

Blueprint Section Every Month

RADIO AGE

The Magazine of the Hour



JUNE 1925
25 CENTS

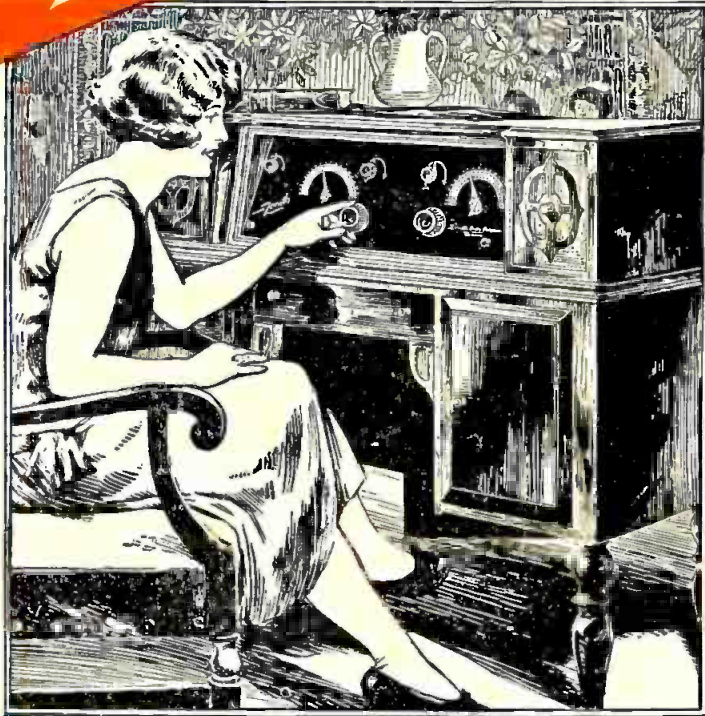
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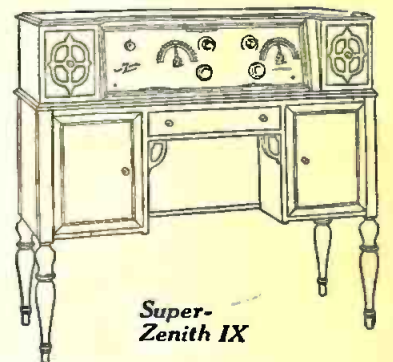
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ing from \$75 to \$200 a week. Merle Wetzel of Chicago Heights, Ill., advanced from lineman to Radio Engineer, increasing his salary 100% *even while taking our course!* Emmett Welch, right after finishing his training, started earning \$300 a month and expenses. Another graduate is now an operator of a broadcasting station—PWX of Havana, Cuba—and earns \$250 a month. Still another graduate, only 16 years old, is averaging \$70 a week in a Radio store.

Wonderful Opportunities

Hardly a week goes by without our receiving urgent calls for our graduates. "We need the services of a competent Radio Engineer." "We want men with executive ability in addition to Radio knowledge to become our local managers." "We require the services of several resident demonstrators"—these are just a few small indications of the great variety of opportunities open to our graduates.

Take advantage of our practical training and the unusual conditions in Radio to step into a big paying position in this wonderful new field. Radio offers you more money than you probably ever dreamed possible—fascinating, easy work—a chance to travel and see the world if you care to, or to take any one of the many Radio positions all around you at home. And Radio offers you a glorious future!

The National Radio Institute is one of America's Pioneer Radio Schools—established in 1914. Our course is an absolutely complete one which qualifies for a government first-class commercial license. It gets you *bigger* paying jobs in Radio.



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(Signed) GEO. A. ADAMS,
Tamaqua, Pa.

RADIO AGE

The Magazine of the Hour

Established March, 1922

WITH WHICH IS COMBINED RADIO TOPICS

Volume 4

June, 1925

Number 6

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A Chat With the Editor

ANY editor who attempts to follow the winding trail pursued by the Radio Corporation of America cuts out a man's job for himself. Month after month and year after year the court records add voluminously to the serious charges brought by independent radio manufacturers against the \$33,000,000 concern. This in addition to the charges made by the United States government through the Federal Trade Commission, which accuses the Radio Corporation of America of being a party to a conspiracy in restraint of trade.

The latest accusation against the R. C. A. is made by the DeForest Radio Company, which has obtained an injunction in the New Jersey courts restraining the Radio Corporation of America from attempting to steal business from the DeForest Corporation and filch scientific secrets from the DeForest Corporation. It is alleged in the bill that the Radio Corporation of America, to quote the New York Times, "introduced spies into its (DeForest Company's) offices to steal business and technical secrets and had seduced DeForest employes into acts of treachery." The Radio Corporation was ordered by the court to turn over all records obtained by the alleged system of espionage and warned the Radio Corporation not to destroy any such records, pending hearing of arguments to make the injunction permanent.

And this is free and glorious America!

It is enough to make a good American blush with shame that such a rotten mess as this should reach the point where it breaks into news-print. We have observed that various big chiefs of big radio interests have acquired a mania for rough-riding the industry. They are riding to their own destruction and riding fast.

Frederick Smith

Editor of RADIO AGE

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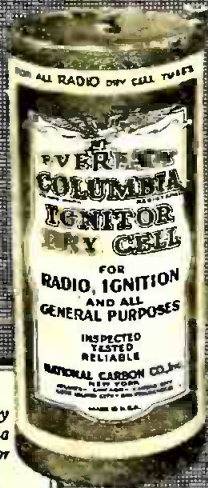


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Eastern Standard Time

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RADIO EDITORIALS

RADIO CORPORATION of America sent one of its patent attorneys all the way from New York to Iowa City, Iowa, to take the deposition of a woman who formerly was a newsdealer in that city. The testimony was wanted by the Radio Corporation for the purpose of convincing the Patent Office in Washington that this magazine was injuring the business of "Wireless Age" by continuing to use the title "Radio Age". The "Wireless Age" is owned and controlled by the Radio Corporation of America.

This magazine was represented at the Iowa City proceedings, May 4. We are going to tell what took place down there in Iowa so that those who have paid good money for stock in the Radio Corporation of America may know how the Broadway radio patriots spend their time and money. We think radio manufacturers, dealers and the radio public generally will be interested, also.

Mrs. C. Merton Sulser, of Iowa City, in June of last year was a wholesale news agent in Iowa City. She received a telegram from "Wireless Age" asking her to undertake the sale of that magazine. Mrs. Sulser did not then, and apparently does not now, know much about radio publications. In spite of the fact that the telegram from the "Wireless Age" carried a New York date line, Mrs. Sulser on June 24 sent a telegram to "Radio Age" in Chicago ordering twenty copies of this magazine monthly. This magazine promptly replied that it already had a wholesale distributor in Iowa City and therefore, could not serve her. On the same day Mrs. Sulser received this letter from "Radio Age" she received a letter from "Wireless Age" supplementing the telegram which had solicited her services as a wholesale agent. Mrs. Sulser waited until July 18 of that year and then wrote a letter to "Wireless Age" telling them she had made a mistake and had sent a telegram to "Radio Age" instead of to "Wireless Age."

Oh joy! Oh Paine's Fireworks! Whoopla! Here was the evidence at last. "Radio Age" had turned down an order from a woman who thought she was ordering something else but was not quite sure which or what. Therefore "Radio Age" was injuring the business of "Wireless Age." Off to Iowa City with lawyers and depositions and everything. Let the welkin ring and the streets grow dark with mystery and let the Patent Office in Washington hold its breath. Let the cashiers dig down for traveling expenses and busy men leave their work.

Yes, the president of Radio Age, Inc. was present to hear the deposition taken. It may be that some other woman in Portland, Ore., Portland, Me., Amarillo, Tex., Birmingham, Ala., Pasadena, Cal., Skunkville, Miss., or Timbuctoo, down near King Tut's tomb, may have made a mistake in ordering magazines and picked as her first choice an independent publication instead of one owned and controlled by the Radio Corporation of America, which admits it entered the radio game from patriotic motives.

It may be that "Radio Age" may be dragged hither

and thither and yon. But not all the harassing tactics of the Broadway people can change the facts.

"Radio Age" rightfully uses its title. It was the first to use that title in interstate commerce. It began the use of the title in March, 1922.

"Wireless Age" wants to grab our name because it is the best name in the radio publication field. It has already changed its own title to read "Wireless Age, the Radio Magazine." The Radio Corporation of America should have changed its name from "Wireless Age" to "Radio Age" before "Radio Age" came into the field. Then it would have some rights.

We suggest to readers that they turn to the contents page and read what the DeForest Radio Company says of the Radio Corporation's espionage system. It makes one wonder what stockholders in the Radio Corporation think of it all. Radio Corporation perhaps does not relish the fact that this magazine hits from the shoulder when it talks about trust practices. We have only one answer to that. Radio fans and dealers and manufacturers are with us, thousands strong.

Having left Iowa City, Iowa, with our depositions, where do we go from here?

THE New York Evening Graphic of April 22 published on the first page an interview in which the following statement was attributed to Gen. J. G. Harbord, president of the Radio Corporation of America:

I understand some of the smaller manufacturers have had a slump in their business. This, I think, in the long run, will be beneficial to the radio business as it will tend to eliminate the weaker manufacturers and make the industry more solidified.

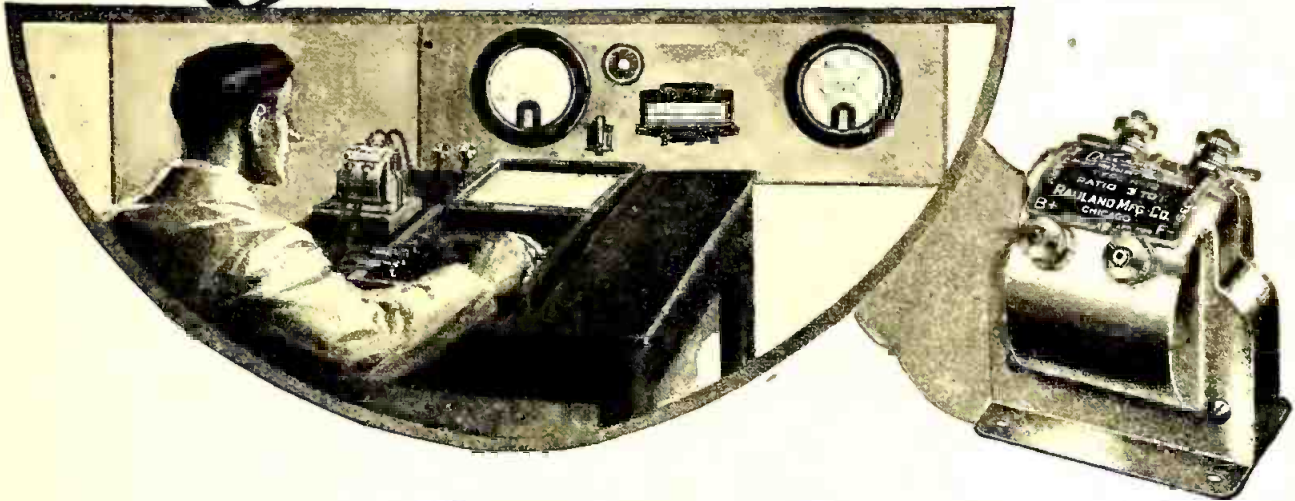
Radio Age wrote to Gen. Harbord and asked him if he had been correctly quoted. He replied that the article was a "mis-statement."

We are glad to present this correction for Gen. Harbord because we are aware of the fact that the radio industry as a whole was astonished by the publication of such an interview. The trade was surprised that the head of a corporation that is under federal charges as a trust conspirator should so frankly discuss the removal of the "smaller" manufacturers from the field of activity.

We have asked the editor of the New York Evening Graphic to let us know as to how the paragraph quoted came to find the light in his newspaper. As we go to press we have had no reply from the editor of the Graphic. We hope he will confirm Gen. Harbord's statement and once and for all clear the Radio Corporation of America of the suspicion that it wishes to "solidify" the radio industry by the "elimination" of the smaller manufacturers. Such elimination would leave Radio Corporation the king of all it surveys. We feel sure that in these days of free competition and all our carefully built bulwarks against restraint of trade and unfair competition, the Radio Corporation would not wish to live if its survival depended upon the death of the independents. NO SIR-REE

Look out for "The Radio Spies!" Read About Them in July "Radio Age"

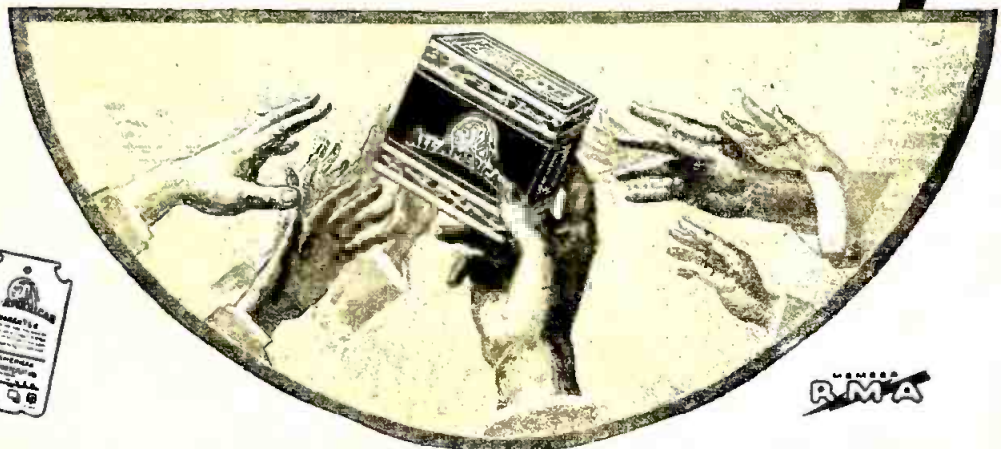
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Of what importance is it to you, as a user of radio transformers, to know that any particular brand, such as ALL-AMERICAN, has held continuously for a number of years the position of proven leadership in quantity of sales?

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Only by the most thorough accuracy and care in manufacturing, and unusual care in testing, is it possible for ALL-AMERICAN to maintain, year after year, this position of commanding leadership. Let it be your protection!

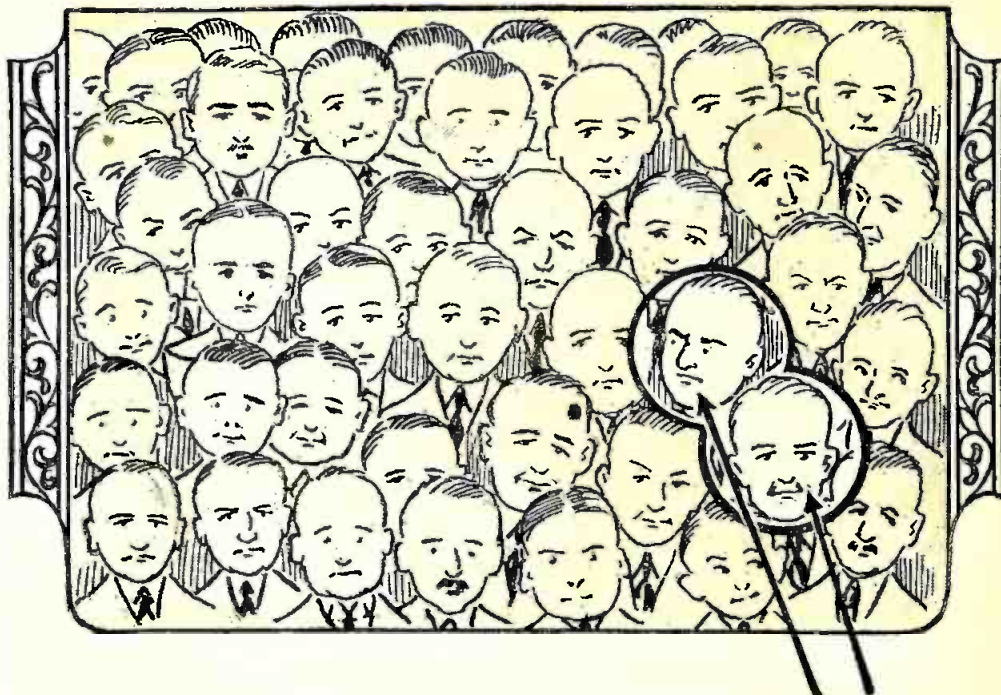


A new edition of the Radio Key Book, just off the press, illustrates an eight-tube set which is the sensation of the year. Send 10 cents for it now, coin or stamps.

ALL-AMERICAN RADIO CORPORATION, 2680 Coyne St., Chicago, Ill.
E. N. Rauland, President

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to 100 people
to reach just two men?**

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RADIO AGE

The Magazine of the Hour

M. B. Smith
Business Manager

A Monthly Publication
Devoted to Practical
Radio

Frederick A. Smith
Editor

Make This a Radio Summer by Reducing STATIC Disturbances

AS the Summer season advances, the "static belt" creeps farther and farther north from the equatorial zone, and by the time that this issue of RADIO AGE is off the press it is certain that the great majority of our readers will have been given a taste of imported tropical conditions, and will be in the market for any ideas or devices which will enable them to tune out that roaring, crackling and crashing that mars their reception and subdues their DX ambitions. We can be grateful that the northerner is treated to only a few months of this sort of trouble instead of having static at his door all the year around as they do in the tropics.

Many anti-static devices have been suggested from time to time which are either wholly or partly successful in reducing the intensity of the static crashes so that the signals can be distinguished above the general uproar. Some are simple and others are rather complicated in theory, but all of them are well worth a tryout until one particular arrangement is found that most perfectly meets your local conditions. Any static eliminator which so reduces the interference to a point where the crackling is not audible during the program, and can only be heard faintly during the intermissions, can be considered highly successful from the broadcast listener's point of view, and with careful attention to the following matter, the amateur can generally rig up some sort of contraption which will greatly improve the clarity of the signals and somewhat extend the range of his receiver.

As noise from static and radio signals are both the result of electrical disturbances, and since both strike the aerial at the same time, it is rather a difficult matter to "unscramble" them so that the charges induced by the electromagnetic radio waves are retained, and the impulses due to atmospheric electric charges are grounded and rejected. In fact, this separation is partly made possible by the fact that some radio signals are of much higher frequency (or shorter wavelength), than the static impulses, and hence the two can sometimes be

By ROSCOE BUNDY

How to Make a Good "Anti-Static" Device

separated by some form of tuning or filter system. By suitable arrangement of choke coils, which will stop the radio waves but which will allow low frequency and D. C. static to escape to earth, it is possible to greatly reduce the rattlings and other disagreeable noises.

Atmospheric Electricity

STATIC may be due to two causes: (1) To strong electrical charges deposited on the aerial by the highly charged air particles of the atmosphere, and (2) True electromagnetic waves sent out by lightning discharges or by emanations from the Aurora Borealis. That the atmosphere is a highly charged envelope may prove a novel explanation to many of our readers, but it has been proved repeatedly by meteorologists that the

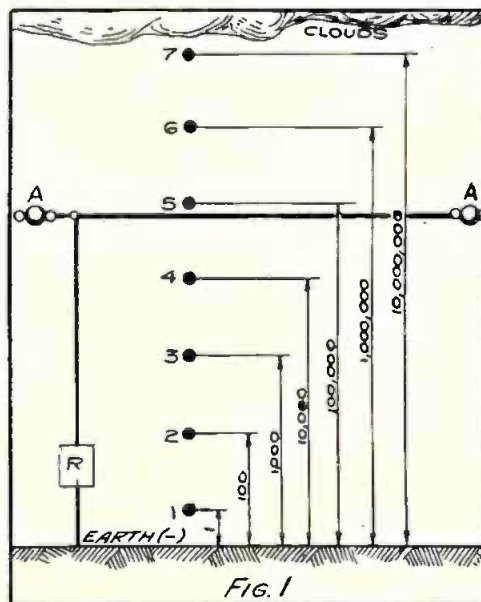
upper strata of the earth's atmosphere may be charged to hundreds of millions of volts above the potential of the earth itself. These charges may not be directly evident to our senses, but they can be measured by the proper instruments carried in sounding balloons or airplanes. Variations in these charges are painfully evident to the listener-in during the Summer season.

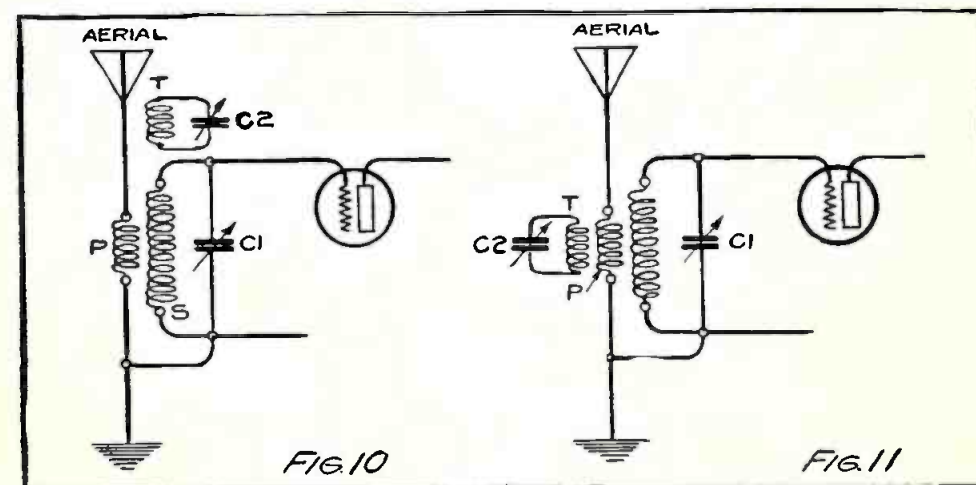
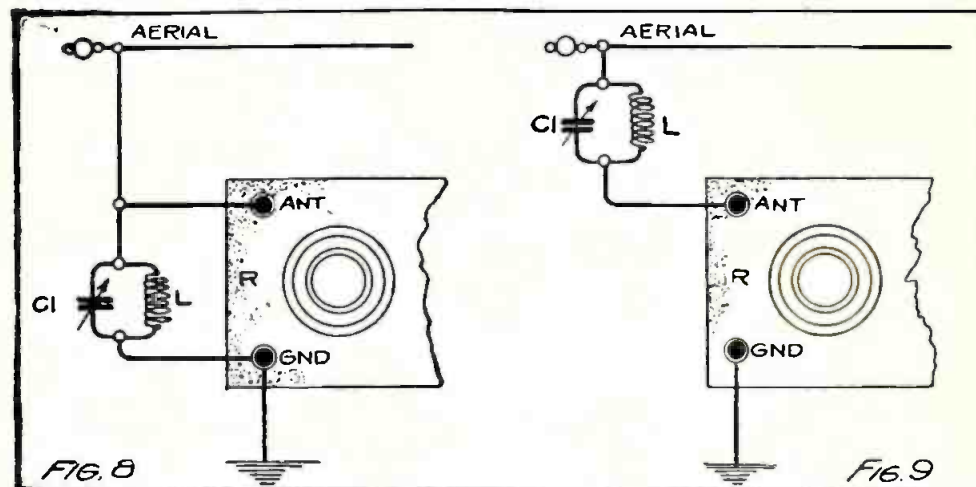
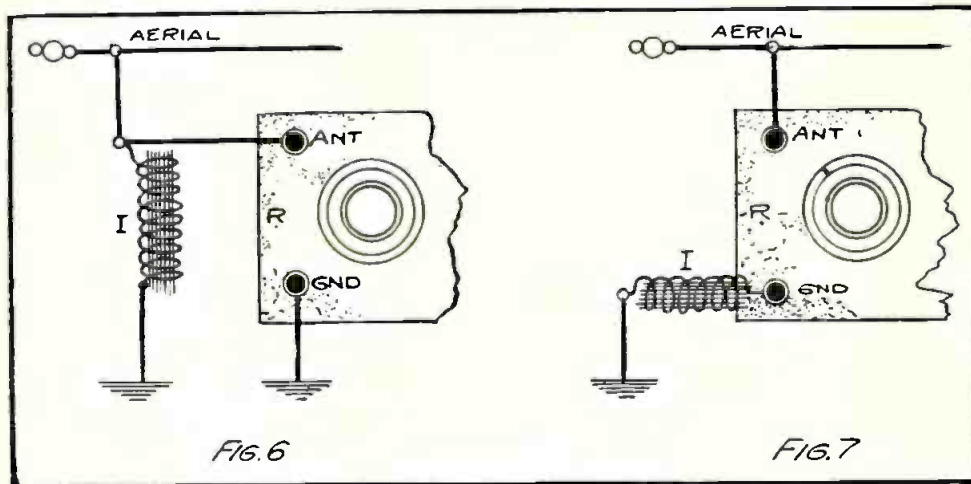
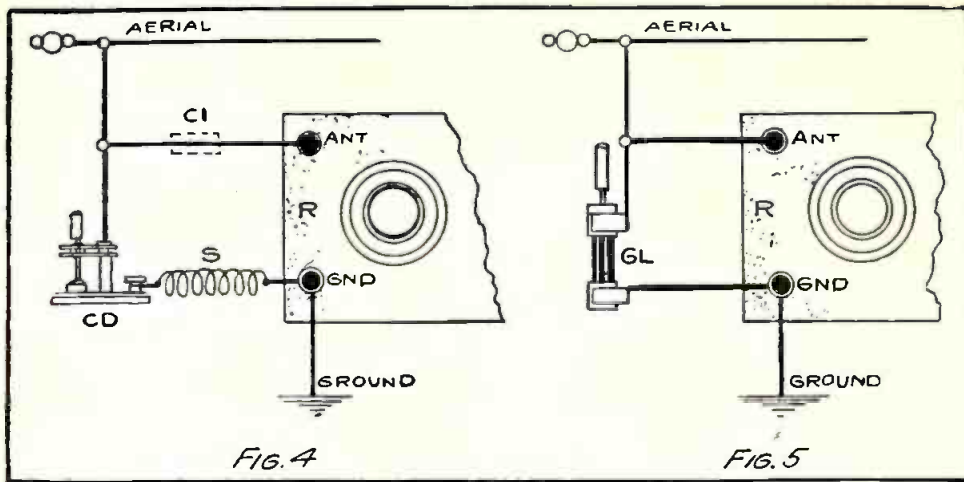
By some means, not universally agreed upon by scientists, each molecule or minute particle of air carries an electrical charge. This charge may have been produced originally by the friction of the air molecule in rubbing over solid objects or over other molecules surrounding it. Again it may have been the result of the action of sunlight or of evaporation. Whatever the cause, it can be easily demonstrated that the air is a strongly charged mass of varying intensity and polarity, sometimes positive and sometimes negative, but always with the charge in evidence.

At high altitudes the potential or intensity of the charge is greater than at points near the earth's surface, and at cloud levels the concentration during thunderstorms may reach hundreds of millions of volts. In fair weather, the charge may have a much lower potential, but in general we can estimate at least 50,000 volts near the normal cloud levels. One investigator estimates the increase to amount to approximately 100 volts per foot of height under average conditions in northern latitudes, but this is only the roughest sort of a guess. Actually, the potentials change day by day at any locality and also through a still greater range with the seasons.

The relative polarities of the earth and atmosphere may change completely within a few hours, and again, the polarity may not be the same at all altitudes, alternating strata of positive and negative charges being found at different heights. As with all natural phenomena it is an irregular and complex proposition.

Fig. 1 illustrates what is known as a "uniform potential gradient;" that is, it shows the even and gradual increase in voltage or potential as we increase our





height above the earth at the stations (1-2-3-4-5-6-7), we assuming that a constant polarity is maintained at all heights. At a very small elevation (1), the difference in potential between the air particle (1) and the earth is one volt. At (2) we have risen about one foot and at this point the potential has increased to 100 volts. At (3) we have moved up by 20 feet and the potential difference is now 1,000 volts. This increase goes on step by step until we reach the elevation (7) where a potential of 10,000,000 volts is indicated.

Puncturing a Foot of Air

UNDER the conditions shown in Fig. 1 no discharge can take place and no damage can be done to objects resting on the earth for the reason that the resistance of a one foot layer of air is far too great for 100 volts to puncture. For example, if station (2) exceeds the potential of station (1) by 100 volts, then no flow of current can take place through the one foot strata of air separating these stations. To puncture an air strata one foot thick would require hundreds of thousands of volts. While the voltage is accumulative with increasing altitudes, the air resistance is also accumulative, thus preventing any discharge from taking place as long as the charge is distributed through the mass of the air. Discharge can only take place when the charges are all concentrated over a small area, as in the case of a thunder and lightning storm.

So long as the charges remain at rest, as shown, they can have no audible effort on an aerial hung at any altitude. To produce sounds in the headset requires that the intensity or polarity be varied so that the diaphragms of the headset are moved back and forth. With an (A-A) aerial hung high above the earth, and grounded through the radio receiver (R), a continuous unvarying depletion of potential will take place which has no effect whatever upon the diaphragm of the phones. Thus, at the aerial (A-A) a potential of approximately 100,000 volts will be maintained which will flow through the grounded receiver (R) to earth. The flow in amperes will be exceedingly low as the air particles give up their charges to the aerial very slowly. The flow of current increases with the area of contact made between the aerial and the air, and hence the flow of atmospheric current is greater with large diameters and long wires than with small diameter short aerials.

When the sun beats down upon the earth, the layer of air next to the earth is heated to a higher temperature than the layers far above it. The heating continues until the buoyancy of the heated air strata becomes so great that it finally breaks through the envelope of cold air and starts a vertical circulation as in Fig. 2. This is a complete circuit, the "upcomer" arising at (a-a), and the "down-comer" descending at (b-b). This is illustrative of the "air pockets" so commonly mentioned by aviators.

When this vertical circulation or "remous" is established, our potentials and polarities are all upset. Negative earth

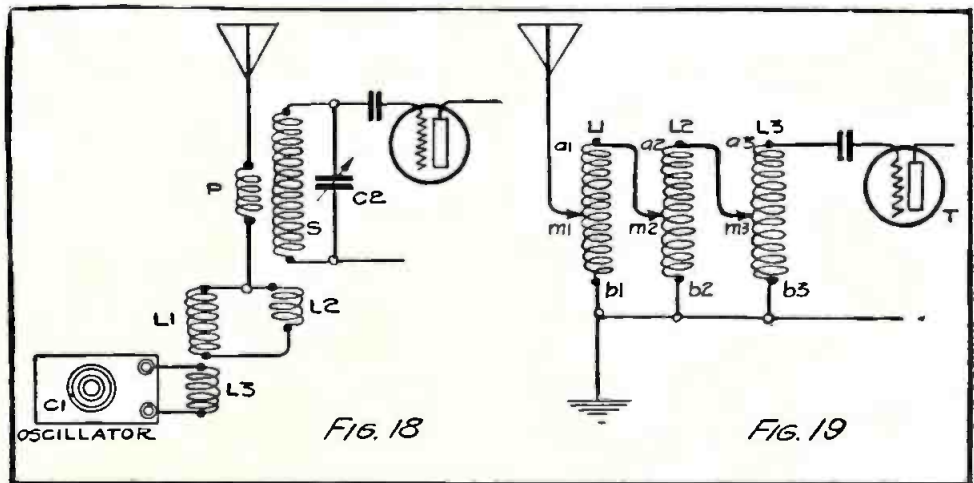
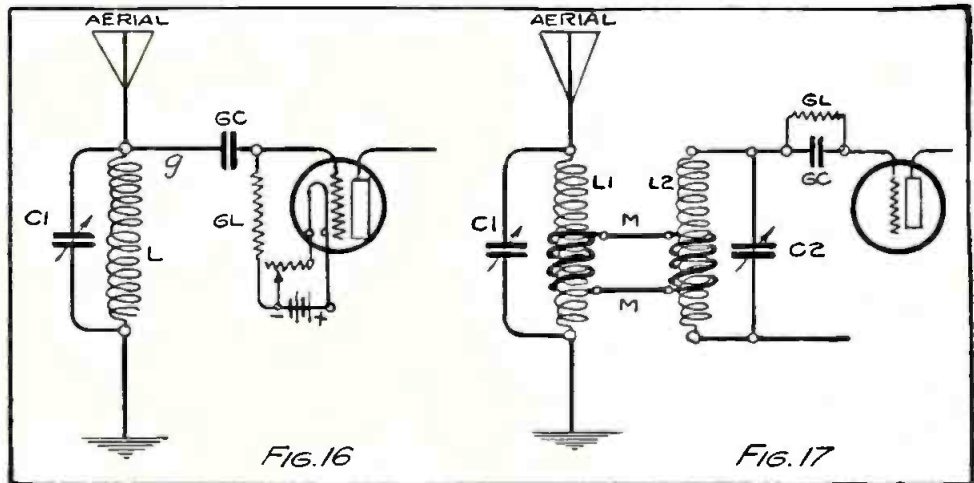
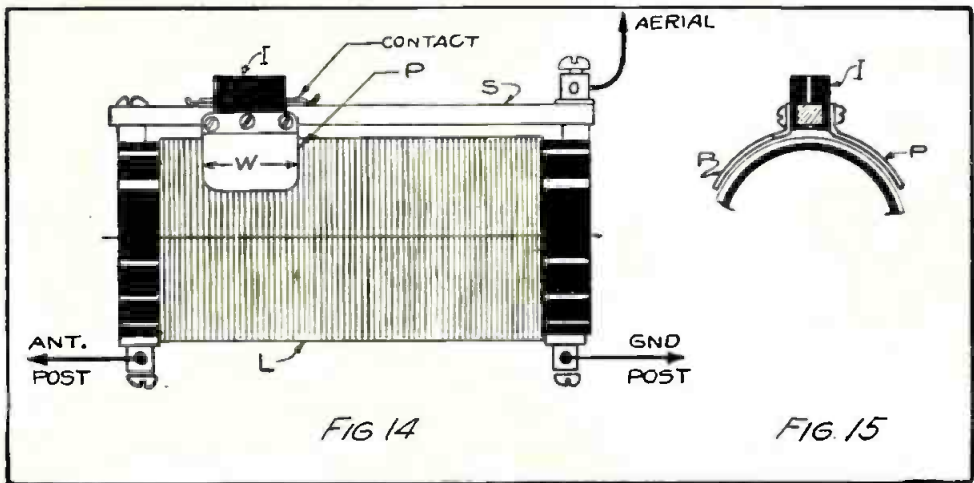
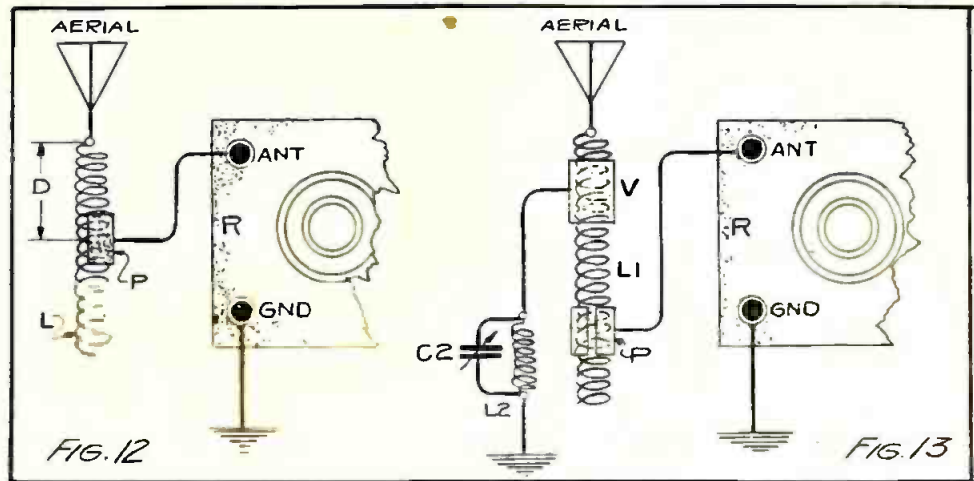
charges are carried up to the aerial at one end by the stream (a-a), and positive high potential air charges are brought into contact with the aerial (A-A) by the down-coming stream (b-b). The total result is that the aerial is subjected to rapidly varying potentials and polarities, and rattling sounds are now heard in the phones of the receiver (R). A high positive charge on the aerial is rapidly succeeded by a low potential negative charge, and again by another positive charge of different intensity; hence there is a rapidly fluctuating series of charges on the aerial which result in the rattle and crashing known as "static." This is one of the many causes of static which may be called "local static."

The hotter the sun, the more rapid the air circulation, and the greater will be the crashing and crackling. When the sun is overcast by clouds, the circulation is reduced or entirely stopped, hence the trouble with local static is greatest with a bright, hot sun and is least in cool, cloudy weather. As any aviator will tell you, "bumpy" air is the worst on hot, still days with no horizontal wind, and practically does not exist in cold weather or with strong horizontal winds which mow down the, vertical currents.

Thunderstorm Mechanism

A THUNDERSTORM is another source of snapping and cracking in the receivers, for the flashes of lightning act like the spark of the old time spark transmitter used in sending code. Further, the thunderstorm sets up violent, vertical air currents, highly charged, which affect the aerial according to the method already described. A high local temperature, a high degree of moisture in the air, and an opportunity to develop vertical air currents give birth to a thunderstorm. Such storms cannot start with strong horizontal winds, although they may afterward cause high winds indirectly after they are thoroughly established.

Fig. 3 is a diagrammatic representation of a thunderstorm during its development. The whole affair starts in with the establishment of a vertical air current on a hot, sultry day with the air containing sufficient moisture to condense rapidly at a slightly reduced temperature. The moist air starts to ascend along (a-a), and in the course of time builds up to an altitude (T) where the temperature is low enough to cause condensation and to form visible clouds of water vapor. At this height, the air is cooled and descends along the line (b-b) until it strikes the earth and is again heated sufficiently to re-ascend along (a-a). This continues until a considerable area of clouds is formed at the altitude (TG), and as each minute particle of water carries an electrical charge with it, the cloud bank finally becomes a highly concentrated, charged mass formed by the accumulation of the individual charges. The ever-increasing velocity of the vertical current throws the vapor higher and higher until some of it is thrown up into an altitude where the temperature is low enough to cause freezing. The water vapor now becomes an intensely white



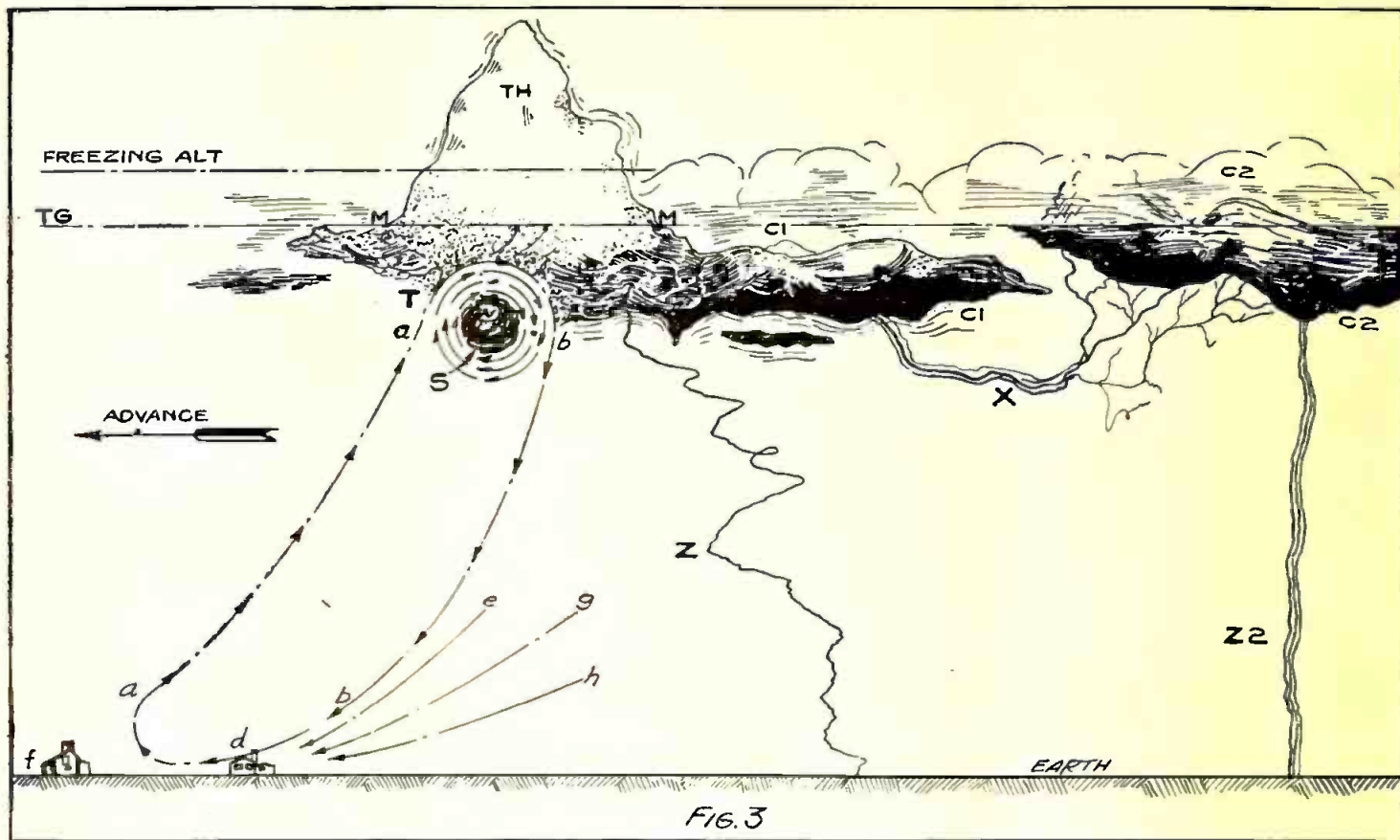


FIG. 3

mass of tiny ice particles at (TH), the brilliantly white peaked mass commonly called the "thunderhead."

In passing from an invisible vapor to a visible cloud composed of small water and ice droplets, the intensity of the vapor charge is increased by condensation. As each drop of visible moisture or droplet contains thousands upon thousands of the vapor particles, the droplet therefore also contains the concentrated charges of all of the vapor particles and the potential of the water drop is therefore enormously greater than that of the vapor. This goes on and on until a terrific, concentrated potential is established at (T) and (TH), which is powerful enough to break down and to discharge to earth through the resistance of several miles of air. This discharge is "lightning," and occurs in its familiar form as at (Z). The total charges of the moisture gathered from many square miles of earth surface are concentrated into the small area (M-M).

With the storm advancing to the left as shown by the arrow, a person at (f) will feel no wind, but when the clouds have moved so that we are standing at (d) we will feel the first blast of ice cold air brought down by the downcomer (b-b). The current is now more inclined to the horizontal so that we feel the wind strongly, and on glancing up we will see the familiar rolling, tumbling "scud" of clouds (S) caught between the up and down moving columns of air. The currents become more and more horizontal as the storm advances and the earth velocities become higher and higher as at (g) and (h). Lightning flashes issue at rapid intervals at (Z), extending from the clouds to earth.

In the course of time, the charge gradually extends to the clouds at the rear (right)

for horizontal equalizing flashes of lightning (X) run back from the thunderhead to the clouds of lower potential as at (C2). We will now have a considerable area of charged cloud (C1-C2), and vertical strokes of lightning will take place at any point in this zone. Continued flashes (X) from cloud to cloud soon bring the potential of (C2) up to that of (C1), and finally one flash (X) will overcharge (C2) so that the heavy earth flash (Z2) will take place. The latter gives the sharp, single, gun-like report that indicates danger. Both (X) or (Z) are reverberating, rumbling and rattling discharges.

Strange to say, the heavy flashes (Z) or (Z2) have little effect on the radio receiver unless they are very close to it, for the reason that the magnetic flux set

up by vertical flashes lies in a horizontal plane and therefore does not cut through the aerial. The real source of noise is in the horizontal transfer discharges such as (X), for these are parallel to the aerial and therefore induce charges in it. Lightning discharges are oscillatory and have much the effect of a spark transmitter producing damped waves. The clouds and the earth form the two plates of the transmitting condenser and the path of the stroke is the inductance. This makes it difficult to tune out such discharges.

Static Crashes and Tuning

WHEN a radio receiving circuit is tuned for the reception of a given wavelength, it will oscillate when the aerial is cut by a wave of that frequency. Unfortunately, the radio receiving circuit will also oscillate at the given wavelength when any other disturbance strikes the aerial, such as the contact charges of the air or the oscillation waves of the lightning discharge. This is independent of the frequency of the disturbing system.

For example, let us say that we have our set tuned to a wavelength of 360 meters. As soon as the 360 meter wave comes from the transmitter, the receiver will oscillate in step with the incoming wave as usual. Now let us say that a strong atmospheric contact charge comes into contact with the aerial with the receiver tuned as before, the charge itself having no frequency. If the charge is heavy enough it will set the receiver circuit to oscillating at 360 meters as before, making it impossible to tune out heavy static charges by the usual means. To make a receiver static-free, it must be arranged so that it will not oscillate when "shocked" by any external force except by the desired radio wave. (To page 52)

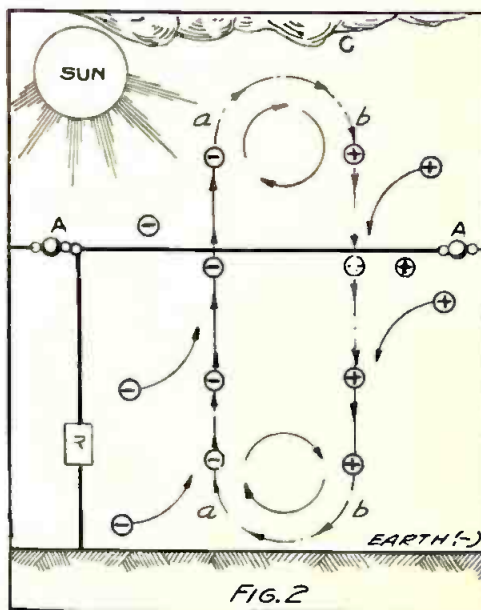
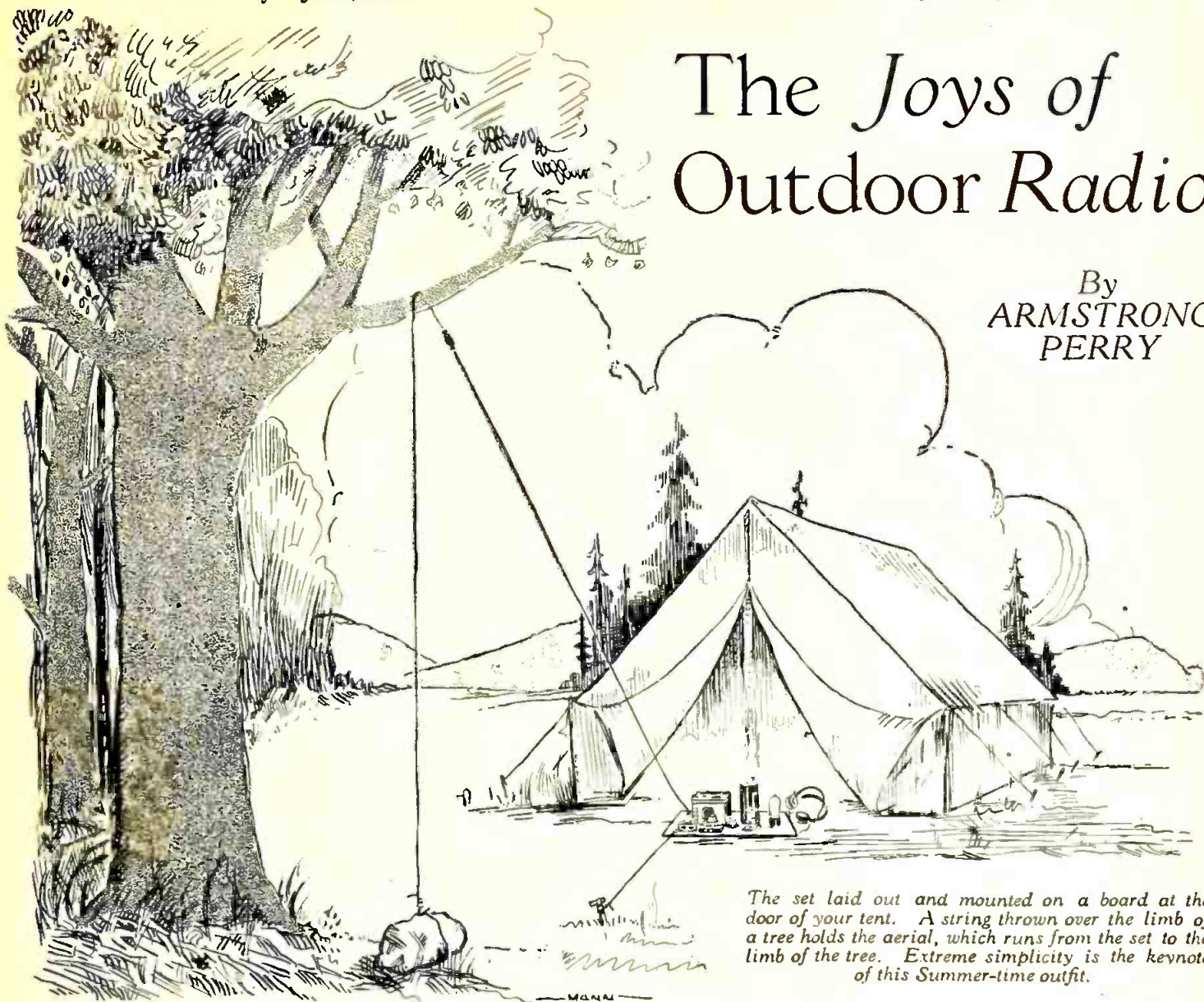


FIG. 2

The Joys of Outdoor Radio

By
ARMSTRONG
PERRY



The set laid out and mounted on a board at the door of your tent. A string thrown over the limb of a tree holds the aerial, which runs from the set to the limb of the tree. Extreme simplicity is the keynote of this Summer-time outfit.

ROUGHING it nowadays consists principally of seeing how many of our city comforts and conveniences we can lug to some locality where, because the trees have not all been cut nor complete sewage systems, water front developments and paving plans completed, city folks can huddle with enough change of scene to make a topic of conversation for the ensuing winter.

The touring car of the Summer traveler carries more equipment and supplies than many a prairie schooner that was both home and transportation for a large family for several months in the pioneer days. Adventurous spirits read eagerly how Enos A. Mills spent days at a time on the summit of the Continental Divide in Winter with only a handful of raisins for food and no shelter at all except possibly his elk-skin sleeping bag, but Enos had to build log cabins with steam heat, hot and cold water and bath tubs in order to tempt said adventurous spirits to go out and have a look at the mountains that he loved.

And we simply must have radio!

Radio Easy to Handle

IT IS easy enough to carry a radio outfit on any outing, long or short. It is risky to carry the home outfit,

even if its bulk and weight are not too great, for cabinets and insulation designed for indoor use are likely to absorb enough moisture in the open on a rainy day to ruin the set. A better method is to improvise a rough and ready outfit that can be used without anxiety, because even if it should be damaged, the loss would not be great.

Reduced to the minimum, a tube set consists of a single-wire aerial, one inductance coil, one variable condenser, one grid leak and condenser, one tube, one rheostat, one "A" battery, one "B" battery, a pair of phones and a ground connection. Amplifier units and a loud speaker can be added if desired.

It is just as much fun to figure out how these devices can be mounted in the smallest space as it is to get out the old fishing rod, shellac the woodwork and oil the joints, but it is not necessary to mount them at all. Unmounted, they can be tucked away in the corners of a haversack or traveling bag in which, ensemble, they would present a problem comparable to that of finding room for the things she forgot in the wife's trunk.

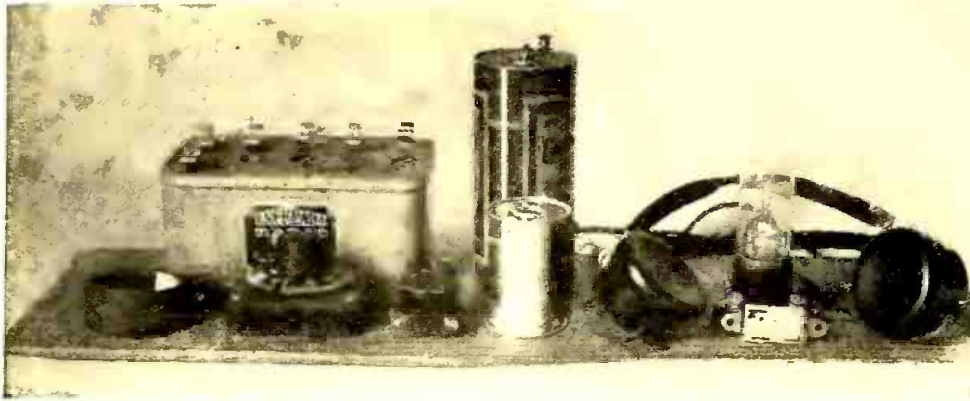
The aerial wire can be of small size that will coil easily. A quarter-pound or half-pound spool of No. 20 or 22 is all right and it can be respoiled in a

minute after it is taken down. Insulators are necessary, but a length of twine soaked in oil will serve the purpose. Where there are trees the aerial can be elevated to a better height than the usual home aerial. It is not necessary to climb the trees unless a too inquisitive bull moose appears during the process of erection. A ball of chalk line and a plumb bob, or any piece of twine with a weight on the end, can be whirled like a sling to throw the weight over a high branch, after which the wire can be hauled aloft at your leisure. Trees themselves have been used as aerials. There was a spasm of it in the early days of broadcasting. So there need be no undue anxiety over accidental contacts between wire and branches unless results at the receiver are poor.

Assortment of Coils

A 50-turn honeycomb coil, mounted, costs only about one dollar, and its weight adds little to a pack. To insure a tuning range to suit all tastes, it is well to have a size or two on each side of this—say 35 turns and 75 turns. A single-coil mount is a convenience but is not indispensable.

The plate type of variable condenser is easily injured, but the danger can



A simple set to take along on your vacation trip and assemble at your leisure. Notice that only parts absolutely necessary are used and yet this outfit will produce satisfactory results at minimum expense.

be eliminated by purchasing one in knock-down form and assembling it as wanted. The assembly occupies even the novice only a few minutes and the second or third time it is put together the operation becomes almost mechanical. Forty-three plates will make the largest condenser commonly used in radio receiving. If you have that many, you can make condensers of any desired size merely by assembling more or less plates. Book-type condensers, ready-made, occupy less room and weigh less. There are also some very small condensers, operated by dials, that have capacities similar to the 11-plate, 23-plate, 43-plate and other sizes.

Grid leaks and grid condensers are so cheap and small as to present no problems. It is only necessary to make sure that you have the correct resistances and capacities for the tube to be used. Low-voltage tubes that can be lighted by dry cells are usually preferred in portable outfits, but if the automobile with its storage battery is sure to be where it is wanted at all times, then the larger tubes with their greater output of energy are practicable. It is unnecessary to say to anyone except the novice that the tube should remain in the original package, swathed in cotton wool and corrugated paper, except when in use. The rest of us have paid our five dollars for that lesson. The little Myers tube is a glutton for punishment and is perhaps the best for vacation purposes.

Folks generally prefer rheostats that are finely variable. They are especially desirable in an out-door outfit which is more or less crudely assembled and needs such advantage as can be gained without adding to the weight. Pressure type rheostats, and those made with sliding contacts that travel the entire length of a wire, instead of passing from turn to turn, give finest control.

Some tubes require only a single No. 6 dry cell, to light the filament. "B" batteries can be purchased in small sizes for portable outfits where weight must be reduced to the minimum. Very sensitive phones with mica diaphragms will make up, to some extent, for the lack of amplification. A short length of the aerial wire with one end in the water or attached to a spike driven into wet earth provides a ground connection.

A book of hook-ups like the RADIO

AGE ANNUAL will come in handy, because even so small an outfit can be assembled in many different ways.

To tell the unvarnished truth, most of the pictures showing folks listening to radio broadcasts around the campfire are especially posed for enterprising photographers and for home consumption. Any city man who has enough honest-to-goodness love of Nature to have braved the mosquitoes and punkies, the investigative ants and the too-neighborly porcupines, through even two or three nights in a real wilderness, knows that by the time darkness brings the ideal radio conditions everybody is snoring unless there happens to be a poker game with an easy mark at one corner of it. He hears enough of "Red Hot Mama" when he gets back where she is and tries to explain why he is a week late, and he cannot see why those who wail "I Want to Be Happy" cannot get that way without disturbing the whole world about it.

On Being Kindhearted

NEVERTHELESS, there are, in every out-door jaunt, plenty of opportunities for the use of radio. One of them is in giving pleasure to humble folks whose only contact with cultured people

from the centers of population is that provided by an occasional sportsman or tourist.

Few city dwellers realize how scarce money and luxuries are in many rural areas where we are enraptured by the wealth of the things provided by Nature. Nor can we who are buffeted by crowds from day to day appreciate the heart hunger of lonely souls who, even when they do meet a person from the big world outside, are sensitive and awkward because they feel they are being laughed at. All improvements reach those on the fringes of civilization last of all. Without going very far from town, it is always possible to find, on the poor roads, households where not even the sewing machine has arrived.

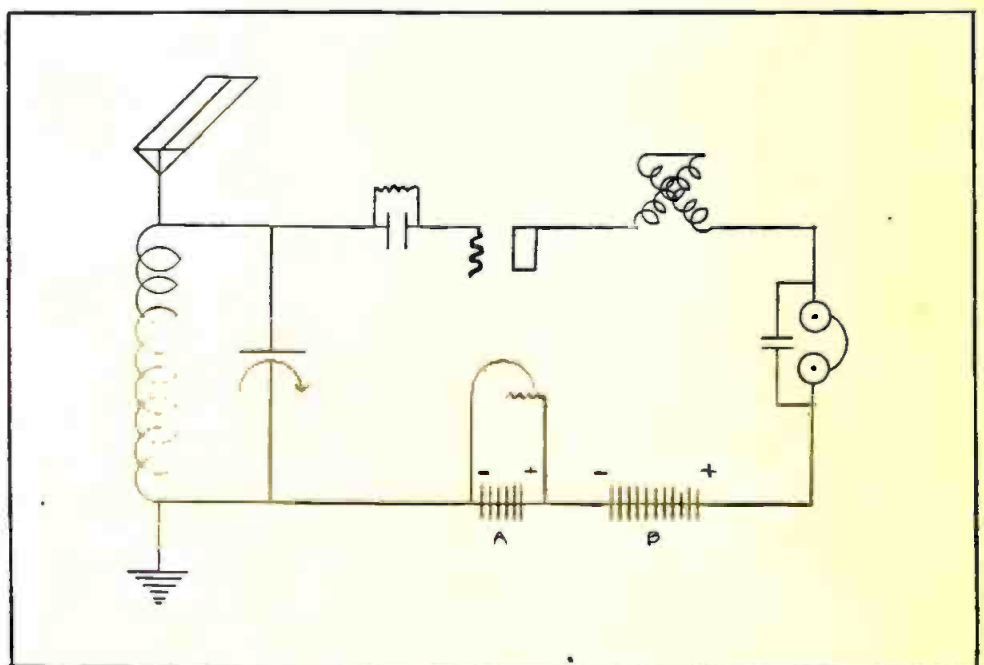
I have visited many of these. In one of them I showed a long-haired, bare-foot boy how to put up the aerial and connect the apparatus according to a wiring diagram. With grand-dad and parents and a half dozen half-scared brothers and sisters watching, open-mouthed, he turned on the juice.

Before my eyes an epoch in that family's history opened. The announcer's voice so startled the youth that he snatched the phones from his head, but he quickly replaced them, then passed them around.

To each of the awe-stricken, simple-minded sons of the forest, the miracle was unbelievable but true. There was no sleep in the house that night and before dawn there came slipping in from a dozen woodland trails the folks whom God forgot.

This obscure family suddenly had become a social center. The boy, whose chief claim to distinction was that he could hit a squirrel or a revenooer in the eye with his 22 rifle, could now shoot at and hit far more distant marks.

The battery ran low and that brought up the question of expense. There were fresh ones in the car, and as for the crude little set, I told them I might call for
(Continued on page 56)



The wiring diagram for Mr. Perry's simple outdoor radio. Adding a variometer as shown above will make the set regenerative and help a bit.

□ A Receiver that Can Be Used All Year 'Round—At Home and Afield

A Seven-Tube Portable Super-Heterodyne

By H. FRANK HOPKINS

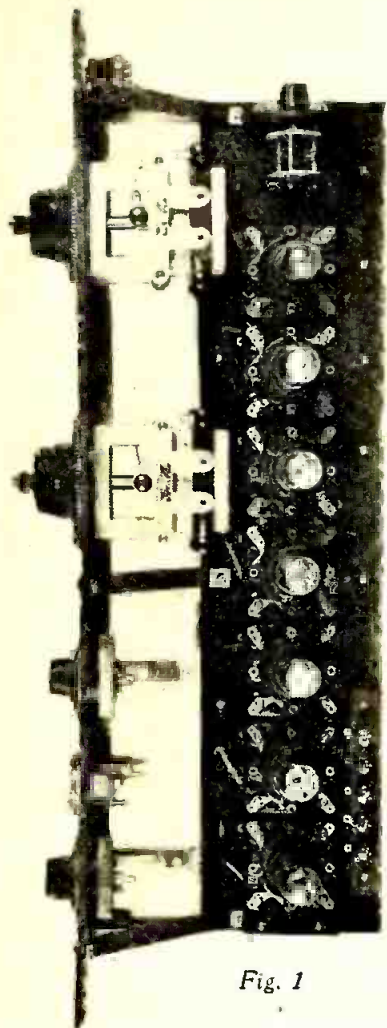


Fig. 1

The top view of the portable super, showing arrangement of the equipment on the tube socket sub-panel and the front panel.

WHY should our radios be shut down when the balmy days of Summer approach and the fish start to bite, when the great open spaces call and we respond?

Some of us can afford to have a good radio receiver at home and another in portable form, but there are many of us who cannot. Then there are those who want the last word in receivers, both at home and afield. They would not be satisfied with the usual type of portable set, so, after much searching and experimenting, the writer has at last found the ideal super-heterodyne circuit that can be built into a combination set. It is a receiver that will fit nicely in the home surroundings during the long Winter months, and still be ultra portable for Summer week-end trips and for extended vacations.

This set is very compact and efficient, utilizing every piece of equipment to its utmost, with some parts doing dual duty, as in the well-known reflex type of circuit, so desirous in portable receivers. Yet neither tone, volume nor distance is sacrificed.

This receiver uses seven "199" tubes, requiring six dry-cell batteries for filament current and 90 volts "B" battery for the plate. Unlike the so-called "portable" receiver, which is usually so unwieldy and heavy, the batteries, loud speaker, loop and such accessories in this

set are carried in one compact case. The load is thus made evenly balanced and not so cumbersome to carry. This case, when the set is used at home, will fit in very nicely with most any surroundings without the usual array of a separate loop, batteries and reproducer.

Analyzing the Circuit

BEFORE going into the details of building the set, let us analyze the circuit, so that we will know its good points and be better enabled to understand why and how it works so well, for there is not doubt it *does* work well, producing clear tone and plenty of volume with surprising selectivity, making it possible to tune in distant stations without interference from nearby powerful stations. Separations of four or five meters in wavelength are easy with this receiver. This is accomplished by using transformers that have been built with great care and have been accurately matched and tested, and are well shielded from outside interference and from each other.

Now, the wave emitted from a broadcasting station is naturally broad. This is necessitated because of the presence of what are called "side bands" or side frequencies, which carry the modulation of the voice or sound being broadcast. The transformers used in this set are designed with a peak of amplification sufficiently broad to cover these side bands or side frequencies efficiently, yet narrow enough to perfectly separate stations of four or five meters difference.

