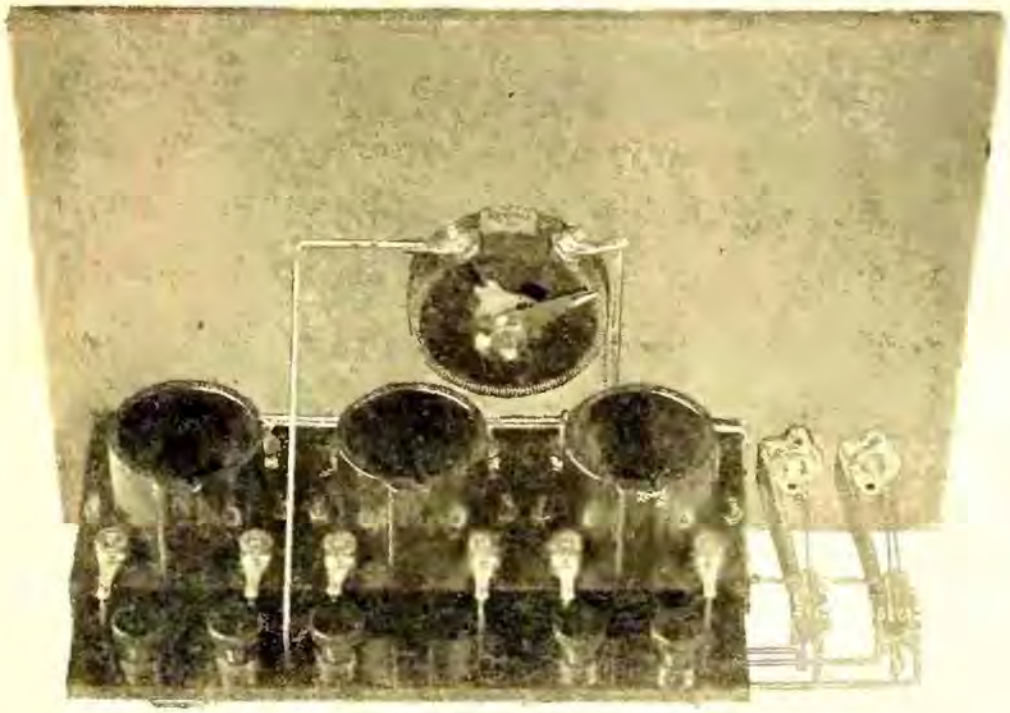
The oboe has twelve or more harmonics, the fourth and fifth predominating, with 30 and 36% respectively of the total loudness.

Each instrument, therefore, has its peculiar characteristics, varying through the various registers. All of these are combined and utilized by the composer to secure pleasing and harmonious effects.

When you consider the fact that sometimes as many as eighty instruments are contributing to an orchestral program involving at any particular instant half a dozen different fundamentals and five times that number of harmonics, the composition of all these air wave impulses is indeed highly complex. This is the first step in radio telephone transmission—the creation of sound waves consisting of air wave impulses of many different fundamental frequencies and a wealth of harmonics.

The first conversion process is the use of these complex air waves in controlling an electric current. The microphone effects this step. It consists of a diaphragm which vibrates when sound waves strike it, just as your own ear drums do. Instead of affecting nerves which register in the brain, the microphone's ear drum compresses carbon granules packed loosely behind it. When highly compressed by a powerful sound wave, the resistance of the carbon granules falls markedly. Less powerful sound waves do not reduce the resistance as much. The microphone is placed in series with a steady source of potential as the resistance of the micro-

(Turn to page 50)



A back view of the amplifier described by Mr. Pfaff, showing sockets and other instruments neatly arranged

For DISTORTIONLESS *Reception*

A NEW AUDIO FREQUENCY AMPLIFIER—RESISTANCE COUPLED

By Ernest R. Pfaff

A VERY good parallel may be drawn between the progress of radio broadcasting receivers with the public, and the development of the phonograph, with respect to the standard of quality of reproduced signals that was demanded several years ago, and the standard that today will satisfy the discriminating enthusiast. When radio first came into popularity, the influence of the telegraphing amateur was most strongly in evidence in audio amplifiers, for this amateur desired not quality of reproduction, but high amplification per stage. In fact, the ideal audio amplifier for telegraph reception would be one that would accentuate to the greatest possible extent only the particular frequencies used for modulating the transmitting wave.

Because of these requirements, practically nothing but transformer coupled audio amplifiers were in use, the transformers themselves generally having a step-up ratio of six to one or ten to one. Their design was such that they amplified best at some hump in their curve; in the case of one, built by a nationally known manufacturer, the maximum amplification secured at twelve hundred cycles was several times that obtained at 100 cycles. Then, as broadcasting came in, requirements changed, and the desirable amplifier for this class of reception was one that would amplify uniformly all frequencies from sixty to six thousand cycles.

Transformer design was improved, with a general tendency among manufacturers and designers to reduce the step-up ratios used. This resulted in the present day transformers which amplify with very good uniformity all frequencies between two hundred and six thousand cycles. But even in the best of audio transformers, there is a very decided drop in amplification below two hundred cycles, which becomes greater as the frequency decreases. At sixty cycles, the amplification of the average audio transformer is practically negligible, as compared to its amplification at frequencies above two or three hundred cycles.

The Organ's Faults

ANYONE who has listened to an organ as received on the average radio set is only too well aware of the absence of the lower frequency notes. When listening to the organ, say in a church, we are all familiar with the deep vibrations evident on the low notes; yet how many radio enthusiasts have ever felt the walls of their homes vibrate when listening to a broadcast organ selection? But where a resistance coupled audio amplifier is used, the fidelity of reproduction is so great as to cause doubt in the mind of even the best trained musician as to whether the selection heard is actually being played in his presence, or is being broadcast.

Due to the inherent characteristics of resistances when used for coupling purposes in an audio amplifier, substantially no discrimination takes place in favor of one range of frequencies at the expense of another range, as in a transformer coupled amplifier. Transformers cannot be built to give absolutely uniform amplification, due to the resonance characteristics of the windings that must be used.

In actual practice two stages of transformer audio amplification are about all that can be used, due to the building up of noise in the system and the fact that such an amplifier in conjunction with a good receiver will give plenty of volume for loud-speaker operation. However, three stages of resistance coupled amplification will be required to give the same or slightly greater volume, since the gain per stage in such an amplifier is lower than in a transformer coupled amplifier. This will be appreciated when it is realized that one transformer and one tube will give a voltage gain of about 18. When the second stage is added, using exactly the same equipment, this figure falls off, due to certain inherent characteristics of such systems. Therefore, we can allow a gain of 18 in the first stage and about 13 in the second stage, or an over-all gain for the system of 18x13, or 234. This means a signal is 234 times stronger when it comes out of such an amplifier than it was when it went in. These figures are low, for great amplification cannot be obtained from a transformer amplifier designed for good quality.

In the case of a three-stage resistance amplifier the gain per stage will be about the same for each stage, since the drop encountered in the previous case does

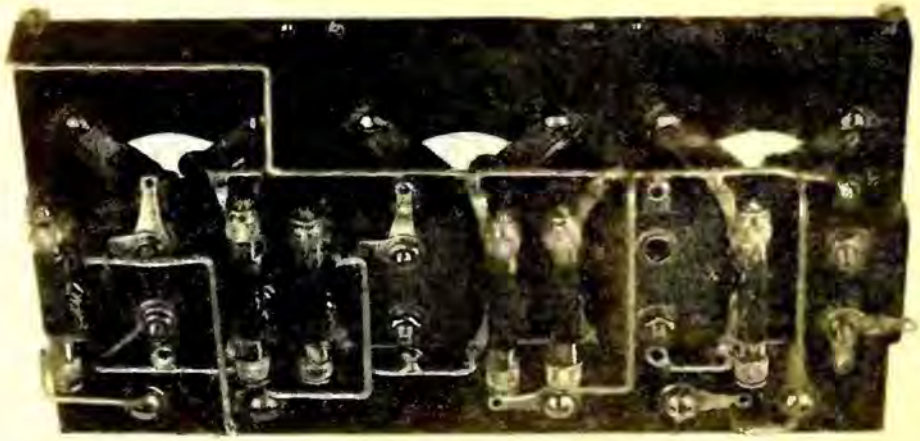


Figure 3. A bottom view of the amplifier, giving a good idea of how resistances and condensers are mounted.

not apply to any appreciable extent. Therefore, we can allow a gain of about 6.5 per stage or about 81% of the amplification factor of an average tube. This in three stages gives a total amplification of 275, or slightly more than that obtained with two transformer stages.

Expense

FROM the standpoint of expense, the resistance system can be built as cheaply, or more cheaply, than the transformer system, due to the lower cost of the component parts. An additional tube will be required, which will about even up the price of the two outfits.

While 135 volts will be required for the resistance system, the B battery current consumption will be only about nine millamperes, as against ten to eleven for the transformer system. Therefore, the B battery expense for both systems being about equal, with the initial battery expense higher for the resistance amplifier, and the upkeep cost of the transformer amplifier nearly balancing this, there is no reason why the average fan should not enjoy the wonderful quality to be obtained with the resistance system.

The amplifier unit described herewith is the result of considerable experiment, and if it may be judged on its performance, its construction will be very decidedly warranted by the true music lover. It is so designed that the unit itself may be mounted upon a standard panel, or it may be incorporated just as it is in any standard receiver circuit in place of the conventional transformer amplifier. Due to its compact arrangement, it may be placed in less than the space required for the standard amplifier in almost any receiver design.

The constants of this amplifier are so proportioned that the maximum amplification will result with a minimum of current consumption. The .0075 coupling condensers have a comparatively low reactance to the frequencies to be handled, and are a far more practical size to work with than those of a larger capacity. Theoretically, these condensers should be on the order of one to five microfarads, but practically, .0075 is entirely large enough. The use of one of these condensers connected from plate to filament of the last stage—a point commonly overlooked—prevents poor quality often experienced with resistance amplifiers.

The coupling resistances are of 1-10 megohms or 100,000 ohms. When using 135 volts on the amplifier, the tube resistance may be considered as about 20,000 ohms, which give a total plate circuit resistance of 120,000 ohms, across which is applied 135 volts. For practical purposes, it may be considered that this voltage divides so that the actual plate voltage of the first two tubes is about 34, so that no "C" battery will be required. If a higher resistance were used, a higher plate voltage would be necessary, but if a lower resistance were used, the amplification would fall off badly. Further, the size of these coupling resistances is about five times the tube resistance, which insures practically uniform amplification at all frequencies to be handled. Actually, the variation in amplification between 60 and 6,000 cycles is only a few per cent.

The grid leaks are of such a size that they will prevent blocking of the system, and maintain the grid potential of the various tubes at a satisfactory operating value. One-half megohm, or 500,000 ohms, is used on the first stage, with one-quarter megohm, or 250,000 ohms, on the second and third stages.

Because of the high resistance used for coupling the output of the receiver (or detector) to the amplifier, the plate voltage of the detector should be about 90 volts, instead of the customary 45. If the amplifier connects to a receiver using audio amplification, the plate voltage of the last tube in the receiver should be run up to 90 or 135 volts.

The resistance in the plate circuit of the last tube is only that of the loud speaker—generally 2,000 ohms—so that practically all of the plate voltage used is applied to this last tube. This being the case, a C battery should theoretically be used in series with the last tube's grid leak, of about 3 to 6 volts. Actually this does not improve reproduction, and so it is not shown in the amplifier circuit. It will reduce the B battery consumption somewhat, and may be incorporated if desired.

The current consumption of the first two tubes is on the order of 1.13 milliamperes per tube, while for the last tube it is about 12 to 14 mils. This makes a total of 14¼ to 16¼ mils. for the three stages, which may be cut by four or five mils. by using the C battery referred to, ON THE LAST STAGE ONLY.

Figure 3 is a bottom view of the unit, showing placement of the six resistances and four condensers, these being attached to a bakelite strip carrying the five binding posts, which is in turn fastened to three panel-mounting sockets.

(Turn to page 60)

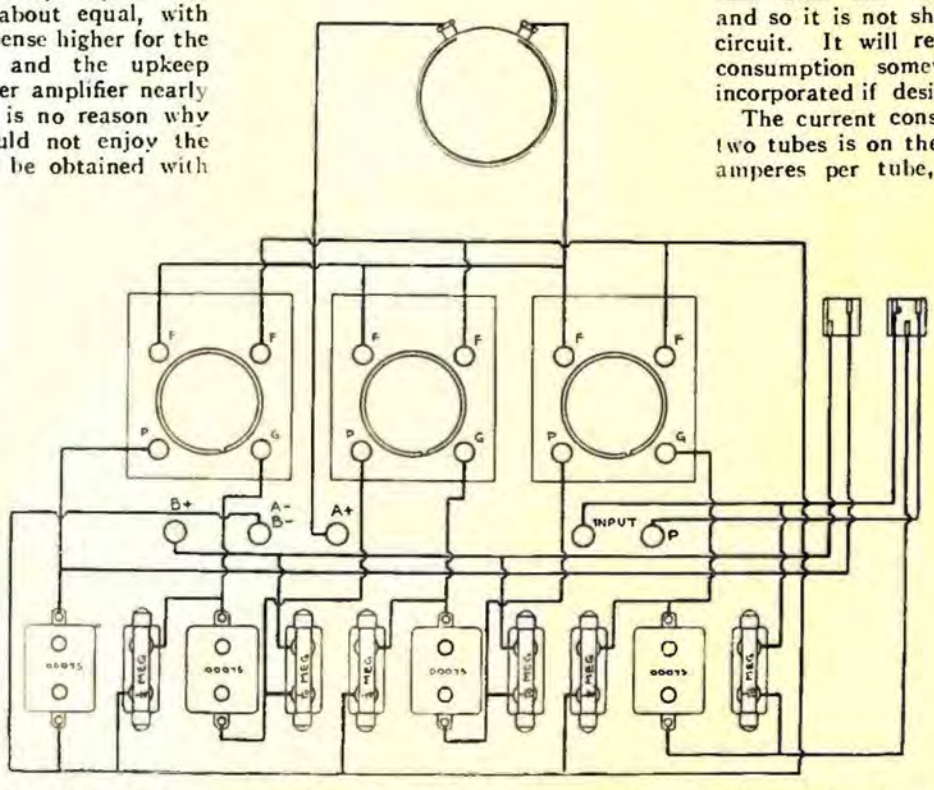
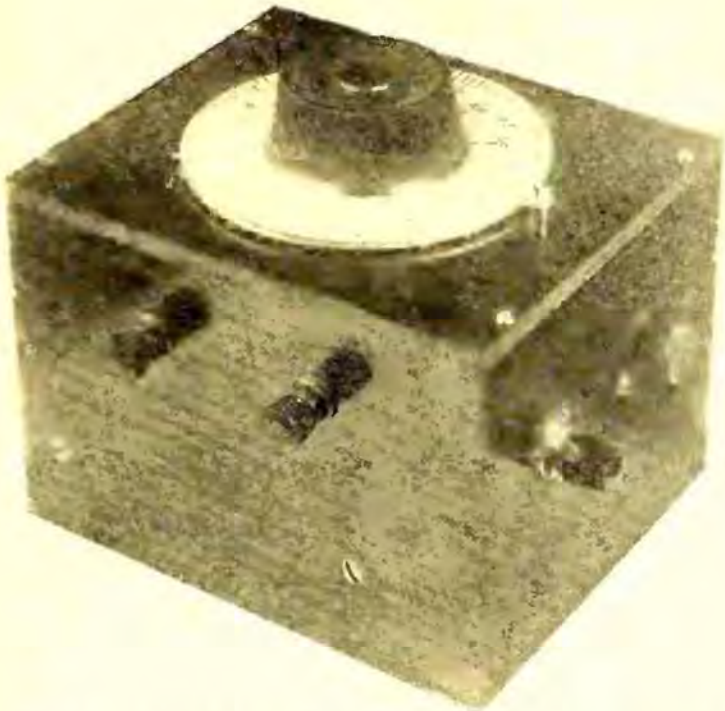


Figure 2. Wiring diagram for distortionless audio amplifier. As all parts have been illustrated pictorially, rather than in symbols, this diagram is very easy to follow, even by the inexperienced set builder.

An IMPROVED *Slide* *Wire* Bridge



By H. FRANK HOPKINS

A New Design for Measuring Capacity

THE slide wire bridge described in the February issue of RADIO AGE has proven itself so popular and of such an asset to set builders and experimenters that, in answer to numerous requests, the writer has completed an improved model of this instrument, wherein the construction has been so simplified as to bring it within reach of the most inexperienced novice and yet retain the accuracy and ease of operation so necessary in an instrument of this kind.

This instrument seems to have filled a long felt want for the layman, making it possible for him to measure the capacity of condensers, the impedance of coils, transformers and such, and to enable him to match and balance his parts with a close degree of accuracy, heretofore attainable by only the more advanced fan with his home laboratory and his knowledge of radio and electrical phenomena.

Time after time, the importance of matched parts and a well balanced receiving set has been explained, yet very few set builders know how to balance and match the parts they are about to build or use. With the aid of this instrument it is within easy reach of the most inexperienced novice who has only a limited knowledge of the radio or electrical science as well as to the more experienced fan with his advanced experience and array of equipment. All that is necessary for the successful operation of the slide wire bridge is a knowledge of simple arithmetic and the use of a little good judgment.

WHILE it is true that there are other instruments that will show a little more accuracy on certain operations,

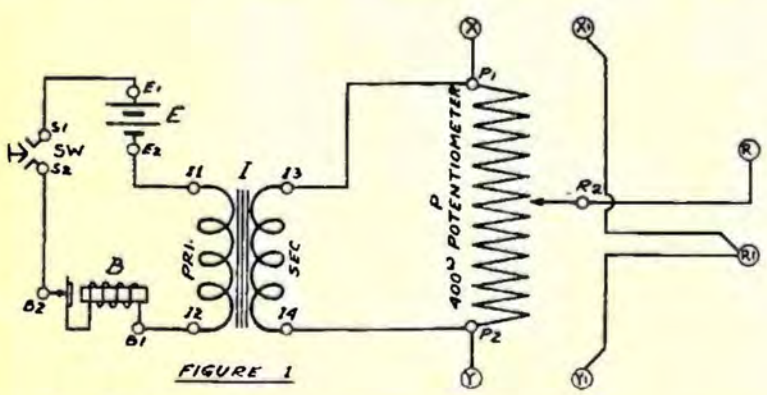


FIGURE 1

WIRING DIAGRAM OF COMPLETE INSTRUMENT. (SEE WIRING TABLE)

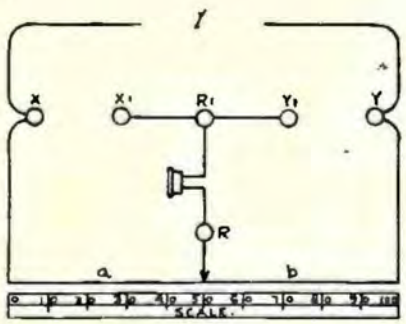


FIGURE 2

SCHEMATIC DIAGRAM OF THE BRIDGE CIRCUIT.

CIRCUIT DIAGRAMS FOR THE IMPROVED SLIDE WIRE BRIDGE.

HFH R-1

such as peaking transformers with a wave meter, measuring capacity by use of a modified form of Wheatstone Bridge, called a Capacity Bridge, and such, it also becomes more difficult because more intricate mathematical formulae and additional expensive equipment are required. The slide wire bridge covers more ground than any of the other instruments and it also keeps the mathematics down to plain multiplication, division and subtraction, while it shows results as accurate as necessary for this type of work. It is also the only simple, accurate method of determining impedance at various frequencies.

All of the parts used in building this instrument have been given a designating letter or number; each terminal is numbered both in the circuit diagrams and the wiring table. This same designation is applied throughout the article and in the formulae that follow so as to readily recognize each part and its place in the circuit. The parts used in building the instrument are all standard equipment and may be purchased from any reliable dealer. The parts should not cost the fan over ten dollars. They are as follows:

One—400 Ohm Potentiometer (P)
One—High Frequency Buzzer. (900 to 1000 cycles) (C)
One—Small induction coil or open core transformer. Construction of the proper type described in this article (I)
One—3 to 4 1-2 volt, Flash light battery (E)
One—Metal plate dial (S)
One—Dial Marker (SM)
One—Battery switch (SW)
Six—Binding posts (X, X1, Y, Y1, R, R1)
One—Set of brass clips for mounting flash light battery (E)
One—5″x7″x1-8″ Composition panel
One—5″x7″x5″ Case or wood box
X—Miscellaneous screws, wire, solder, etc.

The first step in building the instrument will be to lay out and drill the panel for mounting the potentiometer (P). A hole one half inch in diameter should be drilled in the panel, 3 1-2″ down from the top and 2 1-2″ in from the side. This is for the dial shaft of the potentiometer and is large so as to prevent the shaft from binding against the panel. The mounting holes for the potentiometer will then be marked and drilled. These holes will be countersunk from the top of the panel to take a number six, flat-head machine screw.

Four holes will be drilled and countersunk to take number six, oval head wood screws. These are for mounting the panel to the case or box for the instrument, and care should be taken to see that they are not too close to the outer edge or the screw may split the box.

When the panel is completely drilled, the potentiometer (P) will be mounted and the dial attached. The hole for mounting the dial marker will then be located and drilled to fit. The scale for the dial will complete the top panel layout. However, we will lay this part of the bridge aside for the present and start on the box equipment.

Mounting the Equipment

TWO brass details, shown in figure three, will be made and fastened to the bottom of the box as shown in figure four. These details will be spaced to fit the type of flash light battery to be used. Number six round head wood screws will be used to mount all of the equipment except the buzzer; this will have the screws usually furnished.

An induction coil (I) or open core transformer, having a low impedance value and a ratio of transformation of about three to one, may be purchased for about one dollar, or it may be made at an even smaller expense, as follows: A bundle of soft iron wire, No. 20 B and S gauge, having a total diameter of about five-eighths of an inch and an overall length of four inches will be securely tied and wrapped with about ten turns of good wax paper. Two pieces of wood, one quarter of an inch thick and one and one half inches square, will have a hole drilled in the center large enough to fit snugly over one end of the iron core. One of these pieces will be made fast to each end of the bundle of soft iron wire, making a spool.

Shellac or glue may be used to fasten all parts, and it would be well to tie all of the windings with shellac or glue when each coil is completed.

The primary coil will be wound in even layers directly over the iron core on the wax paper wrappings. Two hundred turns of No. 20 B and S gauge, double cotton covered, copper magnet wire will be required. Both ends of this winding will be brought out through holes in one of the end pieces of the spool and the entire coil covered with about six turns of wax paper, thus completing the primary coil.

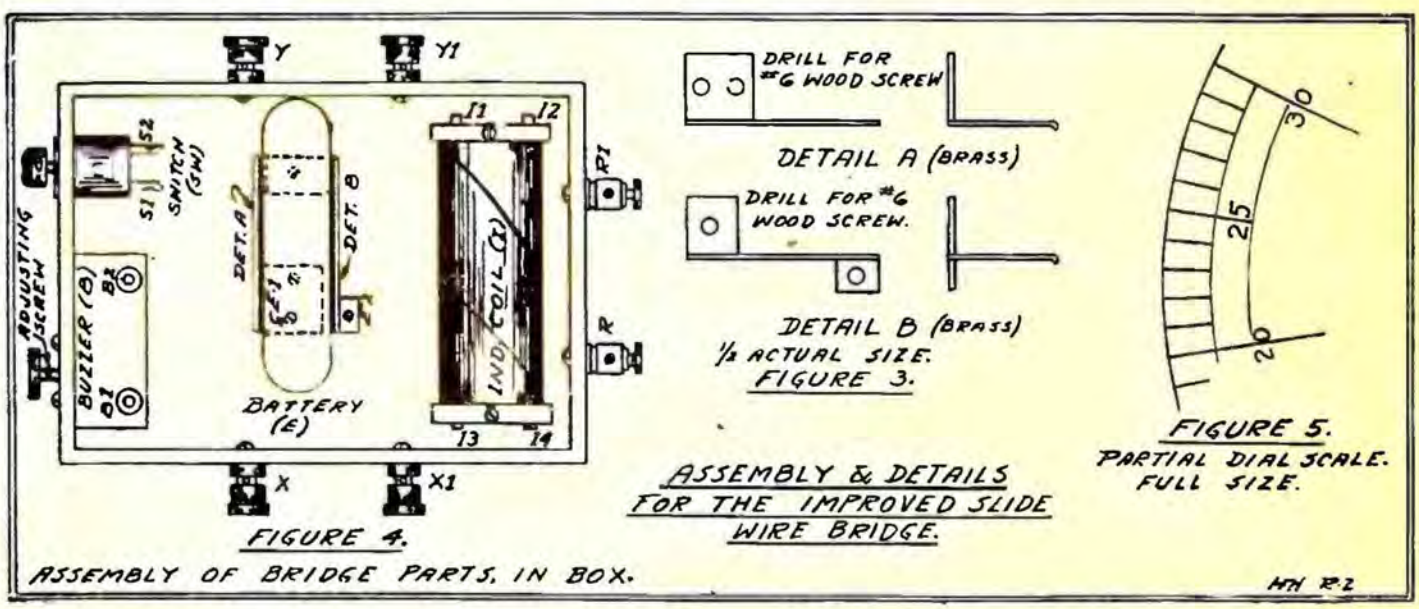
The secondary coil will be wound directly over the primary coil and on top of the wax paper wrappings. Be careful to wind the wire for this coil in the same direction as was done for the primary coil. Six hundred turns of No. 30 B and S gauge, double cotton covered, copper magnet wire will be necessary, bringing each end of the winding out through holes in the end piece opposite to the primary leads.

It would be well to splice a piece of stranded wire to the secondary coil ends, taking two or three turns and bringing out through the end piece in place of the No. 30 solid wire, as this is rather delicate and hard to handle. Ten turns of wax paper will then be wound around the coil and made fast, completing the induction coil, (I). This coil will then have four leads or terminals. The inside lead of the primary coil will be (I1), the outside primary lead (I2), the inside secondary lead will be (I3) and the outside secondary lead will be (I4). The coil will then be mounted in the box or case as shown in figure four.

The Buzzer

A HIGH frequency buzzer, (900 to 1000 cycles) may be secured from any reliable dealer for about two dollars. It should be enclosed under a metal cover. A buzzer of this type is required to set up a current whose frequency is somewhere near the average frequency of voice currents to better balance and measure equipment subject to voice

(Turn to page 53)



Electricity—The *Life* of the *World*

The Wise Old Man of the Night Sheds Some Light on Radio's Miracles

"You were wondering what keeps the sun, moon and stars in their relative positions, and what effect they have on this world of ours," said the Old Man. "Well, I will tell you."

A STORY THAT DELVES INTO RADIO'S FUTURE—BY FRANK D. PEARNE

BILLIE McINTYRE leaned back from the key and stretched out his arms with a deep yawn. This had been a particularly interesting night for Billie, as he had reached more of his ham friends in the last three hours than ever before in a single night. Being somewhat of a dreamer, his mind began to wander from the dots and dashes of the last few hours to the more mysterious things of life. He marvelled at the wonders of nature, for his West Virginia friend had just clicked off the information that a terrific thunderstorm was about to break and gazing out through the window he looked upon as clear and beautiful a sky as he had ever seen.

It was hard to imagine a thunder storm from a sky like that. What difference a few hundred miles could make; what was this great power that could turn these heavens into a huntdering whirlpool of wind, rain and lightning?

Much of his life had been spent in dreaming, studying and experimenting. He watched the magazines and read the best books, and the many theories of radio transmission and reception which he absorbed in the process had made him wonder what it was all about. To Billie, there were many things yet to be explained to his satisfaction. Lighting up the old pipe, he walked across the room to the window and sat down gazing out at the sky above him.

What were all these tiny stars blinking at him? Why were they always there in the same place and order night after night, and what influence did they exert upon this little world of ours?

A Stranger Enters

THESE and many other questions flitted across his mind as he became deeply absorbed in the wonderful spectacle before him.

Suddenly he became conscious of the fact that he was not alone, and even before he could turn around he heard a deep voice behind him drawling out the question:

"Well, young man, have you figured it all out?"

Turning quickly, he beheld a little gray haired old man looking at him from across the room. Strange to say, Billie was not startled. It all seemed perfectly natural for some reason or other, and something seemed to assure him that even at such a late hour whatever might be the mission of this queer looking individual, it meant no harm to him. How he had found his way into the little laboratory through a carefully locked door did not seem to bother him. Rising slowly from his chair, Billie walked toward his visitor.

"I—I don't seem to remember you, sir, but there is something very familiar about your face," he said.

The little old man chuckled, "No, son, there is nothing strange about your not remembering me, for I passed on from this earth many years before you were born. I, too, struggled with these problems of yours—struggled hard and patiently—when I was young, and for the little which I did accomplish, science has rewarded me by mentioning my work and experimenting and by placing my image in the hall of fame."

Suddenly the light of recognition came to Billie. That face he had seen in some of his old books. "You are—?" he exclaimed, but the little man held up his hand and stopped him.

"Never mind who,—my purpose in coming here is to get you out of this rut—to give you a new train of thought and to try and make you do a little thinking for yourself."

Billie made a gesture and opened his mouth to speak, but the little old man stopped him.

"Please do not interrupt me, for I have much to say to you in the short time I can be with you, and I know what you are going to say. Electricity is the life of the world. You were wondering about the sun, moon and stars, and what keeps them in their relative positions, and what effect they have upon this world of ours.

"Has it ever occurred to you that this planet, like the others, is whirling around at tremendous speed, and that this condition might cause It to become highly charged with electricity? Have you ever tried to experiment with a number of very light bodies which have all been charged with electricity, and noticed how they repel one another, keeping them separated at a distance, depending upon the strength of the charge which they hold, and also that when relieved of their charge the re-

pulsion ceases, or if some of them are given a positive charge and some a negative charge they rush together? What then is more natural than to suppose that these planets with their enormous electrical charges—in fact, charges of electricity which are so great as to be far beyond the comprehension of man—act in the same manner and float around in space at a respectful distance from each other?

"Do you suppose that this little mechanism which you call a generator really produces anything? You use it every night to converse with your friends; other so-called generators apparently supply the energy to give light, heat and power, but good, fair reasoning should convince you that man creates nothing. We are, in fact, prisoners on this little planet and have no power to reach out from it and obtain anything which is not already here. The only thing which you can do is to alter conditions in such a way that these changes may be beneficial to mankind.

"Is it not more reasonable, then, to suppose that your so-called generators merely act in such a way that they make use of this great charge by causing a difference in its strength between the points covered by the electrical circuits connected to them?

"Fortunately for you and the rest of the human inhabitants of this earth, man has not yet found any means of making any appreciable change in this charge. The small amount of energy which he has succeeded in moving from point to point has had no effect upon the earth's location compared to other planets, but should the time come, when the requirements cause enough change in this charge to lessen its repelling effect, look out for unusual things to happen. The earth might change its position in relation to the other planets."

Billie listened intently as his strange visitorr ambled on. Many ideas suggested fanciful things as he listened. What would happen if the earth changed its position? Life is possibly only within a small range of temperature. Any slight change in the position of the earth might cause it to become so hot or so cold that the inhabitants could not exist. Is this great thirst for power really a menace to humanity? Would the time ever come when the earth, relieved of its repelling power, would go crashing into some other planet?

"Now," said his friend, "we come to the most interesting of all of these theories. Without the sun, animal life could not exist on certain planets which come within its range, for it sends forth waves of all lengths, many of which are beyond the senses of man to recognize. The principal waves of interest to you are the shorter ones, which produce the effect of light and heat, varying over a great range. Light waves of various length produce different colors and all combined make up the pure, white light which makes it possible for you to see. As the waves become longer, they affect the senses by producing heat, and when they become still longer, they become electrical waves.

"You need no evidence to prove that light waves exist and the heat waves will also exert themselves upon the senses, but what of the electrical waves? Knowing that these waves must exist, you have often wondered how you could make use of them. Science will probably discover in time, that these very elusive waves are the most important of all. They may find that these electrical waves are making it possible for life to exist in this great charge of electricity which surrounds you.

"I notice that you have what you call a high frequency coil over there on your work bench. You have always been under the impression that this coil would produce a high frequency discharge, and as usual you are wrong. You employ a condenser in this circuit —the fastest operating piece of apparatus known to man, and by utilizing some of the earth's charge, you cause this condenser to charge and discharge at enormous speed. Did you ever look at this from a different angle? Did you ever stop to think that in dealing with such high speed of vibration that you were coming within the range of the speed of electrical waves from the sun?

"I don't suppose that it ever occurred to you that this might be just the earth's charge exerting its power. I might suggest that perhaps the function of these electrical waves from the sun is merely to neutralize the effect of the earth's charge, thus making it possible for life to exist and other conditions which would be entirely different without these waves, therefore, when you operate your high frequency coil, you produce nothing but a vibration which comes within the wavelength range of the electrical waves, counter-acting the neutralizing effect of these waves upon the earth's charge, and this charge then begins to assert itself in the form of a bluish glow about the conductors which are connected to it and causing a tremendous discharge across the terminals of the coil when they are brought close together.

"Is this not a case of setting two of nature's forces against each other? If you will give this theory some thought, you may find that certain electrical shocks which are fatal to animal life, are caused by the sudden neutralizing of some of these life-giving electrical waves from the sun, or their effect upon the body. It matters little, which side of the earth the sun happens to be on, as it is all under the influence of these waves, but your own scientists say that when the sun is on the opposite side of the earth, human life is at its lowest ebb, which may prove that these waves do not penetrate the earth as readily as they will affect it from the outside. In other words, their strength is somewhat reduced by passing through the earth.

"Why do you always choose the night hours for transmitting your radio signals? Because you find that signals will go much farther at this time, because they are not so much affected by the sun's electrical waves when it is on the other side.

How the Sun Affects Us

HAVE you ever witnessed the effect of the northern lights at certain times of the year? Where these demonstrations take place, the conditions are not the same as they are here. Days and nights are six months long up there in the north. Sooner or later science may find that the present day theories are all wrong in regard to these phenomena. It may find that the lack of the greater power of the sun's electrical waves has much to do with these demonstrations.

"It is hardly possible that because the sun is missing from this region for such long intervals, the earth's charge is not held in check so faithfully during this time, and that this charge shows itself in the great bluish glow which fills the heavens at certain times of the year. There are many other proofs of the existence of electrical waves coming from the sun, and do not think that it is necessary for you to find a way to utilize them—they are doing their work just as surely as the light and heat waves are doing theirs.

"Remember that millions of waves are coming to this earth from the sun, and it is hard indeed to find the dividing line between them. They are all mixed up so far as we can see. A common magnifying glass will pass light waves through it and when properly focused upon any combustible material, will so concentrate the waves to a small pot and produce enough heat to ignite the material, showing that near the dividing line in light and heat waves, they may be both. What other waves may be discovered in the future is hard to imagine, but rest assured we know very little about them at the present time."

Billie listened closely to all the little han had to say. He seemed to be carried on into a new world. He began to feel a cold perspiration coming over him, and looking over at the high frequency coil which his friend had so carefully explained to him, he observed that it was beginning to show the bluish glow of which the old man had spoken. Suddenly there was a flash across the terminals and a deafening report broke in upon the conversation.

(Turn to page 40)

PRISONERS ON EARTH!

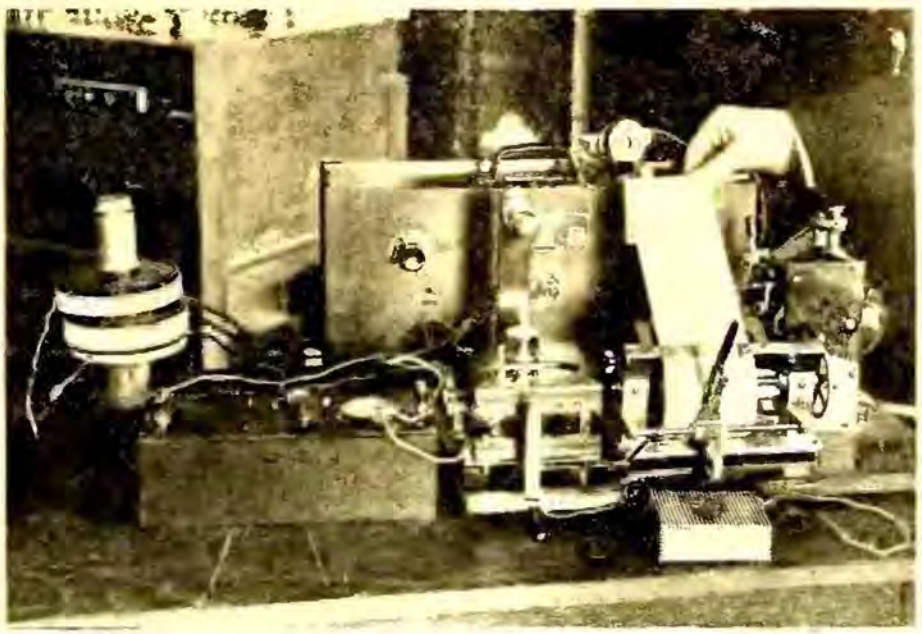
The Wise old Man of Mr. Pearne's article gives an interesting viewpoint of man's relation to the earth he inhabits.