By referring to the circuit diagram, we find that the first tube serves as a "short wave" radio frequency amplifier. This is a feature not usually incorporated in super-heterodyne combinations, and makes for very efficient long distance reception. The grid of the first tube accepts the signal picked up by the loop or antenna and passes it to the short wave radio frequency transformer, where it is amplified and passed to the grid of the second tube. This tube serves as a rectifier and frequency changer, thereby doing double duty. There is no loss of efficiency in this arrangement, and a saving of one tube is effected. The output of the frequency-changing tube has two frequencies; one of short wave or high frequency, and one of long wave or low frequency. The short wave, high

frequency is by-passed and used no more. However, we preserve the long wave or low frequency and pass it on to the first long wave transformer, usually called "intermediate frequency" transformer. There it is amplified and passed to the grid of the first tube, and now the first tube is doing its second duty; that of amplifying at intermediate frequency.

The first tube now passes the intermediate frequency on to the primary coil of the second intermediate frequency transformer, and here it is amplified again through the remaining two stages of the intermediate frequency amplifier. It is readily seen that the first tube has done two duties; that of amplification at short wave or high frequency and also amplification at long wave or intermediate frequency.

"Heterodyne Action"

THE second tube has done the service of amplification at short wave or high frequency and also has created a third frequency known as the long wave radio frequency or "heterodyne" action. From the last intermediate amplifier tube the signal is rectified in the detector tube and passed to the audio frequency tubes and transformers for amplification at "audio" or voice frequency.

Most super-heterodyne receivers employ a potentiometer to control oscillation, by bringing the grid return leads of all of the radio frequency transformers to the center point of the potentiometer and adjusting it so that a positive potential is impressed upon the grid of the tubes, thus preventing oscillation. But in doing so the "B" battery current is raised considerably, thus placing an unusually heavy drain on the "B" batteries and materially shortening their life. This feature is unnecessary in this set, as the intermediate frequency transformers are "neutralized" so that the tubes will operate equally as efficient with a negative grid bias through a $4\frac{1}{2}$ volt "C" battery. The use of the "C" battery in the grid circuit reduces the drain on the "B" batteries and greatly prolongs their life. While the average seven tube radio receiver draws around 50 milliamperes of "B" battery current, this set operates around ten milliamperes, and no potentiometer is necessary.

Volume is controlled by a 60-ohm rheostat in the filament circuit of the first

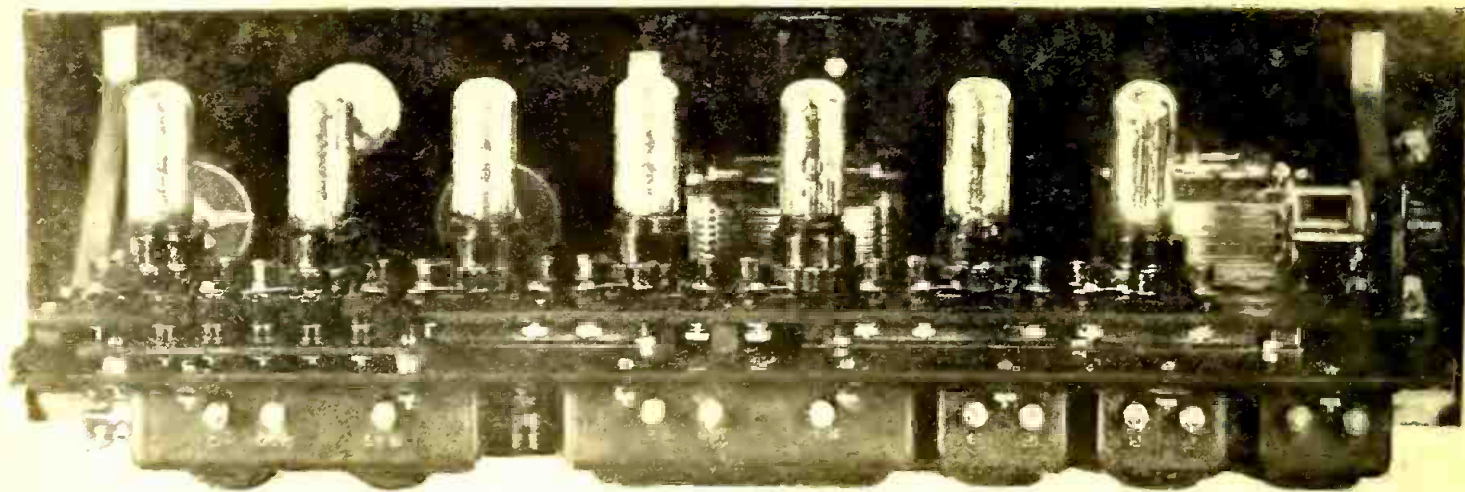


Fig. 2

Rear view of Mr. Hopkins' receiver, showing the assembly of the sub-panel, including the transformers, which are so arranged as to conserve the maximum amount of space and make the set truly portable as well as compact.

intermediate frequency amplifier tube, the intermediate frequency transformers being so well balanced or neutralized that there is no tendency toward oscillation.

When a regenerative loop is used, the strength of the signal impressed upon the first tube is greatly increased. This is accomplished by a capacitive coupling between the grid and plate of the first tube.

Feedback is obtained by a midge variable condenser to the center of the loop. A regenerative loop is a loop having two windings running in the same direction, parallel to one another, and tapped in the center. Another unusual feature of this receiver is the design of the transformers. All of them are enclosed in drawn brass cases, which completely shield the windings from outside interference and prevent internal coupling and oscillation. The windings are all well impregnated with a high grade insulating compound which prevents moisture absorption and protects the windings from damage through rough handling.

The first transformer (R-201) is a long wave, radio frequency transformer having a peak of amplification sufficiently sharp to permit close and accurate tuning without the elimination of the "side band" frequencies which are so necessary to true tonal reproduction. This transformer is peaked by two fixed condensers (.0001 and .001.)

The second transformer (R-202) is a radio frequency transformer having high amplification as low as 225 meters and as high as 700 meters.

The third transformer (R-203) is a long wave, radio frequency transformer. The fourth group (R-200), contains three intermediate frequency transformers whose curve covers a wide band of frequency. The fifth and last group (R-204) contains two audio frequency transformers completely shielded and of as high amplification ratio as is consistent with

LIST OF MATERIALS FOR THE PORTABLE SUPER-HET

- 1 R-200, 3-stage tuned radio frequency transformer.
- 1 R-201, long wave radio frequency transformer.
- 1 R-202 short wave, radio frequency transformer.
- 1 R-203, long wave radio frequency transformer.
- 1 R-204, 2 stage, radio frequency transformer.
- 2 .0005 variable condensers and dials, vernier adjustment. (VC and WC).
- 1 Midget variable condenser, maximum capacity .0001 mfd. (LC).
- 7 Type 199 tube sockets, spring base.
- 1 30-ohm rheostat. (TR).
- 1 60-ohm rheostat. (VR).
- 2 .001 mfd. mica-fixed condensers (A and B).
- 2 .005 mfd. mica-fixed condensers (E and F).
- 1 .0001 mfd. mica-fixed condenser (C).
- 1 .00025 mfd. mica-fixed condenser (D).
- 2 grid leak mountings (for FG and VG).
- 1 Tubular grid leak (2 to 7 megohms, to suit tube used.) (FG).
- 1 Variable grid leak. (200,000 to 300,000 ohms.) (VG).
- 1 Single circuit jack (LP).
- 1 Two-circuit jack (DP).
- 1 "A" Battery switch (S).
- 1 Panel mounting ammeter .0 to 1.8 scale (if desired).
- 3 Single contact jacks and plugs for loop terminals (No. 1, 2, 3).
- 5 Binding posts (A+, A-, B-, B45, and B+).
- 1 front panel, (7" x 22" x $\frac{1}{8}$ ").
- 1 Transformer sub panel (4 $\frac{1}{2}$ " x 21" x $\frac{1}{8}$ ").
- 1 Socket sub panel (2 $\frac{1}{2}$ " x 21" x $\frac{1}{8}$ ").
- 1 Binding post strip (2" x 6" x $\frac{1}{8}$ ").
- 4 Brass brackets for supporting front panel to sub panel assembly.
- 2 Brass spring clips for supporting "C" battery.
- 1 4 $\frac{1}{2}$ -volt "C" Battery.
- Miscellaneous screws, nuts, spacers, wire, terminals, solder, etc.
- 1 $\frac{1}{2}$ " x $\frac{3}{8}$ " brass angle, 12" long for stiffening transformer sub panel.
- 1 cabinet or case, to fit 7" by 22" panel as desired.

good tonal quality. The circuit diagram, together with the views of the assembled set, gives a very accurate idea of the method of mounting the parts of the receiver. When set is laid out as shown, all leads can be run in the shortest distance and no trouble need be expected from feed-back or capacity in the wiring.

The list of parts to build the set is given in an accompanying column. All of the parts bear the same designating letters and numbers as are used in the diagram and throughout this article. This is to better enable the prospective builder to identify each part more easily and to aid him in mounting and wiring the equipment.

Layout of Panels

WHEN all of the parts are secured, we can lay out and drill the transformer sub-panel, the socket sub-panel, and the front panel, to mount the apparatus as shown in the views of the set. This is best done by placing the parts in their respective places and marking the mounting holes with a punch or sharp awl. These holes should be drilled a bit larger than actually required, so as to prevent the mounting screws from binding when lining up the parts.

In preparing the tube socket panel, we will drill two holes for each socket, in addition to those required for mounting the sockets. They will line up with the filament terminals of the tube sockets. The filament terminals will be removed from the sockets and replaced when the sockets are mounted, so that the nut or terminal side is below the sub-panel, making it possible to run the filament current or power leads away from the high frequency leads.

When the transformer sub-panel is drilled, it should be stiffened by mounting the $\frac{1}{2}$ " by $\frac{1}{2}$ " x 12" brass angle on the reverse side to the transformers, in line with the center of the sub-panel, as noted in Fig. 1. The transformers and

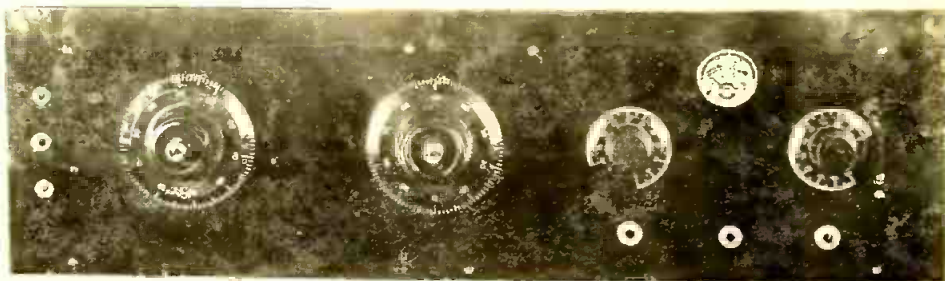


Fig. 3

A front panel view of the portable super-heterodyne, showing the tuning and volume controls and the ammeter for filament current.

grid mountings will then be fastened to the panel and we are ready to assemble the two sub panels.

The two sub panels are assembled with six No. 6 brass machine screws and nuts, 1 1/4" long, mounting the socket sub-panel directly over the 1/2" angle and using 1/2" spaces between the two sub panels as noted in Fig. 2.

The two variable condensers (VC) and (WC) will be mounted to the front panel as will be the two jacks (LP and DP), the three loop jacks (Nos. 1, 2 and 3), the battery switch (S) and the ammeter, if an ammeter is to be included. Now we will lay this panel aside until most of the wiring is completed for the sub-panels.

It will be well to run all of the connections possible on the sub panel assembly, before mounting the front panel, as most of the wiring is required here, making it much easier to reach. The set will be wired with sixty-strand, double silk covered copper wire, except where the fixed condensers are to be supported. For this we will use bus wire covered with a good insulator such as spaghetti.

When mounting the fixed condenser, (C), be sure to place it at least two inches or more from all other wires or transformers. If it is too close, coupling is liable to take place between the plate circuit and grid circuit of the first tube, causing noise or making it hard to tune properly.

Ordinary Loop Possible

THE front panel will be mounted to the sub panel assembly when this wiring is completed and the parts connected up. The four brass brackets will be used for his purpose, as shown in the views of the completed set. A regenerative loop should be used with this set for best results, as covered earlier in this article. However, an ordinary loop may be used by connecting one terminal to loop jack No. 1 and the other terminal to loop jacks No. 2, and 3.

An antenna may also be used if desired, but a two-circuit coil will be required for this. It should be wound on a 3" diameter tube. The primary is to have eight turns of No. 22 double silk covered copper wire, wound in an even layer, one end to be connected to the antenna and the other to a good ground. The secondary coil will have fifty turns of the same wire wound in the same direction on the same tube, one end to be connected to loop jack No. 1 and the other to loop jacks No. 2 and 3.

The set is made ready for operation by connecting the six dry cells in series multiple; that is, two sets of three cells connected in series and the positive terminals of each set connected to binding post A+, and the negative terminals to binding post A-. The 90 volts of B battery will be connected in series and the negative terminal connected to binding post B-, taking a tap off at 45 volts and connecting it to binding post B45, the 90 volt positive lead to be connected to the binding post B+.

Tuning is very simple. It is done by the two dials (VC and WC) and by moving the loop in an arc of 180 degrees.

The midget condenser (LC), when once adjusted, need not be changed. Volume is controlled by the rheostat (VR) and when the set is once logged, one can be certain that when he turns his loop and two dials (VC and WC) to the same setting he will get the same station—if it is on the air, as this setting does not vary when properly built and operated.

Logging the Set

To prepare an accurate log of the dial settings of condensers VC and WC it will be well to secure the regular cross section paper usually used for this purpose and plot a curve for each dial. This can be done by first tuning a station to its best maximum setting on the true wave and spotting a point on the chart for each dial, corresponding to the point of the

dial and the wavelength of the station. For example, suppose we tune in a station whose wavelength is three hundred meters; the setting of dial VC will be approximately 5-32. That is, the sliding element of the condenser will be pulled out until number five is in line with the dial and the dial rotated until it reads thirty-two. This will be spotted on the chart for dial VC at three hundred meters on the vertical scale and fifty-three on the horizontal scale.

The same procedure will be followed for the dial WC. The rheostat dials need not be logged, as they will vary as the filament batteries grow weaker.

QUITE an improvement may be made in the results obtained by this set if the tubes are matched. This may be done by using a tube tester similar to that described by the writer in the May issue of RADIO AGE.

If no tube tester is available, the next best way to match them would be to tune in a station, and then by shifting the tubes until the best results are obtained, with the smallest filament current drain.

The tubes should then be marked so that they will be put back in their proper places in the circuit when once removed. A tube whose characteristics vary to a very great extent from those used for a like purpose on the same filament control, will cause considerable noise in the set and sometimes will be the direct cause of aging the other tubes by requiring excessive filament current to be supplied to the circuit to make this tube operate.

Note: It would be advisable to communicate with the writer in care of RADIO AGE before starting to build this set, and secure a detailed list of parts as used in the original receiver. Detailed panel layouts and bracket dimensions may be had at cost if desired.

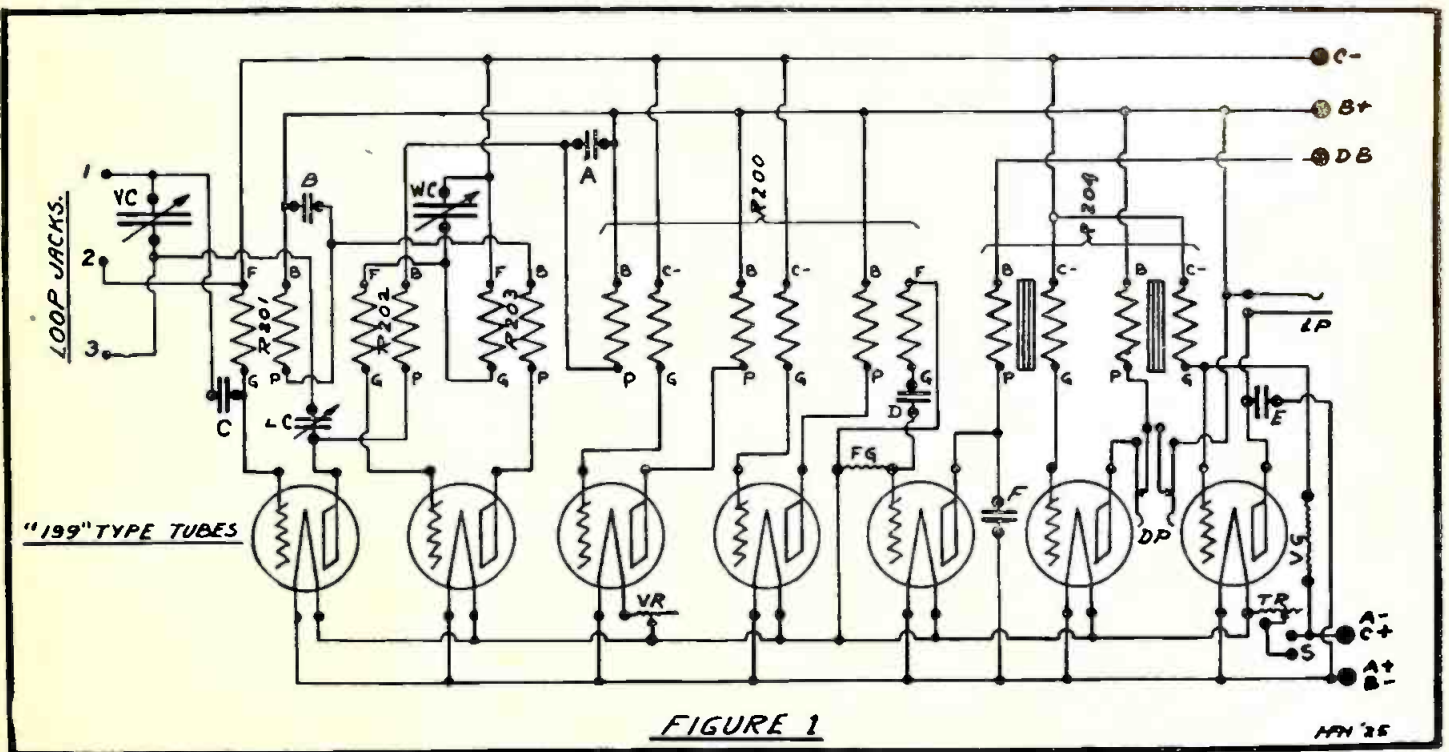


FIGURE 1

APR 25

The Double-Grid Tube in Ordinary Sets

Low Voltage In Regenerative And Reflex Receivers

By C. R. BLUZAT

IN the first part of this article, published in the March RADIO AGE, use was made of only the plate characteristic of the tube, the extra grid being merely used as a means of cutting down the resistance of the plate filament space. The benefit consisted in a low plate potential to obtain a good utilization of the tube. If we increase the plate voltage, the inner grid voltage being constant, we obtain a family of curves very similar to that obtained for the ordinary three-electrode tube, the steepness of the plate current curve increasing as the plate potential is increased.

This is an important feature, as the steepness of these curves is a measure of the amplification factor; the steeper the curve, the bigger the amplification factor and the more efficient is the tube as a straight amplifier or as a regenerative detector.

Referring to Fig. 1 of the first part of the article, we notice that the inner grid current curve is very similar to the plate current curve. This means that the tube may also be used with this grid playing the part of a plate.

Hookups for the ordinary tube apply readily to the two grid tube, tying the "B" battery voltage to the inner grid and disregarding the plate, low voltage "B" battery being used. But the fact that the inner grid current curve is similar to the plate current curve enables one to use both inner grid and plate in an amplifying role.

The theory shows indeed that, in an oscillary state, the maximum power delivered by either grid or plate is VI divided by 2, V being the average voltage; I the average current.

Thus, if both circuits are used together, the output will be about VI if the proper point of functioning is used.

For the same reason, use of both circuits is very advantageous for reception.

Getting Full Efficiency

FIG. 1 shows a hookup where the full efficiency of the tube is obtained. $L1$ and $C1$ are the secondary circuit. $L2$ and $L3$ are two inductances respectively connected to the inner grid and the plate. The electromagnetic coupling between $L2$, $L3$ and $L1$ is variable and the coils act to give a double regeneration. With such a combination, as low as 6 volts for the "B" battery will not cut the volume of the reception in an appreciable manner.

The operation of the set will be very similar to an ordinary regenerative hook-

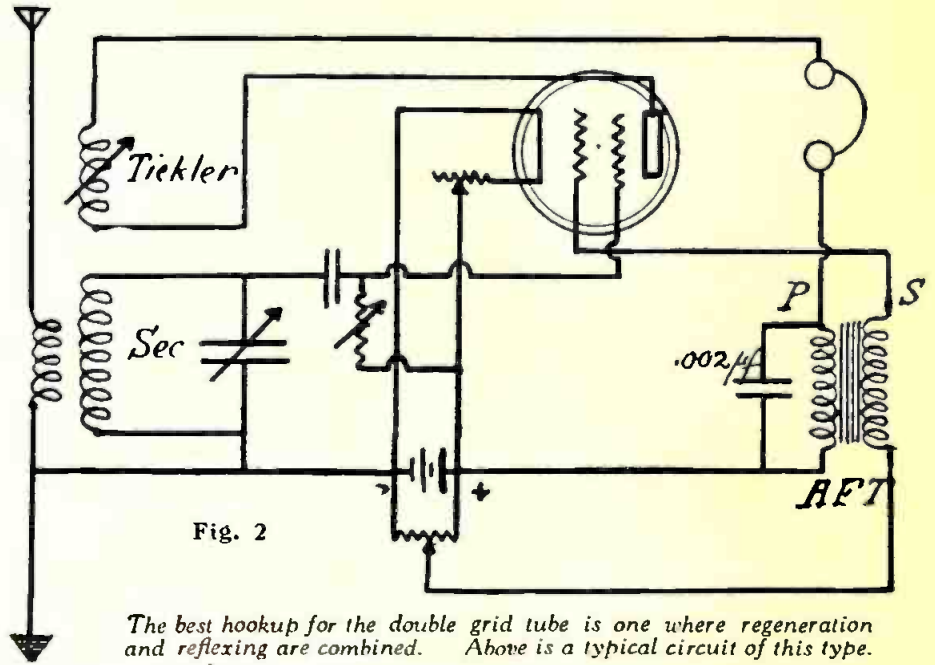


Fig. 2
The best hookup for the double grid tube is one where regeneration and reflexing are combined. Above is a typical circuit of this type.

up as $L1$ and $L2$ act like two ticklers. $L1$ and $C1$ are the same as the usual found in the ordinary receiver to cover the broadcasting range. $L2$ and $L3$ should be about 80 microhenries. Such an inductance value will be obtained by winding 30 turns of No. 18 wire on a tube 3 inches in diameter.

The width of the winding will be about one and a half inch if double cotton covered wire is used. If spiderwebs are preferred, they may be used, the number of turns to get the same inductance being about the same as above if the inside diameter of the winding is the same as the diameter of the tube. Honeycomb coils may also be used—for the secondary and the two ticklers; the aperiodic primary being obtained by winding about 10 turns on top of the secondary honeycomb coil.

The double grid tube may also be used in reflex circuits. The more efficient hookup is one where regeneration and reflexing are combined. Fig. 2 is a

typical circuit of this class. Detection is obtained in the usual fashion with the grid condenser and leak, this function being performed by the control grid. Regeneration is obtained through the action of the tickler. The detected current goes through the primary of the audio transformer. The audio frequency voltage is stepped up in the secondary winding and this amplified voltage is applied to the inner grid. This voltage in turn causes greater variations of current in the plate circuit of the tube and it is this amplified current which actuates the receiver.

THE .002 microfarad condenser is a by-pass condenser for the radio frequency current in the plate circuit. The values of inductances and condensers are much the same as in an ordinary reflex circuit. The circuit is shown with no "B" battery, as good results may be obtained, and also to emphasize the simplicity of the set. The plate, being tied to the positive post of the "A" battery, is at a slightly higher potential than the middle of the filament; if the voltage of the "A" battery is 6v and the drop in the rheostat is 2v, the plate is 4v more positive than the middle of the filament.

This positive voltage is enough to secure good results. The inner grid is tied to the arm of a 200 ohm potentiometer and its potential as regards the filament may be adjusted by moving the potentiometer knob. This hookup will be more efficient, of course, if a higher voltage is impressed on the plate, but the no "B" battery feature is important, as it is a great step toward the simplification of the set. The tube is of the low consumption type, requiring only .35 A and 3v8. This current is low enough to be furnished by dry cells, three being used in series to give the necessary voltage. An efficient one-tube portable set may be made following the hookup of Fig. 2.

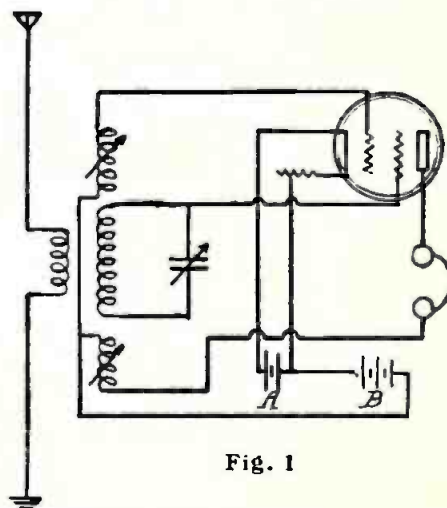


Fig. 1
A simple hookup of the regenerative type, where the full efficiency of the double grid tube is utilized. As low as 6 volts for the "B" battery will not cut the volume of the reception appreciably in this hookup.

A SCIENTIFIC RECEIVER

By M. B. Sleeper

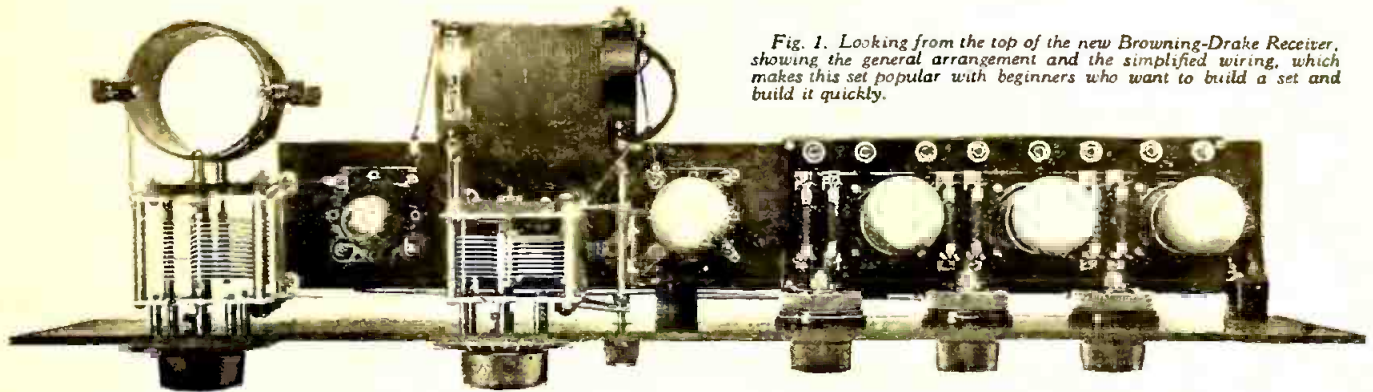


Fig. 1. Looking from the top of the new Browning-Drake Receiver, showing the general arrangement and the simplified wiring, which makes this set popular with beginners who want to build a set and build it quickly.

Mathematical Determination of Constants of Coils and Condensers a Feature of Browning-Drake Set; Has Half as Many Connections as Ordinary 5-Tube

WHEN Messrs. Browning and Drake delivered a lecture on their work before a gathering of radio engineers some time ago, it is doubtful if either of them had any conception of the unusual popularity that their set was destined to receive within the course of a few months. The Browning-Drake receiver is all-popular in the New England States and its popularity, based on sheer merit, is growing day by day.

The Browning-Drake does not employ a trick hookup. Its success is due to the scientific methods applied in determining mathematically the various constants of the coils and condensers when used with the vacuum tubes now available. This can be seen by studying the circuit diagram in Fig. 4.

A special feature of this new receiver is that it has about half as many connections as an ordinary five-tube receiver. Therefore, it is a particularly fine outfit for the beginner or for the set builder who wants something that can be constructed very quickly. As a Summer time proposition, this is an ideal outfit because it can be operated with a small indoor antenna, with correspondingly lower static pick-up.

Tests on this outfit settled definitely the question of B battery consumption. With five tubes in operation, under normal receiving conditions, the total plate current was 10 milliamperes. Five-tube neutrodyne, for example, draw 20 to 30 milliamperes. This is a positive evidence that the resistance coupled amplifier draws less current than the transformer type. Moreover, when strong signals come in, the current is decreased and not increased.

The publication of complete construction data for these receivers has resulted in a demand for a set of this kind employing resistance coupled audio amplification, and representing one of the highest types of radio receivers in use today, combining as it does the extreme sensitivity and selectivity peculiar to this set, with a faithfulness of reproduction, through the use of resistance amplification, which will satisfy even the most critical music lover.

Construction Very Simple

By using a Daven Super-Amplifier unit which comes already wired, the construction of the set has been made very simple and neat, without any appreciable increase in cost. Practically all of the wiring has been kept under the tube panel, adding greatly to the appearance of the outfit when installed in a cabinet.

The tuning is accomplished by means of the two large vernier dials. The one on the left tunes the R. F. amplifier while the right hand dial tunes the detector.

The R. F. amplifier tube filament is regulated by a 30-ohm rheostat. One of 20 ohms controls the detector, and another, of 6 ohms, is connected to the three A. F. amplifier tubes. Tri-jacks are used for plugging in on the detector or last A. F. stage. Below the center rheostat dial is a filament switch, by means of which the tubes can be turned on or off without disturbing the rheostat settings. This switch is provided with an ON-OFF sign which fits against the panel, and the fact that its depth behind the panel is very small makes it just right.

The Browning-Drake receiver will not interfere with reception of other stations,

because the detector tube is not used in an oscillating condition, and the R. F. tube does not oscillate at all.

Standard Parts Required

THE front panel is of Formica measuring 7 by 28 by 3-16-in., and the base panel, of the same material, measures 3½ by 23 by 3-16-in. The panels must be strong mechanically because they support the weight of the instruments and any extreme bending or sagging will probably result in open or short circuited connections.

The two tuning units come already assembled with the coils mounted on the condensers. The first unit consists of a 0.0005 mfd. condenser with the antenna coil, while the second is made up of a 0.00035 mfd. condenser with the radio frequency coil. Both of the condensers are provided with vernier dials. These dials have a reduction ratio of about 5 to 1, and are perfectly smooth and positive in operation.

On the front panel are mounted the three rheostats, battery switch, and two Tri-Jacks. The base panel carries the amplifier unit, one standard socket, one 199 socket, a 0.001 mfd., a fixed condenser, and a 0.00025 mfd. fixed condenser with gridleak mounting clips for the 2-megohm gridleak. Three binding posts are used on the antenna coil.

For hardware, one angle bracket and twelve coil mounting pillars are required. One of the pillars holds the tube panel to the front panel at the right hand end; nine of them are used for extending connections from the amplifier, while the other two are fastened to the underside of the tube panel as supports, for they

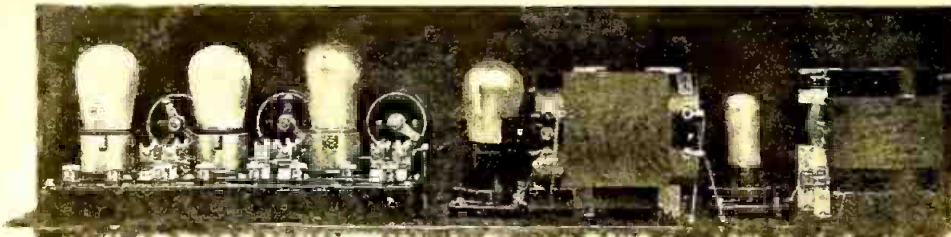


Fig. 2. A picture of the wiring arrangement of the Browning-Drake set. By bringing the terminals from the amplifier to the under side of the base panel, most of the wiring is kept out of sight.

rest on the bottom of the cabinet when the set is installed.

Fig. 2 gives the picture wiring for the set. It shows the connections and wiring exactly as they were arranged in the original receiver. The base panel is dropped down in order to show the parts more clearly.

Put soldering lugs on the terminals of the various instruments as you mount them. The short heavy lines in the picture wiring diagram show the directions in which these lugs must point. Use a good rosin core solder, or plain soft solder with paste put on very sparingly. We have found that the familiar spreading of the soldering paste over the panel at each connection can be eliminated entirely by slipping a small piece of ordinary newspaper, which is quite absorbent, under each lug while the soldering is being done. The paper absorbs the soldering paste, leaving a clean, neat connection. Have the iron thoroughly tinned and hot enough to make the solder flow freely. If you cannot afford an electric soldering iron, you can use a soldering kit, which comes complete at a low cost.

1. Remove the nut under the binding post marked P input on the amplifier. Also remove the short connecting strip to the screw holding the end resistor clip. Put the nut back, and on top of it, screw a coil mounting pillar. This will be the +90V binding post. Remove the screw which fastens the clip of this resistor,

enlarge the hole in the clip and amplifier base, and slip in a 1/2-in. 6-32 R. H. screw. Put a nut and a coil mounting pillar on the screw underneath the base. This will be terminal No. 28 later.

Remove nut under binding post, B Input, on Daven Super-Amplifier. Disconnect connecting bus going to this post, and put back the nut and a coil mounting pillar. This will be the Det+ binding post. Now remove the bus wire which

top of it. This will be terminal 22 later. Remove the screw and nut which fasten the front clip of the second resistor from the right of the amplifier. Enlarge the hole in both the clip and the base, and put in a 1/2-in. 6-32 R. H. screw. Put a nut and a coil mounting pillar on this screw under the base. This will be terminal 16.

Screw a coil mounting pillar on the A Bat+ binding post screw under the base. This will be terminal 33. Repeat this with the P output and B output binding posts.

PUT a 1-2-in. 6-32 R. H. screw through the front left hand mounting hole of the amplifier. This is a "blind" screw. Fasten the angle bracket to the tube panel in the position shown with a 1-2-in. 6-32 F. H. screw and nut. Now fasten the amplifier to the tube panel with three 1 1/4-in. 6-32 R. H. screws and nuts. Put 1/2-in. 6-32 R. H. screws through the holes in the tube panel into the coil

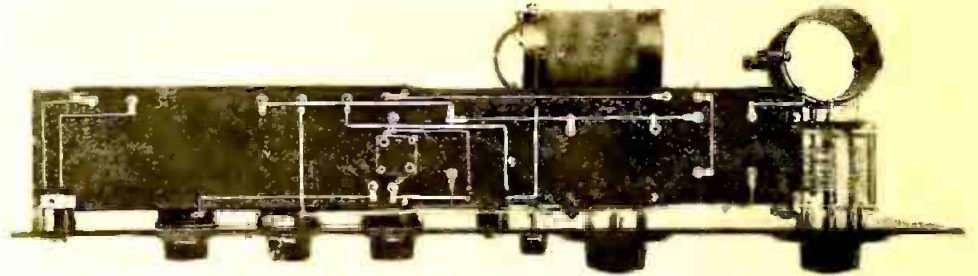


Fig. 3. The clean cut design of the Browning-Drake five-tube receiver, so free from complicated wiring, makes the set unusually attractive as well as efficient for all kinds of radio reception.

ran from this post to the front clip of the first resistor. Enlarge the hole in this clip and the amplifier base and put in a 1/2-in. 6-32 R. H. screw. Put a nut and a coil mounting pillar on this screw under the base. This will be terminal 26 later. Remove the nut under the binding post marked A Bat-, disconnect and remove the bus wire which runs over to the A - feeder bus, and put back the nut with a coil mounting pillar on

mounting pillars under the amplifier base. These serve to bring the connections up to the amplifier. Put the necessary lugs under the heads of these screws, as shown in the bottom view, Fig. 3, of the set. When putting in the screws for terminals 26 and 28 be sure to fasten the tabs on the 0.001 mfd. fixed condenser with them.

2. Remove the screws and nuts from the + and - terminals of the 201-A (Turn to page 50)

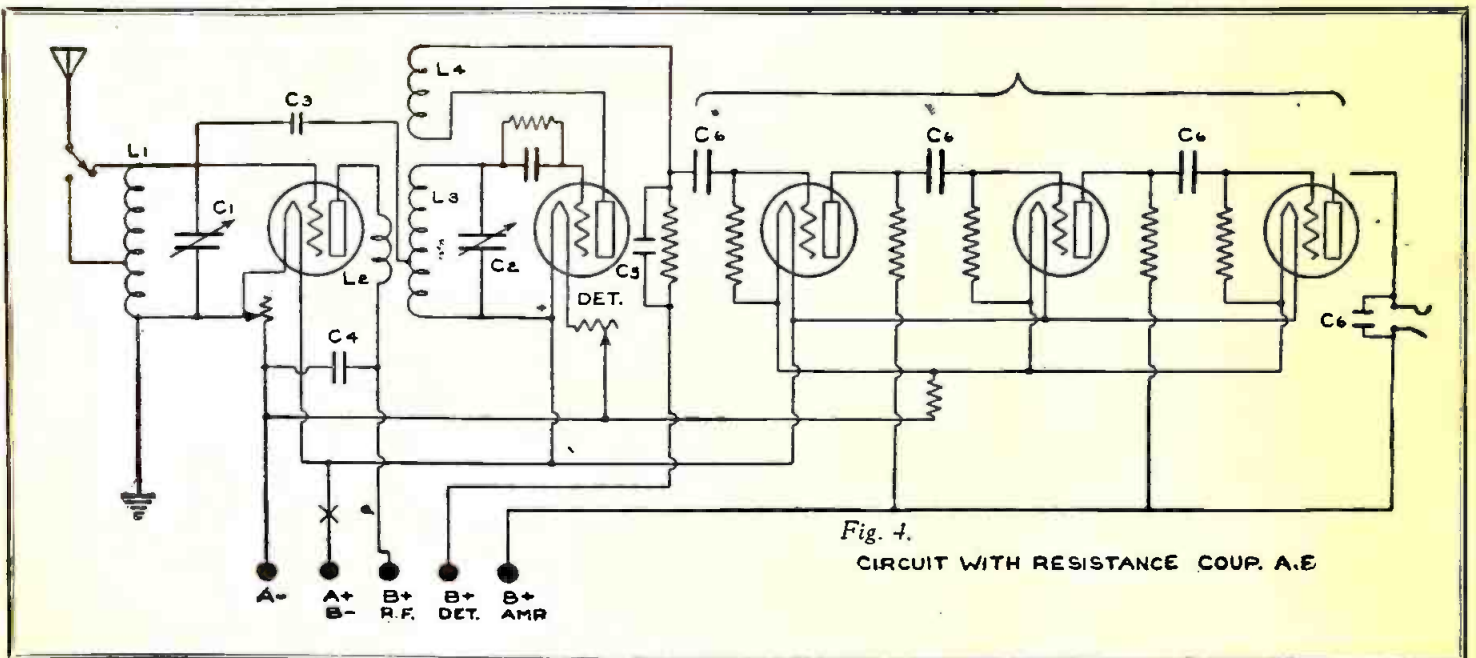


Fig. 4. CIRCUIT WITH RESISTANCE COUP. A.E.

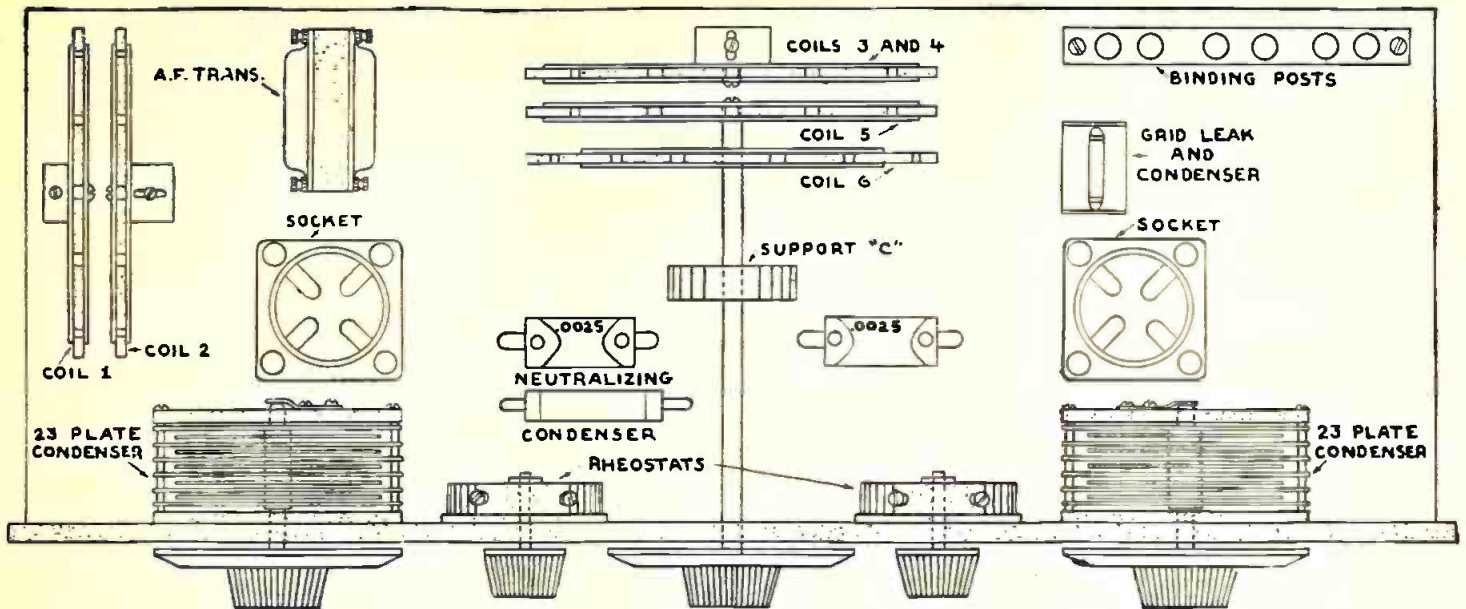


FIGURE 4
GENERAL LAYOUT OF PARTS

Overcoming Radio Frequency Oscillations in the ROBERTS RECEIVER

By FRANK D. PEARNE

IN building any kind of a set which employs radio frequency amplification, the one essential feature is to provide some way to overcome the oscillations of the radio frequency amplifier. This type of amplification is absolutely necessary if the best results are to be expected. It is very true that some regenerative sets which are not equipped with high frequency amplifiers will produce remarkable results in some cases, but for all-round, continuous performance, there is nothing to be compared with radio frequency amplification.

There are several ways of overcoming these undesired oscillations, but the method used by Mr. Roberts is one of the most dependable. In accomplishing this, he makes use of a primary winding consisting of two wires wound together, which really forms two coils wound in the same direction; as the turns of these coils lay side by side, they are very effective.

Only one of these windings is used for the primary, similar to the primary in other radio frequency sets, and the purpose of the other is to prevent oscillations.

The coil which is used as the primary is connected in such a way that it is opposed in inductive relation to the one which is used to neutralize the feed-back. This neutralizing coil is connected to the grid through a condenser, as will be noticed upon looking over the drawing shown in Figure 2, which is a schematic arrangement of the circuit.

Mounting the Coils

IN Figure 3, a simple method of mounting the coils is shown. Coils 3 and 4 are the two parallel windings mentioned before, and are wound on one form. This form is fastened to a wooden block, "A," which has a slotted hole for the screw

which is to hold it to the baseboard, and which will allow a slight shifting of the position of these coils in relation to the others. The secondary, which is coil "5," is mounted in a permanent position on the end of the wooden block, "B," and the tickler coil, which is adjustable, is mounted on the end of a long wooden dowel pin which extends through the wooden support "C" and through the panel, where it terminates in a knob by means of which the coil is drawn forward or back to vary the coupling between it and the secondary coil.

One of the slots in the fiber form on which the tickler coil is wound is made to

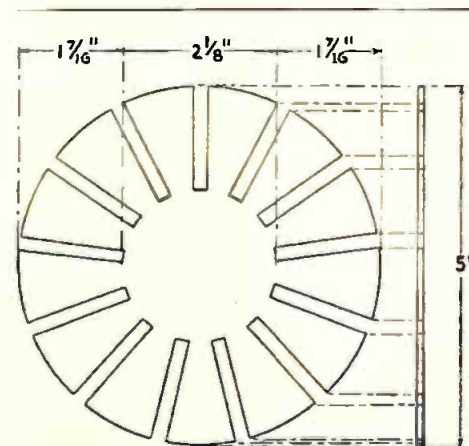


FIGURE 1
SHOWING DIMENSIONS OF FIBER FORM FOR COILS 1-2-3-4-5 AND 6

fit loosely over the wooden strip "B" for the purpose of preventing the turning of the coil. In other words, the wooden block "B" forms a sort of a track to keep the coil from moving to either side. The connections to this coil are made with flexible leads which will allow a back-and-forth

movement without breaking off the leads. The dimensions of all the wooden pieces are given in Figure 3. All of the coils used in this set are wound upon fiber forms of the same size as shown in Figure 1. To construct these forms, procure some sheet fiber 1-16 of an inch thick. This fiber sheet should be perfectly flat and not warped out of shape. Bakelite will also answer for the purpose, but this is more expensive. From this material, cut out five pieces 5 inches in diameter and draw a circle 2 1-8 inches in diameter in the center of each, and divide the outside edge into 13 equal parts and cut a slot 1-4 of an inch wide from the outside edge to the edge of the circle drawn in the center.

These slots will be 1-16 inches deep, which will give ample space for the turns of wire which are to be wound in them. Coils 1, 2 and 6 are wound with No. 22 double silk covered wire. The wire is placed in one of the slots, leaving an end about 6 inches long, and wound over two of the lugs; then through the slot and over the next two lugs on the other side; then through a slot, over the next two on the other side, etc.

Using a Spring Clasp

COIL No. 1 consists of 30 turns wound in this way, and at each fifth turn a small loop is made in the wire, just large enough to solder a wire to, when the set is wired. A better method of making this connection after scraping the insulation

off from these loops is by using a small spring clasp which is connected to a flexible lead. In this way the number of turns used may be varied easily by simply snapping the clasp on the desired tap. Coils No. 2 and 5 are wound just like Coil No. 1, the only difference being that each of these coils must have 45 turns of No. 22 wire.

The coil No. 6, which is the tickler, which is to slide back and forth, is also wound in the same way, but has only 20 turns. If after the set is assembled it is found that

oscillations occur, the number of turns on this coil should be reduced. The coils No. 3 and 4 are wound on one form. They are wound with No. 26 double silk covered wire. For ease of winding, this wire should be first wound on two spools. Place the ends together in one of the slots and wind with the two strands of wire, instead of the single strand as in the other coils. Here the method of winding changes slightly.

Instead of winding over two teeth or lugs as before, wind over only one, pass through the slot and over the other lug on the other side, etc. There should be 22 turns of this double winding; that is, 22 turns of each. After all the winding is completed, there will be five forms and six coils. The coil 1 is the aerial inductance. Coils 2 and 5 are the secondary coils, coils 3 and 4 are the plate and neutralizing coils, and coil 6 is the tickler.

In assembling the set, coils 1 and 2 are mounted on wooden blocks as shown at "A," Figure 3. These are made adjust-

able by means of the slots in the blocks and should be placed about 1-2 inch apart and afterward adjusted until the best position is found, where they are fastened securely and left in this position. Coils 3 and 4, 5 and 6 are mounted at least six inches from 1 and 2, and at right angles to them as shown in Figure 4. By mounting coils 3, 4, 5 and 6 back away from the panel, all chance of body capacity interference will be eliminated. It is just as easy to mount them in this position as any other, as it will require only a longer wooden rod to accomplish this.

Mounting the Parts

THE parts should be mounted about as shown in Figure 4. This arrangement may be varied somewhat, providing the condensers and coils are not placed too close together. In connecting up the various coils, one must be careful to see that the outside terminal of coil No. 1 is connected to the aerial and that the ground connection is made to one of the

taps, or to the inside terminal (whichever arrangement gives the best results). The outside terminals of the coils 2 and 5 must be connected to their respective grids and the outside terminal of the plate coil is connected to the plate of the first tube. The inside terminal of the plate coil must be connected to the outside terminal of the neutralizing coil as shown. A reversal of this connection would ruin the neutralizing effect of the coil. The bottom or inside terminal

coil is connected through the neutralizing condenser to the grid of the first tube. This neutralizing condenser should be the smallest variable condenser which can be obtained.

One which has only two plates will best serve the purpose.

There are many of these midget condensers on the market which are sold for this purpose, but if such cannot be obtained, the ordinary method of using bus bar wire with spaghetti insulation, such as is employed in the neutrodyne circuit, may be used. It will be found, however, that considerably more capacity will be required than that used in the neutrodyne circuit. This part of the set will be more or less experimental, until the proper value is found. The correct capacity at this point is the most important part of the receiver.

The parts required for the construction of this receiver are as follows:

- Six coils as described, two 23 plate

(Turn to page 49)

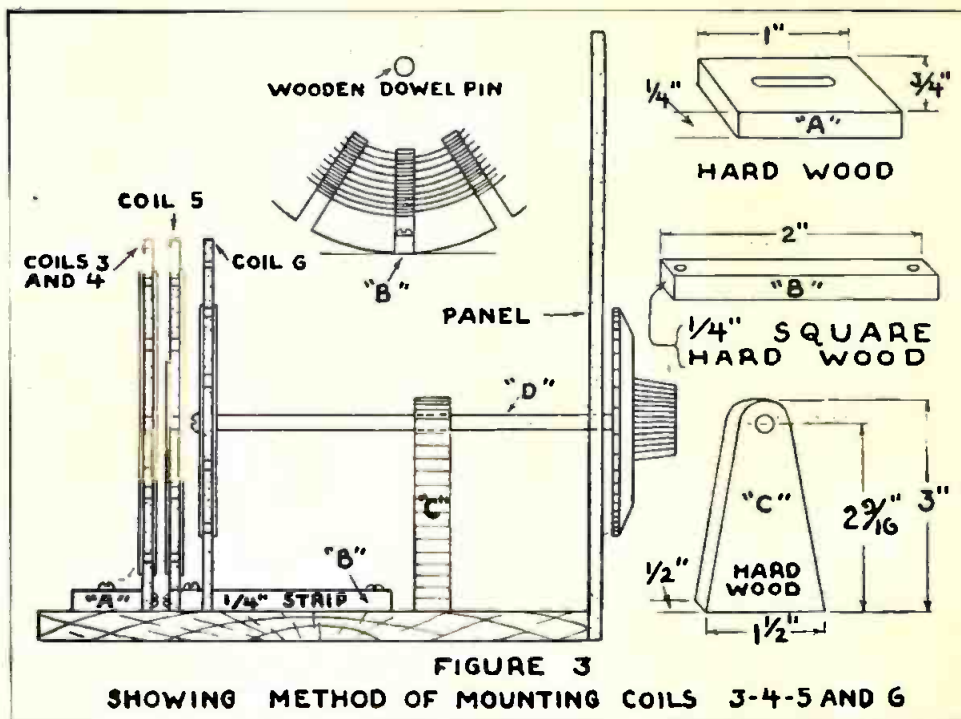
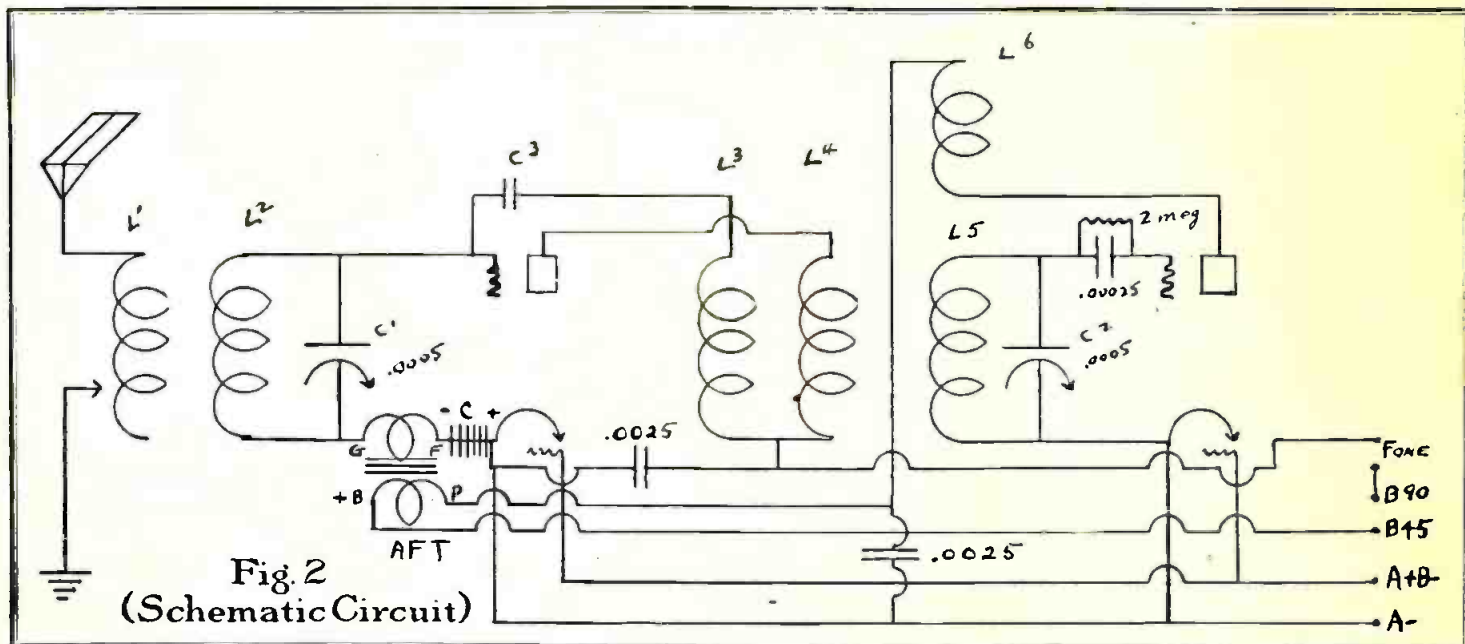


FIGURE 3
SHOWING METHOD OF MOUNTING COILS 3-4-5 AND 6



An IDEAL Set in Practical Form

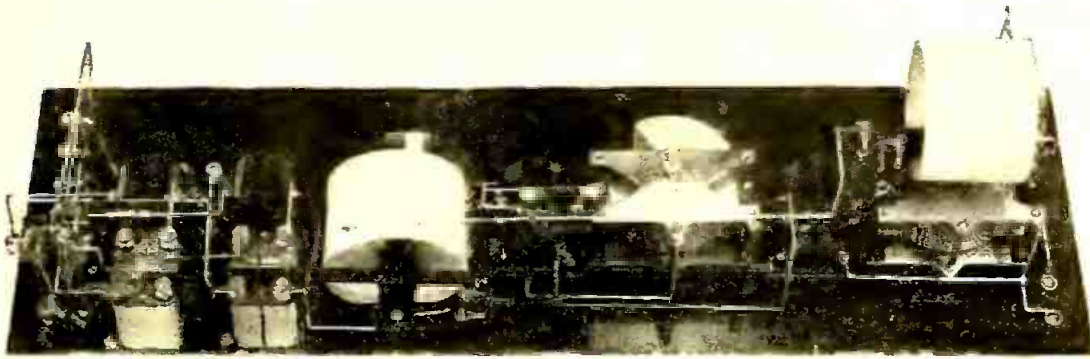


Fig. 1. Rear panel view of set described by Mr. Silver. All apparatus is mounted on the panel, there being no need for a baseboard.



Fig. 2. Front view of the completed set, showing controls.

A Four-Tube, Neutralized Radio Frequency Receiver; Stable Hookup Gives High Efficiency Over Entire Range by Using Regenerative Detector and Usual Amplifier

THEORETICALLY, a broadcasting receiver consisting of one or more stages of regenerative radio frequency amplification, preceding a vacuum tube detector circuit which would also be regenerative and which would be followed by one or two stages of audio amplification, would be just about ideal from the standpoint of the average radio fan who is interested in results, low cost and general simplicity.

As far back as several years ago, this combination was realized to be highly desirable, and a number of text-books can be found in which some such layout was given, generally followed by a notation to the effect that while the system had wonderful possibilities, it would indeed be a good man who could get it to function really satisfactorily. This, it must be remembered, was several years ago when the neutrodyne was but a dream and low-capacity, low-impedance tubes were practically unheard of.

Before going into the details of a practical form of this circuit, it might be well to consider the neutrodyne system and the allied systems of tuned radio frequency amplification. Essentially a neutrodyne is nothing more than a tuned radio frequency amplifier, the neutrodyne principle being merely an arrangement whereby an excessive amount of energy due to regeneration, which might cause oscillation, is so balanced out that oscil-

lation cannot take place. Actually, a neutrodyne is highly regenerative on the shortest wavelengths at which it will operate, but it is so balanced that oscillation cannot take place upon the shortest wave to be received—say 200 meters. When the receiver is tuned to its highest wave, —550 meters,—the amount of regeneration present will have fallen off, with the result that the selectivity and sensitivity are very much poorer than on the lower waves. This is the basic fault of tuned radio frequency amplifying systems—if they are to be simple in operation and thoroughly stable, their efficiency will not remain anywhere near constant over their full wavelength range. Tuned radio amplifiers not employing neutralization must have losses introduced into their circuits if they are to be kept stable, another common stabilizing method being to so arrange the coupling coils that energy, fed through on the low waves, will be insufficient to cause oscillation. Due to the fall-off in regeneration with an increase in wavelength, most such sets are poor performers on the high waves.

Stability a Feature

ONE of the advantages of the neutrodyne is its stability; hence it is possible to realize, by using a neutralized

R. F. amplifier, our ideal receiver, for we can combine a regenerative detector circuit in conjunction with a neutrodyne amplifier that will do much to even up the efficiency of the set over its entire range. If such a combination is carefully designed, the losses in amplification in the R. F. section on the high waves may be compensated for appreciably by the controllable regeneration in the detector circuit; yet the fact that the detector may be oscillating will not unbalance the system.

Before considering the design of a circuit which renders this combination possible and entirely practical, we must realize that in this design we have accomplished two very important operating improvements, almost at one stroke. The first is the eliminating of radiation from the receiver due to the transmission of energy from the detector circuit, when it is oscillating, to the antenna system. This is prevented by the neutralized or balanced condition of the R. F. amplifier, which prevents the passage of energy from its plate circuit back through to its grid circuit.

This permits the detector to be operated in an oscillating condition with no fear of the receiver radiating and disturbing the neighbors. Here, then, is the second important operating improvement—the detector may be made to oscillate and stations located with but

one dial, merely by turning the detector tuning condenser until the desired whistle is heard, as on a regenerative set. The R. F. amplifier is then adjusted until the whistle is loudest, and the detector stopped from oscillating by reducing its tickler coupling. Actually three or more controls are used on such system, of which only one need be used to find unknown stations.

In practically constructing such a system, there are several ends to be achieved, and upon them will depend the means employed. The first point is that the receiver must go down to the noise level and bring in with loud-speaker volume any signals heard with sufficiently greater intensity than the ever-present atmospheric noise to be distinguished from it satisfactorily. Then, the receiver must be selective enough to cut through the entire group of local stations in centers such as Chicago or New York, and bring in dependably stations all over the country. The set must be simple to construct and operate, the upkeep cost must be low, a minimum numbers of tubes should be used, and all parts should be procurable on the open market.

Layout Insures Efficiency

THE practical answer to these and many other more involved requirements, both from the standpoint of theoretical as well as practical efficiency, is illustrated in Figures 1 and 2. Figure 2 is a front view, showing all controls mounted on a standard 7 x 24 panel. The left dial is the antenna, or R. F. stage condenser, the next the detector condenser, and the next the tickler. To the right is the rheostat knob and the battery binding posts. The lay-out is not only pleasing to the eye, but makes for the greatest possible efficiency.

Figure 1 is a rear view of the set. At the right is the antenna inductance, mounted on the back of its tuning condenser. Next is the R. F. tube socket, with the neutralizing condenser mounted directly on its grid post. To its left is the detector condenser, then the detector

socket with its grid-condenser and leak. Next is about the most important piece of equipment in the set, the R. F. coupler, with its adjustable tickler. Upon the design and construction of this coupler depends the stability of the outfit, for even a very slight variation in the size or location of the primary coil, placed inside the bottom end of the stator coil, would throw the results of the whole receiver off. At the left end of the panel are the two audio tube sockets, placed over the audio transformers, and behind the rheostat controlling all four tubes. On the left end of the panel are the battery binding posts, on-off switch and jacks. No sub-base is used, all parts mounting directly upon the panel.

The receiver illustrated consists of one stage of tuned, neutralized R. F. amplification, a regenerative second detector and two stages of distortionless audio amplification. The condensers used are of the grounded rotor, low-loss type, and aside from preventing hand-capacity, are extremely efficient. The antenna coil and R. F. coupler are especially designed for the circuit, and employ self-supporting windings, rendered rigid by a special treating compound. As a matter of fact, tests by Armour of Chicago indicated that these coils so treated have less resistance on a dry day than untreated coils supported with two strips of adhesive tape, while for a damp day the doped coil showed 26 ohms less resistance than the undoped coils. This figured out to be about 500 per cent greater resistance for the untreated winding. These tests indicate that the high efficiency claimed for the untreated coils, with which the market is now flooded, is purely mythical, but much depends upon the use of a good dope, such as is not available on the open market.

Results Obtained

THE test of any design is what it will do, and merely figuring out an ideal receiver on paper is far from building it, and testing it under a variety of conditions.

A large number of these sets have been built and used in and around Chicago, with the results obtained by one builder typical of those obtained by the others, with due allowance for location and conditions. A physician in Wilmette built the set in a period of three hours, hooked it up at four in the afternoon, and before eight o'clock had gotten 27 stations on his loud speaker, ranging from Toronto to Fort Worth, in daylight! In a week he logged over 100 stations, never once resorting to head-phones.

The material required to build the receiver is given in the list below, with an accessory list farther along. It is strongly recommended that the builder adhere strictly to this list. If, however, the experimenter desires to deviate, he should only do so where his knowledge is sufficient to effect the necessary design changes attendant upon the use of material other than those specified.

- 2 Low loss condensers .0005.
 - 3 4-inch Moulded dial—tapered knobs.
 - 1 $6\frac{1}{2}$ Ohm rheostat.
 - 6 Insulated top binding posts
 - 1 2 Spring jack.
 - 1 1 Spring jack.
 - 1 Low loss coupler.
 - 1 Low loss antenna coil.
 - 4 Panel mounting sockets.
 - 2 $3\frac{1}{2}$ Audio transformers.
 - 1 On-Off switch.
 - 1 .00025 Mica Condenser with leak clips.
 - 1 .002 Mica Condenser.
 - 1 .0075 Mica Condenser
 - 1 2 Meg Grid leak.
 - 1 7x24x16" panel.
- Bus-bar, spaghetti, screws, nuts, solder, lugs, etc.
TOOLS REQUIRED: Screw driver, pliers, soldering iron, hand drill with drills, and countersink.

If a plain panel is used, it should be drilled in accordance with the layout given, and the necessary holes countersunk. If desired, it may be given a grained finish by rubbing in one direction only with sand-paper and oil. Indicating marks for the dials may be scratched with a scribe and filled in with Chinese white.