"We are prisoners on this little planet and have no power to reach out from it and obtain anything which is not already here," he says. "Fortunately for us, man has not found a means of making any appreciable change in the earth's actions. The small amount of energy which man creates has no material effect compared to the other planets—but should the time come when man does do something of a revolutionary nature in science—look out! The earth might change its position—and chaos would result."

An Organized War Against Radio Fading

Bureau of Standards Engaged in an Unusual Attempt to Solve Radio's Troublesome Enigma

By S. R. WINTERS



Above is a view of the apparatus assembled by T Parkinson of the Radio Laboratory of the Bureau of Standards in Washington, D. C, for conducting tests relative to the "fading" of radio signals

THE signals are being heard with such surprising clarity and intensity that you marvel at the achievements of radio. Then, with an abruptness that is disconcerting, the signals weaken rapidly until they may become completely inaudible. Meanwhile, the voice of the speaker or the musical strains of the orchestra are seemingly chopped off and you suffer the exasperating experience of having the continuity of the radio program broken.

This strange phenomenon in radio reception is described as fading or swinging of signals. Various theories have been advanced in attempts to explain this enigma but thus far it has defied a plausible explanation that would point to the source of the trouble. It is more baffling, and at times more annoying, than static. Signals from some stations are thus peculiarly afflicted—notably, KDKA of East Pittsburgh—and, not unlike atmospheric disturbances, fading is more pronounced at night than during the day.

The Radio Laboratory of the Bureau of Standards, in recognition of the extent and undermining influence of this radio wave phenomenon, recently inaugurated the most comprehensive investigation of its kind ever undertaken. These observations, under the direction of T. Parkinson, a government radio engineer, will extend over a period of many months and have enlisted the cooperative efforts of college and commercial laboratories, distributed over a wide area of the United States. Quantitative and qualitative measurements and possibly directional observations of fading will be made.

Unusual experiments require uncommon mechanical equipment. This statement is especially applicable to the apparatus to be used in these fading observations, special equipment being designed for this purpose. The truth is, the method and apparatus for making these measurements are so complicated that the participants in the tests are necessarily limited to college and commercial laboratories. However, thousands of radio fans and amateurs who are not properly equipped for undertaking these experiments will be intrigued by the imposing mechanical and electrical equipment employed.

The apparatus assembled by T. Parkinson of the Radio Laboratory of the Bureau of Standards is illustrated in the photograph and diagram reproduced with this article. The pretentious equipment and novel arrangement are inviting enough to the experimenter. It is not conventional in appearance. For instance, a super-heterodyne radio receiving set is shown in the background of the picture and, despite customary practice, there is no loop or coil antenna available. Purposely, this type of energy collector is avoided because in making fading measurements directional effects are undesirable. A loop or coil antenna has pronounced directional characteristics. If only a radio receiver with a loop antenna is available, an open aerial may be coupled to the receiving outfit, the secondary coupling coil having an inductance equivalent to that of the coil antenna and is substituted therefor.

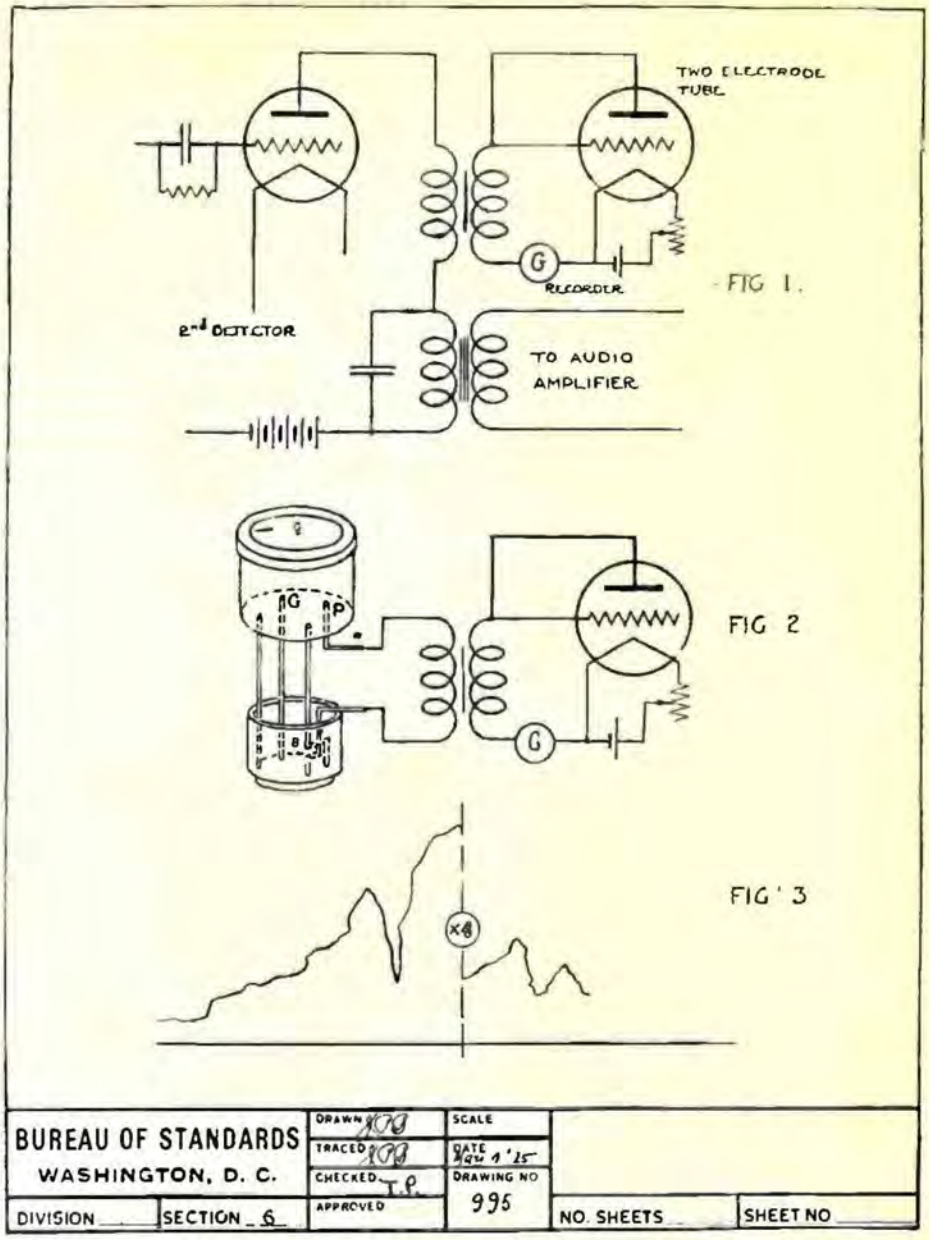
THE type of receiving set most generally used by observers," indicates Mr. Parkinson, "is the super-heterodyne, which has apparently proved satisfactory. In one instance a neutrodyne was used and a heterodyne oscillator was employed to produce an audio-frequency beat note with the received carrier, the beat current being measured at the output from the audio stages. One or two others have used the oscillating detector to produce the beat note and have similarly measured the audio-frequency output. One unfortunate feature of the latter arrangement is that relatively distant generating ('oscillating') receivers may also cause an audio-frequency beat note which is very effective in causing galvanometer deflections. Such disturbances, though audible with the super-heterodyne, have much less influence on the galvanometer and very often cause no observable change whatever.

"It is also feasible to use other types of radio-frequency amplifiers, providing the recorder galvanometer, with rectifier, is so connected as to measure the amplified radio-frequency current. In no case, except that involving a definite audio-frequency beat note, should the output of the audio-frequency amplifiers be measured. Otherwise marked variations due to modulation will appear on the record and make it impossible to distinguish fading effects. Also, when the beat method is employed it will be necessary to keep the beat note at the same pitch if comparisons are to be dependable, as the amplification may vary markedly with the frequency in audio-frequency transformers."

The specially designed unit for observing the pranks of fading or swinging signals is entitled "Type 289 Fading Recorder," and is obtainable from the reputable manufacturers. This outfit includes a sensitive galvanometer. Two types of motors are available for driving the clock-like mechanism of the recorder—an electric or a spring motor drive. The former is a 60-cycle electrically-driven motor, power being obtained by connecting it to a 60-cycle alternating current lighting circuit. The spring

motor, somewhat bulky, requires winding every five or six minutes. This type of motive force, however, has the two-fold advantage of making the observer independent for field work and of eliminating any interference that might emanate from electrical devices. This recorder carries with it a kymograph drum to move the recording tape and a pen for writing down the observations. This graphic record is obtained by means of a hand-operated lever which follows the galvanometer deflections.

"One or two observers have made their own recording outfit," notes the Radio Laboratory of the Bureau of Standards, "and some others have simply used a galvanometer alone and taken readings several times a minute, plotting these afterward on coordinate paper. Very good records showing the major variations have been secured in this way. The continuous record, on the other hand, is easier for the observer and shows up the smaller fluctuations which may sometimes prove significant. A number of records made during the recent sunset fading tests, for instance, show a rapid periodic swing starting about fifteen minutes after the local sunsets at the observing points and lasting approximately a half hour. Such effects may give a helpful clue and would appear only on the continuous record. In this connection it should also be stated that the fading is sometimes so rapid that a slow-motion clock drum will result in a merging of several fluctuations into one heavy line on the record."



The above chart, prepared by the Bureau of Standards, gives an indication of what will be done in the nation-wide drive to enlist radio fans in the war against exasperating radio signals.

USE of a sensitive galvanometer, having a full-scale deflection of 14 micro-amperes, is recommended, although some observers have succeeded in obtaining such amplification that currents as great as 160 micro-amperes were secured. This achievement suggests the possibility of using a less sensitive recording instrument than that already specified. However, the galvanometer employed in the fading recorder being described has a resistance of 2,000 ohms and a full-scale deflection of 10 micro-amperes. In all cases, it is recommended that a sensitive direct-current galvanometer be employed with a rectifier in such a manner as to measure variations in the received carrier-wave current. This Shaw recorder, so called, moves the paper, upon which the observations are written, at a rate of five-eighths of an inch per minute.

"A number of arrangements have been experimented with for rectifying the radio-frequency current to be measured," suggests Mr. Parkinson, who is conducting these fading observations for the Bureau of Standards. "The simplest of these," he explains, "is the crystal detector in series with the galvanometer and the secondary of a radio-frequency transformer, the primary of which is in the plate circuit of a radio-frequency amplifier or detector tube. Since changes in crystal sensitivity, due probably to contact variations, sometimes produce records very similar to fading curves, this method is not altogether dependable.

"The method of balancing out the normal plate current of the detector tube by means of a small current supplied by a separate battery and flowing through the galvanometer in the direction opposite to that of the 'B' battery current has been tried and usually has proved unstable. The balance is difficult to hold under the best conditions and with many tubes is impossible."

"A more dependable arrangement than either of these," indicates Mr. Parkinson in describing the method employed at the Radio Laboratory of the Bureau of Standards, "is the two-electrode electron-tube rectifier. One of the secondary terminals of a radio- or intermediate-frequency transformer is connected to both plate and filament of the electron tube while the other terminal is connected through the recorder galvanometer to the negative filament. Although no 'B' battery is used, there is a space current which may be balanced out by turning the galvanometer zero adjustment until the instrument, with no incoming signals, reads zero.

"The UV-199 type of vacuum tube is apparently most satisfactory, the space current to be balanced out being small and the sensitiveness being fully as great as that of a very good crystal detector when used in circuit with the same transformers and galvanometers. The UV-201A type of tube is also workable but the space current is so great that it becomes necessary to get at the interior of the galvanometer to turn the zero control sufficiently.

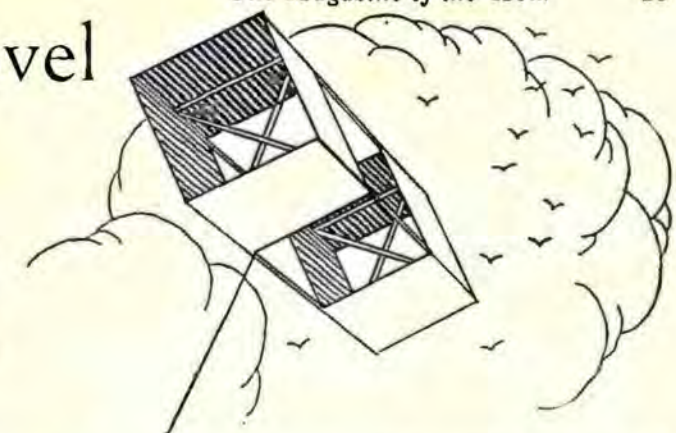
"It may also be balanced out by a small series voltage. By using an extra intermediate-frequency transformer,

(Turn to page)

Experiments *With* Novel Antenna Systems

Solving the Antenna Problem for the Portable Radio Receiver by the Use of Ingeniously-Made Outdoor Antennae

By HARRY G. CARROLL



The box-kite aerial is a most efficient means of erecting an impromptu antenna. Mr. Carroll's experiments with various antennae, during the past Summer, recorded in this article, should prove of immense value to portable radio fans.

THIS Summer's vast army of tourists and vacationists equipped with all manner and forms of portable radio receiving sets has shown what an important part radio will play in the future vacations and outings, and some attention should be given to problems usually encountered in the erection and operation of this type of receiving set.

No doubt, the readers of this article themselves have had this question in their minds more than once, and it is not an easy matter for the layman to devise and erect a truly portable antenna system that will give efficient results under such varying conditions as are encountered on a Summer tour, or at the beach.

The first and most difficult problem to confront the fan is a suitable support for an antenna, high enough above the ground to reach out and bring in the DX stations. It has been found in heavily wooded sections that trees and green vegetation absorb a vast amount of the radiated signal energy and only the super power stations are able to pierce this barrier and give satisfactory results on the average receiver. To overcome this difficulty either a super sensitive receiver is necessary or the antenna must be in such a position as to be above or away from this vegetation as far as possible.

Beach Aerials Rare

THE beach offers another obsta- cle inasmuch as one se l d o m finds a support high enou gh above the ground to erect an antenna, it is usually too conge sted to offer much in this line an yway, so some other means must be resorted to unless one has a set that is sensi- tive enough to operate efficiently with a loop antenna. This does not help ma tters much, since a recent ce nsus shows that the most popular portable receiver is of the regenerative type, using three tubes.

Considering that the aver- age tourist or camper usually employs a re- ceiving set which makes use of an open wire aerial, and not a loop antenna, the writer set out to devise a number of truly portable receiv ing set antenna systems, which wo uld satisfactorily meet conditions con- fronting the out-of-door radio listener.

After considerable ex perimen- tation and testing with different forms of antennae dur ing the course of a four weeks' radio ex- perimental trip in the N orth Woods, the writer has come to the conclusion th at there are three general ty pes of antennae which are well worth tryi ng when out on a touring or vacation trip with the portable as part of the equipm ent.

The fir st type of antenna to be desc ribed is the single wire horizo ntal aerial, which is un- doubt edly the simplest and most com monly used today, both at ho me and in the field. This type is particularly adaptable in the tourist camp and in the woods. It consists chiefly of a single wire, either flexible or solid, 100 to 125 feet in length, both ends being insulated by means of strain insulators, glass porcelain pyrex, etc. Height should be the chief object in the erection of an antenna of this type, as it will be readily seen that the farther away the antenna wires are located from surrounding objects, the less will be the shielding which they affect.

Although it is generally conceded that the higher antennae pick up or absorb more stray atmospherics or static energy than do the lower ones, they are undoubtedly the only ones which will induce sufficient amount of voltage (EMF) in the receiver to enable the distant stations to be heard.

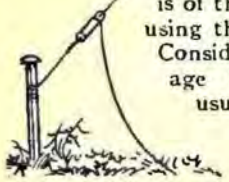
Where broadcasting stations are within a reasonable distance of the receiver, naturally one should make use of a lower antenna, as less static will be picked up and the quality of the programs will be better. On the other hand, however, where long distance stations are desired, the higher antenna is the only solution and the effect which static and atmospheric disturbances have on the received programs of course is a necessary evil.

Using Tree Supports

AN antenna of this kind can be readily erected at a tourist camp, as it has been found that there nearly always exists a number of suitable supports to which it can be fastened. While in the woods trees are most frequently made use of as supports for the aerial wire and this practice will prove satisfactory if a clearing is picked out and the antenna strung between two high trees. The antenna should be supported from the very top and this can be easily accomplished without any climbing by securely fastening a stone or other object of weight to a stout cord and throwing it directly over the top and center of the tree. The weighted end of the cord will come down, thus allowing the aerial wire to be pulled up by fastening it to the other end of the cord. Care should be taken not to pull the wire up too far, so as to bring it in contact with any branches. The same procedure can be followed in elevating the other end of the aerial wire. A lead-in can be fastened to the center or at the end of the horizontal portion of the wire. Only a very slight amount of slack is necessary in the flat or horizontal portion of the antenna in allowing for swaying of trees to and fro in a breeze. In fact, in several instances no slack was allowed at all; even in a heavy wind the antenna remained well supported and no breakage occurred. It was noted that the lighter branches at the top yielded sufficiently to prevent any breakage of the aerial wire or support cord.

A good ground is equally as important as a good antenna and under ordinary conditions an iron pipe or rod preferably galvanized, or copper coated, from four to five feet driven in the ground about four-fifths of its length, will suffice. The ground lead running to the set is wrapped around the pipe in such a manner as to afford a good electrical connection.

It is advisable to drive the ground rod in a low or moist spot if possible. In the event that the ground rod does not give satisfactory results, it may be necessary to try a counterpoise. It is sometimes the case that a good ground cannot be established in this manner due to geographic conditions, as it has been found that large areas of earth have been either totally or partially insulated from the lower earth by stratas of rock.



How the box-kits aerial is connected to the ground. The ground pipe, which connects to the set, is likewise connected to the insulator which in turn is attached to 100 to 200 feet of antenna wire. The kite cord itself, indicated by "X" in the drawing, should be able to stretch out 900 to 1,000 feet.

¶The Fundamental Reason Why MORE *and* BIGGER *Super-Stations are* COMING!

Technical Difficulties in Building Super Power Stations are Enormous; Some of the Satisfactory Results Expected Soon

THE ultimate object which we hope to obtain by super-power broadcasting is, of course, an appreciable improvement in the service to broadcast listeners. To what extent superpower alone can accomplish this result has not been definitely determined. While some phenomena in radio transmission are unquestionably a function of the power of the transmitter, other characteristics are a function of the frequency and the relative location of the transmitting and receiving stations.

Realizing the limitations of the present broadcast service, and appreciating the vast amount of work that remains to be accomplished, the General Electric Company has established what is undoubtedly the largest and most powerful broadcasting transmitting laboratory in the world devoted to development work.

This laboratory is designed to permit a thorough study of radio transmission in general, and broadcast transmission in particular. It provides equipment for obtaining the transmission characteristics of wavelengths between 5 meters and 3000 meters, at powers up to 100 kw. In addition, there have been provided sufficient antenna structures so that the best type of antennas or radiators can be determined for the various wavelengths.

A Mammoth Enterprise

THE laboratory occupies 54 acres of of land, and consists of 13 buildings, three towers 300 feet high, one tower 150 feet high and a number of smaller towers ranging from 60 to 100 feet in height. From and between the towers is arranged a network of antennas with which it is hoped to secure fundamental data on the most efficient antenna for a given wavelength and power.

To return to the subject of what super-power can do for broadcast reception: First, it is obvious that increased power at the transmitter will provide increased energy at the receiving station, thus raising the level of the signal above that of the noise. This should, to some extent, tend to decrease the effect of static and other disturbances; second, it may appreciably decrease the extent to which fading interferes with reception; third, it may increase the range of the transmitter so that programs can be satisfactorily received over a greater area, and hence provide better service both day and night.

At the present time, when the word, "super-power" is applied to so many projects, it is perhaps difficult for the broadcast listener to fully appreciate the technical difficulties that must be overcome in building a transmitter of this size. Some idea of the problem may be gained from the fact that such a transmitter must be capable of receiving an extremely small amount of sound energy, converting it to electrical energy, and amplifying it fifty thousand million times without distortion.

Some apprehension has been felt, and suitably so, by the Department of Commerce, as to the use of appreciably higher power for broadcasting, believing that it might result in the program of a superstation crowding out the programs of the lower power stations, particularly in the vicinty of the station itself.

For this reason, the super-power station of the General Electric is located several miles from the city of Schenectady, so that the intense field, in its immediate vicinity, will not interfere with the reception of other programs by the inhabitants of Schenectady.

It is also for this reason that the present series of tests are being carried on at rather unseasonable hours, since the license for the station is an experimental one, and does not permit broadcasting during the normal broadcasting hours. The Company is in this way co-operating with the Department of Commerce in an effort to get exact data on super-power broadcasting before it is carried on during the earlier hours.

The reports received up to the present time from nearby as well as distant points, indicate that no interference is being caused by the use of super-power. In fact, many reports have commented on the extreme sharpness of the transmission.

It should be remembered that the current in the receiving antenna is not directly proportional to the power of the transmitter, but is proportional to the amperes in the transmitting antenna, so that the power of the transmitter must be increased four times to double the current in the receiving antenna or loop. This fact is mentioned for the benefit of those who might otherwise expect a signal strength greater than the facts warrant.

It is hoped and fully expected that the tests and development work now being carried on will carry radio an appreciable step forward in overcoming those things which are undesirable in present day broadcasting. No one doubts but that these problems will eventually be solved to the entire satisfaction of the broadcast listener.

A Systematic Research

A RADIO development laboratory for research on wavelengths from 5 meters to 3,000 meters with power from 5 watts to 100 kilowatts, has been constructed on a 54 acre plot, two miles southwest of Schenectady, by the General Electric Company.

This work of radio development is undertaken for the purpose of making a systematic study of transmission phenomenon. Because of meager data, there is one group of scientists advocating super-power as the remedy for existing broadcasting defects; another, low power short wave transmission to accomplish the same results; another medium power, long wave transmission and many different types of antenna systems are recommended, including the reflector, vertical, horizontal and angular.

On the plot near Schenectady are one brick building, 60x100 feet, and four smaller frame buildings in which are housed transmitters. There are three steel towers each 300 feet high arranged in the form of a triangle. This arrangement permits the construction of many different types of antennae. A fourth steel tower 150 feet high is used for smaller antenna structures. Three 80 foot wood masts support the antenna now being used for the 109 meter transmitter.

The largest building houses the power equipment, high voltage rectifiers and amplifying and modulating equipment for the stations. There are three rectifiers each having a capacity of 150 kw. at 15,000 volts. These rectifiers convert the alternating current supplied to the

(Turn to page 57)

At Last Sally Is Found!

After years of tireless search, we've solved the question of what's become of Sally! Word comes from California Radio Stations that "Sally Bell," shown above in an exceedingly piquant pose, is capturing the hearts of the broadcast listeners by her eccentric programs with her trusty "uke." She appears most consistently at the Hollywood and Los Angeles stations.

(Photo by Witzel)

What the Broadcasters are Doing

Radio Puts Army, Navy and Marine Bands on Map

WASHINGTON, D. C.—For years the crack musical organization of the country has been the U. S. Marine Band, which began as a fife-and-drum corps in 1798 and came into fame with Sousa as its leader. More latterly it has been ably directed by Capt. William H. Santelmann. The Marine Band has led more historic military reviews and inaugural parades than any other band in the United States. This red-coated organization has formed a picturesque background for social functions at the White House.

Sharing honors with the Marine Band during the past few years have been the Army Band, sponsored by General Pershing, and the Navy Band. When General Pershing, as head of the American Expeditionary Force, returned from Europe at the conclusion of the war, after hearing the famous Garde Republicaine Band of France and the Brigade of Guards Band of the British Army, he set about having a band organized from army bands in this country that would equal these famous organizations.

However, until radio came in, there was a tremendous handicap in Washington, their home, with regard to the Marine, and Army and Navy bands. It was because they were so seldom heard.

True, during the Summer months there were concerts on the White House lawn, the Capitol, and other places. Again there were concerts in the Marine Barracks, so remotely located as to be difficult to find and in an ancient band stand in Potomac Park, a mile from a car line and almost inaccessible to the visitor.

Radio, however, has changed it all. The three great service organizations are now regularly heard on the air and by the hundreds of thousands of citizens throughout the country.

The attentive face above belongs to Frank S. Lane, regular announcer at KFRU, Bristow, Okla. He is a great favorite among the fans in the Middle West, chiefly because his prime characteristic in announcing is—brevity. More power to him!

WBBM Starting Program For Kiddies

STARTING daily at 5:30 p. m., Chicago Daylight Saving Time, WBBM is running a daily program for the kiddies from their Broadmoor Hotel Studio.

It is in the form of a club meeting, run by Joy-Digger, Tiny Dave, Uncle Charlie, and various other performers. The club is known as the Joy-Digger Club of WBBM, and the motto is: "Dig a little joy out of everything every day; it's there if you only dig deep enough."

The programs of the club will consist of songs, stories and instrumental numbers, many of them put on by the kiddies themselves. One program a week will be taken over by the various members of the Boy Scout Troops of Rogers Park.

No, this is not a scene along the European Riviera; it is just a view of the coast-line which will soon be the home of KTNT, about to go on the air at Muscatine, Iowa. KTNT is said to be one of the most beautifully located stations in America. Its towers, location of which is indicated by the arrow in the picture, will tower 150 feet above the Mississippi, with a view of 50 miles in all directions.

Editor of Radio Age on Air from WLS

FREDERICK SMITH, editor of RADIO AGE, delivered an address to the radio public through the microphone of WLS, the Sears-Roebuck station, from its Hotel Sherman studio in Chicago, recently. Excerpts from his talk are as follows:

"Several years ago, when radio broadcasting was in the infancy of its development I made a talk about the new art from this same room. After the luncheon was over a good Rotarian brother came to me and said:

" 'Do you really believe, Smith, that this radio fad is going to be permanent?'

"I told him that in my opinion radio would grow to be a social and economic factor far more important than he or I could at that time imagine. If that good brother is present today I want to call his attention to the fact that radio is now about the most continuously permanent thing we have around the house, with the possible exception of the tax collector. We get the setting up exercises in the early morning to keep us thin. Later the cooking lessons tell us how to eat and wax fat. The forenoon brings us the markets and household hints. Noon brings the organ recitals and other features. In the afternoon are the concerts and general programs. At twilight the bedtime stories and lullabyes and from then on there is jazz until such hours as all honest people should be abed. Wake up in the middle of the night if you choose and tune in on 536 meters and you can hear the World Crier telling about the latest developments in the Moroccan situation. I'll say radio is permanent! It is so permanent that it makes a noise on our so-called silent Monday nights. But when one of us tunes in another tunes out and there is always someone listening."

Now we Have—"The BELASCO of Radio"

The Girl Behind the Scenes at Station WTAM

By P. A. PRICE

HONORS just naturally gravitate toward the deserving and that is why Miss Ruth King, of Cleveland, Ohio, is claiming the attention and admiration of broadcasting stations and broadcast listeners alike, and has been called "The Belasco of Radio." Those famous "Nite Cap" programs that are broadcast on the first Saturday of each month from WTAM; the luncheon concerts that are on the air from this station every day except Sunday; the Wednesday evening dinner hour of music—all the details of these entertaining programs are arranged by the little lady in the accompanying photograph. And now she has been called upon to serve on the Program Committee of Cleveland's first annual radio exposition which is to be held in the public auditorium from November 7th to the 15th of this year.

The holder of many medals for tennis championship, editress of a society paper devoted to country club affairs, an accomplished musician and composer, Ruth King has crowded a host of successful efforts into a few short years of public life. However, it would seem that the young lady was destined to be a Program Director for, when the Cleveland Plain Dealer opened its studio for Station WTAM it was Miss King who was called upon to arrange the programs broadcast from that remote control equipment. Then the Plain Dealer, with other Cleveland newspapers, gave up association with the radio stations and the Euclid Music Company took up the good work and placed Miss King in charge as Program Director of their station that is operated by remote control from WTAM. It was a choice well made, for the young lady's programs were a success from the first.

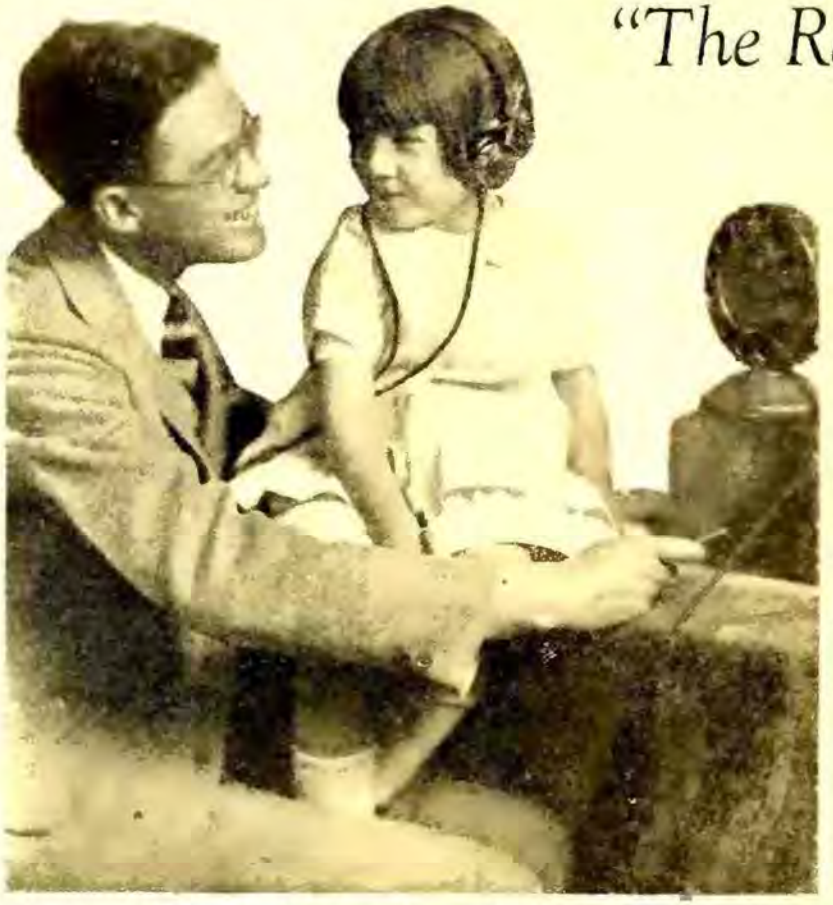
We who listen in have small idea of the effort involved in arranging for a daily program or for such special feature programs as are offered by the "Nite Caps." If Miss King's expression is just a trifle pensive it may be due to a natural worry as to whether some particularly desired artist will appear on schedule time. Artists are proverbially tempermental and this applies to their punctuality as well as their dispositions. Once upon a time this did happen in the studio and Miss King, in looking about for the next artist to appear, found herself deserted and alone. The situation was tragic, but instead of losing her head Miss King used it and calmly announced that the next number would be a piano solo by "Miss Betty Parker" and then as calmly seated herself at the piano and provided the solo herself. Since then "Miss Betty Parker" has played several accompaniments, thus proving that a dual personality is very handy to have in a broadcasting studio.

Ruth King is building a big future for herself by developing her administrative ability. With youth, energy, ambition and ability to drawn upon, Ruth King will go far in the field of radio broadcasting and with her will go the best wishes of a legion of broadcast listeners who look to her for their entertainment and have yet to be disappointed.

"The Radio Boy Wonder" of Hollywood

How a Mere Youngster Started a Radio Station in America's Most Interesting City, Which Is Destined to be America's Most Interesting Contribution to the Radio Art

By C. CLYDE COOK



"The Town Crier of the Day" at KNX, "The Voice of Hollywood," with Little Jean, 5-year-old mute girl who is learning to talk and hear by radio.

SITUATED in the "Heart of Hollywood," Station KNX, the Los Angeles Express, is generally conceded to be one of the most popular stations on the entire Pacific Coast, because of the clarity of reception, superior tone and the high standard of programs that bring within their scope the interests of all radio listeners-in.

"So This Is Hollywood!" can certainly be applied to Station KNX, for this station has the distinction of broadcasting more screen talent, perhaps, than any other station in America.

Because of its convenient location to the homes of many of the world's most famous artists, musicians and people of national and international fame, who naturally accept KNX as their "home station," they are irresistibly attracted to the KNX microphone by the quality standards of broadcasting maintained there. And, though the station will be only a year old in October, KNX already has a greater following of radio fans than stations many years its senior.

And who was responsible for this great station? An admirably gracious young man of about thirty years was instantly pointed out as the founder of this unique institution. But, try as we might, we could not get Guy C. Earle, nephew of Mr. E. T. Earle (former owner of the L. A. Express), to divulge any information concerning his own participation in KNX. From other sources we learned that Guy C. Earle attended the common schools in Oakland, and, after graduating from the University of California, he took a postgraduate course in Columbia.

Recently Guy C. Earle took over the management of the Los Angeles Express, but the station KNX will ever remain his chief concern, for there is something so human and vital about this young newspaper magnate that he derives more joy from broadcasting cheer-inspiring programs on the air than from hoarding up more of this world's goods.

A Real Miracle

ONE of the most trenchant reasons why Mr. Earle derives great pleasure from this station is because a modern miracle is being wrought at KNX, doing what the science of medicine and surgery could not do—give hearing and speech to a little girl, born deaf and dumb. Mr. E. J. Albright, Town Crier of the Day Watch, detailed the miraculous cure being perfected by means of the radio.

"When this little girl, Jean Marie MacWilliams, first placed the head phones on her ears she caught the sounds, and began to give audible proof of it in trying to repeat some of the major chords of sound, with their variations. Taking her to an eminent physician they learned that Jean Marie possessed a very uncommon sense, 'bone conduction;' i. e., the bone picks up tone and it registers by vibrating against the auditory nerve.

"Later her parents brought little Jean Marie to the KNX station and finally I evolved a plan by which I believe Jean Marie will succeed in overcoming her handicap. I proceed to ask her very simple questions and she has progressed so well that she usually answers correctly, and I encourage her in every way possible."

It was too apparent that this announcer was gifted with a magnanimous heart. The demonstration with this once deaf and dumb little girl was astounding, and yet it only proves what marvelous things can be accomplished by radio. This much the "Radio Philosopher," G. Allison Phelps, now the Town Crier of the Night Watch, conceded with his infectious smile. The "Radio Philosopher" has a magnanimous heart, also, and his philosophy of life is absolutely an inspiration to all who hear his lectures over the radio. When he lost his devoted mother five years ago he felt for a time that life was not worth living, but finally he worked out a philosophy which has brought many a radio convert out of the "dumps" just as it did Phelps.

The "Radio Philosopher" has become so in demand, since his lectures delivered over KHJ, the Los Angeles Times, that station KNX suddenly annexed him to their present talented staff, of which Carrie Preston Rittmeister, most able accompanist and program manager, is one of the foremost members. Mrs. Rittmeister also came from station KHJ, where she had served in the same capacity and observed Queen Titania deliver her initial program with her father, the Sandman.

No program arranger ever guarded the standards of their programs more zealously than does Mrs. Rittmeister. This can be easily attested by the thousands of radio fans throughout the United States, who are so fortunate as to be

able to tune in on her incomparable programs. And here is a sample of the pleasing variety of her inimitable programs: 7:30 a. m. KNX morning gym, directed by J. C. Casey, physiotherapist. 8 a. m., inspirational talk and morning prayer; 9 a. m., time signals from Washington; 10 a. m., Town Crier of the Day's morning message; 10:30 a. m., Kate Brew Vaughan, director of household economics department of Evening Express, gives lecture; 11 a. m., nature talk; 12 m. to 1 p. m., Wurlitzer organ recital; 3 p. m., talk by Chef de Cuisine; 4 p. m., Metro-Goldwyn-Mayer Studio program. 5 p. m., market reports; 5:30 p. m. to 6:15 p. m., sport talk by Sid Ziff, sporting editor of Express; 5:55 p. m., the Town Tattler; 6:15 Alder Travelogue; 6:30 p. m. to 7 p. m., Atwater Kent orchestra, 7 p. m. to 7:30 p. m., Ambassador Hotel concert orchestra; 7:30 to 8 p. m., talk on the Movies by Norma Talmadge; 8 to 9 p. m., Venice of America band; Town Crier of the Night Watch, 9 to 10 p. m., Abe Lyman's Cocoanut Grove orchestra; 10 to 11 p. m., Hollywood night, with celebrated stars being introduced; Town Crier of the Night Watch.