The antenna coil should be attached to one of the variable condensers. Care should be taken to see that the loop, or tap on the coil comes near the right-hand end of the condenser, when viewed from the rear, with the stator or fixed plate
(Turn to Page 56)

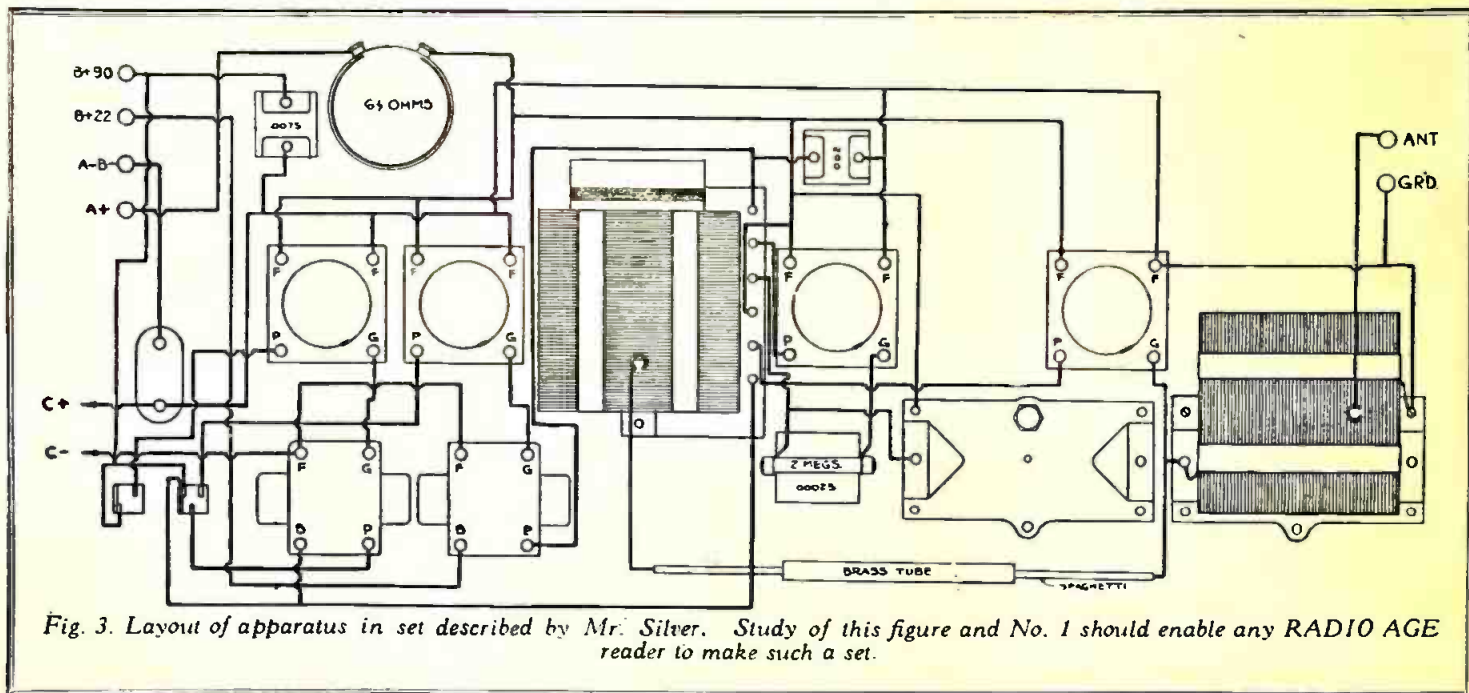
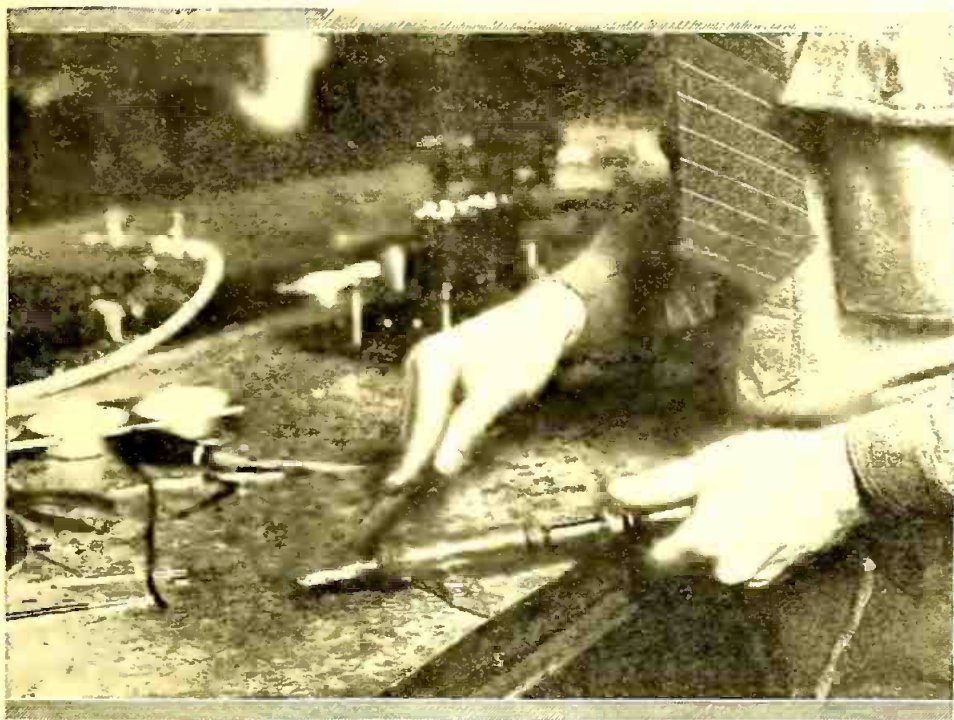


Fig. 3. Layout of apparatus in set described by Mr. Silver. Study of this figure and No. 1 should enable any RADIO AGE reader to make such a set.

Proper SOLDERING Insures Efficient Circuit Operation



Pictorial Tips for the Set-Builder on This Essential Radio Topic

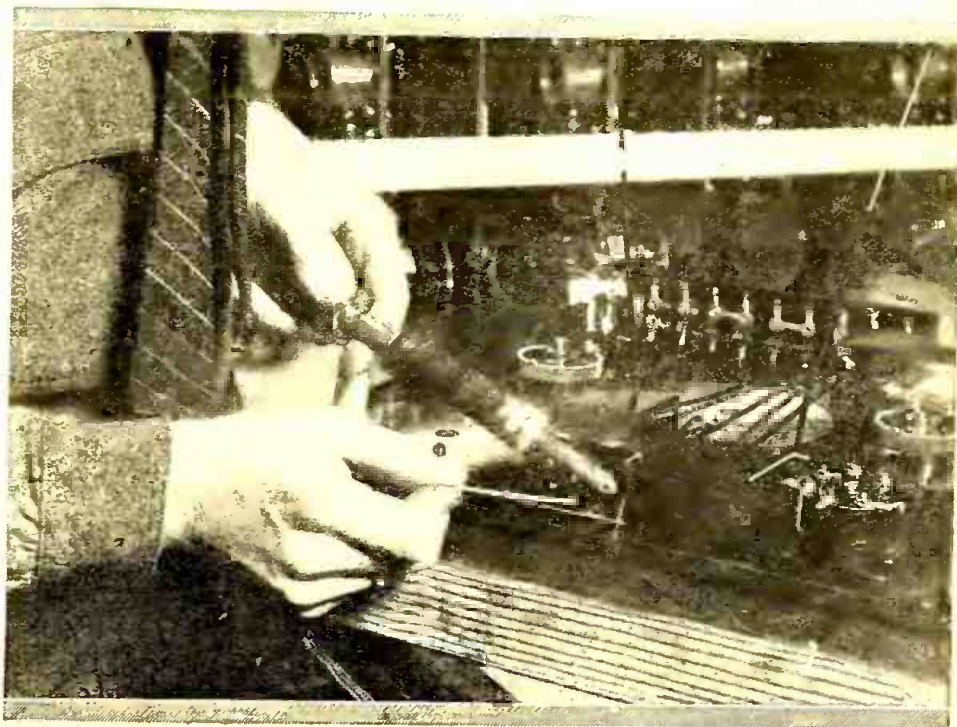
GOOD connections mean good contacts and perfect circuits. These the set-builder must have if he is to be repaid for his efforts with good reception and pure tonal quality. The first thing to be done in setting out on a soldering job is to clean the soldering iron thoroughly, as shown in the photograph at the left. Use a file for this preliminary job, and see that all grit and other impedimenta are removed before actually turning to the solder. This means the solder will be absolutely clean.



PROCEDURE Number Two in doing good soldering is to clean the connections to be soldered with the same care that was given the iron itself. The first photograph at the right illustrates this method. When both iron and wire are clean, good contact is assured. Next, apply the soldering flux, as shown in the photo to the left. Be sparing in the application of the flux, for many poor connections are often caused by the use of the flux in excessive quantities. Do it right the first time and you won't be taking your set apart time and again after it has been put into operation.



AT the right is a good idea of how to apply the solder to the joint. Note that only a small amount of the solder is necessary on the tip of the iron. Rub it over the joint to be soldered until it runs freely, and then let the joint cool. Some radio experts have said that the best test of a soldering job is to drop your wired set on the floor, and if the wires stay intact, the soldering is satisfactory! However, this method often proves disastrous to the rest of the set, so be on the safe side by testing the soldered joints with your hands. And once you are sure the job is satisfactory, leave it alone.





What the Broadcasters are Doing



WJZ Broadcasts for the Tired Business Man

FOR once the male radio fans have come into their own. Women listeners, for whom special "Women's Hour" programs have been instituted and featured since radio began, now have no consideration at the hands of station WJZ, New York City. The long-suffering, bill-paying husbands are being given something for nothing; and the something is designed for their ears and theirs alone.

"For T. B. M's. Only." So read the WJZ program between 8:40 and 10 o'clock on March 9. What a T. B. M. is, every follower of the Great White Way knows; he is the gold-digger's delight, the Great Mogul to whom all Broadway bows low while they relieve him of vast fortunes; viz., the "Tired Business Man." And WJZ has planned to bring him surcease from his suffering, to relieve the chronic ennui of the peculiar species without relieving his pocketbook. Truly radio is a Marvel!

Enter the "Chics"

The Two Marias crooned the kind of blues that only men appreciate; George Laval Chesterton rendered an episode entitled "Wa-a-a-ah!" which was directed straight to the sorely-tried hearts of the T. B. M's.; the World's Worst Radio Speaker unburdened his soul to an audience which shouldn't have contained any women!; Fay Marbe, Broadway's Peppiest Play-Girl, put across a radio act that made WJZ request a special police guard at the studio to fight off the admiring "studio-door Johnnies;" Sam Hermann, with Muriel Pavellock, arranged an act that brings \$5.50 top anywhere in civilization; John C. Cutting, the Baldest Man in Three Continents, described the harrowing night-life which made his hair fall out; and Norman E. Brokenshire mounted his ukelele and sang a song that made the well-known "Parley-Vous" fade into the background of respectability.

"For T. B. M's. Only!" WJZ has given full warning to all feminine listeners to remain away from the loudspeakers and ear-phones on these nights; and for the sake of peace in the family it advises all married men to keep their wives away from the receiving set. And above all, WJZ earnestly entreats all men not to tell their feminine contingents what they are laughing at—if they should stop laughing long enough to be able to tell!



Above is Herbert Sidney Mintz, musical director and announcer of the new Wrigley-Hermann-Thompson radio station, WHT, which has opened towers in Deerfield, Ill., and studios in Chicago. Mintz is an old KYW artist.

ALBERT HAY MALOTTE, the concert organist at McVicker's Theatre, Chicago, has firmly established himself as one of Chicago's favorite radio stars. Mr. Malotte's supreme artistry as well as his natural faculty for picking selections and arranging programs, has, in the short period of time he has been on the air, made him a midnight feature worth staying up late to hear. His concerts start every Wednesday and Friday night at fifteen minutes after midnight at KYW.

Malotte has had a wide and varied experience, having been a professional aviator on the Pacific Coast several years ago. After flying for some time he went to Alaska to fill concert engagements and in a country where almost every man is a dead shot, he won the first prize in a rifle contest. He has been a big game hunter in the Rockies and proudly displays an enormous mountain lion skin whose owner fell under his unerring aim.



Albert Hay Malotte, concert organist at McVicker's Theater, Chicago, who is gaining friends among the Middle Western radio fans through his midnight broadcasts from KYW.

Some Sidelights on Radio and the Stage

By Wilson J. Wetherbee, Director,
Westinghouse KYW

OF LATE producers of the drama and its melodious kin, the musical comedy, have seen spectres stalking in the rapidly increasing popularity of radio. Evidently they are convinced that broadcasting is here to stay and that no amount of scoffing can stem its advance. These folk of the theater appear disconsolate when they should be rejoicing over the discovery of a new medium for popularizing the American stage.

Just why the theatrical world has levelled its guns on radio is a difficult question to answer. There is no one kind of diversion which will satisfy all of the desires of the public. Good showmanship is builded upon no one factor so much as experience, but with the coming of radio, the theatrical producers have apparently been blinded to the words of wisdom which appear in every primer devoted to theatricals.

For the moment let us grant that radio broadcasting will divert the public from the box office. Let us say that the amusement seekers turn to a quiet evening at home and a receiving set for recreation.

The Reaction to Radio

Now that we have the former theatergoer safely at home with his new radio, let us also study his reaction. He hears a clever monologue, enjoys a medley played by a deft fingered pianist, discovers that his feet want to dance to a tune being played by an orchestra and learns also that he would like to see the possessor of the sweet voice which thrilled him with a love ballad. He listens attentively as the announcer gives the name of the artist. Perhaps the performer is an amateur whose only public appearance is over the radio. Again he may recognize the name as that belonging to a famous star who is appearing in some production in his own city. In the latter case the chances are ten to one the listener will buy a seat for the show in which his radio favorite is appearing.

Perhaps the theater manager will scoff at this assumption. The directors of KYW have good reason to believe that their assumption is true. The broadcasting of "Abie's Irish Rose" brought 2,876 persons to the box office within forty-eight hours after the production was broadcast.

California is Leading the Country in the Development of Efficient Radio Stations

The Broadcast Favorites of Southern California

Some Notes from the Sunny Radioland

By RALPH L. POWER

Up at KHJ the Lost Angels go on the air at midnight Saturday for a two or three hour program of fun and frolic, similar to the Hoot Owl program up in Portland. Then, again, they have a Saturday afternoon frolic that is becoming a classic in radioland. One of the most popular instrumentalists from this sta-

gigantic beauty contest prize in the metropolis of Southern California and is a prime favorite with radio fans.

AL WILSON has just finished a film, "The Cloud Rider," and he often tells his radio audience about his stunts in the clouds as a stunt man for filmland. Tune in on Southern California stations and hear their programs.

If you tune in on KFI on alternate Wednesday nights from 9 to 10, Pacific Standard time, you will hear the Wampas program, given by the official organization of the film colony. These programs have presented Adolphe Menjou, Adolpha Menjou, Trixie Friganza, Louise Fazenda, Viola Yorba, Betty Blythe, Bert Lytell, Marguerite de la Motte, John Bowers, Fred Stanton and hundreds of other screen celebrities who entertain by song and speech.

Los Angeles stations now include KFI, on 1,500 watts, and the following on 500: KHJ, KFSG, KNX and KFVB, the last two being in Hollywood. KFON at Long Beach is also a 500 watter.



"Herb" Rawlinson, popular movie star, seems to be having a good time showing his radio listeners how to solve that intricate cross-word puzzle.



(McHenry Photo, Hollywood)

Al Wilson, a stunt aviator for the movies, thrills the radio listeners regularly from KFI, Los Angeles.

WITH its six 500-watt sets, and one 1,500-watt station, Southern California can be tuned in 'most any time and radio fans from the East and Middle Western states are picking up programs from the Pacific Southwest with somewhat more regularity than a year or so ago.

"Herb" Rawlinson, veteran film player, has given speeches and bedtime stories from most of the Los Angeles stations. In fact, he acted as a radio announcer during the recent radio show in that city. But Rawlinson can't get away from rehearsal habits. In the picture we find him trying to explain a cross-word puzzle joke to radioland with the use of a dictionary.

Over at KFSG there are church services on the air day and night. One of the most interesting is the Thursday night water baptismal, at which nearly a hundred people go through the baptismal process. The musical part of the broadcast includes songs by the Southern jubilee singers and the temple silver band music. But the most popular entertainer from this Los Angeles station is Esther Fricke Greene, who presents an hour's program of organ selections three times a week.

tion—the oldest 500 watter in Southern California—is Jules Lepske, member of the famous Philharmonic Orchestra and leader of the Philharmonic Quintet which plays from KHJ twice a week.

Hollywood now has two stations—KNX and KFVB—at which a goodly number of screen stars talk. But the radio public is fairly well fed up with patter and demands entertainment. Herb Rawlinson, by the way, always carries his favorite uke along.

So the Hollywood stations are providing a good deal of musical entertainment. During the Summer months the Hollywood Bowl, a civic enterprise, conducts a series of ten weeks' open air concerts and as a forerunner of these they are now providing some radio concerts.

Their radio pianist is Raymond McFeeters, talented young composer, who acts as concert pianist at the Bowl and as organist at one of the local churches.

Little Peggy Lynne recently won a



(Photo by Witzel)

Raymond McFeeters, the wistful youth shown above, is a regular concert pianist from KNX, Hollywood, where the movie stars come from.



(Photo by Bloom, Chicago)

"STAY A WHILE WITH W-Q-J."

In this intimate way, "Jerry" Sullivan, the unusual announcer and entertainer at WQJ, the Calumet-Rainbo Gardens Station at Chicago, begins his popular jazz programs every evening at 10 o'clock. Jerry has a style of announcing all his own, and needless to say, it has won him hosts of admirers. He was one of the first devotees of the "crooning" method of broadcasting. He is also a pianist of unusual ability.

Trials and Triumphs of an Announcer

*Catering
to the Whims
of a Fickle
Audience
Is No
Child's Play
at KDKA*



H. W. Arlin, the
World's Pioneer
Announcer, Has
Never Tired of
the Radio Game;
Here are Some
of His Reasons

H. W. Arlin, "World's Pioneer Announcer"

ANNOUNCING radio programs might be called the world's most recent profession, because announcers for broadcasting stations were introduced first about four years ago when KDKA, the world's pioneer station of the Westinghouse Company at East Pittsburgh, Pa., was started.

H. W. Arlin, the world's pioneer radio announcer, made his debut early in 1921 and has been continuously "on the air" since. Thus his long service entitles him to the honors of being the veteran of radio announcers.

Mr. Arlin's studio experiences have been many and varied. Life as a radio announcer is not a drab affair, as there is a necessity of being continually on the "qui vive."

In the following interview Mr. Arlin tells of some of his studio experiences and some interesting contacts with his radio public.

He Never Tires

I AM often asked the question, 'Do you become tired of announcing?' or 'Does radio work become monotonous?' My answers to such questions are always in the negative, thanks to an ever-curious and an assisting public. By such an answer, I mean that any monotony which might otherwise tend to creep into the almost continual execution of programs is quickly dispelled by a multitude of extraneous duties with which an announcer is confronted.

"Probably one of the most interesting phases of studio work comes through contact with the public, not entirely by personal association, but also through the telephone and telegraph. No work can become monotonous or tiresome where the public is involved. On the contrary, I have found that a study of the whims and fancies of the public has been an exceedingly interesting one.

Paraphrasing the famous expression of Abraham Lincoln, 'You can please some of the people all of the time, and all of the people some of the time; but you can't please all of the people all of the time.' Not radio, at any extent. This statement could be applied to the view of the public on any one phase of radio entertainment such as music or sports. When applied to all of the phases of radio, it becomes many more times effective. What one person likes, another dislikes, and what one person condemns, another approves; so an announcer is almost justified in concluding that a 'fifty-fifty break' with the listening public is fair enough. However, 100 per cent satisfaction is always the goal.

"In telling of the announcer's contact with the public we may take into consideration only one phase of this contact; that of telephone conversations. The nature of the telephone messages received, together with the conversations that follow, tend to create in one a desire for the study of people. The thoughts and ideas which prompt these many calls are perhaps innumerable; perhaps some one conceives an idea by which radio can be of aid to him in his own personal advancement or the advancement of some pet theory, or possibly some one desires some information which may vary from that of a query regarding what is the proper food to give a sick baby to that of certain details regarding a program to be broadcast several weeks hence.

Some of the Questions

A FEW of the seemingly endless number of such questions and requests may be of interest. A confiding interest in our listeners, (this same public) will necessitate the omission of the names of any personalities involved in the following:

"One of our good Canadian friends recently called to tell us about a circular parking station he had invented for automobiles which would handle two hundred cars and which could be operated by one man. Appreciating the need for better parking service and predicting great success for his venture, he requested that we advise the radio public of his invention with full details as to where to purchase these stations.

"A lady calls us and requests that we announce that she has just left a package of pajamas on the street car and would like to have the service of the radio in recovering them. After being informed that we never make local announcements except in cases of robberies, kidnapping, lost persons and such emergencies, she replies, 'Well, this is an emergency case, because it is the only package I had.'

"An elderly lady, apparently a student of nature, calls and gives us the following important news item: 'Will you please announce that there is about four inches of snow in my back yard and that I have just seen two cardinal red birds?' Of course, a very unusual sight for this time of the year.

"No sooner is the telephone receiver on the hook than the bell again rings and an innocent feminine voice pops the following impression: 'I just heard you announce that you had received a telegram from New York commenting on the program. I would like to know if you are also broadcasting to Ohio tonight, as I would like to request a number for some friends out there who do not have the advantages of a radio.'

"It has also been brought very forcibly to my attention that radio has made a greater impression upon the public than has music. Of the many proofs of this statement, I might cite an occasion on which a program was being presented by the great Fritz Kreisler. (To page 62)

Radio Reveals a New Civilization

Unpublished Details of a Newly Discovered Race, Twenty-Two Centuries Old, Given For First Time From KOA, at Denver.

By FRANK J. McENIRY

WIDELY scattered remains of a vast, altogether unknown civilization which for twenty-two centuries has been buried under three to ten feet of waste and crumbled rock, are just being opened in southwestern United States. They definitely establish, archeologists declare, that Colorado's Cliff Dwellers were not the oldest prehistoric race to flourish on the North American continent.

How long this newly discovered civilization thrived, from whence it came and how and when it was wiped away are facts which excavators from the Colorado State museum are now endeavoring to determine.

In the meantime, however, scientists have been dumbfounded at finding a lost city of pithouses extending along the tops of a straggling series of mesas in southwestern Colorado, which swing from a point near the Colorado-Utah border in the Paradox valley to Pagosa Springs, Colo., and thence south, well into New Mexico.

Unpublished details of this astounding settlement, a comprehensive civilization in itself and the largest yet determined of prehistoric America, were presented by radio on April 8 over KOA, the General Electric station at Denver, by Joseph Emerson Smith, member of a recent archeological expedition into this region by the Colorado museum. This unique program, which was being sponsored by the Denver Tourist bureau, was given as part of a studio presentation beginning at 8:10 p. m.

1000 Years Before Cliff Dwellings

THIS lost city comprised scores of separate and distinct units, which for the sake of defense advantages were confined to the tops of mesas or table lands, high above the valleys below. Five hundred pithouses in one group alone have just been mapped in what is now known as the Chimney Rock-Piedra

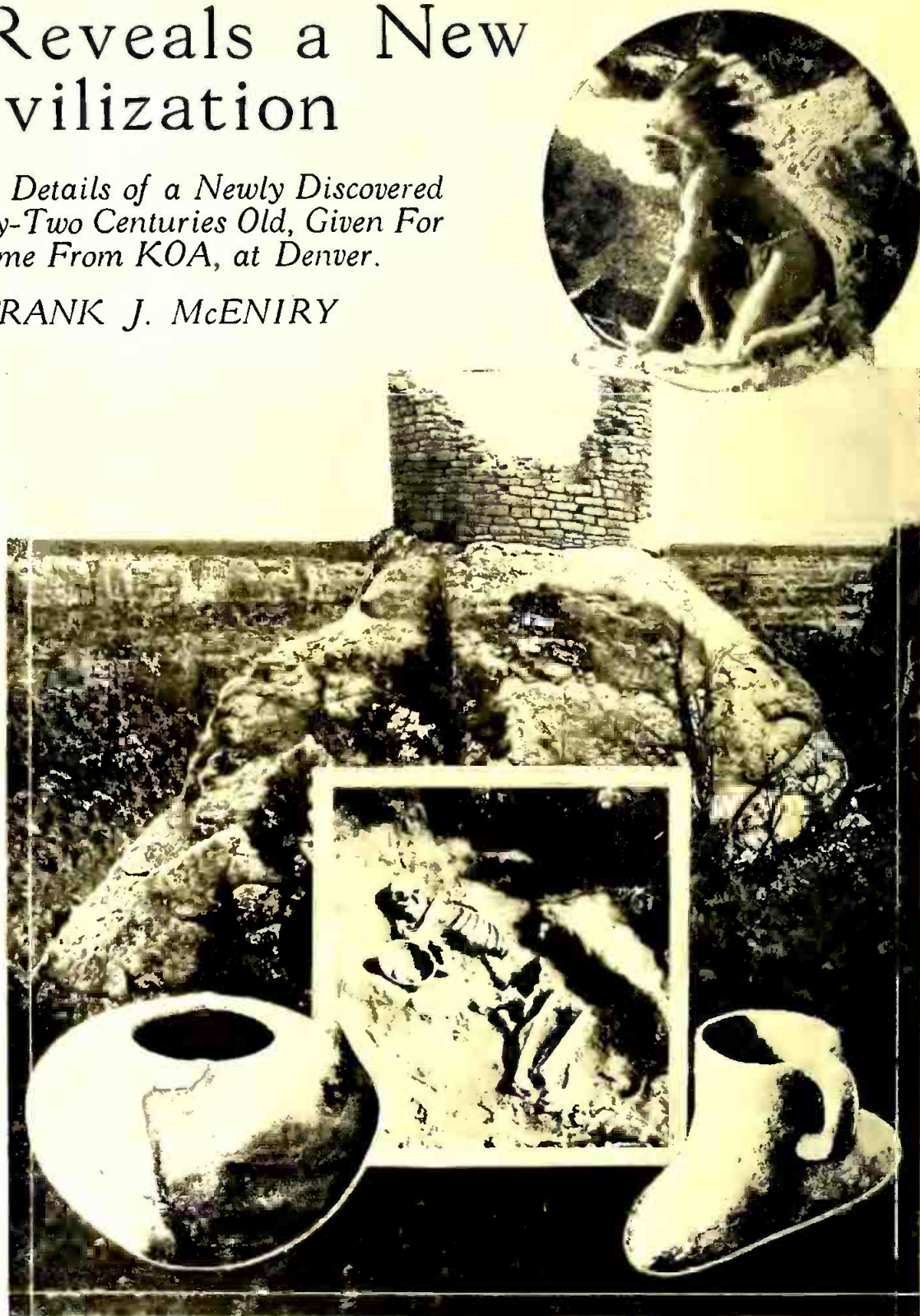
region. This area measures fourteen miles in length and one and one-half mile in width.

That the lost city antedated cliff dwellings by at least 1000 years, archeologists are certain.

"When Socrates, condemned to death, was drinking hemlock in his cell at Athens, in the 'old' world, this great

population of a brown race, that builded, flourished and then disappeared mysteriously, had emerged from a semi-savage state to one of distinct culture," Mr. Smith told his radio audience.

"There is little doubt that the city was a continuous habitation of many thousands of humans," he continued. "Tens of thousands of pithouses, (To page 48)



Above are the ruins of a prehistoric watch tower in Colorado, which once commanded a valley 1,600 feet below. The insert shows the skeleton of a prehistoric woman and remarkably symmetrical pieces of gray ware, which were uncovered in a nearby pit-house, inhabited twenty-two centuries ago.

In the circle at the upper right is Chief Evergreen Tree, whose war-bonneted ancestors looked in awe upon the advances of the encroaching white men. Radio station KOA, located in the heart of this age-old civilization, broadcast the first information concerning the discoveries a few weeks ago.

The World's Biggest Radio Organ

—And The Littlest Organist

How the Prim Little Organist of Station WOO is Proving All Bobbed Heads Are Not Empty

BY MARIE SHIELDS
HALVEY



Here is Mary E. Vogt, the diminutive organist of station WOO, in a restful moment before the console of the great Wanamaker organ in Philadelphia. Miss Vogt is a human though serious-minded young person, and she thinks girls can amount to something besides serving as stylish ornaments.

THE Wanamaker Grand Organ is an institution in Philadelphia. Visitors are taken to see it along with the Navy Yard and the house where Betsy Ross lived. Thousands stand daily in the transept of the store to listen to its splendid harmonies. It has five manuals and more than eighteen thousand pipes, and the organist who sits at the console and makes all this magnificence "go," is a little slip of a girl, not much more than five feet in height and slender as a boy, with a mop of thick black curls and bright, snapping brown eyes.

Her name is Mary E. Vogt, and the story of her life reads like a fairy tale where the fairy godmother arrived at life's darkest moment and the good child was started on the road to success.

Obligated to leave school when she was fourteen to help with the support of younger children at home, fate guided Miss Vogt into the employ of a great and good man; a man whose far-reaching vision saw the little girls and boys in his great store not as poor little wage earners, handling stock or running errands, but as citizens of the future; as men and women who must take their places eventually in the social, business and artistic life of the city that he loved.

Real Talents Developed

HE was the first to develop in his own establishment the idea later embodied by the Board of Education in what are now known as continuation schools. Attendance at the store school was compulsory. Trained educators supervised the studies and watched for signs of any natural aptitude in one field or another. Salesmen, buyers,

accountants, mechanical experts of various kinds were developed under this plan. Whatever the kind of ability the child showed, he or she was encouraged to specialize along that line.

It was not long before the little, brown-eyed Mary Vogt gave evidence in plenty that her future, rightly directed, lay in the world of music. From that point the fairy godmother took her in hand. She was set to study music under Dr. J. Lewis Brown, then musical director for the Wanamaker stores. In a surprisingly short time, she was working in the sheet music department, playing selections requested by customers. For five years now she has been the official performer on the great organ and musical director for the store.

The music of the grand organ was introduced to the radio public two years ago through the medium of WOO, the broadcasting station of the Wanamaker store in Philadelphia. Miss Vogt does not do any announcing. Among the things she emphatically dislikes are women's voices over the radio, germs and cross-word puzzles. She has the radio headquarters regularly scrubbed and disinfected, and she won't allow the girls in her office to work at the puzzles.

"The young mind of today," said Miss Vogt, "needs to read good books and hear real music. To see in the dic-

tionary the meaning of an obsolete or little used word from a cross-word puzzle has no educational value. They might be more profitably employed listening to a good concert."

Interested in "Kids"

THE young mind of today interests her even more than the gorgeous organ she plays so well. She teaches now in the store school where she received her own training, and she finds her greatest delight in guiding these young girls and boys into the career for which they are fitted, even as she herself was guided into the realm of music.

Miss Vogt is deeply interested in the development of the radio. Like other directors who arrange programs for broadcasting, she deplures the tendency of the fans to explore the air—in other words, to jump from one program to another as the signals indicate what they have picked up. Any cultural value radio may have is ruined by this practice. Miss Vogt hopes to see at no distant date broadcasting reduced to a few great high-power stations, with programs of the highest quality relayed by local broadcasters.

She is right up-to-date on the mechanical end of radio, too, and can talk familiarly about the latest inventions for improving transmission

Review of Radio Age's Contest Shows

"The Three Musketeers"

FIGHTING For Winner's SHIELD

By HARRY ALDINE

MIDNIGHT of June fifteen will see the end of the RADIO AGE Popularity Contest, and because of the closeness of the hour, we were tempted to digress from our usual custom of naming a monthly winner. The fact is that in reviewing the three leading contestants there is named the man who secured the greatest number of ballots for the month of April—Bert Davis—but were we to devote this page exclusively to him, we would be doing a grave injustice to the other two, Karl Bonawitz and Bill Hay.

At the beginning of this contest it was the opinion of the Contest Editor that there might be aroused a greater personal interest in the candidates by each month selecting one of them for a brief story. Whom to choose each month without a show of partiality was the next factor to consider. And so it was decided to put this problem squarely up to the readers of RADIO AGE. This was accomplished by naming as a monthly winner the candidate receiving the greatest number of votes through the period of each thirty days.

How It Was Done

IT SO happened that in seven of these ten months the honor was attained by different candidates, but in the other months where a candidate repeated his former record by coralling the greatest number of ballots, the writeup was handed to the next favorite in line.

Karl Bonawitz, Bert Davis and Bill Hay are the three to whom goes the distinction of having twice secured the greatest number of monthly votes, and reference to the "standing to April 15"

will show these same "Three Musketeers" at the point of vantage at the head of the list. There is always present the probability of a dark horse coming to the front, but if present figures mean anything, it will be one of these three who heads the list when the final count is taken.

Of the three, Karl Bonawitz has so far proven to be most consistent. Getting off for an early start, he improved his position, reaching first place seven months ago, which standing he has held up to the present time. This popular organist, however, is being closely pressed by the other two artists.

Bert Davis, on the other hand, performed in an erratic manner, twice having secured a good lead only to lose ground in succeeding months. The period from March 16 to April 15 saw him suddenly spurt from seventh to second place. The next thirty days will decide the fate of this eccentric entertainer.

Bill Hay Holds Own

HOLDING a close third position, Bill Hay had been sharing second and third place with H. W. Arlin in the earlier stages of the contest. At one time he was first on the list and at no time has he dropped below third. He has held second post during the two preceding months. This popular Announcer-Entertainer is to be reckoned with before the final count is taken.

It will be seen by further reference to the present standing that Art Linick and Lee Sims have strengthened their positions. The latter, although a newcomer in the field, leaped the hurdles from twenty-second to twelfth place. The Gold Dust Twins of WEAF also appear upon the scene.

H. W. Arlin, Coon and Sanders' Nighthawks, Jack Nelson and Harry Snodgrass all seem to be within striking distance of the victor's shield. But that is a story in itself to be told after

the final ballots have been cast and counted.

WHEN this contest was started, RADIO AGE expected an enthusiastic response from readers and radio fans, but nothing was dreamed of that compares with the avalanche of votes which has deluged the Contest Editor during the past few months.

A separate department had to be created to handle the volume of correspondence and votes, and every effort was made to see that the contest was conducted according to Hoyle, and that no one received more than his just share.

It has been gratifying indeed to learn with what respect the army of radio fans hold the announcers and entertainers who perform for them nightly over the ether waves. It is only fitting that the beautiful shield RADIO AGE has obtained be presented to the winner of the RADIO AGE Radio Favorite Popularity Contest. A reproduction of the shield will be published in the July RADIO AGE, and the final count in the August issue.

Here's the way it looks to date:

THE WINNERS FOR APRIL

A review of the three leading candidates:

Karl Bonawitz, Bert Davis, Bill Hay.

WINNERS OF PRECEDING MONTHS

July.....	Duncan Sisters, KYW
August.....	Bill Hay, KFKX
September.....	Karl Bonawitz, WIP
October.....	H. W. Arlin, KDKA
November.....	Bert Davis, WQJ
December.....	Jack Nelson, WJJD
January.....	Art Linick, KYW
February.....	Coon-Sanders Orchestra, KYW
March.....	John S. Daggett, KHJ

STANDING TO APRIL 15

Name and Classification	Where Heard
Karl Bonawitz, Organist.....	WIP, Philadelphia
Bert Davis, Entertainer.....	WQJ, Chicago
Bill Hay, Announcer.....	KFKX, Hastings
H. W. Arlin, Announcer.....	KDKA, Pittsburgh
Coon-Sanders' Nighthawks, Orchestra, KYW, Chi.	
Jack Nelson, Announcer.....	WJJD, Mooseheart
Harry M. Snodgrass, Entertainer.....	

Name and Classification	Where Heard
Art Linick, Entertainer.....	WOS, Jefferson City
John S. Daggett, Announcer.....	KYW, Chicago
Ford & Glenn, Entertainers.....	KHJ, Los Angeles
Duncan Sisters, Entertainers.....	WLS, Chicago
Lee Sims, Pianist.....	KYW, Chicago
Lambdin Kay, Announcer.....	WSB, Atlanta
J. Remington Welsh, Organist.....	KYW, Chicago
Fred Smith, Announcer.....	WLW, Cincinnati
E. L. Tyson, Announcer.....	WWJ, Detroit
Hired Hand, Announcer.....	WBAP, Fort Worth
"Sen" Kaney, Announcer.....	KYW, Chicago
Nick B. Harris, Entertainer.....	KFI, Los Angeles
Jerry Sullivan, Announcer-Entertainer, WQJ, Chi.	
Edward H. Smith, Director-Player.....	

Name and Classification	Where Heard
Charles E. Erbstein, Announcer.....	WGY, Schenectady
Wendell Hall, Entertainer.....	WTAS, Elgin
Howard Milholland, Announcer.....	WDAF, Kansas City
Scottish Rite, Orchestra.....	KGO, Oakland
Banks Kennedy, Entertainer.....	WEBH, Chicago
S. Hastings, Announcer.....	KFI, Los Angeles
Robert Boniel, Announcer.....	WEBH, Chicago
Arion Trio, Instrumental.....	KGO, Oakland
Gold Dust Twins, Entertainers.....	WEAF, New York

There remains but thirty days from the time this June issue first reaches the news-stands in which to cast your final vote for your radio favorite. If you have not voted before, your ballot may be the one to decide the contest for your choice. Those who have been casting their ballots each month are invited to clip the coupon for the last time and send it in with the name of your candidate.

Let's go for the final pull, and may the best man win!

POPULARITY CONTEST COUPON

Harry Aldine, Contest Editor
RADIO AGE, 500 N. Dearborn St., Chicago.
I wish to cast my vote for:

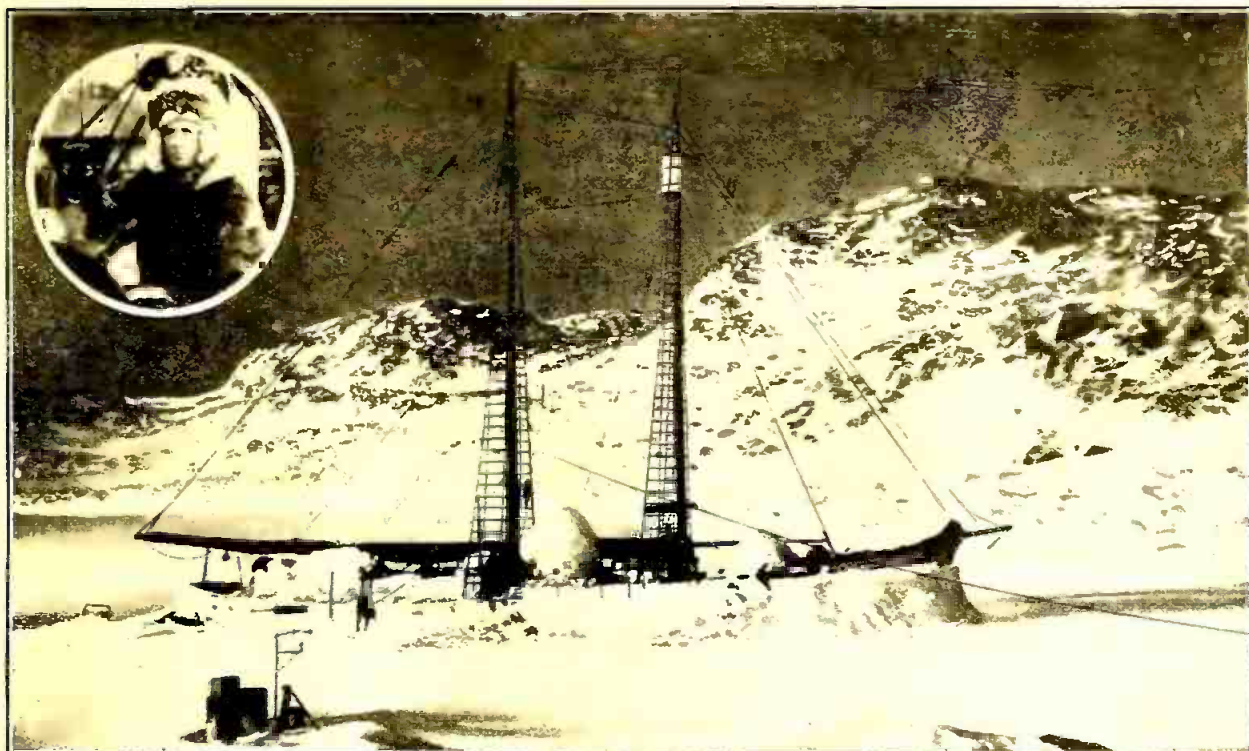
Name of favorite.....

Classification.....

Station..... Date Heard.....

Name (optional).....

Address (optional).....



Opening a NEW ERA in Radio

Three Radio Pioneers to Lead Short Wave Expedition into Far North to Explore the Arctics and Test Out New Radio Theories

By FREDERICK SMITH



Above is shown the "Bowdoin," the ship which carried MacMillan to the Arctics last year. It is seen frozen in, near the Pole. Commander MacMillan is shown in the inset. The lower photo shows H. C. Forbes, John L. Reinartz and Karl Hassel, designers of the Zenith-Reinartz transmitter to be used in the 1925 expedition.

RADIO, history and science are likely to share richly in the results of the arctic expedition which will set off from Wiscasset, Me., about June 20 of this year. There will be one ship and at least two seaplanes to carry northward a group of men who will include in their number distinguished radio engineers, world-famous navigators and explorers, and some of the best aviators to be found in the United States Navy.

By the efforts of these men it is hoped that a new era in short wave radio transmission will be inaugurated. It is an-

anticipated that we, in the more comfortable latitudes, may even be privileged to listen to the folks songs of the polar Esquimeaux, for both ship and airplanes will carry equipment for transmitting and receiving radio messages.

It is hoped that a lost arctic continent may be located and that landing posts may be arranged in such hitherto inaccessible spots that the cause of world commerce and communication will be immensely benefited. Planes equipped with mapping, still picture and moving picture cameras, will fly beyond limits

of dog team travel and bring back facts about what lies in the land of frozen mystery.

To Delve Into History

IN addition there will be original research into such historical data as may still exist relating to the landing of the Norsemen in the farthest North. An effort also will be made to obtain copies of the important records left by Peary at Cape Columbia.

Among those who will participate in
(Turn the page)

this series of dashes into lands where white men have not before been privileged to go are the following:

Donald B. MacMillan, Commander in the navy and leader of the expedition. Commander MacMillan is a scientist, explorer, author, navigator, lecturer.

Eugene F. McDonald, Jr., President of the National Association of Broadcasters and President of the Zenith Radio Corporation, Chicago. Commander McDonald, himself an experienced navigator and hunter, was responsible for the installation of radio equipment on the little schooner "Bowdoin" when it carried Dr. MacMillan to the Arctics in 1923. This was the first demonstration of the value of radio in Arctic explorations. Communication was established with the "Bowdoin" after it went into "Winter quarters" within thirteen degrees of the North Pole and was maintained for months.

U. J. Herrmann, showman, sportsman, founder of the two great annual national radio expositions in Chicago and New York and one of the owners of the new station, WHT, on the Wrigley Building tower, Chicago.

John L. Reinartz, famous radio inventor, designer of the Reinartz circuit, official of the American Radio Relay League, pioneer in short wave development. Lieut. Reinartz will be official broadcaster for the MacMillan expedition and will conduct tests with short wave transmission, which will engage the attention of the entire radio world. He has been employed permanently by the Zenith Radio Corporation, 332 South Michigan Avenue, Chicago and will devote much of his time before the expedition sets off in assisting amateurs in the United States and Canada to learn the construction of short wave transmitters and receivers, which will be of vital importance in getting messages to and from the MacMillan expedition. The Zenith Corporation will build these receivers and transmitters only for its own use, both on the MacMillan ship and in its own transmitting stations in Chicago. But it will assist all who wish to build the instruments with free in-



The upper photograph shows Commander MacMillan greeting Eugene F. McDonald, one of the sponsors of the 1925 trip and a seasoned navigator himself, as well as one of radio's leading pioneers. In the circle is U. J. ("Sport") Herrmann, widely known sportsman and showman, who will accompany the expedition.

formation on application by mail to Lieut. Reinartz. The Zenith Corporation says it hopes to have 1,000 amateurs equipped with short wave transmitters before the MacMillan expedition sails.

Information as to the volunteer naval aviation personnel which will be a part of the expedition will be given RADIO AGE readers in a later issue.

Short Waves Are "Coming"

COMMANDER McDonald predicted to the writer more than a year ago that the radio world would soon be paying more serious attention to the use of short waves as an effective means of radio communications. His plans for the equipment of the arctic expedition prove that he has more faith than ever in this employment of high frequencies

under the most difficult conditions.

He submitted the following facts in a recent interview:

Will Carry Transmitters

"The Expedition is to have four transmitters, 20, 40, 80, and 180 meter wavelengths. We will be in twenty-four hour daylight after we pass 66°30' north latitude. The 20 meter transmitter will be used when we are communicating during the period of the day when this part of the globe is in daylight; 40 meters when this part of the globe is in darkness. The 80 meter transmitter is merely to be used to get us wider circulation among the amateurs that will be able to reach

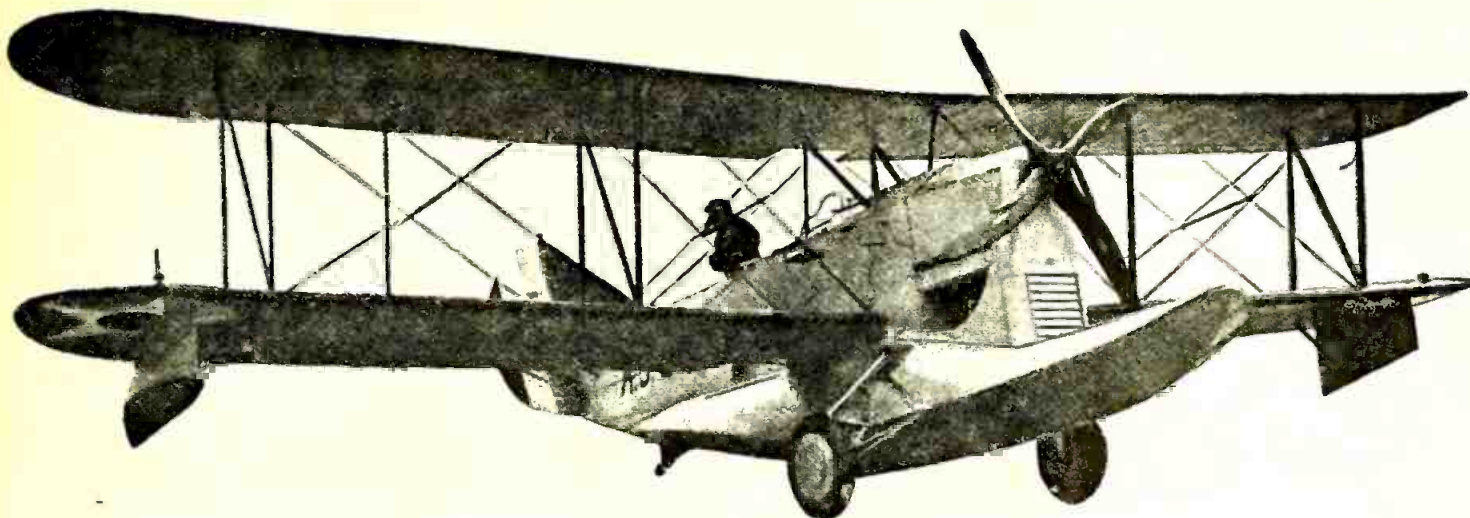
down to that point, and not down to 20 meters. The 180 meter transmitter is taken along merely for the purpose of proving that it will not work in these high latitudes, and twenty-four hour daylight.

"I have employed Reinartz at the highest salary ever paid any radio operator, \$1,000.00 a month, and this is not stage money. I secured him because I believed him to be the short wave wizard of the United States, and money is no object. We must get these messages back from the Arctic even though we are going into the most difficult section of the globe for radio transmission. One hundred meter signals have never been heard in Smith Sound between 55° n.l. and 75° n.l. You will recall the MacMillan signals came back only after they had passed 75°. His port from which he sent most of the communications last year was from 78:30.

Planes Will Transmit

"We are equipping the airplanes with a new type of transmitter using 40 meters. The reason we cannot use 20 meters on the airplanes is that 20 meters are not audible at distances under 2500 miles. Forty meters, however, are audible at all short distances. Lieut. Reinartz pointed out an interesting phenomenon the other day when he told me that while it was necessary to be 500 miles away to hear 20 meter signals in the daytime, it was necessary to be 3,000 miles or over to hear them at night.

"The transmitters for the airplanes will weigh under 100 lbs., and be operated by dry batteries only. The Government radio equipment today for airplanes is operated by a generator propelled by an aeroplane propeller, and therefore will function only while the airplane is in



Here is a typical airplane used for exploring trips, and similar to the planes which will be taken with the MacMillan-McDonald Expedition in June, when they set out for their perilous dash to the mysteries of the north-land. The planes will aid the explorers in guiding the ships and reaching points which are closed to navigation.

commission. If the airplane motor is out of commission, so is the radio, and we cannot take that risk. We want a transmitter capable of sending word back to the ship for the emergency plane to come out in case our motor fails us and we are forced to make a landing far from our base.

Daily "Letters" Home

"We hope to transmit messages back every day. Reinartz confidently hopes that we will be able to send voice back from the Arctic on 20 meters. If this is possible, we'll give you the Esquimeaux Folk Songs by radio. It may be possible if we can transmit the voice back to pick it up, boost it in wavelength, and put it out over the broadcasting station WJAZ."

THE foregoing shows rather impressively what a degree of thought and effort and careful engineering is being devoted to the radio phases of this adventurous enterprise.

While the expedition has the cordial indorsement of the National Geographic Society, to which plans of the itinerary already have been submitted, and although President Coolidge has not only given the expedition his approval but has authorized the participation of the Navy Department, it is, after all, a private enterprise.

It should be remembered by those who prefer to know who are the most useful friends of radio that the negotiations in Washington were conducted successfully only through the earnest co-operation of Secretary Wilbur, of the Navy Department; Rear Admiral William A. Moffett, in charge of naval aviation, and Congressman Fred A. Britten, an Illinois representative who repeatedly has come to the aid of the radio industry and the radio fan. It was the vision of these three men and their vigorous prosecution of the official plans which made the project what it is today, one of the most important scientific ventures ever undertaken.

Will Test High Frequencies

As a result of all this, radio high frequencies will have their chance while the world stands by as referee. The ancient ruins in Labrador and Greenland will be

explored to connect then, if possible, with Eric the Red. The exploring ship will try to make its way to Axel Heiburg land. It is planned to establish an airplane base 250 miles away from the ship at the northernmost point of the land.

The airplanes will have a cruising radius of 1,000 miles and a speed of 120 miles an hour. They will try to fly over the Greenland ice cap, where no man has ever been before. One of the most important missions of these planes will be the mapping of Ellesmere Land and Baffin Bay, in the vicinity of the magnetic north pole.

The party will attempt to make a comprehensive survey of the only remaining "blind spot" in the world—that region of more than a million square miles in extent, which is hidden away at the top of the world between Alaska and the pole.

In the projected exploration of Baffin Land there is a fascinating invitation for Commander McDonald and "Sport" Herrman, both doughty disciples of Isaak Walton. For they probably will find thousands of lakes, hitherto unfinished by white men. Esquimeau have told of enormous numbers of seal, caribou and other wild animals in these wilds.

The "Bowdoin" will sail about June 20 and from that date forward many hundreds of thousands of persons will await daily the news of this intrepid assault on the phalanxes of the proud and stubborn north.

England Hears Radio From Hawaii

WASHINGTON, D. C.—NRRL, the amateur experimental radio station operated by Lieutenant F. H. Schnell, traffic manager of the American Radio Relay League, with the United States fleet in European waters, has succeeded in piling up some enviable records in the way of constant communication on short wave lengths.

Several stations in the East and some on the Pacific Coast have worked with Lieutenant Schnell, while stations that have heard NRRL run from California to England. British station g5NN

picked his message put on the air and relayed the information back to League Headquarters in the United States by radio.

Stations in Rochester, N. Y., Brooklyn, N. Y., and Longmeadow, Mass., were the ones on the Eastern seaboard that successfully conversed with Lieutenant Schnell, while Minneapolis, Long Beach, Cal., Altedena, Cal., and Ellensburg, Wash., also carried out two way telegraphy with Station NRRL.

Reports have been made to the American Radio Relay League headquarters in this city by stations at Gadsen, Ala.; Baltimore, Attleboro, Mass.; Schuylkill, Pa.; New York City; Red Bank, N. J.; Port Arthur, Ont.; Hilton, N. J.; Mt. Ranier, Md.; Los Angeles and Baker, Ore., that Lieutenant Schnell's messages from the special short wave station were heard and copied by the operators.

China to Admit Radio Supplies

Hartford, Conn.—The central Chinese government is planning to lift the embargo on radio material and supplies, according to correspondence of the American Radio Relay League, whose headquarters are in this city.

The Peking government Department of the Telegraph is reported at work on the first drafts of the regulations governing conditions of import.

Those who advocate the removal of the restrictions point out that in Manchuria there are radio stations in operation at Mukden, Changchun, Harbin, Tungkiang, Marchuli, Yinkow and Hula-tao. Others are in course of construction at Antung, Tsitsihar and Tetropavlovsk, while plans for other stations are being considered.

The American Radio Relay League correspondent points out that all of these stations are used for official purposes only, but it is the hope of radio enthusiasts in the Chinese republic that they may be opened to commercial and other uses in the near future.

Vigilance committees designed to reduce interference in radio communication have been formed by the traffic department of the American Radio Relay League and are already functioning.

Radio Age Institute

Manufacturers' Testing Service

MEMBERS of the staff of RADIO AGE will be pleased to test devices and materials for radio manufacturers with the object of determining their efficiency and worth. All apparatus which meets with the approval of various tests imposed by members of the technical staff of RADIO AGE will be awarded our endorsement, and the seal shown to the right will be furnished free of charge. Materials for testing should be sent to

RADIO AGE INSTITUTE
504 N. Dearborn Street, Chicago, Ill.



DEVICES

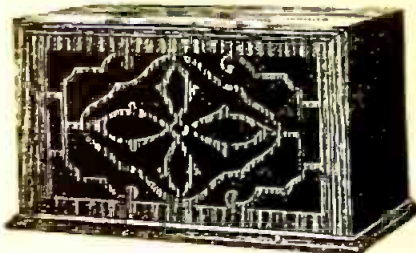
displaying this seal have been tested and approved by the RADIO AGE INSTITUTE.

Apparatus illustrated and described below has successfully passed our tests for June, 1925.



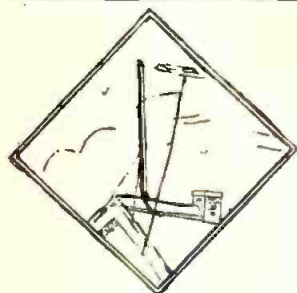
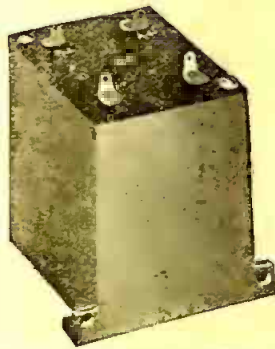
Test No. 59. THOROLA Low Loss Doughnut Coils. Manufactured and submitted by the Reichmann Company of Chicago. These coils embody a new type of winding, which produces a very good ratio of resistance to inductance, which is a true measure of coil efficiency. This winding minimizes energy losses in inductance.

Due to a unique and scientific shape employed in this coil, called "doughnut" or toroidal, selective operation is easily secured, and there is no undesirable "pick-up" as in open coils. The coil submitted for tests was found to satisfactorily pass the tests and requirements of the RADIO AGE Institute over the period in which it was used in our laboratory.



Test No. 62. SONORA RADIO SPEAKER, with concealed horn. Submitted by the manufacturers. The Sonora Phonograph Company of New York. This loud speaker, besides being of unusually attractive design, produces very clear and deep tone; in fact, the tone is almost identical with that produced by high class phonograph, having been designed after that style and with that end in view. A patented all-wood horn, the same as used in the Sonora Phonograph, and a Sonora tone arm and radio reproducer, are encased in the beautiful cabinet, which blends with the furniture of any home. The speaker is small enough to be placed on a table, mantel or on the radio set itself. Satisfactorily passed the tests and requirements of the RADIO AGE Institute.

Test No. 66. SILVER "TWO-TENS" and "TWO-ELEVEN'S." Long wave transformers. Supplied in sets of 2 or 3 210s (iron core interstage and one 211, (filter for input or output) with identical peaks and separate curves. The feature of these transformers lies in the fact that the makers plot the curve in their own laboratory and record them directly on a tag attached to each transformer before it is placed on sale. Tests to determine the accuracy of these charted and matched transformers were conducted in this magazine's laboratory and in every instance the tag attached to each transformer was found to have the correct curve. Manufactured and submitted by Silver-Marshall, Inc., 105 S. Wabash Ave., Chicago. Satisfactorily passed the tests and requirements of the RADIO AGE Institute.



Test No. 60. The UNIVERSAL AERIAL MAST FITTINGS, manufactured and submitted by the Universal Mast Company of 3215 Montrose ave., Chicago, Ill. These fittings come complete in one box and are a welcome surcease from the bother of making new aerial supports every time a fan wishes to

erect a new aerial, after moving, etc. The material for masts using these fittings should preferably be 2 x 2 in. cypress or yellow pine. The bases can be attached to such masts very easily. The guy attachment, also contained in the kit, is fastened one-third up from the bottom of the mast. The ends of the base plates may be flattened down to give additional bearing surface. These fittings were tested both on wooden and on apartment building roofs, and were found practicable for both, besides being unusually firm against the wear and tear of wind, rain, etc. Satisfactorily passed the tests and requirements of the RADIO AGE Institute.



Test No. 63. MICA FIXED CONDENSER, manufactured and submitted by the Sangamo Electric Company of Springfield, Ill., makers of electric meters. This condenser is guaranteed accurate within 10 per cent of the marked capacity and

to sustain its original accuracy under all conditions. Their accuracy is likewise not affected by the heat or acid used in soldering. These condensers show up best in reflex circuits because of their accuracy. The condenser is sealed in a smooth brown bakelite case, making it impervious to atmospheric changes. Also presents a neat appearance. Satisfactorily passed the tests and requirements of the RADIO AGE Institute.



Test No. 67. The Remo RADIO TUBE REACTIVATOR. Manufactured by the Remo Corporation of Meriden, Connecticut. An instrument selling at a reasonable price for reviving weak or old tubes and bringing them back in volume as good or better than new ones. Designed for standard amplifying tubes of the UV201A type or UV199 tubes. Three UV201A or two UV199 tubes can be accommodated at once. Detector tubes of the UV200 or WD12 type cannot be revived. The Remo Reactivator is used only with regular 110 volt 60 cycle AC current and is furnished with cord and plug. While such a device is comparatively new in the radio field, the Remo Reactivator satisfactorily passed strict tests of the RADIO AGE Institute in the tests for which it was used.

Test No. 64. RADIO PLUG submitted by Pacent Electric Co., Inc., 91 Seventh Ave., New York City, N. Y. A plug for connecting either a loud speaker or a headset to the output jack of any receiving set. It is well made, having firm grip for the telephone or loud-speaker tips. Tested and approved by RADIO AGE Institute.



Test No. 68. 1926 MODEL NEUTROWOUND RECEIVER. A new principle—incorporated in the Neutrowound Radio Receiving Set—enables the operator to "tune in" near or distant stations, and operate at the highest peak of radio-frequency amplification—at all wave lengths—insuring consistent reception, over very great distances with the maximum selectivity—free from outside interference. The all-metal case not only serves as a sturdy protection for the vital parts of the receiving set, but also acts as an electro-magnetic shielding against outside interference. Howls, noises and distortions are eliminated. Satisfactorily passed the tests and requirements of RADIO AGE Institute.



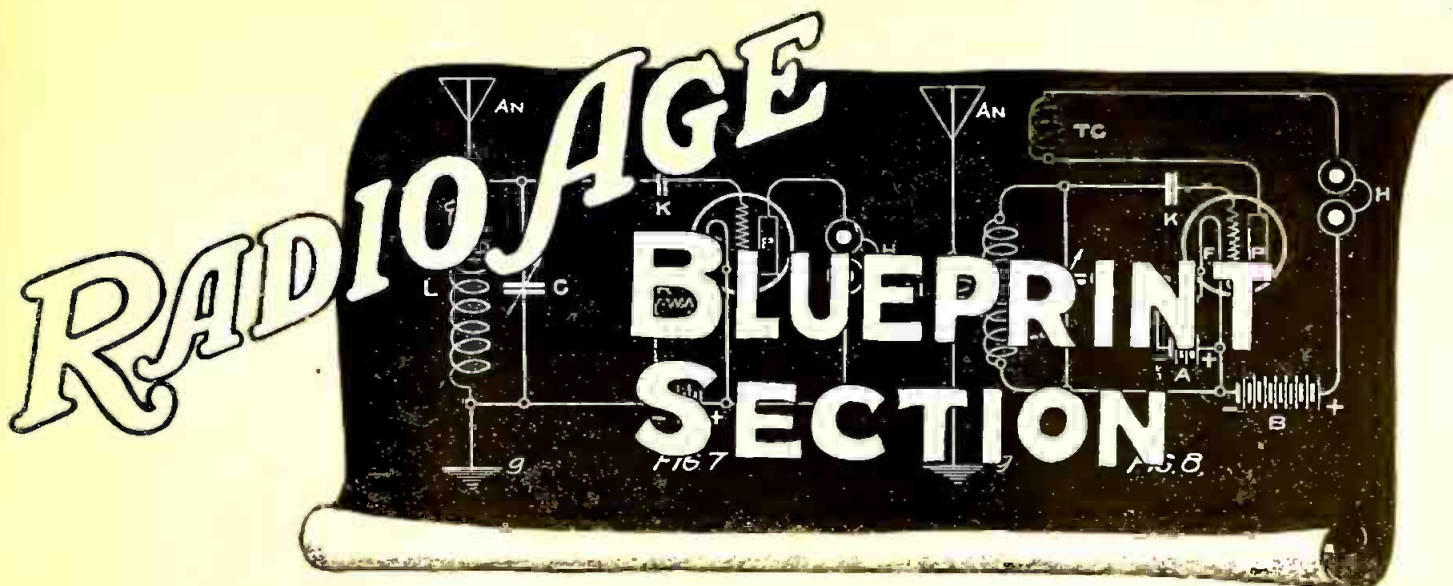
Test No. 61. RADION BUILT-IN LOUD SPEAKER HORN, Manufactured and submitted by the American Hard Rubber Co. of 11 Mercer St., New York City. A unique horn barely a foot high, which can be built in a portable or other receiving set, and a standard head-phone unit attached to its base. May also be used for a loud speaker in a hotel room, etc., where intense volume is not desired. Instead clear and sweet tone is produced. The horn is made of RADION, the American Hard Rubber Company's material, also used for radio panels, etc. The horn sent to this magazine was tested both for portable and built-in sets, and in every way satisfactorily passed the tests and requirements of the RADIO AGE Institute.



Test No. 65. Metallized Grid Leak, submitted by Durham and Co., Inc., 1936 Market St., Philadelphia, Pa. Consists briefly of a glass rod of small and uniform diameter, coated with a metallized high resistance material by means of a high temperature and gas process. Resistance then impregnated in a non-hydroscopic insulating fluid, and after an aging period, is cut and assembled in the air tight cartridge. The end caps are soldered to the resistance unit instead of using low melting alloy. Tested and approved by RADIO AGE Institute.



Test No. 69. VALLEY BATTERY CLIP. Submitted by the Valley Electric Company of St. Louis, Mo. This clip is of the conventional type in use for A battery connections, having firm, toothed jaws for gripping the positive or negative posts on batteries. A screw is provided for making firm contact with the wire. Satisfactorily passed the tests and requirements of RADIO AGE Institute.



Economy of Parts and Space in A 3-Tube Portable Reflex

By JOHN B. RATHBUN

Copyright: 1925

Reversed Capacity Feedback Cuts Out Free Oscillations

TO BE truly portable, according to my idea, means that a receiving set should be easily carried about from place to place without seriously straining its owner's physiology, and at the same time it should be so compact that it will not take up any more room than necessary in a trunk. There are portables and portables, but the absolute zero in portability is the set made up in a traveler's sample case which weighs about 100 pounds and occupies about fifty per cent of the trunk space. On the other extreme is the freak midget set which has been variously fitted into pill boxes, fountain pens and pickle bottles, and which has absolutely no purpose in life except to exhibit the maker's ingenuity. The real portable should have a good range and sufficient volume to operate a loud speaker, and yet at the same time should not take up a great deal more space than a camera, even when fully equipped with batteries.

No really practicable portable has been turned out with less than three tubes, for it is impossible to operate a loud speaker satisfactorily with less tubes on anything but local stations. For this reason I will assume a three tube set from the beginning and will build up all the other data about this premise. Whether this is to be a regenerative, radio frequency or reflex still remains to be seen, but as the maximum volume is to be obtained from a minimum number of tubes and batteries, I have strong leanings for the reflex type. The reflex circuit is not always the greatest distance getter, but what it does get, it gets good and loud.

Batteries Consume Space

PROBABLY the most important item in a portable is that of the batteries, for the batteries weigh more and take up more space than the rest of the equip-

ment. Our current supply system must be reduced to the lowest possible limit even at some sacrifice in the life of the batteries. If the batteries stand up for a month while traveling about, it is generally considered satisfactory for vacation tours. At home, we can substitute larger batteries installed outside the set,

but in touring, the space and weight are the principal items. With this idea in mind, we will study the battery situation and the proper tubes to go with these batteries.

Storage batteries are out of the question, of course, hence only dry cells are available for the filament and plate current. This means that the tubes must either be of the WD-12 or the UV-199 type, which are specially designed for dry cell service. They do not give the volume of the 201A power tubes used with storage batteries, but they give excellent results if properly handled.

The WD-11 and WD-12 are the same tube with the exception of the base. The base of the WD-11 is a special small size, while the WD-12 fits in a standard socket. Both tubes operate on the 1.5 volts produced by a single dry cell and take 0.25 ampere per tube. Each tube therefore takes $1.5 \times 0.25 = 0.375$ watt, or 3-8 watt. One No. 6 dry cell is provided for each tube, which can be connected independently to each tube of a multi-tube set or to a multiple connected battery with as many cells as tubes. As 0.25 ampere is the rated discharge rate for a No. 6 cell, it is not possible to use a smaller battery.

Next come the UV-199 or the C-299 tubes, which require 3.0 volts at the filament, and which take only 0.06 ampere of current. As the voltage of a battery falls off with use, we must use three dry cells in series, which gives us a total of 4.5 with a fresh battery. This excess is taken care of by a 30 to 40-ohm rheostat, which permits the use of a battery between the limits of 4.5 volts and 3.0 volts, the battery being discarded when the voltage drops to the latter point. The power taken is therefore: $4.5 \times 0.06 = 0.27$ watt, very much less power than is required with the WD-12.

(Turn to page 38)

"EVERYTHING I NEED IN RADIO"

"I bought a copy of the RADIO AGE ANNUAL for 1925 and I found that everything I wanted to know about radio, from crystal sets to complicated multi-tubers, was contained between its two covers," wrote an enthusiastic beginner.

"I never knew so much could be contained in one book without crowding or omitting necessary details. But you haven't left a thing out of the ANNUAL for 1925."

Letters such as the above are sent to us every day, voicing sincere appreciation of the ANNUAL for 1925, the most complete radio hookup book ever printed. And the price for the 120 pages of technical "nuggets" is but ONE DOLLAR, postpaid.

Send your order now while our supply of the limited first edition lasts.

Blueprints of the 3-Tube Portable Reflex on Two Pages Following

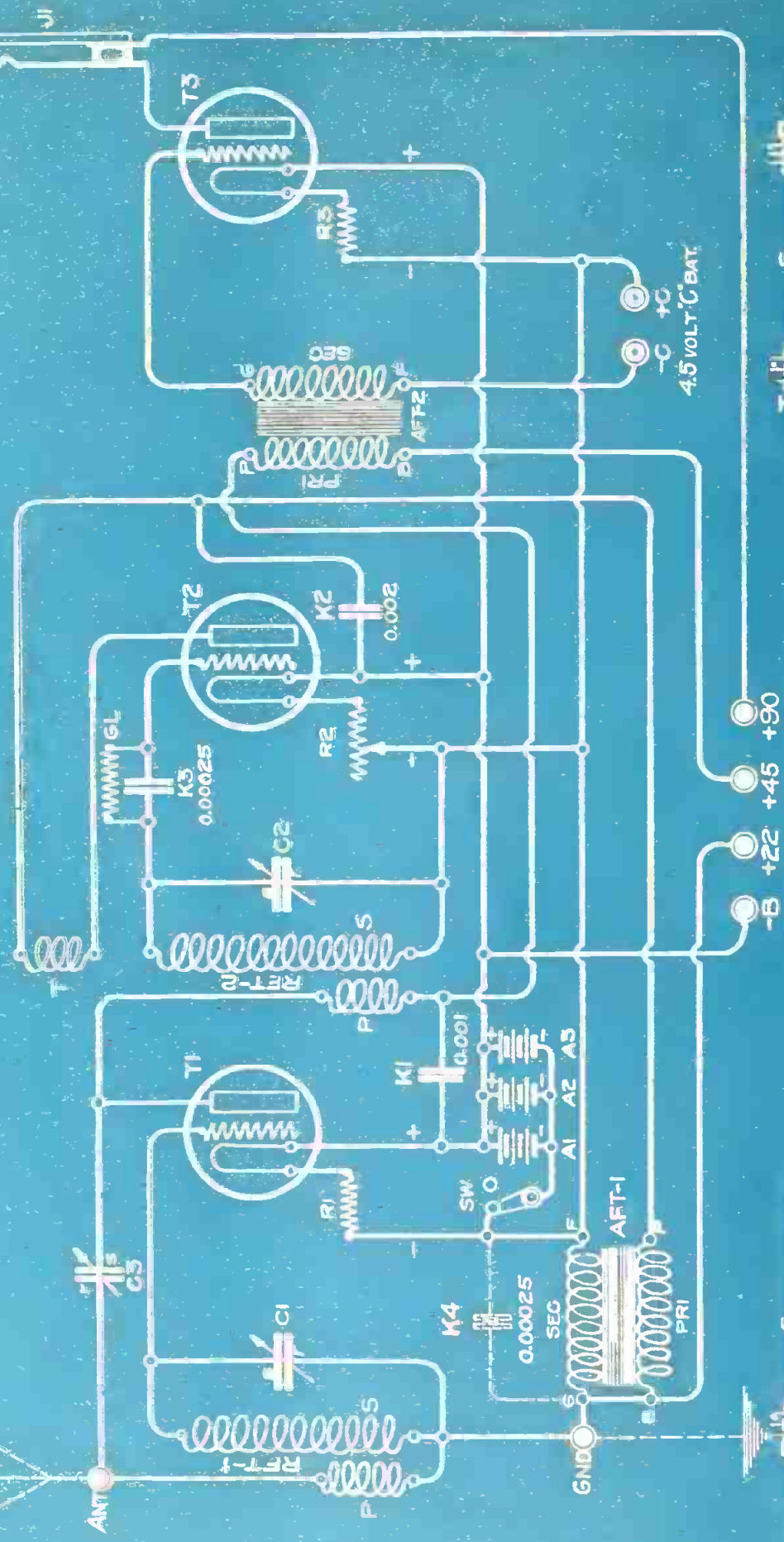


FIG. 1A
CIRCUIT DIAGRAM

"JUNIOR PORTABLE"
ONE REFLEXED STAGE, REGENERATIVE
TUBE DETECTOR, ONE STAGE OF AUDIO
AMPLIFICATION ON THREE TUBES.

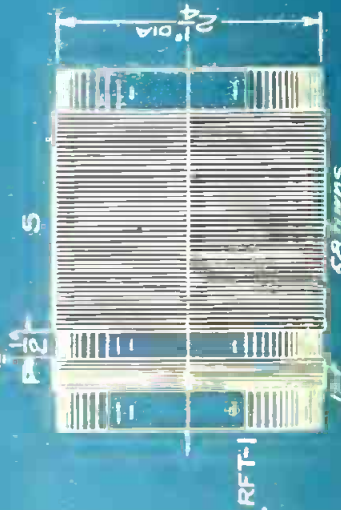


FIG. 1b

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CHICAGO, ILL.

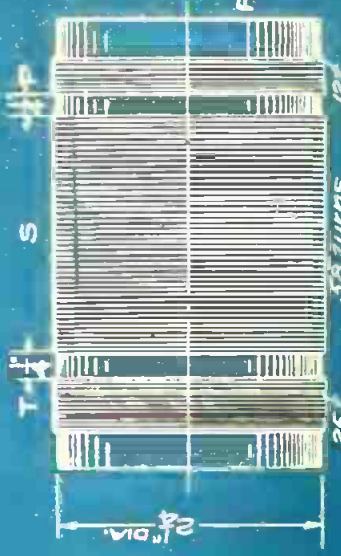


FIG. 1c

J. B. RATHBUN
RFX-126

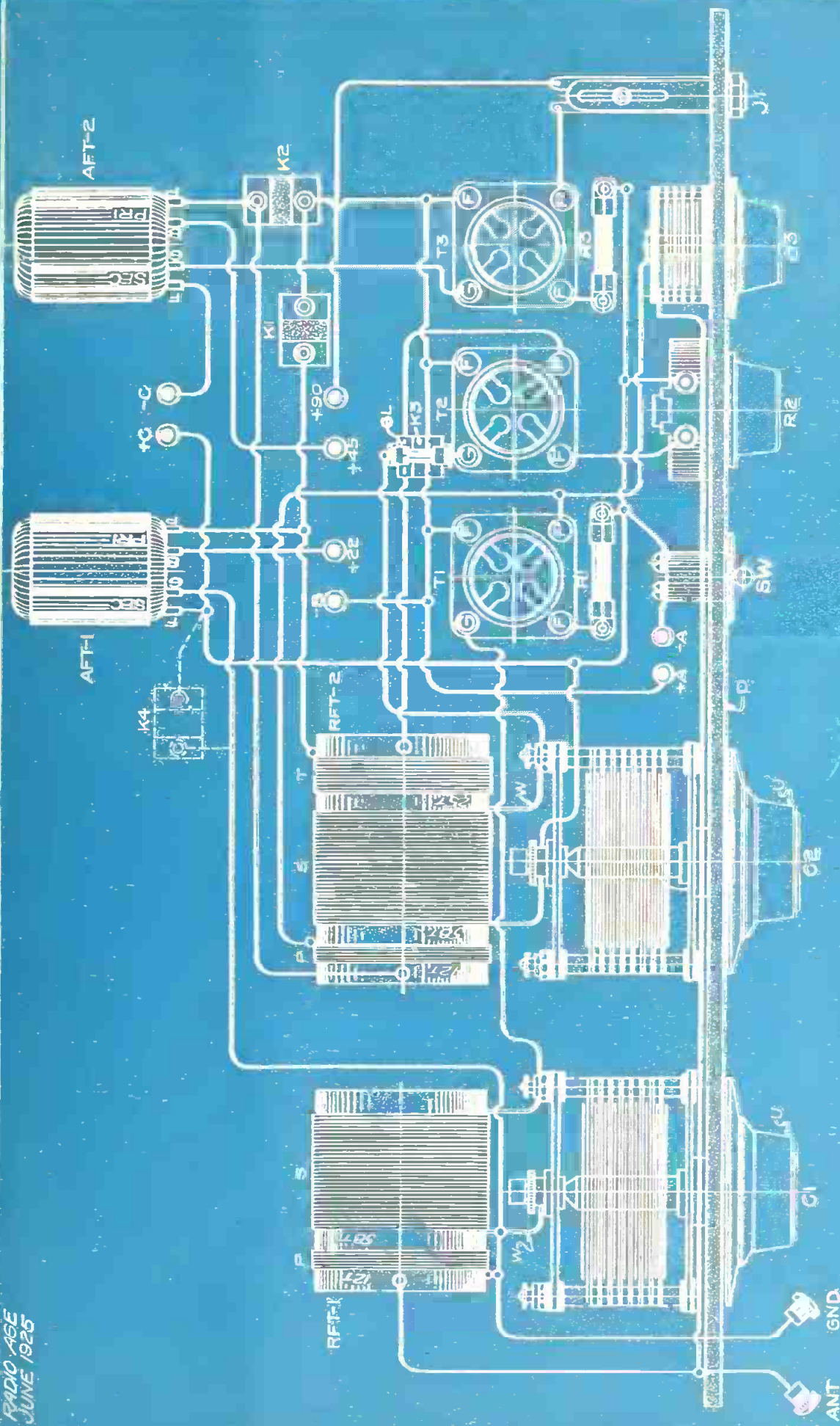


FIG. 2
"JUNIOR PORTABLE"

PICTURE WIRING DIAGRAM SHOWING ELECTRICAL CONNECTIONS BUT NOT ACTUAL MECHANICAL ARRANGEMENT OF PARTS. THE COILS OF RFT-1 AND RFT-2 ARE REALLY A RIGHT ANGLE TO EACH OTHER, AND THE CONDENSERS C1 AND C2 ARE IN A VERTICAL ROW.

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RADIO AGE INC. (PROCESS PAT. PEND.)
CHICAGO, ILL.

J.B. RATHBUN
RF-146

(Continued from page 35)

Qualities of "199" Tube

NOT only is the power loss with the UV-199 tube, but the amplification is greater than with the WD-12, and the 199 is much more satisfactory in the application of radio frequency currents in reflex sets. In fact, the 199 comes next to the 201A tube in regard to amplification and only takes one-quarter of the current. Three No. 6 "A" batteries will operate three 199 tubes for a long time, for the discharge rate is only $3 \times 0.06 = 0.18$ ampere, or less than a single WD-12 tube. The 199 is the ideal tube for a portable set from many stand-points, and takes up a minimum of room.

As the rating of a No. 6 dry cell is 0.25 ampere for filament lighting, this size of cell will operate three 199 tubes for a very long period, much longer, in fact, than would be absolutely necessary with a portable receiver. For this reason, we can use a smaller filament battery with satisfactory results, and if the set is not used for too long a period, a 4.5 volt C battery can be used for each tube. As the C battery takes up much less space and weighs much less than a No. 6 cell, we can use a 4.5 volt C for each tube or a total of three C batteries in all. For home use, where less frequent replacements are desirable, we can use a larger external battery—a storage battery if necessary.

An alternative will be to use two C batteries in parallel for each tube. This will give longer life than the singles as connected above, but will take less space than three No. 6 cells. The following table will give the comparative sizes:

NO. OF CELLS	SIZE OF CELLS	SPACE OCCUPIED
3 No. 6	5" x 5" x 6.5"	= 162.5 cubic in.
3 C	4.1" x 3" x 4"	= 49.5 cubic in.
6 C	4.1" x 6" x 4"	= 99.0 cubic in.

In effect, the three C batteries will be connected in parallel through a switch, and we will use the C batteries, as we wish to get the smallest possible set. If longer service from No. 6 cells is required, then the only change necessary will be to use a single group of three cell in series of the No. 6 type, and to correspondingly enlarge the battery compartment of the set.

The Hookup in Detail

In general, the "Junior Reflex" is a regenerative reflex using a tube detector with a tickler coil feed-back and equipped with one additional stage of straight audio frequency amplification. This arrangement gives us one stage of radio frequency amplification, a regenerative stage, and two stages of audio amplification. Enough for three tubes. A short, temporary aerial of from 40 to 60 feet will be all that is ordinarily required, either of the indoor or outdoor type, and I have had good service with a 30 foot indoor aerial run around the picture moulding of the room. So far as possible, small or miniature parts are used to economize space, and it is surprising how much apparatus we can get into a small cabinet when we make up our mind to concentrate our efforts to this end.

A special method of avoiding oscillations by means of a reversed capacity feed-back is applied to the radio frequency tube, which has proved effective in all the cases experimented upon by the writer. The plate current is fed back into the primary of the tuning coil through a very small variable condenser in such a way that it opposes the free oscillation tendency of the first tube. It is a simple application of the reversed feed-back system without the necessity of a tickler coil. As the suppression of free oscillations is one of the most difficult propositions met with by the amateur

with a separation between the two coils of approximately 1-2 inch. The wire is No. 26 D. S. C. magnet wire.

Condenser for Suppression

OSCILLATIONS in the radio frequency circuit are suppressed by the very small variable condenser (C) connected between the primary coil (on the aerial side) and the plate of the first tube (T1). This is a condenser such as the "Chelton Midget" or the "Amplex" neutralizing condenser, having a maximum capacity of from 0.000025 to 0.00006 mf. This is somewhat critical on most sets, hence the condenser (C3) is represented by a dial on the front of the panel. When properly adjusted the first stage can be cleared up quickly and easily by this simple adjustment.

The output of the first tube passes through the primary (P) of the special transformer (RFT-2) which transfers the radio frequency current to the detector tube (T2). This coil (P) is located about 1-4 inch from the end of the secondary coil (S), and at the other end of (S) is the tickler coil (T) provided for regeneration in the detector stage. All three coils are in fixed relation on the same tube, and the detector circuit is tuned to wavelength by the variable condenser (C2) connected across the secondary coil (S). The tickler (T) has about 25 turns, the secondary (S) has 58 turns and the primary (P) is a 12 turn coil. The general details of this coil or transformer are shown by Fig. 1C, but it may be found necessary to give a few more or less turns on (T) until the proper regeneration is obtained with the vernier rheostat (R2) turned to the "half-on" position.

As the current flowing through the coil (T) is almost entirely dependent upon the filament emission, and hence the rheostat adjustment, a very accurate rheostat will be required. A 40-ohm rheostat will be found about right at this point for the proper control of regeneration by the filament emission system. If the tube has to be turned up bright for the regenerative effect, increase the number of turns on (T) until it starts to "flop over" with the rheostat turned about half way on. The regulating resistance for the radio reflex tube (T1) is an Amperite shown at (R1), and a second Amperite is at (R3) for the automatic control of the amplifier filaments. The amplifier tubes (T1-T3) are not critical, but the detector tube (T2) is very critical so that a rheostat must be used instead of an Amperite at this point.

The detector tube circuit is a conventional feed-back circuit and has the usual grid condenser (K3) and grid leak (GL). The grid leak is from 1 to 2 megohms, and the condenser (K3) is probably best at 0.00025 mf. A bypass condenser (fixed) is placed at (K2) which is of assistance in reducing the R. F. resistance of the detector plate circuit. The value may range from 0.001 mf to 0.002 mf, depending upon conditions in the circuit. The circuit tuning condenser (C2) has a capacity of 0.00035 mf., so that (C1) and (C2) will "log" well together.

As is usual, the output of the detector

MATERIALS FOR "JUNIOR PORTABLE"

Code Letters	No. of Pcs.	Name	Size
A-3	3	"C" batteries, large.	4.5 volt.
AFT-2	2	Audio Frequency Transformers.	4-1 to 6-1 ratio.
B-4	4	"B" batteries.	22.5 volt blocks. Small size (1200 m. h.).
C1-C2-2	2	Vernier variable condensers.	0.00035 mf 17 plate.
C3-1	1	Equalizing variable condenser.	Chelton Midget, 0.00006 mf.
C-1	1	Small bias battery.	
D-1	1	Bakelite panel	10" x 8.3-4" x 3-16"
E-1	1	Bakelite tube shelf	4" x 6 1-8" x 1-8"
F-6	6	Marked binding posts.	
GL-1	1	Grid leak (adjustable or fixed).	1.0 to 2.0 megohms.
J1-1	1	Single circuit jack.	
K1-1	1	Fixed condenser, mica ins.	type 0.001 mf.
K2-1	1	Fixed condenser, mica ins.	type 0.002 mf.
K3-1	1	Fixed condenser with leak taps	0.00025 mf.
R4-1	1	Fixed condenser, mica ins.	type 0.00025 mf.
R1-R3-2	2	Amperites for fila. control	(109, 4.5 volts).
R2-1	1	Filament rheostat, vernier.	40 ohm type.
RFT-1-1	1	Standard air core R. F. transform	neutrodyne type.
RFT-2-1	1	Bakelite tube.	2 1-4" diam. 3" long.
RFT-2-1-4	1	lb. silk covered magnet wire	No. 26 D. S. C.
S-4	4	small brass shelf or support angles	
12'	12'	Bus wire, No. 14, tinned copper.	
1'	1'	Rosin core solder.	
1'	1'	Spaschetti.	
25	25	Miscellaneous machine screws.	
U-2	2	Condenser dials (if not with con.)	3" Diam
SW-1	1	Battery cutout switch.	Standard.
T1-T2-T3-3	3	UV-199 tubes.	
V-3	3	"199" tube sockets, absorb. base.	
W-4	4	Condenser angles for holding coils on condensers.	
X-8'	8'	Flexible fixture cord for battery connections.	No. 18.
Y-1	1	Special cabinet (Complete).	
1	1	Phone plug.	
60'	60'	Annunciator wire, wax cotton or No. 18 flexible	fixture wire for aerial.

in the construction of a reflex circuit, he will find this a most important point.

Fig. 1A is a schematic diagram of the "Junior Portable," showing the three tubes, the transformers, and all connections. The tube (T1) is the reflexed radio frequency and audio frequency tube; tube (T2) is the detector, and (T3) is the straight audio frequency amplifier. All radio frequency stages are tuned by variable condensers so that the maximum amplification peak is attained, and at this same time this is a valuable aid to the selectivity of the set. The second tuning coil or radio frequency transformer is of a special type, as it contains three coils which act respectively as the primary, secondary and tickler coils. Only two dials are required for the tuning operation proper, the regeneration being controlled by the detector rheostat, a method that is entirely practicable with a vernier rheostat, and which greatly simplifies the construction and tuning.

At RFT1 we have the usual aperiodic tuning coil with the primary (P) and the secondary (S) which is tuned by the 17 plate (0.00035 mf) variable condenser (C1) connected across the secondary in the conventional manner. A detail of this tuning unit is shown in Fig. 1B, which shows the principal dimensions. There are 58 turns on the secondary and 12 turns on the primary coil (P),

tube is reflexed back to the first tube (T1) by means of the audio frequency transformer (AFT-1), the latter being in the grid return circuit of the first stage. This can be any make of transformer having a ratio varying from 4-1 to 6-1, but as we wish to gain every inch possible, I have shown the miniature Premier Hegehog transformer in the picture diagrams. In some cases, a 0.00025 mf fixed condenser (K4) improves results when connected across the secondary coil of (AFT-1), and again, this seems to have but little effect. It seems to be a matter of experiment with each individual set to determine whether (K4) should be used. Its effect is principally on DX rather than on volume with local stations, so that we should try for distance in making this adjustment rather than to experiment for volume alone.

The output of the reflexed tube (T1) now passes to the primary coil of the second audio transformer (AFT-2), and this latter transformer is a part of a straight audio stage that is not reflexed. Connections are made to (T3) in the usual standard manner, and the total output of all three tubes passes out through the output jack (J1) to the phones or loud speaker. This is not a complicated circuit to hook up, but it requires some readjustments as with any reflex circuit, particularly in regard to the values of the bypass condensers.

For the smallest portable set, three 4.5 volt "C" batteries are used for the filament current as at (A1-A2-A3), the cells being in parallel and connected to the circuit through the battery cutout switch marked (SW).

22.5 Volts for Detector

PLATE or "B" battery connections are tapped according to the requirements of the various stages. A voltage of 22.5 volts generally proves best for the detector circuit under all around conditions, although 45 volts may give greater volume and selectivity on local stations. A potential of 45 volts is most effective on the radio frequency tubes on distance, hence a 45 volt tap is indicated for this stage. The audio stage requires 90 volts for the best performance, and 67 volts gives nearly as good results with one less block of "B" battery. The set can also be operated with 45 volts on the audio stage, but with greatly diminished volume on all stations. I do not recommend placing the full 90 volts on the radio frequency stage, and never on the detector stage, and after experimenting extensively I find that the best all around results will be found with the plate battery connections as indicated.

Four small B batteries (90 volts total) can be used for this set and will last most of the season. The smallest B batteries are the 450 milliampere-hour cells which measure 2" wide, 3-3-8" long and 2-9-16" high. The next largest size take up very little more space and give much longer service. This is the 1200 milliampere-hour size which is 2-9-16" wide, 4-1-6" long and 2-3-4" high. The latter size are the more practicable, especially

with three tubes, and are shown in the assembly diagram. With three tubes kicking out from 10 to 12 milliamperes, the 450 m. a. h. type does not last very long before the voltage runs down and the volume falls off.

In the table on page 38 is listed all of the material required for building this set, each item in the list being preceded by a letter corresponding to the letters on the diagram. All of these parts are standard and the majority are built by a number of radio concerns so that it will not be difficult to pick up all of the parts at your dealer's. The only special parts are the cabinet, which must be built to fit the job at hand, and the tuning coils and RF transformer, which can easily be wound up at home. A neutroformer or tuning unit can be purchased for use in place of RFT-1, but RFT-2 is special and is not stocked.

**Outdoors or
Indoors—You
Will Find All Your
Radio Needs
Satisfied In
RADIO AGE
Every Month.**

**Another Blueprint
Hookup In July
RADIO AGE—Out June 15**

Fig. 2 shows all of the parts connected up in "picture" form for the benefit of the novice who does not understand conventional or symbolic diagrams. Either Fig. 1 or Fig. 2 can be used in making the actual connections, for both show the same circuit and the parts are lettered with corresponding letters.

Fig. 3 is a rear elevation of the set with the back panel removed and shows how the parts are assembled, ready for wiring. The three tubes and sockets are mounted on the top of the shelf (E) while the audio transformers are hung underneath. This not only saves room but it also shortens and simplifies the wiring. Of course, machine screws must be used for this assembly instead of the more usual wood screws, as all parts are fastened to bakelite. The shelf is attached to the panel by means of the small brass angle brackets (S) which can be made at home or purchased at almost any radio store.

I wish to call your attention to the fact that the two radio frequency transformers or tuning coils (RFT-1) and (RFT-2) must be placed at right angles to one another, as shown, to prevent coupling back between stages and to prevent oscillations being set up by induction. The coils are supported by brass lug connections to the terminals of the variable condensers so that their weight is substantially supported. It should be particularly noted that the stator or sta-

tionary plates of the variable condensers (C1-C2-C3) connect to the grids of the tubes to prevent the body capacity effect from being carried out to the front of the panel through the shafts of the condensers. The grids are at a high potential, and anything connected to the grids is easily affected by the capacity of the hand and is detuned by this capacity effect.

All of the batteries are carried in the bottom of the cabinet, very closely packed together to prevent movement, and connections are made with the circuit above through the flexible cords (X). Connections are more certain and more easily made if "spade" type clips are soldered to the ends of these cords. Do not use solid wire for this purpose or simple cotton covered wire, as such wire is likely to short-circuit. Flexible fixture wire has a rubber covering which is further protected by a cotton braid, making a short circuit unlikely.

The Aerial Wire

THE aerial wire can be a temporary affair run around the picture moulding of the room, strung up temporarily from room to room, hung between trees or other supports. It is connected to the antenna post (ANT) with the other end left free and unconnected. For indoor service about 60 feet of annunciator will be sufficient and no supporting insulators will be needed, as the waxed cotton cover will be sufficient insulation when laid along the plaster of the walls or along wood surfaces. For outdoor work, or where it is likely to be damp, a wire with rubber insulation should be used, such as flexible fixture wire or lamp cord. Lamp cord is excellent for this purpose, as it has a low R. F. resistance and is sufficiently flexible to allow winding up in a small coil.

After cutting the batteries into circuit by means of the battery switch (SW), the detector rheostat (R2) and the equalizing condenser (C3) are adjusted until all whistling and howling stop. There should be a slight hissing or frying noise which will indicate that the tubes are functioning, but the adjustments should not be much above this point. Next, turn the wavelength adjustment condensers (C1) and (C2) very slowly and at about the same rate of speed until a "station whistle" or voice is picked up. Juggle the condenser dials until the signal is at a maximum, and then manipulate the detector rheostat (R2) just under the point where it is about to break down into free oscillations and where the signal is at a maximum. Working the detector rheostat in connection with the condenser (C3) will give the maximum volume.

Remember that (C3) is for the purpose of checking oscillations in the radio frequency circuit, and that this controls the radio frequency circuit in about the same way that the detector rheostat controls the detector. Howling can be checked by either (C3) or (R2) depending upon whether the trouble is in the radio frequency or detector circuits.

The selectivity depends upon the
(Turn to page 42)

Blueprints of the 3-Tube Portable Reflex on Two Pages Following

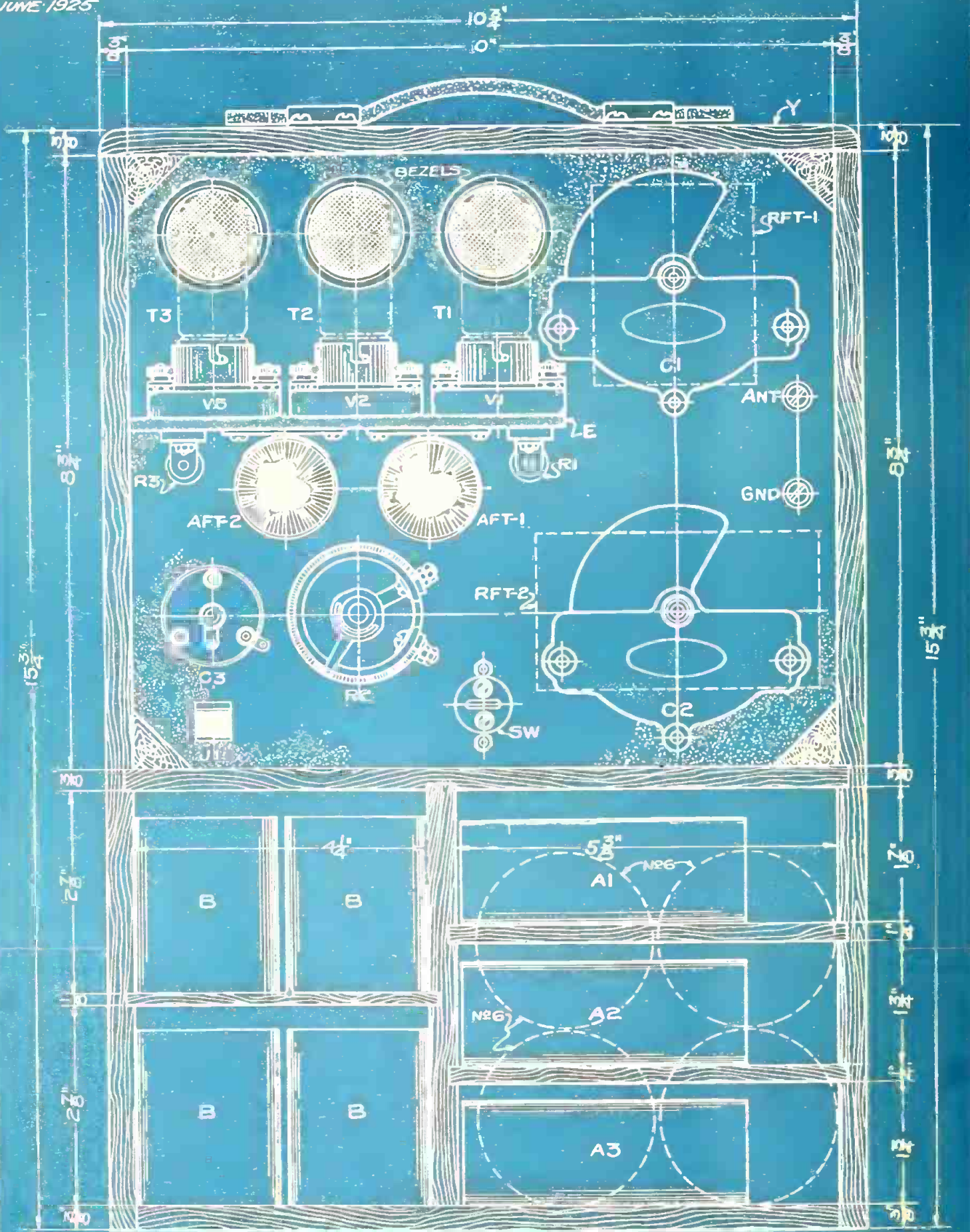


FIG. 3

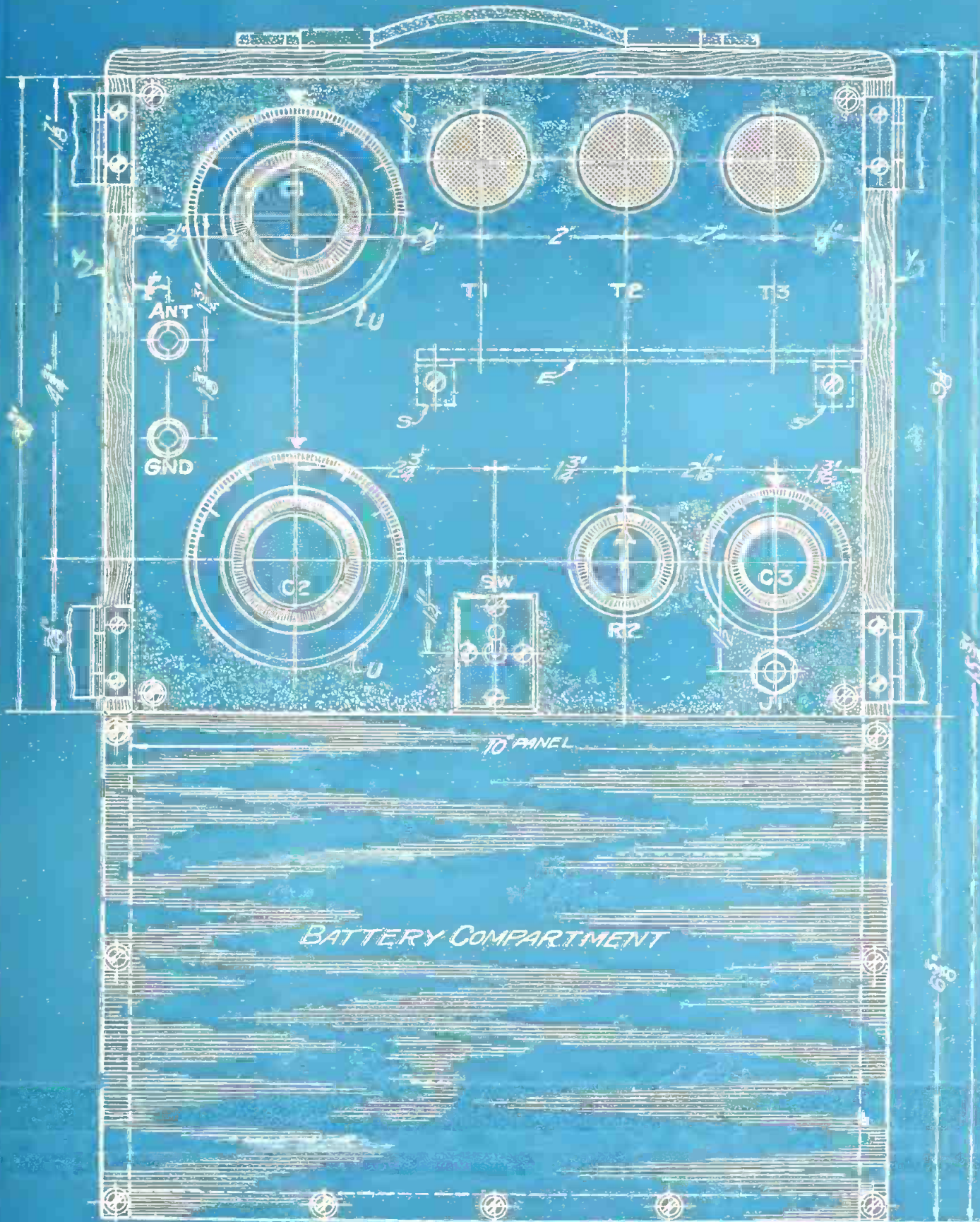


FIG. 4
"JUNIOR PORTABLE"
FRONT ELEVATION "A"
(PROCESS PAT. PEND.)

Battery Problem Easily Handled

(Continued from page 39)

distance of the primary coil (P) from the secondary (S). The greater the distance the looser will be the coupling and the greater the selectivity. This applies to both (RFT-1) and (RFT-2). Usually the best spacing of the coils is as shown by Figs. 1B and 1C, but with some types of audio frequency transformers, this must be increased. The wavelength range is determined by the number of turns on the secondary coils (S), and as shown, will cover a range of from 200 to 600 meters.

Fig. 4 is a front elevation of the panel, showing the dials and other controls. It is advisable to allow the cabinet to project beyond the panel in front for the protection of the dials, and to provide a door at this point, so that the set can be completely closed.

Trouble Shooting

WHEN the signals are weak and the selectivity seems poor, the trouble is usually due to coil reversal; that is, the various coils in the tuner or transformer do not bear the proper inductive relation to one another. If, for example, the primary coil should be connected so that it produces a magnetic field that opposes the field of the secondary coil, then the output will be practically neutralized and there will be little reception. It is for this reason that I suggest that you connect up all of the primary coils permanently when you wire the set, and make temporary connections to the secondary coils and tickler coil with magnet wire.

After you connect up the set, you can tune in, and if results are not satisfactory at the first attempt, try reversing the connections to the secondary and tickler one at a time, until you get the best results. After the best point is found, you can complete the wiring by substitut-

ing soldered bus wire connections for the temporary wires. This may save you a lot of work and should be observed.

Be sure that the prongs of the tubes are making proper contact with the springs in the sockets, and try this out before you screw the sockets down into place. A loose tube or loose contacts mean all kinds of trouble, and trouble that is difficult to remedy after the set is completed and in the cabinet. Also carefully examine the jack connections, and make sure that a projecting lump of solder is not short-circuiting the jack. The lugs are very close together and it is easy to short-circuit at this point.

Use only the small "midget" type variable condensers for the transfer (C3). A standard condenser, even as small as a three plate, is much too large to cover the range even with all of the plates out of engagement. The zero capacity of standard condensers is very frequently greater than the maximum capacity desired at (C3).

Sometimes reception is improved by connecting a 0.001 mf fixed condenser across the ends of the jack (J1), and sometimes this has no effect at all. It all depends upon the winding characteristics of the coils in your phones and speaker.

In making battery connections, be sure that the positive pole of your "B" battery is connected into circuit at the point indicated in the drawings, that is, the positive of the "B" battery must always go to the plate directly, or to the plate through the tickler coil or transformer primary. If this polarity is not observed, the set will be absolutely dead without a hiss or grunt to be heard.

A biasing "C" battery for the grid of the audio amplifying tube (T3) can be connected in at (-C) and (+C) as shown just under the audio transformer (AFT-2)

in Figs. 1-2. This will save enough "B" battery current to pay its way, but if it is not desired at the present time, the binding posts or connections (-C) and (+C) can be sort circuits as indicated by the dotted line running between these two connections. The "C" battery can be the smallest type of "C" battery or else can be a small flash light battery, either giving a total potential of 4.5 volts on the grid of the tube (T3).

Phonograph Music Directors Set New Standards

THE broadcasting of music has grown like Topsy. In the case of a single artist it has been comparatively easy to indicate a definite position before the microphone and one which is likely to secure the best results. But where several artists are concerned or there are a number of musicians, as in an orchestra, the problem has become more and more complicated, and in the rapid development of broadcasting it has been one which has not had as much attention in the past as it unquestionably will have in the future.

However, it was not new to the phonograph people, for in the making of records they have been experimenting for years in the proper placing of the instruments. An orchestra forming in a broadcasting studio as a rule looks like an orchestra playing any place else, but in a phonograph recording laboratory, it is a most unusual sight.

The man playing the cello may be on a chair with legs so long that the player's head almost touches the ceiling. On the other hand, the tuba player may almost be sitting on the floor. Sometimes the music racks are suspended from the ceiling; again they are giraffe-like affairs rising from the floor.

End your Radio Troubles for 30c in Stamps

We have laid aside a limited number of back issues RADIO AGE for your use. Below are listed hookups to be found in these issues. Select the ones you want and enclose 30c in stamps for each desired. The supply is limited, so enrich your store of radio knowledge by laying in an ample stock of copies NOW!

January, 1924

- Tuning Out Interference—Wave Traps—Eliminators
- Filters.
- A Junior Super-Heterodyne.
- Push-Pull Amplifier.
- Rosenbloom Circuit.

March, 1924

- An Eight-Tube Super-Heterodyne.
- A simple, low loss tuner.
- A Tuned Radio Frequency Amplifier.
- Simple Reflex Set.

April, 1924

- An Efficient Super-Heterodyne (fully illustrated).
- A Ten-Dollar Receiver.
- Anti-Body Capacity Hookups.
- Reflexing the Three-Circuit Tuner.
- Index and first two installments of Radio Age Data Sheets.

May, 1924

- Construction of a Simple Portable Set.
- Radio Panels.
- Third Installment of Radio Age Data Sheets.

June, 1924

- Important Factors in Constructing a Super-Heterodyne.
- A Universal Amplifier.
- A Sure Fire Reflex Set.
- Adding Radio and Audio to Baby Heterodyne.
- Radio Age Data Sheets.

July, 1924

- A Portable Tuned Impedance Reflex.
- Operating Detector Tube by Grid Bias.
- A Three-Tube Wizard Circuit.
- Data Sheets.

August, 1924

- Breaking Into Radio Without a Diagram.
- The English 4-Element Tube.
- Filtered Heterodyne Audio Stages.
- An Audio Amplifier Without an "A" Battery.
- Data Sheets.

September, 1924

- How Careful Mounting Will Improve Reception.
- One Tuning Control for Hair's Breadth Selectivity.
- Four Pages of Real Blueprints of a New Baby Heterodyne and an Aperiodic Variometer Set.
- Data Sheets.

October, 1924

- An Easily Made Super-Het.
- Two Radio and Two Audio for Clear Tone.
- A Simple Regenerative Set.
- The Ultradyne for Real DX.
- Real Blueprints of a 3-Tube Neurodyne and a Midget Reflex Set.

November, 1924

- Blueprints of a Single Tube Loop Set and a Capacity Feedback Receiver.
- A 3-Tube Low Loss Regenerator.
- Mastering the 3-Circuit Tuner.

December, 1924

- Blueprints of a New 8-Tube Super-Heterodyne.
- How to Make a Receiver that Minimizes Static.
- A Trans-Atlantic DX Receiver.
- How to Make a Home Made Battery Charger and a Loud Speaker at a Small Cost.

January, 1925

- A Reflexed Neurodyne
- A Six Tube Super-Het.
- An Efficient Portable Set.
- A Tuned Plate Regenerator.
- Making a Station-Finder.

February, 1925

- A Sure Shot Super-Het.
- A Three Circuit Regenerator.
- A Real, Low Loss Set.
- Blueprints of a 3-tube Reflex.

March, 1925

- A Permanent Super-Het.
- A 5-Tube R. F. Receiver.
- How to Wind Low Loss Coils.
- A Short Wave Receiver
- Blue Prints of a Two-Tube Ultra Audion and a Regenerative Reflex.

April, 1925

- A 3-Tube Portable Set
- "B" Voltage from the A. C. Socket
- An Amplifier for the 3-Circuit Tuner
- Blueprints of a Five-Tube Radio Frequency Receiver

May, 1925

- A "Quiet" Regenerator.
- A Power Supply Receiver.
- How to Make a Tube-Tester.
- A Unique Super-Het and an Improved Reinartz.
- A Six Tube Portable Receiver Illustrated with Blueprints.

RADIO AGE, Inc.

500 N. Dearborn St., Chicago



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.

BRIDES and static. One is about as hard to silence as the other in the merry month of June, as many of our Dial Twisters can testify after sitting up half the night coyly fishing for the elusive DX signals while the Better Eight-Tenths wonders why she, of all the people in the world, should have been manacled to a radio maniac. (We have often wondered what the feminine portion of the Dial Twister's family thinks of the RADIO AGE button).

Returning from our buttons to our muttens, nothing startling has been discovered since our last issue of RADIO AGE, although the low-loss campaign goes ahead rapidly. The outstanding feature along this line is the figure 8 coil, the binocular coil, the doughnut coil and other coils of a similar type wherein by the form of windings the magnetic field of the coil itself is kept within its own bounds, thus cutting down the interstage coupling which has been the bugbear of any radio fan who ever tried his hand at tuned or untuned radio frequency amplifiers.

With this type of coil and the proper design of the set, the necessity for neutralization of the tubes can be done away with, which should prove a boon to all radio experimenters. Let's see which one of our Dial Twisters will report the best results with the new type of coils.

They say musicians have no home, but since radio came into such popularity, the musician's home is wherever he parks his loudspeaker (not referring to the ladies, however.) Thomas V. McLaughlin, musical director of the Hello Jake Company, and now on the road, says he bought his first copy of RADIO AGE in May, 1923, and has not missed an issue since that time. Mr. McLaughlin made the Reinartz described in that particular month's RADIO AGE and later added two stages of audio. Travelling as he does, he is not permitted the pleasure of an antenna, so at night in the hotel room he uses the radiator for an antenna and the cold water faucet for the ground. Once he forgot to connect the radiator while at Newcastle, Pa., and heard WOAW in spite of that fact. His first set was made on the side of a prune box, since he had no panel. Despite the fact Mr. McLaughlin comes from Brooklyn, N. Y., he signs off with the following poetry:

*I have no five tube neutrodyne,
Nor an eight tube super-het—
But RADIO AGE, from page to page,
Is the best that I've seen yet.*

Lloyd H. Shera, San Miguel, California, using a two tube reflex, is bringing in the East Coast and Canada quite well. Some of his stations shown are:

CONTRIBUTOR.

O. C. Wallace, Jr., 205 Lewis Bldg., Montreal, Canada.

DIAL TWISTERS

Name	Address	City
Thomas V. McLaughlin		En Route
Lloyd Stove	Box 363	National City, Calif.
Lloyd H. Shera		San Miguel, Calif.
Raymond Breeden	1105 Orange, N. W.	Roanoke, Va.
J. W. Landon	113 Scoville Way	Pittsburgh, Pa.
A. P. Smith	R. F. D. 8	Bangor, Me.
W. C. Dukes, Jr.	P. O. Box 449	Mobile, Ala.
J. W. McCullah		Soldiers Home, Calif.
S. Stansfield	8035 Wilson Ave.	Detroit, Mich.
Guy Arthur	P. O. Box 245	Massilon, Ohio
Fern Frame	768 Adams St.	Gary, Ind.
W. G. McDonald	19 Marlborough Apts.	Calgary, Alta., Can.
Jack Warwick	217 St. James St.	Port Arthur, Ont., Can.
Eugene Arneson	470 Exchange St.	Kenosha, Wisc.
F. S. Reed	9123 Baltimore Ave.	Chicago, Ill.
Harry Emerick	311 Bedford St.	Johnstown, Pa.
T. F. Hyland	R. 3. Box 459	Sebastapol, Calif.
Harry T. Adams	379 Going St.	Pontiac, Mich.
Otto C. Glatt	87 Dunn Ave.	Toronto, Can.
Arthur C. Wilson	557 West 1st South	Salt Lake City, Utah
J. A. McCormick	24 South 6th St.	Fort Dodge, Iowa
Paul Nelson	223 Du Page St.	Michigan City, Ind.
W. G. Mortimer	144 Central Ave.	London, Ont., Can.
Eric Gustafson	6 Bergen Ave.	Jamaica, L. I., N. Y.
N. J. Hiscox	Box 761	Brampton, Ont., Can.
Clarence Fairfield, Jr.	315 N. F St.	Hamilton, Ohio
Frank J. Sanzone	244 Hull St.	Brooklyn, N. Y.
R. A. DeVries	114 Eighth Ave.	New York City, N. Y.
J. J. Griffiths	2782 Rouen St.	Montreal, Can.
Harry S. Chasen	1724 N. Payson St.	Baltimore, Md.
Charles P. Smith	129 E. Pomona Terrace	Germantown, Pa.
Wm. A. Swicky	1045 Maple Ave.	Los Angeles, Calif.

KDKA, KOA, WCX, WBAB, WDAF, WEBB, WFAB, WGN, WGY, WHAA, WHO, WLS, WOAL, WOC, WQJ, WSAJ, WTAM, WTAB, WCCO, WLW, WFCN, WFDG, CFRC, and a long list of others which we think would stagger our linotype operators.

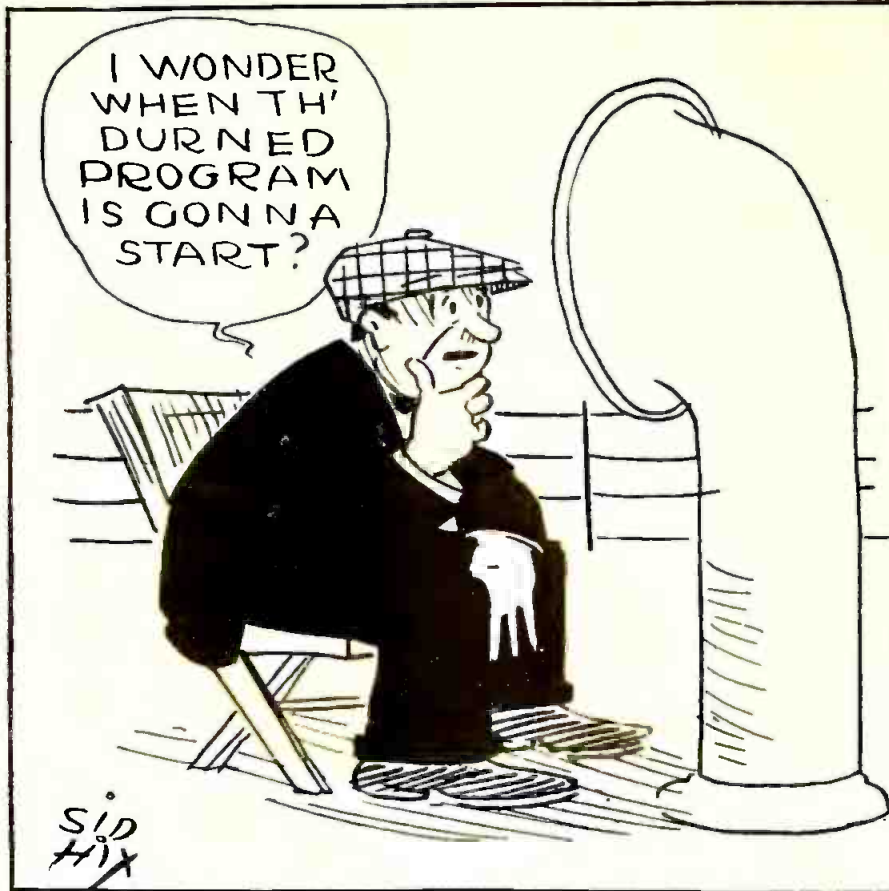
Harry S. Chasen, 1724 N. Payson St., Baltimore, Md. sends in a sketch of what he calls the "Bearcat Roamer" consisting of a tapped secondary coil and condenser, untuned primary, and a variometer in the plate circuit, a typical regenerative circuit, with which he is having great success. He is using all low-loss parts and believes much of his success can be attributed to that fact.

John James Griffiths, 2782 Rouen St., Montreal, Canada, using a three circuit set and the "peanut" tubes which are available in that country, sends in a good list of stations which entitles him to the button.

Here's a most interesting letter from

Robert A. DeVries, 114 Eighth Ave., New York City, who says: "I am writing to give my views on your interesting magazine and also to qualify for a Dial Twister's button. I've been buying your magazine for over two years, when I used to have to wait until the middle of the month to get it, and then I used to enjoy it more than now. Your magazine was then devoted to radio beginners, enthusiasts and experimenters. Your magazine was then only a few pages but in those few pages was printed matter interesting enough for the type of radio fans I've mentioned, and interesting enough to make it grow to its present proportions. Here's what I am getting at. You are now printing radio stories and elaborate interviews of announcers, etc.; reach the set-owner by telling him what the other fellow is doing; that is why Dial Twisters and their hook-ups are the most interesting

(Turn the page)



part of the magazine. How about a column devoted to queer and unusual things that happen in radio, contributed by the readers? For instance, I have push-pull amplifiers in my set and when I removed the loud speaker plug I lifted the lid on the cabinet and could hear music from one of our powerful locals. Also, Saturday, February 7, Stations KFI, KOA and WMBF were broadcasting the song 'My Best Girl' at the same time. Isn't that unusual? My set is a three-circuit tuner built from the March issue of RADIO AGE, and to it I have added one stage of r. f. I am sending a list of some of the stations over 1,000 miles which I have logged."

N. J. Hiscox, Box 761, Brampton, Ontario, Canada, tells us he is using a honeycomb coil set with detector and one stage of audio which is now in its fifth year, and like Johnny Walker, still going strong. It is a home-made set and was the first set in his vicinity.

Eric Gustafson, 6 Bergen Ave., Jamaica, N. Y., has found that by putting a fixed capacity from the upper phone binding post to the negative lead of the A battery, he gets much better results. This is what is known as "by-passing" and is one of the kinks that every dyed-in-the-wool experimenter does almost unconsciously. If more fans did like Mr. Gustafson, the "What's wrong with my set" type of letter would not be so abundant around these parts.

O. C. Wallace, Jr., 205 Lewis Bldg., Montreal, Que., Canada, sends in a neat little design of one stage of radio frequency amplification to be added to the conventional Reinartz tuner. He says it has increased his range and selectivity. He uses a separate A and B battery. His r. f. coil is wound on a $3\frac{1}{2}$ inch tube. The aperiodic primary consists of ten turns and is spaced about a quarter-of-an-inch from the secondary, which consists

of 42 turns. The diagram herewith is being amended so that you do not have to have separate A and B batteries but can add your r. f. stage to your present Reinartz. The condenser used across the secondary is a .0005 mfd.

Arthur O. Wilson, 557 West First South St., Salt Lake City, Utah, says his second attempt at set building was the ultra-audion, blueprinted in the March RADIO AGE, and he is now starting on the one described by Mr. Sonn in the April number. He found best results with a 120 turn tapped astatic wound coil, which type of winding he will be glad to describe to any one who writes him. His list of stations is not only a testimonial for the ultra-audion; but gets him the D. T. button.

Another ultra-audion fan is found in Otto C. Glatt, 87 Dunn Ave., Toronto, Canada (goodness, how these Canadians are coming to the front in radio). He is an inveterate RADIO AGE fan and asks us to fade, if we can, his record on the night of March 7th, of WMBF, KOA, 6KW, KGO, KHJ, KFI, KNX, all of which have been verified.

T. F. Hyland, R. 3, Box 459, Sebastopol, Calif., built up a tuned plate regenerator as described in the January RADIO AGE, on which he gets as far East as KDKA and as far North as Calgary. He thinks this is a fine set for the novice to build.

Using a one tube set, Harry Emerick, 311 Bedford St., Johnstown, Pa., drags them in from CNRO to PWX and from WBZ to KGO. He declares he is an avid RADIO AGE reader and especially delights in turning to this portion of the magazine on its arrival each month.

F. S. Reed, 9123 Baltimore Ave., Chicago, Ill., comes to bat with this one: "Let's rule out the U. S. as far as signals are concerned. Most any good set will bring in the worth-while stations in this

country. Let the Dial Twisters enlarge their territory. Have been building hook-ups for many years and never found so very much new. I use an Armstrong three circuit with a stage of radio ahead. It will bring in anything on a 75 foot aerial that a super will do on a loop. I have logged PWX, 2LO, CKY, CNRO, KFI. Why bother about a portable set? Just use dry cell tubes if you are not intending traveling by auto. The old three circuit with a wire thrown up in a tree will go it o. k. So what's left?"

Here's a crystal hound; that is, he used to be. Raymond Breeden, 1105 Orange Ave., N. W. Roanoke, Va., who tells us his first experience in picking up KDKA, WGY and WEA; later this was increased to WEBJ, WJZ, WOR, WOC, WLW, his maximum distance being somewhat over 600 miles on a crystal. Then he went in for a single tube set and got all of the old stations he had heard on crystal and a new bunch in addition, which included KGO, CNRO, CKAC. Raymond is only a youngster in years, but he turns them out like a veteran at logging.

Lloyd Stove, Box 363, National City, Calif., with a super, using loop and ground, reports the Canadians, Hawaiians, Mexicans and our friend 2-LO. He tuned in 115 stations with an average mileage per station of 1315 miles. All except London were heard on the loud speaker.

Since Mr. Stove is located in California, the full list of his stations might be of interest to our readers. The list follows:

KFNV, KOB, KDYL, KPPT, KFL, KFHA, CZF, KFAJ, KFM, KFAJ, KFEL, KIZ, KOA, KFCF, KGW, KFAE, KFIQ, KUM, WCAT, KOA, KPOK, KIG, KFLI, KJR, WOAI, WCAR, WBAP, KFKK, WIAD, WFAA, KFRU, GKCD, KFKB, KSAC, GHCM, CFAU, DFCN, CKCX, CNRC, KFAB, WEAY, KFRU, WOAW, WAAW, KFNF, KFMQ, WDAF, WHB, KTHS, WGAQ, KFDN, WHO, WOI, CYL, GYB, GYX, WOS, WCAI, KFMN, WCCO, WSU, KSD, KFUC, WMC, WSAB, CKY, CNRW, WJJD, WHA, WEBW, WLBL, WTAS, WCEE, WHAD, KYW, WEBH, WGN, WGN, WLS, WMAQ, WQJ, WBCN, WCBQ, WHAS, WLW, WSAI, WGST, WSB, WREC, WBAY, WEAQ, WCX, WEAR, WTAM, WCAE, KQV, KDEA, WGR, WMAK, WCAP, WMBF, KGU, WCAU, WFI, PWX, WAHG, WEA, WJZ, WNYC, WGY, WHAZ, WBZ, WEI, and last but not least 2-LO. London: (Verified by the British Broadcasting Co.)

Then from south of the Smith and Wesson line comes a letter from W. C. Dukes, Jr., P. O. Box 449, Mobile, Alabama, telling us of his work with a three circuit regenerative set using WD-11 tubes. On headset he has brought in the East and West coasts, Canadian stations, two of the Mexican stations and Havana, Cuba. A short list of stations follows:

WTAS, KDKA, KFDN, KFI, WBBM, WKAA, WORD, KFKB, KFMQ, WSAI, WEBH, WHB, KTHS, WGY, WMBF, WOAI, WOS, WOAW, KSD, KYW, WBAP, WMC, WQJ, WSB, KFRU, WMH, WLS, WFAA, KFI, WHO, WDAF.

Al P. Smith, R. F. D. No. 8, Bangor, Me., gives a list of stations heard, one of which was during the tests, being 5NO at Newcastle, England. He uses the dry cell type of tubes and has a neutralized stage of r. f. detector regenerative and one stage of audio. He has also built a three circuit receiver with three stage resistance coupling, which he used for short wave work. The list follows:

WEI, WNAC, WMAF, GWI, WBZ, KYW, WDBH, WTAS, WGN, WEBH, WREC, WGR, WHN, WEA, WJY, WJZ, WAHG, WGY, WHAS, WTAM, KDKA, WIP, WJAR, WCAP, WRC, GHAC, CFCF, CHYG, CKAC, WKAQ, PWX, WMC, WCBQ, WQAM, WDAE, WOC, WHAS, KFKX.

S. Stansfield, 8035 Wilson Ave., Detroit, Mich., who is a faithful follower of RADIO AGE blueprints and diagrams, made up a Reinartz with two stages of audio, using WD-11 tubes. Stations

heard by him, mileage greater than 500, follow:

WPG, KFNF, WBZ, KFKB, KFKN, WOAW, WFAF, WGY, WEEL, KFEL, WDAF, WCCO, WBB, WEAJ, WAHG, WJIN, KOA, WCAI, WMAK.

Guy Arthur, P. O. Box 245, Massillon, Ohio, a constant reader of RADIO AGE, spends most of his spare time experimenting with circuits furnished by this magazine. He relies on his "squealer"—a three tube regenerative, for distance. During the tests he picked up 2LO. He now gets 'em from coast to coast, and is now interested in a reflex set using two tubes.

Jack Warwick, 217 St. James St., Port Arthur, Ont., Can., writes as follows: "I have studied with great interest contributions under 'Pickups and Hookups,' and thought perhaps some of the readers might be interested in my experiences. During construction lost the diagram and had to finish it the best I could, with good results. As near as I can remember, it is a regenerative (that's as much as I know about radio, Mr. Editor); couldn't tell you the 'diff' between or names of any hookups. The equipment for my set is 2 tubes (Myers) six volt detector tube, 2 1-2 volt amplifier tube, Crosley vari-coil, with 10 taps; 23 plate aluminum condenser, couple of 6 ohm rheostats, etc., with a 125 foot single strand aerial. Here are some of the stations I pick up:

CRAC, CNRO, CFCG, CNRW, CNRT, KDKA, KFI, KFKN, KFNF, KFRU, WOAW, WDAF, WOC, WHO, WSUI, WFAF, WEEL, WBZ, WTAS, WTAM, WCB, WCCO, WCAE, WGN, WGY, WGR, WFAA, WCX, WIP, WLB, WOS, WREO, WCAI, WQJ, WSAI, WSB, WWJ, WMC.

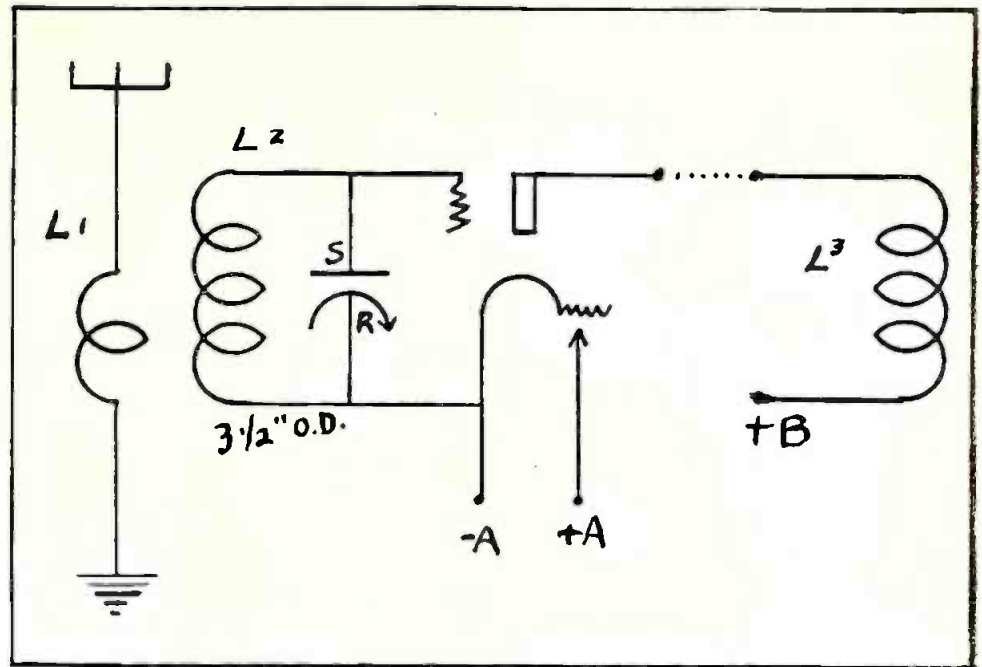
Harry T. Adams, 379 Going St., Pontiac, Mich., tells us he made a three tube neutrodyne from the blueprints in the October, 1924, issue of RADIO AGE and has since added a pair of push-pull transformers. He now gets both of the coasts most of the time on the loud speaker, getting good quality and selectivity.