And thus concludes an all-day program of greatly diversified entertainment, instruction, inspiration, etc., the equal of which is hard to find on any other broadcast program. Another reason for the unusual quality of the KNX programs is the famed string orchestra of Calmon Luboviski, who was born in Chicago of Russian parentage, and later became the one and only pupil of the internationally famous violinist, Ference de Vecsey. After eight years of intensive study under this master's guidance Luboviski returned to America, entrusted with the master's secrets of tone and technique, where he electrified large audiences in the largest symphony orchestras of the United States.

A Tireless Worker

SINCE last September Luboviski has filled two hundred concert engagements, and this tireless genius is now broadcasting exclusively over the KNX broadcast station in conjunction with the world-famed Luboviski trio, consisting of Mischa Gegna, cello soloist, Joseph Vecsei, pianist soloist, and Calmon Luboviski, violin soloist. And Luboviski's Russian string quartette needs no introduction to radio fans throughout the United States, as they have broadcast from several hundred stations in the few short years of their existence.

Another shining star in KNX's constellation of radioland's luminous firmament is Raquel Nieto, coloratura soprano, one of the most marvelous voices heard in radioland, and discovered by station KNX. She has been acclaimed by her most discriminating listeners as a future Galli Curci, and in view of the fact that Miss Nieto is but twenty years of age this is quite commendable. Hailing from Mexico City, this titian-haired, blue-eyed Spanish artist has a great future in store for her.

When Norma Talmadge appears in the KNX studio in the near future and broadcasts the marvels of the moving

Miss Marguerite Rickard, lyric soprano of KNX, and exceedingly easy to look at. Miss Rickard's brother, Vernon Rickard, is announcer at WGN, Chicago, so it must run in the family.

picture, and portrays her extensive work in the cinema drama, radio fans throughout the United States will again experience one of the many innovations which has made KNX the peer of all stations which specialize in studio talent. Miss Talmadge has a clear, bell-like voice, and the enthusiasm with which she enters into these broadcasting programs is actually an inspiration to those who are fortunate enough to hear her.

Guy C. Earle, Jr., the "Boy Wonder of Hollywood" who is manager and owner of KNX, the Los Angeles Express Station. It is due to his efforts that KNX has become one of the most widely known radiocasts in the country.

Miss June Pursell, heralded as the KNX Radio Girl, and who has now gone on the Orpheum Circuit of Vaudeville to entertain vast audiences with her resonant voice, possesses such a deep, masculine voice that she has often been mistaken for a male broadcaster. However, this only goes to prove that Mrs Rittmeister is ever vigilant to gather into the fold of KNX station a galaxy of stars which will give the thousands of radioland listeners-in the greatest possible variety of talent, coupled with the best obtainable degree of high standard of quality.

KNX is on the air more hours, perhaps, than any other station in the United States, since they start the day off with gym instruction at 7:30 in the morning, and hundreds of letters pouring into the studio daily, attest the value this physical exercise has been to many converts of radioland. And few stations can compare with KNX for variety of program. So if you want a real air-fest, every hour of the day, just tune in on station KNX, the Los Angeles Express, Hollywood, California.

Radio Problems Explained at Convention

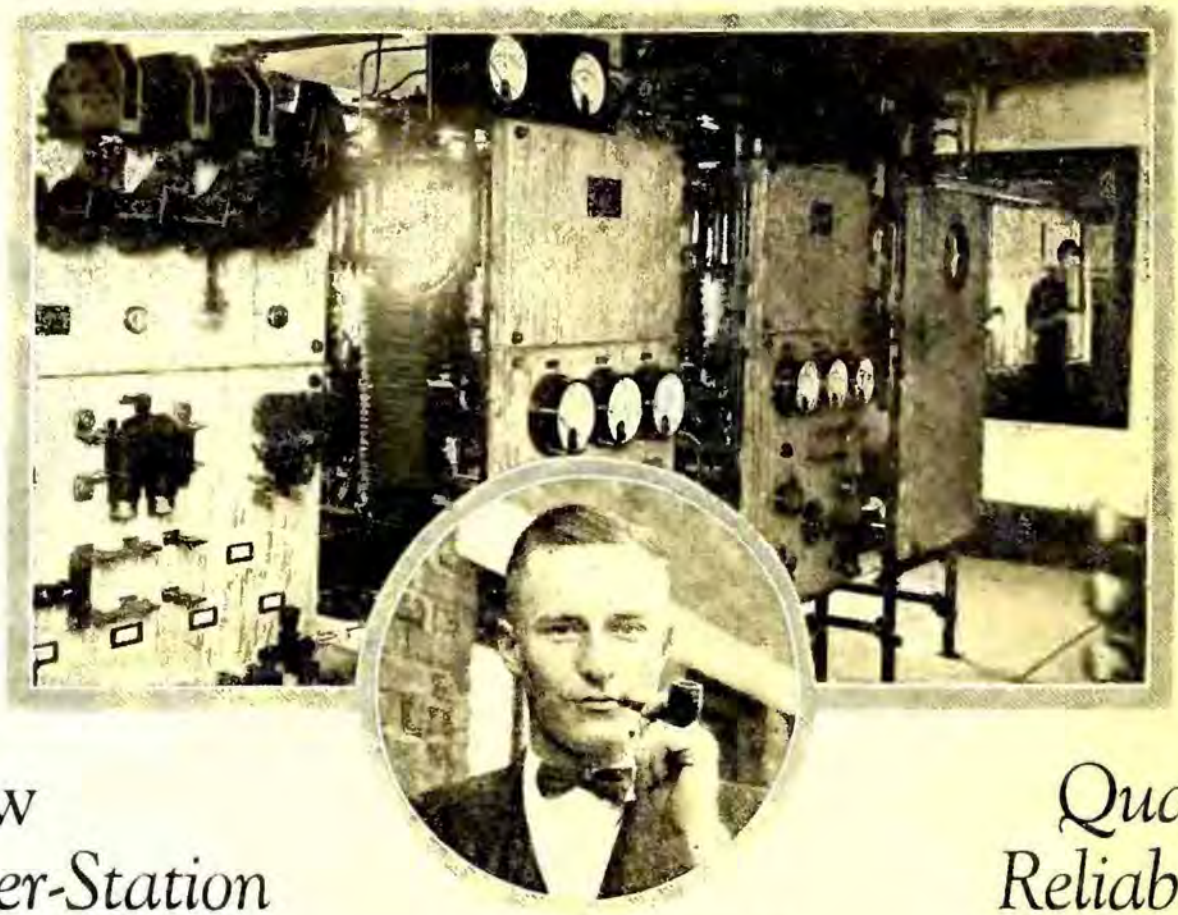
CHICAGO, ILL.—Radio interference, the development and use of the radio vacuum tube and design of radio receivers were subjects touched upon at the sessions of the Third National Convention of the American Radio Relay League at the Edgewater Beach Hotel in this city. Outstanding figures in each of three divisions of radio science presented papers for the information of the several hundred transmitting radio amateurs attending the gathering.

Professor W. J. Williams of Rensselaer Polytechnic Institute and director of radio broadcasting station WHAZ of Troy, N. Y., covered the information now available about the various types of radio interference. He told of his experiences with power, telephone and telegraph companies in attempting to run down radio interference. He touched upon the influence of the vast number of power lines in the country, pointed out some of the difficulties experienced with electrical appliances and vehicles, such as trolley cars and electric railroads.

A detailed explanation showed that all of these sources were contributing something to the vast total of interference. Prof. Williams' paper was based upon perhaps the most exhaustive research made on the subject. Working with the various other users of electrical energy, he has come into contact with practically every known cause of interference.

J. C. Warner, in charge of small tube development at the General Electric Company Research Laboratory, drew upon his store of experience gathered in the years during which vacuum tubes have made such tremendous strides. He announced the completion of work tending toward a standardization of tube bases and sockets, a matter that has in the past made necessary structural alteration to meet many desired changes.

The demand for a dry battery tube that will supply sufficient undistorted audio frequency to operate a large loud speaker has been met, Mr. Warner said.



The upper photo shows KYW's station along the east wall, looking south. To the right are seen the control board, modulator panel, oscillator panel and tuning panel. In the circle is Walter C. Evans, chief engineer of the new KYW

How *Super-Station* KYW *Achieves Quality, Reliability, and* POWER

KDKA'S SISTER STATION OPENS ON CONGRESS HOTEL, CHICAGO

By Walter C. Evans

THE principal considerations striven for in the design and installation of the new Westinghouse Station KYW on the roof of the Congress Hotel were perfection of quality, reliability, and reserve power. The resources and best engineering skill of a great company have gone into the new equipment in order that the vocal solo or complex orchestration may be turned over to a discriminating public, identical with the original sound.

Years of experience in the design of electrical apparatus is apparent in the well arranged panels, the easily accessible units with everything in duplicate so that program interruptions due to electrical causes may be reduced to an absolute minimum.

Considerable more power is provided for than will ever, in all probability, be needed for ordinary broadcasting. This is a desirable feature, for it is a better operating proposition to run a large piece of electrical equipment at a fraction of its capacity than to overload a small installation. This will leave a large margin of reserve power in case of national emergencies, paralysis of telegraph and telephone lines or similar contingencies.

To get a good working idea of this Leviathan of the radio field, we will begin with the primary source of power and follow it through to the antenna.

Current at 4400 volts is obtained from the local public service company over two separate transmission lines from different generating stations. This gives 100% insurance against power line interruptions. A 100 kilowatt transformer sub-station has been built in the basement of the hotel where the transmission lines are stepped down to 220 volts and carried through large capacity cables to the radio station on the roof. These are connected with a power distribution board or feeder panel through which all of the different pieces of apparatus draw their source of power. This panel also carries suitable cut-outs to open the circuits and shuts off the current should accidents occur to the different machines.

Next in line is the contactor panel, which does the thinking for the set (and, if necessary, for the operator). It is so arranged that the operator need only press one small push button and in slightly over 10 seconds the whole station gets under way. The push button first energizes the water pump which forces a stream of cold water through the jackets of the tubes. When the water pressure comes up to a pre-determined value, it allows the next contactor to operate which starts up the filament motor generator units. As the generators reach their full voltage, relays in the filament lines make contact, the next circuit breaker does its bit and the 60 cycle rectifier for the grid bias and another small rectifier for the plates of the fifty watt amplifier tubes add their energy to the circuit. If everything to this point has taken place to the satisfaction of the control panel, it allows the large contactor to close and current is furnished to the bank of 22,000 volt transformers outside the station room. Should anything be amiss while this procedure is going on, the contactor will remove the offending apparatus from the circuit and start over again.

The Big Transformers

THE four 10 kilowatt, 22,000 volt transformers outside the station are connected with the two transformers in parallel on each phase and the output is connected to four water-cooled kenetron rectifier tubes, which give full wave rectification on two phases with a resulting pure direct current at voltages up to 10,000. The out-put of the rectifiers pass through a bank of high voltage choke coils and condensers which smooth out the direct current until it is free from the slightest traces of ripple or hum.

This current is fed to the four water-cooled modulator tubes and to two water cooled oscillators. The oscillators work directly into a "tank" circuit which

(Turn to page 62)

They Never Run Out of Ideas in This Radio Game

The FIRST CHILD *Announcer*

Between Announcing and Acting for the So-Called Cinema This Kid is Very Busy!

By MARY JANE LAWRENCE

You may not believe it, but "Dicky" Brandon, shown above in a Witzel photo, is a coming movie star—second only to the famous Jackie—and he has Jackie beaten in that he's the only professional radio announcer among the kiddies—that we know of, anyway. We're open to disputes, however.

IT SEEMS as if there's something new under the sun every day in this interesting radio game. The latest thing—and it certainly is deserving of mention—is the advent of a young movie star into the ranks of dyed-in-the-wool, professional announcers.

Heretofore most of the country's famed announcers have impressed us with their maturity and staid indifference; viz., J. Andrew White, Graham MacNamee, and others. But what does young Dicky Brandon's press agent do but put some cute knickers on his youthful form and made him the most famous of *all* announcers—overnight!

You see, it's this way. Dicky is a movie actor by trade. He lives in Hollywood, Los Angeles and New York at specified periods of the year, and though he's but six years of age, he knows his stuff and is looking covetously at the Juvenile Movie Crown now held by Jackie Coogan, the original Kid. And it's safe to say that Dicky is at least second to Jackie.

"First in Something"

NOT to be outdone by holding a second place, however, Dicky decided to be first in something—and after a couple of visits to radio studios on the Pacific coast, he decided his *forte* lay in that direction. Dicky is particularly adept at elocution, singing, and plain kiddish nonsense, so he had no trouble in getting booked for programs with the best of them.

That was four months ago, and today Dicky spends most of his time announcing via radio and the rest of his time—really his "spare-time," playing juvenile leads for several movie companies out where the oranges grow, and where it never rains except on *unusual* days.

How did it come about? Well, dearie, Dicky just *horned* his way into the announcing game, to use a plebeian expression. And once he got into it, he found it well nigh impossible to get out. He had a habit of stopping in the middle of his programs when he was first beginning, and carrying on an informal chat with his potential listeners.

A Modest Youth

OF COURSE, such a procedure made a "hit," and although Dicky persisted that he was just doing what he'd heard other announcers doing, he was told his extreme youth made it seem original, even if he claimed it wasn't.

So Dicky was won to radio and the "experienced" announcers gnashed their teeth and took a back seat.

From a personality standpoint, Dicky's a wow. The picture shows him as Little Fauntleroy, but that's only in the movies. He'll probably grow up to be a he-man, if he decides whether to be a movie star or a radio announcer. Right now he's lying awake nights wondering just *what* to be. You see, a man in these days has gotta work hard to support his father and mother. And at the age of six Dicky Brandon realizes he's getting old and must look to the future. Do you blame him?

He tells us that he stays awake nights pondering over his career. But we have half a mind to believe it's the income tax.

He Does His Stuff

RECENTLY Dicky demonstrated he could do anything in the radio line by taking over the entire direction of a Los Angeles station for one evening, when he was announcer, director, program arranger, office boy, and what-not.

Dicky rounded up his own gang of juvenile entertainers one evening at 7 o clock, just before the sun went down, and from 7 to 8 o'clock it was "Dicky's hour" in every sense of the word. Kid songs, monologues, foolishness and childish laughter rippled out on the radio waves—the first "stunt" of its kind ever produced.

After the evening s entertainment Dicky was literally snowed under with congratulatory telegrams, phone calls and special messages—all attesting his inborn ability as a "radio genius extraordinary" at the tender age of six years!

Radio Interests Get Together

RADIO COUNCIL PLANNED

Radio Manufacturers' Association Starts Drive to Unite all Radiodom in One Common, Constructive Purpose

THE organization of a National Radio Council to include representatives of the manufacturers, jobbers, dealers, broadcasting, agricultural interests, trade papers, listeners, and others interested in radio, is being planned by the Radio Manufacturers' Association as the result of a report made by Frank Reichmann, chairman of its committee on publicity and public relations.

Mr. Reichmann in his report says:

"All listeners organizations, especially the American Radio Association and the Broadcast Listeners Association of America, should be invited to hold their next convention at the same time and place as the RMA.

"Every broadcasting station should be invited to send a delegate to a meeting of broadcasters to be held at the same time.

"All local radio trades associations should be asked to send delegates to a similar meeting, probably under the auspices of the National Radio Trades Association.

"The publishers of all radio trade papers should also meet at the same time and organize their branch of the industry.

"I especially want to call attention to the necessity of organizing the radio listeners throughout the country. The experience of the National Automobile Chamber of Commerce is one by which we can profit. The automobile manufacturers, as a body, were unable to compel the construction of hard roads, or carry on legislative reforms which are vital to the industry. By supporting the American Automobile Association, composed of car owners, this work was all carried out in a very satisfactory manner, the manufacturers giving their support to the "Three A's". A great deal of similar work can be carried on through the local radio trade associations, which have been or are being, organized, in practically every city in the country. Also, it would be to the advantage of the entire industry to have all these radio trade associations welded into some national body which can cooperate with the manufacturers. The same applies to the publications and the broadcasters.

Harmful Laws Feared

I WISH to emphasize, at this time, the fact that this Association cannot now, and probably never will be in a position to, watch for and guard against the passage of hostile and harmful legislation in the assemblies of the entire forty-eight states. Such legislation is certain to be proposed. The industry can protect itself only by organizing the listeners, the dealers, and the jobbers in every state, and leaving the matter to them. This is what the automotive industry has done.

"In connection with the broadcasting situation, this committee suggests that members of the Association who operate broadcasting stations immediately be requested to organize a broadcasting division of this Association.

"Closer affiliation of all the local radio trades association would also make it possible to carry out an organized campaign to increase the sale of radio apparatus. We believe that the manufacturers' association should outline such a campaign and suggest it to the local association for the latter's use. One thing in this connection would be a group advertising campaign of the dealers, in each city, using advertisements which would call attention to the more important special events to be broadcast by the stations in the immediate locality. Closer affiliation between the broadcasters, trade association and the manufacturers would help a great deal to carry through campaigns of this kind.

"This committee recommends the establishment of a National Radio Council to be composed of representatives of the Radio Manufacturers' Association, the dealers and jobbers, manufacturers agents, the broadcasters, the radio paper publications, and the listeners.

"We are advised that the National Radio Trades Association. which has done much excellent work in the past, is anxious that the manufacturers get behind an organization of the dealers and jobbers. We are also advised that the National Association of Broadcasters is willing to help in organizing a central council, and we are assured that we will have the active support of the two leading listeners organizations—the American Radio Association and the Broadcast Listeners Association of America.

"We are also of the opinion that the American Radio Relay League should be invited to become a member of the council and we can assure you at this time that the Farm Radio Council will become an active member.

"Inasmuch as all radio shows are primarily advertising and publicity features, this committee believes that special attention should be directed by all show managements to obtaining the cooperation of public officials in making the radio shows civic events. For the same reason we believe that special effort should be made by the management of all shows to insure the attendance of school children through the inducement of specially priced tickets, prizes for home built radio apparatus, etc.

"This committee also recommends that the association take up the matter of further encouraging the teaching of radio in all manual training classes in all public and private schools.

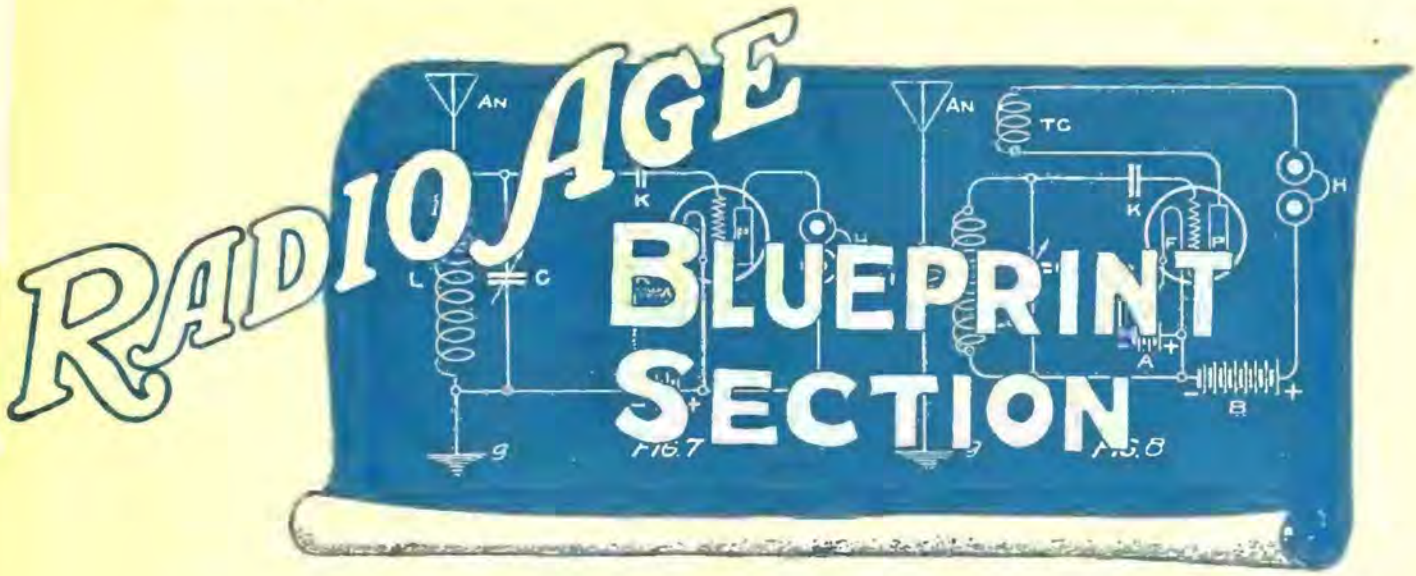
"This committee believes that by careful, conservative action during the coming year, a great deal can be done to cement together all those interested in radio, to the end that the industry will be better prepared to repel legislative and other attacks, and that even greater public interest in radio will be assured."

The report was approved at the Atlantic City convention of the RMA and the work of organizing a national council is already under way.

The following officers elected at the recent RMA convention in Atlantic City will meet on Tuesday evening, September 15, to consider plans for greatly broadening the work of the Association:

President—Herbert H. Frost.
Secretary—Carl D. Boyd.
Treasurer—S. I. Marks.
Directors At-Large—
Powell Crosley, Jr., First Vice President, Harry L. Bradley, L. G. Baldwin, Edward H. Jewett, E. T. Cunningham.
Directors Eastern Division—
Godfrey Gort, Second Vice-President, H. H. Eby, Alex. Eisemann, R. E. Thompson, James L. Schwank, A. U. Howard, S. B. Trainer.
Directors Western Division—
E. N. Rauland, Third Vice-President, A. J. Carter, Frank Reichmann, J. M. Stone, H. H. Frost, W. H. Huth, John C. Tully, L. E. Parker.

IT is planned that the eastern and western boards and members meet at regular intervals in New York and Chicago while the entire board will alternate its meetings between the two cities. Many problems of tremendous importance to the industry are now in the hands of the committees and action is expected during the New York meetings. These board and committee meetings will culminate in a general membership meeting on Thursday evening, September 17.



The Latest in Radio Construction

Single and Dual Controls for 5-Tube Sets

By JOHN B. RATHBUN

Timely Set Builders Will Welcome Novel Idea to Simplify the Tuning of R. F. Sets

THERE has been much argument of late on the subject of simplifying the wavelength tuning controls on five-tube radio-frequency receivers, reducing the conventional three controls to one or two dials. While there is much to be said in favor of the simpler control system, it is not all pure gain, for the reduction in the number of dials is attended with certain difficulties often overlooked by the adherents of the single and dual control that will be evident on a short study of the proposition by an unbiased investigator. Mechanical simplification is often attended by certain practical psychological problems which in turn depend upon the state of mind of the operator.

Under ordinary conditions, selectivity increases with the number of tuning units employed, and with the three tuning controls ordinarily employed on five-tube radio frequency receivers a high degree of selectivity can be attained without making any one of the controls unduly critical. For example, with three controls, each of the individual units can be quite broad yet collectively the combination results in excellent selectivity for each of the units corrects and augments the effects of the unit going before. Under ordinary conditions, using three dials, a station may come in with fair volume over five divisions or more on each of the dials and yet the set as a whole will be extremely sharp. If one dial tends to be very sharp and critical, the effects can be modified by making adjustments with the remaining dials.

Now let us assume the same degree of total or overall selectivity with only two dials operating the former three tuning units through gearing or similar mechanical connection. As the total movement must be had with two dials instead of three, the stations will no longer be tuned in over so wide a range of scale divisions, and instead of being in evidence over five dial divisions as before, the band will be reduced to approximately three divisions. Thus, the tuning is more critical and requires closer and more careful dial adjustment than when the three dials are employed.

There are fewer dials to look after, that is true, but on the other hand it is more difficult to separate stations lying close together in regard to wavelength, and the effect of bunched stations on the lower wavelengths is more difficult to overcome. Two dial control absolutely demands modern variable condensers of the straight-line-wavelength or straight-line-frequency type by which the stations are distributed over the dials with greater uniformity than with the old straight-line capacity type having simple semi-circular plates. Two dials are more easily moved together or "tracked" than three dials, but the tracking must be done more accurately.

With a single dial control still more accurate adjustment will be required for a given selectivity, for instead of coming in over five dial divisions as with the three dials, only one-third the number of divisions will now be available. Here, the necessity for uniform station distribution over the scale applies with triple force, and with approximately six stations to each of the 100 dial divisions, extreme care in adjustment is necessary. Each wavelength must be absolutely definite within less than one-sixth of a dial division if we expect to tune in each of the 600 or more broadcasting stations now licensed without the further correction of a second or third dial.

With less than three controls, highly selective tuning units are necessary to prevent the overlapping of signals lying within a few meters of each other. It is absolutely essential that the inductances be immune to external fields and influences and that they act only on the impulses received through the antenna system. Further, there should be some means of adjusting the sharpness of the tuning within the set so that it can be closely adjusted to meet local conditions. It should be fairly broad out in the country where there is little interference and should be capable of a considerable sharpening in districts where there are many strong local stations.

Now comes the counter argument that it is easier to make close sharp adjustments on one or two dials than it is to make fairly broad adjustments on three dials. Well, perhaps it is under certain conditions, but to my mind it is largely a matter of personal taste. It depends upon whether the individual prefers to make three rather broad adjustments or only one or two sharp and accurate adjustments. At first glance it would seem that the single dial system would be the ideal proposition, and so it would be if there were only 50 to 100 stations spread well over the length of the dial, but owing

(Turn to page 36)

Blueprints Explaining the Single and Dual Controls on pages 34, 35, 38 and 39

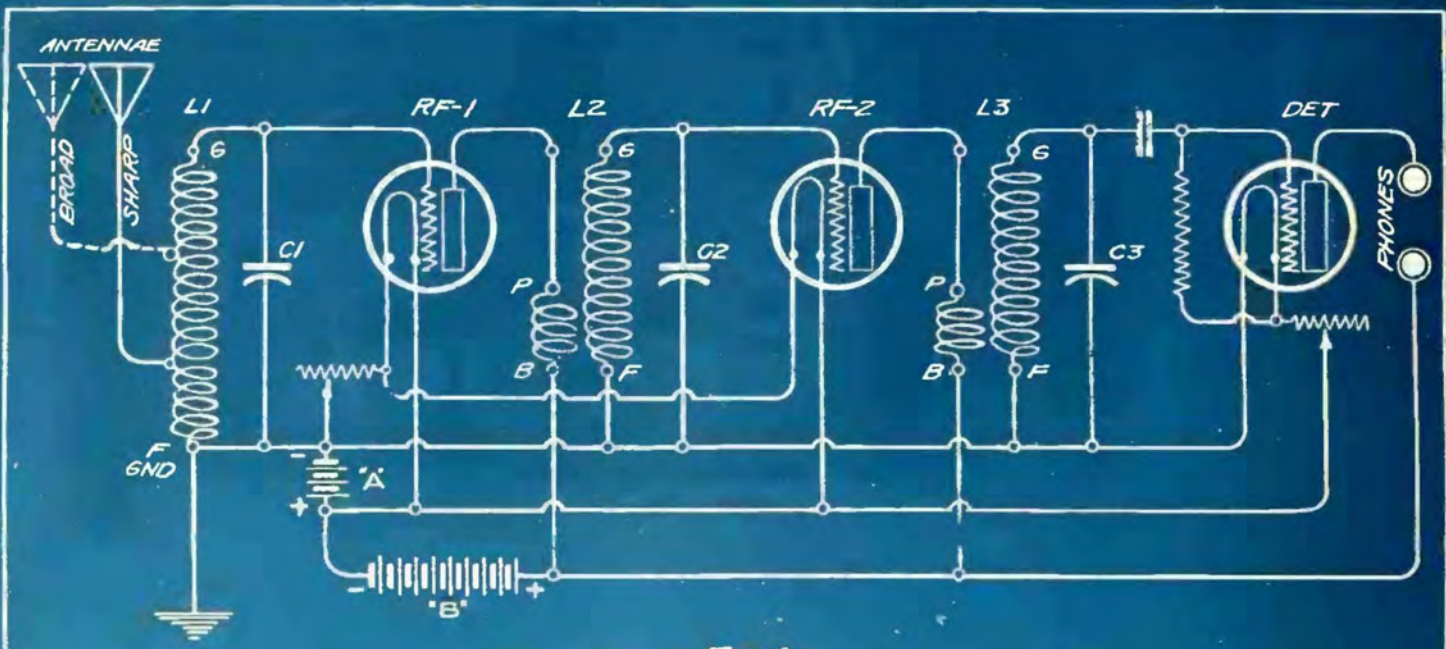


FIG. 1

TYPICAL RADIO FREQUENCY CIRCUIT DIAGRAM SHOWING TWO STAGES OF RADIO FREQUENCY AND DETECTOR TUBE.

FIG. 2

DIRECT CONDENSER GEARING SYSTEM WITH SINGLE DIAL CONTROL ON C2.

FIG. 3

REDUCTION GEARED CONDENSERS WITH A SINGLE 360 DEGREE DIAL CONTROL.

J.B. RATHBUN
RFT-1000

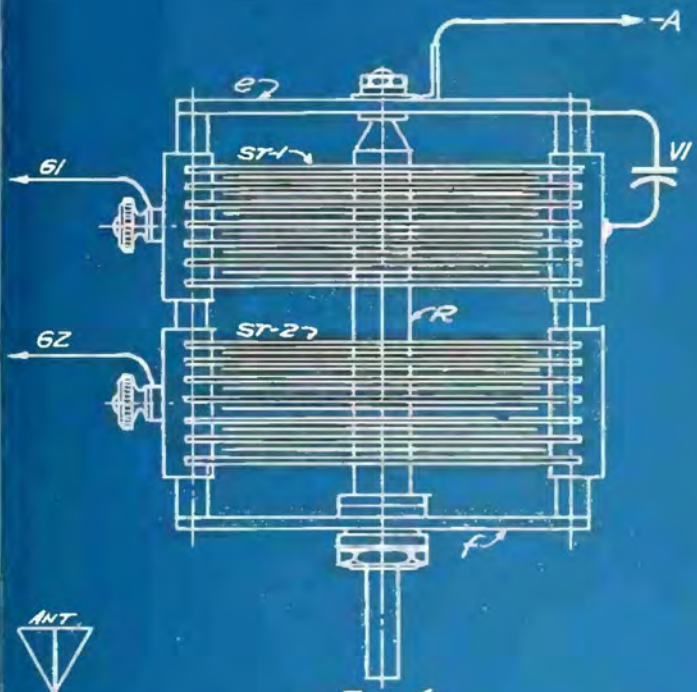


FIG. 4

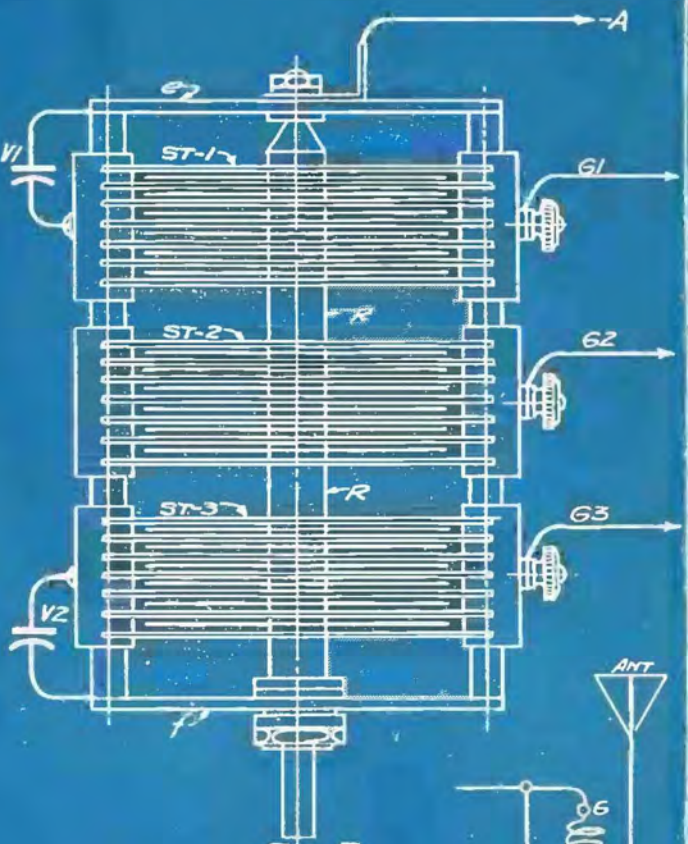


FIG. 5

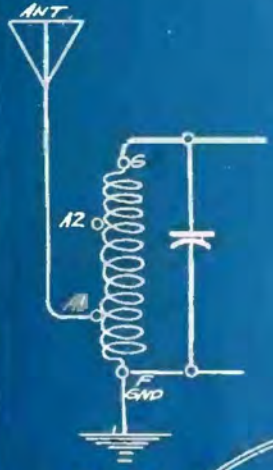


FIG. 6A

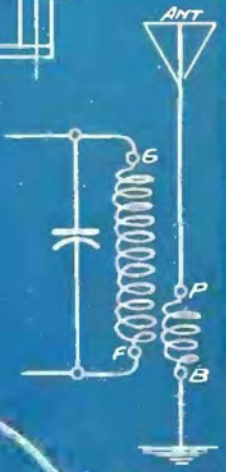


FIG 7A

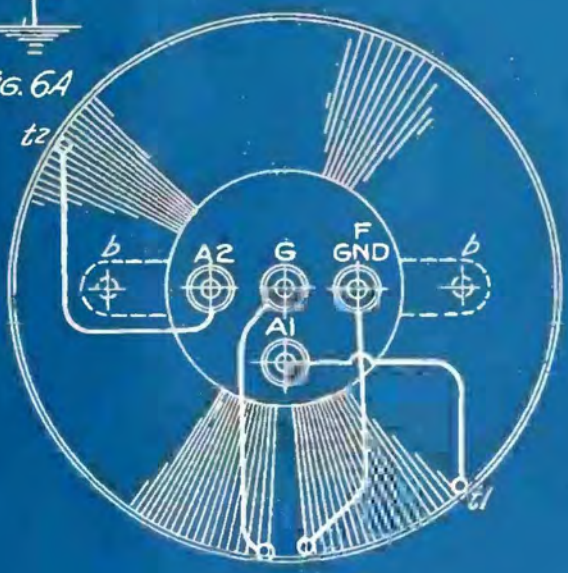


FIG. 6
COUPLER COIL

FIG. 7
TRANSFORMER COIL

J.B. RATHBUN
RFT-1000

(Continued from page 33)

to the present congestion this is far from being the case. Stations bunched at the ends of the dials, and varying only by ten kilocycles from one another, makes single dial adjustments rather difficult.

Tuned R. F. Circuits

BEFORE the various tuning methods can be taken up in detail, it will be advisable to examine the circuit diagram of a conventional two stage radio frequency circuit so that the conditions can be more fully understood. In Fig. 1 is shown the circuit of two tuned radio frequency stages and detector, the radio tubes being at (RF–1) and (RF–2) while the detector tube is at (DET). All three tubes are tuned accurately to wavelength by the three variable condensers (C1–C2–C3) connected across the secondary windings of the air-core radio frequency couplers or transformers (L1-L2-L3), and as shown in the diagram, these condenser adjustments may be individual or else they can all be adjusted at one time by means of certain mechanism about to be described.

It is important to note at this point that the (F) ends of the secondary coils are all connected to a common wire, the (–A) line and ground connection, and that all the rotors of the variable condensers are therefore also connected to this ground (–A) wire. The stators of the condensers are connected individually to the grids (G) of the three tubes. This makes "gang condenser" construction possible. A single rotor element can be used for all three stages meshing with three independent stator units, and all units can be used with one tuning dial attached to the rotor shaft.

One method of single dial tuning is to couple the rotors of the three variable condensers (C1–C2–C3) together mechanically by means of gear wheels at (G1–G2–G3) shown in Fig. 2. The electrical connections are made exactly as in Fig. 1, and one movement of the dial (D) mounted on the center shaft of condenser (C2) tunes all three stages simultaneously. While this does not simplify the tuning units to any extent, yet it does reduce the dial control to one operation and for this reason the arrangement has proved quite popular.

At (V1) and (V2) are two variable condensers of very small capacity used for balancing the condensers (C1) and (C3) so that all of the main condensers are of exactly the same capacity and so that they will all accurately "track" with one another at any given dial position. When once adjusted, the balancing or compensating condensers (V1) and (V2) need no further attention. This, or an equivalent method, must be used as the commercial variable condensers never have exactly the same characteristics when purchased on the open market, and it is imperative that they act in exact unison on the turning of the dial.

The gears (G1–G2–G3) are made of fiber or other non-conducting material, and are provided with a means of fastening them tightly to their respective condenser shafts without danger of slipping. The diameters depend upon the center-to-center distance between condensers, but in all cases the diameters and numbers of teeth must be the same on all gears. If there is a variation in the diameter or number of teeth, then the shafts will turn through different angles when the knob is turned and the set cannot be tuned in.

An improvement on the first gear arrangement is shown in Fig. 3 where the gears (G1–G2–G3) are fastened on the condenser shafts as before, but are connected together by small intermediate pinions (P1) and (P2). In the first place, the diameter of the gears is considerably reduced by this method, thus making it a simpler matter to mount the apparatus on the panel. Secondly, by making the diameter of pinion (P1) exactly half the diameter of the gears (G1–G2–G3), the dial (D) mounted on the shaft of (P1) will turn through 360° instead of through 180° and this will doubly spread out the stations and facilitate tuning.

It is evident that a full 360° turn will reduce the number of stations per dial division and thus will eliminate overlapping and will make the set correspondingly more selective and less critical. In effect it is really a vernier system with an increased active arc of dial, thus at least partly offsetting one of the bad features of single dial control. The small compensating adjustable condensers are at (V1) and (V2) as before, for balancing up unequalities in the main tuning elements. In case where a 180° dial is desired, it can be mounted on one of the condenser shafts as before so that it will turn at the same rate as the condenser plates.

Gang Condenser Control

GANG condensers consist of a single assembly made up of two or more electrically independent stators and a single rotor which meshes simultaneously with all of the stators with a single dial movement. The principle on which this system works was suggested in the paragraph dealing with the circuit diagram of Fig. 1 where it was stated that the rotors of all variable condensers are connected to the common (–A) line. The use of a single rotor greatly simplifies the construction, and in many cases takes up less space—at least panel space.

A "two-gang" condenser is shown by Fig. 4 where the two independent stator units (ST–1, ST–2) are carried by the frame (e–f), and where a single rotor on the shaft (R) meshes with both stator sections. The stators, are of course, insulated from one another and from the rotor. The rotor connection (–A) goes to the (–A) line and ground while the stator sections connect with the grids of two tubes at (G1) and (G2). If three tubes are to be controlled, then a second simple condenser is installed for the third tube; making two controls necessary. The panel space required is only that of a single condenser, but the assembly of course extends farther back into the cabinet than with a single condenser.

Fig. 5 shows a "three-gang" condenser with three independent stators (ST–1, ST–2, ST–3) and a single rotor (R). With this assembly it is possible to tune all three stages of the circuit of Fig. 1 by a single tuning dial mounted on the end of the rotor shaft. A condenser of this sort takes a panel space equal to that of a single condenser, but it is so long that it generally extends the full depth of the cabinet. However, this is not a serious objection as the tube sockets can be rearranged without trouble.

It will be noted that small compensating condensers (V1) and (V2) are connected between the rotor and stator plates in both cases for balancing the capacity of the stators as previously explained. One such compensator is used for the two gang condenser and two compensators (V1) and (V2) are employed on the three gang type. Usually, the compensating condensers consist of a pair of small adjustable leaves mounted directly on the condenser and built into it so that separate condensers are not needed for the purpose. As they need adjustment only once after the set is built, there is no necessity of mounting dials for the compensators on the front panel.

Self-Contained Field Coils

ANY air-core radio frequency coupler and transformer can be used in connection with the gang and geared condensers. It is possible to pack such coils into a very small space without back-feeding between stages.

A single circuit coupler is shown by Fig. 6. It consists of a single continuous winding which terminates at the posts (G) and (F) and is tapped at the points (t1) and (t2) for the connection of the antenna. The schematic diagram of the equivalent solenoid coil is shown by Fig. 6A which is lettered to correspond to the coupler drawing. This single circuit coupler is used for the antenna coupler as installed at (L1) in Fig. 1, and the two taps (A1) and (A2) provide for different degrees of sharpness or broadness in the tuning.

Approximately 200 turns of No. 24 D.S.C. wire, 1½" in diameter is used for making the coil. Tap (t1) for terminal (A1) is taken at the sixteenth turn, while tap (t2) for terminal (A2) is taken at the sixtieth turn. Some little experimenting will be required to balance up the coil properly in order to cover the band of broadcasting wavelengths ranging from 200 to 550 meters when used in connection with a 0.00035 mf. variable condenser, and for this reason it is better to purchase the coils than to attempt their manufacture at home. When a solenoid is bent into a toroidal form, it does not follow the same laws as it did when used as a straight solenoid.

Antenna connection (A1) gives extreme sharp tuning, for the coupler then acts like an auto-transformer with a high ratio between the virtual secondary and primary coils. Connecting the antenna to (A2) greatly broadens the tuning for use where there is not much local interference. In this way we can control the tuning values to suit local conditions.

A two circuit coil, consisting of an independent primary and secondary, is outlined in Fig. 7. This coil is used as a

radio frequency transformer as at (L2) and (L3) in Fig. 1 and its secondary coil is tuned by a 0.00035 mf. condenser as before. Roughly, the secondary consists of 160 turns of wire in the secondary and 40 turns in the primary, but this is subject to slight variations in the method of winding. As with the coupler coil, this is quite a trick to make at home, and it will be found much surer and will cost no more in the long run to purchase the coils ready made. This will eliminate much of the guesswork and the amateur deals with enough unknown quantities as it is. There are at least three standard makes of these coils now on the market and they can be obtained without difficulty from reliable dealers. A schematic diagram of the coil in solenoid form, is given by Fig. 7A which is lettered to correspond with Fig. 7.

Both the coupler and transformer are provided with a metal bracket (b) which at one time supports the coil from the condenser and makes a connection between the (G) end of the secondary coil and the stator plates of a low-loss condenser.

When used as a transformer, the plate of the preceeding tube is connected to the coil post (P), the coil post (G) connects with the grid of the following tube, the post (B) connects to the positive "B" (+B) 45 volt battery line, and post (F) connects with (–A) and ground.

Completely Assembled Set

THE completely assembled five-tube radio frequency set is a very com- arrangement adapted to a 7" x 18" panel, and an examination will show that hardly a cubic inch of space is wasted, yet the parts are easily accessible for wiring and for adjustment. In spite of the close packing of the parts into the limited space there is no trouble with feed-backs or other interchanges of energy between the inductances.

A conventional straight radio frequency circuit is employed in the receiver shown, the excellent results obtained being determined by the materials rather than upon any trick in the circuit itself, but of course any other circuit can be used that calls for the same equipment given in these specifications. There are two radio frequency stages, detector, and two audio frequency stages which give a high degree of selectivity and good distance on the loud speaker. When desired, the reflex principle can be employed with the equivalent of four stages of radio frequency and two stages of ausio amplification, but in view of the performance with the radio frequency circuit this is not necessary nor even desirable.

One single variable condenser (0.00035 mf.) is used to tune the antenna coupler, while a two-gang condenser shown at the left tunes both radio frequency transformer by a connection across the coil secondaries as indicated in Fig. 1. By this means we have only two wavelength tuning controls for the five tubes, a control system that is simple to understand and handle and yet is not excessively sharp nor critical. A single dial control with a three-gang condenser is so long that it interferes seriously with the layout scheme determined upon for the sockets, and is not so easy to handle as the circuit arrangement finally adopted.

All five tube sockets are mounted in a row on a strip of bakelike that serves as a sub-panel and the sub-panel in turn is connected by metal end brackets to the front panel so that no wood sub-base is necessary. However, it is not absolutely necessary to follow this exact construction and the standard form of wood bottom board can be used if desired. In the photograph, the audio transformers are placed out of the way beneath the sub-base where they also act as supports for the thin strip of bakelite, and holes drilled in the sub-panel allow the transformer binding posts to pass through for support and electrical connection.

Special attention is called to the gang-condenser at the left and its connection to the two transformers. The transformers are connected to the gang-condenser and supported by it through thin metal strips bent up to form brackets as well as electrical conductors. These three parts are then assembled in one unit before the condenser is attached to the front panel, making the wiring a very simple matter as all of the wiring connections are then few and in the open.

Circuit Diagram

A pictorial wiring diagram of the receiver is shown by Fig. 9. This circuit is a simple, five-tube radio-frequency layout without an attempt at regeneration, reflexing or other diversion from standard practice, the high efficiency of the coils making it unnecessary to use other than a standard circuit. A potentiometer (PO) used for controlling the grid potential of the first radio frequency tube is the only control outside of the wavelength controls affected by the three variable condensers, and the potentiometer is used to clarify reception and to vary the volume rather than to control free oscillations.

To simplify the filament controls, a somewhat novel arrangement of the control resistances has been adopted. Only one rheostat (R1) is installed and that rheostat controls the radio-frequency tube current. The filament current for the detector tube (DET) and the two audio frequency amplifying tubes marked (AUD–1) and (AUD–2) are controlled automatically by three (R2–R3–R4) Amperites and therefore need no attention while tuning-in. It has been found by experiment that the detector tube is not in the least critical to rheostatic control in this circuit and therefor can be controlled by a fixed resistance (R2) as well as by the detector rheostat commonly used in other circuits. The battery cutout switch (SW) opens and closes the "A" battery circuit and must be installed as there is no other method available for shutting down the detector and two audio tubes.

Looking at the coils, it will be seen that the antenna coupler (L1) is of the single circuit type illustrated by Fig. 6 and carries the two corresponding antenna taps (A1) and (A2) for sharp and broad tuning respectively. The posts are connected to the terminals (ANT–1) and (ANT–2) on the left end of the sub-panel where the proper antenna connection can be found by experiment.

Dotted lines (a–b) drawn to all of the coils represent the metal bracket connection made from the (G) post to the stator of the variable condensers, these brackets at once affording a connection and support for the coils. The connection from the (–F) post on the coils to the grounded condenser rotor is made by a strand of rubber covered flexible wire in all cases. This completes the connections made to the 0.00035 mf. variable condensers, and it should be noted that the stator posts are marked (s) and the rotor posts of the condensers are marked (r) to prevent confusion when other makes of condensers are installed. There is a different in the method of bringing out the condenser connection posts in different makes of condensers and this is likely to lead to confusion if not watched carefully.

A 0.00025 mf. grid condenser (GC) and a 2 megohm leak (GL) will be found most suitable for the detector tube. The fixed condensers used as radio frequency bypasses, and marked (K1, K2, K3, etc.) are clearly marked with their capacities and call for no comment except for the 0.005 mf. fixed condenser (K1) used as a bypass for the potentiometer. It should be noted that (K1) is connected at one end to the center post of the potentiometer (PO), and at the other end to the (–A) line, when a wire wound potentiometer is used. With the carbon pilet ype, or pencil mark type of potentiometer this bypass condenser can be eliminated as such potentiometers have little or no inductance and therefore do not affect the tuning when the potentiometer knob is turned.

For the clearest and most satisfactory reception, the audio frequency transformers (AFT–1) and (AFT–2) should have a ratio of 3.5-to-1 or 4-to-1. Higher ratios may give a somewhat greater amplification and volume but they may also cause noise and distortion.

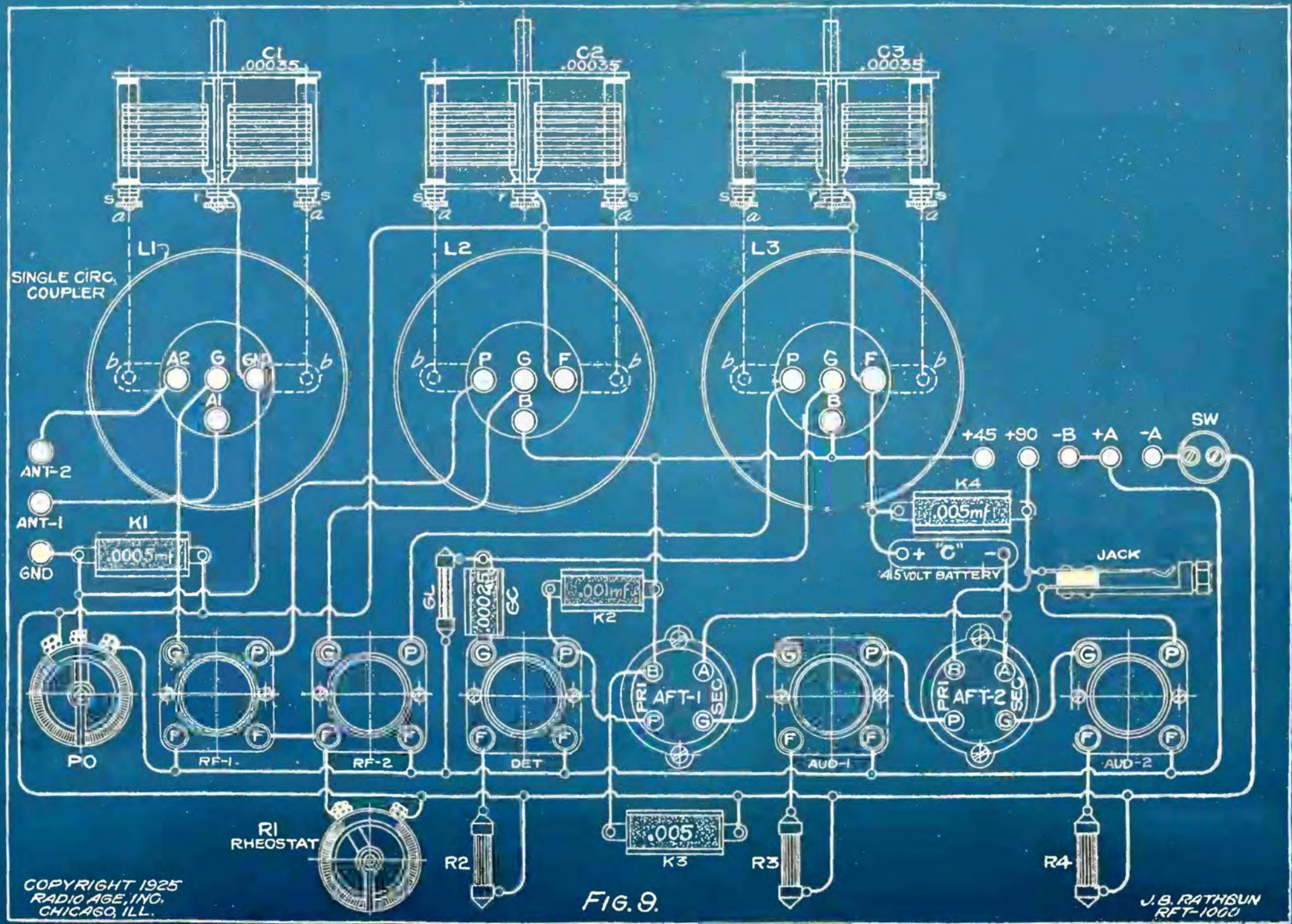
Wiring Notes

Wiring will be much simplified by the use of small rubber covered flexible wire instead of the more usual square buswire. Not so much care is necessary in arranging the runs of the wire to avoid short circuits, the difficulties of soldering in close corners is done away with, and the apparatus can be arranged to a better advantage if it is not limited by considerations of wiring. The distance between the binding posts is measured, allowing a little slack in the rubber cover flexible wire, and then after cutting to length, the ends are skinned and connection lugs or eyelets are soldered to the ends of the wire. As this soldering can be done on the bench or table, and afterwards connected in place, it is an exceeding convenient method.

Assembly Drawing

Fig. 10 is a plan view of the assembled parts drawn to scale. It will be of service in laying out the work although the exact dimensions may vary from those

(Turn to page 40)


C1 .00035
C2 .00035
C3 .00035
L1
L2
L3
SINGLE CIRC. COUPLER
A2
G
GND
A1
P
G
F
B
ANT-2
ANT-1
GND
K1
.0005mf
.00025
GL
GC
.001mf
K2
K4
.005mf
+45
+90
-B
+A
-A
SW
+ "C" -
4.5 VOLT BATTERY
JACK
PRI
SEC
AFT-1
AFT-2
PO
RF-1
RF-2
DET
AUD-1
AUD-2
R1
RHEOSTAT
R2
.005
K3
R3
R4
COPYRIGHT 1925
RADIO AGE, INC.
CHICAGO, ILL.
FIG. 9.
J.B. RATHBUN
RFT-1000

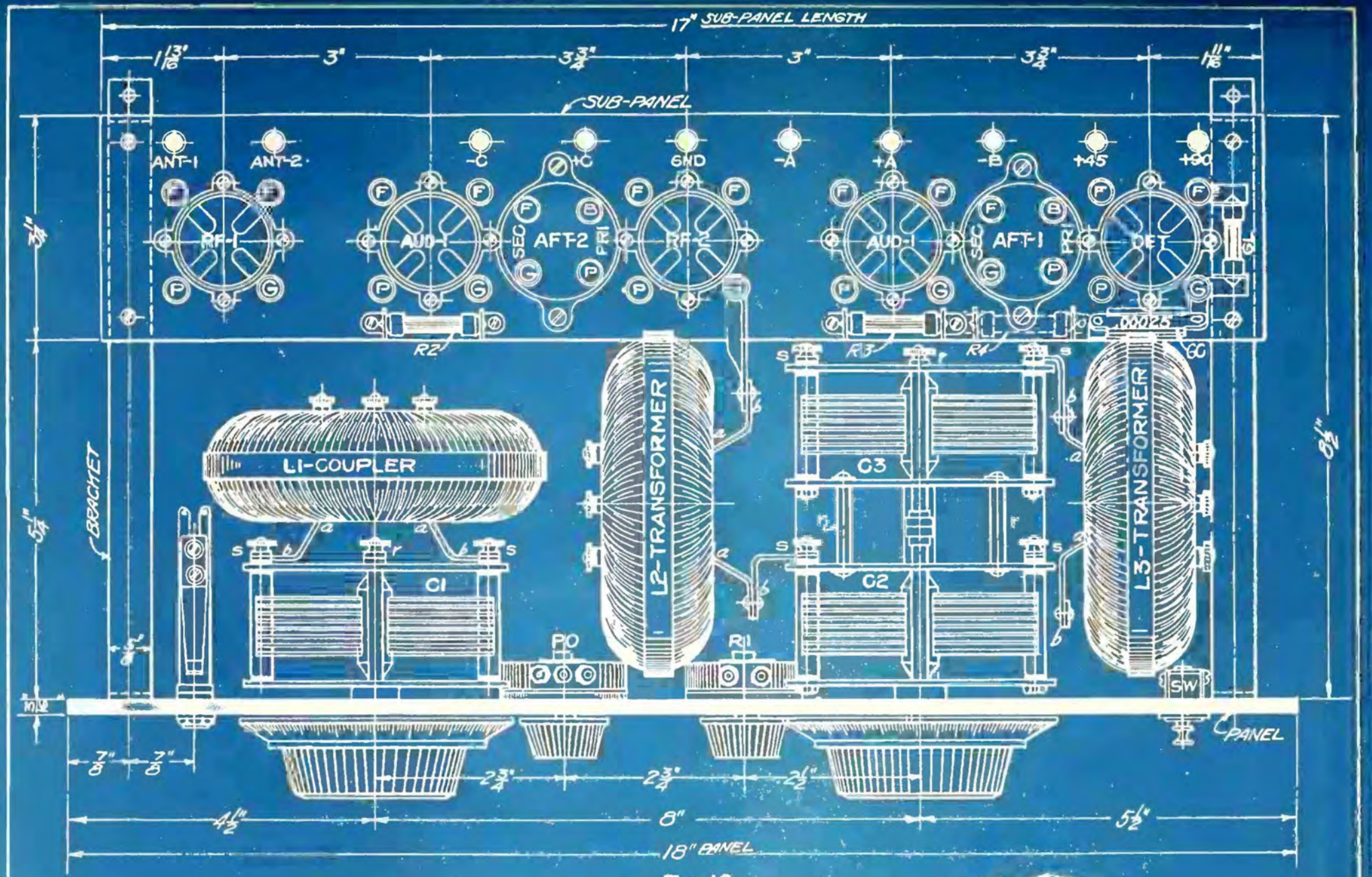


FIG. 10.

PLAN OF ASSEMBLY (B)
SHOWING LOCATION OF PRINCIPAL ELEMENTS OF CIRCUIT IN PLACE. TUBES ON REAR SUB-PANEL.

FIG. 10A

J.B. RATHBUN
RFT-1000

(Continued from page 37)

shown on the drawing owing to the differences in the various makes of apparatus. The circuit shown is assembled on a 7" x 18" standard panel and requires a cabinet at least 8½ inches in depth. To avoid confusion, no wiring is shown on this layout—simply the apparatus, panels and supports.

At points where metal brackets are used for the support and connection of the coils, these brackets are marked (b) so that they can be distinguished from the apparatus. The brackets can be made easily from No. 24 to No. 26 gauge sheet brass, the strips being from ⅜ inch to ½ inch wide according to the apparatus used. In any case, the brackets must be heavy and stiff enough to afford a firm support that will not vibrate when the set is being handled.

Compensating Condensers

The purpose of the very small compensating condensers used for balancing the stators of the gang-condensers has already been described, and one of the condensers is shown at (V1) in Figs. 9, 10. Usually a small neutralizing condenser is sufficient for this purpose or one of the "Midget" variable condensers having a maximum capacity of about 0.000045 mf. If either of these condensers is not available, then a home made condenser can be made by using two strips of brass with a sheet of mica between them.

This homemade condenser is of the "book" type as illustrated by Fig. 10–A. The brass strips (p–q) are approximately ¾ inch wide and 1½ inch long, and are fastened firmly to the sub-panel at one end with the strip of mica between them. The upper brass strip (p) overhangs the rest of the assembly so as to carry the adjusting screw (m) by which the capacity can be adjusted. The upper strip (p) is given a curvature before assembly so that it normally tends to stand away from the other strip (p). By turning down the adjusting screw (m), the capacity can be increased gradually until the two stator units are of equal capacity.

Radio Advances Cause of a Universal Language

NEW YORK.—Educators should be vitally concerned—and probably are giving the matter intensive study—in the announcements of super-power broadcasting stations that are in contemplation and some actually under way at the 50 kilowatt rating, in the opinion of U. J. Herrmann, managing director of the Radio World's Fair. An International language is likely to become a necessity within a very few years, Mr. Herrmann believes, when transoceanic transmission of musical and oratorical programs will be regular features to delight people of many nations.

"A determination of what this international language will be must now be arrived at," contends Mr. Herrmann. "Realizing this, advocates of ILO and Esperanto are debating the question more emphatically than ever. Of course, English now encircles the globe, as the language of trade and increasing use in diplomacy, and there are strong reasons why it should be adopted as the universal tongue."

This universal language situation will be discussed in the forum that will be a feature of the Radio World's Fair, during the week of September 14th-19th, when leading educators will be guests of the management, along with students from a hundred schools and colleges.

Clay Irwin, pioneer in radio industrial promotion, advertising and general publicity, has been appointed associate director of the Radio World's Fair, succeeding the late James F. Kerr, who died last June. Announcement of this important news to the radio trade and to broadcast listeners was made this week by U. J. Herrmann, managing director, who has just returned from the Far North and the MacMillan Expedition to expedite the elaborate preparations that are being made to make the Second Radio World's Fair a record breaker in the number of exhibits and in attend-and as well as for special features of public interest.

The First Radio World's Fair was so large that it required Madison Square Garden and the Sixty-ninth Regiment Armory to house it; the second, scheduled for September 14th to 19th, 1925, will require the facilities of the largest hall in the world, the 258th Field Artillery Armory, five times as large as Madison Square Garden. In itself, this is a significant manifestation of the tremendous development of radio.

Mr. Irwin has been a familiar figure at radio expositions throughout the country and is known to the leaders of the industry, not only from a merchandising standpoint but as a writer. He has been an enthusiastic "fan" since radio broadcasting started.

Mr. Irwin started the radio section of the Brooklyn Eagle in April, 1924, became manager of the entire radio department in September, 1924, and started broadcasting through a special studio in the Eagle Building shortly thereafter in connection with Station WAHG. These programs became well known throughout the United States and Canada. He resigned to become special representative of the Conde Nast Publishing Company in the establishment of a radio department in the advertising end of their business. In such capacity he participated in many merchandising conferences to upbuild the new giant industry of radio.

Broadcasting to MacMillan from Chicago

Every Wednesday at midnight an unusual radio program has been broadcast from Station WGN on the Drake Hotel, Chicago, to the MacMillan Arctic Expedition. The programs began on the day that Lt. Comm. MacMillan sailed from Boston, June 17, Bunker Hill Day, and will be continued until the return of his Arctic Exploring Expedition late in September. Commander MacMillan made special request before sailing for the Arctic that his old friend and college fraternity brother, the Reverend Gardner MacWhorter of Chicago, should again render the service of weekly communication from home that he gave during the MacMillan Expedition of 1923-24 from the Zenith-Edgewater Beach station WJAZ.

The new Zenith broadcasting station WJAZ located at Mount Prospect, Illinois, some twenty odd miles out of Chicago, with the handsome Spanish renaissance studio on the twenty-third floor of the new Straus Building, at Michigan and Jackson Boulevards, Chicago, was not completed in time to carry on this unique broadcasting feature, and WGN was placed at the disposal of the Reverend Gardner MacWhorter during June and July in order that the weekly midnight programs might be given. At an early date the new station WJAZ will be opened and then the familiar call: "This is 9 XN calling WNP" will again be heard until the return of the MacMillan Expedition. (9 XN is the experimental call letters of WJAZ Station and WNP is Wireless North Pole, the Zenith station on board Commander MacMillan's private Arctic schooner "Bowdoin" now on her third expedition into the Arctic.)

The MacMillan programs are sent at midnight central standard time and are usually of an hour or an hour and a half duration, consisting of several numbers of music given by friends who have volunteered for this personal service to Commander MacMillan, then a short address by some close friend of Commander MacMillan who has usually come from a distance to speak to the Commander, and the rest of the time is given over to the reading by the Reverend Gardner MacWhorter of personal messages from relatives of the men in the Arctic expedition's personnel, a comprehensive news digest of the world's events of greatest interest to the explorers, and an occasional humorous incident that may provoke a little laughter in the cabin of the "Bowdoin" or the S. S. "Peary," the sister ship of the "Bowdoin," under command of Lieut. Comm. Eugene F. McDonald, Jr.

During the past two months many distinguished guests have taken part in the MacMillan programs from Chicago, including: Dean Paul Nixon of Bowdoin College, Maine, Commander MacMillan's Alma Mater; U. J. Herrmann, proprietor of the Cort Theatre, Chicago, manager of the New York and Chicago "Radio World's Fairs;" Mr. and Mrs. Frederick H. Rawson of Chicago, parents of Kenneth Rawson, fourteen year old Cabin-boy of the "Bowdoin"; Mr. and Mrs. Elliott Jenkins, (Mrs. Jenkins being the former Alexandra Carlisle who placed Calvin Coolidge in nomination for the Presidency of the United States at the Republican National Convention in Chicago in 1920); S. I. Marks, treasurer of the Zenith Radio Corporation; H. H. Roemer also of the Zenith Radio Corporation; Jack Gregson, president of the Chicago Bowdoin College alumni; F. W. Thurnau, J. W. Cook, and H. F. Juckett, officers of the Theta Delta Chi fraternity, of which Comm. MacMillan is a member.

The Wise Old Man

(Continued from page 20)

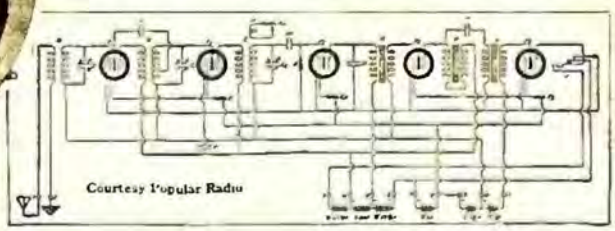
He jumped to his feet and rubbed his hand across his eyes. His pipe was on the floor and the rain was pouring in the open window and the lightning was flashing. He looked towards his friend but he had disappeared as mysteriously as he had appeared and gazing at the clock on the table it told Billie that it was four o'clock in the morning. He had been asleep four hours and the thunderstorm was now a reality.

Tuned Radio Frequency Kit
$12.00
Complete with Brackets

The complete Low Loss Inductance System, comprising two tuned circuit transformers and an antennae coupler with a uniquely constructed variable primary for governing the selectivity of the antennae circuit.

NOW—All the world can have it!

The sensational favor which Chicago and New York showered upon the AERO COIL has prompted its designers to make it available to every fan in the Nation. Vigorous plans are, therefore, under way to place the Aero Coil where every city and village can see it and witness its markedly superior performance.



Declared by Chicago and New York the most SELECTIVE, *most* POWERFUL *Inductance Ever Designed!*

Enjoy the *"knife-edge" selectivity* with which Aero Coils cut through the tangled mass of Chicago and New York broadcasting *at will!* Enjoy the *uncanny sensitivity* with which sets built of Aero Coils pick up the far off, small, low-wattage stations that you never thought existed! Be thrilled by the *amazing volume* with which Aero Coils amplify for the loud speaker, reception which you have always had to listen to on the head phones! Build a 5-Tube Tuned Radio Frequency Set with Aero Coils . . . . . the true low loss inductance system.

PATENTS PROTECT ITS SUPER-EFFICIENCY

Its *lower* circuit resistance, its *lower* high frequency resistance, its *lower* distributed capacity, and the fact that its dielectric is 95% air are the reasons why the Aero Coil tunes so sharply into resonance—and why it actually uses the energy which other types of inductances waste. Hence, Aero Coil is the inductance of today—and tomorrow, and you can be assured that it is—for the construction which makes it the *ideal* inductance is patented, and no inductance can be made so good as Aero Coil unless in violation of these patents!

95% Air dielectric —No dope on windings — All turns air-spaced—Solenoid (cylindrical) windings —Variable primary

Engineers recognize cylindrical winding to be superior to any other. The Aero Coil is the only Air dielectric cylindrical inductance with a variable primary. Aero Coil patents prevent imitation.

Build Your Set Now!

The construction which makes possible the far superior results obtained from Aero Coils also makes them cost a bit more—but, performance considered, their price is low. $12.00 for a set of three, complete with nickel plated mounting brackets which fit any condenser. Go to your dealer's today and obtain a set of three. A circular containing complete hookups for building the most selective, most sensitive, most powerful five-tube receivers ever designed is enclosed in each package.

If your dealer has not yet obtained his stock of Aero Coils, order direct, enclosing price with your order.

Free Booklet showing new circuits and giving full constructional information of help to any fan or set builder—mailed on request. Write for the Aero Booklet.

AERO PRODUCTS, Inc.
217 North Desplaines Street, Chicago, Illinois
Successors to
HENNINGER RADIO MFG. CO.

AERO COIL

All Aero Coils embrace a patent-protected method of construction which makes possible a far more efficient inductance performance than is possible with any other type of coil.

Use AERO COILS

Wherever An Inductance Is Required

[THE ONLY AIR DIELECTRIC COILS HAVING VARIABLE PRIMARIES IN ANTENNAE CIRCUITS]

The Aero Coil 3-Circuit Tuner

Another adaptation of the patented protected Aero Coil construction and for that reason the most efficient three-circuit tuner ever offered. More than covers the broadcast wave band when shunted with a good .0005 condenser. This is the tuner which in a 3-tube set brought in Havana, Cuba, in the day-time in Chicago. Price..... **$8.00**

The Aero Coil Radio Frequency Regenerative Kit

Consists of one AERO COIL 3-Circuit Tuner and one AERO COIL Antennae Coupling Transformer. Makes the most powerful, most selective 4-tube, non-radiating set possible to build. Price **$11.00**

The Aero Coil Wave Trap Unit

Also for Crystal Sets

By reason of the characteristics made possible by the Aero Coil construction, this unit makes a very efficient wave trap or crystal set. Price **$4.00**

The Aero Coil Oscillator for Super Heterodynes

The characteristics achieved through the use of the Aero Coil principle make of this instrument the ready means to tremendously increase the efficiency of the oscillator circuit in any Super Heterodyne receiver. Pr. **$6.50**

Prepared by KIRTLAND-ENGEL ADVERTISING COMPANY - CHICAGO

* *Tested and Approved by* RADIO AGE *

Hoover Will Call Conference This Fall

Secretary of Commerce Hoover will call a national radio conference here this fall, he announced on his return to Washington last month. Although he has not had time to set a date or draw up a program, he feels that a conference is necessary once a year and believes the three already held have benefited the department in its work. They have also demonstrated the willingness of the fans, manufacturers, broadcasters, amateurs and other interests to cooperate in keeping the air as clear and clean as possible.

The conference will be called in October or November, it is now believed, partly because of the many other problems confronting the Commerce head, and in order to give the Department Radio Officials and the representatives of the industry time to draw up plans and suggestions to be considered by the general conference.

Officials of the Department believe one of the most interesting questions to be discussed will be the limitation of power, or perhaps the removal of the power limitations now in force, if public sentiment backed by experiments now going on indicate that there is no reason for limiting the power of broadcasting stations.

Forty-two broadcasting stations are now using 1,000 or more watts; seven of them are operating with at least 5KW, a once dreaded figure, although no serious complaints have been received since these broadcasters went on the air. Two stations are now experimenting with, or about to try, 50 KW. WGY's tests seem to have been satisfactory, and it is said that WJZ, the Radio Corporation's new high-power project located outside of New York, will soon start testing its new 50 KW set. Other stations are preparing to try out broadcasting with 5KW or more. It is estimated that at least twenty B stations are equipped to go to 5KW, although only eight have been licensed to do so at this writing.

Whether or not the recent increase in power will continue to spread over the country is not known; neither is it definitely known how far apart very high-powered stations must be located to prevent undue interference, or how great a separation there must be between the wave lengths they employ.

If a large number of the present stations went to high power, regardless of their proximity to each other or the relationship of their broadcasting channels, there would probably be difficulty in separating them. It may be found desirable to locate the very high-powered stations in distant states or perhaps a hundred or two miles apart, assigning them wave lengths separated by fifty meters or more. This would of course tend to limit the number of such stations, but this will probably adjust itself. There will not be many operators rich enough to build and maintain 50 KW stations, which cost almost a half million dollars to install.

Nevertheless, the views of the public will be sought, as well as those of the broadcasters, before any definite or limiting action on power is taken by the Department. It may be necessary to have the old radio regulations and even the laws amended, and it is understood that the Department will probably have a tentative radio law in shape for discussion by the time the conference convenes.

Secretary Hoover is a great believer in radio as a public service and he is also disposed to let the public in on any hearing which will affect such a public service —hence the Fall conference is a certainty.

Professional Set Builders Organize

Custom-built receivers are to be promoted on an extensive scale if plans of the newly organized Professional Radio Set Builders Association are carried through. This organization elected officers on July 24th, at its first meeting held in the offices of the Allen D. Cardwell Mfg. Corp'n, in Brooklyn.

Despite the dullness of the Summer season, unusual interest was displayed in getting the new body under way. Plans involve newspaper advertising, a testing laboratory, publicity bureau, and a general organization to benefit the dealers and professional men who build sets to order, some of the members sell as many as a thousand sets a season, others only a few.

The association particularly is endeavoring to counteract the tendency of the non-technical public to buy inferior apparatus offered at prices inconsistent with good design and service. It hopes to educate the public to accept radio sets which afford more service though costing more initially.

Officers of the association have been elected with headquarters at 71-73 West Broadway, New York City. A membership committee was appointed to run up the list of active supporters and to start organizing local chapters of the association in cities all over the United States. It is planned eventually to standardize the conditions of membership so that the public are guaranteed service and satisfaction on any sets turned out by members of the association.

A number of manufacturers of high grade radio apparatus have endorsed the ideals of the association and are contributing to its support.

Pick-ups and Hook-ups by our Readers

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.

Conducted by Fred Hill

REPRESENTING southern reception, Robert Barbee, 6114 Caddo Ave., Cedar Grove, La., submits a list of stations picked up on a factory built set, the list ranging from the East to the West coast.

Interesting daylight reception is reported by Robert C. Potter, R. R. 3, Beamsville, Ont., Canada, who is already a member of the Dial Twisters. He has picked up 47 stations in all on a crystal set. His daylight list includes several Canadians and WBZ, WGY, KDKA, WEAR, WTAM and WMAK, all of which makes an excellent record for some of our crystal gazers in the States to attempt to beat.

H. Predosa, 2864 Lincoln Ave., Chicago, Ill., writes as follows: "Received your answer in regard to the three tube neutrodyne and want to congratulate you on your promptness. The reason for this is that one time I wrote to the ——— Magazine for a little information and had to wait two months for a reply, and the nature of the question was similar to the one I wrote you." All of which more or less confirms our opinion that when a fan writes in, he desires an answer. The staff has made it a point to answer all questions just as quickly as it is possible to do so.