W. G. McDonald, 19 Marlborough Apts., Calgary, Alberta, Canada, has the following interesting letter for this section:

"I have been a reader of your excellent magazine for some time, and admire the way in which it is gotten up. The department to which this letter is addressed is the best of the lot, and I always read it the first of any. The communications from the DX fans are always interesting in their various viewpoints and contentions. I would like to tell you about the results which I have obtained with the old 'dumb-bell' single circuit, made up by myself with only middling quality parts, using that excellent little tube, the Canadian peanut, which is really the W. E. 'N' Tube, and which you Americans are very unlucky, in my estimation, to be unable to procure.

"I have used all makes of American, French and English tubes besides our various Canadian ones, and considering the dry-cell A Battery, our little peanut has them all beaten a mile. My aerial is two wires, 65 feet long and 20 feet high. We have in this city seven active stations, six of whom never heard of a sharply tuned transmitter, and having outputs at the present time which I believe are as strong or stronger than your best stations.

"That is one fault of Canadian broadcasting, and when it takes receivers of the super or neutrodyne class of excellent construction to get rid of locals, you can understand under what difficulties my



O. C. Wallace's contribution for the Reinartz fan who desires to add a stage of radio frequency amplification ahead of the present detector in the Reinartz circuit. L1 is an inductance of 10 turns wound on the lower end of an insulating tube 3 1-2 inches in diameter. This can be wound with No. 20 DCC. L2 is the secondary inductance consisting of 42 turns of the same sized wire. This winding is started about a quarter of an inch away from the primary. L3 is the primary (be sure it is thoroughly isolated from the other parts of the old Reinartz tuner) of your present tuner. It now becomes the primary of the radio frequency transformer. The condenser shown is a .0005 mfd variable, any good make. The dotted line shows the connection of one end of the old primary to the plate of the new r. f. unit; the other end of L3 going to the positive of the B battery. Wires can be run from -A and plus A to the usual binding posts on your set so a separate A and B battery will not be required. The stator of the variable condenser goes to the grid and the rotor to the filament line.

little single circuit is working. The list of stations I have received over 500 miles is as follows:

KDKA, KDYL, KDZB, KFAP, KFAW, KFBK, KFEC, KFEL, KFI, KFJM, KFKA, KFKB, KFKN, KGO, KHL, KJL, KKL, KLP, KSD, KUC, KWG, KWH, KYW, WAAW, WBAD, WBAP, WBZ, WCAE, WCAI, WCAP, WCB, WDAF, WFAF, WEBH, WFAA, WGN, WGR, WGY, WHA, WHAA, WHAS, WBB, WHO, WJY, WJZ, WLW, WMAI, WMAW, WOC, WOI, WOR, WOS, WRC, WSAI, WTAM, WTAS, CJLE, CKCD, CKY.

"I have a total of 104 stations in my log book, but some of them are last year's reception, and a great number under 500 miles.

"Besides these BCL stations, I have received amateurs in almost every district of U. S. and Canada; ships in the Atlantic, and off the coast of Asia. Altogether, I think that the single circuit is hard to beat where one does not get QRM from broadcasters, and does not cause it by unwise use of the tickler. Considering the situation of Canada with regard to the U. S. stations, I think we Canadians are doing very well. Would like to hear from some more Canucks through the pages of RADIO AGE. Canadian 4-IM signing off."

Some of our readers who belong to the dot and dash fraternity might be interested in a new record made by the Naval Radio Laboratory at Bellevue, D. C., in establishing two way communication with Australia on twenty meters on the night of April 20.

Around midnight, according to reports which have reached RADIO AGE, the operator on watch at Bellevue heard the Australian station calling England. He immediately broke in and called the Australian. The two stations then communicated with each other for more than thirty minutes. There was a particular absence of static and other forms of interference.

Bellevue Laboratory has been making some rather remarkable distance feats on short waves. Australia has been copied before at Bellevue, but the first time two way communication was established was on April 20.

The transmitter used at Bellevue employed less than two kilowatts, while the antenna was of the vertical cage type with a four wire counterpoise. It is of incidental interest that during the two way conversation it was morning in Australia while it was midnight at Bellevue.

While the above feat was accomplished by the use of 2,000 watts in the antenna, and American amateurs have communicated before with much less power, nevertheless, this fact does not detract from the importance of the achievement on behalf of the Navy.

Loop Record

E. H. Scott, of Chicago, but now at Tasman, Nelson, New Zealand, has written RADIO AGE telling of his reception of many American stations, nineteen in all, among which some of the Chicago stations figure prominently.

To make certain of his reception Mr. Scott wrote all the stations and asked them to send their verifications to the RADIO AGE, and to date quite a number have been received.

Chicago Stations heard by Mr. Scott were: WEBH, WGN, WQJ, WJJD, KYW. He also heard KGO, KNX, KFI, WFAA, WDAF, KPO, KOA, WCB, CFCN and KHJ.

World's "Record"

The Editor of The Dominion, a newspaper at Wellington, gives Mr. Scott credit for a world's record for reception on a loop. He is using an eight tube super. The time difference between Chicago and New Zealand is seventeen and a half hours, New Zealand being ahead of Chicago time.

The above seems to be a pretty good test for a super using a loop, since most of the distances are in excess of five thousand miles while the maximum runs up to 8,000 miles.

Standard Radio Receivers

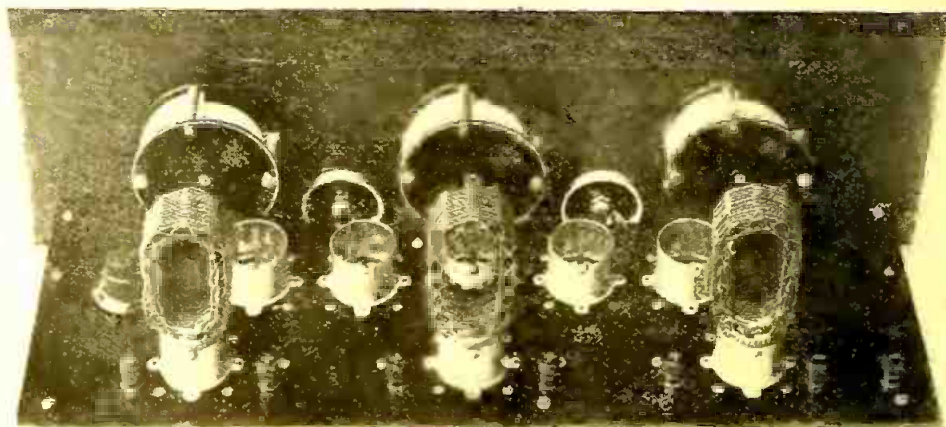
Recently RADIO AGE inaugurated a new department called "Know Before You Buy," to serve as a guide to the prospective radio purchaser in deciding on the receiver best suited to his individual needs. Fans throughout the country have shown an instantaneous response to this new feature, and accordingly it is continued and will be a feature of all forthcoming 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.

High or Low Waves, Here's a Receiver That Brings 'Em All In

IF AN extended use of lower wavelengths in broadcasting is to be, as many leading radio engineers believe, the answer to the problem of providing wavelength designations not only for the broadcasters already operating but also for broadcasters who have asked for licenses and are awaiting allocations, here is a set with which the fan may tune in on any of wave frequencies, from forty meters on up to 555 meters or more, by means of a very ingenious but simple adjustment of transformers.

One of the chief drawbacks to universal broadcasting on low wave-lengths is the fact that millions of sets now in use will not tune in carrier waves below 200 meters or above 600 meters.

Stations such as KDKA and WGY are taking advantage of the extraordinary qualities of extremely low wavelengths to transmit programs over tremendous distances in the daytime. These low waves are picked up by stations in other countries and rebroadcast. With the set described herein, it will not be necessary to hear these programs over the repeat stations but the original low wave transmitters may be tuned in and listened to with equal ease. In fact, this set has demonstrated that the extremely low wavelengths carry programs better in every respect than do the customary carrier waves, and an interesting and



rapidly growing field of low wavelength entertainment is opening up for and awaiting the audience that can tune it in.

The accompanying illustration reveals how the Washburn Interchangeable Five turns the trick and also how easily and quickly the set may be adapted to receive carrier waves from 40 meters on up. The receiver employs five tubes, utilizing a radio frequency circuit and is controlled by three dials. The transformers are of a rigid type, air core, low loss and built to stand rough usage. They are mounted on special bakelite adapters that will fit into standard tube sockets, so that they are interchanged exactly as standard base tubes are interchanged and with the same ease and quickness. The picture shows three sets of the

interchangeable transformer coils. When Set No. 1 is in position, waves from 224 to 555 meters may be tuned in. The intermediate set of transformer coils permits of tuning in carrier waves between 170 and 235 meters. The low set will tune in carrier waves from 40 to 160. It will be seen that the three sets have overlapping capacities. Special additional coils render possible the reception of wavelengths indefinitely upward.

The Washburn Interchangeable Five recently was subjected to a series of rigid tests by the Jefferson Electric Laboratories, Chicago, and as a result given the highest commendation.

The Washburn Interchangeable Five is manufactured by the Washburn Burner Corporation of Kokomo, Indiana.

The Freshman Masterpiece Unique Circuit

The Freshman "Masterpiece" is a five tube tuned radio frequency receiver, built of the finest low loss material and priced to fit the layman's purse, manufactured by Chas. Freshman Co., Inc., New York City.

The Freshman Masterpiece utilizes a circuit designed by A. W. Franklin, a well known radio and electrical engineer. This system totally eliminates oscillations by the use of scientifically designed radio frequency units in which low loss coils of special construction are employed.

The set is known throughout the world for its ability to receive those far-off stations. It is mounted in a genuine solid mahogany cabinet, and the price, without accessories, is \$60.00.

Thousands of communications from users of the Freshman Masterpiece testify to the Chas. Freshman Company's claim that these sets furnish

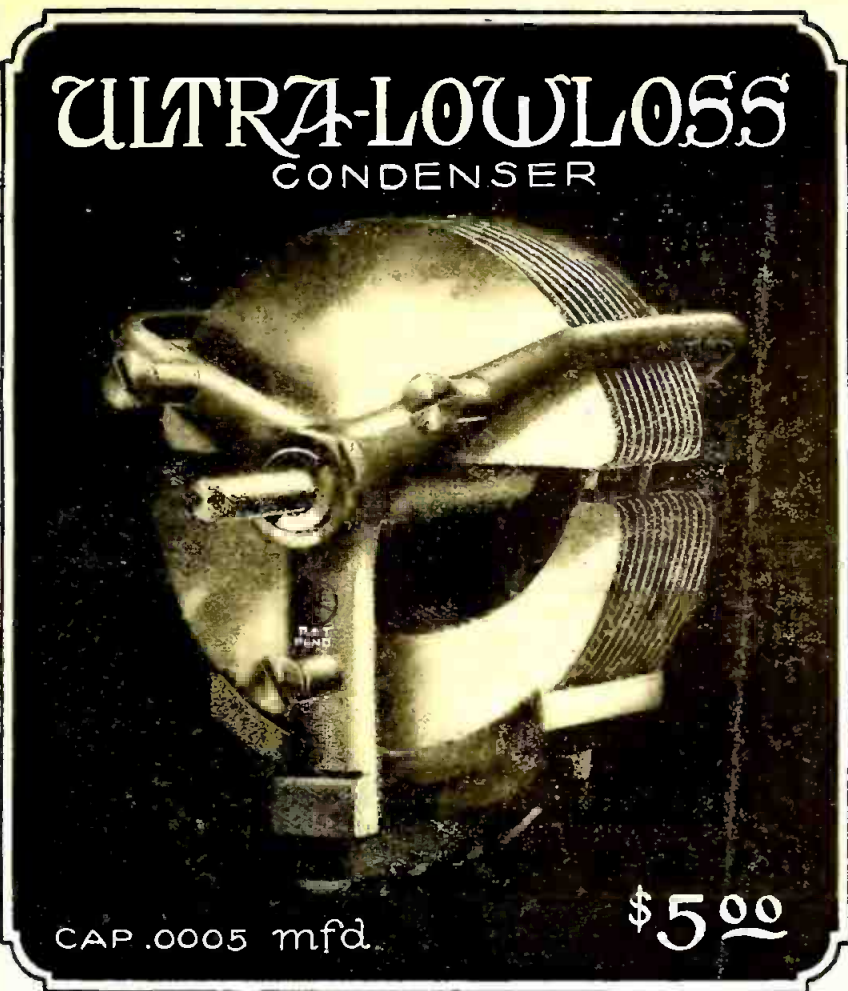
selectivity, volume, ease of operation and perfect tone qualities.

Many distance records have been achieved with the Freshman Masterpiece, bringing in distant broadcasting stations with local volume.

There are but three tuning controls, each of which is set at approximately the same dial reading; therefore, once a station is tuned in, one can rely upon getting the same station each time at the same dial setting.



The Grebe Synchronphase
and the
"Thermiodyne"
Described on page 61



CAP .0005 mfd.

\$5.00

As positive as Big Ben

SET Big Ben at seven and at seven o'clock you're bound to get the alarm.

Just so, the Ultra-Lowloss condenser can be set at any wave-length—the corresponding station will come in clear and sharp. You know instantly where to turn, once a station of known wavelength is located. Makes tuning easy—direct—positive. Special Cutlass Stator Plates spread wave-lengths evenly over a 100 degree scale dial so that each degree represents approximately 3½ meters.

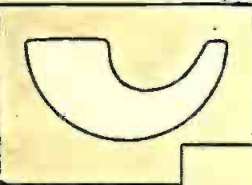
Ultra-Lowloss condensers are designed by R. E. Lacault, originator of the famous Ultradyné Receivers, and built upon scientific principles which overcome losses usually experienced in other condensers.

At your dealer's, otherwise send purchase price and you will be supplied postpaid.

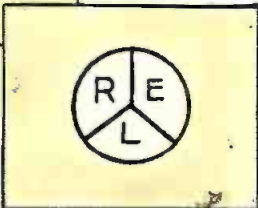
Design of lowloss coils furnished free with each condenser for amateur and broadcast wavelengths showing which will function most efficiently with the condenser.

To Manufacturers Who Wish to Improve Their Sets

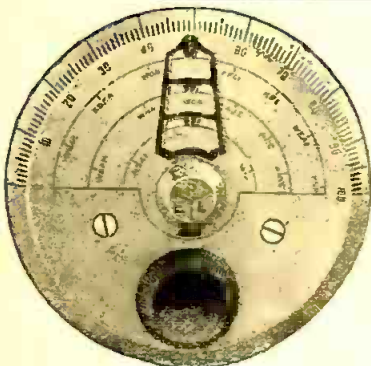
Mr. Lacault will gladly consult with any manufacturer regarding the application of this condenser to his circuit for obtaining best possible efficiency.



Cutlass Stator Plate exclusively an Ultra-Lowloss feature



A guarantee of satisfaction and Lacault design



ULTRA-VERNIER TUNING CONTROL

Simplifies radio tuning. Pencil-record a station on the dial—thereafter, simply turn the finder to your pencil mark to get that station instantly. Easy—quick to mount. Eliminates fumbling, guessing. Furnished clockwise or anti-clockwise in gold or silver finish. Gear ratio 20 to 1.

Silver \$2.50 Gold \$3.50

ULTRA-LOWLOSS CONDENSER

PHENIX RADIO CORPORATION, 116-B East 25th St. New York City

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RADIO AGE, Inc., will give a year's free subscription to this magazine to any reader who will obtain for us a news-dealer who will handle our magazine in a town or city where we are not already represented.

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Gentlemen: In order to get a free subscription to RADIO AGE, "The Magazine with Blueprints," for one year, I herewith send you the name of a dealer who will sell RADIO AGE in the city mentioned. It is understood that if you already have a dealer in this city that the offer of a free subscription does not hold good.

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Street Number.....

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

My name.....

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4-25

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Radio Discovers a New Civilization

(Continued from page 28)

large and small, dotted the tops of the 'mesas'. Archeological surveys indicate they were excavated by the original builders to a depth of three to five feet and were surrounded by sleeping chambers and granaries. The roofs originally were of the tepee style, willow or oak beams being fastened together by a wattling or weaving of pliable branches. The outer surface was then plastered with adobe, and over this thin slabs of rock were laid. Walls were of stone.

Habits of the Lost "Race"

ENTRANCE was through a steep decline or tunnel, sufficiently large to accommodate only one body at a time. Doors were large, close-fitting slabs of rock. Fires were built in the exact center of the large or main room according to mute evidences, and a circular opening at the apex of the sharply sloping roof permitted the escape of smoke and furnished ventilation."

One pithouse revealed a handsome bowl showing a design of four stars or equilateral crosses, a symbol still found among Pueblo and Navajo Indians and said to designate the evening star. This specimen was accompanied by a badly decomposed skeleton. Beneath the well-packed adobe floor of another prehistoric dwelling, excavators found a virtually perfect skeleton of a woman between 35 and 40 years of age and approximately five feet ten inches in height.

"She was buried in a most unusual position," Smith observed. "The right cheek was resting on the right hand and the left arm was placed across the breast. The knees were flexed. Beside the skeleton was an unusually elaborate gray bowl decorated with the designs of conventionalized butterflies. Close at hand we found a complete pottery face—that of a doll, which was supported originally on a body consisting of a corncob."

Excavators are agreed that the final stage of development of this prehistoric civilization was exemplified by an ancient "apartment" house—thirty-nine rooms of which already have been opened—and two monumental watch towers, now in ruins. These were found on top a precipitous table rock, overlooking a valley 1600 feet below, in the San Juan National forest in southern Colorado.

The next step is one of mystery, Smith points out. Was this prehistoric race overpowered and completely obliterated or was it ravaged by disease?

Smith's description to KOA's international audience was accompanied by incidental Indian music by native tribesmen, including Chief Evergreen Tree of the Cochiti tribe. The subject was presented in three sections as follows: "Legends of a Lost People—the Brown Man of Colorado," "Legends of a Vanishing People—the Red Man of Colorado" and "Legends of a Conquering People—the White Man of Colorado."

"Tube Characteristics and How to Understand Them", a continuation of the article on Making a Tube Tester, will be H. Frank Hopkins' contribution for the July RADIO AGE.

How to Make the Roberts Receiver

(Continued from page 20)

variable vernier condensers, one audio frequency transformer having a ratio of about 4 to 1, one standard socket, one UV-199 socket, one midget variable condenser, two .0025 M.F. fixed mica condensers, one .00025 M.F. fixed mica grid condenser, one 2 megohm grid leak, one bakelite panel 7x14x3-16 inches, one baseboard 6x13 1-2x1-2 inches, one 25 ohm rheostat, one 60 ohm rheostat, ten binding posts, one UV-201-A vacuum tube, one UV-199 vacuum tube, four dry cells, one 4 1-2 volt "C" battery, two 45 volt plate batteries, about 20 feet of No. 14 bus bar wire, a loud speaker and a pair of good phones.

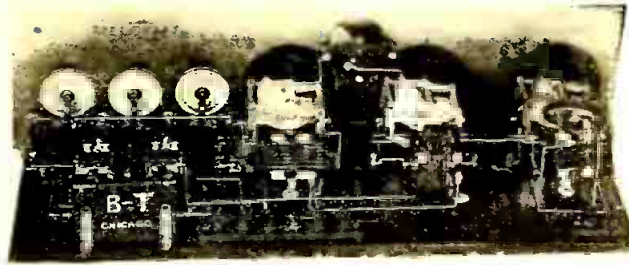
Wiring the Set

THE set is wired as follows: from the aerial binding post to the outside terminal of coil 1 and from one of the taps on coil 1, or the inside end, whichever gives the best results, to the ground binding post. From the outside terminal of coil 2 to the stationary plates on the first variable condenser and to the grid post on the first socket, which is to take the UV-201-A tube. The inside terminal of coil 2 is connected to the rotating plates of the first variable condenser. The positive of the "C" battery is connected to the filament. One terminal of the midget neutralizing condenser is also connected to the grid of the first tube and the other terminal of this condenser is connected to the inside terminal of coil 3. The outside terminal of this coil 3 is connected to the inside terminal of coil 4, to the remaining terminal of one of the .0025 M.F. condensers, and to one of the output terminals, which may be the top spring of a single circuit jack or a binding post as desired.

The outside terminal of the coil 5 is connected to the plate post on the first tube. The outside terminal of coil 5 is connected to the stationary plates of the second variable condenser and to one terminal of the grid leak and condenser, the other terminal of the grid leak and condenser being connected to the grid post on the second socket, which is the UV-199.

The inside terminal of coil 6 is connected to the plate post on the second socket and the outside terminal is connected to the remaining terminal of the second .0025 fixed condenser and to the post "B" on the audio frequency transformer. The other post on the transformer marked "P" is connected to the 45 volt tap on the plate battery. (This is at the junction between the two batteries.) The negative terminal of the plate battery is connected to the positive terminal of the filament batteries (the dry cells) and to the levers of both of the rheostats.

The other rheostat terminals are connected to the remaining filament posts on their respective sockets, as shown. The 90 volt positive post on the plate battery is connected to the other output terminal, which may be either the lower spring on a single circuit jack, or a binding post as desired.



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A Five Tube Set that Reduces Wiring Worries

(Continued from page 18)

socket. Replace them with two 3-4-in. 6-32 R. H. screws in the opposite direction, with the round heads resting directly on top of the contact springs. Put the thumb nuts on the screws under the base of the socket, and then put the protruding ends of the screws tight through the tube panel and fasten them with nuts on the underside. Put a 3-4-in. 6-32 R. H. screw through the mounting hole near the G terminal, into a nut between the socket base and the tube panel. Fasten with another nut under the tube panel. Slip the eyelet hole of the 0.00025 mfd. grid condenser through the G terminal screw, and fasten it with the thumb nut. Snap the gridleak in place on the condenser.

Remove all four terminal screws of the UV-199 socket, replacing them with 3-4-in. 6-32 R. H. screws, and fasten the socket to the tube panel in the same way as the other, remembering to put the necessary lugs under the nuts below the panel, and being careful to keep the socket turned in the position shown in the picture wiring diagram.

Take two 1/2-in. 6-32 R. H. screws and put a lug under the head of each. Put these through the two holes at 2 and 6 in the tube panel, put a lug on each, under the panel, and fasten with nuts.

3. Now proceed with the wiring of the tube panel. While doing this be sure to keep the panel perfectly flat so that no wires will sag when it is finally fastened to the front panel.

Connect 1, the right hand binding post of the amplifier unit, looking at the tube panel from the rear, to 2. Connect 3, one of the lugs under the + terminal of the standard socket, to 4, the F terminal of the UV-199 socket. Connect 5, the P terminal of this socket, to 6.

4. Mount the three rheostats on the front panel, in the order shown in the picture wiring diagram, using the screws provided. Put lugs on the terminal screws, bent as shown. Remove the two binding posts from the switch, and replace them with 6-32 nuts, putting a soldering lug under each nut. Mount the switch on the panel, being sure to place the Off-On sign against the panel and behind the mounting nut. The slot for the key must be in a horizontal position. Make sure that the soldering lug which rests on the small insulating washer does not touch the metal switch case for this will short the switch.

Mount the two jacks with the terminals arranged in the order shown and fasten the lugs under the terminal nuts.

Take four of the mounting legs and fasten the long parts to the four screws which hold the front and rear end plates of condenser C₂ to the lower spacing pillars. Remove these screws one at a time, put them through the upper holes of the mounting leg, and turn them back into the pillars again. Keep the short ends of the legs pointing toward the rear of the set. Fasten two mounting legs

to the left hand side of condenser C₁, looking at the set from the rear, in the same way. Take the three binding posts and slip the screws into the A₁, A₂, and GND eyelet terminals of the antenna coil, fastening them with the nuts on the inside. Put a lug on the inside at the A₁ post, under the nut.

To remove the dial from the variable condenser, first loosen the set screw which holds the knob to the shaft and remove the knob. Take out the three R. H. screws which fasten the large dial to the friction disc box, remove the four screws holding the box to the condenser mounting posts, and loosen the set screw on the collar which fits over the condenser shaft. You can now pull the box and collar off the shaft. You will find three washers on each condenser mounting post. Take off all but one from each post.

Remove the set screw from the collar, put the collar through the large hole in the front panel, and screw the set screw back again. Put the condenser behind the panel, and put in the screws which go through the friction disc box and thread into the mounting pillars, put back the three small screws holding the dial to the gear box and, finally, fasten the knob in place by tightening the set screw in it. Turn the condenser plates so that they are totally interleaved, loosen the set screw on the collar over the condenser shaft, set the dial so that the 100 division line coincides with the index line engraved on the panel, and tighten the set screw again. Screw the small knob on to the threaded end of the tickler shaft. Fasten a coil mounting pillar to the front panel at the right hand end with a 1-2-in. 6-32 F. H. screw. No put the three knobs on the rheostats, locking them to the contact arms by means of the thumb nuts at the rear. The index line on each knob should coincide with the off mark on the dial when the contact arm is all the way around to the left.

5. Connect the three terminals 7, 8, 9 of the rheostats together. This wire should run close to the front panel. Connect 8 to 10. Fasten the front panel to the tube panel by means of 1-2-in. 6-32 R. H. screws and nuts through the short ends of the mounting legs on the variable condensers. Put a lug under the front mounting screw nut on condenser C₁ and a lug under each nut of the rear mounting screws on C₂. Fasten the angle bracket at the amplifier end of the tube panel to the coil mounting pillar on the front panel with a 1/2-in. 6-32 R. H. screw. About 1/4-in. of this screw will have to be clipped off before inserting it.

Testing and Installation

THIS completes the wiring of the set. The antenna and ground connections are made directly to binding posts on the

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antenna coil. The battery connections are made to the binding posts on the A. F. amplifier unit. The two binding posts marked Input P and B should have these markings removed. The post formerly marked P now becomes the +90V terminal, and the one formerly marked B is now the DET+ terminal. These markings are shown correctly in the picture wiring diagram. The markings for the rest of the binding posts remain as they are.

Connect a 6-volt storage A battery to the A+ and A- binding posts. Insert the tubes and turn the key in the lock switch to the right. When the rheostats are turned up, the tubes should light. If everything seems all right, connect 90 volts of B battery across the B- and 90V+ binding post, and bring off a 45-volt tap to the DET+ binding post. Connect either the 135 or 150-volt tap to the +150V. binding post. Light the filaments and plug the phones or loud speaker first into the detector jack and then into the last stage jack. A strong click should be heard in both cases.

Connect the antenna and ground and set the tickler coil at right angles to the main winding. Revolve the left hand condenser slowly while the other is turned back and forth.

Co-op Radio Station Being Planned

A cooperative broadcasting station to be owned and operated in or near Chicago by local radio fans themselves may be on the air some time next Winter if plans proposed by Gustave Frankel, president of the Mohawk Electric Corporation, materialize. The idea has received the endorsement of scores of leading citizens, besides winning instant approval from many other quarters.

Such a station, it is believed, would be a forward step in the history of broadcasting. While there is at this time no imminent danger of anything like a decline in broadcasting the establishing of this station would aid immensely in solving any impending problem of that nature.

"We have been altogether too dependent upon others for our daily radio programs," said Mr. Frankel in discussing the project recently. "The air has been filled with so much entertainment that we have come to take it for granted, as if it had always been there. There is no gainsaying that while listening over the radio is no longer a fad, broadcasting still is. The people who are providing us with entertainment today are doing it at their own expense, some of them for the sake of the advertising derived, but most of them for more or less philanthropical reasons. In time some of these stations will go out of commission.

"Then, again, there are well-founded rumors that a certain powerful trust is seeking a monopoly of broadcasting with a view toward ultimately making listeners pay for their service. Cooperative stations, supported by the people by popular subscription, would guard against any such monopoly. Other advantages would be the privilege of arranging their own programs and selecting their own talent."

The expense of building and maintaining such a station, Mr. Frankel pointed out, could be easily defrayed if 25,000 persons contributed.

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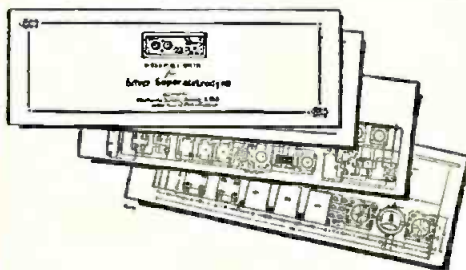


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Specified Parts For the Silver 4-Tube "Ideal" Receiver Described in This Month's Radio Age

The famous Silver Four-Tube "Ideal" Receiver will positively do on a seventy-foot aerial what any super will do on a loop. This receiver is the ultimate in four-tube design, being one of the latest developments of McMurdo Silver, Assoc., I. R. E., and designer of the Silver Super. Anyone can build it by simply following a few clear and accurate construction details. Complete parts for this receiver, as shown below, for **\$44.40**

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1 Howard 6 1-2 Ohm Rheostat	1.10	1 .002 Mica Condenser40
6 Insulated Top Bindings Posts	Each .05	1 .0075 Mica Condenser75
1 Carter 102A Jack	..... .80	1 2 Mgr. Grid Leak	..... .50
1 Carter 101 Jack	..... .70	1 7x2 1/2x3-16 Bakelite Panel, Drilled, Grained and Engraved	7.00
1 Silver Low Loss Coupler No. 105	..... 5.00	Bus-Bar, Spaghetti, Screws, Nuts, Solder, Lugs, Etc.	1.00
1 Silver Low Loss Antenna Coil No. 205	..... 2.50		
4 Hoosick Falls Panel Mounting Sockets	Each .60		
1 Thordarson 3 1-2:1 Audio Transformer 4.00		



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Reducing STATIC Disturbances This Summer

(Continued from page 10)

Tuned circuits, tuned to a given wavelength, are not set to oscillating by other wavelengths unless these waves are unusually strong. We all know that most receivers will oscillate at their tuned frequency when in the vicinity of a powerful broadcasting station, even when the station is operating on a widely different wavelength. The shock must be many times the ordinary signal strength to set up such conditions, and the atmospheric contact charges are heavy enough to do this very thing. In other words, we now have no means of separating the desired signal from the undesired static, since both disturbances oscillate the set at the same frequency. The tuning unit is ineffective in such a case and must be given outside aid. This may be compared to the case of a tuning fork which is free to vibrate at a fixed frequency, but which will also vibrate at this frequency when struck by a force of any other frequency.

Simple Static Reducers

It is an old saying that the elimination of static means a reduction of signal strength, and this is true of most static eliminators so far devised. However, the weakening of the signal is not of so much importance as the relative weakening of the static and the signal, or the "Signal Static ratio" as it is called. If a certain system weakens the static at a more rapid rate than it weakens the signal, then we will eventually reach a point where the static will disappear entirely with some of the signal still in evidence. It is only when the strength of the static greatly exceeds the signal that it becomes highly objectionable, and even when they are equal the practical effect is not bad.

One of the simplest eliminators of the "high loss" type is the crystal eliminator of Fig. 4. A crystal detector (CD) is connected across the aerial and ground posts (ANT) and (GND) of the receiver (R) and through the choke coil (S). The choke coil can be adjusted so that the high frequency radio waves are retarded, while the low frequency static goes to ground. It makes no difference how carefully this device may be adjusted for there will always be some loss of radio waves to ground and half the static waves or charges will always be thrown over into the set for half the static waves cannot pass through the detector (CD). However, this is frequently of service and is at least a partial solution of the problem. A low capacity condenser (C1) placed in the cross-aerial-line to the receiver, is adjusted so that the high frequency radio waves will pass into the set, but so that the capacity will not be great enough to pass the low frequency static waves. This may or may not be of assistance with lightning discharges, but is usually effective with local "contact static" met with in clear weather. As the crystal detector passes half the waves, it tends to give a signal static ratio of one to one.

Another stunt, but not so good as the first, is to place a high resistance (GL) or grid leak across the posts of the receiver (R) as shown in Fig. 5. This should be a variable resistance or leak which may vary from 50,000 ohms to one megohm according to conditions. It is strictly an emergency aid, for it allows a greater percentage of the signal to escape to ground than the crystal detector type.

Ground Chokes (Static Drains)

A simple and often very effective method is the "ground choke coil" method shown by Figs. 6-7. These are suitable only with inductively coupled receivers having a primary aerial circuit electrically separated from the secondary circuit. This includes sets equipped with loose-couplers, vario-couplers, or other two and three circuit tuning units.

In Fig. 6, a choke coil (I) is connected directly from the aerial to ground. This choke must have a sufficiently high inductive value to hold back the longest radio waves that we expect to receive. The long wave static will pass freely through the choke without the high frequency radio waves following. I have seen all sorts of values used, for (I), ranging from a 400 turn honeycomb coil to the secondary winding of an audio transformer. I have had the best results by connecting the primary coil of an audio transformer at (I), leaving the secondary coil open, but this may not suit every case as well as it does mine. In any event, the inductance must be very much higher than that employed for tuning in broadcasting wavelengths.

Fig. 7 is an alternative arrangement of the same choke coil (I) in which the choke is placed in series with the ground wire of the receiver. In some cases, and with certain types of receivers, this may work better than the arrangement in Fig. 6. It is easy to try, and therefore I will put the selection up to you.

Tuned Traps (Selectors)

VERY often the wave trap idea works out successfully, and has the further advantage that it can also be used to increase the selectivity of the receiver. In Fig. 8 we have a combination of a variable condenser (C1) and a honeycomb coil (L) connected across the aerial and ground posts of the receiver (R). This arrangement is adapted only to two or three circuit tuners with inductively coupled aerial circuits. It will short-circuit a single circuit receiver of the ultra-audion type.

By tuning the variable condenser (C1), the wavelength of the trap will be varied so that all the radio frequency signals are shunted into the receiver while the undesired waves of different wavelengths pass through to ground without entering the receiver. Under some conditions this is highly effective. It is difficult to prescribe any definite sizes for the condenser and coil owing to the great variation in conditions, but as a starter I would say that a 23 plate (0.0005 mf) variable condenser with a 50 turn coil

(L) would be about right. A vernier must be used, as the trap tunes very sharply and there is a certain hot spot on the dial which covers only one or two divisions.

Fig. 9 shows the same scheme adapted to single circuit tuners with the trap placed in series with the set. This also works well with certain two circuit tuners, and both methods should be tried out with two circuit tuners until the best results are obtained. The condenser and coil can be mounted in a separate cabinet, making a convenient unit for tuning your set.

Aerial Specifications

For the minimum reception of static, the aerial conditions must be carefully controlled, even when static drains are employed. For Summer reception a low aerial is the best, an aerial that is not more than 25 or 30 feet above the ground. This follows from the data in Fig. 1, which shows that atmospheric potentials increase rapidly for every increase in altitude. A single wire not more than 60 feet long is the best, and while this may reduce the signal strength slightly, it also decreases the static more rapidly, thus giving a better signal static ratio than a longer wire. The lower the natural period of the aerial system, the less likely it is to respond to low frequency static impulses.

Where possible, the aerial should have strong directional qualities so that it will embrace as small an area of static disturbance as possible. The fact that a loop aerial is very directional, picking up only the signals that lie in the plane of the loop, makes this type almost ideal for Summer use. Umbrella or "V" type aerials are to be avoided.

Inductive Type Reducers

A type of tuned absorption reducer is frequently very successful and is easily adjusted to local conditions. This is a modified form of the traps already described. In addition to reducing static, it also makes the circuit more selective. In Fig. 10 we have the common form of coupler having the aperiodic primary (P) and the secondary (S), the latter being tuned as usual by the variable condenser (C1). This is the common tuning unit employed on the majority of present day sets. An addition is made by winding the coil (T) on the end of the secondary in inductive relation to (S). A variable condenser (C2) across coil (T) makes very close tuning possible, and a very marked reduction in static generally follows. The coil (T) may contain from 40 to 60 turns of small wire, say No 30 or No. 32. This will save space and will make the unit more compact. The coil (T) is located about 1-2 inch from the end of (S). Condenser (C2) is usually about 0.0005 mf capacity. Still sharper tuning is possible by placing the coil near the primary instead of near the secondary. This is shown in Fig. 11, where the same size units are used. In fact, the sharper the tuning and the looser the coupling, the less static we will receive.

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developed by the Signal Corps of the United States Army. This is an artificial antenna in very compact form made by wrapping about 400 turns of wire around a long cylinder, and then capacitatively connecting the receiving circuit at critical points on the coil. Remarkable results are said to have been obtained with this arrangement without materially reducing the strength of the signals.

Fig. 12 shows the circuit where (L) is the coil and (P) is a sliding split ring, which closely embraces the coil but does not make actual electrical contact with the wire. In effect, (P) is the plate of a condenser connected to the antenna post (ANT) of the set (R) which picks up certain desired impulses in the coil and transmits them to the receiver. The ring (P) is split or made discontinuous so that eddy currents will not be formed in the metal. When working on long wavelengths, the coil (L) is about 38 inches long and is wound on a 2 3/4 inch diameter tube. This is a single layer winding and is therefore objectionably long.

For work on broadcasting wavelengths, the coil can be much condensed by using a single layer winding of No. 30 gauge wire on a tube 18 inches long and with a diameter of from three to four inches. A further reduction in size may be had by employing a double banked winding, the winding being divided up into sections one inch long. With a banked winding, the length is shortened to about 12 inches with the diameter remaining as before. The size of the wire is not of importance and it may be that even finer wire than No. 30 could be used with good results.

The sliding ring (P) by capacity collection picks up radio waves that correspond in wavelength to the inductive portion of the coil (L) included between the ring and the aerial connection; hence any desired wavelength can be picked up in this manner and transferred to the grid of the tube. By using two collector rings on a single coil, and located in different positions along the length, two different wavelengths or frequencies can be picked up, which immediately suggest that one ring can be used for grounding static discharges while the second ring can be used to transmit the desired radio signal to the receiving set.

Fig. 13 shows how two collector rings, (P) and (V) can be employed for the elimination of static. In this figure, the guard ring (V) is connected to earth through the trap (C2-L2) while the collector ring (P) carries the radio signal to the antenna post of the receiver (R). The ground from (V) can be a direct ground, or it can be arranged with the trap (C2-L2) as shown, for better control. Once adjusted, (V) remains constantly in one position on the coil, for the length is so chosen that it includes the band of static waves having a frequency of between 200 and 300 cycles per second. The length of (V) is from one-third to one-half the total length of the coil (L1).

Fig. 14 is a simplified version of the resonance coil that can be built by the home experimenter, the construction recalling the old time single-slide tuner

except that the slider does not make actual metal-to-metal contact with the wire coil. This is by far the best arrangement that can be used by the amateur, but it is somewhat cumbersome. The coil (L) consists of about 400 turns of No. 18 D. C. C. wire wound on a four-inch diameter tube. The square brass rod slider guide (S) is fastened to the tube so that free movement of (P) can be had from end to end of the coil.

It is essential that (P) be split to prevent the circulation of eddy currents, and this is effectively attained by making (P) in two pieces with a strip of insulation between them. In Fig. 15 is a cross-section through the assembly showing the two halves (P) attached to and separated by the hard insulation (I), the insulation (I) also acting with a sliding fit on the slider guide (S). The parts (P) can be made of sheet copper bent to an arc which closely fits over the wire. The arc of embrace is about one-third the total circumference or 120 degrees, although this is not an exact or critical dimension. Returning to Fig. 14, the width of the slider may be equal to from eight to ten turns of the coil.

Loose Coupling Methods

There is a distinct relation between loose coupling and static, or between selectivity and static. A very loose coupling between the primary and secondary coils of your tuning unit will be of great assistance in getting rid of the noises. If you have a single circuit tuner or a very closely coupled two circuit tuner, then it will be difficult to get rid of the trouble without outside assistance. Unipolar tuners or Marconi "link" couplers are of great assistance in ridding your circuit of static and at the same time increasing their selectivity. Selectivity of this sort reduces the signal strength somewhat, but as it can reduce the static at a still greater rate, the ratio of signal strength to static is greatly improved.

A "unipolar tuner" is one in which there is only a single connection (g) running from the tuning inductance to the grid of the tube, as in Fig. 16. There is no grid return wire. The coil (L) is tuned by the variable condenser (C1) as usual. This is an exceedingly sharp tuner, and one in which static capacity effects can be reduced to minimum. The values of (C1) and (L) are as usual with this tuner.

A type of tuner once used by the Marconi Company is shown in Fig. 17, which also provides for extreme selectivity. The primary inductance (L1) is tuned by the variable condenser (C1), and instead of being directly coupled by induction to the secondary coil (L2), the connection is made by the "link" of wire (M). The connection (M) consists of two or three turns of lamp cord about each of the coils (L1) and (L2), and then the two coils (L1-L2) are placed about one foot apart or at right angles to one another so that there can be no direct inductive coupling between the primary and secondary circuits. As a heavy current flows in (M), it must be of very heavy low-resistance wire or preferably of heavy lamp cord. The secondary (L2) is tuned by the second variable condenser in the usual manner. (To page 55)

PATENTS

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Figs. 16-17 show only the "front ends" of the receiving circuits for simplicity in describing the methods. The rest of the circuit can be of any imaginable type; regenerative, radio frequency or reflex. In the unipolar type, you should note that the grid leak (GL) runs from the grid directly to the (-A) of the battery and is not in parallel with the grid condenser. This is made necessary for the reason that there is no grid return line in this circuit, and if the parallel connection were used, the circuit through the grid leak would not be completed.

Modulated Primary Type

BASED on the theory that any tuned circuit will oscillate at a given frequency determined by the tuning when excited by the impact of any strong wave of any frequency, a very original eliminator has been devised by Dr. McCaa. This is a rather complicated circuit, both in construction and theory, and rather suggests a combination of the super-heterodyne and the super-regenerative principles in oscillating the circuit and in opening and electrically closing the circuit for the admission of signals only. An external oscillator circuit and tube is supplied for the excitation of the receiving circuit, which is tuned to the wavelength of the incoming signal or to a harmonic of the signal. Static is not entirely eliminated but it is reduced in strength until it is equal to the signal strength. This is a greater advance than would be considered at first glance.

A schematic diagram is shown in Fig. 18 where (P) and (S) are the primary and secondary coils respectively of the usual tuning unit. The secondary (S) of the receiver is tuned to wavelength by the variable condenser (C2) as in the majority of receiving circuits. An oscillating circuit of the super-heterodyne type is inductively coupled to the secondary coil (S) of the receiving circuit by the coupling coil (L2) of the intermediate circuit (L1-L2). By varying the condenser dial (C1) of the oscillator, the impressed oscillations on (S) can be controlled to meet the requirements of the incoming signal just as with the oscillator circuit of a super-heterodyne. When the oscillator creates a wave that exactly opposes the signal wave entering the aerial, the intermediate circuit (L1-L2) is neutralized, and (S) is excited by the signal together with a little of the static. The signal is received, and all of the static whose voltage does not exceed the voltage of the signal. In other words, the worst that can happen is to have a static "bump" that is equal to the signal strength. The static can never exceed the signal, and generally is somewhat less.

Cascade Balanced System

Getting rid of the static by means of successive elimination has been proposed many times with varying results. In other words, the output of the aerial is led through a succession of inductances until all of the undesired waves are grounded and only the desired signals reach the tube. In general, this is exactly the reason for the selectivity of the common five tube tuned radio frequency receiver, for three stages of tuning



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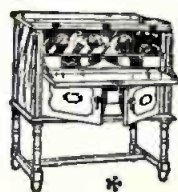
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HOW MUCH COUPLING?

Coupling is a subject that interests every experimenter desiring to improve the operation of his set. How about your coupling troubles? Brainard Foote takes them up one by one and solves them in an enlightening article he has written for the July RADIO AGE, on the stands June 15.

eliminate what can not be accomplished by one stage alone.

Fig. 19 shows a typical example of this sort of arrangement employing three inductance coils (L1), (L2) and (L3) connected in cascade with the receiver tube (T). The lower ends of the coils are all grounded at (b1-b2-b3) for the elimination of the static. The other ends of the coils (a1-a2-a3) lead indirectly to the grid of the tube through a series of intermediate taps (m1-m2-m3). By varying the position of the taps (m1-m2-m3) we have a means of separating low frequencies from high frequencies or a total of three different wavelengths.

For example, if (m1) is nearer to (a1) than to (b1), then the inductance of the upper end of the coil will be less than the lower, and the high frequency current will pass out through (a1) to (m2) of the succeeding coil, while the low wavelengths will be grounded at (b1-b2), and so on through the series.

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The Joys of Outdoor Radio

(Continued from page 12)

it if I came back that way; otherwise they could keep it until my next trip, which might be a year or more later.

But I did not charge it to profit and loss. In the car they placed a "snack" before I started on. There was a leg of 'possum, a wild strawberry shortcake, and enough wild honey to sweeten life for weeks. Also a quart of a liquid, colorless product of the corn fields which was of no use to me but which would have brought a good price on the New York stock exchange. Beside me for a distance rode a pale-eyed, long-whiskered guide who showed me where well-stocked trout pools lay, where deer and b'ar abounded, where roads were only bad and where they were worse.

By some underground system my identity was so quickly and so thoroughly established that wherever I went in those mountains in the days that followed I was received with friendly nods and abundant hospitality instead of with the suspicion with which city fellers are likely to be watched.

IF YOU DON'T See what you need in RADIO AGE'S Advertising Columns, write to the Radio Age Buyers' Service, 500 N. Dearborn St., Chicago, and all buying specifications will be furnished you free of charge.

Maybe an Opportunity awaits You in the Radio Age Classified Section See page 70

An Ideal Four-Tube Set in Practical Form

(Continued from page 22)

section of the condenser turned down, as in Figure 2. This will provide a firm mounting for the antenna coil on the back of the condenser.

All screws and nuts on condensers, transformers, sockets, etc. should be tightened up, and jacks and sockets carefully checked for proper contact and spring tension. Jack springs should make good contact with the phone plug, and socket springs should be bent up to make good contact with the tube-base pins. Soldering lugs should be put on the tube sockets, the filament lugs pointing toward the panel except in the case of audio frequency sockets. The two lugs, one on either of these sockets that will be adjacent when the sockets are on the panel, should be turned toward each other so that the wires to them can be put in without touching the rheostat.

Binding posts should be put on the panel, with lugs pointing straight in under the screw heads of each post. The binding posts now being on the panel, the four sockets, rheostats, jacks, on-off switch and audio transformers should be fastened on with screws and nuts.

Precautions Before Wiring

BEFORE starting the wiring, a well-tinned soldering iron should be heated, or an electric one used, and a quantity of rosin-core solder and a can of non-corrosive soldering paste procured.

The wiring should be done according to the pictorial diagram, placing the additional parts in position on the panel as it progresses to facilitate easy placing of the various wires. If the diagram and Figure 2 are studied, no difficulty should be encountered. Upon completion the set is ready for test, and the following accessories will be needed:

- 1 90 Volt B-battery (4 22½ volt or 2-45 volt batteries).
- 1 6 Volt storage battery, if storage battery tubes are used, or three dry cells, if UV 199 tubes are used.
- 1 4½ volt C-battery.
- 4 tubes (UV 201-A for storage battery recommended) or UV 199 with adapters if dry cell. (The use of 199 sockets was not considered as there are no satisfactory panel-mounting 199 sockets, and adapters with standard sockets make a satisfactory electrical arrangement, and an excellent mechanical one).
- 1 Pair of phones with phone plug, or loud speaker with plug, or preferably both (any standard make).

A suitable antenna would consist of a 70 to 100 foot single wire run between two trees or two buildings. The lead-in wire should not be over fifty feet long.

The set should now be connected to the antenna and ground and to the A-battery, but not the B or C batteries. The tubes, upon insertion in their sockets, should light up if the on-off switch is pulled out and the rheostat turned on. If they do, disconnect the A +battery lead and connect it first to the B22 and then to the B 90 binding post. If the tubes then light, the wiring is incorrect and should be checked. Assuming they do not, the A battery should be reconnected properly, and the B and C batteries connected. The C+post connects to the flexible lead soldered to the on-off switch, and the C - post connects to the

flexible lead attached to the F terminals of the audio transformers. The B batteries should be connected in series so that 22 volts will come between the AB - and the 22 + posts, and 67 volts between the 22 + and 90 + posts, or 90 volts between the AB - and the 90 + posts.

Operation

The tickler dial should be turned to zero and the tubes lighted up by turning the rheostat about three-quarters on for UV 201-A tubes or one-quarter on for UV 199 tubes, and once set it need not be varied, but should always be operated as low as is consistent with good signal strength. The first two condenser dials should be rotated, holding about the same settings over their entire scales, with the phones in the three-contact, or first stage jack. These two condenser dials will operate as the first two dials on a neutrodyne, keeping about the same relative separation in degrees over the entire wavelength range of the receiver. If there is any tendency for the RF amplifier to oscillate, it will be evidenced by clicking in the phones at certain dial settings on the lower, and possibly on the higher waves. If stations are heard as a whistle, it means the amplifier is oscillating and must be neutralized. The tickler has been left set at zero.

A station should now be tuned in on the lower waves, or with little of either condenser in use. When the clicking or squealing is noticed, the neutralizing condenser should be adjusted in small steps until this clicking or whistling disappears. The set is then neutralized. This method is both simple and effective, although there are others that might be employed.

The set now operating, the tickler coil should be turned toward 100 on its dial until a plunk is heard, and stations come in again as a whistle. This is entirely correct, as the whistle can be cut out by reducing the tickler coupling. If the "plunk" cannot be heard, even using 45 volts on the detector instead of 22, the two top lugs on the vario coupler should be reversed.

In tuning the set, either of two methods may be used. The first one is to tune in a station with the two condensers, leaving the tickler at zero, and then strengthening the signal, with the tickler when heard. The second and preferable one is to turn the tickler up until stations come in as a squeal, rotate the detector condenser until a squeal is heard, then vary the first condenser for maximum intensity, following this by turning the tickler back until the squeal disappears and the station modulation is heard. In either case final adjustments will have to be made on all dials when receiving weak signals.

If the receiver is broad in tuning, a small fixed condenser connected in series with the antenna lead-in will remedy matters. It should be either .0001, .00025 or .0005, mfd capacity arranged

so that it can be short-circuited by a single-pole, single-throw knife switch when desired.

If an indoor antenna is to be used, it may be put up in an attic, and should consist of several wires run parallel to each other and connected together at both ends, or it may be as long a wire as is convenient run around a picture moulding. Some difficulty may be experienced in neutralizing the set on such indoor antennas, however.

[Further specifications and diagrams concerning this receiver may be had by sending 25 cents in stamps to McMurdo Silver, care this magazine.]

WJJD Tries Some Intentional Fading

What movie fan doesn't know what a "fade-out" is? And now comes the radio fade-out.

When Jack Nelson was at old WDAP, he established the custom of singing his song, "May You Laugh in Your Dreams," as the finale to late programs, after all signing off announcements had been made. He does the same now on the late programs of WJJD, the Loyal Order of Moose station at Mooseheart, Illinois, where he is Director and Announcer, but Ralph Shugart, the Engineer has added the new twist which is receiving many comments.

When Mr. Nelson is half way through the song, it begins to decrease in volume until the last notes of his singing and playing fade away into silence. The effect is such that the listeners feel they are drifting into space. One listener said that the only way he could describe it was to say, "It makes me feel just as though I were dropping off to sleep in a clover field in the middle of a drowsy summer afternoon. Boy, he certainly gives me the spring fever!"

WBBM Inaugurates Sunday Jazz

A Tea Dance Program featuring the Dixie Boys' Orchestra, interspersed with popular numbers was heard from WBBM Sunday, April 19, from four to six p. m. It has been announced that this was the beginning of a regular Sunday afternoon Jazz Frolic from WBBM to be broadcast from their studio in the Broadmoor Hotel, Chicago.

The popularity of this hour was shown by the immense volume of 'phone calls which were received during the program. Six trunk lines were kept busy during the entire program, and many calls undoubtedly were missed. The next day's mail was strong in its praise of this popular program, and it would seem that the idea has made a big hit with the Sunday radio listeners. Out of all the comments received, only one criticism was noted, showing beyond much doubt that the Sunday afternoon listeners approved of the idea of a popular program.

WBBM announces that hereafter this will be a regular feature of their Sunday afternoon program, running from four to six p. m. The Dixie Boys Orchestra will be a feature regularly on this program as well as popular artists of the lighter music.

Creative Lighting Effects Feature New WJAZ Studio

DISTINCTIVE developments in lighting effects will play an important and unusual part in WJAZ studio broadcasting from their new location in the Straus Building, Chicago.

In 1923-4, the Zenith Radio Corporation owned and operated Station WJAZ at the Edgewater Beach Hotel, Chicago. This station was known to the entire radio world and when Zenith sold this station, hundreds of thousands of letters were received appealing to WJAZ to come back on the air. Although the station was sold, the call letters were retained and the radio listening public will soon hear the familiar WJAZ going out over the radio waves. These old listeners and a host of new friends will again be able to hear the high class, pleasing programs previously associated with Zenith WJAZ broadcasting.

The new studio will mark an epoch in the construction of radio broadcasting apparatus. The entire 23rd floor in the beautiful new Straus Building will be utilized by the studio, reception room, and executive offices of the Zenith Corporation. The studio architectural furnishings will be in Spanish style with Louis XVI period furniture. Oriental rugs, heavy drapes and rich tapestries will further enhance the effect. Acoustician experts have arranged interiors so that the delicate pitch of the violin and the deep resonant tones of the bass viol will all be harmoniously perfect in their transmission.

Dr. M. Luckiesh, Director of the Lighting Research Laboratory, has been secured to plan and direct the indirect illumination for this studio. Dr. Luckiesh is the author of books which are generally accepted as authoritative works on lighting.

Lights—soft gradations of light and bold, illuminative effects, will make the atmosphere of this studio fit in with the mood of the selection being given by the artist. It has long been a problem in radio to secure the proper settings for artistic broadcasting. Many times renditions of music from broadcasting stations have been below standard. The operatic stars on the stage are surrounded by appropriate settings which help create in them the spirit of the character being portrayed, while on the other hand, in a bare room, an invisible audience handicaps these same artists in giving strength and realism to their selections. Although the stage settings will not be available, this new thought in lighting will take the place of painted scenery and effect a perfect rendition.

Artists broadcasting from this new studio will not experience that strangeness associated with the knowledge that they are entertaining vast audiences, to them invisible. An entirely novel and new microphonic speaker will be part of the modern equipment installed. This speaker will be so designed that by the use of motion picture photography—an audience is thrown on the screen of the micro-speakaphone and is constantly before the artist performing. Grand Opera stars have enthused over the arrangement and have voiced their whole-hearted approval.

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Pick This Out On Your Piccolo!

*Even tho' your set is growling
'Til you think a cat is howling
And the music comes in waiting, hissing sniffs,
You will giggle, grin and chuckle
'Till you hafta loose the buckle
On your belt, if you've the latest book of ZIFFS*

You wouldn't go fishing without bait, would you? Well, then, don't try to get Hong Kong on a stormy night with a crystal set, till you've put your John Henry on the tag below:

ZIFF'S BUZZARDS ROOST
Maywood, Ill.

Dear Badzib:
I got a radio. I got Hawaii. I got drowned out. I got peeved.
I don't see nothin' to laugh at, you big bum!
Here's two bits. Send me the May ZIFFS, and I will!

They Call Me.....

And I live at.....

Some Progress Toward Non-Oscillating Circuits

By JOHN B. RATHBUN and P. D. LOWELL

KNOWING that RADIO AGE readers, especially at this time, when sets are being rebuilt for the Winter radio session, are deeply interested in any advances in the construction of tuning units whereby stabilized radio frequency amplification may become an established fact, we are printing two articles in this issue which should shed a great deal of light on the subject.

The first is written by John B. Rathbun, well known to our readers as the conductor of the blueprint diagrams section, a department enjoying well merited popularity. His article is on tests made with a toroid, so constructed that its field is self-contained.

The other article, more from the manufacturing standpoint, is written by P. D. Lowell, research engineer with A. H. Grebe and Co., Inc.

Both of these writers have treated the subject in a concise and illuminating manner, so much that we feel our readers will have no trouble in following and absorbing the data given.

Balloon Tires for the Radio Set

By John B. Rathbun

FOR more than a year radio manufacturers have been concentrating their attention on the development of tuning inductances and radio frequency transformers, appreciating the fact that the efficiency and selectivity of a circuit is no greater than the efficiency of the inductance employed. As a result, almost numberless "low-loss" coils have been placed on the market within the last few months which possess many points of merit, but which are very similar in general design and which from the standpoint of the magnetic circuit are really nothing but refined editions of the old solenoid type coil.

Dielectric losses have been reduced to a minimum, distributed capacity has made its farewell bow to the radio public, but little attention was paid to the stray magnetic fields set up by the coils which still cause trouble through back-coupling and other inductive disturbances.

Open magnetic circuit inductances of the conventional

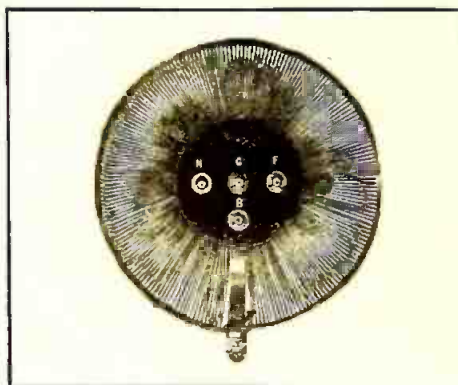


Fig. 1

The above is the type of fieldless inductance described in this article by Mr. Rathbun.

type, no matter what their construction may be, are by their very nature quite susceptible to stray magnetic fields from nearby broadcasting stations or from other parts of the circuit, and therefore suffer from a variety of undesirable interferences and couplings which reduce the selectivity and result in disagreeable noises. With powerful local broadcasting stations, such coils act as miniature loop aerials, picking up signals within the receiving set and making selectivity

impossible. Further, the solenoid type air core transformer shoots out a magnetic field for several feet around the set which may produce excessive regeneration in one or more of the radio frequency stages, with the accompanying howling and shrieking that has been experienced by all radio experimenters.

All this has been done away with by the new ring-like inductances which are variously known as Balloon Circloids, Toroidal coils, or the Terus, the latter being the geometrical term for a ring having a circular cross-section. Electrically, there is nothing new about this form of magnetic circuit, but it is decidedly novel in its application to radio circuits as a means of eliminating inductive interferences. Consider a long hollow coil of wire wrapped around a circular core, with its two ends meeting, and you have the Balloon Circloid or Toroid which forms the subject of this article. With the two ends of the coil meeting, it is evident that we can have no poles, and having no external poles, it cannot produce nor be affected by an external magnetic field.

Fig. 1 is a photographic view of a new zero field coil, and is one of several now being produced for the market. The ring-like coil is bent around the center core, which acts both as a support for the coil and the connection posts while

around the outer periphery is a narrow band of insulating material which stiffens and protects the coils against mechanical injury. This is a two-circuit transformer or tuning unit with a primary and secondary winding as in any coil used for coupling, and can be used in any radio frequency or reflex circuit as a transformer and tuning unit. As all of the magnetic field is within the coil, there is no dielectric loss due to the supports, and it is therefore a low-loss coil in every sense of the word.

So far as the coil itself is concerned, it is absolutely neutral to radio waves or magnetic fields, no matter in which direction they may strike the windings, and the coil can therefore be crowded close to other inductances without coupling to (Turn to page 60)

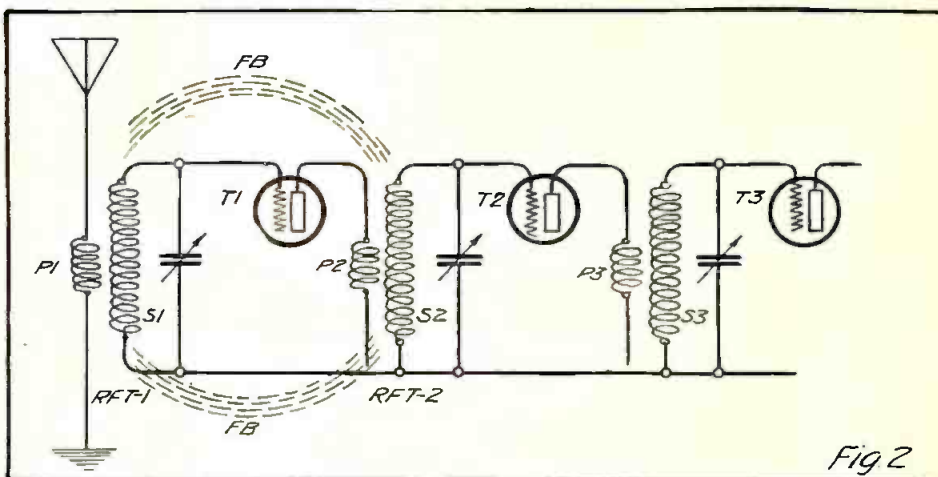


Fig. 2

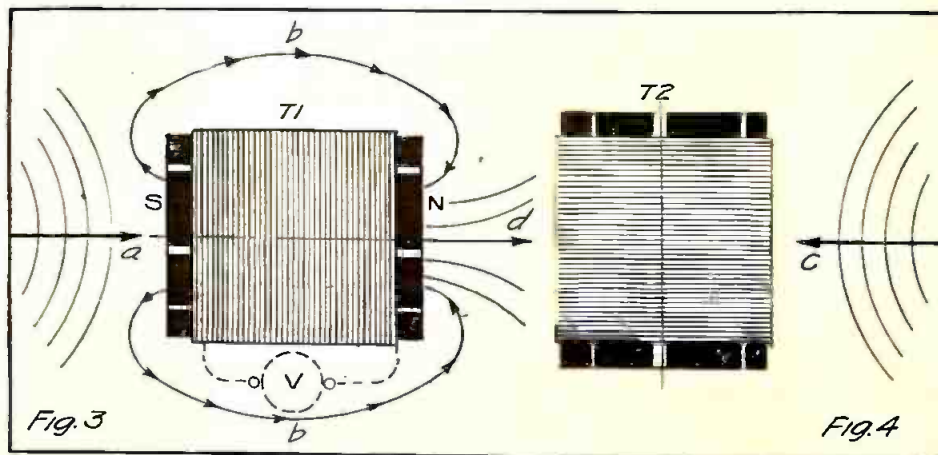


Fig. 3

Fig. 4

2nd Radio World's Fair to Excel 1924 Show

New York City—Practically all of the exhibiting space in the Second Radio World's Fair to be held here in the 258th Field Artillery Armory, September 14 to 19, is now under reservation and even at this early date the success of the gigantic enterprise is assured. All signs indicate that it will be the greatest trade show of any sort ever held in America.

Not only will there be an overflow of exhibits by the leading manufacturers of all countries, but a record breaking attendance is already a certainty in spite of the fact that the opening date is still five months away. Tremendous interest is being manifested by radio manufacturers, dealers, inventors and enthusiasts both here and abroad, and the patronage is sure to exceed that of the First Radio World's Fair of last September in Madison Square Garden and the 69th Regiment Armory.

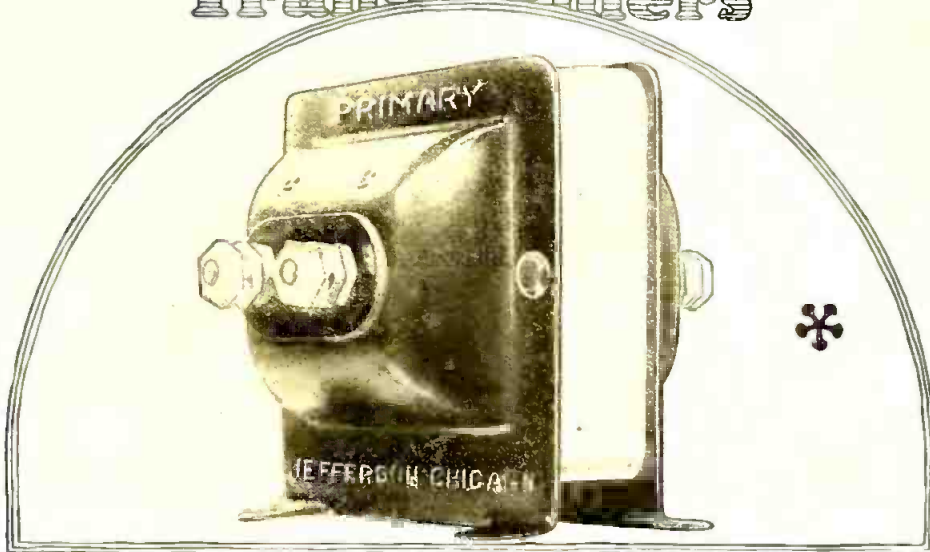
The Echophone Portable Receiver

An ideal portable receiver which combines high efficiency with light weight and attractive appearance. Takes up no more room than an ordinary travelling bag, weighing only 28 lbs. fully equipped sixe 9" x 12 1/2" x 18".

One of the distinctive features of the set is the standard 60 foot aerial which winds on a reel built into the case. A few turns of the wrist and it is ready for use. For carrying purposes the aerial quickly winds back into place and out of sight. This unique and complete aerial eliminates entirely the usual loss of volume and efficiency.

Finished in Du Pont Leather, the Echophone Portable is in keeping with the finest living room appointments, yet it has ample strength for severe vacation service. Available with "3" tube receiving unit of exceptional power. Range of 1,800 to 2,000 miles. Simple to operate—only two dials to tune.

Jefferson Transformers



-the choice of experts

THE fact that Jefferson Transformers are preferred for experimental work by many radio experts and authorities is a clear indication of Jefferson supremacy.

Proper amplification—perfect reproduction—clear, undistorted reception; that's the why and wherefore! To radio authorities the country over Jefferson means the utmost in transformer performance.

Jefferson Transformers are the result of twenty years experience in the manufacture of transformers. To maintain a uniform quality every Jefferson Transformer is subjected to a series of exacting electrical and mechanical tests which must be successfully passed before leaving our hands.

Jefferson Transformers meet matched construction specifications.

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Jump Spark—Make and Break Coils
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INTERCHANGEABLE COILS

Each kit contains three matched low loss interchangeable coils; complete diagram and wiring instructions for building five tube tuned Radio frequency set. Interchangeable coils are mounted in Bakelite bases designed for use in standard tube sockets. Kit No. 1—40 to 180 meters, \$7.00; Kit No. 2—100 to 300 meters, \$8.00; Kit No. 3—224 to 555 meters, \$9.00.

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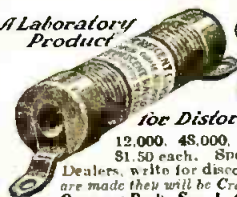
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High Powered Broadcasters Satisfactory

WASHINGTON.—There are today thirty stations broadcasting with power in excess of 500 watts, and complaints filed with the Department of Commerce are very few. On the whole, the increased power seems satisfactory and probably before the Summer is over more higher-powered stations will be operating.

When the question of increased broadcasting power was raised during the national radio conference, some of the smaller station owners and many fans expressed the fear that hundreds of stations would be blanketed or that receivers would only be able to pick up the high-powered stations. This has not proven to be the case. On the contrary, broadcasting seems to have improved, in that more distant stations are available to listeners, some even tune sharper than before the increase in power; interference from static has been decreased, fading is less pronounced, and daylight reception is better. Even the fans situated near the higher-powered stations have not complained, nor have the regular A and B stations objected.

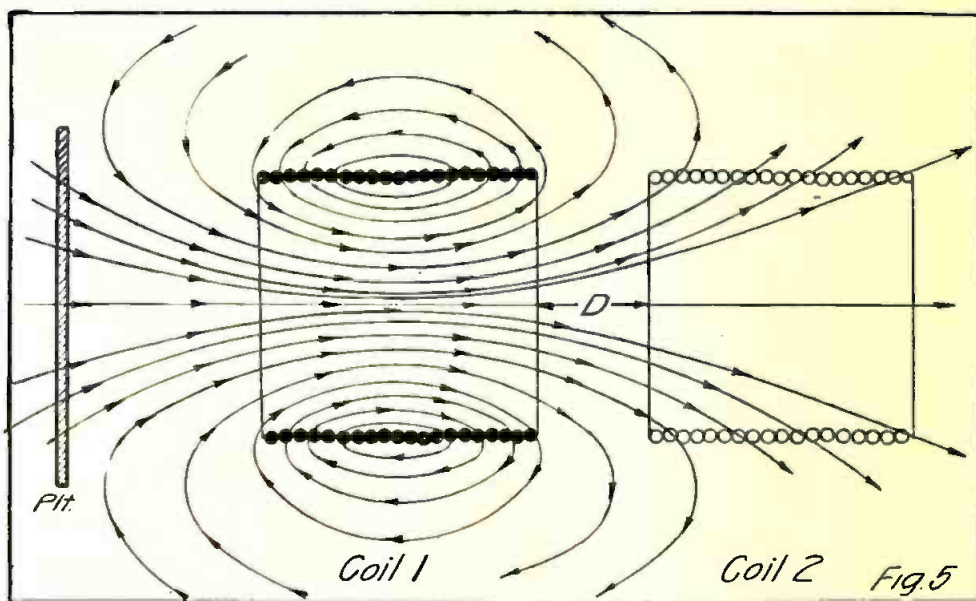
An examination of the list of thirteen stations using over 1000 watts, which is the ordinary limit set for Class B stations, shows that four are using 2000 watts, and nine, 1500 watts. Most of the fans know the calls of those stations by heart, which indicates that they come in well almost anywhere in the country on good receiving sets. The four 2KW stations are: WEAJ, American Tel. & Tel. Co., New York; WLW, Crosley, Harrison, Ohio; KGO, General Electric Co., Oakland, Calif.; and KFJ, Earle C. Anthony, Los Angeles, Calif. Those using 1500 Watts, or 1½ KWS are: KYW, Chicago; WBZ, Springfield; KFXX, Hastings; WGY, Schenectady; WTAM, Cleveland; WOC, Davenport; WCCO, Anoko, Minn.; WCBD, Zion; and KOA, Denver.

They are all pretty well distributed. They are owned by private organizations except that three are General Electric Co., stations, and three are owned by the Westinghouse Electric Manufacturing Co. The Bell System operates one, the others being owned by radio manufacturers, and other organizations. It does not seem to indicate a radio monopoly. The Radio Corporation is not represented directly, although two large electric manufacturing companies control six stations together. There is, of course, another high-power station, but it operates under a rather unique license: it is the broadcasting development station KDKA at Pittsburgh. This station, owned by the Westinghouse Co., is licensed to use varying power up to 10KW but ordinarily it is understood to operate with about 5KW, except when conducting special tests, usually when other stations are silent. It is never complained of.

None of these stations is really a super-power station, which was decried as impractical and undesirable when mentioned at the last radio conference. Before many months, however, it is expected that the Radio Corporation will open a very high powered station somewhere outside New York for national broadcasting. Originally it was intended that it was to be a 50KW station, but the Department has never officially stated this power would be authorized.

Balloon Tires for Your Radio

(Continued from page 58)



them. It is responsive only to currents which are electrically connected to the windings through the binding posts.

Interstage Feed-back

IN ANY radio frequency or reflex circuit using inductances and transformers of the conventional type, there is always some exchange of energy between the various radio stages, due to magnetic coupling, and if this magnetic coupling is tight enough, we will produce audio frequency oscillations and counter oscillations which will interfere with reception. Feed-back through the grid to plate capacity may be easily suppressed by neutralizing condensers, reversed feed-back or other devices, but it is not such an easy matter to dispose of magnetic coupling.

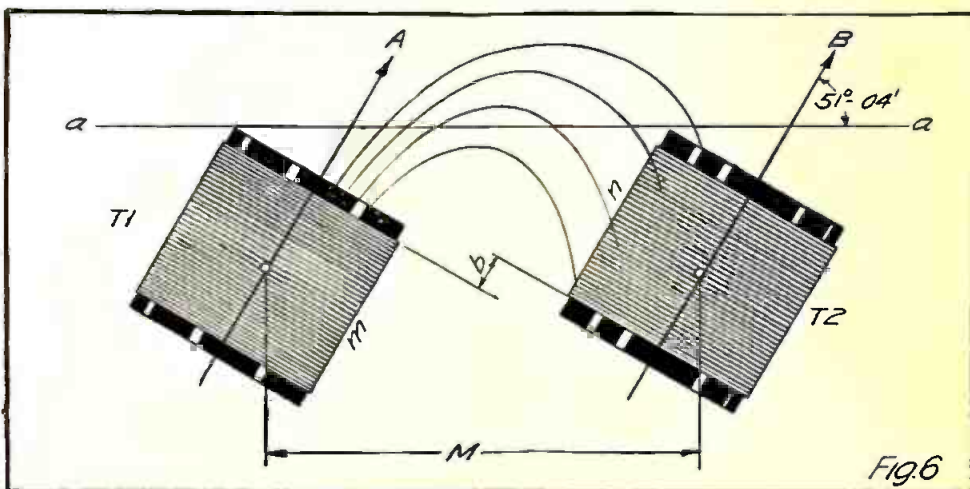
Even with the elaborate precautions taken in the neutrodyne circuits, magnetic coupling between stages is not altogether avoided by placing the transformers at critical angles or by neutralizing the grids. The trouble will always exist to some extent as long as there is an external field, and further, the coils used in such circuits are always free to pick up disturbances, no matter how they may be arranged. Up to the present time all effort has been put toward suppressing excessive regeneration after it was finally

started, but with the circloid the trouble is eliminated by coils which do not permit of inductive disturbances in the first place.

Fig. 2 is a diagrammatic circuit of a radio frequency set where (P1) and (S1) are the primary and secondary of the tuning unit (RFT-1), and (P2) and (S2) are the primary and secondary coils of the first radio frequency transformer (RFT-2). The third stage equipment does not concern us at present. When the set is in operation, the first R. F. tube (T1) delivers its output to the transformer primary (P2), and by induction, energizes the secondary (S2) which is connected to the second radio frequency tube (T2).

A powerful magnetic field is built up around the transformer (T2) by the plate current, and if close enough to the tuner unit (RFT-1), the stray field (FB) indicated by the dotted lines, will cause magnetic coupling between the tuner and transformer. In other words, the coils (P2-S2) act on the tuning coil just like the tickler coil of the regenerative circuit, and may either cause excessive regeneration and howling in the first tube (T1) or cause counter impulses which will act against the incoming signals and weaken them. If the inten-

(Continued on page 63)



Standard Radio Receivers

(Continued from page 46)



Craftsmanship Big Feature of the Grebe

A RECEIVER that combines mechanical efficiency with beautiful craftsmanship of design has been achieved by the A. H. Grebe Company, Richmond Hill, N. Y., makers of the Grebe Synchronphase Radio Receiver.

This set is distinctive for its appearance, the tuning dials being built horizontally into the set instead of vertically, as is the custom with most radio manufacturers.

Several experts have found that sharper and more comfortable tuning is possible with controls of this type, and accordingly the Grebe Company incorporated the idea when they designed their famous "Synchronphase" several years ago.

The Grebe Synchronphase is a receiver

of the tuned radio frequency type, containing five tubes. Greater sensitivity has been attained through two stages of balanced tuned radio frequency—the result of years of research. Extreme selectivity is achieved by the use of the popular binocular coils, which have come into favor with hosts of set builders lately.

The settings for various broadcasts stations are equally spaced over the dials, being accomplished by straight-line-frequency condensers. The three dial readings are identical for a given station.

The Synchronphase is made in two types, MU-1, for storage battery operation, and MU-2, for dry cell operation. The price is \$155.



Only One Tuning Control with the Thermiodyne

THE Thermiodyne 6-tube Tuned Radio Frequency Receiver has as its predominating feature one tuning control for all six tubes.

The Thermiodyne was one of the first commercial receivers to adopt this form of tuning design, and it has gained followers among many fans.

Furthermore, this single control is so logged in the factory that stations and wavelengths are marked on the tuning dial, thus making it possible to receive stations immediately without any tiresome "fishing."

No outdoor antenna is necessary with

this receiver. Neither is a directional loop needed.

The Thermiodyne company also claims that its receiver does not squeal, cannot radiate and cannot distort.

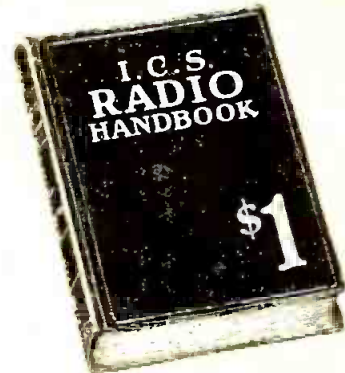
The circuit consists of three stages of thermionic frequency, detector and two stages of audio frequency. Distance and volume are very satisfactory on the loud speaker.

The single tuning control in the center of the panel consists of 180 degrees.

The Thermiodyne sells for \$140 and is manufactured by the Thermiodyne Corporation of New York City.

Which will survive—the five or the six-tube set? Roscoe Bundy Gives Some Real Reasons For His Decision—in July Radio Age —Out June 15

Biggest dollar's worth in **RADIO**



Compiled by HARRY F. DART, E.E. Formerly with the Western Electric Co., and U. S. Army Instructor of Radio Technically edited by F. H. DOANE

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ONE of the most complete books of its kind ever published. Written, compiled and edited by practical radio experts of national reputation. Packed with concise, sound information useful to every radio fan—from beginner to veteran hard-boiled owl. Contents—

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Fall Radio Conference Seems Probable

Secretary Hoover will probably call another national radio conference this fall, in continuation of his policy to hold conferences annually. The definite plans and date are as yet undecided, but it is believed that invitations will go out calling the sessions in Washington in November, certainly before Congress reassembles.

Results secured at the three past conferences have been so valuable to the Secretary of Commerce that he is disposed to refer all questions involving the different elements of the radio industry and art to a representative assembly of all interests from the manufacturing and commercial concerns to the amateurs and listeners.

Paris Conference on September First

The International Telegraph Convention scheduled for Paris in May has been definitely postponed until September 1, according to advices reaching Washington. As it is believed this parley will require at least a month's time, following which delegates will have to return to their own countries to report and for further instructions, the International Radio Conference here will probably not be called until after the first of the year. It is probable that the date will be approximately in March or April, 1926.

It is understood that the Government of the United States will be represented at the telegraph conference by officials of the State, War, Navy and Commerce Departments.

Trials and Triumphs of the Announcers

(Continued from page 27)

The telephone rings and the following question comes from one of our listeners: 'Do I have to listen to that novice all evening?' A very provoking question to ask an announcer on such an occasion. He was then asked if he knew who he was listening to and after replying in the negative, he was very politely told that if his set was not working properly or that if he didn't appreciate the music, he was in no way obligated to keep on listening the rest of the evening. This, apparently, answered his first question satisfactorily, and was an answer which fortunately savored very little of the thoughts that were running through the announcer's brain.

The Fickle Public

ALACK of appreciation for the success of artists or for the repertoire used by them sometimes results in requests which provoke a smile from the person to whom they are addressed. When presenting a program at KDKA recently, Mrs. Christine Miller Clemson who before her marriage was one of the country's contraltos and a concert singer with an enviable record, was requested to sing the jazz number 'Red Hot Mamma.'

"Perhaps one of the most common requests received is that requesting an artist to sing a particular number. In spite of the fact that there are thousands of songs, a good many listeners cannot quite understand why the singer does not have the particular number they request. Song pluggers are requested to sing 'Arias' and grand opera stars are requested to sing jazz numbers by the well-meaning audience. It also happens quite often that in spite of the fact that we receive hundreds of requests for numbers during a particular evening, some well meaning individual is at a loss to know why his or her particular request was not granted.

"Oftentimes a party will call and ask the following question or a similar one: 'I have a five-tube neurodyne set and cannot hear anything. Will you please tell me what is the matter with my set?' The opinion seems to be quite prevalent among a good many listeners that the wavelength determines the distance which a station can be heard, and usually the belief prevails that the distance a station can be heard varies directly with its wavelength. This opinion is the cause of some very humorous questions being asked.

"Among the innumerable questions are such questions as these: What time is it? Where is station WXY located? What is the name of the waltz the band played last Saturday night? What is the wavelength of station WXY? How far are you broadcasting tonight? Who is going to give your program on the 2nd of next month?"

"And so the announcer soon finds himself converted into an information bureau from which the dissemination of news adds a very colorful diversion to his vocation."

Model L-2 Ultradyne



The All Year Round Super-Heterodyne

This new model super-heterodyne receiver is the last word in radio sets, and may be had completely assembled and wired for only \$121.90.

Accessories

Atlas Loud Speaker, 2 45-volt Eveready B batteries,
8 Radiotrons, tested and matched 90 A. H. Mogul A battery, in
Nazeley Portenna Loop. mahogany case.

These accessories list at \$83.50. If ordered with the Ultradyne, the price will be only \$53.50.

New Freshman Masterpiece Kit.

Contains all necessary parts to build the famous Freshman "Masterpiece" 5-tube tuned radio frequency receiver. The kit sells for only \$39.50. A solid walnut cabinet may be had for \$7.00.

See Our Ad in Last Month's Radio Age For Bargains in Kits

Erla Superflex—Factory Sealed Kits.

1-tube kit.....	\$19.50	4-tube kit.....	44.50
2-tube kit.....	29.50	5-tube kit.....	49.50
3-tube kit.....	39.50	5-tube kit, for loop aerial use..	49.50

We Will Wire Any Kit For \$5 Per Tube Size

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Gentlemen: Please enter my subscription for RADIO AGE, the Magazine of the Hour, for one year, beginning with your next issue, for which I enclose \$2.50.

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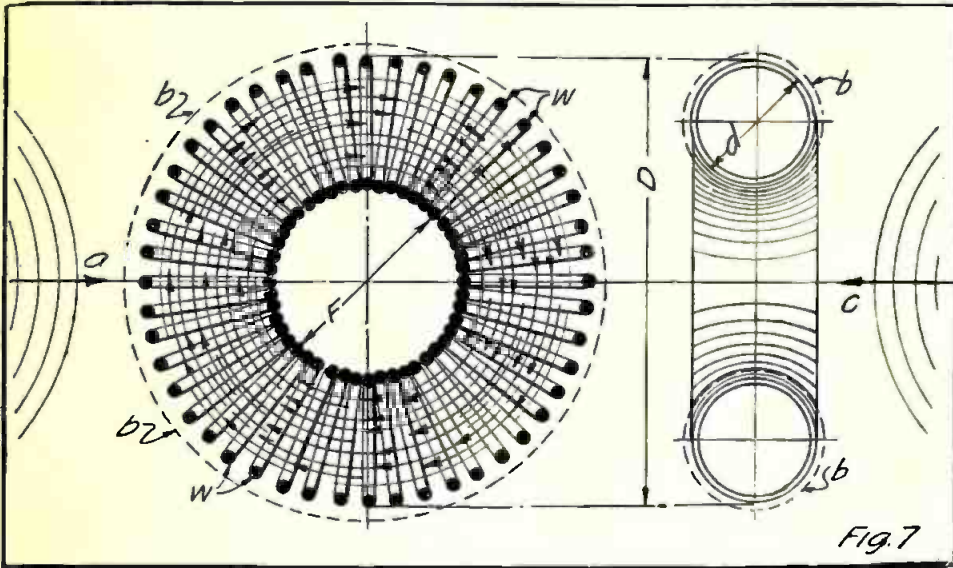
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Send cash, money order or draft.

The Binocular Coil

(Continued from page 60)



sity of the stray feed-back (FB) could be controlled, it might be even desirable, but as it cannot be controlled, it means trouble. The closer the two coils and the more nearly that they are in line, the greater will be the feed-back.

This figure will explain why many radio frequency sets will produce aerial radiations and annoy the neighbors although a radio frequency set is said to be proof against this trouble. With the stray feed-back (FB), we have a truly regenerative circuit in the first stage which is just as capable of "tweet-tweet-tweeting" in a nearby receiver as the most violent of single tube ultra-audions. This condition at once eliminates every advantage of an R. F. circuit.

One of the greatest advances in the

suppression of self-oscillation was made by Prof. Hazeltine in the development of the Neurodyne circuit. He not only

overcame the grid-plate capacity feed-back by means of the opposing neutralizing condensers, but he also devised a fairly effective method of reducing the magnetic inter-linkage between the radio frequency transformers which helped a whole lot in the advancement of the radio frequency amplifier. However, he still used the conventional solenoid

type open coil with strongly marked poles, and therefore did not entirely eliminate magnetic feed-back. By placing his transformer coils at definite angles, he reduced the linkage, but of course there was always some stray field

(Continued on page 65)

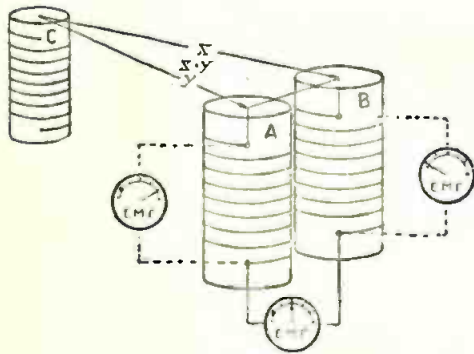
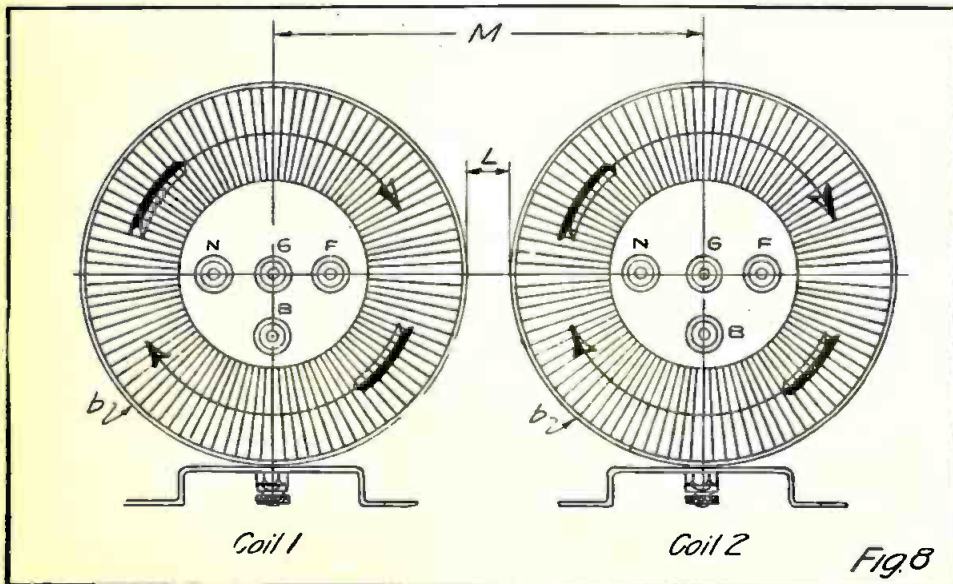


Fig. 9



DUPLEX MATCHED CONDENSERS

Afford Uniform Dial Settings



And Simplify Logging

Know the satisfaction and ease of tuning that come when all dials read alike. Use **DUPLEX Matched Condensers**—the supreme achievement in condenser building. Condensers are the "heart" of any set and matched condensers are absolutely necessary if your set is to be free from "heart" trouble. **DUPLEX Matched Condensers** are made in strict accordance with Bureau of Standards specifications for lowest losses and best electrical characteristics. They are tested, matched, packed and sealed in the laboratory, to remain unopened until used. **DUPLEX Matched Condensers** are used in the famous Neurodyne. Matching is essential. Folder explaining how and why matched condensers are essential sent on request. **DUPLEX CONDENSER & RADIO CORP.** 42 Flatbush Ave. Ext., Bklyn, N. Y.



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or more to have an aerial spoil the appearance of your home? Antenna eliminates all unsightly wiring, lightning arresters, etc., and precludes the possibility of dangerous grounding on a power line. It also stops "canary bird" re-radiation from nearby oscillating sets interfering.

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is not only a real distance getter, but also overcomes troublesome static.

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Corrected List of Broadcasting Stations

Table listing broadcasting stations with columns for call letters, station name, location, and frequency. Includes entries like KDKA Westinghouse Electric & Mfg. Co., WFLX George Roy Clough, and KFIJ Liberty Theatre (E. E. Marsh).

Developments Toward Non-Oscillating Circuits

(Continued from page 63)

which could not be conquered, and he depended upon his neutralizing scheme to stop such oscillations as might be started magnetically. In short, all attempts up to a very recent date have been toward suppressing oscillations after they had started rather than prevent their formation.

Magnetic Fields

A MAGNETIC field is set up around any conductor that carries an electric current, and conversely, an electric current is set up in the conductor when it is "cut" at right angles by a moving magnetic field. This is illustrated by Fig. 3 where (T1) is an air core solenoid coil with an electric current passing through the turns of wire wound on the tube. Magnetic lines of force or the "field" (b) are established by the current for a considerable distance around the coil, and any conductor within the area embraced by the curved lines will be magnetically affected. When carrying high frequency radio currents, the effects of the field may be sometimes detected for several feet from the coil, particularly in the direction of the axis (d). At each end are the magnetic poles marked (N) and (S), which with direct current are the "north" and "south" poles.

Now let us say that the source of current is disconnected from the coil, and that some type of current indicator such as a voltmeter is connected across the ends of the coil as at (V) in dotted lines. If a magnetic field or radio wave-front (a) now advances and cuts through the coil along the axis in the direction of (a), a current will be "induced" in the coil, and the current indicator (V) will be deflected as long as the magnetic field moves in respect to the wire. If (a) is a rapidly oscillating radio wave-front, then oscillating currents will be induced in the coil continuously as long as the field continues.

Now let us consider the second coil (T2) in Fig. 4 which has been set up at right angles to the first coil (C1), and in line with the magnetic flux (d). As the field (d) now acts along the wires instead of at right angles to them, practically no current will be induced in the wire of (T2). Similarly a radio wave-front (C) will induce no current as long as it travels exactly in line with the conductors. In practice, however, there will be a little induced current for the reason that the flux travels in curved lines instead of along a straight line, and for the reason that the turns of wire are curved helices and not straight. In other words, the magnetic flux cannot ever be exactly parallel to the wire, and there will always be some component that will travel at an angle to the wire.

Fig. 5 shows the actual conditions very clearly when two coils are placed end to end or axially in line, so that the magnetic flux from coil (1) cuts through the length of coil (2). The black dots on Coil (1) indicate current carry supply wires, while the open circles on Coil (2) are wires carrying induced currents. An arrangement of this sort is absolutely impracticable in a radio set, for the flux may travel as far as two or three feet from Coil (1) and induce currents or cause regeneration in the circuit of Coil (2). It is also bad practice to place a metal plate in this

field as shown at the left by "Plt." The magnetic flux will induce eddy currents in the plate and cause other trouble.

Placing the coils at right angles is of great assistance, but does not entirely prevent back-coupling in strong fields. Besides the magnetic coupling there will also be electro-static coupling due to the condenser effect between the coils, if they are very close together. With (D) equal to as much as 12 inches, there will be a very perceptible coupling.

Standard radio frequency practice with solenoid type transformers is shown by Fig. 6, this arrangement being originally devised by Prof. Hazeltine for use in the Neutrodyne circuit. The transformers are mounted at an angle of 51°-04', and are spaced apart by the center to center distance (M) until the adjacent faces (M) and (n) of the two coils are separated by the distance (b). The latter spacing prevents electrostatic coupling between the two coils for the coils no longer face each other. The angle chosen is such that the stray magnetic flux induces as little current as possible, the curvature of the lines of force being nearly parallel to the turns of wire under these conditions. However, there will always be some coupling as indicated by the curved flux lines. It can't be avoided as long as there is an external field.

The Circloid Field

AT LAST we are at the point where we can appreciate the advantages of the circloid transformer coil, the coil without an external field. A pair of sectional views of this coil are shown in Fig. 7 which will explain the path of the flux and the low leakage coefficient and also its indifference to stray fields from other coils or from random aerial action. In effect, this is simply an ordinary solenoid bent around a circle having a diameter (F), the coil diameter being (d) and the external diameter (D). Each round, black dot represents a wire in section as at (W). The wires, of course, are spaced farther apart on the outer circumference than around (D) so that the inner circle appears almost like a solid black line.

Inside the coil will be seen the arrows indicating the path of the magnetic flux which in all cases faithfully follows the outline of the wire strands. The flux of one wire tends to start out tangentially to the circle along a straight line, but is pulled back into place by the influence of the next turn so that the main portion of the flux is within the conductor area. There is no end and hence no definite polarity is indicated at any point that would induce external leakage.

Now let the arrow (a) at the left of the figure represent a stray field or the wave-front from a local broadcasting station travelling toward the coil. As such a wave embraces the entire coil, it will induce no current for the turns in the upper half run in the opposite direction to those in the lower half, and therefore all induced charges oppose each other so that no current can flow. In other words, we will suffer no interference from the coil considered as an aerial. Taking the right hand view, we see that the advancing wave-front (C) moving at

(Turn to page 67)

* Tested and Approved by RADIO AGE *

OLD MAN STATIC "KILLED" AT LAST

Statchoke Has Startled the Radio World—Insures Clear, Long Distance, Summer Reception.

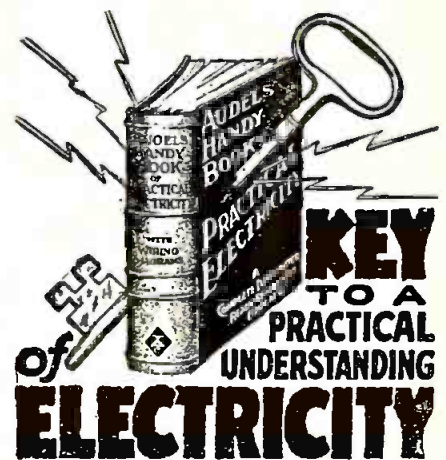
The long promised invention which insures clear, long distance, "summer radio" without the agony of static, has just been announced. Radio experts and fans who have tested this new imported invention pronounce it marvelous. Awarded Certificate of Merit by Radio News of Canada.

In addition to reducing static to a minimum, the Statchoke increases the volume as well as clarity of distant reception, sharpens the selectivity of tuning in, eliminates that harshness of the tubes so noticeable on local loud speaker reception and acts as a safety lightning arrester.

The Statchoke somewhat resembles a small transformer, and by a system of coils it allows only the correct current value to enter the set, choking out other high current variation from the aerial, which is passed off through a secondary ground connection.

So confident are the American distributors that Statchoke will give you clear long distance summer reception that they have set aside 25,000 units for initial distribution direct to the radio fans, at a special price of only \$2.50 each.

If interested write today to Radio Dept., Imperial Laboratories, 9575 Coca Cola Bldg., Kansas City, Mo., and the Statchoke will be sent you by insured mail. Write today as this is a special offer and may not appear again.



Audel's Handy Book of Electricity, Price \$4.

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The 1040 pages and 2600 diagrams give accurate, up-to-date and complete information on—Rules and Laws, RADIO, Storage Batteries, WIRING DIAGRAMS, Power and House Wiring, Automatic Phones, Auto Ignition, Motor Troubles, ARMATURE WINDING, Cable Splicing, Elevators and Cranes, Sign Flashers, Transformers, Practical Management, Modern Applications—READY REFERENCE on every electrical subject. Pocket Size, handsomely bound in flexible Red LEATHER. Easy Terms. Shipped for Free Examination. No obligation to buy unless satisfied.

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Occupation.....
Employed by..... 6T302

Table listing radio stations, call letters, and locations across the United States. Columns include call letters (e.g., WCBJ, WCLB), station names (e.g., J. C. Maus, Northern Radio Mfg. Co.), and cities/states (e.g., Jennings, Louisiana, Houlton, Me.).

The Latest in Binocular Coils

(Continued from page 65)

right angles to the plane of the coil cannot generate a current, as opposing currents will be generated on the near and far sides of the conductors. No matter in which direction a stray field may strike the coil, it is wholly unable to induce a troublesome current.

In Fig. 8 are shown two of the coils mounted side by side with the center-to-center distance (M). By experiment it has been shown that the faces of the coil can be spaced so that (L) is from 1/4" to 1/2" without trouble from feed-back.

Here (b) represents the extreme of field as before, and the heavy arrows show the course of the magnetic flux. In the center is the disc which supports the coil and the connection posts, and at the bottom is the floor bracket used for base mounting. This bracket can also be used for mounting the coil on the back of a variable condenser, when such construction is desired. The connections are plainly marked and the transformer can be hooked up in any circuit just as with any other air core transformer for straight R. F. amplification, reflexing or as a tuning coil. A .00035 condenser is recommended for the broadcasting range of wavelengths.

The Binocular Coil

By P. D. Lowell, Research Engineer, A. H. Grebe & Co.

IN DESIGNING and constructing a radio frequency amplifier having a plurality of tuned stages, it is extremely important that all electro-magnetic induction between the coils of the tuned stages shall be eliminated; otherwise a feeding back of energy will occur, thereby causing violent oscillations in the whole amplifier circuit. These oscillations are of course very objectionable and an amplifier is entirely useless in this condition.

It has been customary heretofore, in order to reduce the magnetic induction between stages, to mount the inductance coils in such a position that their axes are at a 90° angle with respect to one another. This method is fairly satisfactory, provided that they are really positioned at exactly the 90° angle. It is very clear, however, that this would be a difficult practice to follow, inasmuch as the slightest variation from the 90° angle will cause instability in the operation of the receiving apparatus.

The same line of reasoning holds true for any method where the faces of the coils must be at a certain angle with respect to one another in order that electromagnetic induction shall be reduced.

Our laboratory has produced a new form of inductance unit which is composed of two solenoidal coils mounted closely together with their axes parallel and with the two windings connected in such a manner that their electromagnetic fields are opposing each other.

This means that as soon as one coil of the unit starts to radiate a magnetic field, the other coil of the unit at the same time radiates a magnetic field of equal intensity but of opposite direction, and the two fields immediately counter-balance each other and the resulting field becomes zero.

The great advantages in the use of such inductance units in the tuned stages of an amplifier are very apparent. The units may be mounted at quite a variety of positions with respect to one another and their positioning does not need to be as accurate as with the usual form of inductance coils.

In a receiver comprising a number of tuned stages, maximum overall selectivity is obtained only when the energy from the aerial must pass through each tuned stage before reaching the detector. Quite frequently it is found that a receiving set which is amply selective for moderately distant stations, sets up no tuning barrier for powerful nearby stations. The fault usually lies in the cylindrical coils which, because of their external field, pick up the interfering signal directly in the detector and intermediate stages. The filtering effect of the tuned stages is thus greatly reduced and the undesirable station allowed to come through.

This phenomenon is entirely eliminated when binocular coils are used, because the inherent selectivity of each tuned stage is maintained even when the set is operated close to a powerful broadcasting station.

The following is an explanation of the schematic diagram, Fig. 9.

"A" and "B" are two similar coils connected in series or parallel in such a manner that their electromagnetic field are opposing each other.

When a source of electromagnetic field is radiated from an exterior source such as coil "C," we can assume that E. M. F. of X + 2 units value is induced in coil "A" and an E. M. F. of -2 units is induced in coil "B". Therefore "A" and "B" being connected in the proper manner, the X + 2 units and the -2 units will counter-balance one another and the resulting E. M. F. across the terminals of the whole inductance will be zero.

The DAVEN RESISTANCE COUPLED AMPLIFIER KIT

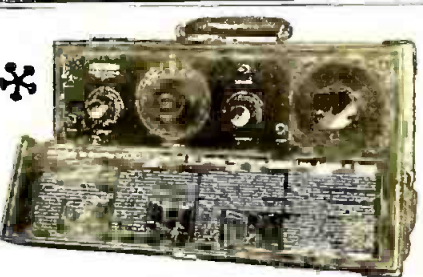
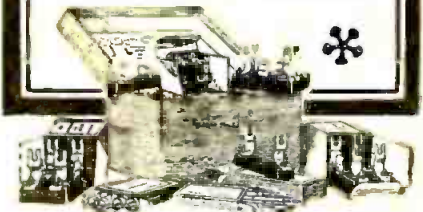
Those who build their own can easily achieve perfect reproduction. There's nothing to equal Resistance Coupling. The DAVEN AMPLIFIER KIT

comes with full instructions for assembly. Easy to build—efficient in operation. (Without sockets and condensers.)

Supplied in either 3 or 4 stages. Sold Everywhere.

Ask your dealer for the "RESISTOR MANUAL." It's full of information on Resistance Coupling. Price 25c. Postpaid 35c.

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The Famous Truly Portable TELMACO P-1 Receiver

Four Tubes Do the Work of Seven

The peer of portables in size, weight, ease of tuning, selectivity, distance, volume, workmanship and price. Aerial, loud speaker and batteries self contained. Complete with tubes and batteries. \$125.00 \$143.50. Receiver only

P-1 Kit Saves You Money!

Our offer of the Telmaco P-1 Receiver in kit form has met with enthusiastic reception. This contains all parts, as built by us, including case, drilled and engraved panel, and illustrated instructions. \$80.00 Complete kit. Ask your dealer or write us. Descriptive folder free.

Radio Division:

Telephone Maintenance Co. 20 So. Wells St. Dept. C Chicago, Ill.



Quality Radio Exclusively Established 1918

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For Guaranteed Results. * \$3.50 For This Transformer Will Assure Positive Performance For All Hookups.

If your dealer cannot supply, order direct.

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Wholesale radio only. One of the first and still in the lead. Write for discounts.

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The Radio Age Annual for 1924!

ONLY A FEW LEFT AT 50c EACH

If you have not bought your copy of the famous RADIO AGE ANNUAL for 1924, you may get one at a special price of 50 cents by filling in the coupon below and sending it with stamps, money order or draft, at once. The supply is nearly exhausted, and no more will be printed, so ACT NOW!

1924 ANNUAL COUPON

Radio Age, Inc., 500 N. Dearborn St., Chicago, Ill.

Gentlemen: Please find enclosed 50 cents, for which you may send me a copy of the RADIO AGE ANNUAL for 1924, in accordance with your special price offer for April.

Name _____
 Address _____
 City _____ State _____

WSAN Allentown Call Publishing Co. Allentown, Pa. 229	WTAQ S. H. Van Gordon & Son Oseoo, Wis. 220
WSAP Seventh Day Adventist Church New York, N. Y. 263	WTAR Reliance Electric Co. Norfolk, Va. 280
WSAR Doughty & Welch Electrical Co. Fall River, Mass. 254	WTAS Charles E. Erbstein Elgin, Ill. 303
WSAY Camp Marienfeld Chesham, N. H. 229	WTAT Edison Electric Illuminating Co. (portable) Boston, Mass. 244
WSAY C. W. Vick Radio Construction Co. Houston, Tex. 360	WTAU Ruesg Battery & Electric Co. Tecumseh, Nebr. 242
WSAY Irving Austin (Port Chester Chamber of Commerce) Port Chester, N. Y. 233	WTAW Agricultural & Mechanical College of Texas College Station, Tex. 280
WSAZ Chas. Electric Shop Pomeroy, Ohio 258	WTAY Williams Hardware Co. Stretator, Ill. 231
WSB Atlanta Journal Atlanta, Ga. 428	WTAY Oak Leaves Broadcastng Station Oak Park, Ill. 283
WSKC World's Star Knitting Co. Bay City, Mich. 261	WTAY Thomas J. McGuire Lamberaville, N. J. 283
WSL J. and M. Elec. Co. Utica, N. Y. 273	WTAY Flint Senior High School Flint, Mich. 218
WSMB Saenger Amusement Co. and Maison Blanche Co. New Orleans, La. 319	WTAY Kansas State Agricultural College Manhattan, Kans. 273
WSMH Shattuck Music House Owosso, Mich. 240	WTAY Travelers Insurance Co. Hartford, Conn. 323
WSOE School of Engineering Milwaukee, Wis. 246	WTAY H. G. Saal Co. Chicago, Ill. 268
WSRF Hardem Sales and Service Broadlands, Ill. 233	WTAY Wright & Wright (Inc.) Philadelphia, Pa. 360
WSUI State University of Iowa Iowa City, Iowa 498	WTAY The Alamo Ball Room Joliet, Ill. 242
WTAB Fall River Daily Herald Publishing Co. Fall River, Mass. 248	WTAY Ford Motor Co. Dearborn, Mich. 273
WTAF Penn Traffic Co. Johnstown, Pa. 360	WTAY Detroit News (Evening News Assn.) Detroit, Mich. 352
WTAL Louis J. Gallo Toledo, Ohio 242	WTAY Loyola University New Orleans, La. 260
WTAL Toledo Radio & Electric Co. Toledo, Ohio 252	WTAY Michigan College of Mines Houghton, Mich. 244
WTAP Cambridge Radio & Electric Co. Cambridge, Ill. 242	

Canadian Stations

CFAC Calgary Herald Calgary, Alberta 430	CHXC J. R. Booth Ottawa, Ont. 435
CFCA Star Pub. & Prtg. Co. Toronto, Ontario 400	CHYC Northern Electric Co. Montreal, Quebec 410
CFCF Marconi Wireless Teleg. Co. Canada Montreal, Quebec 440	CJBC Jarvis Baptist Church Toronto, Ont. 312
CFCH Ahitibi Power & Paper Co. Iroquois Falls, Ont. 400	CJCA Edmonton Journal Edmonton, Alberta 455
CFCK La Cie de L'Evenement Quebec, Quebec 410	CJCG London Free Press Prtg. Co. London, Ont. 430
CFCC Radio Supply Co. Edmonton, Alberta 410	CJCD T. Eaton Co. Toronto, Ont. 410
CFCN W. W. Grant Radio (Ltd.) Calgary, Alberta 440	CJCE Sprott-Shaw Radio Co. Vancouver, B. C. 420
CFCO Radio Specialties (Ltd.) Vancouver, B. C. 450	CJCF The News Record Kitchener, Ont. 295
CFCR Laurentide Air Service Sudbury, Ont. 410	CJCI Maritime Radio Corp. St. John, New Brunswick 400
CFCT Victoria City Temple Victoria, B. C. 410	CJCK Radio Corp. of Calgary Calgary, Alta. 316
CFCU The Jack Elliott Radio Limited Hamilton, Ont. 410	CJCM J. L. Phillips Mont Joli, Quebec 430
CFCV The Radio Shop London, Ont. 420	CJCN Simons Agnew & Co. Toronto, Ont. 410
CFCW Sparks Co. Nanaimo, B. C. 430	CJCN Evening Telegram Toronto, Ont. 430
CFCH Henry Birks & Sons Calgary, Alta. 440	CKAC La Presse Pub. Co. Montreal, Quebec 430
CFCL Chas. Guy Hunter 551 Adelaide St. London, Ont. 410	CKCD Vancouver Daily Province Vancouver, B. C. 410
CFCC The Electric Shop (Ltd.) Saskatoon, Saskatchewan 400	CKCE Canadian Independ. Telephone Co. Toronto, Ont. 450
CFRC Queens University Kingston, Ontario 450	CKCK Leader Pub. Co. Regina, Saskatchewan 420
CFUC University of Montreal Montreal, Quebec 400	CKCO Ottawa Radio Association Ottawa, Ont. 440
CFXC Westminster Trust Co. New Westminster, B. C. 440	CKCX P. Burns & Co. Calgary, Alberta 440
CFYC Victor Wentworth Odium Vancouver, B. C. 400	CKLC Wilkinson Electric Company Calgary, Alberta 400
CHAC Radio Engineers Halifax, Nova Scotia 400	CKOC Wentworth Radio Supply Co. Hamilton, Ont. 410
CHBC Albertan Publishing Co. Calgary, Alberta 410	CNRA Canadian National Railways Moncton, N. B. 313
CHCB Marconi Company Toronto, Ont. 410	CNRC Canadian National Railways Calgary, Canada 357
CHCD Canadian Wireless & Elec. Co. Quebec, Quebec 410	CNRE Canadian National Railways Edmonton, Alta. 455
CHCE Western Canada Radio Sup. (Ltd.) Victoria, B. C. 400	CNRM Canadian National Railways Montreal, P. Q. 410
CHCL Vancouver Merchants Exchange Vancouver, B. C. 440	CNRO Canadian National Railways Ottawa, Ont. 430
CHCM Riley & McCormack Calgary, Alberta 415	CNRR Canadian National Railways Regina, Sask. 312
CHCS The Hamilton Spectator Hamilton, Ont. 420	CNRS Canadian National Railways Saskatoon, Sask. 329
CHIC Northern Electric Co. Toronto, Ont. 356	CNRT Canadian National Railways Toronto, Ont. 357
CHNC Toronto Radio Research Toronto, Ont. 350	CNRW Canadian National Railways Winnipeg, Man. 384

Cuban Stations

PWX Cuban Telephone Co. Habana 400	2K Alvara Diaz Habana 200
2DW Pedro Zayas Habana 300	2HS Julio Power Habana 180
2AB Alberto S. de Bustamante Habana 240	2OL Oscar Collado Habana 290
2OK Mario Garcia Velez Habana 360	2WW Amadeo Saenz Habana 210
2BY Frederick W. Borton Habana 260	5EV Leopoldo E. Figueroe Colon 360
2CX Frederick W. Borton Habana 320	6KW Frank H. Jones Tuinucu 340
2EY Westinhouse Elec. Co. Habana 230	6KJ Frank H. Jones Tuinucu 275
2TW Roberto E. Ramires Habana 230	6CX Antonio T. Figueroe Cienfuegos 170
2HC Herald de Cuba Habana 275	6DW Eduardo Terry Cienfuegos 225
2LC Luis Casas Habana 250	6BY Jose Ganduxa Cienfuegos 300
2KD E. Sanchez de Fuentes Habana 350	6AZ Valentin Ullivarri Cienfuegos 200
2MN Fausto Simon Habana 270	8BY Alberto Revelo Stgo. de Cuba 250
2MG Manuel G. Salas Habana 280	8FU Andres Vinnet Stgo. de Cuba 225
2JD Raul Pares Falcon Habana 150	8DW Pedro C. Anduz Stgo. de Cuba 275

European Broadcasting Stations


British Stations

2LO London 365	5NO Newcastle 400
51T Birmingham 475	5SS 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

DeForest License



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The Universal all-wave inductance. Back and front panel mountings. Send 25c for Super Het., R. F. and Honeycomb Coil Circuits and Complete Catalog.
Chas. A. Branston, Inc., Dept. 13, 815 Main St., Buffalo, N. Y.

5000 RADIO DEALERS buy from HUDSON-ROSS 123 W. Madison St. Chicago Send for dealers discount.

Free Mailing Lists
Will help you increase sales. Send for FREE catalog giving counts and prices on thousands of classified names of your best prospective customers—National, State and Local—Individuals, Professions, Business Concerns.
99% Guaranteed 5¢ each by refund of 5¢ each
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In the **July Radio Age**
Brainard Foote, Frank D. Pearne, Roscoe Bundy, H. Frank Hopkins, John B. Rathbun, and others will give you
Radio Circuit Forecasts for the Fall of 1925!
A real insight into the future of Radio—theoretical and technical!
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Dealers—if you want the best products, the fastest shipments and the most liberal discounts, write on your letterhead for our catalog L1003.

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225 E. ILLINOIS ST. — CHICAGO

WITH THE MANUFACTURERS



Brandes' New Adjustable Table-Talker

The new Adjustable Table-Talker recently announced by C. Brandes, Inc., makers of the Matched Tone Headsets and pioneers of the \$10 loud speaker market, is another step forward in the loud speaker development. It has always been Brandes' idea, says their sales manager, to give to the radio purchaser the "greatest buy in radio" and the new Brandes Table-Talker is today the best value on the market for the price.

It is another pioneering step in that it offers not only an adjustment feature, but a gooseneck fibre horn which gives much better reproduction than the ordinary straight neck horn.

The adjustment lever is located at the back of the base in an inconspicuous place and yet in a very convenient position. This adjustment greatly increases the volume of sound produced and sensitivity of the Table-Talker and makes tuning-in distant stations much easier. All adjustments can be made as shown above without lifting the Table-Talker from the table.

The horn over all is 18 inches high having a 10 inch bell. It is finished in a neutral shade of dark brown and has a felt padded base. It requires no extra batteries for operation and is furnished with a five foot polarity-indicating cord.

Hudson-Ross History Reads Like a Fable

How the smallness of Cinderella's slipper made her a princess was once looked upon as a mere fable. But Gloria Swanson's trim ankle lifted her out of a stove heated flat to the titled position of a marchioness.

Only three years ago Hudson-Ross was nothing more than an idea. But the idea was like Cinderella's slipper or Gloria's ankle. It was what has made this company leap into leadership almost overnight.

Modest quarters were secured in the Madison Square Building on Madison Street. The unusual service Hudson-Ross gave their dealers in handling only nationally advertised radio, increased their business until every available foot of their space in the building was taken up.

Now comes the coach and four of the Princess that called for Cinderella. Business has reached such proportions that more commodious quarters were rented at 116-118 So. Wells St., Chicago.

May 1st, of course, was the great date. From that day on Hudson-Ross occupied the finest offices of any radio house in the west.

But mere physical property is not enough to keep pace with the demands of their dealers. Service is the company's outstanding feature.

A Pencil Looks Tall Beside Amplion Dragonfly

People who room, live in kitchenette apartments, thin-walled flat buildings or other places where a "Loud" Loud speaker might invite the wrath of neighbors, must have been in mind when this Amplion "Dragonfly" was created.



The explanation of The Amplion Corporation of America, 280 Madison Ave., New York City, is that this "Dragonfly" is a replica on a reduced scale of a larger Amplion, with all its features.

A rubber bushing insulates the horn from the tone conduit. Another rubber bushing insulates the tone conduit from the unit. The curve of the tone conduit provides long tone travel, with gradual amplification, in compact space.

The unit itself is the same as is supplied to set makers for built-in loud speakers. It has the Amplion "Floating Diaphragm" feature and an adjustment for "tuning" it to each set.

The Adapto Radio Cabinet

A beautiful console now on the market, encloses everything radio from sight in an uncommonly safe and accessible way. Because it accommodates practically any sized receiver with absolutely no fuss or cabinet work, through the use of special adapter frames, it is called the Adapto Radio Cabinet. This console represents a significant step forward in radio consoles. It comes in either mahogany or walnut, soft-toned wood, harmonious with the finest receiver and the most distinctive room. The radio receiver may be removed instantly without removing a single nail or screw. There is a drawer that represents the utmost in convenience—it opens easily, smoothly, and holds storage battery, battery charger, distilled water, hydrometer. A built-in switch throws the battery charger in operation instantly while in place. The horn is built at the top. There is a small drawer for tools, a spacious shelf for B batteries. Further information about the Adapto Radio Cabinet may be had by writing L. R. Donehue Co., Perth Amboy, N. J.

The Hemco Loop Aerial

The Hemco Loop Aerial, manufactured by George Richards & Company, Inc., 557 West Monroe Street, Chicago, was designed to meet the demand for a reasonable priced and durable loop aerial that would insure efficient reception.

The manufacturers of the Hemco Loop Aerial feel that this has been accomplished as the Hemco Loop Aerial possesses a number of advantages over many of the Loops on the market today. Made in sizes of 18" and 24" it is constructed of a 65 strand wire, 5 strands of which are phosphorus bronze spirally wound on specially treated arms which are protected at both ends by ferrules. These wooden arms are nicely finished and trimmed with nickel.

The binding posts on the Hemco Loop Aerial are carried on a hard rubber base, and the three tap feature permits the use of this Aerial on circuits where Rice methods of regeneration is used.

Probably the most important feature of the Hemco Loop Aerial is the fact that the patented spring arm feature keeps the wire taut at all times. Concealed springs hold the wires under tension from the moment the Loop is opened.

Dongan Voltmeters to Be Standard

An announcement has just been made by the radio Division of the Dongan Electric Manufacturing Company, Detroit, of interest both to the trade and the set manufacturers. In line with the tendency on the part of set manufacturers to build more complete receiving sets, Dongan has brought out a line of voltmeters that many of the manufacturers have already adopted as standard equipment.

The commercial set builders realize that the apparently inefficient operation of the set is often due to improper tube or "B" battery voltage. Frequently the owner of the set does not realize this, and blames the unsatisfactory results upon the set itself. In fact, several of the large set builders have found that much of the service work required is due to improper tube or B battery voltage.

Many of the sets now being designed for next season include Dongan Voltmeters mounted on the panels. Obviously this addition as standard equipment is going to serve the double purpose of protecting the good will of the manufacturer and improving the consistent reception of the set to the pleasure of the owner.

Dongan is best known in radio as the manufacturer of Dongan Audio Transformers, a product this company builds for thirty-five set manufacturers as well as the jobbing trade. (Turn to page 72)

CLASSIFIED ADVERTISEMENTS

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 July issue must be sent in by June 1.

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 DEALERS

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

STAMPS AND COINS

158 Genuine Foreign Stamps. Mexico War Issues. Venezuela, Salvador and India Service. Guatemala, China, etc., only 5c. Finest approval sheets, 50 to 60 per cent. Agents Wanted. Big 72-p. Lists Free. We Buy Stamps. Established 20 Years. Husman Stamp Co., Dept. 152, St. Louis, Mo.

WANTED

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

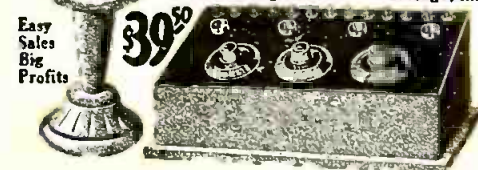
INVENTIONS

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.

Make \$100 Weekly-sell RADIO

Demonstrate Once—Results Mean Sure Sale
Coast to coast, lowest prices, attractive four-tube instrument \$39.50. Big commission to you. Exclusive territory to proven salesmen. Territory going fast, write today for large illustrated book No. 100. Don't fail to name your county.

OZARKA, Inc.
829 Washington Blvd., Chicago, Ill.



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.

MANUFACTURING FACILITIES

AN OLD AND WELL ESTABLISHED MANUFACTURING COMPANY IN THE MIDDLE WEST WITH LARGE WELL EQUIPPED PLANTS AND UNUSUAL FINANCIAL RESOURCES, DESIRING TO ENTER THE RADIO FIELD WILL CONSIDER THE MANUFACTURE AND SALE OF RADIO SETS OR DEVICES OF OUTSTANDING AND UNUSUAL MERIT ON A ROYALTY BASIS. ADDRESS BOX 1A, RADIO AGE.

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

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

FOR SALE—3 Pfanstiehl tuning units, 3 Cardwell Condensers, 1 Bradleymeter, 2 Bradleystats. All goods New. Earl Price, Lodi, Wis.

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.

JOIN THE RADIO Parts Exchange Club. Your parts inspected (Fee 25c), and exchanged for the parts you need. What have you; what parts do you require? Write us for details. The Radio Parts Exchange Club, 112 So. Homan Ave., Chicago.

"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 OPPORTUNITY

MR. MANUFACTURER: Would you be interested in a national advertising campaign to reach more than two million prospective buyers of quality radio products—each week? Do you want to establish agencies in new territory and create national interest in your product—at a very conservative cost? It can be done. Let us explain our system without obligation to you. Drop a card to Radiograph Laboratories, 1234 Rosemont Ave., Chicago, Ill., Box 6.

The Traffic Cop of the Air

Add a Ferbend Wave Trap to your Radio Set and "Police" your reception. Regulate traffic. Guaranteed to tune out any interfering station. Widely imitated but never equalled. The original and only successful WAVE TRAP. Now in its third year. Sent Postpaid upon receipt of \$1.50 or C. O. D. plus postage. Send for Free Booklet

FARBEND WAVE TRAP

FARBEND ELECTRIC CO.
16 E. 50. Water St. Chicago

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, Aston, Illinois.

RADIO CIRCUITS

SPECIAL FOR MAY
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.

VOCATIONS

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

RADIO SUPPLIES

Ten per cent discount on all standard radio parts, from condensers to transformers to tubes, etc. Send for our latest price list, with special bargains on Static-eliminators, portable loud speakers, Radiotrons, German silver wire, etc. RADIOGRAPH LABORATORIES, 1234 Rosemont Ave., Dept. 4, Chicago, Ill.

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.

CRYSTALS

TESTED GALENA CRYSTALS, 50c pound bulk. Buskett, Geologist, Joplin, Mo.

PERSONAL

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

Look! You Radio Bug! 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.

MAGAZINES

DREAMS. A magazine for all who dream. If you are interested in the subjects of science, sex, psychology, health, love and romance, you cannot afford to be without this magazine. Three dollars will bring this most fascinating monthly publication to your home for one year. M. P. Smith Publishing Co., 508 N. Dearborn St., Chicago, Ill.

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

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 | 95 Grid leak holders | 186 Rheostats, automatic |
| 2 Aerial protectors | 96 Grid, transmitting leaks | 187 Rheostats, battery |
| 3 Aerial insulators | 97 Grid leaks, tube | 188 Rheostats, dial |
| 4 Aerials | 98 Grid leaks, variable | 189 Rheostats, filament |
| 5 Aerials, loop | 99 Grinders, electric | 190 Rheostats, potentiometer |
| 6 Amplifiers | 100 Ground clamps | 191 Rheostats, power |
| 7 Amplifying units | 101 Ground rods | 192 Rheostats, vernier |
| 8 Ammeters | 102 Handles, switch | 193 Rods, ground |
| 9 "B" batteries | 103 Head bands | 194 Rotors |
| 10 Batteries (state voltage) | 104 Head phones | 195 Scrapers, wire |
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| 15 Battery plates | 109 Horns, fibre | 200 Sets, receiving—crystal |
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| 17 Bezels | 111 Horns, metal | 202 Sets, receiving—Neutrodyne |
| 18 Binding posts | 112 Horns, wooden | 203 Sets, receiving—portable |
| 19 Binding posts, insulated | 113 Hydrometers | 204 Sets, receiving—radio frequency |
| 20 Books | 114 Indicators, polarity | 205 Sets, receiving—reflex |
| 21 Boxes, battery | 115 Inductances, C. W. | 206 Sets, receiving—regenerative |
| 22 Boxes, grounding | 116 Insulation, molded | 207 Sets, receiving—Reinartz |
| 23 Bridges, wheatstone | 117 Insulation material | 208 Sets, receiving—sectional |
| 24 Broadcasting equipment | 118 Insulators, aerial | 209 Sets, receiving—short wave |
| 25 Bushings | 119 Insulators, composition | 210 Sets, receiving—super-regenerative |
| 26 Buzzers | 120 Insulators, fibre | 211 Sets, transmitting |
| 27 Cabinets | 121 Insulators, high voltage | 212 Slate |
| 28 Cabinets, battery | 122 Insulators, cloth | 213 Shellac |
| 29 Cabinets, loud speaker | 123 Insulators, glass | 214 Sliders |
| 30 Carbons, battery | 124 Insulators, hard rubber | 215 Socket adapters |
| 31 Cat whiskers | 125 Insulators, porcelain | 216 Sockets |
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| 37 Coils, grid | 131 Knobs | 222 Solder solution |
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| 50 Condensers, variable grid | 144 Meters, D. C. | 235 Switches, filament |
| 51 Condensers, variable mica | 145 Mica | 236 Switches, ground |
| 52 Condensers, vernier | 146 Mica sheets | 237 Switches, inductance |
| 53 Contact points | 147 Milliammeters | 238 Switches, panel |
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| 55 Cord tips | 149 Molded insulation | 240 Tone wheels |
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| 57 Couplers, loose | 151 Mountings, coil | 242 Transformers, audio frequency |
| 58 Couplers, molded | 152 Mountings, condenser leak | 243 Transformers, filament |
| 59 Couplers, vario | 153 Mountings, end | 244 Transformers, modulation |
| 60 Crystal alloy | 154 Mountings, grid leak | 245 Transformers, power |
| 61 Crystal holders | 155 Mountings, honeycomb coil | 246 Transformers, push-pull |
| 62 Crystals, rough | 156 Mountings, inductance switch | 247 Transformers, radio frequency |
| 63 Crystals, mineral | 157 Name plates | 248 Transformers, variable |
| 64 Crystals, synthetic | 158 Neutrodyne set parts | 249 Transmitters |
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| 93 Generators, high frequency | | |
| 94 Grid choppers, rotary | | |



Solid Rubber Case

You Save 50%

World 6-Volt Storage Batteries are famous for their guaranteed quality and service. Backed by years of Successful Manufacture and Thousands of Satisfied Users. You save 50% and get a

2-Year Guarantee Bond In Writing
World Battery owners "tell their friends." That's our best proof of performance. Send your order in today.

RADIO BATTERIES
6-Volt, 100-Ampere . . . \$12.25
6-Volt, 120-Ampere . . . 13.25
6-Volt, 140-Ampere . . . 15.00

AUTO BATTERIES
6-Volt, 11-Plate . . . \$12.25
6-Volt, 13-Plate . . . 14.25
12-Volt, 7-Plate . . . 17.00

SEND NO MONEY
Just state battery wanted and we will ship day order is received, by Express C. O. D., subject to your examination on arrival.
Extra Offer: 5% discount for cash in full with order. Buy now and get a guaranteed battery at 50% saving to you.

WORLD BATTERY COMPANY
1219 S. Wabash Ave., Dept. 36 Chicago, Ill.



Approved and Listed as Standard by Leading Authorities including Radio News Laboratories, Popular Science Institute of Standards, Radio Laboratories, Radio Broadcast Laboratories and Lefax, Inc.

Solid Rubber Container
Now Standard equipment on all World Storage Batteries. No more leakage or breakage of jars or rotting of box.

Geared 80 to 1

Easy to tune—New principle prevents all back lash, gives infinite tuning precision. Fits all standard condenser shafts.

At all Dealers, \$3.50.

MYDAR RADIO CO.
9-K Campbell St. Newark, N. J.

ACCURATUNE

REGISTERED GEARED BOTH US PAT OFF
MICROMETER CONTROLS

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 Mfgs.' Rep. Manufacturer

Firm [If identified with Radio industry]

My Occupation

My Name

Address

City State

SUPER-HETERODYNE
Ultradyn—Haynes Griffin—Remler
Dealers: Send for Discounts

HUDSON-ROSS

123 W. Madison St. Chicago

With the Radio Manufacturers

(Continued from page 69)

Ultra-Lowloss Condenser

Here is a departure in condenser construction. Every detail in the construction of Ultra-Lowloss Condensers has been designed with one predominating thought in mind—highest possible efficiency by overcoming losses usually experienced in other condensers.

Special design and cut of stator plates produces a straight line wavelength curve—separates stations evenly over the dial.



Minimum of metal in the field and frame of high resistance material reduces eddy current losses. Monoblock mounting with plates cast into block reduces series resistance and insures perfect contact with all plates. The use of only one strip of insulation answers the function of two and four pieces and reduces leakage losses proportionately. Adjustable ball bearing insures smooth rotation and constant capacity calibration.

In addition to low-loss features, the Ultra-Lowloss Condenser is specially designed to simplify close accurate tuning. With two stations of known wavelengths located on the dial, other stations separated by the same number of meters are the same number of degrees apart on the dial. The dials may therefore be accurately calibrated.