Our genial English informant, R. A. Ganatt, 17 Lorne Road, Stroud Green N. 4, England, who furnished us with a bit of gossip from his side of the Atlantic in the August issue, gives us some more data of interest to our radio fans who have a flair for radio's international scope:

British tubes at last are being made with the standard four prong base similar to the type to which the American listeners are accustomed.

Glass panels instead of bakelite are now the thing in France and Britain. (Oh, the weary hours of drilling!)

Croydon Aerodrome, near London, call GED, uses a wavelength of 900 meters. (Not much chance for the Americans to log him, on account of the upper limits of most sets being 550 meters. However, there is some chance for the dyed-in-the-wool experimenters with separate coils for the different bands.

"Secret Wireless, Ltd.," is the name of a newly organized company in England contemplating broadcasting to a paying audience who use special adapters for the broadcast. It is expected that theater broadcasts will be furnished patrons of the company. (It may work over there, but where's the kick in having your stuff piped nto the house like gas or water? Eh wot?)

Ganatt says in the majority of cases where two way communication between England and America has been accomplished by amateurs, such work has been done by the English amateurs living in suburban districts and not in cities like London and Manchester, where there is the worst shielding imaginable. (Some of our friends in England should try Chicago's Loop district for transmission. It's like transmitting underground.)

J. Robert Chandler, Arcade Box 1004, Los Angeles, Calif., tells us: "I have read your RADIO AGE for July from cover to cover and get more real radio news than from any magazine for a long time; and I read most of the magazines. In regard to the best type of set, I believe if I lived in a big city a regenerative set would do for me; if in the country a 5 tube r. f. set and if real far away a super-het." The DX list accompanying the letter entitles Mr. Chandler to the DT emblem.

B. Odell, 270 Odgen St., Orange, N. J., says he is quite pleased with the 8 tube super he built from the description by Calcaterra in the May number of RADIO AGE.

O. L. Overton, Station G, Memphis, Tenn., sends in his idea of a "go-getter"

CONTRIBUTORS

Name	Address	City
Walton Van Winkle, Jr.	2528 Benvenue Ave.	Berkeley, Calif.
Arol Schmidt	484 40th St.	Milwaukee, Wis.

DIAL TWISTERS

Albert W. Small	1210 12th St., N. W.	Washington, D. C.
Robert Barbee	6114 Caddo Ave.	Cedar Grove, La.
Vialis F. Walz		Glen Haven, Wis.
Chas. W. Justus	2072 Greenwood Ave.	Toledo, Ohio
George Wistow	95 Leslie St.	Toronto, Ont. Can.
J. P. Morrison, Jr.	1711 South Peoria	Tulsa, Okla.
Joseph H. Miller	217 Pearl St.	Brooklyn, N. Y.
Winston Klontz		Mt. Morris, Ill.
C. C. Schlegel		Kenesaw, Nebr.
J. D. Johnston	U. S. S. Denver	New York, N. Y.
Bertram Susdorf		Rantoul, Ill.
John W. Wilson, Jr.	1764 Gilpin St.	Denver, Colo.
Willis Stratton	R. F. D. Route 1	Canandaigau, N. Y.
J. M. Landon	113 Scoville Way	N. S. Pittsburgh, Pa.
Harold Huffman	Box 4, Van Dyke P. O.	Van Dyke, Mich.
Chas. E. Ross	Elgin State Hosp.	Elgin, Ill.
Fred C. Favre		Cressville, N. J.
George Tucker	1257 Benitean Ave.	Detroit, Mich.
Ramon Quesada	36 Angeles St.	Havana, Cuba
V. Alcock	Lynton Green Lanes, Palmers Green	London, Eng.
John Skewis	1731 Beaufalt Ave.	Detroit, Mich.
Okey Deem	1716 East 7th St.	Parkersburg, W. Va.
G. M. Hewson	Drawer 705	Drumheller, Alta., Can.
Elmer H. Glafke	202 Rumely St.	LaPorte, Ind.
F. McGarr		Binghamton, N. Y.
Ray Masterson	744 Greene St.	Marietta, Ohio
T. C. J. Dixon	1913 Decatur St.	Houston, Tex.
Willie R. Jones	1249 Wood St.	Shreveport, La.
Mrs. Frank A. Duston	Box 424	St. Stephen N. B., Can.
G. V. Skal	Ober Schreiberhau	Rsgb., Germany
R. F. Cochrane	1303 Main St.	Moncton, N. B., Can.
Elmer Hopper		Paris, Tex.

Fig. I. The picture above shows Herbert Hiley, of the British station G21H, situated at Keighley, Yorkshire, who has been successful in establishing communication with M. Fresni, Rua Aswaldo Cruz, Nieteroky, Brazil, a distance of 5400 miles with a wavelength of 42 meters and 15 watts in the antenna, the circuit used being a Hartley loose coupled. Mr. Hiley is shown logging a station. The photograph is by courtesy of G. Crowther, 28 Cark Road, Keighley, England.

set which is a variant of the well known Weagant, single circuited. He reports excellent results with it, as many other fans have.

Vialis F. Walz, Glen Haven, Wis., found the ultra-audion circuit in our "Radio Rodeo" in August and has been having great luck with it. The panel was three ply board; it was hooked up with bell wire and no soldering done. After getting a nifty bunch of stations, Mr. Walz intends making the set over in permanent form for use in chasing DX stations. The ability of the ultra-audion to transmit signals with a microphone in the ground lead depends entirely upon the antenna, ground and the amount of power which the tube will handle. Of course, to do any transmitting it will be necessary to have a transmitting license from the U. S. Department of Commerce. Application for such may be made to Mr. E. A. Beane, Radio Supervisor, Ninth Radio Disgrict, Federal Bldg., Chicago, Ill. The above information is given for Mr. Walz and the host of others who have written in asking regarding the use of a microphone in the ground lead. Primarily the set would be only a very short range transmitter.

Charles W. Justus, 2072 Greenwood Ave., Toledo, Ohio, remarks that the coast to coast set which was published in the March issue should be included in the blueprint section which this magazine maintains each month. He feels that such good hookups should be shown in the prints. Maybe some of our readers feel that way, too. Let's see what they have to say.

George Wistow, 95 Leslie St., Toronto, Ont., Canada, must have an adding machine running hot, for he reports hearing 265 stations within a span of eight nights, the list showing an average of something like thirty stations a night.

For the benefit of our transmitting fans and our general readers, we are running in this section a picture of the station of Herbert Hiley, British G21H, located at Keighley, Yorkshire, who has been successful in establishing communication with M. Fresni, Rua Aswaldo Cruz, Nieteroky, Brazil. The distance in this case was 5400 miles. The wave used was 42 meters and the power, 15 watts, output. The circuit used was a Hartley loose-coupled.

Using a regenerative set with transformer and resistance coupled audio amplification, Walter Van Winkle, Jr., 2528 Benvenue Ave., Berkeley, Calif., whiles away the hours logging the two coasts, despite the presnce of about fifteen locals in the Bay counties. The resistance coupled amplification and the push-pull arrangement has been touched upon previously by Mr. Rathbun in the September blueprints.

J. P. Morrison, Jr., 1711 South Peoria, Tulsa, Okla., sends us an excellent list of stations heard during the Summer. He is a recent convert to RADIO AGE and thinks ours the best magazine catering to the broadcast listener.

Joseph H. Miller, 217 Pearl St., Brooklyn, N. Y., working through local interference, has a commendable list showing a great deal of perseverance. The circuit is a three circuit type with only one tube. Before the single tuber came into being, Mr. Miller was a confirmed crystal fan. In addition to the broadcasting stations, a number of "hams" are included in the list.

Using a single tuber, Winston Klontz, Mt. Morris, Ill., furnishes a worthy list of radio reception, taking in the two coasts and Canada.

C. G. Schlegel, of Kenesaw, Neb., asks us to give some of the superdyne circuits, believing that our August number catered principally to the newly initiated instead of the dyed-in-the-wool experimenter. The circuit to which he refers is not so much a circuit as it is a trade name.

Writing from the U. S. S. Denver, care Postmaster, New York, N. Y., J. D. Johnston relates his experiences with radio, beginning with a crystal set and thence via the usual route to a three tube regenerative, a five tube neutrodyne and finally the super-het, using the modulation principle instead of the conventional double detection.

Attesting the popularity of the one tube regenerative, we have John W. Wilson, Jr., of 1764 Gilpin St., Denver, Col., sending in his application for the DT honors. We often wonder if the possessor of a five tube set or even a super ever really gets the thrill out of the game that he did when he first listened on a pair of "cans" to a weakling signal from a distant broadcaster.

Being anxious to hear what is transpiring on the lower wave bands, Bertrand Susdorf, of Rantoul, Ill., rigged up a short waver and picks up KDKA, WGY and an occasional other station in the region below 100 meters. In addition he has a three circuit set used for the standard broadcast band.

Over two hundred American broadcasters, three hundred some odd amateurs in the U. S. and fifty or more abroad, to say nothing of 2EH Scotland, 5NO, Newcastle, Eng., YL, Paris, France, 4AG, Dunedin, New Zealand and CB8, Buenos Aires, Willis Stratton, R. F. D. Route No. 1, Canadaigua, N. Y., easily qualifies for DX honors and the coveted DT button. Fine biz, we say.

J. W. Landon, 113 Scoville Way, N. S. Pittsburgh, Pa., on seeing in a recent number that William J. Sergeant was interested in a four tube set that would tune sharp, furnished Mr. Sergeant with the diagram and constants of the circuit he is using. Just another indication of the wonderful bond of friendship that exists between members of the same fraternity.

We almost fell out of our chair when the following letter appeared at the RADIO AGE office: "At last I have found what I wanted. It is 'RADIO

Send for this RADIO BOOK FREE

1926 Catalog of RADIO BARGAINS Save 1/3 to 1/2

The World's Largest Exclusive Radio Mail Order House Will Send You This Wonderful Book FREE

64 illustrated pages containing thousands of bargains in radio sets, semi-finished sets and radio kits of all styles, sizes and approved circuits. **5 tube complete sets as low as $29.50.** Beautiful models of the very latest designs and types. Elaborate console models with **loud speakers built right into cabinets** of genuine mahogany and walnut. **ALL SETS GUARANTEED.** Coast to coast receiving range. Catalogue also contains everything in radio supplies, including batteries, chargers, loud speakers, transformers, condensers, rheostats and any other parts you may want for improving your set or building a new one. **Guaranteed saving to you of 1/3 to 1/2.**

AMERICAN RADYNOLA 5 TUBE SET

$29.50

The Biggest 5-Tube Value on the Market

Positively the world's greatest 5 tube radio bargain. REGULAR $75.00 VALUE. Our large quantity production enables us to sell this set for ONLY $29.50, fully built and wired in beautiful mahogany cabinet of latest design with sloping Bakelite panel of Satin finish, handsomely etched and engraved as illustrated. Constructed of the finest low-loss condensers, coils and sockets, bakelite baseboard, panel and dials. PRICE FOR SET ONLY, ... **$29.50**
Transportation charges extra, shipping weight 25 pounds.

This Set with All Accessories, Including The Famous American Bell Loud Speaker

with adjustable unit, 2-45 volt "B" batteries, one guaranteed 100 Ampere Hour storage "A" battery, cable for battery connection, 5-201A tubes, Aerial and ground equipment, and everything complete ready to set up and operate. Nothing else to buy. PRICE **$59.75** Transportation charges extra. Shipping weight 100 pounds. Complete instructions with set. . . . . .

Order Direct From This Page! Save 1/3 to 1/2. Our guarantee protects you. Money cheerfully refunded if you are not satisfied Write your order and prices plainly. Send post office money order or bank draft for full amount to insure safety. Refer to any bank or commercial agency regarding our reliability.

Semi-Finished 5-Tube RADIO FREQUENCY RECEIVING SET

This special offer is astounding the radio world. Coast to coast reception on loud speaker. Low-loss condensers and sockets. Highest quality transformers. Bakelite rheostats. All wiring concealed under Bakelite baseboard. 7 x 18 panel fits into any standard 7 x 18 cabinet. Complete instructions for operating. GUARANTEED SAVING TO YOU OF $80.00. Price of set all mounted. Not wired. **$18.75**
Cabinet of same model as American Radynola pictured above $5.65 extra . . . . .

You must have our catalog no matter what set or kit you want. Our line is complete and includes all popular sets, such as **Superheterodyne, Neutrodyne, Ultradyne, Reinartz, Regenerative,** Radio Frequency, Browning-Drake, Reflex and all other latest circuits. Kits, sets and parts manufactured by all well known manufacturers such as **Frost, Howard, Baldwin, Brandes, Western Electric, Columbia** and others.

Our semi-finished sets come with all parts mounted on panel and baseboard ready for wiring. Do not fail to send for our catalog. Remember—we are the largest exclusive radio mail order dealers in the world and carry the best of everything in radio. We save you 1-3 to 1-2 on the following kits. Detailed description appear in our catalog.

Semi-Finished 8-Tube Super-Heterodyne

World's famous 8-tube Super-Heterodyne

Fully mounted on panel and baseboard. These pictures show interior set and how it looks when enclosed in cabinet. Comes completely assembled ready to wire and operate. We have testimonials from thousands of builders of this set. **Some Have Received Foreign Stations on Loop Aerial.** Unsurpassed in volume and tone quality. Low-loss straight line frequency condensers, vernier dials, finest quality rheostats. Matched Remler or Columbia long wave transformers. Requires only three screws for attaching panel and baseboard and set is ready to operate. 7x30 panel. Price of set only.

Requires following accessories to complete this set. 7x30 cabinet, 8-201A tubes for storage battery operation or 199 tubes for dry cell operation. 100 Ampere hour storage battery, 2-45 volts "B" batteries, loud speaker, center tapped loop aerial. All these items are listed in our catalog at a tremendous saving. **$43.75**

NEUTRODYNE
Genuine Licensed Neutrodyne kit of parts come fully assembled on the panel and baseboard with complete instructions ready to wire
$29.75

COCKADAY
3-tube Cockaday kit of parts, fully assembled on panel and baseboard, ready to wire
$15.85

REFLEX
4-tube Acme Reflex does the work of 7. Fully assembled on panel and baseboard, ready to wire
$38.65

ULTRA-AUDION
One-tube Ultra-Audion. Wizard of radio. Fully assembled and ready to wire, with instructions
$6.35

ALL SETS & KITS
described on this page shipped prepaid east of the Rockies, not including Canada. American Radynola 5-tube radio frequency receiver shipped charges collect.

OUR CATALOG
includes complete list of broadcasting stations and general information and facts about our free service division. Our radio engineers will help you solve all your radio problems. Send your name and address on a card or in a letter. We will send catalog FREE.

OUR GUARANTEE
Every article exactly as represented. Every article is tested before shipping. Complete satisfaction or money cheerfully refunded.

RANDOLPH RADIO CORPORATION

159 N. Union Ave. Dept. 13 Chicago, Illinois

AGE,' the radio magazine with blueprints, not overstuffed with technical terms and not entirely neglecting the beginner. I have been a fan for five years and have been getting most of the radio periodicals. Recently I stopped buying the artists' pictures and outlandish histories of radio until now I am only receiving one, and as soon a my subscription expires that magazine will expire with it as far as I am concerned. Today was the first time I saw your magazine and I have only had time to read one article; but it appeals to me so I want to hasten to get on your subscription list. I see the wisdom of your not naming the firms names or any of the parts used in your articles, but I am so taken with Mr. Rathbun's article on the 8 tube super that I wish to build it.

"This one article is worth more than the yearly subscription cost."

This was written by James M. Bennett, P. O. Box 1431, Weirton, West Virginia, and we'll say it is some letter.

Harold Huffman, P. O. Box 4, Van Dyke, Mich., favors us with a list of stations picked up on a single tube set, using a split variometer. The list includes some Canadians.

"Good parts" is the reason assigned by F. C. Favre for his success with home made radio sets and the number of stations logged according to a letter received from him at Cressville, N. J.

No, Geraldine, there are no battery solutions that take the place of an electric charge for your battery. A storage battery is a typical example of the "put and take" game. You take out so much and you must put back so much. Since you take current you must replace current. You don't take the solution so why should you figure on adding solution?

For the benefit of James R. Hartshorne, 2258 Bedford Ave., Brooklyn, N. Y., and a host of other Dial Twisters, we would like to announce that the D. T. buttons are sent out every month just about the time the issue is run off the press. Sometimes there is a little delay incident to a press of business, but as a rule by the time the issue is on the news stands your button should have arrived.

George Tucker, 1257 Bevitean Ave., Detroit, Mich., with a factory built set logged fourteen stations in a half hour. Since seeing the August number, he is interested in a super to see if he can better his record.

Arol Schmidt, 484 40th St., Milwaukee, Wis., favors us with a letter telling about Mr. Dunwoodie, at Apia, Samoa, who regularly receives KYW, KFKX, and who also has logged Portland, Ore., and a Canadian station, the distance being something on the order of eight thousand miles. Mr. Schmidt encloses a diagram of the receiver used by Mr. Dunwoodie, which is a two stage radio and a detector, the latter coupled capacitatively from the grid of the detector to the plate inductance of the preceding tube. The detector is regenerative, a la Armstrong. The antenna coil is 35 turns, its secondary, 50 turns spanned by a .0005; the output of the first tube goes through a r. f. transformer, untuned, to the grid of the second tube. The plate inductance of the second tube, which is also the secondary of the detector circuit, contains from 40 to 60 turns, bridged by a .0005 mfd condenser. The tickler coil has 75 turns. In Mr. Dunwoodie's case spiderweb coils are used; any tubes are suitable and only 45 volts is necessary for a B battery. The return from the first grid is put on the slider of a 400 ohm potentiometer. A diagram of the circuit is shown in Figure 2.

A one tube Reinartz, home made, is all that Ramon Quesada, 36 Angeles St., Havana, Cuba, requires to bring in both the coasts, Mexico and Canada. The list of stations logged is not very long but the distances are all in excess of a thousand miles. Que tal, amigo?

RADIO AGE has one Dial Twister (he will be when this issue is off the press) who receives all kinds of European stations. Don't all jump at once. He is a sea-going operator, V. Alcock, Lynton, Green Lanes, Palmers Green, London, England, who seems to run London to Galveston and return. In addition to all the European stations, he picked up a flock of the American stations, quite a few Canadians, Mexicans and a Cuban, all of these on the voyage previously mentioned. Many a D. T. would give his right arm for a chance to cross the Atlantic with nothing to do but log 'em on all sides.

John Skewis, 1731 Beaufalt Ave., Detroit, Mich., tells us he built about twenty sets last winter, and has just finished the set shown on page 23 of the February Radio Age, which he says beats them all. Mr. Skewis is a shut-in and has plenty of time on his hands. He says: "It's a pleasure for me to take one of your hookups and construct it, as I have full confidence in its being as stated in your magazine." Using the set referred to on page 23 of the February Radio Age, he picked up CNRE, Edmonton, Alberta, Canada, about 1500 miles from Detroit, bringing in the station on the loud speaker. He now only awaits the coming of good DX weather to get up a DX list that will knock 'em cold. That's the spirit.

Albert W. Small, 1210 Twelfth St., N. W., Washington, D. C., has fine results with the ultra-audion, using either the resistance coupled or transformer coupled audio amplification.

Okey Deem, 1716 East 7th St., Parkersburg, West Virginia, will not be weaned from the Armstrong single circuit regenerative, which brings him all manner of signals, and whose list entitles him to one of the buttons.

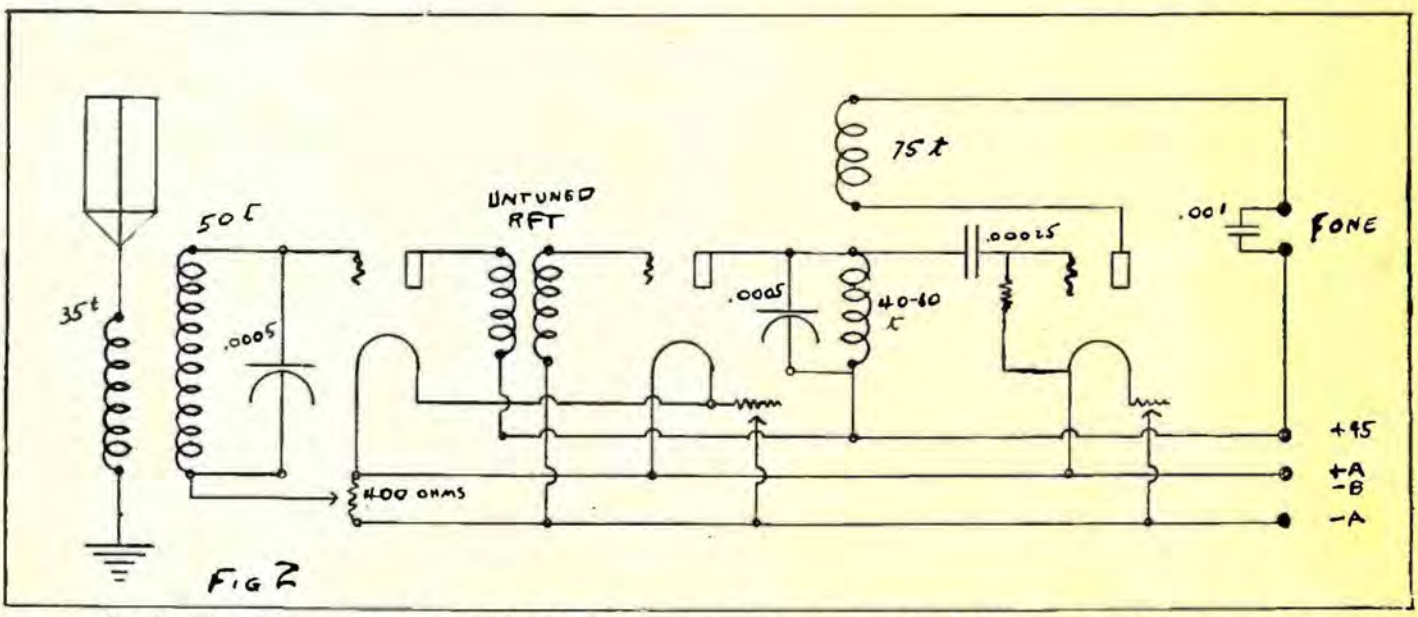


Fig. 2. Many of you have wondered what Mr. Dunwoodie at Apia, Samoa, about 8,000 miles from Chicago, used for reception. Well, the story is shown above. Two stages of radio and regenerative detector. The diagram is self-explanatory. Spiderwebs may be used for the coils, or any other form of good inductance. The set will work with any tubes and only 45 volts B battery is required.

Ward's New Radio Catalogue
Is Yours Free

Yours Free—the newest, most interesting book published on Radio. A book prepared by Radio experts—a complete Radio manual.

52 fully illustrated pages showing what is new in Radio and what has been approved by the best experts.

It shows sets from one tube to five tubes, the new one dial control, parts and supplies, batteries and cabinets. It gives a list of stations, a radio log for recording stations.

Ward's is Headquarters for Radio

Ward's is today one of the greatest Radio stores in the world—selling everything in Radio without the usual Radio Profits. And besides, we sell only the tested and approved equipment—selected and tested by our own experts, who are up to the minute in Radio. Thousands of customers write us of their delight and saving on Ward's Radio sets.

Our 53 year old Policy

For 53 years we have sold only quality merchandise under a Golden Rule Policy. You can rely absolutely upon the quality of everything shown in this Radio Catalogue.

ESTABLISHED 1872

Montgomery Ward & Co.

The Oldest Mail Order House is Today the Most Progressive

Baltimore Chicago Kansas City St. Paul Portland, Ore. Oakland, Calif. Ft. Worth

To Montgomery Ward & Co., Dept. 18-R
Baltimore Chicago Kansas City St. Paul
Portland, Ore. Oakland, Calif. Fort Worth
(Mail this coupon to our house nearest you.)
Please mail my free copy of Montgomery Ward's New Radio Catalogue.

Name .....

Local address .....

Post office .....

State .....

* *Tested and Approved by* RADIO AGE *

An Organized Warfare Against Fading

(Continued from page 22)

with primary inserted in the plate circuit of the second detector of a super-heterodyne, the proposed rectifying unit can be added either within or outside the receiving set by the arrangement indicated in Figure 1 of the circuit diagram. Here it will be noted that the audio-frequency transformer with primary shunted by a condenser to by-pass radio-frequency currents is left in the circuit so that the telephones may be used in an audio stage for monitoring purposes.

"Where the wiring of the receiving set is inaccessible, as with the 'Radiola 8,' the primary of the extra intermediate-frequency transformer (42 kilocycles) may be inserted by means of an adapter which raises the electron tube so as to allow opening the plate circuit between the socket and the tube itself, as shown in Figure 2 on the diagram. (Adapter may be constructed from the base of an old UV-199 tube and any adapter made for this type of vacuum tube. The second detector of the 'Radiola' is the third tube from the left when facing the cabinet.) By employing only the first stage of audio amplification for the monitoring telephones it is possible to utilize the vacuum tube of the second audio stage (at the extreme left when facing the set) for the two-electrode rectifier by making another adapter which raises the tube and leaves only the filament connections in circuit.

"A voltmeter should be placed across the filaments of all vacuum tubes and voltages should be kept the same throughout all test periods. This applies also to the two-electrode tube, if used. If the same filament battery and the same type of tubes are used for rectifier and receiving set one voltmeter will suffice for all. 'B' batteries should be in condition to insure constant voltage throughout a test period.

"Some observers have had difficulty with a serious lag in the response of the galvanometer pointer. This effect can usually be minimized by critical damping. Probably the easiest way to accomplish this is to shunt a resistance box across the galvanometer while in circuit and vary the resistance until the pointer responds quickly to current variations. In case a shunt resistance fails, a series resistance may serve the purpose. The former should correct the vibration effect; the latter is needed in case the pointer lags.

"When recording is done on a continuous tape the exact time should be indicated on the record approximately every 15 minutes as a means of checking for later comparisons. Where readings are taken and plotted later it will naturally be necessary to check the time much more closely as deflections will be read several times a minute. Changes in receiver amplification made during a record should be noted, together with the approximate ratio of change.

The Improved Roberts

*

Approved by Ten leading manufacturers

Send for this most complete book, giving full instructions on assembling, wiring, and operating the Hammarlund-Roberts receiver.

25c

The All-American Radio Corp., contribute the Rauland Lyric Transformer to the efficiency of this new receiver.

THE new Hammarlund-Roberts receiver is the united achievement of ten leading engineers, endorsed by ten of the best-known radio manufacturers. No one man's or one group's conception of five tube possibilities but the composite of the leaders' convictions.

This concentration of the leaders in engineering and manufacturing skill upon one purpose—the perfection of tried and proven radio principles by new and intense applications produced new results so vital and so valuable that they put the Hammarlund-Roberts far beyond your expectations of performance.

In designing this new standard of efficiency, the consulting engineers had at their disposal the finest parts the market affords—regardless of cost. They were not handicapped in building to a price.

These ten leading manufacturers offer to the American public greater value than ever before. A radio receiver constructed throughout of the latest, most efficient parts designs at a price within the means of every one. A five tube receiver that equals the Super-Heterodyne in selectivity and volume. A receiver so simple in design that anyone can build it from the instructions in the "Hammarlund-Roberts Construction Book." You will wonder at this new simplicity; this new efficiency; this new saving.

Write for this most complete book

HAMMARLUND-ROBERTS 1182-D-Broadway, N. Y.

ASSOCIATE MANUFACTURERS

All-American Radio Corp.
Alden Manufacturing Co
Radiall Company
Carter Radio Company
Dubilier Condensers
Union Radio Corp.
International Resistance Co.
Hammarlund Mfg. Co., Inc.

Na-ald sockets and dials, Carter Rheostats, Jacks and Switches approved for the Hammarlund-Roberts.

Hammarlund-
ROBERTS

* *Tested and Approved by* RADIO AGE *

Where Does the Power Come From?

(Continued from page 14)

phone circuit varies. Naturally, the source of potential used must be unvarying, for a fluctuating potential would cause noisy and distorted transmission. For this reason, generators are never used in microphone circuits because of fluctuations which are necessarily impressed upon the output. Batteries of some kind are always employed.

When faithfulness of reproduction is attained in transmission, the microphone has responded accurately to an air wave form of extraordinary complexity, with full consideration to overtones or harmonics, correctly proportioned according to the character of the various instruments. The current supply to the microphone supply has been unvarying, without tending to increase the energy on some frequencies at the expense of others. Billions of chemical actions have contributed to an even and responsive potential supply, so that the finest graduations of sound waves have been translated into current variations.

A. F. Circuits

BECAUSE the frequencies involved in the microphone circuit when passed through telephone receivers cause sound waves to which the ear responds, they are termed "audio-frequency" currents. They are identical with those transmitted over telephone lines. In receiving sets the audio-frequency amplifier magnifies such currents. The term "audio-frequency" is used to designate electric currents of less than 10,000 cycles or alternations per second, because such currents can be used to set up sound waves affecting the auditory nerves.

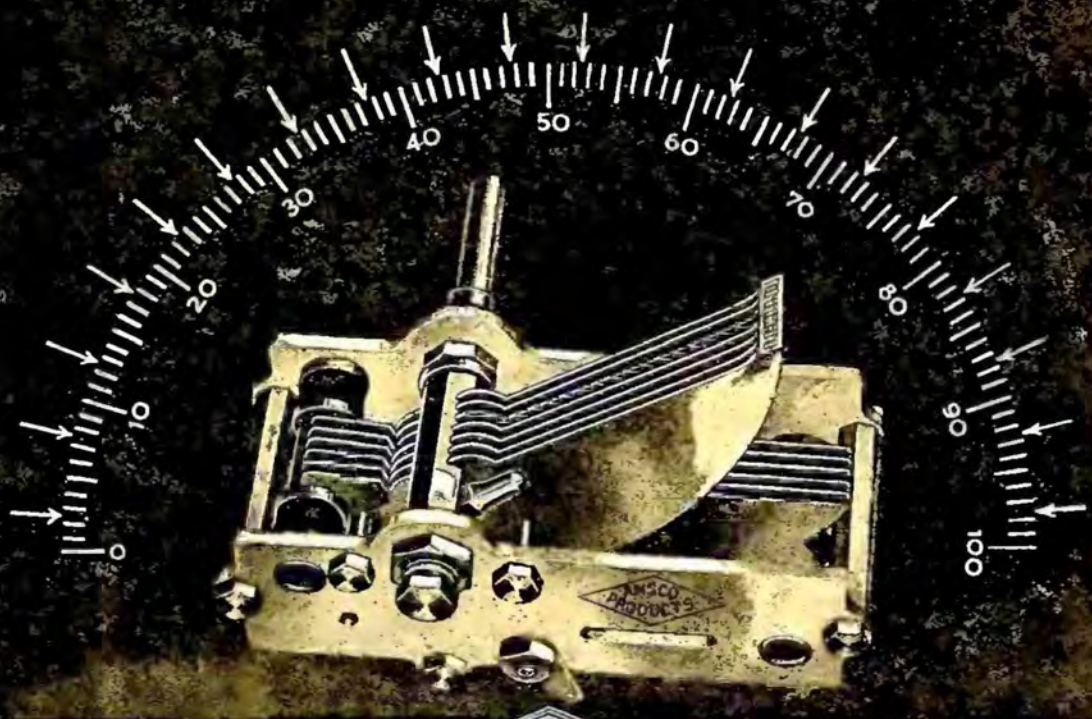
An electric copy of the sound waves having been produced by the microphone and its associated equipment, it is next amplified by vacuum tube amplifiers until it is a very powerful audio-frequency current. If broadcasting is done with the aid of telephone lines from a remote control point, from four to ten stages of amplification may be used. All these amplifiers use batteries in order to assure an absolutely quiet reproduction, free of hums and clicks. This current is further amplified by the modulator tubes of the transmitter until it is of the same order of magnitude as the radio frequency carrier current itself. All of this manifold amplification must be carried out without the introduction of distortion or extraneous noise if good quality of reproduction is to result.

Another process is required, however, before these currents can be radiated into the ether. While audio-frequency currents pass successfully through wire telephone circuits, they do not set up electro-magnetic waves when used to charge an antenna system. The property of setting up electro-magnetic waves in the ether is possessed by radio frequency currents. In broadcasting, very high frequencies are used. The wavelength of a station is determined by the fre-

(Turn to page 52)

The AMSCO ALLOCATING CONDENSER

(STRAIGHT LINE FREQUENCY)

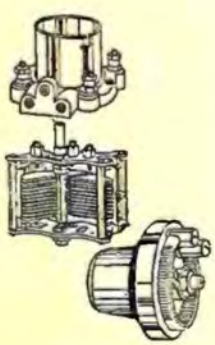


AMSCO

✻

Spreads the Stations Over the Dial—The new AMSCO Allocating Condenser is the triumphant combination of electrical engineering and mechanical ingenuity. *Electrically efficient* in *unscrambling* the stations on your dials. Each dial degree from 1 to 100 will be found to represent 10 broadcasting kilocycles accurately over the entire scale—*"a station for every degree." Mechanically ingenious* in correcting the fault of other S.L.F. Condensers—*it conserves space!* Scientific low-loss construction. Rigidity with light weight.

Made in three capacities—Single or Siamese. Ask your dealer, or write for details of the entire AMSCO Line of engineered radio parts.



AMSCO PRODUCTS, INC. *Dept. P.*
Broome and Lafayette Streets, New York City

New!—a handsome instrument at a low price, the AMSCO Vernier Dial gives finesse to your fingers. Steps down 13 to 1, backwards or forwards, without momentum or back-lash.

✻ *Tested and Approved by* RADIO AGE ✻

Where Does the Power Come From?

(Continued from page 50)

quency of the currents used to charge or discharge the antenna. Thus, for instance, a wavelength of 300 meters is set up by a current of a million frequency and 492 meters by 610,000 frequency.

Various methods for generating these high frequency currents have long been known to radio art. But how to combine the radiating properties of radio frequency with the audio-frequency component necessary to the transmission of speech and music long baffled the scientists who devoted themselves to the problem. The first use of radio frequency currents in communication was for dot and dash telegraphy. By means of the transmitting key, the generator of high frequency currents is connected and disconnected from the antenna system in accordance with the telegraph code.

How It Started

THE first attempts at radio telephony consisted of using a variable resistance to vary the amount of radio frequency current in the antenna, according to the sound waves to be sent out. Thus, the carrying qualities of the radio frequency current are utilized, while the distinctive communication possibilities of speech are retained.

In these early radio telephone transmitters, microphones were used in series with the antenna system to accomplish this variation of the radio frequency or "carrier" current. But microphones are practical only for controlling small currents. When the radio frequency heavy currents necessary for long distance transmission are passed through them, they fail to carry the load.

The process of combining radio and audio-frequencies is called modulation. A practical method obviating the necessity for heavy microphone currents suitable for high power transmission was developed by R. A. Heising. It depends for its operation upon varying the plate potential of a vacuum tube transmitter rather than changing the resistance of the antenna system as radio frequency currents are applied to it. With the Heising system, the audio-frequency microphone currents are magnified by successive stages of amplification until they are of the same order of magnitude as the radio frequency carrier. These amplified microphone currents are used to add or subtract from the plate potential supply of the radio frequency oscillator tubes. Thus, the carrying qualities of radio frequency currents are combined with the communication properties of audio-frequency currents to set up electro-magnetic waves in the ether.

The work of the receiving set is just the reverse of that of the transmitter. In an antenna system within the influence of electro-magnetic waves from a distant transmitter, there is set up within it a combination of radio and audio-frequency currents identical in frequency and characteristics with those of the distant transmitter which set up the electro-magnetic waves.

(Turn to page 55)

An IMPROVED Slide Wire Bridge

(Continued from page 18)

frequency currents. This buzzer will then be mounted on one of the end pieces of the box, with the adjusting screw protruding through to the outside of the box. The buzzer will have terminals (B1) and (B2).

An "ON"—"OFF" battery switch will be mounted on the same end piece of the box as the buzzer and will have terminals (S1) and (S2).

Two binding posts will be mounted on the end piece opposite the one on which the above equipment is mounted and will be designated (R) and (R1). Two binding posts will also be mounted on each side of the box. Those on one side will be designated (X) and (X1). and those on the other side (Y) and (Y1) The instrument will then be ready to be wired.

Stranded, rubber-covered or braided, cotton covered wire should be used to wire the instrument, as this wire is not as liable to come loose at the terminals or soldered connections as solid or bus wire. It is also necessary that some flexible wire be used for certain leads to make it possible to remove the cover, or panel, when it is necessary to replace the flash-light battery (E). This battery should not have to be replaced for at least five or six months as the current drain from the average high frequency buzzer is only about thirty milli-amperes. The following wiring chart will simplify the connecting up of the instrument and offers a good means to check the wiring for errors.