Radio Faking on the Wane

Radio advertising is becoming more accurate, the first issue of the new publication of the merchandising section of the Better Business Bureau, "Accuracy," says in an article headed "Radio Faking on the Wane." With this good news for the buyers of radio equipment, "Accuracy" also refers to the recent steps taken by various trade groups to cooperate with the Better Business Bureau in its efforts to keep radio advertising free from misrepresentation, and says:

"This situation is not merely contemporaneous with the launching of the merchandising section of this Bureau and the tangible corrective actions taken in numerous specific cases. Constructive efforts which have been put forth from several directions are bearing fruit.

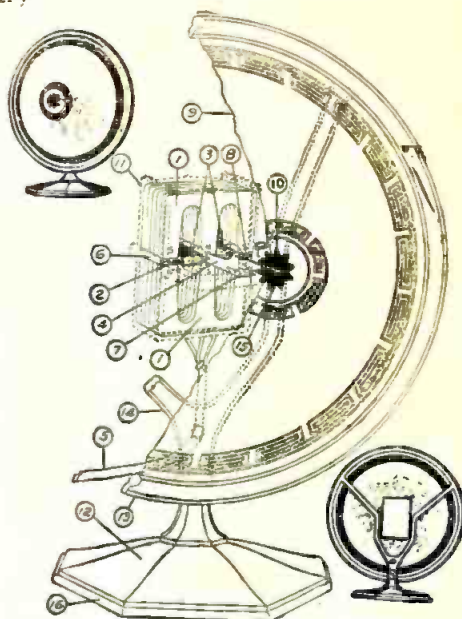
"First, the industry is outgrowing its infancy and leaders are, by example, establishing standards of selling practice. Second, for months past, the radio trade press has devoted much space to educational articles and to strong editorials urging that the fair name of the industry be protected. Third, local newspapers, jealous of reader-confidence, are on the alert to reject deceptive radio advertising.

New Crosley "Musicone" On the Market

The Crosley Radio Corporation of Cincinnati, Ohio, have placed their new loud speaker, the "Musicone," on the market for radio fans, thus entering into the loud speaker field in addition to the manufacture of the famous Crosley line of radio receivers.

The Crosley Musicone has many new and unusual features, which are described in the illustration and explanatory table on this page. The speaker sells at a comparatively low price.

A new unit noted for its clarity and volume has been incorporated into the Musicone, which is now being distributed to Crosley dealers throughout the country.



Parts in the Crosley Musicone

- | | |
|----------------------|-------------------------|
| 1. Laminated magnets | 9. Cone diaphragm |
| 2. Armature | 10. Set screw |
| 3. Armature coils | 11. Magnet frame |
| 4. Armature lever | 12. Base |
| 5. Cord | 13. Rim |
| 6. Pure rubber pads | 14. Frame |
| 7. Lever spring | 15. Metal reinforcement |
| 8. Lever rod | 16. Felt base |

"Who's On The Air" Published

Those who have not as yet made the acquaintance of the new book called, "Who's on the Air," have a pleasant surprise in store for them.

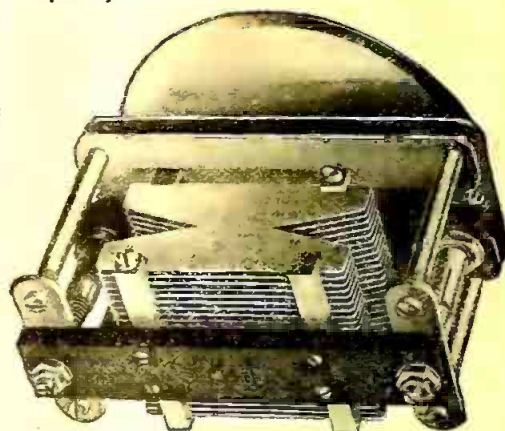
This book is the only radio book of its kind and contains a ready reference to who is on the air between the hours of 8:30 a. m. and 3 p. m., Eastern Time. All the listener has to do is look at his watch and open the book and he can immediately ascertain who is on the air according to their regular broadcasting schedules.

The author of this book must have been an enthusiastic radio fan, because he has certainly tried to give his brother fans their full dollar's worth. The center spread is a distance map. There are six pages of broadcasting stations arranged by call letters and three pages arranged geographically, a page showing the power of the station, four pages for logging stations, and numerous other pages showing symbols, terms, etc.

"Who's on the Air" fills a real need in radio reception and is made up in a way that makes it a very convenient aid to

Wade Square Law Condenser

The Wade Condenser is unusual in design and incorporates many features which are new and found in no other condenser. Both sets of plates are specially insulated from frame. A grounding terminal is provided on the frame; thus the frame becomes a shield and the condenser may be used in the most sensitive circuits, eliminating body capacity effects.



Angular cutting of the plates gives perfect straight line wavelength curve, which distributes the stations evenly over the dial. This feature not only simplifies tuning, but adapts the condenser for use in wave meter and standard circuits. It also makes it possible to locate any station on the dial after once having located any station of given wavelength.

Equipped with a four inch vernier silver finished dial graduated in three hundred and sixty degrees. Gear ratio, sixteen to one, which is equal to thirty-two to one on the ordinary one hundred and eighty degree dial. This three hundred and sixty degree dial gives greater distance between stations for tuning.

Plates are stamped brass, soldered together in one unit. This arrangement reduces series resistance and skin effect losses.

Wade Condensers are manufactured by the Wade Manufacturing Company, Inc., 1819 Broadway, New York.

WENR Now on the Air

Station WENR, owned and operated by the All-American Radio Corporation, at 2650 Coyne Street, Chicago, Illinois, after a successful initial test program, went on the air last month with a regular schedule.

The power used for the present is 100 watts, with a wavelength of 266 meters, and will divide time with station WBCN, also of Chicago and on the same wavelength. The present schedule of WENR is: Tuesday, Thursday and Friday evenings from 7 to 8 and from 9 to 10; Saturday 6 to 8 p. m., and 2:30 to 4 p. m. Sundays.

The program director of the new station is Frank Westphal.

the broadcast listener. Although the need of such a book has existed for some time, the tremendous amount of patience and monotonous labor has probably discouraged its production before.

Further information can be obtained from the Air Guide Publishers, 409 National Bldg., Cleveland, Ohio.

Is The 'ANNUAL' in your Vacation Kit?



IF YOU intend to take a trip this Summer, you're surely going to keep in touch with Radio, either by bringing a set along or building one during the dull afternoons, from parts you can take with you. AND how are you going to build this set or study up on radio for the big season that is bound to come in September?

The answer is simple. All you have to do is to invest ONE DOLLAR in a RADIO AGE ANNUAL for 1925, the world's most complete and authoritative hookup book, and take it with you, whether you go to Eagle River or the River of Doubt.

Let the ANNUAL for 1925 be your Radio Companion this Summer! It will tell you whatever you want to know in the radio line—from troubleshooting of the little faults that may develop far from home—to the actual construction of simple portable sets or elaborate multi-tubers.

GET THE ANNUAL NOW—and THEN go on your vacation! It will be your radio safeguard!

A Wealth of Blueprints for your Dollar!

How many blueprints could you buy for a dollar if you started out to buy them, one by one? Very few, you'll admit. Yet in the RADIO AGE ANNUAL for 1925 you'll find sixteen full pages of blueprints in actual color, explaining concisely every important simple and complicated hookup developed during the past year! The 32-page blueprint section of the ANNUAL is worth many times the purchase price of the book alone. Order the ANNUAL NOW—for the limited first edition is rapidly being bought up by eager radio enthusiasts.

\$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, feed-

back receivers, neutrodyne, 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.

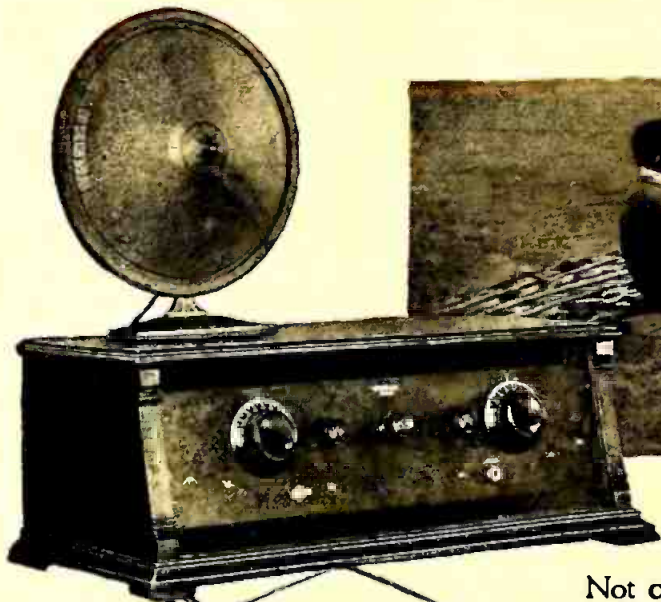
Gentlemen: I want to be one of the first to get the RADIO AGE ANNUAL FOR 1925. Enclosed find \$1.00. If I am not satisfied with the ANNUAL I will return it within five days and you will refund my dollar.

Name.....

Address.....

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

What the Trirdyn gets where it's hotter than Summer!



Crosley Trirdyn—on the Sahara Desert at mid-day—brings in Radio-Paris on the loud-speaker!

Not only at mid-day, but in February—in Northern Africa and far hotter than any American summer.

The picture above, a post card snap shot sent from Tunis to Mr. Crosley, by D.F. Keith of Toronto, Ont., tells this story on the other side:—

Tunis, North Africa, March 3, 1925

Dear Mr. Crosley:

Fishing here is rotten but radio is fine. On the Sahara, using three tubes on the Trirdyn circuit, reception from Paris came through on the loud-speaker. Along the south coast of the Mediterranean, using this set, six or eight high power European stations came in with good volume by day-light and all of them after dark. Can usually get a few American after 1 a. m. Can you fish with us this year?

Cordially,
(Signed) D. F. Keith

Further details on the margins of the picture:—

Sahara Desert, 250 miles south of Algiers, February, 1925. Receiving noon-day concert from "Radio-Paris", Paris, using aerial and counterpoise.

Who said summer in America is a poor time for radio—if the receiver is a Crosley Trirdyn?

Every radio fan—actual and aspiring—is invited to think this over and then act.

On the Trirdyn is the beautiful new Crosley Musicone, radio's most startling development. The Musicone's abilities and its beauty are so superior that we expect it to replace half a million loud-speakers this year. \$17.50.

The Crosley Radio Corporation, 663 Sassafras St., Cincinnati
Powel Crosley, Jr., President

CROSLEY RADIO

Better—Costs Less

* Tested and Approved by RADIO AGE *

\$65⁰⁰
Accessories Extra

*** Crosley Trirdyn Special**

Three tubes better the results of five or six

A highly efficient, non-radiating combination of tuned radio frequency, Armstrong regeneration and reflexed amplification.

New cabinet, sloping panel
Battery self-contained
Exclusive Crosley
3-tube circuit



Blueprint Section Every Month

RADIO AGE

The Magazine of the Hour



JULY
1925
25¢

278
1925
29
JUN
31 60
1925

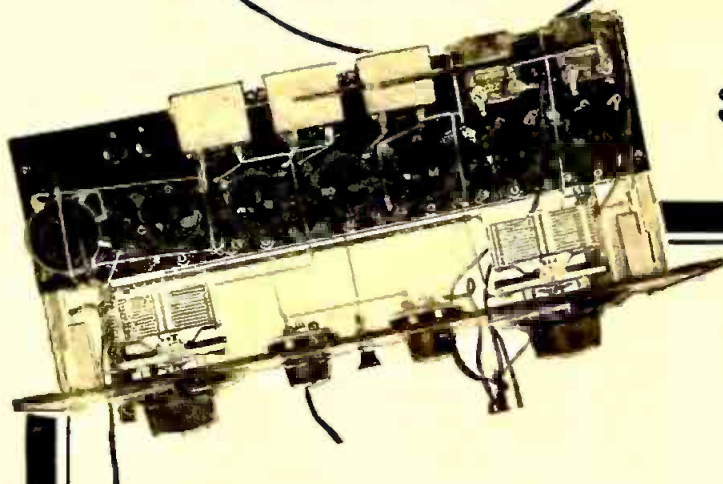
In This Issue—

- Ten Commandments for the Listener
- A New Super-Heterodyne
- Solving Tube Troubles
- News of Radio Age's Popularity Contest

ANKER
PAUL
MEHLUM
1925

MEET YOUR BROADCAST FAVORITES

SUPER- AUTODYNE



New!

A Perfected Super-Heterodyne

Again Silver-Marshall Engineering leads the field, just as it has since the first Silver Design was offered less than a year ago.

Not content with a seven-tube super-heterodyne, which has become the acknowledged standard of comparison with radio engineers and editors, McMurdo Silver, Assoc., I. R. E., has developed "The Super-Autodyne," a six-tube receiver that will outperform average seven and eight-tube sets.

Read the description of this remarkable radio achievement in this issue of "Radio Age." Plans and instructions describing this set in detail may be had for 50c.

Complete Parts

2 S-M 305A S-L-W Condensers	Each \$ 5.00	2 Thordarson 3 1-2-1 Transformers	Each \$ 4.00
2 4" Moulded Dials	1.00	2 .002 Condensers	.40
1 U. S. L. 6-Ohm Rheostat	1.00	1 .0075 Condensers	.75
1 U. S. L. 240 Ohm Potentiometer	1.50	2 .000025 Balancing Condensers	1.50
3 Insulated Top Binding Posts	.05	1 S-M .25 Meg. Leak	.50
1 Carter 101 Jack	.70	1 S-M 2 meg. Leak	.50
1 Carter 102A Jack	.80	1 Carter No. 3 Jack Switch	1.15
1 S-M 211 Filter with Matched Tuning Capacity	8.00	1 Benjamin 8630 Switch	.30
2 S-M Charted Intermediate Transformers	8.00	1 Belden Color cable	.85
1 S-M 101B Coupling Unit	2.50	1 Pair Benjamin 8629 Shelf Brackets	.70
1 S-M 6-Gang Socket shelf (536-201A, 537-UV199)	10.80	1 Bakelite panel, 7"x18"x3-16", drilled, grained and engraved	6.00
		Spaghetti, bus bar, lugs, screws, butts, etc.	1.00

Send for "The WHY of the Super-Autodyne"—It's Free;
Dealers—Ask for Our New S-M Catalog

Silver-Marshall, 114 S. Wabash Avenue,
Chicago, Illinois

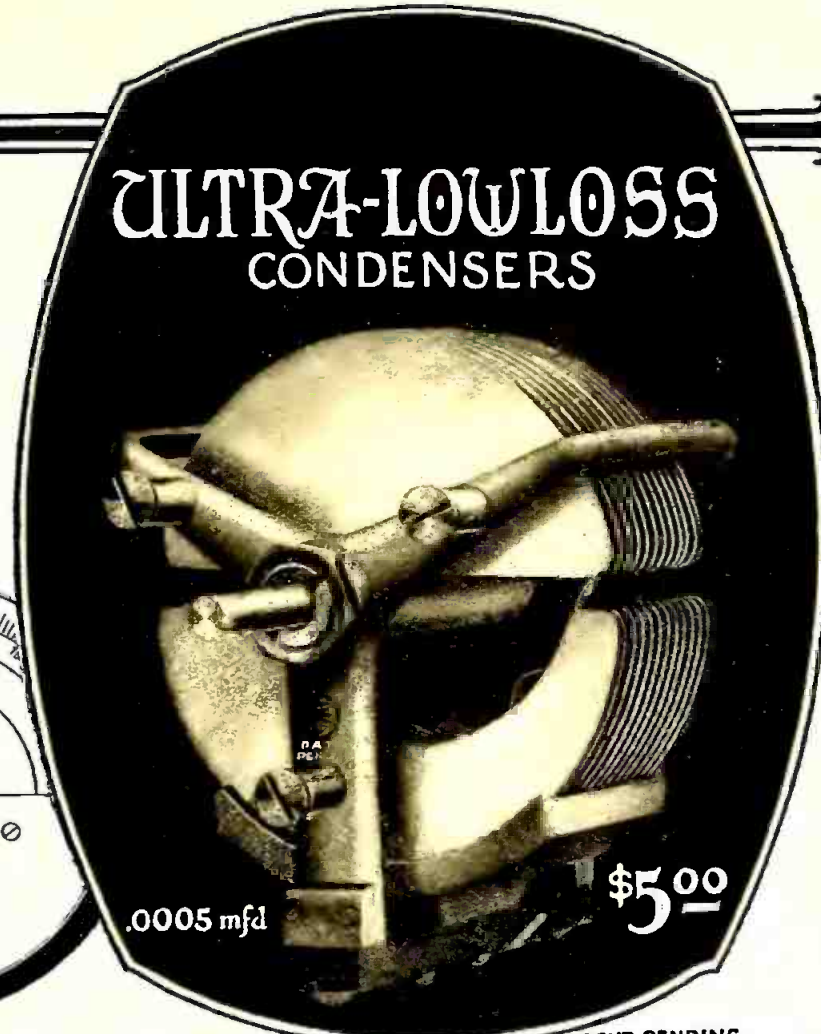
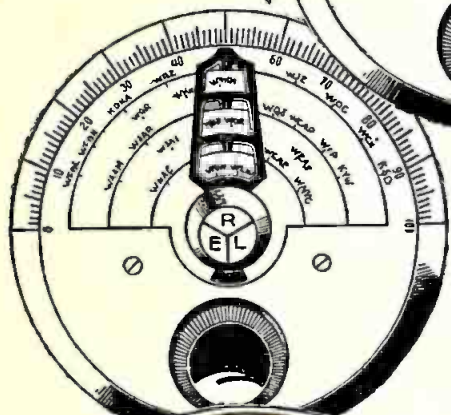
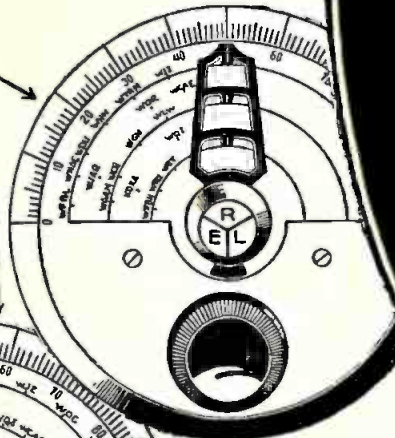
*Trade
Mark

Stations Don't "Bunch" On the Dials



Showing stations "Bunched" as they are found on a 100 degree dial using any ordinary condenser.

The location of the same stations on the same dial using Ultra-LowLoss Condensers—"spread," simplifying tuning.



Tuning Simplified Now!

THE day of tedious fumbling about for your stations is past—science has been brought into play. Now, with the Ultra-LowLoss Condenser you can instantly tune in on any station as easy as turning the hands of a clock to the hour.

With one station of known wave length located on the dial, all others can be found instantly. Each degree on a 100 degree dial represents approximately $3\frac{1}{2}$ meters difference in wave length. This applies to both high and low wave lengths. Other than 100 degree dials vary accordingly.

This simplification of tuning is made possible by the new Cutless Stator Plates to be found only in the Ultra-LowLoss Condensers. Every feature of the Ultra-LowLoss Condenser was developed with one predominating purpose—to overcome losses common in other condensers. Designed by R. E. Lacault, originator of the famous Ultradyne Receivers and Ultra-Vernier Tuning Controls.

At your dealer's, otherwise send purchase price and you will be supplied postpaid.

Design of lowloss coils furnished with each condenser for amateur and broadcast wave lengths showing which will function most efficiently with the condenser.

To Manufacturers Who Wish To Improve Their Sets
Mr. Lacault will gladly consult with any manufacturer regarding the application of this condenser to his circuit for obtaining best possible efficiency.

ULTRA-VERNIER TUNING CONTROL

Simplifies radio tuning. Pencil record a station on the dial—thereafter, simply turn the finder to your pencil mark and you get that station instantly. Easy—quick to mount. Eliminates fumbling, guessing. A single vernier control, gear ratio 20 to 1. Furnished clockwise or anti-clockwise in gold or silver finish.

Silver \$2.50

Gold \$3.50



This seal on a radio product is your assurance of satisfaction and a guarantee of Lacault design.

ULTRA-LOWLOSS CONDENSER

PHENIX RADIO CORPORATION, 116-B East 25th St.
New York City

RADIO AGE

The Magazine of the Hour

Established March, 1922

WITH WHICH IS COMBINED RADIO TOPICS

Volume 4 ✓

July, 1925

Number 7 ✓

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A Chat With the Editor

YOU can count on the fingers of your two hands the basic radio receiver circuits from which all the many scores of hook-ups now existing may be developed. All those basic circuits are to appear in blueprint form in the August issue of this magazine. Our technical staff has selected the typical circuits which represent the various basic arrangements, most of which have appeared during 1924 and 1925 in RADIO AGE.

John B. Rathbun, the able draughtsman whose blueprints in this magazine have become standard in schools and in many thousands of radio homes, will have in this *de luxe* edition of RADIO AGE an exhibit of tested basic circuits which will make our August issue one of the most important radio contributions since broadcasting began. The blueprint section of the August number will itself be of almost the bulk of the regular magazine. With the addition of other standard RADIO AGE features the book will take on proportions that should delight the fan who wants his radio course from crystal to super, all under one cover.

Notwithstanding the unusual value offered in this big issue of our magazine the news-stand price will be the same as other issues; 25 cents. It is a matter of wide comment that RADIO AGE costs no more from month to month than other standard radio publications, although its blueprint section in each issue sets it apart from all other magazines. Now we are to offer you a complete collection of blue prints with complete constructional instruction in a single issue and for the regular price.

We would advise readers who wish to make sure of getting this remarkable August number that they tell their newsdealer to reserve their magazine for August NOW. If your dealer does not handle RADIO AGE write to us at 500 North Dearborn street, Chicago, enclosing 25 cents in stamps and we will mail you one on July 15, the day it goes on sale.

Frederick Smith

Editor of RADIO AGE

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EVERY TUESDAY AT 9 P. M.
(Eastern Standard Time)

For real radio enjoyment tune in the "Eveready Group." Broadcast through stations—

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| WJAR Providence | WSAI Cincinnati |
| WEEL Boston | WWJ Detroit |
| WFI Philadelphia | WCCO { Minneapolis |
| WGR Buffalo | { St. Paul |
| WCAE Pittsburgh | WOC Davenport |

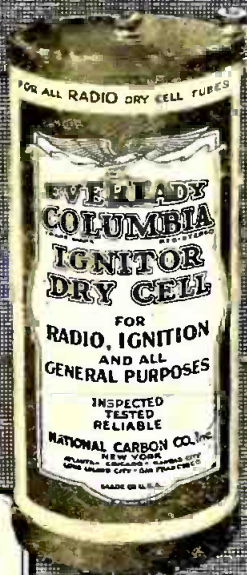
Get a good set— and Evereadys

To ENJOY radio for the rest of your life, get the best set you can afford. There are receivers at all prices, made by reputable manufacturers; it isn't necessary for anyone to get 'round-the-corner, unproved, unreliable merchandise at any price. That applies to batteries too. Eveready Radio Batteries are made in so many sizes and prices that there is a correct, long-lasting Eveready for every receiver and for every radio home, ship or commercial station. Specify Evereadys for your new radio set. It is false economy to buy nondescript batteries at any time. In the long run you'll find it most economical to buy either the large or extra large Evereadys. Always buy Evereadys and enjoy the knowledge that no one can get any more in batteries for the money than you. There is an Eveready dealer nearby.

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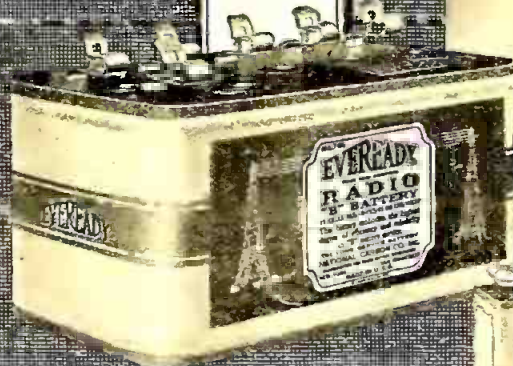
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RADIO EDITORIALS

RADIO CORPORATION of America has completed its "proof" that in adopting the name RADIO AGE this magazine stepped on the cloven hoof of the corporation. The RCA contends that RADIO AGE, as a name, infringes on the name "Wireless Age," a publication owned by the Radio Corporation. Radio Corporation last fall brought formal action in the United States Patent Office at Washington opposing the application to have RADIO AGE registered as a trade mark.

The \$33,000,000 group apparently held the fond notion that RADIO AGE would immediately yield its rights, rather than go into a legal battle with one of the Four Horsemen of Radio. On the contrary, RADIO AGE engaged the services of several of the best lawyers obtainable and we have seen the thing through. On May 5, in the Corporation offices in New York, the Corporation completed the taking of testimony of its own witnesses. The Corporation labored and brought forth a peanut tube.

It was an imposing array of witnesses and we regretted that Mr. Sarnoff, vice president and general manager of the RCA horse, was unable to be present. Mr. Sarnoff was busy preparing for a banquet. He is a banqueteer of parts. No hungry Cassius he.

At the last Hoover conference, Charles E. Erbstein faced the representatives there present in the interest of the Radio Corporation. Westinghouse, General Electric and American Telephone and Telegraph, and told them they were the Four Horsemen of Radio.

The name stuck. A few weeks later Mr. Sarnoff and Mr. Erbstein were present at a radio dinner in New York. Mr. Sarnoff approached Mr. Erbstein and asked in a gently sardonic tone:

"Tell me; which one of the Four Horsemen am I?"

"Pestilence!" responded Mr. Erbstein in a flash.

"Not famine?" inquired Mr. Sarnoff, somewhat taken back.

"You, Famine? Never!" murmured Mr. Erbstein.

So, on the occasion of the taking of depositions calculated to prove that RADIO AGE is guilty of unfair competition and is injuring the business of "Wireless Age," Mr. Sarnoff was preparing for another banquet.

It was necessary that the RCA witnesses swear to facts that would support the contention that the words "wireless" and "radio" mean the same thing. If this were proved, Radio Corporation might hope to get somewhere with its argument that in adopting the name, RADIO AGE, this magazine was appropriating, in effect, the name "Wireless Age," which does not belong to this magazine, but belongs to the New York monthly wireless publication, every share of stock in which is owned by Radio Corporation.

The witnesses then swore "wireless" and "radio" meant the same thing. No distinction whatever so far as the man on the street was concerned. But it developed, on cross examination, that all the witnesses were on the payroll of the Corporation and therefore could not well be criticised if their expert views on the significance of words partook of the same general tendency as the views of the kind and loving old Radio Corporation.

It also was necessary to prove that the use of the name RADIO AGE was causing injury to the business

of Radio Corporation's magazine, which, they assure us, is called "Wireless Age." Therefore, a witness testified that newsdealers get the two magazines all mixed up and that although one is published in New York and the other in Chicago, dealers often send unsold copies of RADIO AGE to "Wireless Age." The circulation manager of "Wireless Age" produced one letter in support of this contention. He said he had looked hard for other documentary evidence of the universal confusion between RADIO AGE and "Wireless Age" but the one letter was the best he could do.

Another Corporation employe swore that at the Pageant of Progress in 1922 he heard subscription solicitors in the RADIO AGE booth telling the gullible public that RADIO AGE was published by the Radio Corporation of America. This witness testified he immediately complained to the manager of the Pageant that the RADIO AGE solicitors were telling naughty little lies. So, he testified, the manager threw the solicitors out of the Pageant, and the RADIO AGE booth remained empty and free of guile from then on until the show closed. This witness admitted he never brought these matters to the attention of the officers of RADIO AGE, Inc., and that he didn't report the incident to "Wireless Age" until May, 1924—almost two years later. A long time to carry such a pineapple around in one's craw.

Mr. Pierre Boucheron, general manager of the advertising and publicity departments of Radio Corporation and vice president and General manager of Wireless Press, Inc., which publishes "Wireless Age" for Radio Corporation, was easily the star witness for Radio Corporation. He, too, thought "wireless" and "radio" were identical in meaning. But on cross examination he admitted that since the action against RADIO AGE was begun, the name of the magazine which is claiming it is suffering great injury from competition by RADIO AGE *changed its own name* from "The Wireless Age" to "Wireless Age, The Radio Magazine." The change was officially announced in the corporation's magazine last November. It was explained in this announcement that the old title was being retained in part so that the magazine might be more easily identified by those who were more specially interested in *wireless*. Yet "wireless" and "radio" mean the same thing!

A man might be obviously right from start to finish in a controversy such as this and in the end might prove himself to be right. But he would have been compelled to finance his defense and, though he be right as a trivet, he could not obtain recourse against predatory interests who put him to all the trouble and expense. That's why a \$33,000,000 band of patriots has a big advantage in opposing an individual of much more modest resources. Doesn't seem to be quite all square with our fundamental ideals of equal opportunity and equal rights under the law, does it? We were warned three years ago that if RADIO AGE criticised certain radio interests those interests would step on us. Yet we criticised radio monopoly and we are going to keep it up. If we still thrive where others faint, it may be because our readers and newsdealers are not so confused as some folks hope they are.

"Radio Age" Contest Is

Popularity Now Closed!

Race is Still Neck and Neck As Aldine Starts the Official Count of Last-Minute Ballots; Name of Winner to Be Revealed Next Month



At the left is the attractive shield which will be awarded the winner in the RADIO AGE Popularity Contest, which closed on June 15. Its size overall is six by eight inches, and a detailed description is contained in the article on this page by Mr. Aldine, the persevering Contest Editor for this magazine.

BY THE time this issue of RADIO AGE appears on the news-stands, the RADIO AGE Popularity Contest will have ended, as only those votes received before midnight of June 15 will be credited to the total count of candidates.

As this review is being written (May 16,) there still remain a full thirty days, during which period the winner will be definitely named, and judging from the heavy voting which has taken place during the past thirty days, no candidate is yet assured of the coveted position at the head of the list. At no time in the history of the contest have the three leading candidates been so closely bunched.

To further complicate matters, "Uncle John" Daggett, 'way out on the Pacific Coast, has jumped from ninth to fourth place, where he stands menacingly, offering dangerous competition to the three popular leaders. By referring further to the "Standing to May 15" it will be found that Art Linick has also bettered his position by stepping one more round toward the top of the ladder, from eighth to seventh place.

On this page will be found an illus-

By HARRY ALDINE

tration of the shield which will be awarded the winner of the RADIO AGE Popularity Contest. From a background of artistic black will stand out in raised gold letters The Winner's Name, and the inscription, "First Annual RADIO AGE Broadcast Entertainers' Popularity Contest—1924-25."

Surrounding this will be a plain gold border conforming to the shape of the shield. The gold plate will in turn be mounted on a dead black bevel-edged wooden plaque, to which is attached a chain for hanging. The size, overall, is six by eight inches.

While several ideas were offered for the design of the shield, the one accepted seemed to conform most to the principles of dignified simplicity, and was therefore the most forceful manner of declaring to the world the winner of the contest.

Following is the standing of the candidates as they are lined up at present:

WINNERS OF PRECEDING MONTHS

July.....	Duncan Sisters, KYW
August.....	Bill Hay, KFKX
September..	Karl Bonawitz, WIP

October.....	H. W. Arlin, KDKA
November.....	Bert Davis, WQJ
December.....	Jack Nelson, WJJD
January.....	Art Linick, KYW
February.....	Coon-Sanders Orchestra, KYW
March.....	John S. Daggett, KHJ

STANDING TO MAY 15

Name and Classification	Where Heard
Karl Bonawitz, Organist.....	WIP, Philadelphia
Bert Davis, Entertainer.....	WQJ, Chicago
Bill Hay, Announcer.....	KFKX, Hastings
John S. Daggett, Announcer.....	KHJ, Los Angeles
H. W. Arlin, Announcer.....	KDKA, Pittsburgh
Coon-Sanders' Nighthawks, Orchestra, KYW, Chi.	
Jack Nelson, Announcer.....	WJJD, Mooseheart
Art Linick, Entertainer.....	KYW, Chicago
Harry M. Snodgrass, Entertainer.....	WOS, Jefferson City
Ford & Glenn, Entertainers.....	WLS, Chicago
Duncan Sisters, Entertainers.....	KWY, Chicago
Lee Sims, Pianist.....	KWY, Chicago
Lambdin Kay, Announcer.....	WSB, Atlanta
J. Remington Welsh, Organist.....	KWY, Chicago
Fred Smith, Announcer.....	WLW, Cincinnati
E. L. Tyson, Announcer.....	WWJ, Detroit
Hired Hand, Announcer.....	WBAP, Fort Worth
"Sen" Kaney, Announcer.....	KWY, Chicago
Nick B. Harris, Entertainer.....	KFI, Los Angeles
Jerry Sullivan, Announcer-Entertainer, WQJ, Chi.	
Edward H. Smith, Director-Player.....	WGY, Schenectady
Charles E. Erbstein, Announcer.....	WTAS, Elgin
Wendell Hall, Entertainer.....	WDAF, Kansas City
Howard Milholland, Announcer.....	KGO, Oakland
Scottich Rite, Orchestra.....	KGO, Oakland
Banks Kennedy, Entertainer.....	WEBH, Chicago
S. Hastings, Announcer.....	KFI, Los Angeles
Robert Boniel, Announcer.....	WEBH, Chicago
Arion Trio, Instrumental.....	KGO, Oakland
Gold Dust Twins, Entertainers.....	WEAF, New York



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letters to 100 people
to reach just two men?

Then, before you invest your advertising dollars—**THINK!**

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RADIO AGE

The Magazine of the Hour

M. B. Smith
Business Manager

A Monthly Publication
Devoted to Practical
Radio

Frederick A. Smith
Editor

What will Tomorrow Bring— Four, Five or Six TUBES?

Our readers' vote is requested upon the number of tubes that will prove most popular during the coming radio season. Will economy rule with the use of the four tube set, will we adhere to the present popular five tube set, or will we attain quality with the six tube set regardless of the increased price? This is a question that the radio dealers and RADIO AGE would like to have answered by our readers.

IT was not so very long ago that the three tube regenerative receiver marked the height of affluence in the radio world and that the owner of such a super-set was enviously regarded by his fellow B. C. L.'s who were still getting their music via the single tube and the crystal set. In those days we could consistently get coast-to-coast reception or its equivalent on three tubes, and with the tubes retailing at \$6.50 each and the receiver itself hovering around the \$200 mark, the old three lunker was held in the same regard as the most elaborate five tube set of the present day. It tuned as broad as a barn, howled like a fiend and munched up the signals, but in her day the old three did her stuff, as the many DX records of 1921-1922 will testify.

Repeated refinements in the regenerative circuit, brought the three tube regenerative up to a high degree of efficiency in bringing in distance, but in the craze for distance we sacrificed selectivity and tonal quality. They were superlatively sensitive to weak signals, but as most of the old timers were of the single circuit type or were provided with the old inefficient vario-coupler, they were very broad-tuning and could not possibly cope with the present day congestion of radio traffic, even though they did have from five to ten tuning controls. There were more dials and less selectivity in 1922 than at any other time in radio history.

Just as a review on the subject of tuning controls let me list the dials and knobs that commonly appeared on the panels of the old time three tube three circuit regenerative:

1. Primary Variable Condenser Dial.
2. Rotor of Vario-Coupler Dial.
3. "Tens" Tap Switch Knob.
4. "Units" Tap Switch Knob.
5. Series-Parallel Switch (Sometimes).
6. Secondary Variable Condenser Dial.

By ROSCOE BUNDY

Trend Seems To Be Toward Clear Music

7. Secondary Tap Switch Knob.
8. Grid variometer Dial.
9. Plate variometer Dial.
10. Variable Grid Leak Dial.
11. Detector Rheostat Knob.
12. First Stage Audio Rheostat Knob.
13. Second Stage Audio Rheostat Knob.
14. Battery Switch Knob.

The Man Pays This Time!

SOME price to pay for an attempt at selectivity! A maze of confusing controls that were not half as effective as the three tuning dials and two rheostats that appear on the panel of the present time tuned radio frequency receiver, and which required considerable practice before they could all be brought into adjustment.

The constant urge for more distance resulted in the first appearance of radio frequency steps which at that time were simply auxiliaries to the original regenerative receiver and increased the complication considerably without much return

in the way of improved performance. The radio frequency steps were coupled with primitive untuned radio frequency transformers that were little better than coupling condensers, and which peaked badly on some particular wavelength, generally on the wavelength of one of the local stations that you were trying to tune out.

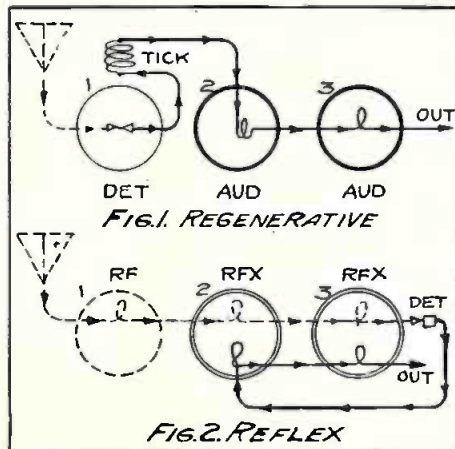
At this stage of development the addition of tubes was a serious proposition, for the tubes then drew anywhere from 0.75 to 1.0 ampere each, so that a four tube outfit would draw up to four amperes total, or four times as much "A" battery juice as the largest tubes of the present day.

You could easily run down a freshly charged battery in the course of one evening and then wait over for a day while you recharged your battery with some ineffective trickle charger, generally of the buzzer type. Those were the days when the buzz of the charger was continuous in the land and when the battery spent as much time on the charger as on the receiver. You would feed it five amperes all day only to have the receiver drain out all of the profits by 12 o'clock p. m.

There is no doubt but what the 0.25 ampere tube of the 201A type made the multi-tube set a practical possibility, and that further increases in the number of tubes will also depend upon the development of tubes of the 199 type which will make dry cell operation practicable with five tubes or more.

The Reflex Enters

OWING to the necessity for battery conservation with the old tubes, the coming of the reflex circuit was heralded with joy and much of 1923 was devoted to the development of the reflex circuit by experimentally inclined amateurs. Partly for the reason that the radio frequency transformers of 1923 did not measure up to the standards demanded by the reflex, and partly for the reason that reflex principles were not well understood, the reflex did not attain the popularity that was expected by its sponsors, and there was a decided tendency toward falling back on the old reliable regenerative circuit, with which almost any beginner could expect to get some sort of results. There were many reflexes that gave phenomenal performance, but in the main, the radio public soon discovered that the reflex of that time was not an ideal circuit for the



Figs. 1-2. Three Tube Circuits Commonly Used. Dotted Line Represents Radio Frequency and Solid Line is Audio Frequency.

novice and that special precautions were necessary that rather took it out of the home-builder's province.

Things hovered around this condition for some time until a change in radio took place with the appearance of the five tube neutrodyne, the father of all the numerous five tube "dynes" now on the market and the salvation of the reflex principle. The neutrodyne was not the first tuned radio frequency outfit by any means, for we had plate tuned circuits long before this, but it was the first stable five tube radio frequency set that could be built with any degree of success by the average home-builder.

With all due respect to the neutralizing principle as applied to the suppression of self-oscillation in the radio frequency stages, the real advantage of the neutrodyne, according to my idea, lay in the constructional details such as the tuned radio frequency transformer and the aperiodic or semi-aperiodic coupler. By these units we could approach a degree of selectivity hitherto unknown, by means of very simple units; and further, we could peak our radio frequency amplification on the desired wavelength instead of adopting the compromise amplification of the older fixed transformer. Again, this was the first fairly high power set within reach of the average amateur and the first practicable set with more than three tubes which had appeared. Tonal quality was improved as well as distance and selectivity, and in general it took the radio world by storm in spite of the cost of the five tubes, which averaged about \$5.00 each at that time.

The rapid increase in the popularity of the neutrodyne brought a perfect flood of five-tube tuned frequency sets on the market with all sorts of weird methods of suppressing free oscillations. The question of battery current consumption could no longer be leveled against these circuits, for the 201A tube gave a total consumption of only 1.25 amperes against the 3.0 amperes formerly necessary with the old tubes in the three tube regenerative receivers; hence we could run longer per charge with the new five tube combination than with the old detector-and-two-stage outfit.

Under the new system, coast-to-coast reception on the loud speaker was so common as to cause no comment and we could bring in real distance through the most powerful, local broadcasting stations with ease. For the first time we could bring in a station without the

accompaniment of the shrieks and wild wailings that were prevalent in the regenerative era and hear music and voice without a background of hissing and frying sounds that formerly detracted so much from the enjoyment of a program. In clarity of tone, the five tuber was nearly equal to the reflex at its best, and the problem of perfect reception was therefore put up squarely to the manufacturers of loud speakers. It was now a question of developing a horn that was a fit running mate for the receiver.

New Twists Developed

In the meantime, we must not forget that all this improvement also stimulated experimental work on the regenera-

fixed primary coil. In fact, a modern three-tube circuit with this sort of tuner is fully the equal of an old four tube using the vario-coupler, and is not half as bothersome. Further, it can be "logged" so that each station comes in on a definite dial position, which was not formerly the case, making tuning certain and prompt when provided with a table of station wavelengths and a well prepared "log" of the corresponding dial positions. Logging is an essential with a modern receiver of any type.

Out of this perfection in regeneratives sprang a hybrid four-tube circuit type which is very popular today. This consists of a stage of tuned radio placed in front of the three tube regenerative which both increases the distance and selectivity and also counteracts the tendency of the regenerative unit toward causing annoying aerial radiations. The Brownings-Drake circuit is a prominent example of this type, which consists of one stage of tuned radio frequency amplification, regenerative detector, and two stages of audio frequency amplification. Both the coupler-tuner and the radio frequency transformer are special adaptations of the tuned coils originally used in the neutrodyne, although much more efficient and selective because of the absence of electrostatic coupling between the primary and secondary coils. Such circuits are rapidly increasing in favor, for they have great distance getting qualities for the number of tubes employed and are simple and cheap to build.

Revised Reflex Circuits

OUR reflex circuits now took on new life with the advent of the aperi-

odic type coupler and tuned air core radio frequency transformers, with the result that the modern reflex much more nearly approaches its theoretical advantages. The radio frequency component is now tuned by the same air core transformer units employed in the tuned radio frequency sets with greatly increased range and stability. By the same means, ohmic resistance is reduced, selectivity increased, and wonderful results are being obtained with only a few tubes. Two tube reflex sets with coast-to-coast reception and loud speaker volume on 500 mile stations are not uncommon where the improvements have been added. Where fixed R. F. transformers are used we now have true magnetic coupling instead of the capacity coupling had in the older types, and with modern untuned transformers we have excellent performance.

RADIO AGE BALLOT

(How Many Tubes Do You Prefer?)

BALLOT EDITOR,
Radio Age, Inc.,
500 N. Dearborn St.,
Chicago, Ill.

On the following list I have checked off the radio receiver that best fits my requirements, and have written my reasons in the blank space following the specifications.

CLASS 1. THREE AND FOUR TUBES. (a) Three Tube regenerative with transformer coupled audio stages, (b) Four Tube Regenerative with resistance coupling, (c) Three Tube Reflex, (d) Four tube reflex with loop, (e) Four tube regenerative with one stage of radio frequency.

CLASS 2. FIVE AND SIX TUBES. (a) Five Tubes, two stages of radio, detector, and two stages of resistance coupled audio, (b) Five tubes, One stage of radio, regenerative, detector and three resistance coupled stages, (c) Five Tube Reflex with loop, (d) Five Tubes, Two stages radio, regenerative detector and two stages of transformer coupled audio, (e) Six Tubes, Two stages of radio, regenerative detector, and three stages of resistance coupled audio, (f) Six Tubes, two radio, detector, three stages transformer coupled audio.

CLASS 3. SUPER-HETERODYNES. (a) Six Tube, (b) Seven tube (c) Eight tube.

REASON FOR MY CHOICE.....
.....
.....
.....

Name.....
Street or R. F. D.
City..... State.....

NOTE: If you do not wish to tear this blank out of your book, send a brief note covering the above points. It will do just as well.

tive and reflex circuits in which many of the radio frequency construction details were employed. For example, the aperiodic type coupler was now employed on regenerative and reflex circuits as well as with the tuned radio frequency outfits, at one time improving their performance and simplifying the controls. The old vario-coupler became a thing of the past. Single control regeneratives became more and more common, both wavelength and regeneration being sometimes controlled by a single variable condenser while taps and tap switches were placed in the discard.

A regenerative circuit of the new era consisted of a dial for tuning to wavelength, and perhaps another dial for the tickler. This was all there was to the proposition and we not only simplified things, but also obtained better selectivity, tone and distance with the

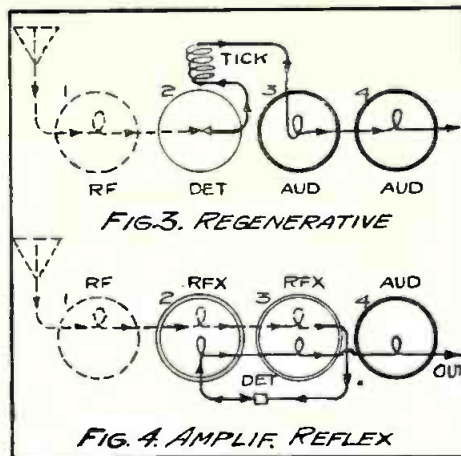
Three tube reflex circuits, using tuned radio frequency transformers throughout, give fully the results of a five tube straight radio frequency set when properly built, and have the advantage that they can be operated with dry cell "A" batteries with success. There are a number of "kit-sets" or complete sets of parts now on the market for building reflexes of this type, so that the construction of a reflex no longer is a problem for the advanced student of radio, but is entirely practicable for the rawest novice. This is in contrast to the conditions experienced in the old days when the builder of a reflex frequently had to buy enough material for two sets before he could find parts that would match up and function properly when hooked up in a reflex circuit.

In writing the above paragraph it brings to mind the great advantages enjoyed by the present day radio set builder compared with the trials and tribulations of the old-timer who had little to work with in the way of materials and still less data. In the old times, a smudgy illustration cut out of a newspaper with an exceeding inaccurate description was considered a "find," and with a few yards of barb wire and other miscellaneous junk, a valiant attempt was made toward the construction of a workable receiver. Nowadays, the builder can obtain accurate apparatus put up in complete kits so that an hour's work with a screw driver and pliers is all that is necessary. Each wire is cut to length and a detailed series of picture diagrams gives all the data that anyone could possibly ask for. In one way, however, all this spoon-feeding is a bad proposition, for it is getting to such a point that the experimenter is now too dependent upon others and is rapidly losing his spirit of self-reliance. Here at RADIO AGE, we find that the slightest omission in a description or in a drawing is sufficient to throw him all out of joint, and instead of trying a few simple experiments that could be performed in five minutes, he will write in and calmly wait for some one to work out his simplest problems for him.

The Super-Heterodyne

During the past year much work has been done on the development of the super-heterodyne principle and great progress has also been made along these lines. Properly designed, and with the proper materials, the super-het is the king of all receivers, but once again we warn the novice that he should obtain his apparatus in kit-set form to insure all of the parts being properly matched so that they will work together. To assemble a super-heterodyne out of a miscellaneous mass of unmatched parts of different makes requires a considerable amount of skill and experience.

Continued experiment has resulted in



Figs. 3-4. Four Tube circuits, Regenerative, With One Radio Stage (3) and Reflex Four Tube (4)

the development of six and seven tube super-hets which give fully as good performance as the standard eight-tube type, and have the further advantage that they are more compact, cost less, and take less battery current. Satisfactory results are being had with six and seven 199 tubes, which brings the set well down toward the limits of dry cell operation, and with such sets we obtain wonderful selectivity and loud speaker operation over great distances. Their tone value is of the best, and with a little experience they are easy to tune and handle. In fact, two condenser dials and a potentiometer are the only controls necessary.

Super-heterodynes are essentially a type designed for operation on a loop aerial, and for this reason they make a great appeal to those who have no chance to erect an effective outdoor aerial. Certain radio frequency and reflex receivers will also give good results on a loop, but the super-het is particularly adapted for this kind of service, and to a great extent, its selectivity is due to the directional properties of the loop aerial with which it is used. Its only drawback is its cost, which is considerably greater

than that of a corresponding grade of radio frequency or reflex receiver, and this item, of course, is sufficient to rule it out among many classes of radio fans.

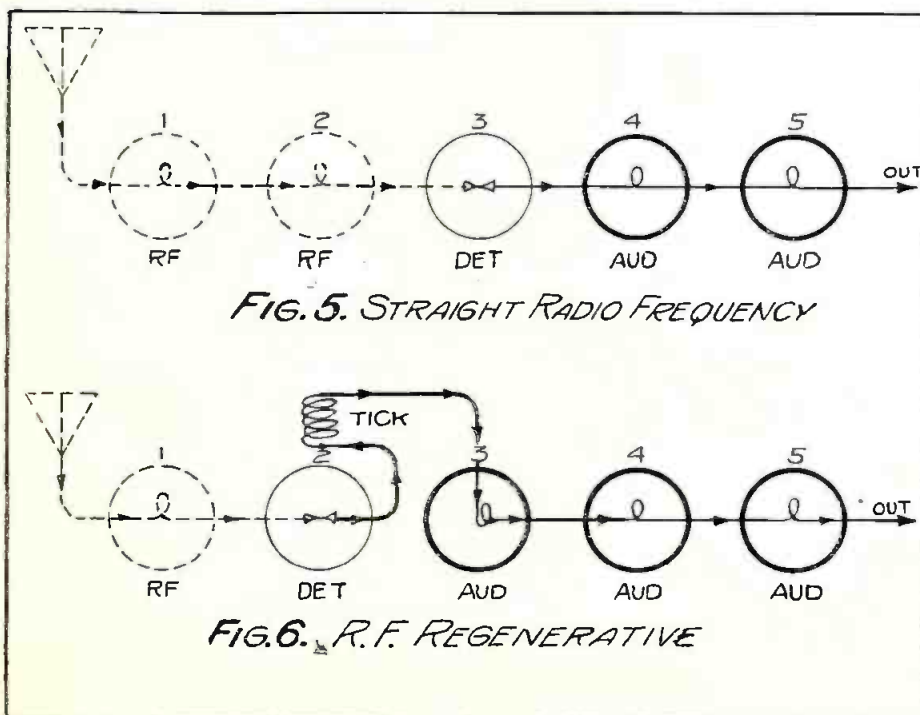
When the DX fever was at its height, with every effort bent toward getting distance at any cost, very little attention was paid toward eliminating disagreeable noises or for improving the tone of the receiver. In fact, the noise in the early broadcast receivers, coupled with the crude loud speakers of that period, was very effective in holding back prospective customers who possessed the most elementary sense of tone. The field was entirely in the hands of the distance fanatics, and they continued to hold it until the coming of the tuned radio frequency sets, with their improved reception, made an appeal to another class of listeners. The latter formed the bulk of those who purchased radio during the past year; people who objected to listening to the mangled remains of a sonata, just so that they could boast of hearing some peanut station 1,500 miles away. Better have good, clear, local reception on a crystal set for these prospects than a mushed up mess coming in from a distant station.

In addition to the inherent noises of the regenerative receiver, which were really not always so bad on the headphones, the early audio transformers were far from being perfect and added their din to the collection of noises annexed in the detector stage. High ratio audio transformers with their distortion, poor design and other factors made life miserable for the musician who was forced to hear the blasting and blare of the old horns or noise chutes. Improved transformer design, together with the use of low turn ratios, has greatly improved these conditions so that there is little distortion or noise within the receiver itself. Further, the introduction of resistance coupling in the audio stages made another step toward perfect tone, so that the tendency of today is rather in the direction of clear, undistorted reception than toward mere distance.

I am thoroughly convinced that future improvements in radio apparatus will be

along the lines of tonal improvement and that the buying public is more interested in tone quality than in the attainment of distance. A good, clear natural tone with moderate distance getting qualities; low current consumption so that dry batteries can be employed; stable performance without nerve racking shrieks and howls, and perfect selectivity are the characteristics of the salable radio receiver of the future. The experimenter and the DX hound have already been served, so that our next appeal is to that class of music lovers who have not yet seen fit to buy radio equipment.

The reproduction must be fully equal to that of the best modern phono-



Figs. 5-6. Five Tube Circuits. Two Stages of Radio Frequency and Audio (5), and Resistance Coupled Five Tube With One Radio Stage (6).

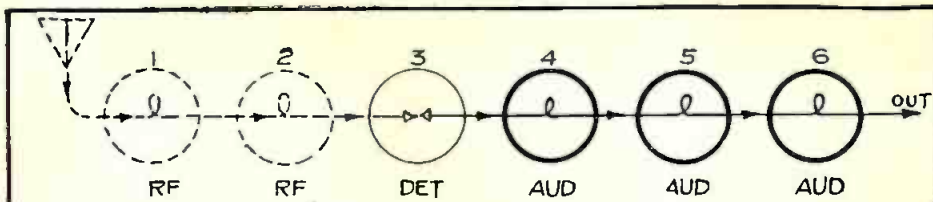


FIG. 7. TWO STAGE RADIO AMPLIFIER

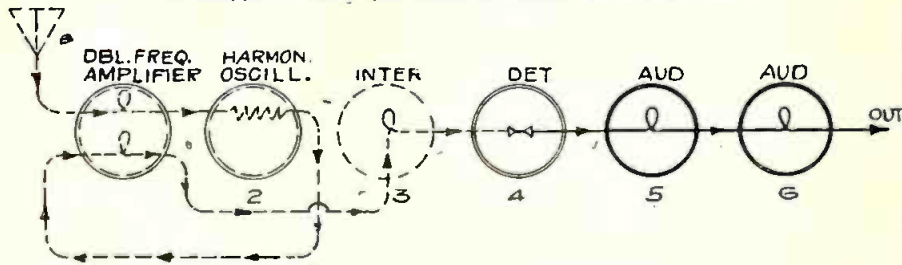


FIG. 8. SUPER-HETERODYNE

THE ABOVE SIX TUBE SUPER-HETERODYNE IS OF THE SECOND HARMONIC TYPE IN WHICH THE FIRST TUBE IS REFLEXED AT BOTH LONG AND SHORT R.F. WAVELENGTHS.

Figs. 7-8. Six Tube Circuits. Two Stages of Radio With Resistance Coupling (7), Super-heterodyne (8).

graph, and this should not be so difficult to attain, as there are certain mechanically connected linkages in the phonograph which do not exist in the radio; hence sound without distortion should be more perfectly accomplished where the transmission is performed electrically than where loose jointed mechanisms are employed.

Resistance Coupling

PERFECT as the modern audio frequency transformer may be, there is even less distortion with resistance coupling, for the amplification is always in exact "straight-line" proportion to the drop of potential over the resistor coupler. As with other items in radio, however, the resistance coupling method is a compromise that is not without drawbacks of its own. In the first place, we must use three amplifying tubes with the resistor to get the degree of amplification obtained by two tubes with transformer coupling; and in the second place, we must use at least 135 volts of "B" battery instead of the conventional 90 volts used with the transformers. It is the same here as everywhere else. If we wish to gain the benefits of perfect reproduction, we must pay the price of admission, and according to my ideas, the better quality obtained by the resistors fully compensates for one extra tube and one extra block of "B" battery. The application of the resistors is simple and reasonable in cost.

In what is to follow, add one tube to the set for resistance coupling where transformer coupling is specified. Some increase in amplification with little or no effect on the quality can be had by combining resistance and transformer coupling with one transformer stage and two resistance coupled stages.

How Many Tubes?

At last we are getting back to our original question, the subject of this article, after wandering around among the various types of radio receivers. What is your preference, or rather, what sort of a radio outfit would you buy if you were to purchase one tomorrow? With a limited amount of cash available, would you prefer a three tube regenera-

tive with good distance getting qualities but only fair tone value, to a four tube set with slightly better distance and tone providing that the latter only cost a few dollars more? Would you prefer these sets to a three or four tube reflex with wonderful tone value, great volume, and moderate distance? I am omitting reference to the one and two tube sets which are really for the head-set and can only be used on the speaker with powerful local stations.

If you had more money to spend, would you spend it on the conventional five tube tuned radio frequency set with transformer audio stages, or would you like to add another tube for resistance coupling so that you would have the superlative in tone value for the R. F. class of receiver? How would a five tube reflex operating on a loop strike you?

Now for the third class, which costs quite a little more than any of the others. We speak of the super-heterodyne with its loop aerial, from six to eight tubes, and with its excellent tone and volume? Do you believe that these increased virtues compensate for the additional cost over those offered by the five and six tube sets of class two? That's what the manufacturer wishes to know, that is what we wish to know, and that is what will affect the market in which you are to buy your radio. There is only one way in which public demand can be determined and that is by asking the buying public to vote on their opinion or desires just as we are doing here. We have guessed until we are blue in the face, but as yet have come to no conclusion, and there are a whole lot more in the same boat with us.

In making your choice, please consider the many factors that enter into the proposition. The question of tube economy, compactness and portability, dry cells versus the storage battery, first cost, distance, tone, volume, selectivity, loop aerial or outdoor aerial, and the cost of maintenance. There is some one combination of these factors that will suit your conditions best and we wish to know what it is. We have divided the receivers into three classes according to price, for we believe that price is the determining factor in the majority of cases.

If this were not so, then everyone would place their check mark opposite one of the more powerful and costly sets and we would be as much in the dark as ever.

Mark your ballot candidly; we want to know just what is on the minds of our readers. Place your check mark opposite the type that you most desire and then make a note of why you prefer this particular circuit. This is as much to your advantage as to ours and is not an advertising scheme—we want to know.

The Universal Need

LOUD-SPEAKER operation is almost a universal requirement with the receiving set of today; hence, we must always be assured of the equivalent of at least two transformer coupled audio frequency stages. So far as marketable sets go, the days of the headset are probably gone, even, on distances that were considered of the DX order several years ago. Even with portable sets, we see provision for the loud speaker and in most cases the loud speaker unit is built into the set proper.

Shorter and shorter aeriels, or aeriels of the indoor type, increase with the increasing numbers of broadcasting stations, for a short aerial is almost a necessary adjunct to selectivity in these days. Loop aeriels are very popular for much the same reason, and also because they avoid the trouble of erecting an outdoor structure.

There is probably not any increased risk due to thunderstorms; in fact, the risk may possibly be less, but they are not desirable.

Talks on Cuisine Station KYW

A SERIES of eight talks closely related to the cuisine in your home is being given over Westinghouse station KYW, each Thursday at 9:15 p. m. until June 25, which will be the date of the last talk.

KYW has secured the co-operation of John C. Cutting, to give these talks. Mr. Cutting has been telling the New York women, over WJZ, how to manage their homes and husbands. This was a weekly feature in New York for over sixteen months, and his thoughtful and valuable home hints, so delightfully put forth, proved to be of such value that the same propaganda is going to be exploited in Chicago, over Westinghouse station KYW.

Mr. Cutting, who is secretary of the Meat Council of Chicago, began his series of weekly talks from KYW on May 7, at 9:15 p. m. having chosen for his first subject "Filling Four Stomachs With a Dollar Bill." Mr. Cutting, who enjoyed the prestige of being the only man on WJZ's program who discussed subjects dear to a woman's heart, has a faculty of putting these talks over with the enthusiasm and pep required to promote his idea. He will tell young wives how to spank up a roast or hem-stitch hamburger in a way that will bring them the eternal love of their respective husbands.

Tune in and let him do his stuff. KYW, Thursdays at 9:15 p. m.

Formulae and Tables for Testing and Plotting Charts for Vacuum Tubes Used in Radio Reception

Learning Vacuum Tube Characteristics

By H. FRANK HOPKINS



The milliammeter shown above shows the plate current characteristic in milliamperes.

THERE are numerous characteristics of vacuum tubes used in radio reception and transmission that may be determined, but which have no value to the average radio fan. However, there are a few of vital importance to all users of vacuum tubes and it is the writer's intention to make clear such of these characteristics which are of importance to the fan so that he will be able to plot curves or charts and match his tubes as easily as he tunes his receiving set.

The equipment required for this work is a good vacuum tube test set, such as described in the May issue of RADIO AGE. An instrument such as this may be built at a nominal cost or one similar may be purchased ready made at a good range of prices, from the simple one-meter affair to those having a complete set of meters.

The One-Meter Tester

THE one meter tube testers are limited in their use, however, and outside of a plate current curve at a fixed grid bias, no other features may be determined. This type of test set

will only give a fair idea of how a tube will act. They will sometimes show a good plate current curve, but fail to perform efficiently when in operation. Therefore, it is worth the difference in price to have a set that will show the filament current or voltage and the grid bias voltage in addition to the plate current.

For this article, the RADIO AGE test set was used. It consists of three meters; a filament voltmeter, a grid volt meter and a plate milliammeter with the necessary resistances to vary the filament and plate voltage and grid bias voltage as desired.

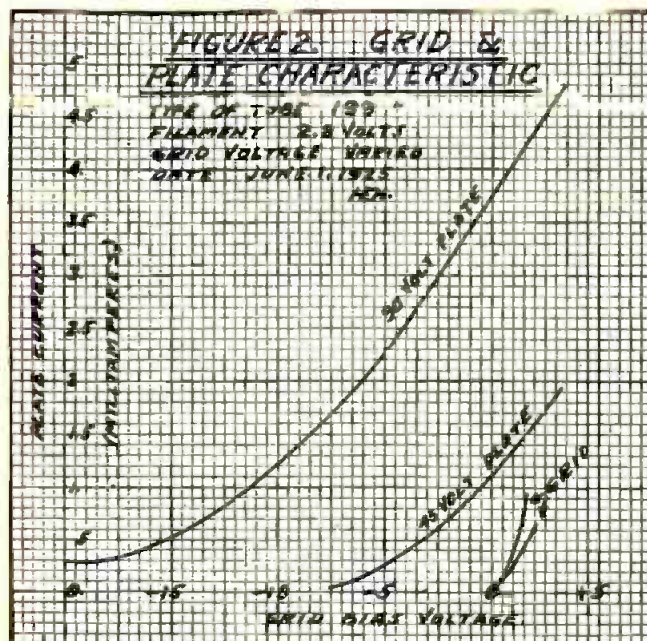
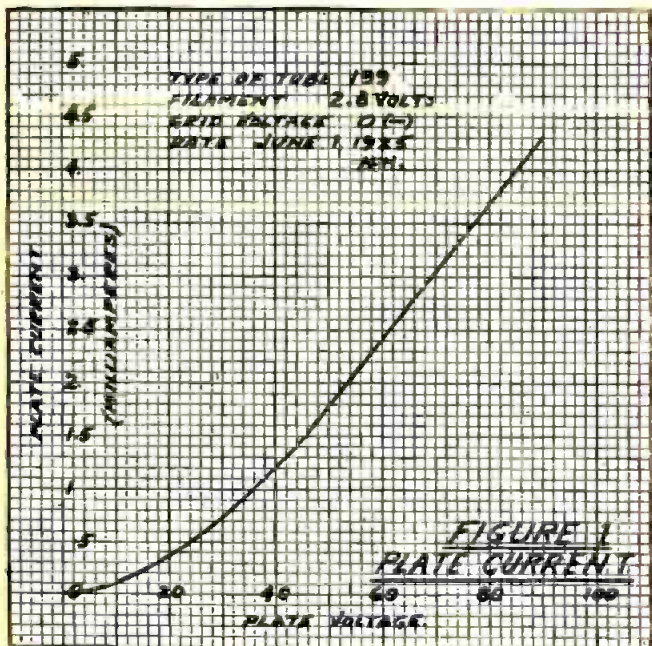
It was prepared for operation by connecting an "A" or filament battery of suitable voltage for the tube under test—to terminals (A BAT+) and (A BAT -).