WIRING CHART

RUN ONE LEAD FROM	TO TERMINAL
Switch terminal (S1)	Battery terminal (E1)
Switch terminal (S2)	Buzzer terminal (B2)
Buzzer terminal (B1)	Coil terminal (I2)
Battery terminal (E2)	Coil terminal (I1)
Coil terminal (I3)	Pot. terminal (P1)
Pot. terminal (P1)	Binding post (X)
Coil terminal (I4)	Pot. terminal (P2)
Pot. terminal (P2)	Binding post (Y)
Pot. terminal (R2)	Binding post (R)
Binding post (Y1)	Binding post (R1)
Binding post (R1)	Binding post (X1)

A piece of white bristol board, for the scale, will be cut into a disk five inches in diameter. A hole will be cut in the center to pass over the knob or sleeve of the metal dial (S). The scale should be marked on this disk so that when the dial is rotated as far to the right as possible, the dial marker will be directly over the "0" point on the scale and when it is turned as far to the left as possible, the marker will be over the "100" point on the scale. A partial scale is shown in figure five, to exact size, and may be used as a guide in spacing the sections if desired. A scale smaller than five inches in diameter may be used if necessary, but the divisions will fall closer together than on the larger one and it will be more difficult to get a reading as accurate as with the larger one.

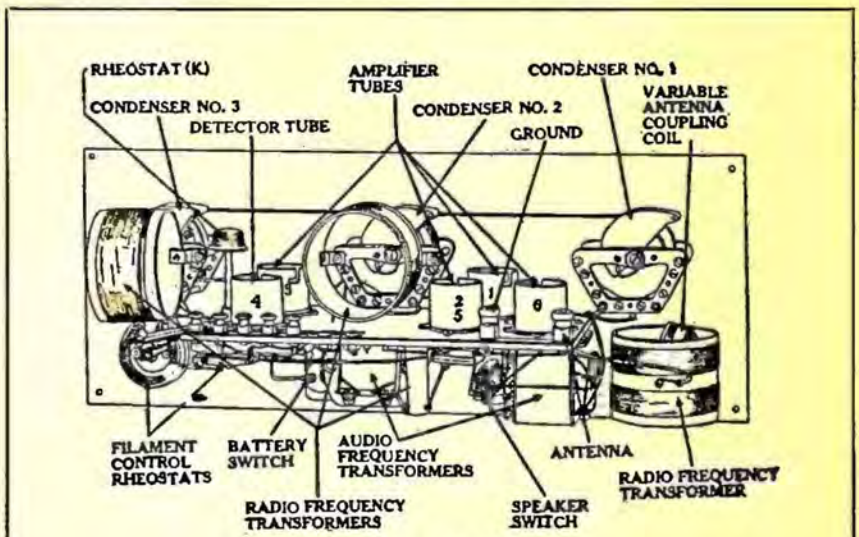
When the scale has been fastened to the dial (S) and the battery (E) has been placed in the clips (details, figure three), the panel will be made fast to the box and the set is ready for operation.

(Turn to page 64)

Standard Radio Receivers

Some time ago RADIO AGE inaugurated a new department called "Know Before You Buy," to serve as a guide to the prospective radio purchaser in deciding on the receiver best suited to his individual needs. Fans throughout the country have shown a keen interest in this new feature, and accordingly it is being made a feature of all numbers of RADIO AGE. Readers are invited to write us concerning the sets in which they are interested. and manufacturers also are asked to send us material describing their sets.

Day-Fan Five-Tube Receiver



Inside view of five-tube set

IN all Day-Fan sets the makers use the Duoplex circuit, which is a development of their own laboratory. The four tube Duoplex has two stages of tuned radio frequency, detector and two stages of audio frequency amplification. The five tube Duoplex has three stages of radio frequency amplification (two being tuned and one untuned), detector, and two stages of audio frequency amplification. The four tube circuit has five tube range, volume, and selectivity. The five tube circuit has six tube range, volume, and selectivity. Under favorable conditions, Day-Fan receivers will bring in any station anywhere in the United States, Canada or the West Indies when the desired station is broadcasting at 1000 watts or more.

The single dial control on the five tube sets is a distinctive Day-Fan achievement. It has all the advantages of the three dial with the simplicity of single dial control. It can be operated in the dark, and beautiful music is often most greatly appreciated in a dimly lighted room. The children can tune in just as well as the grown-ups, and yet none of the advantages of the three-dial control have been sacrificed to attain this extreme simplicity.

The exceptional tone quality of the Day-Fan receivers is due to very careful research and costly design and manufacture. We all know that there are many sounds above and below the range of ordinary music and to which our ears do not respond, but perhaps you had not realized that the radio receivers of the past entirely excluded the pedal notes of the organ and the deep bass notes of the orchestra. Such tones are of vital importance in bringing out the grandeur of orchestral and organ music and without them such music loses a great deal. By the design and construction of Day-Fan audio transformers all of these low tones are faithfully reproduced with the result that the music coming from the Day-Fan is of great beauty and fullness of tone.

What to Expect From a Radio Set

The radio set today is a highly efficient and truly remarkable instrument. When properly operated it will give excellent results and will bring into the home—entertainment, instruction and news in a manner that was undreamed of four years ago. There are, however, certain conditions under which no radio set can give satisfaction. These conditions may be divided into two classes; those which can be corrected and those over which the operator has no control. Some of the conditions which the owner can regulate for himself are:

1. Your receiver should be made by a reputable manufacturer who has the organization and facilities for correctly designing and manufacturing so highly sensitive an instrument

2. You can select accessories of a grade at least equal to that of your receiver, as no receiving set can be better than its accessories.

3. You can erect an efficient antenna and make a satisfactory ground connection, as these are extremely important for satisfactory operation.

(Continued from page 52)

Often two stages of radio frequency amplification are used to bring up the magnitude of this tiny current set up in an antenna system.

The power to operate your receiver, therefore, does not come from the transmitting station; the energy received from the transmitting station is simply used to control the output of the "B" battery through the valve action of the grid of the vacuum tube. This valve or amplification is somewhat similar to the valve effect of a water faucet controlling a stream of water. A child can turn on and off a faucet controlling 200 pounds of pressure. In the same way, the grid of a vacuum tube controls a much larger current flowing through the plate circuit, suppied by the "B" battery.

If the radio frequency amplifier has increased the combination of radio and audio-frequency currents to a sufficient magnitude, the detector tube then smooths out the radio frequency component, so that the effect of the audio-frequency component only remains. Thus the process of modulation is reversed. The audio-frequency amplifier then performs its function of increasing the magnitude of this current. Finally, it is converted into sound waves by the telephone or loud speaker, reversing the action of the microphone circuit of the transmitter.

The vacuum tube plays an important part in each of these many steps. Any undesired variation in plate potential introduced at any point at once affects the fidelity of ultimate reproduction. For this reason, "B" batteries are used in preference to any other source of plate potential. The "B" battery relies upon electro-chemical action, contributed by billions of atoms within each cell and its output is, therefore, continuous and unvarying. A generator depends for its action upon the sum of impulses set up in a number of inductances revolving in a magnetic field. Some generators have as many as 760 coils revolving at a thousand RMP, but even such a generator has variations in its output, which, when applied to the plate of the vacuum tube, produce a hum in the receiving set.

New "B" Power Unit Produced

The Radio Units, Inc., of Maywood, Ill., announce the "B" RADIOPOWER UNIT. It is essentially an automatic "B" battery and not a "B" battery eliminator, since it consists of a dry storage battery together with a trickle charging arrangement built into a handsome walnut cabinet.

They are also producing the PADDLE-WHEEL COIL, a new and superior type of inductance which was released to the trade late last season.

"Up in the Arctic with the Short waves."—By Armstrong Perry, in Nov. RADIO AGE.

WITH THE MANUFACTURERS

The Story of the Powerola Radio

Powerola is electric radio without any batteries or chemicals whatever. It can be used universally, operating directly from the standard A. C. or D. C. lighting circuits in the home, office or place of business. By plugging into the house lighting socket, the tubes in the receiver are lit and the set ready for tuning. It becomes another electric necessity like an electric iron, toaster, or other electrical device.

For alternating current, two rectifying bulbs (2 ampere), in connection with a transformer, condensers and choke in these circuits, enables the receiver to obliterate all power-line hums and noises, and to deliver the required voltages and watt power. For direct current a simple but practical arrangement is employed in connection with a choke, some condensers and resistances, and with the filaments of the tubes in series, which also smoothes out all generator hums and noises, and produces the needed constants and potentials. There are no additional controls added on the rectifier or set to compensate a variation in voltage on the 110 volt supply, A. C. or D. C. Powerola is designed for A. C. 100-115 volts, 40-60 cycles, and for D. C. 110-120 volts.

Five standard tubes, such as the five or six volt 201A or 301A, and standard phones and loud speakers, are employed.

The Terminal Electric Company established in 1910, for the past fifteen years has been manufacturing battery-eliminating power devices. It is an old established, and highly regarded manufacturing firm. The value and security of such an experienced precision manufacturer cannot be under-estimated. Every piece of material which is of the best and every stage of manufacture is thoroughly tested. Powerola has strength and charm, is built to last a life time and is fully guaranteed.

Details of Daven Radio Corporation Expansion

Due to increased business and the necessity of giving the best service possible to manufacturers, Daven distributors and Daven dealers, The Daven Radio Corporation recently adjusted their organization and made many new and important changes.

W. H. Frasse, President, announces the appointment of K. R. Moses as Sales Manager. Mr. Moses was previously Sales Promotion Manager of Crosley Radio Corporation, and Sales Manager of the Amberola Division of the Thomas A. Edison, Inc. Mr. Moses has had twelve years of phonograph and radio experience, consequently the problems of merchandising radio are nothing new to him.

W. A. Balevre has been appointed Advertising and Sales Promotion Manager. Mr. Balevre has been connected with the Daven Radio Corporation for the past eighteen months and before that was with the Adams Morgan Co.

Burns Concert Speaker Unit Now Ready

The American Electric Company of Chicago now announce the marketing of an attractive new Speaker Unit—the No. 120 Concert model. This has all the excellent tone qualities of the No. 100 Burns Unit and in addition has a much greater range, being particularly adapted to reach the extremes of the musical scale.

With this Concert Unit it is no longer necessary to sacrifice those high notes or the low bass ones, which have hitherto been lost and which left much to be desired in the quality of loud speaker reproduction.

The exceptional tone quality of the Burns Speaker has already won for it thousands of enthusiastic users. In the Concert model a mellowness of tone combines most effectively with the extreme sensitiveness of the instrument. The slightest variations of sounds, the voice with all its fine shadings and the various musical instruments with their wide range of pitch are reproduced with exquisite trueness.

Remarkable tone volume is secured yet it is easily regulated to suit the occasion and to harmonize with the subject being reproduced. A convenient tone adjuster is placed on back of mechanism case.

The substantial size of this new unit and exactness of construction assures a sturdiness and durability not otherwise obtainable. Rigid inspection is employed throughout the course of manufacturing.

The Concert Unit is arranged with connectors for fitting any standard make of phonograph.

Thomas Loop Distributed Nationally

The W. I. Thomas Company, fibre manufacturers of Chicago, have announced they have nation-wide distribution for their line of loop aerials, known as "Thomas Selecto Loops."

The Thomas loops, one of which is illustrated in the accompanying drawing, come in two sizes—large and small. The model shown sells for $12.50 and incorporates all the latest design in loop aerials, being the result of several months' experiment.

Mr. W. I. Thomas has just announced that exclusive Western distribution of the loops has been awarded the Radiograph Laboratories, of 210 E. Ohio St., Chicago. Thomas loops are being nationally advertised this season.

New WSBC Station Using Storage Batteries

Making its maiden bow and bid for popular favor is the 1,000 Watt Radio Broadcast Transmitter sponsored by the World Battery Company of Chicago, operating under Station Call Letters WSBC on 210 meters, and constructed by the Engineers of that concern.

The World Battery Company Transmitter, as the new outfit is officially designated, is novel in many respects and unique in that the power for the operation is supplied entirely by storage batteries, made up of identically the same materials as are used in the standard, stock batteries supplied to radio users for the operation of receiving sets. For instance, the "B" or tube plate supply of 2,400 volts is furnished by the equivalent of over 400 ordinary receiving 6-Volt "A" batteries made up of the same parts that are used in the unit familiar to all radio fans. By an ingenious switch arrangement these can be connected in straight series to operate the set or in series parallel for charging.

The "C" or biasing batteries as well as those used for the microphone circuits are made up of the parts used in the standard 24 volt units such as are used for the "B" supply in receiving sets.

Although the battery installation is a good deal more expensive than is the equivalent motor generator set, it is felt that the additional expense is more than compensated for by the clarity of transmission, it being well known that the smooth steady flow of power from storage batteries insures a clearness that can only be approximated by the generator system. Other exclusive features are incorporated in the design and construction of the transmitter proper.

New Straight 8 Out in Sept. Priess Announces

Announcement has been made at the offices of William H. Priess, president of the Priess Radio Corporation, that the company's new receiver, known as the "Straight 8," was in production and would make its appearance before the public in September, which on account of the radio expositions, is popularly assumed to be the seasonal opening.

A good deal has been heard about this set, for it has been known all along that the makers were aiming to produce a receiver of exceptional power; a distance getter and volume producer unmeasured by previous standards.

Uncommon secrecy has been maintained all during the experiments, which have run into many thousands over an unusual length of time. Besides Mr. Priess's personal application and that of his laboratory staff, consulting engineering talent has been employed to an unusual degree.

No descriptive statement of the "Straight 8" has appeared as yet, and it is understood that the makers prefer to let its performance talk for it.

More Super Stations are Coming!

(Continued from page 24)

station into direct current, which is used for plate supply on the various transmitters. The modulating equipment may be connected with any of the smaller buildings by means of a system of overhead transmission lines. Speech and music to be broadcast are obtained from the studio of WGY over an aerial cable circuit. It is further amplified at the station before reaching the group of metal tubes known as modulators. The transmitter to be modulated obtains its plate supply in common with the modulator tubes through a group of reactors.

A dark room is provided in the main building for developing oscillograph films recording modulation. A circulating pump having a capacity of 150 gallons per minute supplies cooling water for all metal tubes. The water is piped to all of the smaller buildings.

In addition to the rectifiers, a 12,000 volt direct current generator is used for supplying plate voltage for master oscillators and other low powered equipment. Generators supplying 4,000 volts and 2500 volts are used for plate supply to the smaller tubes. The filaments of all tubes are heated by direct current. There are several direct current generators of 300 ampere capacity at 33 volts and 1000 amperes capacity at this voltage.

At present there are two transmitters located in the main building—one is operated at 50 kw. on 379.5 meters. This transmitter is of the master oscillator — intermediate amplifier — power amplifier type using 20 kw. water cooled tubes in the high power stages.

The second transmitter operating at 1560 (2XAH) meters has a maximum of 40 kw. and is of the same general type as 2XAG except that push-pull amplifiers are used in the power stages.

The 109 meter transmitter is located in one of the smaller wooden buildings. Circuits for this equipment are the master oscillator intermediate amplifier power amplifier type, in order to obtain constancy of frequency. The high voltage supply is carried from the main building to this transmitter by means of overhead-lines. Modulation for the 109 meter transmitter is provided in Building No. 1 from the main bank of modulators.

The antenna system is supported by three wooden poles each 80 feet high, arranged in the form of a triangle. This type of antenna stucture has been employed in order to permit a study of the various types of antennas which may be suitable for operation at this wavelength.

In common with all the other low wavelength transmitters, the low voltage and high current machine equipment is located in a separate building adjacent to the transmitter house proper. With fairly long wavelength transmitters the machine equipment can be placed in the transmitter house; with short wavelength transmitters it is necessary to not only spring-suspend the tubes but remove the motor generator sets to a distant point in order to reduce the vibration to a minimum.

With the Manufacturers

(Continued from page 56)

The one serious problem in radio reception has always been the battery problem. Manufacturers have spent many sleepless nights trying to develop a foolproof device that would eliminate either the "A" or "B" battery, or possibly both. In most cases these devices were very costly and had their weak points.

In solving this problem, a new and untraversed channel of thought was conceived by A. L. Levin of the Lestein Corporation of America, New York City. His idea was to make the tube itself, which is necessarily of special construction, do the major part of the work and use a simple adaptor, which is not the ordinary battery eliminator, which will function to eliminate the necessity of rewiring a set that has been in service.

Their new tube operates equally well on any 110 volt supply having either direct or alternating characteristic. It contains two electron emitting surfaces, which result in a far richer electronic emission per unit of surface than is obtained in the present storage battery type tube, which in turn tends to prevent the possibility of overloading.

The filament, which is lit directly from the 110 volt supply, also functions as a heater for an additional element, which when heated, emits electrons. The electronic emission from the filament is used for rectifying purposes and the emission from the new element, surrounding it in the form of a circle, which measures 1-8 inch in diameter, functions in the same manner as the filament emission from the present day tubes.

The general size and appearance of this new tube is the same as that of the present day storage battery 201A type tube. The standard four prong base is used, and the internal elements are so wired to these prongs that the filament, plate, and grid leads will connect to any standard base socket used with the present day tubes.

Radio fans can control the workings of their sets without any technical knowledge or annoyance. The adaptor can be easily connected with all radio receiving sets on the market today. The tube, will be known as the "LESTRON" tube and can be used in any radio set and where ever the present radio tubes are used and will eliminate all batteries.

New Eveready "Layerbilt" a Big Advance

The new flat cell "B" battery recently announced by the National Carbon Company, makers of Eveready batteries, utilizes the new principle of patented battery construction by substitution of flat cells for cylindrical cells. There is about 30% more active electricity-producing material than in the Heavy Duty

battery No. 770 of identical external dimensions. It retails for $5.50 and is guaranteed to give considerably longer life than any other "B" battery of the same dimensions. More than 30,000 of these batteries have already been tested by users in actual service and from 30 to 52% longer life has been obtained under the same conditions of service as compared with any cylindrical cell batteries of the same external dimensions.

A Quiet Battery Charger

The Interstate Electric Company of St. Louis, Mo., has augmented its line of Battery Chargers by designing a Twin Bulb Handy Battery Charger.

The manufacturer states that this machine is absolutely quiet in operation and is also a fast rate charger. Either one or two of the bulbs in the machine may be used. When both bulbs are used it is possible to charge six volt batteries at four to five amperes.

The Twin Bulb Charger charges efficiently both "A" and "B" batteries and will charge "B" batteries 24, 48, 72, 96, 120, voltage in series. The Twin Bulb Charger employs the advanced "PUSH PULL" principle using both halves of the A. C. wave.

No moving parts are used in this machine or liquids or vibrators of any kind. Naturally adjustments, corrosion and sticking trouble are eliminated. This charger is fully enclosed in a beautiful mahogany finished metal case, with a handle and accurate ammeter.

The retail price will be $17.00 without the bulbs, making it a reasonably priced charger.

Armstrong Perry, Brainard Foote, Frank Pearne, H. F. Hopkins, John B. Rathbun, Roscoe Bundy—"The Cream of Radio Experts"—All in November RADIO AGE!

A Distortionless Audio Amplifier

(Continued from page 16)

Thus, the sockets may be fastened to a panel or they may be screwed to a baseboard with small wood supports between them and the base, just sufficient to hold the resistance clips above the baseboard.

Figure 1 shows a top view of this same unit attached to a 7x10 bakelite panel, which also carries the rheostat controlling all tubes, and the input and output jacks. These jacks cut out the entire amplifier, or cut it all in, as desired. The volume may be very nicely controlled by the rheostat, which also serves to turn the unit off when not in use.

Parts Required

THE material necessary to build the unit costs about $18.00, and is listed below. All parts should be of first class manufacture, particularly the resistances and condensers. Standard panel sockets should be used, which will accommodate either UV201A or WD12 tubes. UV199 would have to be used with adapters, but this will not impair the efficiency of the set, though it does make for an excellent mechanical arrangement. DeForest DV3 dry cell tubes will fit standard sockets, or the new UV199, soon to be out with standard bases, will fit the sockets recommended.

1 6½ ohm rheostat
1 101 jack, 1 spring
1 102A JACK, 2 SPRINGS
5 INSULATED TOP BINDING POSTS
3 PANEL-MOUNTING SOCKETS
6 .0075 CONDENSERS
6 GRID LEAK MOUNTS
3 ½ MEG. LEAKS
1 ½ MEG. LEAK
2 ¼ MEG. LEAKS
17 x 2½ x 3/16" BAKELITE PANEL
17 x 10 x 3/16" BAKELITE PANEL
LUGS, BUS-BAR, NO. 4-32 FLATHEAD SCREWS AND NUTS, SOLDER AND SPAGHETTI.

The panels should be prepared by drilling them in accordance with the drawing, Fig. 2, using the drill sizes shown, and countersinking holes where this operation is indicated. The smaller panel has some holes countersunk on one side, and some countersunk on the other. This is because the heads of the screws fastening the sockets come under the leak clips and condensers, and the screw heads fastening these parts come under the sockets. Three-quarter-inch flat-head brass No. 6-32 machine screws should be used. These will be so long as to interfere with the leaks where they are used to hold the clips, when they may be broken off with a pair of pliers; or shorter screws may be used to hold the leak clips.

The assembly is started by putting through the sub-panel the six screws used to hold the sockets, but not fastening the sockets to them with nuts. Then, with these six screws hanging loose in their holes, the four condensers and six leak clips are screwed on to the sub-panel by putting flat-head screws through it from the other side. After this has been done, the three sockets may be placed in position, and nuts tightened up on the six screws used for holding them. A reference to Figure 3 will show

how the parts are put in place on the sub-panel, and just how lugs are put on the leak clips and condensers. Lugs are shown on some condensers, and if soldering paste is to be used, the wiring should be run to these lugs, and not to the condensers. If no paste is used in soldering to the condensers, the wires may be soldered direct to the small rivets used for holding the brass plates of the condensers together.

The five binding posts are put on the sub-panel as shown in Fig. 3, with lugs under the screw heads as indicated.

The wiring may be started, using a well tinned iron, rosin core solder, and a small quantity of non-corrosive paste. Each lug should be tinned separately and each wire should be bent and cut for its position before any attempt is made to solder it in position. It should be tinned first at points where it will be soldered to a lug.

Operation

ONCE the amplifier has been completed, the proper batteries need only be connected to it, the tubes inserted, and the unit connected to a set and loud speaker, and it will work. However, before connecting it for operation there are one or two tests to make. First, the A battery should be connected to its posts, the tubes inserted, and the rheostat turned on. The tubes will light if all connections are correct. If they do, disconnect the A+ wire, and connect it to the b+ post. The tubes should not light, and if they do, there is an error in the wiring which must be corrected. Assuming they light only when the A battery is connected to its proper posts, a 90- or 135-volt B battery should be connected to the posts marked for it in the diagram. Two or three 45-volt batteries will give this voltage nicely.

If the same batteries are to be used on the amplifier that operate the receiver, these will generally consist of the necessary A battery together with 90 volts of B battery. If this is the case, the simplest way to connect the amplifier is to run two wires from its A+ and A− posts, to the A+ and A− posts of the receiver. Then, if no more B battery than is used on the receiver is to be used with the amplifier, the B+ post of the amplifier need only be connected to the B+ post of the receiver. If additional voltage is to be used on the amplifier—say 135 volts where 90 volts is used on the receiver—an extra 45 volt battery should be connected with its plus lead to the plus B post of the amplifier and its minus lead to the plus B post of the receiver.

In no case is it necessary to make a connection from the amplifier to the B−, as the B− is always connected to the A battery at the receiver. This return may be connected in the case of the receiver to either the plus or minus side of the A battery, but in any case it will be fed through on the common A battery wiring to the amplifier. It is of very little importance whether this B return is connected to the plus or minus lead of the A battery, so whatever wiring is used for the receiver will do for the amplifier.

How the New KYW is Getting Power

(Continued from page 30)

determines and holds the wavelength constant and which is impedance coupled to the antenna. A development of the Hartley oscillating circuit is used and the modulators work on the Heising principle.

The impedance or choke coupling between the tank and the antenna circuits is considerable of an advantage to the radio listeners, because it secures extremely loose coupling of the transmitter and the choke eliminate practically all energy in the harmonics which have been a source of trouble in the past.

The antenna is composed of two 3½ inch horizontal cages, 140 feet long and supported by two 125 feet steel towers. The down leads are two similar cages and connect the antenna to an open circuit tuning inductance near the base of the south tower. The counterpoise is a 10 wire fan, radiating from the south tower to points equally distant, entirely around the hotel roof. More than 1¾ miles of hard drawn copper wire went into the construction of the antenna system.

50 Pairs of Wires!

TWO cables each containing fifty pairs of telephone wires connect the new KYW station with the several studios and the numerous outside points from which programs are broadcast. The cables terminate on a large telephone test board, through which telephone lines may be balanced and equalized to pass all the complex voice and musical frequencies from 50 to 6000 cycles.

Provision is made on this board for setting up phantom and simplex circuits over any line so that studio equipment may be remote controlled and adjusted from the station. The telephone test board is connected through plug and jack arrangement to a smaller board on the operating desk, only the circuits to be used that day coming in on the operator's board. By means of this small switchboard he is able to change from one studio to another, talk to any studio or connect back the output of one studio into another so the waiting artists there may hear the program.

A small, well arranged, control desk starts, stops, and adjusts the entire station as well as handles the programs coming in over the telephone lines. The operator need not leave his chair to test any part of the equipment or to take care of any of the manifold details incidental to operation.

A bank of amplifiers or repeators within easy reach of the operator pass the incoming voice current through tubes progressing from a few watts in the first stage to four fifty watt tubes in the last stage. The volume of the voice current is many times multiplied in this manner until it reaches a value sufficient to actuate the four water cooled modulato tubes.

KYW is now on an equal basis with her older sisters, KDKA and WBZ, and is prepared to put a consistent signal of the highest quality into the homes of the middle western listeners-in throughout the entire year.

How to Make a New Slide Wire Bridge

(Continued from page 53)

The operation of the slide wire bridge is simple. As previously explained, all that is required will be to connect an ordinary set of head-phones to the binding posts (R) and (R1) and turn the switch (SW) to the "ON" position. The coils or condensers to be matched or balanced will be connected to the binding posts (X) and (X1) and (Y) and (Y1), as directed in the following examples.

Balancing Transformer

TO BALANCE the coils of a transformer or other type of inductive coil, connect the inside terminal of one of the coils to binding post (X) and the outside terminal of the same coil to binding post (X1). The same procedure will be taken with the other coil except the terminals will be connected to binding posts (Y) and (Y1). The switch (SW) will be turned to its "ON" position and the dial rotated to the right or left until no tone is heard in the head phones. If the silent point falls on 50, the impedance of the coils is the same; if the silent period shows a dial reading of 40, the coil connected to the binding posts (X) and (X1) has a greater impedance than the coil connected across binding posts (Y) and (Y1) and it will be necessary to add turns of wire to coil (Y) until the dial reading shows 50 at the silent period.

If the dial reading should fall on 60, the coil connected across binding posts (Y) and (Y1) will have an impedance greater than coil (X) and it will be necessary to remove turns of wire from coil (Y) to match it with coil (X). When it is desired to match a coil or winding with a coil or winding that is not to be changed it would be well to get into the habit of considering the coil connected to binding posts (Y) and (Y1) as the master and always work coil (X) as the variable or coil to be balanced.

To balance more than two coils or windings, the first two will be balanced as above and coil (X) will be removed; the third coil will then be connected to the binding posts (X) and (X1) and be balanced in the same manner.

Transformers or coils so matched or balanced will have characteristics similar enough to fall within a few meters of one another and should work well together.

Balancing Or Measuring Capacity

To measure the capacity between windings of a transformer, the same procedure will be followed as for measuring impedance, except that the inside terminal of the primary coil will be connected to binding post (X) or (Y) and the inside terminal of the secondary coil connected to binding post (X1) or (Y1). The dial will be rotated until the silent period is located and a balance obtained as was done for impedance; if the reading should fall on 50, the coils are matched, if it falls on 40, the capacity

(Turn to page 65)

between coils of the transformer (Y) is greater than that of coil (X) and the windings will have to be placed closer together or the dielectric material between the coils will have to be changed until the reading shows 50.

To measure the capacity of a condenser, a condenser whose capacity is known will be connected across binding posts (X) and (X1) and the condenser to be measured will be connected across binding posts (Y) and (Y1) the same operation will take place as on the other measurements except in determining the capacity. This will be done by reading the dial and working the following formula—assuming the capacity of the master condenser to be .5 mf. dial reading 25, then the capacity of condenser (X) will be greater than that of (Y) as explained in "Thompsons" method. To charge two condensers of unequal capacity with equal quantities of electricity requires a higher E. M. F. applied at the terminals of the smaller condenser, that is, the E. M. F. applied at the terminals must be inversely proportional to the capacities.

From this, it will be seen that a greater amount of electricity is being applied to the condenser (X) than to condenser (Y); therefore condenser (Y) is three times as large as (X) from reading the dial as (Y) $=\frac{a}{b}$ x (X) or 1.5 mf. For a graphic explaination of this formula see figure two.

Measuring Impedance of Inductive Coils

To measure the impedance of a coil, a coil whose impedance is known, will be connected across the binding posts (Y) and (Y1) and the coil to be measured will be connected across binding posts (X) and (X1). The same operation will take place as on the other measurements except in determining the impedance; this will be done by reading the dial and working the following formula—assuming the impedance of the master coil to be one henry, dial reading 60, then the impedance of the coil (X) will be $\frac{b}{a}$ x(X) or, substituting the values of the scale readings a=60. From this, b would be 40, as in the schematic diagram, figure two; b=100−a. The formula would then be $\frac{40}{60}$x1 henry=Y or .66 Henry.

Many other forms of measurements may be made on this instrument as well as those mentioned above. The same formulas will be used, slightly modified, remembering that the dial reading will take the place of "a" and that "b" will always be the result of subtracting the amount of a from the entire scale of the bridge, which is 100. From this, it will be found that if "a"=25 which would be the dial reading, then "b" will be 75 or the sum difference between the dial reading of 25 and the scale of 100.

To accurately measure resistance to direct current, it would be necessary to connect a galvanometer across the terminals (R) and (R1) and to connect the small battery across terminals (I3) and (I4), with the switch (SW) in the (OFF) position.

Corrected List of Broadcasting Stations

KDKA	Westinghouse Electric & Mfg. Co.	East Pittsburgh, Pa.	309
KDLR	Radio Electric Co.	Devils Lake, N. D.	231
KDPM	Westinghouse Electric & Mfg. Co.	Cleveland, Ohio	270
KDYL	Newhouse Hotel	Salt Lake City, Utah	250
KDZB	Frank E. Siefert	Bakersfield, Calif.	240
KDZI	Electric Supply Co.	Wenatchee, Wash.	360
KFAB	Nebraska Buick Auto Co., 13th & Que Sts.	Lincoln, Nebr.	341
KFAD	McArthur Bros. Mercantile Co.	Phoenix, Ariz.	273
KFAE	State College of Washington	Pullman, Wash.	348
KFAF	Western Radio Corporation	Denver, Colo.	278
KFAJ	University of Colorado	Boulder, Colo.	360
KFAN	University of Idaho	Moscow, Idaho	230
KFAU	Boise High School	Boise, Idaho	271
KFAW	The Radio Den (W. B. Ashford)	Santa Ana, Calif.	280
KFBB	F. A. Buttrey & Co.	Havre, Mont.	360
KFBC	W. K. Azbill	San Diego, Calif.	278
KFBG	First Presbyterian Church	Tacoma, Wash.	250
KFBK	Kimball-Upson Co.	Sacramento, Calif.	283
KFBL	Leese Bros.	Everett, Wash.	224
KFBS	School District No. One	Trinidad, Colorado	238
KFCB	Nielson Radio Supply Co.	Phoenix, Ariz.	238
KFCC	The First Congregational Church	Helena, Mont.	248
KFCF	Frank A. Moore	Walla Walla, Wash.	256
KFCZ	Omaha Central High School	Omaha, Nebr.	258
KFDD	St. Michaels Cathedral	Boise, Idaho	252
KFDH	University of Arizona	Tucson, Ariz.	368
KFDJ	Oregon Agricultural College	Corvallis, Oreg.	254
KFDM	Magnolia Petroleum Co.	Beaumont, Texas	315
KFDX	First Baptist Church	Shreveport, La.	360
KFDY	South Dakota State College	Brookings, S. Dak.	360
KFDZ	Harry O. Iverson	Minneapolis, Minn.	231
KFEC	Meier & Frank Co.	Portland, Oreg.	248
KFEK	Augsbury Seminary	Minneapolis, Minn.	261
KFEL	Winner Radio Corp.	Denver, Colo.	254
KFEQ	J. L. Scroggin	Oak, Nebr.	268
KFEY	Bunker Hill & Sullivan Mining and Concentrating Co.	Kellogg, Idaho	233
KFFP	First Baptist Church	Moberly, Mo.	260
KFFV	Graceland College	Lamoni, Iowa	280
KFGB	Heidhreder Radio Supply Co.	Utica, Neb.	224
KFGC	Louisiana State University	Baton Rouge, La.	254
KFGD	Chickasha Radio & Electric Co.	Chickasha, Okla.	248
KFGH	Leland Stanford University	Stanford University, Calif.	273
KFGS	Crary Hardware Co.	Boone, Iowa	226
KFHA	Western State College of Colorado	Gunnison, Colo.	252
KFHH	Ambrose A. McCue	Neah Bay, Wash.	261
KFHL	Penn College	Oskaloosa, Iowa	240
KFI	E. C. Anthony, Inc.	Los Angeles, Calif.	468
KFIF	Benson Polytechnic Institute	Portland, Oreg.	248
KFIO	North Central High School	Spokane, Wash.	252
KFIQ	First Methodist Church	Yakima, Wash.	242
KFIU	Alaska Electric Light & Power Co.	Juneau, Alaska	226
KFIZ	Daily Commonwealth	Fond du Lac, Wis.	273
KFJB	Marshall Electrical Co.	Marshalltown, Iowa	248
KFJC	R. B. Fegan (Episcopal Church)	Junction City, Kansas	219
KFJF	National Radio Manufacturing Co.	Oklahoma City, Okla.	252
KFJI	Liberty Theatre (E. E. Marsh)	Astoria, Oreg.	252
KFJL	Hardsaeg Manufacturing Co.	Ottumwa, Iowa	242
KFJM	University of North Dakota	Grand Forks, N. Dak.	280
KFJR	Ashley C. Dixon & Son	Stevensville, Mont.	258
KFJX	Iowa State Teacher's College	Cedar Falls, Iowa	280
KFJY	Tuowall Radio Co.	Fort Dodge, Iowa	246
KFJZ	W. E. Branch	Fort Worth, Texas	254
KFKA	Colorado State Teachers College	Greeley, Colo.	273
KFKQ	Conway Radio Laboratories (Ben H. Woodruff)	Conway, Ark.	250
KFKU	The University of Kansas	Lawrence, Kans.	275
KFKX	Westinghouse Electric & Manufacturing Co.	Hastings, Nebr.	288
KFLD	Paul E. Greenlaw	Franklinton, La.	234
KFLP	Everett M. Foster	Cedar Rapids, Ia.	256
KFLR	University of New Mexico	Albuquerque, New Mexico	254
KFLU	Rio Grande Radio Supply House	San Benito, Texas	236
KFLV	Rev. A. T. Frykman	Rockford, Ill.	229
KFLX	George Roy Clough	Galveston, Texas	240
KFLZ	Atlantic Automobile Co.	Atlantic, Ia.	273
KFMB	Christian Churches	Little Rock, Ark.	254
KFMQ	University of Arkansas	Fayetteville, Ark.	299
KFMR	Morningside College	Sioux City, Iowa	261
KFMW	M. G. Sateren	Houghton, Mich.	266
KFMX	Carleton College	Northfield, Minn.	336
KFNF	Henry Field Seed Co.	Shenandoah, Iowa	266
KFNG	Wooten's Radio Shop	Coldwater, Miss.	254
KFNV	L. A. Drake Battery and Radio Supply Shop	Santa Rosa, Calif.	234
KFOA	Rhodes Department Store	Seattle, Wash.	454
KFOL	Leslie M. Schafbush	Marengo, Iowa	234
KFON	Echophone Radio Shop	Long Beach, Calif.	234
KFOO	Latter Day Saints University	Salt Lake City, Utah	261
KFOP	Rohrer Elec. Co.	Marshfield, Ore.	240
KFOR	David City Tire & Electric Co.	David City, Nebraska	226
KFOT	College Hill Radio Club	Wichita, Kansas	231
KFOX	Board of Education, Technical High School	Omaha, Nebraska	248
KFOY	Beacon Radio Service	St. Paul, Minn.	226
KFPG	Garretson and Dennis	Los Angeles, Calif.	238
KFPL	C. C. Baxter	Dublin, Texas	242
KFPM	The New Furniture Co.	Greenville, Texas	242
KFPR	Los Angeles County Forestry Dept.	Los Angeles, Calif.	231
KFPT	Cape & Johnson	Salt Lake City, Utah	286
KFPW	St. Johns M. E. Church	Carterville, Mo.	268
KFPY	Symons Investment Co.	Spokane, Wash.	283
KFQA	The Principia	St. Louis, Mo.	264
KFQB	The Searchlight Publishing Co.	Fort Worth, Texas	221
KFQC	Kidd Brothers Radio Shop	Taft, Calif.	258
KFQH	Radio Service Co.	Burlingame, Calif.	231
KFQP	G. S. Carson, Jr.	Iowa City, Ia.	284
KFQT	Texas National Guard	Dennison, Texas	252
KFQU	W. Riker	Holy City, Calif.	253
KFQW	C. F. Knierim	North Bend, Wash.	248
KFQZ	Taft Products Co.	Hollywood, Calif.	240
KFRC	City of Paris Dry Goods Co.	San Francisco, Calif.	268
KFRU	Etherical Radio Co.	Bristow, Okla.	394
KFRW	United Churches of Olympia	Olympia, Wash.	220
KFRX	J. Gordon Klemgard	Pullman, Wash.	217
KFRZ	The Electric Shop	Hartington, Neb.	222
KFSG	Angelus Temple	Los Angeles, Calif.	272
KFSY	The Van Blaricon Co.	Helena, Mont.	261
KFUJ	Hopper Plumbing and Heating Co.	Breckenridge, Minn.	242
KFUL	Thomas Gorman & Bros. Music Co.	Galveston, Texas	258
KFUM	W. D. Pyle	Colorado Springs, Colo.	242
KFUO	Concordia Seminary	St. Louis, Mo.	549
KFUP	Fitzsimmons General Hospital	Denver, Colo.	234
KFUQ	Julius Brunton and Sons Co.	San Francisco, Calif.	234
KFUR	H. W. Peery and C. Radfield	Ogden, Utah	224
KFUS	Louis L. Sherman	Oakland, Calif.	233
KFUT	University of Utah	Salt Lake City, Utah	271
KFUU	Colburn Radio Labs.	San Leandro, Calif.	231
KFUZ	Y. M. C. A.	Virginia, Minn.	244
KFVD	McWhinnie Electric Co.	San Pedro, Calif.	202
KFVE	Film Corporation of America	St. Louis, Mo.	245
KFVF	Clarence B. Juneau	Hollywood, Calif.	208
KFVG	First M. E. Church	Independence, Kansas	236
KFVH	Whan Radio Shop (Herbert Whan)	Manhattan, Kansas	218
KFVI	Headquarters Troop, 56th Calvary	Houston, Texas	248
KFVN	Carl E. Bagley	Welcome, Minn.	227
KFVO	F. M. Henry	Kirksville, Mo.	226
KFVR	Moonlight Ranch	Route 6, Denver, Colo.	246
KFVS	Cape Girardeau Battery Station	Cape Girardeau, Mo.	224
KFVY	Radio Supply Co.	Albuquerque, N. M.	250
KFVZ	Glad Tidings Tabernacle	San Francisco, Calif.	234
KFWA	Browning Bros. Co.	Ogden, Utah	214
KFWB	Warner Bros.	Hollywood, Calif.	252
KFWC	L. E. Wall	Upland, Calif.	211
KFWV	Wilbur Jerman	385 58th St. S., Portland, Ore.	212
WGBU	Florida Cities Finance Co.	Fulford By-The-Sea, Florida	278
KFXB	Bertram O. Heller	Big Bear Lake, Calif.	203
KFWD	Arkansas Light & Power Co.	Arkadelphia, Arkansas	266
KFWF	St. Louis Truth Center	St. Louis, Mo.	214
KFWH	F. Wellington Morse, Jr.	Chico, Calif.	254
KFWI	Radio Entertainments, Inc.	South San Francisco, Calif.	220
KFWM	Oakland Educational Society	Oakland, Calif.	224
KFWO	Lawrence Mott	Avalon, Calif.	211
KFWP	Rio Grande Radio Supply House	Brownsville, Texas	214
KFWU	Louisiana College	Pineville, La.	238
KFXC	Santa Maria Valley Railroad Co.	Santa Maria, Calif.	210
KFXD	L. H. Strong	Logan, Utah	205
KFXE	Electrical Research & Mfg. Co.	Waterloo, Iowa	236
KFXF	Pikes Peak Broadcasting Co.	Colorado Springs, Colo.	250
KGB	Tacoma Daily Ledger	Tacoma, Wash.	252
KGO	General Electric Co.	Oakland, Calif.	361
KGU	Marion A. Mulrony	Honolulu, Hawaii, Waikiki Beach	370
KGW	Portland Morning Oregonian	Portland, Oreg.	491
KGY	St. Martins College (Reh. Sebastian Ruth)	Lacy, Wash.	253
KHJ	Times-Mirror Co.	Los Angeles, Calif.	405
KHQ	Louis Wasmer	Seattle, Wash.	273
KJR	Northwest Radio Service Co.	Seattle, Wash.	384
KJS	Bible Institute of Los Angeles, Inc.	Los Angeles, Calif.	293
KLDS	Reorganized Church of Jesus Christ of Latter Day Saints,	Independence, Mo.	441
KLS	Warner Brothers Radio Supplies Co.	Oakland, Calif.	242
KLX	Tribune Publishing Co.	Oakland, Calif.	508
KLZ	Reynolds Radio Co.	Denver, Colo.	283
KMA			
KMJ	San Joaquin Light & Power Corp.	Fresno, Calif.	243
KMO	Love Electric Co.	Tacoma, Wash.	250
KNX	Los Angeles Evening Express	Los Angeles, Calif.	337
KOA	General Electric Co.	Denver, Colo.	323
KOB	New Mexico College of Agriculture & Mechanic Arts,	State College, N. Mex.	348
KOIL	Monarch Manufacturing Co.	Council Bluffs, Iowa	278
KOP	Detroit Police Department	Detroit, Mich.	286
KPO	Hale Bros.	San Francisco, Calif.	428
KPPC	Pasadena Presbyterian Church	Pasadena, Calif.	229
KPRC	Houston Post-Dispatch	Houston, Texas	270
KQP	Apple City Radio Club	Hood River, Oregon	270
KQV	Doubleday-Hill Electric Co.	Pittsburgh, Pa.	270
KQW	Charls D. Herrold	San Jose, Calif.	226
KRE	V. C. Battery & Electric Co.	Berkeley, Calif.	275
KSAC	Kansas State Agricultural College	Manhattan, Kans.	341
KSD	Post Dispatch (Pulitzer Pub. Co.)	St. Louis, Mo.	545
KSL	Radio Service Corp. of Utah	Salt Lake City, Utah	299
KTAB	Tenth Ave. Baptist Church	Oakland, Cal.	216
KTCL	American Radio Telephone Co., Inc.	Seattle, Wash.	306
KTHS	New Arlington Hotel Co.	Hot Springs, Ark.	375
KTW	First Presbyterian Church	Seattle, Wash.	455
KUO	Examiner Printing Co.	San Francisco, Calif.	246
KUOM	State University of Montana	Missoula, Montana	244
KUPR	Union Pacific Railroad Co.	Omaha, Neb.	270
KWG	Portable Wireless Telephone Co.	Stockton, Calif.	248
KWKC	Wilson Duncan Studios	Kansas City, Mo.	236
KWWG	City of Brownsville	Brownsville, Texas	278
KYO	Electric Shop	Honolulu, Hawaii	270
KYW	Westinghouse Electric & Mfg. Co.	Chicago, Ill.	535
KZM	Preston D. Allen	Oakland, Calif.	242
WAAB	Valdemar Jansen	New Orleans, La.	263
WAAC	Tulane University	New Orleans, La.	275
WAAD	Ohio Mechanics Institute	Cincinnati, Ohio	248
WAAF	Chicago Daily Drovers Journal	Chicago, Ill.	286
WAAM	I. R. Nelson Co.	Newark, N. J.	263
WAAW	Omaha Grain Exchange	Omaha, Nebr.	285
WABA	Lake Forest University	Lake Forest, Ill.	227
WABB	Harrisburg Sporting Goods Co.	Harrisburg, Pa.	266
WABC	Asheville Battery Co., Inc.	Asheville, N. C.	254
WABI	Bangor Railway & Electric Co.	Bangor, Me.	240
WABL	Connecticut Agricultural College	Storrs, Conn.	283
WABO	Lake Avenue Baptist Church	Rochester, N. Y.	283
WABQ	Haverford College, Radio Club	Haverford, Pa.	261
WABR	Scott High School, N. W. B. Foley	Toledo, Ohio	270
WABW	College of Wooster	Wooster, Ohio	234
WABX	Henry B. Joy	Mt. Clemens, Mich.	270
WABY	John Magaldi, Jr.	Philadelphia, Pa.	242
WABZ	Coliseum Place Baptist Church	New Orleans, La.	263
WADC	Allen T. Simmons (Allen Theatre)	Akron, Ohio	258
WAFD	Albert B. Parfet Co.	Port Huron, Mich.	233
WAHG	A. H. Grebe & Co.	Richmond Hill, N. Y.	315
WAPI	Alabama Polytechnic Institute	Auburn, Ala.	248
WAMD	Huhhard & Co.	Minneapolis, Minn.	244
WBAA	Purdue University	W. Lafayette, Ind.	283
WBAC	Clemso Agric. College	Clemson College, S. C.	331
WBAH	The Dayton Co.	Minneapolis, Minn.	417
WBAK	Pennsylvania State Police	Harrisburg, Pa.	275
WBAO	James Millikan University	Decatur, Ill.	360
WBAP	Wortham-Carter Publishing Co. (Star Telegram)	Fort Worth, Texas	476
WBAV	Erner & Hopkins Co.	Columbus, Ohio	292
WBAX	John H. Stenger, Jr.	Wilkes-Barre, Pa.	254
WBAY	Western Electric Co.	New York, N. Y.	492
WBBG	Irving Vermilya	Mattapoisett, Mass.	248
WBBL	Grace Covenant Presbyterian Church	Richmond, Va.	253
WBBM	Atlass Investment Co.	Chicago, Ill.	226
WBBN	Blake, A. B.	Wilmington, N. C.	275
WBBP	Petoskey High School	Petoskey, Mich.	246
WBBR	Peoples Pulpit Asso.	Rossville, N. Y.	273
WBBS	First Baptist Church	New Orleans, La.	252
WBBU	Jenks Motor Sales Co.	Monmouth, Ill.	224
WBBX	Ruffner Junior High School	Norfolk, Va.	222
WBBY	Washington Light Infantry Co. "B" 118th Inf.	Charleston, S. C.	268
WBCN	Foster & McDoland	Chicago, Ill.	266
WBDC	Baxter Laundry Co.	Grand Rapids, Mich.	256
WBES	Bliss Electrical School	Takoma Park, Md.	222
WBGA	Jones Elec. & Radio Mfg. Co.	Baltimore, Md.	254
WBOQ	A. H. Grebe & Co., Inc.	Richmond Hill, N. Y.	236
WBR	Pennsylvania State Police	Butler, Pa.	286
WBRC	Bell Radio Corporation	Birmingham, Ala.	248
WBRE	Baltimore Radio Exchange	Wilkes-Barre, Pa.	231
WBS	D. W. May, Inc.	Newark, N. J.	252
WBT	Southern Radio Corp.	Charlotte, N. C.	275
WBZ	Westinghouse Electric & Mfg. Co.	Springfield, Mass.	333
WBZA	Westinghouse Electric & Mfg. Co. Hotel Brunswick,	Boston, Mass.	242
WCAD	St. Lawrence University	Canton, N. Y.	280
WCAE	Kaufmann & Baer Co. and The Pittsburgh Press	Pittsburgh, Pa.	461
WCAH	Entrekin Electric Co.	Columbus, Ohio	286
WCAJ	Nebraska Wesleyan University	University Place, Nebr.	283
WCAL	St. Olaf College	Northfield, Minn.	336
WCAO	Sanders & Stayman Co.	Baltimore, Md.	275
WCAP	Chesapeake & Potomac Telephone Co.	Washington, D. C.	468
WCAR	Alamo Radio Electric Co.	San Antonio, Texas	263
WCAS	W. H. Dunwoody Industrial Institute	Minneapolis, Minn.	280
WCAT	State College of Mines	Rapid City, S. Dak.	240
WCAU	Durham & Co.	Philadelphia, Pa.	278
WCAX	University of Vermont	Burlington, Vt.	250
WCAZ	Carthage College	Carthage, Ill.	248
WCBA	Charles W. Heibachm	Allentown, Pa.	280
WCBC	University of Michigan	Ann Arbor, Mich.	280
WCBD	Wilbur C. Voliva	Zion, Ill.	344
WCBE	Uhalt Radio Co.	New Orleans, La.	263
WCBF	Paul J. Miller	Pittsburgh, Pa.	236
WCBG	Howard S. Williams (Portable)	Pascagoula, Miss.	268
WCBH	University of Miss.	Oxford, Miss.	242

Some Real Facts About Quality

(Continued from page 13)

nently. The violin and smaller horn instruments carry the weight of the music. Now, with the cone speaker alone, the drums come into evidence with their steady beat—the chords on the piano, the bass violin with its "plunk! plunk!" and the bass saxophone. Neither of these represents the orchestra fairly, yet with both speakers connected, these various instruments may be picked out individually and the effect as a whole is extremely realistic.

The lower notes can be heard to a considerable extent even with a transformer-coupled amplifier, so that these suggestions are applicable to both kinds of audio amplifier.

Fig. 3 shows a useful method of connecting the two loud speakers where two tubes are connected in parallel for the last stage of the amplifier, whether it be resistance or transformer coupled. Each speaker has a tube to itself, so that the distribution of output is fairly even and the improvement is more noticeable than where the speakers are in parallel as well as the tubes. The use of a good power tube, is, however, slightly superior to paralleling of tubes nevertheless.

A simple loud speaker for low notes is illustrated in a rear view on page 11. It is simply an ordinary mandolin about 10 inches in diameter, having the unit of a Baldwin large type receiver as an actuating unit. The unit is taken out of its case. Fig. 5 gives a cross section of the assembly. Piece "a" is a small block of wood about 3 ¼ inches long and 1-2x1-2 inch in cross-section. A ¼ inch hole is drilled at the center for passage of the driving pin and there are two holes for No. 8/32 machine screws that are about 2 ¾ inches apart. This forms the inner clamp for the unit. The outer clamp is of similar nature, long enough to fit very tightly between the sides of the mandolin frame with a "forced fit." Thus piece "b," the outer clamp, is merely forced into position by wedging it inside the mandolin. The fingerboard is removed to permit the assembly of the unit and clamps. Pieces "c," "c" are two long 8/32 machine screws for tightening the clamps.

The driving pin may be made of a long common pin with the head clipped off. The diaphragm is cut out of the Baldwin unit and the short driving pin already in it cut and removed from the armature. The new pin, which should be long enough to extend from the armature to the mandolin head and allow about ⅛ inch clearance under the inner clamp "a," is inserted, sharp point first, in the small hole in the armature. The point is bent around to form a hook and it may be soldered if desired, although this is not absolutely essential. A hole is punched in the exact center of the mandolin head, which should be stretched rather tightly over the frame. If the sheepskin is too loose, it may be tighened by tightening the clamping screws around the rim—using the key wrench made for the purpose.

Fastening the Pin

The assembly must be carefully inserted in the mandolin so that the pin passes through the hole in the head. The frame may be sprung out of shape slightly to permit the outer clamp to enter and then released when the job is finished. The pin must not touch the

WCBM	Charles Swarz	Baltimore, Md.	229
WCBN	James P. Boland	Ft. Benj. Harrison, Ind.	266
WCBQ	First Baptist Church	Nashville, Tenn.	236
WCBR	C. H. Masster	Providence, R. I.	246
WCBT	Clark University, Collegiate Dept.	Worcester, Mass.	238
WCBU	Arnold Wireless Supply Co.	Arnold, Pa.	254
WCBX	Radio Shop of Newark (Herman Lubinsky)	Newark, N. J.	233
WCCO	Washburn-Crosby Co.	Twin Cities, Minn.	416
WCEE	Charles E. Erbstein, Villa Olivia	near Elgin, Ill.	275
WCLO	C. E. Whitmore	Camp Lake, Wisc.	231
WCLS	H. M. Couch	Joliet, Ill.	214
WCSH	Henry P. Rines	Portland, Maine	256
WCTS	C. T. Scheror Co.	Worcester, Mass.	268
WCX WJR	Free Press and Jewett Radio & Phonograph Co.	Detroit, Mich	516
WDAE	Tampa Daily Times	Tampa, Fla..	365
WDAF	Kansas City Star	Kansas City, Mo.	365
WDAG	J. Laurence Martin	Amarillo, Texas	263
WDAR	Lit Brothers	Philadelphia, Pa.	393
WDAY	Radio Equipment Corp.	Fargo, N. Dak.	244
WDBA	Fred Ray	Columbus, Ga.	236
WDBB	A. H. Waite & Co., Inc.	Taunton, Mass.	229
WDBC	Kirk, Johnson & Co.	Lancaster, Pa.	258
WDBD	Herman Edwin Burns	Martinsburg, W. Va.	268
WDBE	Gilham-Schoen Elec. Co.	Atlantic, Ga.	278
WDBJ	Richardson Wayland Electric Corp.	Roanoke, Va.	229
WDBK	M. P. Broz.	Cleveland, Ohio	227
WDBL	Wis. Dept. of Markets	Stevens Point, Wis.	278
WDBN	Electric Light & Power Co.	Bangor, Me.	252
WDBO	Rollins College, Inc.	Winter Park, Fla.	240
WDBQ	Morton Radio Supply Co.	Salem, N. J.	234
WDBR	Tremont Temple Baptist Church	Boston, Mass	256
WDBV	The Strand Theatre	Fort Wayne, Ind.	258
WDBX	Otto Baur	New York, N. Y.	233
WDBY	North Shore Congregational Church	Chicago, Ill.	258
WDBZ	Boy Scouts, City Hall	Kingstown, N. Y.	233
WDOD	Chattanooga Radio Co., Inc.	Chattanooga, Tenn.	256
WDWF	Dutee Wilcox Flint, Inc.	Cranston, R. I.	441
WDZ	J. L. Bush	Tuscola, Ill.	278
WEAA	F. D. Fallain	Flint, Mich.	250
WEAF	American Telephone & Telegraph Co.	New York, N. Y.	485
WEAH	Hotel Lassen	Wichita, Kans.	280
WEAI	Cornell University	Ithaca, N. Y.	286
WEAJ	University of South Dakota	Vermillion, S. Dak.	283
WEAM	Borough of North Plainfield (W. Gibson Buttfield)	North Plainfield, N. J.	286
WEAN	Shepard Co.	Providence, R. I.	273
WEAO	Ohio State University	Columbus, Ohio	293
WEAR	Goodyear Tire and Rubber Co.	Cleveland, Ohio	389
WEAU	Davidson Bros. Co.	Sioux City, Iowa	275
WEAY	Iris Theatre (Will Horowitz, Jr.)	Houston, Texas	270
WEB	Benwood Co.	St. Louis, Mo.	273
WEBA	Electric Shop	Highland Park, N. J.	233
WEBC	Walter Cecil Bridges	Superior, Wis.	242
WEBD	Electrical Equipment and Service Co.	Anderson, Ind.	246
WEBE	Roy W. Walker	Cambridge, Ohio	248
WEBH	Edgewater Beach Hotel, Chicago Evening Post Station	Chicago, Ill.	370
WEBJ	Third Avenue Railway Co.	New York, N. Y.	273
WEBK	Grand Rapids Radio Co.	Grand Rapids, Mich.	242
WEBM	Radio Corporation of America	Portable	226
WEBP	E. B. Pedicord	New Orleans, La.	280
WEBT	The Dayton Coop. Industrial High School	Dayton, Ohio	270
WEBW	Beloit College	Beloit, Wis.	283
WEEI	The Edison Electric Illuminating Co	Boston, Mass.	475
WEHS	Robert E. Hughes	Evanston, Ill.	205
WEMC		Berrien Springs, Mich.	285
WENR	All-American Radio Corporation	Chicago, Illinois	266
WEW	St. Louis University	St. Louis, Mo.	280
WFAA	Dallas News & Dallas Journal	Dallas, Tex.	472
WFAM	Times Publishing Co.	St. Cloud, Minn.	273
WFAV	University of Nebraska, Department of Electrical Engineering	Lincoln, Nebr.	275
WFBC	First Baptist Church	Knoxville, Tenn.	250
WFBD	Gethsemane Baptist Church	Philadelphia, Pa.	234
WFBE	Van De Walle Music and Radio Co.	Seymour, Ind.	226
WFBG	The Wm. F. Cable Co.	Altoona, Pa.	261
WFBH	Concourse Radio Corporation	New York, N. Y.	273
WFBJ	St. John's University	Collegeville, Minn.	236
WFBQ	Wynne Radio Co.	Raleigh, N. C.	255
WFBR	Fifth Inf. Md. Nat'l Guard, 5th Reg. Armory	Baltimore, Md.	452
WFBW	Ainsworth-Gates Radio Co.	Cincinnati, Ohio	309
WFBZ	Knox College	Galesburg, Ill.	254
WFI	Strawbridge and Clothier	Philadelphia, Pa.	394
WFKB	Francis K. Bridgman	Chicago, Ill.	217
WFUV	G. Pearson Ward	Springfield, Mo.	252
WFUW	Earl William Lewis	Moberly, Mo.	233
WGAL	Lancaster Electric Supply & Construction Co.	Lancaster, Pa.	218
WGAQ	Youree Hotel	Shreveport, La.	252
WGAZ	South Bend Tribune	South Bend, Ind.	360
WGBB	Harry H. Carman, 217 Bedell St.	Freeport, N. Y.	244
WGBC	First Baptist Church	Memphis, Tenn.	266
WGBF	Fink Furniture Co.	Evansville, Ind.	217
WGBG	Brietenbach's Radio Shop	Thrifton, Va.	226
WGBI	Frank S. Megarree	Scranton, Pa.	240
WGBK	Lawrence Campbell	Johnstown, Pa.	218
WGBM	Theodore N. Saaty	Providence, R. I.	234
WGBL	Elyria Radio Asso. (Albert H. Ernst)	Elyria, Ohio	227
WGBQ	Stout Institute	Menominee, Wis.	234
WGBR	Marshfield Broadcasting Assn.	Marshfield, Wis.	229
WGBS	Gimbel Brothers	New York, N. Y.	315
WGRT	Furman University	Greenville, S. C.	236
WGRX	University of Maine	Orono, Mo.	252
WGES	Coyne Electrical School	Oak Park, Ill.	250
WGI	American R. & R. Co.	Medford Hillside, Mass.	261
WGMU	A. H. Grebe & Co., Inc., Portable	Richmond Hill, N. Y.	236
WGN	The Tribune	Chicago, Ill.	370
WGR	Federal T. and T. Co.	Buffalo, N. Y.	319
WGY	General Elec. Co.	Schenectady, N. Y.	379
WHA	University of Wisconsin	Madison, Wis.	535
WHAD	Marquette University and Milwaukee Journal	Milwaukee, Wis.	280
WHAG	University of Cincinnati	Cincinnati, Ohio	222
WHAH	Hafer Supply Co.	Joplin, Mo.	283
WHAM	University of Rochester (Eastman School of Music)	Rochester, N. Y.	278
WHAP	H. Alvin Simmons, 290 Flatbush Ave.	Brooklyn, N. Y.	240
WHAR	Seaside House	Atlantic City, N. J.	275
WHAS	Courier-Journal & Louisville Times	Louisville, Ky.	399
WHAT	Dr. George W. Young	Minneapolis, Minn.	231
WHAV	Wilmington Electrical Specialty Co.	Wilmington, Del.	360
WHAZ	Rensselaer Polytechnic Institute	Troy, N. Y.	385
WHB	Sweeney School Co.	Kansas City, Mo.	365
WHBA	C. C. Shaffer	Oil City, Pa.	250
WHBB	Hobel's Store	Stevens Point, Wis.	240
WHBC	Rev. E. P. Graham	Canton, Ohio	245
WHBD	Chas. W. Howard	Bellefontaine, Ohio	222
WHBF	Beardsley Specialty Company	Rock Island, Illinois	222
WHBG	John S. Skane	Harrisburg, Pa.	231
WHBH	Culver Military Academy	Culver, Ind.	222
WHBI	Lauer Auto Co.	Ft. Wayne, Ind.	234
WHBK	Franklin St. Garage, Inc.	Ellsworth, Me.	231
WHBL	James H. Slusser	Logansport, Ind.	220
WHBM	C. L. Carroll, Portable Station	Chicago, Ill.	233
WHBN	First Ave. Methodist Church	St. Petersburg, Florida	258
WHBP	Johnstown Automobile Co.	Johnstown, Pennsylvania	256
WHBQ	St. John's M. E. Church South	Memphis, Tenn.	233
WHBR	Scientific Electric & Mfg. Co., 3664 Vine St.	Cincinnati, Ohio	216
WHBU	Riviera Theatre and Bing's Clothing	Anderson, Ind.	218
WHBW	D. R. Kienzle	Philadelphia, Pa.	215
WHBY	St. Norbert's College	West De Pere, Wis.	250
WHEC	Hickson Electric Co., Inc.	Rochester, N. Y.	258
WHK	Radiovox Company	Cleveland, Ohio	273
WHN	George Schubert	New York, N. Y.	360
WHO	Bankers' Life Co.	Des Moines, Ia.	526
WHT	Wrigley Building, Chicago	Deerfield, Ill.	238
WIAD	Howard R. Miller	Philadelphia, Pa.	254
WIAQ	Chronicle Publishing Co.	Marion, Ind.	226
WIAS	Home Electric Co.	Burlington, Iowa	283
WIBA	The Capital-Times Studio	Madison, Wis.	236
WIBC	L. M. Tate Post, No. 29, Veterans of Foreign Wars	St. Petersburg, Florida	222
WIBD	X-L Radio Service	Joliet, Illinois	200
WIBG	St. Paul's Protestant Episcopal Church	Elkins Park, Pa.	222
WIBO	Nelson Brothers	Chicago, Ill.	226
WIBH	Elite-Radio Stores	New Bedford, Mass.	209
WIBI	Frederick B. Zittell, Jr.	Flushing, N. Y.	219
WIBJ	C. L. Carrell (Portable)	Chicago, Ill.	216
WIBK	University of Toledo	Toledo, Ohio	205
WIBP	First Presbyterian Church	Meiridian, Miss.	210
WIBQ	F. M. Schmidt	Farina, Ill.	205
WIBR	Thurman A. Owings	Werton, W. Va.	246
WIBS	New Jersey Nat'l Guard Hdqs. Co.	Elizabeth, N. J.	203
WIBT	Orlando Edgar Miller (Portable Station)	New York, N. Y.	211
WIBU	The Electric Farm	Poynette, Wis.	222
WIBW	Dr. L. L. Dill	Logansport, Ind.	220
WIBX	Grid-Leak Inc.	Utica, N. Y.	205
WIBZ	Powell Electric Company	Montgomery, Ala.	231
WIL	Continental Electric Supply Co.	Washington, D. C.	360
WIP	Gimbel Bros.	Philadelphia, Pa.	509
WJAB	American Electric Co.	Lincoln, Nebr.	229
WJAD	Jackson's Radio Engineering Laboratories	Waco, Texas	352
WJAG	Norfolk Daily News	Norfolk, Nebr.	283
WJAK	Clifford L. White	Greentown, Iowa	254
WJAM	D. M. Perham	Cedar Rapids, Iowa	268
WJAR	The Outlet Co. (J. Samuels & Bro.)	Providence, R. I.	306
WJAS	Pittsburgh Radio Supply House	Pittsburgh, Pa.	286
WJAZ	Chicago Radio Laboratory	Chicago, Ill.	268
WJBA	D. H. Lentz, Jr.	Joliet, Ill.	207
WJBB	L. W. McClure	St. Petersburg, Fla.	207
WJBC	Hummer Furniture Co.	LaSalle, Ill.	234
WJBD	Ashland Broadcasting Committee	Ashland, Wis.	233
WJBI	Robert S. Johnson	Red Bank, New Jersey	219
WJD	Denison University	Granville, Ohio	229
WJJD	Supreme Lodge, Loyal Order of Moose	Mooseheart, Ill.	303
WJR WCX	Jewett Radion & Phonograph Co and Detroit Free Press	Pontiac, Mich.	517
WJY	Radio Corp. of America	New York, N. Y.	455
WJZ	Radio Corp. of America	New York, N. Y.	455
WKAA	H. F. Pass	Cedar Rapids, Iowa	278
WKAD	Chas. Looff (Crescent Park)	East Providence, R. I.	240
WKAF	WKAF Broadcasting Co.	Milwaukee, Wis.	261
WKAQ	Radio Corp. of Porto Rico	San Juan, P. R.	340
WKAR	Michigan Agriculture College	East Lansing, Mich.	285
WKAV	Laconia Radio Club	Laconia, N. H.	254
WKBE	K. & B. Electric Co.	Webster, Massachusetts	231
WKBF	Dutee Wilcox Flint	Cranston, Rhode Island	286
WKBG	C. L. Carrel, Portable	Chicago, Ill.	216
WKBK	Miss Shirley Katz	New York, N. Y.	210
WKY	Wky Radio Shop	Oklahoma City, Okla.	275
WLAG	Cutting & Washington Radio Corp.	Minneapolis, Minn.	417
WLAL	First Christian Church	Tulsa, Okla.	250
WLAP	Wm. V. Jordan	Louisville, Ky.	286
WLAQ	Arthur E. Shilling	Kalamazoo, Mich.	283
WLAX	Putnam Electric Co.	Greencastle, Ind.	231
WLB	University of Minnesota	Minneapolis, Minn.	278
WLBL	Wisconsin State Dept. of Markets	Stevenspoint, Wis.	278
WLS	Sears Roebuck & Co.	Chicago, Ill.	344
WLTS	Lane Technical High School	Chicago, Ill.	258
WLW	Crosley Mfg. Co.	Cincinnati, Ohio	422
WLWL	Missionary Society of St. Paul the Apostle	New York, N. Y.	288
WMAC	J. Edw. Page (Olive B. Meredith)	Casenovia, N. Y.	261
WMAF	Round Hills Radio Corp.	Dartmouth, Mass.	440
WMAK	Norton Laboratories	Lockport, N. Y.	273
WMAL	Trenton Hardware Co.	Trenton, N. J.	256
WMAN	First Baptist Church	Columbus, Ohio	286
WMAQ	Chicago Daily News	Chicago, Ill.	447
WMAY	Kingshighway Presbyterian Church	St. Louis, Mo.	280
WMAZ	Mercer University	Macon, Ga.	261
WMBB	Trianon Ball Room	Chicago, Ill.	250
WMBF	Miami Beach Hotel	Miami Beach, Fla.	384
WMC	Commercial Appeal	Memphis, Tenn.	503
WMCA	Hotel McAlpin (Greeley Square Hotel Co.)	New York City	341
WMH	Ainsworth-Gates Radio Co.	Cincinnati, O.	321
WNAC	Shepard Stores	Boston, Mass.	284
WNAD	University of Oklahoma	Norman, Okla.	258
WNAL	Omaha Central High School	Omaha, Nebr.	255
WNAP	Wittenberg College	Springfield, Ohio	271
WNAR	First Christian Church	Butler, Mo.	230
WNAT	Lennig Brothers Co. (Frederick Lennig)	Philadelphia, Pa.	254
WNAX	Dakota Radio Apparatus Co.	Yankton, S. Dak.	248
WNOX	Peoples Tel. & Tel. Co.	Knoxville, Tenn.	268
WNYC	Dept. of Plant and Structures	New York, N. Y.	526
WOAC	Page Organ Co.	Lima, Ohio	260
WOAE	Midland College	Fremont, Nebr.	280
WOAG	Apollo Theatre (Belvidere Amusement Co.)	Belvidere, Ill.	274
WOAI	Southern Equipment Co.	San Antonio, Texas	392
WOAN	Vaughn Conservatory of Music (James D. Vaughn)	Lawrenceburg, Tenn.	280
WOAO	Lyradion Mfg. Co.	Mishawaka, Ind.	369
WOAR	Lundskow, Henry P.	Kenosha, Wis.	225
WOAT	Boyd M. Hamp	Wilmington, Del.	360
WOAV	Pennsylvania National Guard, 2d Battalion, 112th Infantry	Erie, Pa.	242
WOAW	Woodmen of the World	Omaha, Nebraska	526
WOAX	Franklyn J. Wolff	Trenton, N. J.	240
WOC	Palmer School of Chiropractic	Davenport, Iowa	484
WOCG	Triple Alliance Radio Station	Sycamore, Illinois	205
WOCL	Hotel Jamestown, Inc.	Jamestown, N. Y.	275
WODA	James K. O'Dea	Paterson, New Jersey	203
WOI	Iowa State College	Ames, Iowa	270
WOK	Neutrowound Radio Mfg. Co.	Homewood, Ill.	217
WOO	John Wanamaker	Philadelphia, Pa.	509
WOR	L. Bamberger and Co.	Newark, N. J.	405
WORD	Peoples Pulpit Assn.	Batavia, Ill.	275
WOS	State Marketing Bureau	Jefferson City, Mo.	440
WOWL	Owl Battery Company	New Orleans, La.	270
WOWO	Main Auto Supply Co.	Fort Wayne, Ind.	227
WPAB	Pennsylvania State College	State College, Pa.	283
WPAC	Donaldson Radio Co.	Okmulgee, Okla.	360
WPAJ	Doolittle Radio Corp.	New Haven, Conn.	268
WPAK	North Dakota Agricultural College	Agricultural College, N. D.	283
WPAL	Superior Radio & Telephone Equipment Co.	Columbus, Ohio	286
WPG	The Municipality of Atlantic City	Atlantic City, N. J.	300
WQAA	Horace A. Beale, Jr.	Parkersburg, Pa.	270
WQAC	E. B. Gish	Amarillo, Texas	234
WQAE	Moore Radio News Station (Edmund B. Moore)	Springfield, Vt.	275
WQAM	Electrical Equipment Co.	Miami, Fla.	283
WQAN	Scranton Times	Scranton, Pa.	280
WQAO	Calvary Baptist Church	New York, N. Y.	260
WOJ	Calumet Rainbo Broadcasting Co.	Chicago, Ill.	447
WRAF	The Radio Club (Inc.)	Laporte, Ind.	224
WRAK	Economy Light Co.	Escanaba, Mich.	256
WRAM	Lombard College	Galesburg, Ill.	244
WRAQ	St. Louis Radio Service Co.	St. Louis, Mo.	263
WRAV	Antioch College	Yellow Springs, Ohio	242
WRAW	Avenue Radio Shop (Horace D. Good)	Reading, Pa.	238
WRAX	Flaxon's Garage	Gloucester, City N. J.	268
WRRC	Imanuel Lutheran Church	Valparaiso, Ind.	278
WRC	Radio Corp. of America	Washington, D. C.	468
WREO	Reo Motor Car Co.	Lansing, Mich.	286
WRHF	Washington Radio Hospital Fund	Washington, C. D.	256
WRHM	Rosedale Hospital, Inc.	Minneapolis, Minn.	252
WRNY	Experimenter Publishing Co.	New York, N. Y.	258
WRK	Doron Bros.	Hamilton, Ohio	360
WRL	Union College	Schenectady, N. Y.	270
WRM	University of Illinois	Urbana, Ill.	273
WRMU	A. H. Grebe & Co., Inc., Motor Yacht "MU-1"	New York, N. Y.	236
WRW	Tarrytown Radio Res. Labs.	Tarrytown, N. Y.	273
WSAC	Clemson Agricultural College	Clemson College, S. C.	336

(Continued from page 67)

inner clamp or the coils in the unit. The pin is rotated, in case the soldered method hasn't been used, so that the bent end cannot touch the receiver coils, or the magnets. A few drops of sealing-wax on the head of the mandolin and on the pin serve to complete the speaker. The result is not a speaker that accentuates high notes in particular, its chief field being in the lower range. Hence, while suitable for independent operation for certain kinds of reception, its use as an accompaniment to a horn speaker is the chief consideration here.

In adjustment, the position of the outer clamp depends upon the strength of the current through the windings. Moreover, the direction of current through the windings must be such that upon closing the plate circuit of the tube (as by inserting the jack) the pin will pull (not push) upon the mandolin head. This may be felt on the head or may be seen by watching the slight movement of the armature in the unit. Care must be taken not to disturb the opposing spring located at the other end of the armature.

This auxiliary speaker may be located underneath a table in the room, near the horn speaker and it may be connected either in series or in parallel with it. Both connections should be tried. The outer clamp should be set so that no rattling occurs during reception—this being found with the proper tension on the head.

In this manner, or by supplementing the horn loud speaker with a device capable of reproducing the lower notes, the radio receiver as a whole becomes a more faithful repeater of what is going on at the broadcasting studio. Coupled with an improved audio amplifier, the radio set as the Home Theater comes into its intended role in full measure.

Aiding Condenser Handling

Thousands of radio fans have discovered that by the simple process of pressing on their condenser dials they can tune one station in and another out. The majority of them do not realize that this is extremely bad practice, and if persisted in will ultimately ruin the bearings of the condenser. This condition only exists where the two stations are close together in frequency and are crowded on the dial settings.

The obvious solution to this condition was early realized. It consisted of a tuning mechanism which would move the rotary plates of the condenser very slowly over the smallest possible distance in order to get the very minute change in capacity needed to tune the receiver to the frequency of the particular broadcasting station.

This led to the many various types of so-called "Vernier dials." The difficulty up to the present however has been twofold; first, the use of gears in these dials resulted in a certain amount of blacklash which prevented the condenser from remaining in a certain position; and, second, the condenser design itself was not correct for accurate tuning on the higher frequencies.

The latest type of vernier dial, known as the Microvern, employs an extremely simple mechanical principle which produces a reduction in turning movement of five to one without the use of gears. The reduction ratio of five to one has been found good under all normal conditions, as it is fast enough for rapid station finding, and slow enough for careful final adjustment.

WWGS	Radio Engineering Corp.	Richmond Hill, N. Y.	213
WSAI	United States Playing Card Co.	Cincinnati, Ohio	325
WSAJ	Grove City College	Grove City, Pa.	258
WSAN	Allentown Call Publishing Co.	Allentown, Pa.	229
WSAP	Seventh Day Adventist Church	New York, N. Y.	263
WSAR	Daughty & Welch Electrical Co.	Fall River, Mass.	254
WSAU	Camp Marienfaild	Chesham, New Hampshire	229
WSAV	C. W. Vick Radio Construction Co.	Houston, Texas	360
WSAY	Irving Austin (Port Chestar Chamber of Commerce)	Port Chester, N. Y.	233
WSAZ	Chas. Electric Shop	Pomeroy, Ohio	258
WSBF	Stix-Baer-Fuller D. G. Co.	St. Louis, Mo.	275
WSBC	World Battley Co.	1219 S. Wabash Ave., Chicago, Ill.	210
WSB	Atlanta Journal	Atlanta, Ga.	428
WSKC	World's Star Knitting Co.	Bay City, Mich.	261
WSMB	Saenger Amusement Co. and Maison Blanche Co.	New Orleans, La.	319
WSMH	Shattuck Music House	Owosso, Mich.	240
WSMK	S. M. K. Radio Corp.	Dayton, Ohio	275
WTAW	Agricultural & Mechanical College of Texas	College Station, Texas	280
WTAM	Willard Storage Battery Co.	Cleveland, Ohio	390
WTAX	Williams Hardware Co.	Streator, Ill.	231
WTAZ	Thomas J. McGuire	Lambertville, N. J.	283
WTHS	Flint Senior High School	Flint, Mich.	218
WTG	Kansas State Agricultural College	Manhattan, Kans.	273
WTIC	Travelers Insurance Co.	Hartford, Conn.	323
WTX	H. G. Saal Co.	Chicago, Ill.	268
WWAD	Wright & Wright (Inc.)	Philadelphia, Pa.	360
WWAE	The Alamo Ball Room	Joliet, Ill.	242
WWI	Ford Motor Co.	Dearborn, Mich.	273
WWJ	Detroit News (Evening News Assn.)	Detroit, Mich.	352
WWL	Loyola University	New Orleans, La.	260
WSOE	School of Engineering	Milwaukee, Wis.	246
WSRF	Hardam Sales and Service	Broadlands, Ill.	233
WSTA	Camp Marianfeld	Chesham, N. H.	229
WSUI	State University of Iowa	Iowa City, Iowa	498
WTAB	Fall River Daily Herald Publishing Co	Fall River, Mass.	248
WTAC	Penn Traffic Co.	Johnstown, Pa.	360
WTAD	Robt. E. Compton	Carthage, Ill.	236
WTAL	Toledo Radio & Electric Co.	Toledo, Ohio	252
WTAP	Cambridge Radio & Electric Co.	Cambridge, Ill.	242
WTAQ	S. H. Van Gordon & Son	Osseo, Wis.	220
WWGL	Radio Engineering Corp.	Richmond Hill, N. Y.	213
WTAR	Reliance Electric Co.	Norfolk, Va.	283
WTAS	Charles E. Erbstein	Elgin, Ill.	304
WTAT	Edison Electric Illuminating Co.	(portable) Boston, Mass.	240

Canadian Stations

CFAC	Calgary Herald	Calgary, Alta.	434
CFCA	Toronto Star Pub. & Prtg. Co.	Toronto, Ont.	357
CFCF	Marconi Wireless Teleg. Co., (Ltd.) Canada	Montreal, Que.	411
CFCH	Abitibi Power & Paper Co., (Ltd.)	Iroquois Falls, Ont.	500
CFCK	Radio Supply Co.	Edmonton, Alta.	517
CFCN	W. W. Grant (Ltd.)	Calgary, Alta.	434
CFCR	Laurentide Air Service	Sudbury, Ont.	410
CFCT	Victoria City Temple	Victoria, B. C.	329
CFCU	The Jack Elliott (Ltd.)	Hamilton, Ont.	341
CFHC	Henry Birks & Sons	Calgary, Alta.	434
CFKC	Thorold Radio Supply	Thorold, Ont.	248
CFQC	The Electric Shop (Ltd.)	Saskatoon, Sask.	329
CFRC	Queens University	Kingston, Ont.	450
CFXC	Westminster Trust Co.	Westminster, B. C.	291
CFYC	CommercialRadio (Ltd.)	Vancouver, B. C.	411
CHBC	The Calgary Albertan	Calgary, Alta.	434
CHCM	Riley & McCormack (Ltd.)	Calgary, Alta.	434
CHCS	The Hamilton Spectator	Hamilton, Ont.	341
CHIC	Northern Electric Co.	Toronto, Ont.	357
CHNC	Toronto Radio Research Society	Toronto, Ont.	357
CHUC	International Bible Ass'n.	Saskatoon, Sask.	329
CHXC	R. Booth, Jr.	Ottawa, Ont.	434
CHYC	Northern Electric Co.	Montreal, Que.	411
CJCA	Edmonton Journal	Edmonton, Alta.	511
CJCL	A. Couture	Montreal, Que.	279
CJGC	London Free Press	London, Ont.	321
CKAC	La Presse	Montreal, Que.	411
CKCD	Vancouver Daily Province	Vancouver, B. C.	397
CKCK	Leader Pub. Co.	Regina, Sask.	476
CKCO	Ottawa Radio Association	Ottawa, Ont.	434
CKCX	P. Burns & Co., (Ltd.)	Calgary, Alta.	434
CKFC	First Congregational Church	Vancouver, B. C.	411
CKLC	Wilkinson Electric Co., (Ltd.)	Calgary, Alta.	434
CKNC	Canadian National Carbon Co.	Toronto, Ont.	357
CKOC	Wentworth Radio Supply Co.	Hamilton, Ont.	341
CKY	Manitoba Tel. System	Winnipeg, Man.	384
CNRA	Canadian National Railways	Moncton, N. B.	312
CNRC	Canadian National Railways	Calgary, Canada	434
CNRE	Canadian National Railways	Edmonton, Alta.	517
CNRM	Canadian National Railways	Montreal, P. Q.	411
CNRO	Canadian National Railways	Ottawa, Ont.	434
CNRR	Canadian National Railways	Regina, Sask.	476
CNRS	Canadian National Railways	Saskatoon, Sask.	329
CNRT	Canadian National Railways	Toronto, Ont.	357
CNRV	Canadian National Railways	Vancouver, B. C.	411
CNRW	Canadian National Railways	Winnipeg, Man.	384

Cuban Stations

PWX	Cuban Telephone Co.	Habana	400
2DW	Pedro Zayas	Habana	300
2AB	Alberto S. de Bustamante	Habana	240
2OK	Mario Garcia Velez	Habana	360
2BY	Frederick W. Borton	Habana	260
2CX	Frederick W. Borton	Habana	320
2EV	Westinghouse Elec. Co.	Habana	220
2TW	Roberto E. Ramirez	Habana	230
2HC	Heraldo de Cuba	Habana	275
2LC	Luis Casas	Habana	250
2KD	E. Sanchez de Fuentes	Habana	350
2MN	Fausto Simon	Habana	270
2MG	Manuel G. Salas	Habana	280
2JD	Raul Perez Falcon	Habana	105
2K	Alvara Dasa	Habana	200
2HS	Julio Power	Habana	180
2OL	Oscar Collado	Habana	290
2WW	Amadeo Saenz	Habana	210
5EV	Leopoldo E. Figueroa	Colon	360
6KW	Frank H. Jones	Tuinucu	340
6KJ	Frank H. Hones	Tuinucu	275
6CX	Antonio T. Figueroa	Cienfuegos	170
6DW	Eduardo Terry	Cienfuegos	225
6BY	Josa Ganduxa	Cienfuegos	300
6AZ	Valentin Ullivarri	Cienfuegos	200
8BY	Alberto Ravelo	Stgo. de Cuba	250
8FU	Andres Vinnet	Stgo. de Cuba	225
8DW	Pedro C. Andus	Stgo. de Cuba	275

European Broadcasting Stations

British Stations

2LO	London	365	5NO	Newcastle	400
5IT	Birmingham	475	5SC	Glasgow	420
5WA	Cardiff	350	2BD	Aberdeen	492
6BM	Bournemouth	385	6SL	Sheffield (relay station)	303
2ZY	Manchester	375			

French Stations

YN	Lyons	740	8AJ	Paris	1,780
FL	Paris (Eiffel Tower)	2,600	ESP	Paris	450

Stewart-Warner Opens a Studio

Last Saturday night, August 1, marked the opening of one of Chicago's newest and most beautiful broadcasting studios. This studio is owned and operated by the Stewart-Warner Speedometer Corporation, and is located at 1826 Diversey Parkway.

The construction is of the latest and most scientific, using a special material which does not deaden the tone of the instrument or the voice, but retains it in all its naturalness and at the same time prevents any reverberations that have a tendency to jumble the music.

The fine manner in which this station has been received all over the country shows the important part that the studio construction plays in the satisfactory broadcasting of programs.

This studio is equipped with two Baldwin special broadcast grand pianos, a Wurlitzer harp, a beautiful announcer's desk, which is an exact copy of the desk used by George Washington in the White House.

The furnishings, selected with great care, are in perfect keeping with the beautiful surroundings. The entire color scheme blends in a most delightful manner, creating an atmosphere of harmony.

The studio is a departure from the usual draped studio, which, it is said, greatly adds to the comfort of the artists, being cool and pleasant even in the hottest weather.

The beautifully appointed reception room adjoining the studio provides every convenience for the waiting artists. It is furnished with a console model, Stewart-Warner Matched-Unit Radio which reproduces the program just as it is being broadcast, providing entertainment for those who are waiting their turn to go on the air.

All programs from this station are broadcast on a 226 meter wave length over Station WBBM.

Mohawk Electric Corporation Announcements

Announcement is made by the Mohawk Electric Corporation of Chicago, that they have recently completed arrangements with The Zinke Company of Chicago to sell the entire line of Mohawk Products. The Zinke Company, who have been established for 20 years, will maintain their policy of selling through the jobber Mohawk Receiving Sets and Mokawk Parts. An extensive selling campaign is planned for the sale of the Mohawk One Dial Receiving Sets.

The Mohawk Electric Corporation announce a revision downward of prices on their line of receiving sets which have "Just ONE Dial to Tune."

The Model VA, now known as Model 100 is priced at $100.00.

Model X is reduced from $250.00 to $175.00, while model XII was formerly sold for $300.00 now $275.00.

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 ten cents per word for a single insertion. Liberal discounts are allowed on three, six and twelve-time insertions, of five, fifteen and thirty per cent respectively. Unless placed through an accredited advertising agency, cash should accompany all orders. Name and address must be included at foregoing rates and no advertisement of less than ten words will be accepted.

All classified ads for the November issue must be sent in by October 1.

ADVERTISING SERVICE

QUEX Sales Letters Get More Business. Write him today. Quex, 4418 Michigan Ave., Chicago.

ENGINEERS about to begin six-months' research trip to territory West of the Mississippi, between Canada and Mexico, are willing to consider propositions for taking on radio lines on a distribution basis, with a view to establishing dealers, jobbers, agents, etc., in sparsely settled districts. Such territory would be exclusively apportioned. Address all communications in confidence. Only reputable lines and concerns will be considered. 100 per cent distribution and advertising representation assured at minimum per capita cost. Address, Harvey T. Kelley, Suite 301, 210 East Ohio Street, Chicago, Ill.

AGENTS WANTED

FORDS. 60 miles on one gallon of Gas. It has been proven such mileage can be made. AIRLOCK guarantees to increase gas mileage; also prevents radiator boiling in summer or freezing in winter. Cools, Fuels, Decarbonizes the Ford motor. Splendid territory open. AIRLOCK PRODUCTS, Box 703G, Willow Street, Long Beach, Calif.

RADIO—Join our sales organization and make big money. We want a man in every county to sell well advertised sets and parts made by the leading manufacturers. Widener of Kansas City makes $150.00 weekly. You can do as well or better. Write today for catalog, and discounts. Name your county. Waveland Radio Company, Div. 52, 1027 No. State St., Chicago, Ill.

MANUFACTURER'S AGENT calling on Radio-Electrical Jobbers, Chicago and vicinity, has opening for 3 additional lines carrying volume business, as we cater to large jobbers. Edelstein, 1804 McCormick Bld., Chicago.

AGENTS—WRITE FOR FREE SAMPLES. Sell Madison "Better-Made" Shirts for large manufacturer direct to wearer. No capital or experience required. Many earn $100 weekly and bonus. MADISON MFGRS., 501 Broadway, New York.

90c an hour to advertise and distribute samples to consumer. Write quick for territory and particulars. American Products Co., 2130 American Building, Cincinnati, Ohio.

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.

RADIO SALESMEN and SET BUILDERS in every county write Grenzer Radio, 1479 Hodiamont, St. Louis, Mo.

"B" BATTERIES

100 VOLT EDISON TYPE "B" BATTERY, knocked down. Parts and plans—complete, $12.50. Lane Mfg. 2937 W. Lake, Chicago.

BATTERIES FOR SALE—Four 24-volt "Main" Storage "B" Batteries, never used, shipped and ready to wire for $38.00. First order gets the batteries. Address Box B, Radio Age, 500 N. Dearborn St., Chicago, Ill.

BUSINESS OPPORTUNITIES

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

Classified ad. copy for the November RADIO AGE must be sent in by October 1, 1925.

CRYSTALS

Supersensitive Galena Crystals: Pound $1.00, prepaid. ALKEMITE. Allsensitive Crystals 50c. Buskett, Geologist, Joplin, Missouri.

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. Devine, Room 1101, 116 West 32nd St., New York, N. Y.

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.

PERSONAL

LONELY HEARTS: Exchange letters; make interesting new friends in our jolly club. Eva Moore, Box 908, Jacksonville, Florida. Enclose stamp.

Look! You Radio Bugs! Join Radio Correspondence Club. Entirely new. Broaden your acquaintance, exchange ideas. Membership open to LADY BUGS also. Dime stamp brings pamphlet and Radio Novelty Cards. Radio Rose, Box 662, Cleveland, Ohio.

PRINTING

WE print Stationery, Booklets, Catalogs, Circulars. Samples. Commercial Press, Batavia, Ohio.

RADIO

A PRACTICAL TUBE RECEIVING SET FOR $10, Postpaid, less phones and tube. Complete with phones, tube and battery, $18.00. J. B. RATHBUN, 1067 Winona St., Chicago, Ill.

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

Three Cosmopolitan Phusiformers, each $5.50, book of instructions included. F. A. Mall, Triopli, Iowa.

15 to 25 per cent discount on nationally advertised sets and parts. Every item guaranteed. Tell us your needs. IMPERIAL RADIO COMPANY, Delaware, Ohio.

RADIO SETS. Our prices save you money. Lists free. The Radio Shoppe, Box 645, East Liverpool, Ohio.

AT LAST The Radco Static Eliminator. Eliminates 50 to 90% Static. Many satisfied users. Write for particulars. Radio Specialties Company, Sioux Falls, South Dakota.

RADIO CIRCUITS

SPECIAL FOR OCTOBER

The Reinartz Radio Booklet, by Frank D. Pearne, fully illustrated, and RADIO AGE, for $2.50. Price of Booklet alone is 50c. Send check, currency or money order to RADIO AGE, 500 N. Dearborn Street, Chicago.

RADIO DEALERS

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

RADIO SUPPLIES

WE CAN SAVE You money on radio supplies. 30 per cent discount AND MORE on tubes, batteries, loud speakers, static eliminators, condensers, transformers German silver wire, and all standard radio apparatus. We buy in quantity lots to enable selling to you wholesale. Additional discount for cash. Send for catalog or exclusive proposition for your territory. Address, Box 9A, RADIOGRAPH LABORATORIES, 1234 Rosemont avenue, Chicago, Ill. New fall lines now ready.

SALESMEN WANTED

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 $955 in one month. Representatives wanted at once. This plan is sweeping the country—write today before your county is gone. OZARKA, INC., 126 West Austin Ave., F., Chicago.

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 Brilliante, St. Louis, Missouri.

VOCATIONS

Make Big Money. Safe and Lock Expert. Wayne Strong, 3800 Lan Franco St., Los Angeles, Calif.

WANTED

WANTED—To complete my set RADIO AGE need August, September, October, November, 1923, issues, bound or unbound. Advise price. Lloyd C. Henning, Hollbrook, Arizona.

WIRELESS

WANT TO MEMORIZE THE WIRELESS CODE? The Coryden Snyder Code Method, Patented, is quickest. Send 50c coin, stamps or M. O. to C. G. 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 Sounder or Buzzer, 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.

WRITERS

NEW WRITERS WANTED—Articles, stories, poems, scenarios, etc. $13,500 just paid to unknown writer. Entirely new field. (No. bunk.) NOT A CORRESPONDENCE COURSE. Moving picture industry and publishers crying for new original material. YOU CAN DO IT. We buy manuscripts for books and magazines. Send self addressed envelope for list of 100 subjects. CALIFORNIA STUDIOS, P. O. Box 697, Los Angeles, Calif.

WRITERS—Cash in on your knowledge of radio by writing for Radio Magazines and Newspaper Supplements. Write up your radio experiences, your new hook-up, your knowledge of broadcasting stations and artists. Experienced authors will correct and improve your manuscripts—make them typically professional work. FREE Criticism and Advisory Service until your manuscript is sold! ALL Magazines and Papers demanding fiction and articles dealing with radio. Here is YOUR OPPORTUNITY to profit! Send for FREE booklet, "How You Can Sell Your Manuscripts." Willis Arnold and Associates, 210 East Ohio St. Chicago, Ill.

Make big money writing Movie Plays. Circulars free W. C. Krug, Ashton, Illinois.

Have you ordered your November Radio Age?

THE RADIO AGE BUYERS' SERVICE

What do you want to purchase in the radio line? Let the staff of RADIO AGE save you time and money by sending in the coupon below. Enter the number of the article you would like to know more about in the spaces provided in the coupon.

1 "A" Batteries
2 Aerial protectors
3 Aerial insulators
4 Aerials
5 Aerials, loop
6 Amplifiers
7 Amplifying units
8 Ammeters
9 "B" batteries
10 Batteries (state voltage)
11 Batteries, dry cell
12 Batteries, storage
13 Battery chargers
14 Battery clips
15 Battery plates
16 Battery substitutes
17 Bezels
18 Binding posts
19 Binding posts, insulated
20 Books
21 Boxes, battery
22 Boxes, grounding
23 Bridges, wheatstone
24 Broadcasting equipment
25 Bushings
26 Buzzers
27 Cabinets
28 Cabinets, battery
29 Cabinets, loud speaker
30 Carbons, battery
31 Cat whiskers
32 Code practisers
33 Coils
34 Coils, choke
35 Coils, coupling
36 Coils, filter
37 Coils, grid
38 Coils, honeycomb
39 Coils, inductance
40 Coils, Reinartz
41 Coils, stabilizer
42 Coils, tuning
43 Condenser Parts
44 Condenser plates
45 Condensers, antenna coupling
46 Condensers, by-pass
47 Condensers, coupling
48 Condensers, filter
49 Condensers, fixed (paper, grid, or phone)
50 Condensers, variable grid
51 Condensers, variable mica
52 Condensers, vernier
53 Contact points
54 Contacts, switch
55 Cord tips
56 Cords, for head sets
57 Couplers, loose
58 Couplers, molded
59 Couplers, vario
60 Crystal alloy
61 Crystal holders
62 Crystals, rough
63 Crystals, mineral
64 Crystals, synthetic
65 Crystals, unmounted
66 Crystals, mounted
67 Deaks, radio
68 Detector units
69 Detectors, crystal
70 Detectors, fixed crystal
71 Dial, adjusters
72 Dials, composition
73 Dials, hard rubber
74 Dials, rheostat
75 Dials, metal
76 Dials, vernier
77 Dials with knobs
78 Dies
79 Drills, electric
80 Dry cells
81 Earth grounds
82 Electrolyte
83 Enamels, battery
84 Enamels, metal
85 End stops
86 Eyelets
87 Experimental work
88 Fibre sheet, vulcanized
89 Filter reactors
90 Fixtures
91 Fuse cut outs
92 Fuses, tube
93 Generators, high frequency
94 Grid choppers, rotary
95 Grid leak holders
96 Grid, transmitting leaks
97 Grid leaks, tube
98 Grid leaks, variable
99 Grinders, electric
100 Ground clamps
101 Ground rods
102 Handles, switch
103 Head bands
104 Head phones
105 Head sets
106 Honeycomb coil adapters
107 Hook ups
108 Horns, composition
109 Horns, fibre
110 Horns, mache
111 Horns, metal
112 Horns, wooden
113 Hydrometers
114 Indicators, polarity
115 Inductances, C. W.
116 Insulation, molded
117 Insulation material
118 Insulators, aerial
119 Insulators, composition
120 Insulators, fibre
121 Insulators, high voltage
122 Insulators, cloth
123 Insulators, glass
124 Insulators, hard rubber
125 Insulators, porcelain
126 Irons, soldering
127 Jacks
128 Filament control
129 Jars, battery
130 Keys, transmitting
131 Knobs
132 Knock-down panel units
133 Laboratories, testing
134 Lever, switch
135 Lightning arresters
136 Loosecouplers
137 Loud speakers
138 Loud speaker units
139 Lugs, battery
140 Lugs, terminal
141 Measuring instruments
142 Megohmeters
143 Meters, A. C.
144 Meters, D. C.
145 Mica
146 Mica sheets
147 Milliammeters
148 Minerals
149 Molded insulation
150 Molybdenum
151 Mountings, coil
152 Mountings, condenser leak
153 Mountings, end
154 Mountings, grid leak
155 Mountings, honeycomb coil
156 Mountings, inductance switch
157 Name plates
158 Neutrodyne set parts
159 Nuts
160 Ohmeters
161 Oscillators
162 Panel cutting and drilling
163 Panels, drilled and undrilled
164 Panels, fibre
165 Panels, hard rubber
166 Parts
167 Paste, soldering
168 Patent attorneys
169 Phone connectors, multiple
170 Phonograph adapters
171 Plates, condenser
172 Plugs, coil
173 Plugs, telephone
174 Pointers, dial and knob
175 Poles, aerial
176 Potentiometers
177 Punching machines
178 Reinartz set parts
179 Regenerative set parts
180 Receiver caps
181 Rectifiers, battery
182 Resistance leaks
183 Resistance units
184 Rheostat bases
185 Rheostat strips
186 Rheostats, automatic
187 Rheostats, battery
188 Rheostats, dial
189 Rheostats, filament
190 Rheostats, potentiometer
191 Rheostats, power
192 Rheostats, vernier
193 Rods, ground
194 Rotors
195 Scrapers, wire
196 Screw drivers
197 Screws
198 Schools, radio
199 Sets, receiving—cabinet
200 Sets, receiving—crystal
201 Sets, receiving—knock-down
202 Sets, receiving — Neutrodyne
203 Sets, receiving—portable
204 Sets, receiving—radio frequency
205 Sets, receiving—reflex
206 Sets, receiving—regenerative
207 Sets, receiving—Reinartz
208 Sets, receiving—sectional
209 Sets, receiving—short wave
210 Sets, receiving—super-regenerative
211 Sets, transmitting
212 Slate
213 Shellac
214 Sliders
215 Socket adapters
216 Sockets
217 Solder
218 Soldering irons, electric
219 Soldering paste
220 Solder flux
221 Solder salts
222 Solder solution
223 Spaghetti tubing
224 Spark coils
225 Spark gaps
226 Stampings
227 Stators
228 Stop points
229 Switch arms
230 Switch levers
231 Switch points
232 Switch stops
233 Switches, aerial
234 Switches, battery
235 Switches, filament
236 Switches, ground
237 Switches, inductance
238 Switches, panel
239 Switches, single and double throw
240 Tone wheels
241 Towers, aerial
242 Transformers, audio frequency
243 Transformers, filament
244 Transformers, modulation
245 Transformers, power
246 Transformers, push-pull
247 Transformers, radio frequency
248 Transformers, variable
249 Transmitters
250 Tubes, vacuum—peanut
251 Tubes, vacuum—two element
252 Tubes, vacuum—three element
253 Tuners
254 Variocouplers, hard rubber
255 Variocouplers, molded
256 Variocouplers, wooden
257 Variometers, hard rubber
258 Variometers, molded
259 Variometers, wooden
260 Varnish, insulating
261 Voltmeters
262 Washers
263 Wave meters
264 Wave traps
265 Wire, aerial
266 Wire, braided and stranded
267 Wire, copper
268 Wire, insulated
269 Wire, Litz
270 Wire, magnet
271 Wire, platinum
272 Wire, tungsten

RADIO AGE BUYERS' SERVICE, **500 N. Dearborn St., Chicago, Ill.**

Please see that I am supplied with buying specifications and prices on the articles numbered herewith:

I am a— ☐ Dealer ☐ Jobber ☐ Mfgrs.' Rep. ☐ Manufacturer

Firm [If identified with Radio industry] .....

My Occupation .....

My Name .....

Address .....

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

* *Tested and Approved by* RADIO AGE *

The Far West Gets Its Radio Thrill

Far back in the days of the gold rush in Nevada—Tuscarora, became one of the most prominent settlements in this vast area of the unexplored western frontier. The bright metal manifested itself in greater quantities and with less difficulty to obtain than in almost any section during these feverish days of prospecting, and many brought back wealth which can be traced today to represent the beginning of some of America's wealthiest families.

No greater excitement and common law ruled a community more true to the wildest days of the western frontier, than picturesque Tuscarora—and, these same old surroundings stand today as then, except for its quiet populace—doubtless the fringe of pioneers of those "gold days" who had passed down from one generation to another.

WJAZ—The Zenith portable broadcasting truck, touring to the western coast on experimental broadcasting in locations which have baffled radio engineers, after having experimented in broadcasting from Pike's Peak, began their long journey to Nevada and over the Rockies when they stopped at Tuscarora. Very few Tuscarorans have ever had the opportunity to see much of this day's modern invention, and as WJAZ's radio transmitting apparatus, mounted on a motor truck stopped for the day—Tuscarora awakened from its peaceful daily routine and again "came out" with that same excitement and gala front as of those bygone days.

Placer miner Lee Wah, one of the few remaining Chinamen of the 1500 Chinese laborers brought to Tuscarora more than 65 years ago to build the Central Pacific Railway, after much explanation and assurances, finally appeared before the "Mike" with his original Chinese cymbals, gong and drums which are over 100 years old and rendered selections which the WJAZ portable station broadcast on the air to the public far out and beyond.

Lee Wah displayed suspicious tolerance while performing before the microphone, believing the entire procedure to be a huge joke, and fell in with the occasion as purely a matter of humor and to be a good fellow. But when the cameraman pointed their outfits his way, Lee Wah ran in great panic for cover. The bull's eye lenses to the Chinaman, were no different from any regulation frontier 45 Colt's pistol of the days when Lee, (with all of the early settlers), came in to make his stipend as a laundryman.

Neat Pliers Made by Schollhorn

A very handy and effective radio plier is made by The William Schollhorn Company, New Haven, Conn. The pliers are made of stamped steel, very strong and sturdy. They are specially suitable for turning eyelets of various sizes in bus bar wire. Between the jaws just above the square recess is a flat vise-like surface to be used to flatten out the eyelet after it has been turned. Below the recess is a sharp pair of bus bar cutters. These pliers have the advantage of being large enough to afford a good grip without being excessively heavy.

Hookups That Will Always Be Up-To-Date!

What You Get:

The RADIO AGE ANNUAL for 1925 is brim full of hookups and "how-to-do-it" articles. In addition to the array of constructional set articles, you will find instructions for building wave traps, battery chargers, amplifiers, loud speakers, etc. And to top it all you'll find the big 32-page blueprint section containing the prize hookups for 1924 and 1925! Real blueprints to work by! Each blueprint is worth the cost of the book! 120 pages of features in all!

You may try to save money on radio parts—you may content yourself with a mediocre, carelessly-planned radio set, but after all is said and done and the results given the acid test, you will find ***there is no substitute*** for a good radio hookup.

In choosing the hookup for your needs this Fall—the set that will penetrate the strong stations and bring in pleasing and clear DX, you must get the absolute ***best*** or you will regret your choice in the end, when you will be forced to dismantle the "just-as-good" hookup and make the real thing.

The RADIO AGE ANNUAL for 1925 contains nothing but tested hookups; circuits that have emerged with flying colors from the most stringent tests radio engineers could impose. The ANNUAL does not contain a hookup that will not please you in every way and be just as good a year from now as it is today.

Before beginning your new radio season, get the ANNUAL for 1925 and take your pick. You can't go wrong. Only a few hundred ANNUALS left, at a dollar a copy. Get yours now!

$1.00 a Copy

RADIO AGE ANNUAL FOR 1925

$1.00 a Copy

Some of the Features

How to read and understand hookups.
How to understand radio phenomena.
Building your first simple set.
How to select the right receiver.
Substituting a tube for a crystal—building the first tube set.
How to amplify any kind of set.
Making a reflex set.
Building your first Reinartz set.
The renowned Baby Heterodyne No. 1.
Adding audio and radio stages to the Baby Het.
How to make a battery charger.
How to make a loud speaker.
RADIO AGE ANNUAL BLUEPRINT SECTION with such popular hookups as the aperiodic variometer, loop sets, feedback receivers, neutrodynes, reflex hookups, Baby Het No. 2, a Wonder Super-Het, and others.
How to get rid of interference.
How to make an amplifying unit.
How to recognize and deal with every kind of tube trouble.
Another super-heterodyne for the super experimenters.
Hints on tracing troubles in super-heterodyne circuits.
A three-tube long distance regenerator.
A 3-tube set that easily receives KGO on the loud speaker from Ohio.
Improving the ever popular Reinartz.
AND MANY OTHER UP-TO-THE-MINUTE HOOKUPS AND ARTICLES.

RADIO AGE ANNUAL COUPON

RADIO AGE, INC.,
500 North Dearborn St., Chicago, Ill.

Gentlemen: I want to be a proud owner of the RADIO AGE ANNUAL FOR 1925. Enclosed find $1.00. If I am not satisfied with the ANNUAL I will return it within five days and you will refund my dollar

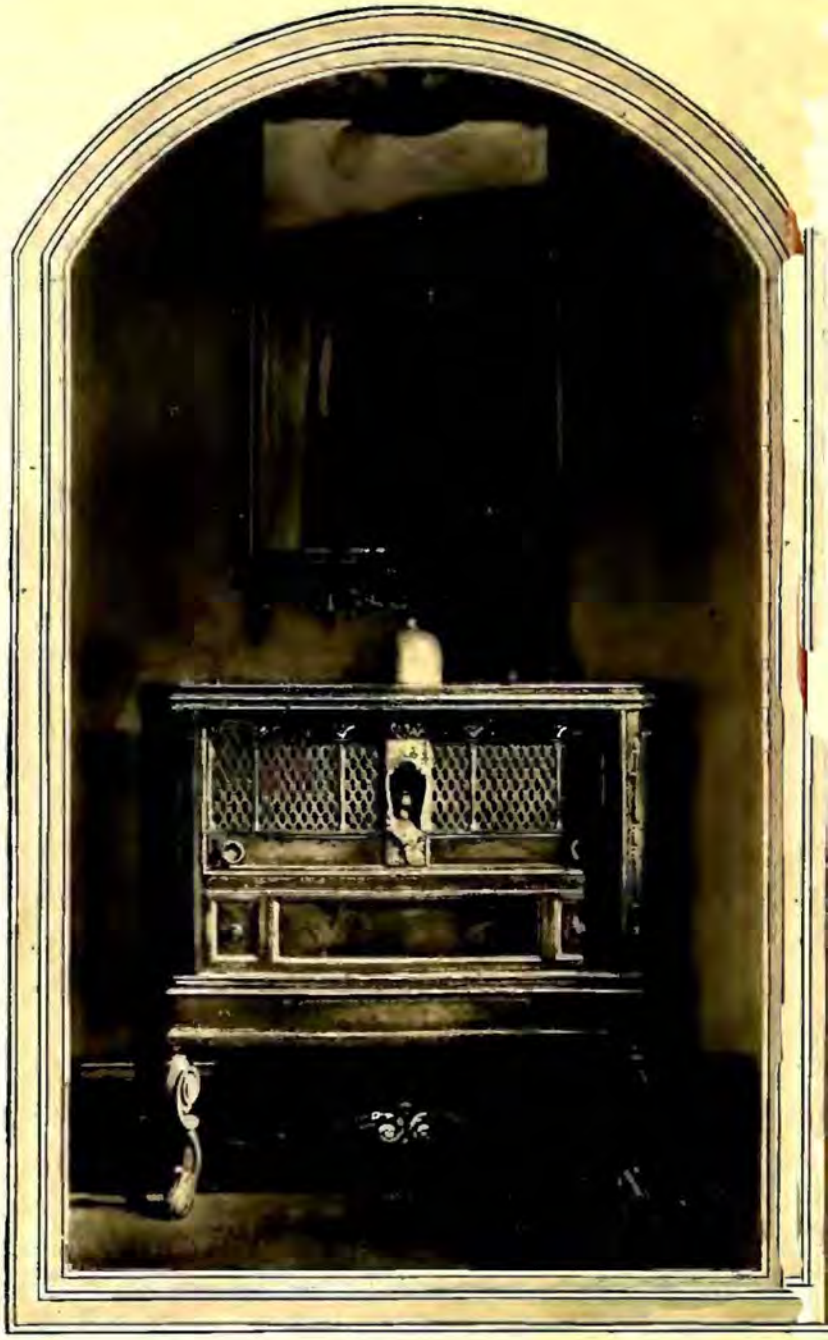
Name.....

Address.....

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

10-25

"as Good as Zenith"



"I WANT a radio set which will give me the same true quality of tone—the same selectivity—the same volume without distortion—the same long distance range as *Zenith.*" That is the expressed desire of thousands and thousands of radio enthusiasts.

The reason for their ambition is simply this: Zenith radio sets are never offered to the public until all laboratory experiments have been carried to a satisfactory conclusion—*until in side-by-side tests with other radio sets Zenith supremacy has been completely demonstrated.*

Zenith radio sets will never be produced on a quantity basis at the sacrifice of quality.

But—which is better: to be distinguished merely for volume of production—*or to be distinguished for a degree of excellence so high that it sets the standard throughout the industry?* Ask your nearest Zenith dealer for a demonstration.

ZENITH RADIO CORPORATION
Straus Building, Chicago

Super-Zeniths are priced at from $240 to $2,000. Each instrument is sold under a quality guarantee. Above is shown the De Luxe Italian model.

Again Commander Donald B. MacMillan has chosen Zenith exclusively for his expedition to the Arctic. When human lives may depend upon the reliability of radio performance, only one reason can explain his choice: Zenith has proved to be the best obtainable, at any price.

ZENITH
TRADE MARK REG.
→LONG DISTANCE← RADIO
TRADE MARK REG.

Costs More—but Does More!

✲ *Tested and Approved by* RADIO AGE ✲