A "B" or plate battery of ninety volts was connected across the binding posts (B-) and (B90) with taps at 22½ volts, connected to binding post (B22), 45 volts to binding post (B45), and 67½ volts to binding post (B67). Two 7½ volt "C" or grid batteries were connected to the "C"

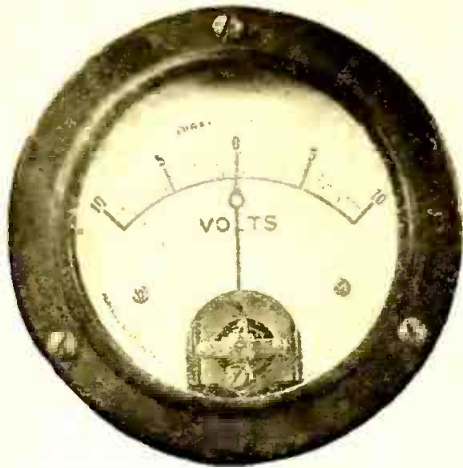
battery terminals. The negative terminal of one connected to binding post (C-) the positive terminal of this and the negative terminal of the second "C" battery connected to binding post (C+-) and the positive terminal of the second "C" battery to binding post (C+).

The filament rheostat (R) is moved to its off position, a tube placed in the socket (T) and the set is ready for operation. By moving the switch (BS) to point (-) and closing switch (GS) a negative grid bias voltage will be shown on the two-scale voltmeter (GM), this grid bias voltage may be varied at will from 0 volts to 7½ volts by moving the potentiometer (GP) until the meter shows the desired voltage. By moving the switch (BS) to the (+) point, a positive grid bias will be shown on the meter (GM) and will be varied as above.

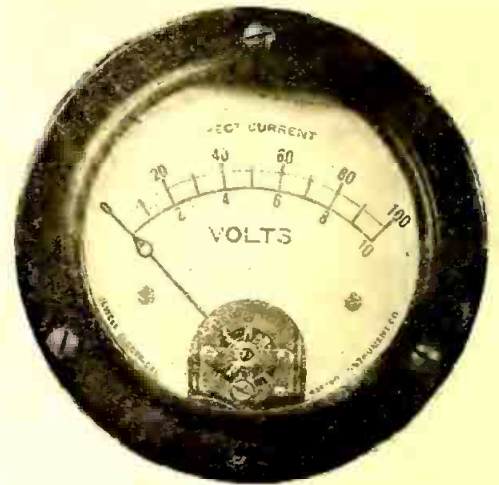
The switch (PS) and the rheostat (BR) regulate the "B" or plate battery voltage. By moving the switch (PS) to terminal (1) and moving the rheostat (BR) a plate voltage range from



Figs. 1 and 2. Fig. 1 shows the typical curve of plate current voltage, while Fig. 2 shows the typical curves of grid and plate characteristics, the result of tests described in the accompanying article.



The two-scale voltmeter, showing the grid bias voltage.



The 0-10, 0-100 scale voltmeter, which shows the filament voltage and plate voltage, respectively.

0 to 22½ volts is obtained, to point (2) from 22½ to 45 volts, to point (3) from 45 to 67½ volts and to point (4) from 67½ to 90 volts. This voltage is read on the meter (PF) by moving the transfer switch to position (4). The filament voltage will be read on the same meter (PF) by moving the transfer switch to position (3). The filament voltage is varied by the rheostat (R).

Plate Current Curve

FOR the first test, we will use a 3-4 volt 199 type of tube—placed in the socket (T) by use of an adapter. This is a high vacuum receiving tube with the filament normally operating at 3 volts and a filament current drain of .06 amperes or 60 milliamperes. This type of tube is most used in super-heterodyne receiving sets and is by far the most critical of everyday tubes.

A piece of cross section paper will be prepared by marking the plate voltage scale on the lower edge and the plate current scale on the left edge as in figure one. The filament voltage will be adjusted to a point just below 3 volts, say 2.8 volts, the grid will have a 0 volt

negative reading on the meter (6m) and the plate voltage will be adjusted to 0 volts.

By moving the rheostat (BR) the plate voltage is increased. A reading will be taken from the milliammeter and a point corresponding to this reading and the reading of the plate voltmeter (PF) will be marked on the cross section paper, as in the chart (figure one). This reading—with 5 volts on the plate, showed a plate current of about .1 milliampere. At 10 volts it read practically the same, and so on, gradually until 20 volts was applied and read at .3 milliampere. At 25 volts the plate current was about .5 at 30 .7 and at 40 it was 1.2 milliamperes. It increased rapidly until 90 volts showed a plate current of about 4.3 milliamperes—which is average for a tube of this type.

When all of these points are marked they will be joined by a line running through each, and a completed plate current curve as in figure one will be made. Simple, isn't it? This performance may be repeated—on the same chart, at different grid bias voltage—say a 1-2 volt negative and a 1-2 volt positive bias, thus giving a complete plate current story of the tube at various operating conditions.

Grid Characteristic Curves

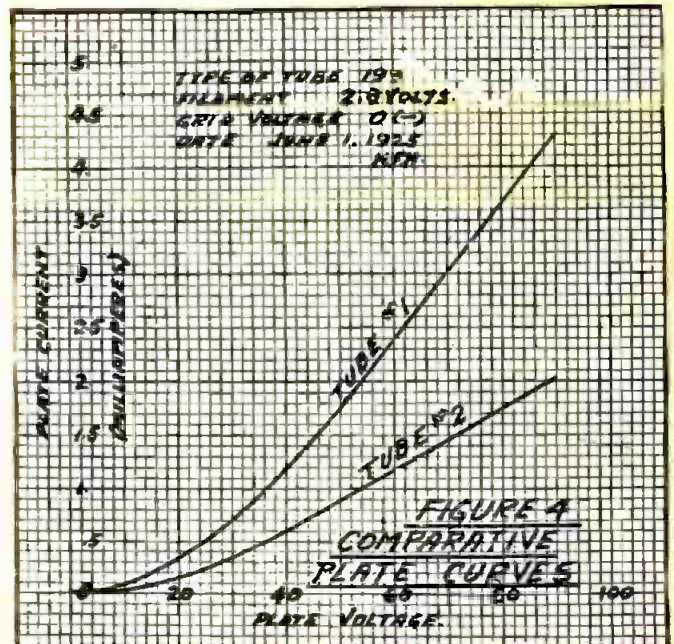
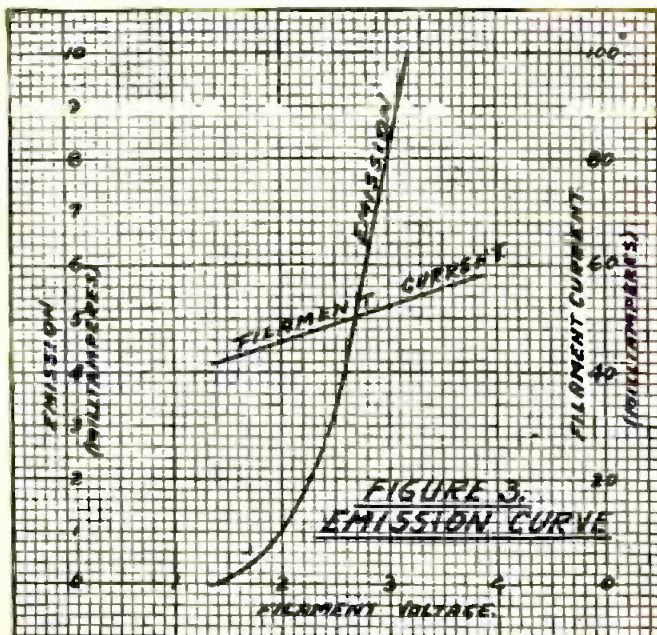
TO make a grid characteristic curve—figure 2, the plate voltage will be set at 40 volts—the grid bias voltage will be adjusted until the meter (GM) shows 0 with the switch on point (+). The reading of the milliammeter (MA) will be located on the chart as before—and readings for each fraction of a volt will be spotted—as in figure two. The 40 volt curve showed a plate current of 1.2 milliamperes and at 1 volt (+) it read 1.5 milliamperes and so on to 2 volts (+) it read 1.8 milliamperes. Going back to 0 volts and shifting the switch (BS) to a negative bias, the readings were taken the same as above, except they were inversely proportional to the grid voltage,

showing 1.2 milliamperes at 0 volts negative and so on down until .1 milliamperes was obtained at slightly over 4 volts negative bias.

This curve will show the best "C" battery voltage or grid bias for a tube at various plate voltages, and it may not be amiss to say that as we add to the plate voltage, the higher the grid bias voltage may be, several curves may be made on one chart for this characteristic at various plate voltages, as shown in Figure four, on page 12 of RADIO AGE for May, 1925.

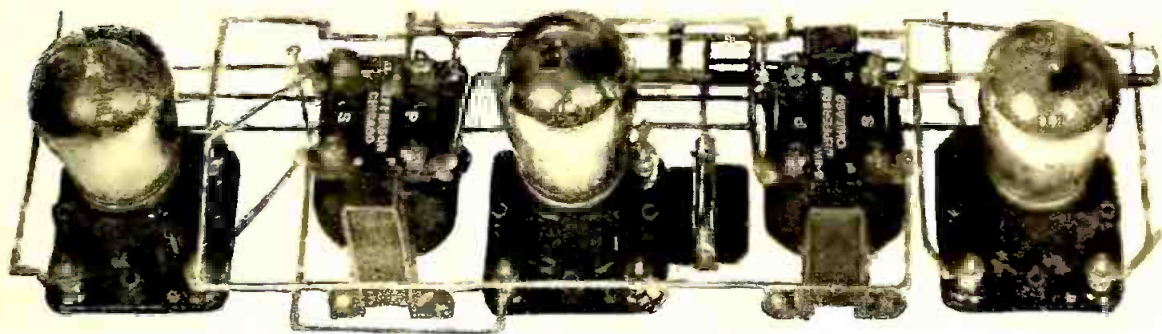
A filament voltage curve may be made and a filament current curve also if an ammeter is included in the test set. This will be plotted from periodic readings as in the other curves, and will make it possible to show an emission curve (Figure 3). This is one of the factors so important to users of vacuum tubes, as the life of a tube depends upon the proper emission of the electrons from the filament, and is usually ended by a decrease in emission, necessitating excessive filament voltage to keep it in

(Turn to page 53)



Figs. 3 and 4. Fig. 3 is an example of an emission curve, as described in Mr. Hopkins' article. Fig. 4 reveals the difference between a good tube under normal operation and a poor tube under the same conditions.

How Much Coupling is Necessary?



Coupling can be construed as the method by which energy is transferred from one circuit to another. It can be energy from the antenna to the detector tube, energy between tubes of a radio frequency amplifier, or again audio energy passing between audio stages. Coupling passes the energy across in each case.

Big Advantage in Having a Variable Coupling Scheme to Enable Adapting the Receiver to Different Aerials; Suiting Coupling to Varied Wavelengths a Real Problem

By BRAINARD FOOTE

COUPLING" is a broad term in its interpretation. It signifies the method by which energy is transferred from one radio circuit to another. Whether it be the energy from the antenna travelling to the detector tube, or energy being transferred between tubes of a radio frequency amplifier, or still again the audio energy passing between the audio stages—it is through coupling that the energy is passed across.

To have coupling, there must be two associated circuits carrying alternating current. One circuit may consist largely of inductance (coil) and the other largely of capacity (condenser) or the coupling may even exist because of a resistance which is common to both of the circuits. The sort of coupling with which we must deal almost exclusively is that due to associated inductances or coils. And inasmuch as the coupled coils wound on iron cores which form the commercial audio transformer are not to be adjusted, our discussion will be confined to radio frequency transformers.

R. F. Coupling

LET us first talk about the coupling between the aerial system and the radio receiving set. In Fig. 1 two methods whereby this coupling is accomplished are illustrated. The type of "A" is perhaps more common and it possesses several distinct advantages. In the first place, the separation between the primary P and the secondary S may be made fairly great, and the capacity effect of the aerial upon the secondary thereby minimized. In other words, a receiver so coupled to the aerial will tune almost the same on any aerial, large or small.

In "B" another popular scheme is shown. Here there is really a transformer as in "A" with two distinct windings, but a portion of the secondary acts as the primary also. Here the coupling is very much closer than in "A" for the same number of turns included. Its disadvantage lies in the great effect of the aerial's capacity upon the broadness of the secondary tuning condenser. A

large aerial will increase broadness and a small aerial will reduce it. Slightly greater volume may be had with connection "B," however, so that many listeners prefer it even though it does upset the dial readings. In the case of a set like the neutrodyne, the three dials do not read the same, but the first one is lower than the other two.

It is of great advantage to have a variable coupling scheme to adapt the set to different aerials. With a long aerial, only 5 to 10 turns are needed in coil P, but with a very small aerial, as many as 15 or 20 may be used. The dotted line in "A" shows where the filament circuit is grounded, a measure ordinarily desirable because of its good effect upon inductive noises and upon hand capacity.

A coupler as in "A" may be wound on one piece of tubing, with a primary coil of as many turns as are necessary for the individual case. To get the maximum of volume on different wavelengths, a small switch might be provided to change the number of turns, as follows:—short waves 5, medium waves 10 and long waves 15 turns. KSD and stations of similar wavelength may then be almost doubled in volume, with the average set. But for the shorter waves, the number of turns must be reduced because of the absorption effect of so large a primary coil.

Antenna Wavelength

THE aerial system has a "natural" wavelength of its own, which must be reckoned with. Users of tuned R. F. or even regenerative receivers with aerials having very long lead-ins have found certain "dead spots" on the dial. These are caused by absorption where attempt is made to tune the set to the natural of the antenna. This natural ought to be less than the shortest broadcast wavelength received, in order that it may not interfere seriously with short wave reception. To smooth out such a dead spot caused by a lengthy aerial system, either reduce the aerial's capacity or use a series condenser of .00025 or .0005 mfd. capacity. The simplest method of reducing the capacity of the antenna, if it is too long, is to shorten it. Simply shortening it, however, does only half the job. The greatest improvement comes by increasing its altitude. An antenna of 60 or 70 feet, raised 20 feet above a roof, is far superior for sensitivity to a 150 foot aerial only five feet above the roof. Not only does the passing radio wave induce more voltage in the wires because of their greater height, but the antenna's natural wavelength is reduced at the same time.

So much for antenna coupling. We now come to a more "ticklish" coupler—that which transfers energy from one R. F. amplifier tube to another one, or to the detector. (Turn the page)

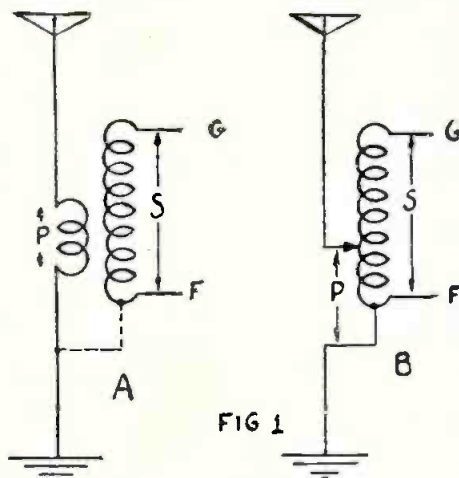


Fig. 1—The aerial is coupled to the set by a "coupling coil." This may be a separate winding as at "A" or a portion of the secondary as at "B." The former method is better in most cases. The aerial's natural wavelength must be kept low if you wish good short-wave as well as long-wave reception.

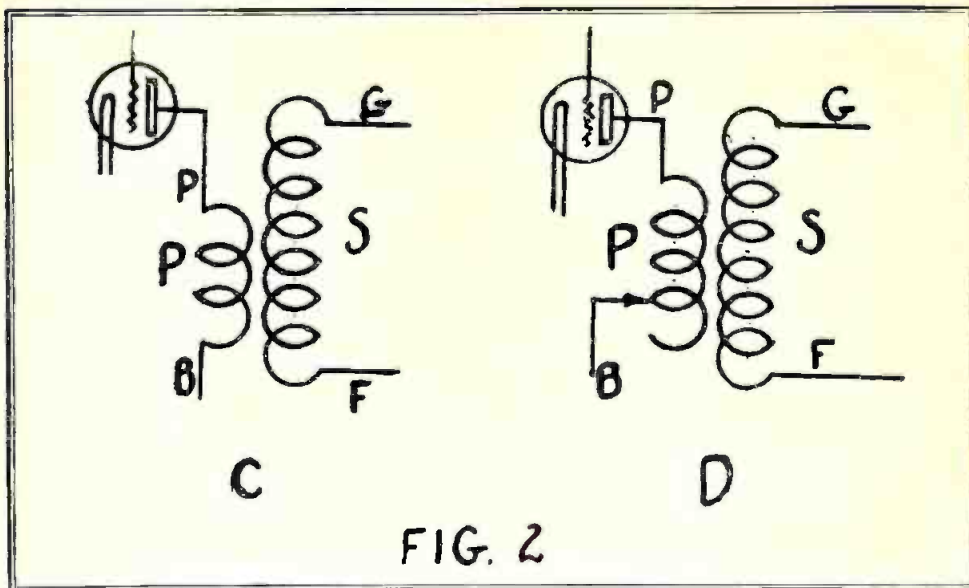


FIG. 2

Fig. 2—How radio frequency tubes are coupled to each other. At "C" is the universally popular "fixed primary" type. This, however, is efficient only over a moderate wave band. Varying the coupling from about 5 to 12 turns, as at "B," gives better results on all wavelengths.

In Fig. 2, "C," is shown such a coupler in circuit form. The secondary, of course, is of the proper size to cover the broadcast band in conjunction with the variable condenser that tunes it. The primary is as large as possible, but not so large that it passes sufficient energy back to the grid to cause oscillation of the tube. In practise, such an ideal transformer is out of the question, for it is perfectly efficient for only one wavelength or a very narrow band of wavelengths.

The average tuned R. F. transformer is of this type and is so constructed that its primary does not feed back enough energy to cause oscillation on the shorter wavelengths. For this reason, it is not quite as efficient as it might be on longer waves. This peculiarity accounts for the difficulty many tuned R. F. receivers experience in getting volume from long wave stations like KYW, KSD and the like, whereas stations of much less power on the shorter waves can be received with enormous volume, by comparison.

Variable Coupling

OF COURSE, the obvious method for getting around this inequality of wavelength is to change the coupling, making it greater on longer wavelengths.

Shall this changing be accomplished by a moving coil whose angular relationship can be altered—like a ticklercoil? Or shall we have a permanently set winding, with its number of turns controllable by a tap switch? The first method is better from the standpoint of uniformity and gradual movement, but it has a big disadvantage. The capacity coupling is changed too much and causes upsets in the secondary dial settings. Besides, there are too many turns on the coil for short wavelengths and the plate circuit is tuned so high that oscillation commences.

Hence the better plan is to provide a tap switch for cutting in or out the primary turns. It is astonishing what an immense difference in signal volume may be had with such a device, with variable coupling for the last stage of the radio frequency amplifier, or between the R. F.

amplifier and detector in the case of a single step amplifier. By this method, the R. F. coupling is as great as possible without causing oscillations and the volume as well as the selectivity are very much greater.

In "D," Fig. 2, is shown the variable primary coupler. Here a tap switch is connected to change the coupling for long and short waves. Such a plan is of most value in sets having only one stage of tuned radio frequency and a detector, either crystal or tube. With the average coupling coil, a fixed primary of about 6 to 8 turns is adopted. Many tuned R. F. reflex sets are made up in this manner. If they are good for long waves, oscillations prevent good reception on short waves, and if excellent on short waves, the long wave stations come in poorly, although with no trace of oscillation.

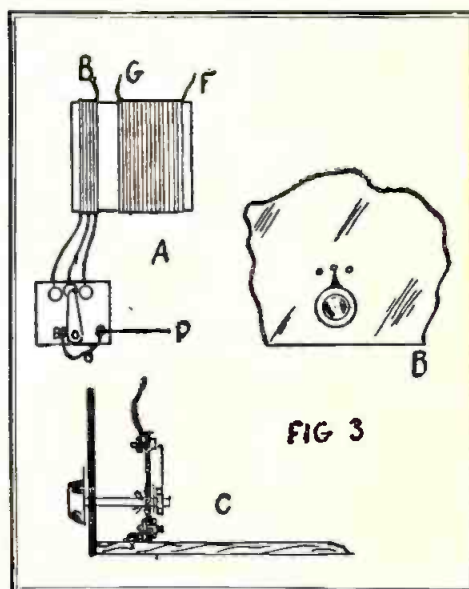


FIG. 3

Fig. 3—Details of a variable coupler. Primary and secondary are fairly well separated, to avoid capacitive coupling. A sub-panel tap switch permits the use of any desired number of turns in the primary. White dots on the panel show where the lever is to be set.

Perhaps the easiest method of adopting the variable primary is to install a number of switch points and a switch knob and lever on the panel, where it is readily accessible from the R. F. transformer in the set. This, however, requires long connecting leads and is unsightly in view of modern receiver construction. A superior method is indicated in Fig. 3. At "A" the coupler itself is pictured, "G" and "F" being the secondary terminals. The smaller winding is the primary and it consists of approximately 15 turns. With a crystal detector, it may be advisable to go as high as 20 turns, although no more than this are needed if the R. F. amplifier tubes are good ones.

For the average set used chiefly for local reception, the switch may have three taps and the entire primary have only twelve turns in all. A tap is taken at the 7th turn, at the 9th and at the 12th. In sets using two stages of radio, the primary may be smaller, even for DX work, some primary coils working well with a total of ten turns, tapped at the 5th and 8th and 10th. The number of turns in the primary must really be worked out by the individual set operator to fit his own conditions.

Back-Panel

THE switch points are laid out on a small piece of panel material, about 2 inches square. The switch lever may be of the regular style or be cut from spring brass or phosphor bronze. It is soldered to the $\frac{1}{4}$ -inch set collar. Good contact to the lever may be made by using a long set screw and attaching a nut to it for holding the end of a short piece of flexible wire. This forms the plate connection "P" of the transformer. The taps are laid out and so connected that a left-to-right movement of the panel knob brings an increase in coupling. The set collar is attached to a length of bakelite or brass rod, $\frac{1}{4}$ -inch diameter, which passes through a $\frac{1}{4}$ -inch hole in the sub-panel and also in the main panel. The assembly is given at "C" and at "B" the front panel is shown. Three small white dots indicate the position of the switch arm. These are made by filling with white wax crayon small depressions made with the twist drill.

In case there is special interest in DX reception, more taps are taken, thus giving a more gradual change in coupling. The best way to determine how the primary should be wound is to make up an experimental primary coil of about 20 turns, with a tap at every second turn. The taps are merely bared places in the wire, twisted into loops. A spring clip is then used to connect to the taps in lieu of the switch arm and points.

In most cases, the final result will be a coil of about twelve turns, with taps at the 5th, 7th, 8th, 9th, 10th and 12th turns, or about six taps in all. The adjustments should be tested with good "B" batteries of at least 90 and preferably a little higher voltage, with good R. F. amplifier tubes and the coupling coils properly in place with about 1-4 inch separation between the primary and secondary.

(Turn to page 50)

THE receiving system to be described in this paper is the result of a very considerable amount of research and experiment put forth in an endeavor to produce a super-heterodyne that would give equal or better results than could be obtained with any existing type, yet which would employ a maximum of six tubes, for this number must certainly be considered the maximum allowable limit henceforth, if the word "efficiency" be used in connection with this system of reception.

In the past, there has been no question in the mind of even the most uninformed fan but that the super-heterodyne was the ideal radio receiver, and the ultimate desire of every enthusiast has been to be the proud owner of a set containing many more brightly lit tubes than any other set in his community. Yet this has been the real drawback of the super; the necessity of using from seven to ten tubes in order to obtain truly super-heterodyne results. Therefore, the aim of receiver designers has not been to improve results, for a super that really justifies the name will go down to the lowest noise-level—the limit of practical sensitivity; but rather, to reduce the number of tubes used and at the same time retain the sensitivity, selectivity and quality of reproduction obtainable with the best of sets.

Two Ways To Do It

TO the mind of the engineer, there are but two practical methods of attacking this problem; either make the tubes used do more work, or raise the efficiency of each circuit of the receiver right up to the maximum limit, or do both simultaneously. The first method of attack may be considered an expedient, and boils down to reflexing, causing one or more tubes to perform various functions, such as radio and audio amplification simultaneously. This is not entirely practical, in view of the frequencies to be handled, except in one section—the frequency changer. Here, there is no reason why one tube may not be used for the first detector and oscillator, providing the separate tuning circuits may be satisfactorily isolated. Up to the present, this has been impossible, except by the second harmonic method, which will be considered later.

A Big Step Toward Efficiency in Super-Heterodyne Design

A SIX TUBE "SUPER-AUTODYNE" RECEIVER

The Super-Het Reduced to Six Tubes, Yet Giving Results More Efficient Than Seven and Eight

By McMURDO SILVER



Fig. 1. The completed super-autodyne illustrating clearly what can be done with standard circuits in producing a symmetrical design that is pleasing to the eye.

The next method, and the more straight-forward one, is to improve the efficiency of each section of the system so that fewer tubes will be required to give the same amplification that has hitherto been obtained. An example of such a receiver was described by the author in the March issue of RADIO AGE. This set incorporated a regenerative first detector, thus giving the greatest possible gain obtainable for

A REMARKABLE ROUND-UP OF HOOKUPS

The August RADIO AGE will be the most unusual issue of a radio magazine ever printed. It will consist of more than 100 pages of basic radio hookups from crystal to super-het, illustrated with actual color RADIO AGE blueprints. Don't miss this wonder issue.

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the input circuit. But two stages of intermediate frequency amplification were used, for due to the careful design of the transformer employed, it was found possible to realize as much amplification with two stages as had previously been realized with three stages. In each circuit, efficiency had been increased as much as possible, and the fact that with but seven tubes receivers of this type give a fairly consistent range of two to three thousand loud-speaker miles, even under present weather conditions, is probably the best indication that this latter method of attacking the problem is the most logical one.

A Practical Combination

THE next step was obviously to combine the detector and oscillator functions in one tube. The difficulty which has heretofore prevented the use of one tube for

both detector and oscillator has been that of isolating the loop or pickup circuit from the local oscillator circuit. It has been impossible to couple a tuned pickup circuit to a tuned oscillator when the two are to operate but fifty or sixty kilocycles apart throughout the broadcast wavelength range, and not have the tuning of one section react on that of the other.

Armstrong and Houck developed the expedient of the second harmonic system, whereby the oscillator, working at double the desired wave, did not react greatly upon the loop circuit. Then, a harmonic of the oscillator was used for heterodyning. This meant two waves were being produced by the oscillator of sufficient power to cause radiation, which necessitated the use of a muffler tube ahead of the detector-oscillator to prevent radiation. Thus, two tubes were still used, though the gain in signal strength was equal to or slightly better than that obtained with a good regenerative detector and oscillator. At best, the system is not entirely satisfactory for home assembly.

Then came the development by J. H. Pressley, a Signal Corps engineer, of the balanced autodyne circuit, which not only performs the required function with one tube, but does it much better than either the second harmonic autodyne, with its amplifying muffler, or what has hitherto been considered about the limit

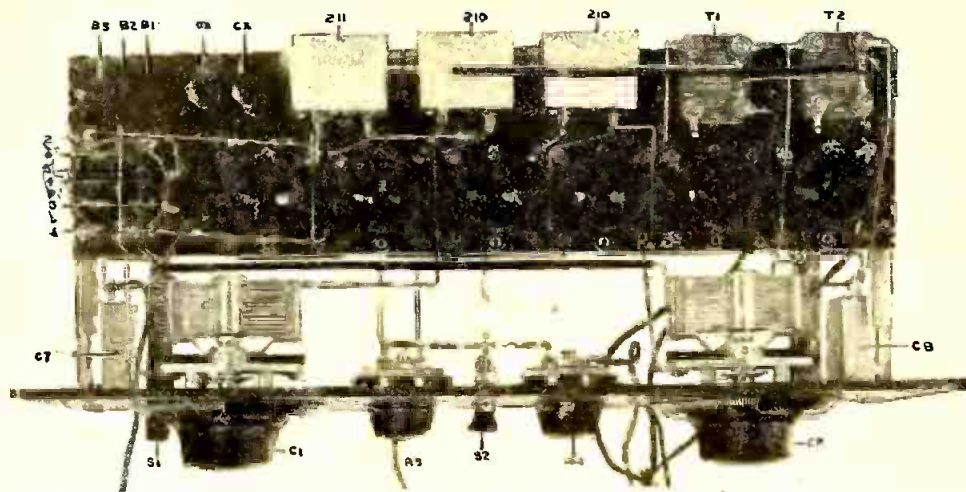


Fig. 2. Interior view of the super-autodyne. The instrument designations will be found in the text. The sockets, from left to right, are: V1, autodyne, V2, 1st R. F.; V3, 2nd R. F.; V4, 2nd Det.; V5, 1st A. F.; V6, 2nd A. F.; Socket shelves may also be procured for UV199 or C299 tubes.

for sensitivity—the regenerative detector and separate oscillator. This autodyne circuit, in actual tests, appears to give a much greater gain than any of the frequency-changing circuits previously utilized, and, at the same time, is far simpler to build and operate than any of its predecessors.

The Circuit

THE actual first tube circuit is shown in Figure 4. The coils L2, L3 are theoretically equal, as are the condensers CX, CX. Actually, they cannot be made fixed and equal, so CX, CX are made adjustable, to obtain substantially a condition of equality. These units make up a bridge circuit, shown by the heavy lines. Since L2 equals L3, the potential across them is equal, so that it is also equal between points 3 and 4, and 5 and 6. Likewise, the potential across CX and CX is equal. Since the potential across 3 and 6 is the same for both inductance and capacity, then points 4, 5 and the joint between CX, CX are at equal potential, and are also theoretically at zero potential, since these points are neutral with respect to 3 and 6. Then, circuit B1, C2, B2, may be connected at these neutral points, with substantially no reaction on the frequency of the bridge circuit. Further, as these points are neutral with respect to 3 and 6, no energy in the bridge circuit can get into B1, C2, B2, since there is no potential difference across these points of the bridge. Therefore, the frequency adjustment of the bridge circuit cannot react upon that of the B1, C2, B2, circuit, and vice versa.

Since the signal is fed from the loop and its tuning condenser to the oscillator, it will divide equally across the bridge arms. If a tube detector is connected across one capacity CX, the drop in potential may be used to cause rectification. It would appear that some of the signal voltage is lost by this method, but actually it is not. It is, as a matter of fact, considerably reinforced when the new component is finally fed to the amplifier, probably due to regenerative amplification. The coil L1, coupled to L2, L3, causes the bridge circuit to oscillate at a frequency determined by

these coils, CX, CX and C1, which is made variable for the purpose of tuning the oscillator circuit. As previously explained, this energy cannot get into the loop circuit, so radiation is confined to what may be experienced from the oscillator coil system itself—a negligible amount. By means of this circuit, which is surprisingly efficient when it is considered that one tube delivers a stronger signal than two tubes in the conventional circuit, and is consequently much more sensitive, it is possible to eliminate one tube from the receiver, and still obtain better results than with two.

The intermediate amplifier is the only other unusual feature of the receiver. It employs but two stages and is on the order of those described by the writer in RADIO AGE for March, 1925. It differs, however, in that it employs special laboratory charted transformers which are a compromise between the extreme selectivity of properly designed air-core coils, and the great stability and amplification of good iron core transformers. But two core laminations are used in each transformer, of 7 mill silicon steel, one in the shape of an "F" and one an "L." The air gap formed, together with other recently developed features of the design, permits the realization of almost an ideal curve—extra-

ordinarily high amplification over a 10,000 cycle band, with a sharp cutoff either side. The amplifier, employing two of these transformers, together with a sharply tuned filter which is provided with a laboratory adjusted tuning capacity, C5, gives tremendous amplification, for it also employs controlled regeneration, adjustable by means of R3.

More Stages Unnecessary

WHILE more than two stages might be employed, two will go down to the best noise level, so that more are unnecessary. Further, there is a decided drop in amplification in adding more stages, which will react upon the preceding two, so that three stages give only slightly better results than two. This should really be written "slightly more noise," for two stages give more than enough gain.

Before going into a description of a receiver designed along the lines outlined, it might be well to justify the use of the name "super-autodyne." "Heterodyne" is generally considered to refer to a source of external power—a separate detector and oscillator tube. "Autodyne" refers commonly to a tube performing the functions of rectification and oscillation simultaneously, so it was considered logical to call the six tube receiver a "super-autodyne"—and it certainly deserves the appellation, "super," for the results obtainable are surprising.

Below is a log, representing one hour's work by an operator unfamiliar with the system. The set was located 600 feet from WGN, one-half mile from KYW, and WMAQ, and many other Chicago locals were also operating. All stations were heard on the loud-speaker.

WCEE	19	48.5	S	KSCO	67.5	78	L
WTAS	23	61	S	WCBZ	29	29	L
KDKA	23.5	65	S	WHAZ	33	30	L
WGR	31	71	S	WLW	42	41	L
WDAF	31.5	21	L	WTAC	50.5	64	L
WTAM	36	31	L	KFI	49.5	53	L
KSID	36.5	33.5	L	KSUI	43	32	L
WCCO	40.5	39	L	WQJ	50	45	L
WOS	44.5	45	L	WTAY	16	37	S
WCAP	50	63	L	WBCN	18	43	S
WSU1	53	58	L	WJJD	22.5	61	S
WEAF	55.5	58	L	WLS	28	85	S
WCX	60.5	67	L	WBAP	52	56	L
WOAW	63	70	L	WEBB	32	95	S
WGN	32	28	L				

The station separation was very pleasing on some of the unlisted lower wave stations, due to the use of the straight-line-wavelength condensers. A comparison with a standard five-tube neutro-

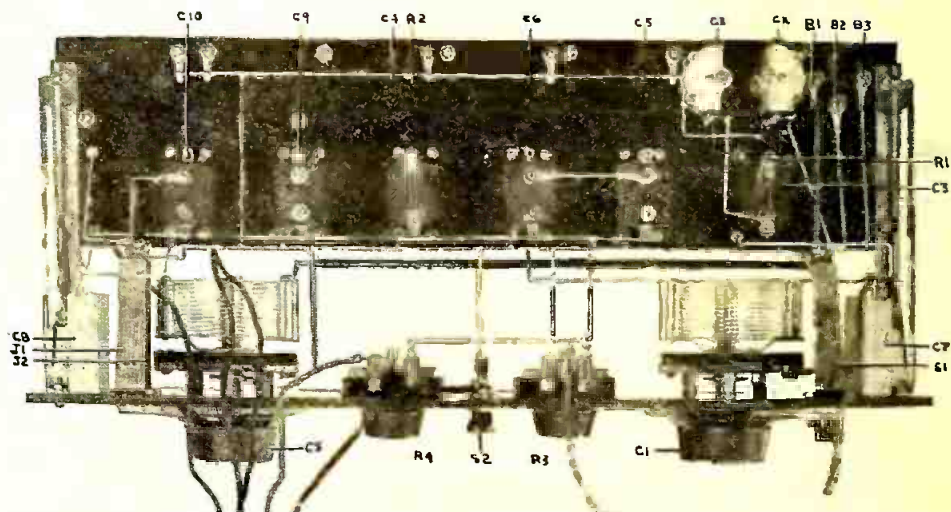


Fig. 3. Bottom view of the socket shelf assembly. Notice how all parts are rigidly fastened in place—an important feature for portable receivers.

dyne on a 100 foot antenna was unfavorable to the neutrodyne both on the count of selectivity as well as sensitivity and volume. A standard super (see March RADIO AGE) failed to produce any better results, as did another eight-tube set employing air-core transformers.

While the outfit will deliver about the same energy with either dry cell or storage battery tubes, the dry cell tubes will generally be sadly over-loaded, and it is, therefore, suggested that UV-201-A tubes be used throughout, although even so, it is possible to overload the sixth tube. This will be appreciated when it is realized that in Chicago it is possible to get volume sufficient for dancing from the West Coast stations on five tubes using only a small loop, under favorable conditions.

The portability of the set may be realized even with storage battery tubes by means of special leads if a car is handy. These leads permit connection to the car battery through the dashboard light socket for the "A" supply. If this is not possible, it is suggested that the necessary dry batteries be carried in an old hand satchel, or even a lunch box or tool kit. Then connections can be made quickly with the color cable used for the battery leads, and the receiver set up in a few seconds' time. This battery can also easily contain the folded loop and a small speaker, when they are not in use. Blanket straps will provide an easy means of carrying the receiver, so that the whole set can readily be managed by one man.

Portable or Permanent

THE advantage of this arrangement is that the same set serves for camping or traveling that is used to provide entertainment at home at other times. It is possible, if the builder prefers, to have a luggage shop make a carrying case so arranged that the receiver is at the top, the batteries below, and the loud speaker in the lower compartment with them, either at the side or in the

middle. A small speaker is to be recommended for its small size and general portability, and it certainly talks up very much "bigger" than it looks.

The material required to build this receiver is listed below, with the designation letters used in the diagrams and cuts following the quantity of each item required. While it is entirely permissible to substitute any other standard parts for those listed, it is strongly recommended that the parts specified be used for several reasons. The actual space available is such that parts of larger or different dimensions could not be substituted in some instances, and in the case of the RF Transformers, and SLW condenser, it would be inadvisable to substitute, since the results of the receiver depend in a large measure upon the use of the types recommended.

- 2 C1, C2—S. L. W. Condensers.
- 2 4" Moulded dials, vernier type preferably
- 1 R4 6 ohm rheostat
- 1 R3 240 ohm potentiometer
- 3 BL, B2, B3 insulated top binding posts
- 1 J2 101 jack (1-spring)
- 1 J1 102-A jack (2-spring)
- 1 C-5, 211 filter with matched tuning capacity
- 2 Z10, Z10 charted intermediate transformers
- 1 L1, L2, L3, coupling unit
- 1 6 gang socket shelf (536-201-A, No. 537-199)
- 2 T1, T2, 3 1/2:1 or 2:1 transformers
- 2 C7, C8 .5 condensers
- 2 C3-C4 .00025 condensers with clips
- 2 C9, C10 .002 Condensers
- 1 C6 .0075 condenser
- 2 CX, CX .000025 condensers
- 1 R1 .5 Meg leak
- 1 R2 2 meg leak
- 1 S1 No. 3 jack switch (S. P. D. T.)
- 1 S2 8630 switch (S. P. S. T.)
- 1 No. 701 color cable (5 leads)
- 1 pair No. 8629 shelf brackets
- 1 Bakelite Panel, 7" x 13" x 1/4"
- Small parts: 29 6/32 R. H. C. P. Machine screws 3/8"
- 2 6/32 H. N. P. Machine screws 1 1/2"
- 31 6/32 nuts, 1 spaghetti, 10 bus-bar, 25-lugs

- Tools required:
- 1 hand-drill with drills and counter-sink
 - 1 soldering iron with rosin-core solder and non-corrosive paste
 - 1 side-cutting pliers
 - 1 screw driver

Inspecting the Set

AS SOON as the material has been procured, each item should be carefully examined to see that all screws and nuts are tight, and lugs placed as shown in the photographs, so that those on the various instruments will point in the best directions for short leads. Socket springs should be bent up to make good contact with tube pins. Condenser bearings should be adjusted to give the desired tension.

The actual assembly of the receiver is extremely simple, providing a standard socket gang and a drilled panel are used. If this is not done, it will be necessary to drill up a sub-base and panel to take the instruments. The panel may be grained if desired by rubbing with fine sandpaper and oil until all traces of the original finish has been removed. Indicating marks for the condensers can be scratched with a scribe and filled with white.

If Figures 2 and 3 are carefully studied, no difficulty should be encountered in mounting all the parts, following the designations shown, which are also given in the parts list. As the parts are mounted, the wiring may be started and put in progressively on the base and panel, then the two joined together and the final connections made. It is necessary to use a well-tinned soldering iron, with rosin core solder and some non-corrosive paste. The battery leads are brought out through a color cable, coded in accordance with the A. M. E. S. code, thus obviating binding posts and providing permanently attached connecting leads at one operation.

After the receiver has been wired, the necessary batteries should be connected to it, the rheostat just turned on, and the autodyne tube inserted in its socket. The phones must be connected to the set, the switch S1 set at "L," C1 at 40, and C2 varied rapidly throughout its scale.

A "plunk" will be heard, indicating an unbalanced bridge circuit. With one condenser CX set all in, turn the other CX slowly out, rotating C2, meanwhile. If the plunk does not disappear, reverse the operation, leaving the other balancing condenser all in to start with. Once the plunk has been balanced out for all settings of C1 and C2, condensers CX, CX should never be touched. If squealing or clicking is experienced at low settings of C1, it will be necessary to use a smaller grid leak at R1. This leak will generally vary between .25 and .5 megohms.

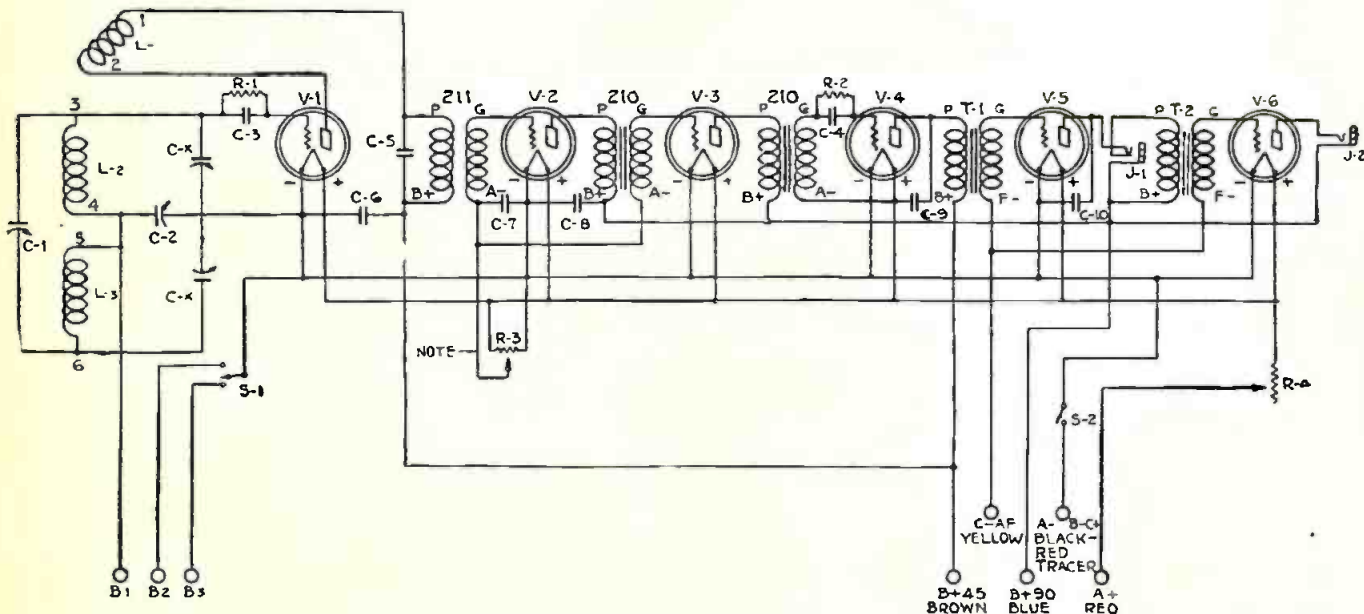
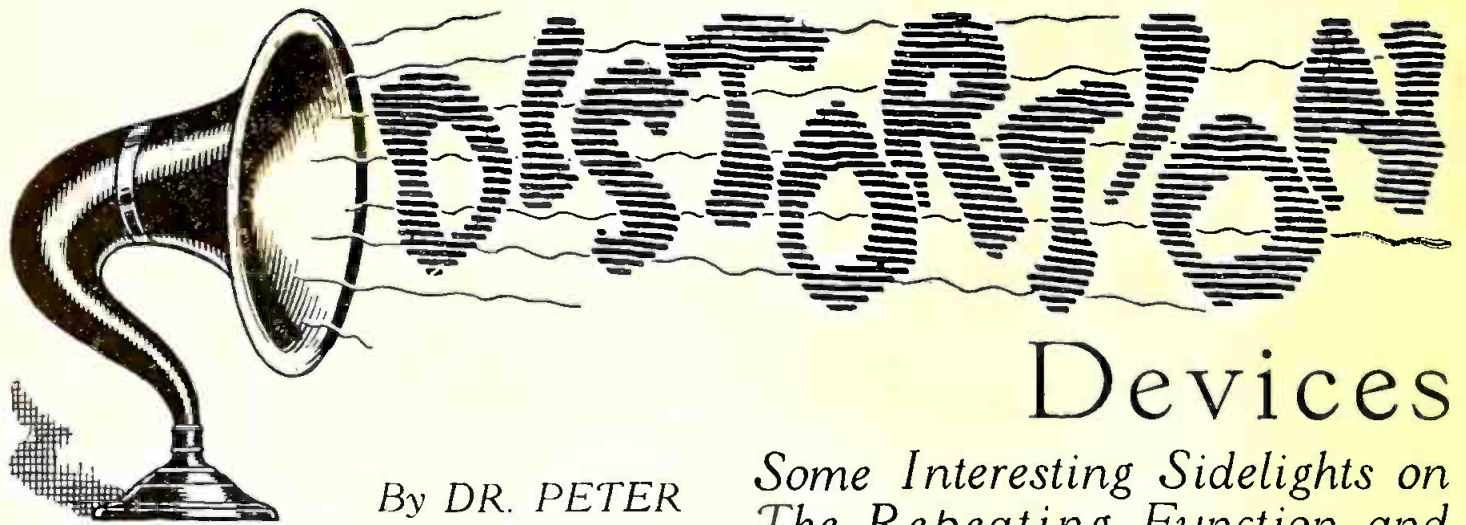


Fig. 4. The wiring diagram of the new super-autodyne receiver. Heretofore to obtain neutrodyne results on a loop aerial, seven and eight tubes were necessary. But in this receiver only six tubes are needed to achieve the same end.

Vacuum Tubes as

Devices



By DR. PETER
I. WOLD

Some Interesting Sidelights on
The Repeating Function and
"Distorting" Function of Tubes

IN THESE days all of us have become so well acquainted with vacuum tubes, through actual use or through the countless articles on radio sets making use of them, that anything further might almost seem superfluous. On the other hand, there may be some who have only recently acquired an interest in radio, or it may be that the exceedingly versatile device very commonly but very poorly called a vacuum tube offers some point of view which may be new to many.

If you have followed the radio art for some time, you have heard of these tubes being used in a number of different ways, as for audio frequency amplification, radio frequency amplification, detection, regeneration, reflex regeneration, any or all of these occurring in your receiving sets; and if your interest carries over to the broadcasting station, you have heard of oscillation generators and modulation.

All of these terms may suggest a confusing variety of uses for the vacuum tube, but it may simplify matters if it is pointed out that this tube has two functions only, which are separate and distinct, and the various uses mentioned come under the one or the other. These two functions may be spoken of as the *repeating* function and as the *distorting* function. The two are present in every tube in an amount depending on the design of the tube; i. e., the relative sizes and spacing of the elements in the tube. By the way in which the tube is operated, and by the circuit with which it is associated, one of these functions may be emphasized.

What It All Means

BY the first of these functions, I mean that of re-

peating electrical variations impressed on the grid generally with amplification and, at least theoretically, faithfully, or without any distortion. By the second, I refer to that property of the tube by which electrical variations on the grid result in variations, generally amplified, which are substantially different. As an example of the first, we may take the relaying of telephone messages across a transcontinental line in which the greatest precautions are taken to make the repeating action as faithful as possible; i. e., to reduce distortion to a minimum. As an example of the second, we may take the detection of a radio message in which electrical oscillations or variations of perhaps a million cycles—and therefore quite inaudible—are so distorted or converted as to

give oscillations of an audible frequency.

The repeating action of the tube and its circuit, with amplification, would probably be held to be the more important property, for it includes such applications as long distance telephony and all the actions in radio work mentioned above, except those of detection and modulation. On the other hand, its property as a distortion device is the more interesting, though not so generally understood.

Let me remind you for a moment of the essential elements of the standard vacuum tube. There is a filament which may be raised to a high temperature, whereupon it may give off electrons—those smallest particles of matter or electricity which we have come to recognize as playing so important a part in all our affairs. Then there is a plate kept at a positive potential by the B battery, and which therefore attracts the electrons from the filament, thus giving rise to an electric current to the plate. Finally, there is the grid placed between the two. When the grid is made more positive, a larger current flows to the plate, and when it becomes more negative a smaller current flows. It is possible thus to control a current by changing the potential of the grid; and the important point is that the energy for exercising this control may be very much less than the energy of the controlled current. It is for this reason that the device acts as an amplifier.

Getting Minimum Distortion

IF, starting with a small current to the plate, you draw a line showing how this current changes as the potential of the (Turn to page 60)

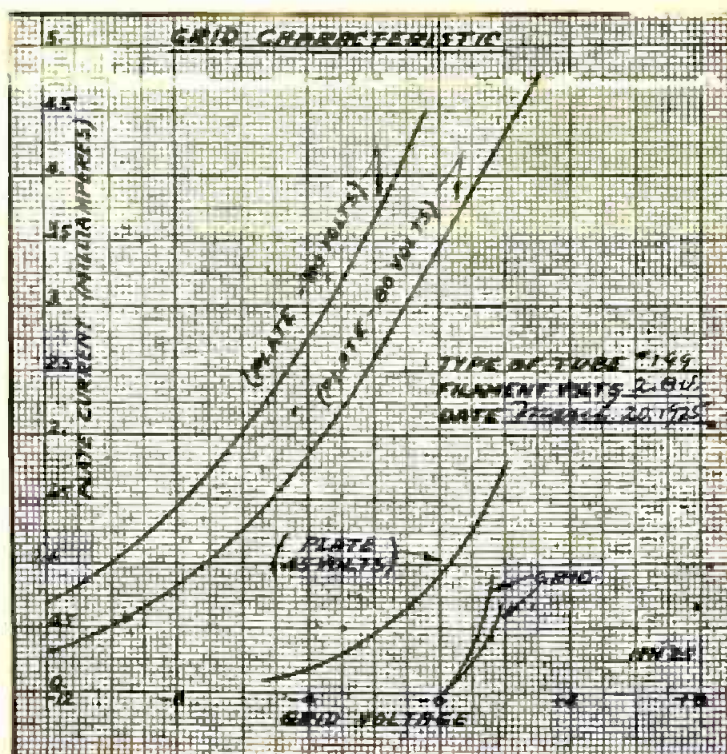
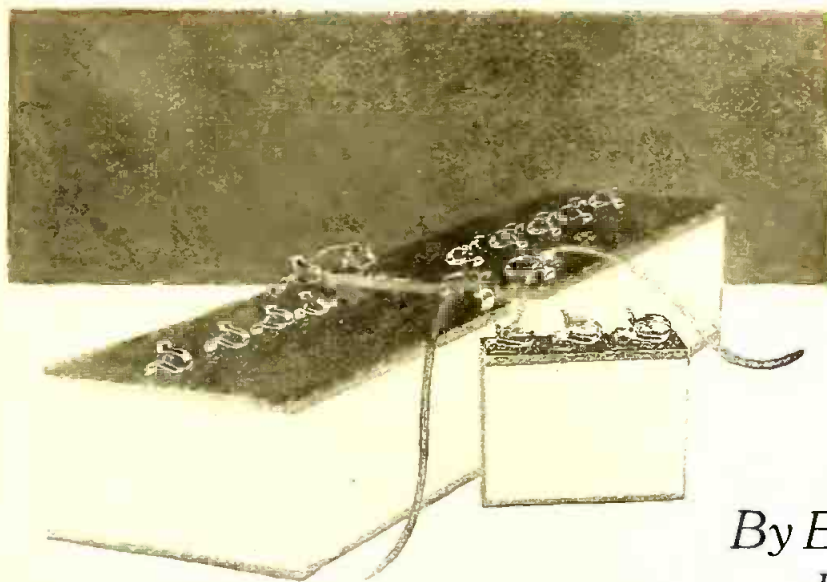


Fig. 1. A typical grid characteristic chart for 199 type (3 volt) tubes with plate voltages of 45-80 and 90 volts.

The Correct "B" Battery for your Portable

Success
or
Failure
of the
Vacation
Radio
Depends
on the
Condition
of Your
"B" Battery
Outfit



Liberal
Supply
at Start
Will
Insure
Success

By Edgar H.
Felix

THE B battery is the power plant of your radio set and its failure means that the portable is temporarily useless. At home, batteries are not difficult to replace from the liberally stocked shelves of a nearby radio store, but in the wild and woolly haunts where many of us seek rest from the rigors of city life, B batteries are as rare as the proverbial dinosaur.

Hence, give this important element of your Summer radio set all of the consideration which it deserves. Take the same precautions that you would before starting on a motor trip across a hundred mile desert—make sure that your fuel supply will be sufficient to carry you to the next service station, with an ample margin to spare.

There are two kinds of service for which portable sets are designed and your B batteries should be selected with these in mind. First, there is the pack set, which can be carried on a hike, like other portable camp equipment; and second, there is the self-contained semi-portable, for temporary installation during vacation time, in camp or bungalow.

The Pack Set

IN THE pack set, everything must be sacrificed to secure light weight.

Economical upkeep and long service without renewal of batteries must give way to the utmost portability. For this reason, the smallest and lightest B battery obtainable must be used, because the larger sizes are altogether too bulky and heavy to be carried for any great distance.

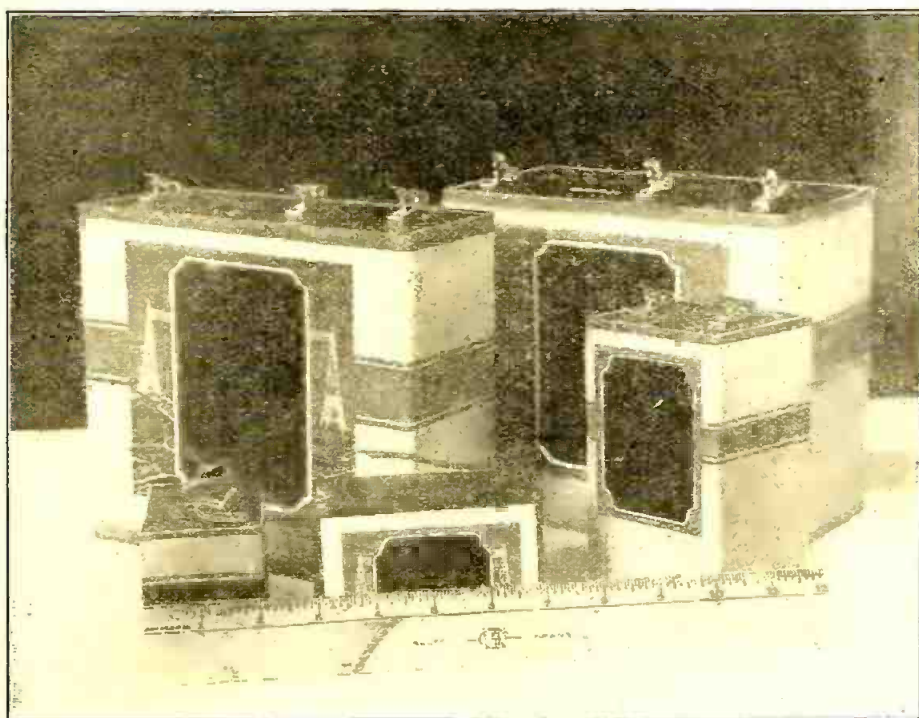
To meet these requirements, B battery manufacturers have placed tiny radio power plants on the market. These consist of an assemblage of very small cells, sealed in a small container. They represent the greatest possible amount of electrical energy which can be crowded into so small a space. But the output of

any B battery, in milli-ampere hours, is proportional to the quantity of active chemicals within each cell. Only a certain amount of each essential chemical can be placed in a given space. Consequently, the size of the battery places definite limitations upon the output which may be expected from it. The smaller the battery, the shorter its life and its current output. B battery costs, per hour of operation, increase rapidly as the size of the battery becomes smaller.

Before starting on your trip with a portable set, be certain that you have a B battery power supply which will last

over the period of your trip. Do not expect long life from tiny batteries called upon to deliver heavy currents for multi-tube sets. The smallest B battery, shown at the left of the illustration on this page, has all the capacity which can be incorporated in a battery of that size. It has a volume of 17.5 cubic inches.

The next larger size, at the center, has a cubic content of 28.6 cubic inches, or 63% larger. The tall, slim battery at the right is 50.3 cubic inches or 186% larger than the smallest battery. Obviously, there is considerable advantage both in milli-ampere hour capacity and economy in



This layout shows the various sizes of "B" batteries. It is advisable to spend liberally in equipping a portable set with "B" batteries, for a stingy investment at the start usually results in woe later on.

Voltage of Tubes	No. of Tubes in Set	Type of Tubes (see foot-note)	Total Rated Ampere Drain	Storage "A" Battery Size Recommended	
				Amp. Hours at 1 Amp. Drain	Days between Chargings
5-Volt Tubes C-300 and UV-200 are interchangeable C-301A, DV-2 and UV-201A are interchangeable	1	UV-200	1	65 or 47	22 16
	2	UV-201A	$\frac{3}{4}$	47	33
	2	1 UV-200 1 UV-201A	$1\frac{1}{4}$	80 or 65	22 17
	3	UV-201A	$\frac{3}{4}$	65 or 47	29 22
	3	1 UV-200 2 UV-201A	$1\frac{1}{2}$	95 or 65	21 14
	4	UV-201A	1	65 or 47	22 16
	4	1 UV-200 3 UV-201A	$1\frac{3}{4}$	115 or 80	22 15
	5	UV-201A	$1\frac{3}{4}$	80 or 65	22 17
	5	1 UV-200 4 UV-201A	2	115 or 80	19 13
	6	UV-201A	$1\frac{1}{2}$	95 or 65	21 14
	8	UV-201A	2	125 or 95	21 15
			$2\frac{3}{4}$	140 or 95	22 13
		For sets using current at a rate higher than 2 amperes.	$2\frac{1}{2}$	140 or 125	19 16

For combinations of tubes not listed: Use the same battery combinations recommended for tubes having voltage and current requirements similar to the tubes you have.
NOTE: If you use a loud speaker operated from your "A" Battery, add $\frac{1}{2}$ ampere to the total rated current drain of your tubes and then select a battery giving this total current consumption.

This chart, recently prepared by storage battery experts, should come in handy for fans whose knowledge of "A" battery characteristics is limited. Cut it out and tack it up near your radio set.

buying the largest possible battery which you can carry with you.

A pack set, intended for several weeks' use during vacation time, will give more satisfactory service if large batteries are used outside the set, while it is used at its semi-permanent location. When designing your portable, therefore, equip it with flexible B battery leads so that, whenever possible, you can use larger batteries and so that you may limit the service on the small batteries to those occasions when convenience in portability compels their use. For instance, if you plan to take your set with you on an all-day picnic, use the small portable batteries; but when you get back to the permanent camp at the shore of the lake, substitute the larger batteries for the smaller ones. Your two sets of batteries may then last you all through the summer season.

The Semi-Portable Set

THE semi-portable set can give all of the satisfaction of the permanent installation, so far as battery upkeep is concerned. Thousands of motor campers take good radio sets with them because they provide the finest kind of entertainment after the day's drive. Even if the battery compartments in the set do not

provide sufficient space for larger batteries, leave the diminutive batteries home, and make space in your car for large or even extra large B batteries. If you have room for a radio set, you have room for the right kind of batteries to go with it. Nothing takes quite so much space as a radio set which is useless because its tiny inadequate B batteries have given out.

The realization that an adequately powered set is the only kind which gives satisfaction is gradually becoming general. Nevertheless, many sets on the market, including some intended for permanent installation, are equipped with compartments for small B batteries, encouraging inadequate sources of power supply.

On any loud speaker set, the audio-frequency amplifier can be made very economical in its current requirements through the use of a C battery. A $4\frac{1}{2}$ volt negative bias on the grids of the audio-frequency amplifier tubes frequently reduces their current drain by one-half or two-thirds. Consequently, the little C battery is well worth its weight, even in a pack set. The current drain to which the C battery is subjected is so small that its serviceability is limited only by its shelf life.

The illustration shows five sizes of B batteries in such a manner that you will be able to identify them when you purchase B batteries for your portable sets.

The smaller sizes, shown at the front of the illustration, should be used only when portability requires their selection. Their output in milli-ampere hours increases more than in proportion to their increase in size. Considering that the largest of these portable units—the tall battery at the right—has less than 25% of the electrical capacity of the large battery shown at the left in the back, the greater lasting qualities of the larger batteries become obvious.

The large size, back of the small batteries at the left, has considerably greater lasting quality than the next preceding size. It is the middle ground between the utmost economy, as embodied in the extra large size, and the uneconomical smaller sizes. There are several makes of semi-portable sets equipped with battery compartments which will house these large batteries.

On the other hand, if it is possible to employ the heavy duty battery for a three or five tube set, as illustrated at the right, you attain the greatest economy possible in radio receiving power supply. These batteries will last much longer than the smaller sizes and they represent the best buy in radio power.

Selecting Strong Batteries

WHEN selecting a storage battery, every owner of a receiving set desires one of sufficient capacity to make frequent recharging unnecessary, yet small enough to reduce the first cost to a minimum. Has ideas as to just what to specify, in order to obtain this highly desirable combination, may be somewhat hazy, but he is never in doubt as to the result he seeks.

Various types of storage battery selection charts have been developed in the past, which were intended to assist the owner of a receiving set in making a proper selection. Lately a chart has been developed which takes into consideration number, type and combinations of tubes in a way that makes selection of a satisfactory battery a simple matter.

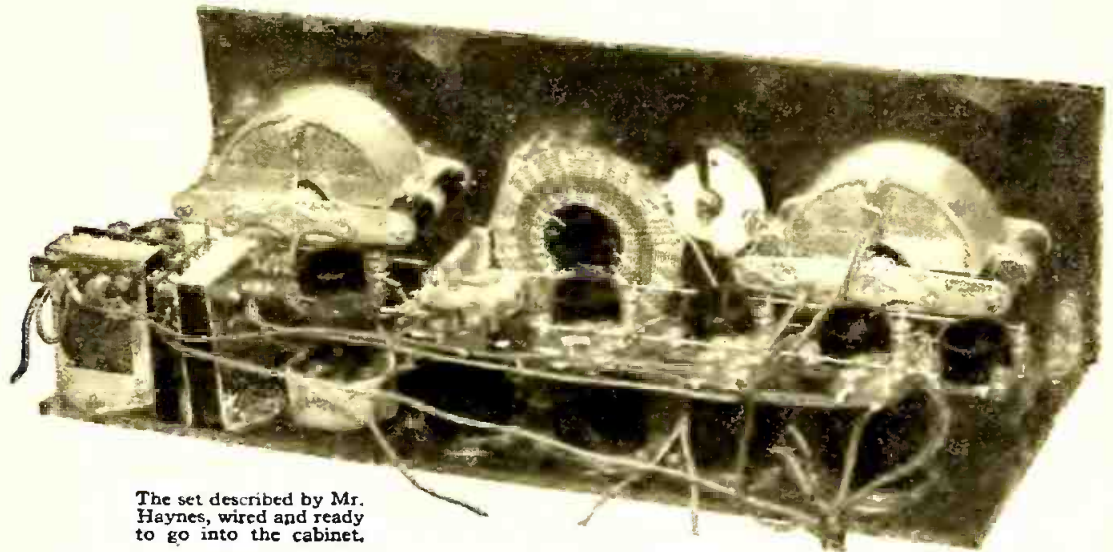
Voltage of tubes, number of tubes, type of tubes, rated ampere drain and recharging interval are treated in the chart in such a way that the receiving set owner has a choice of two recharging periods. For instance, for a set using one UV-200 and three UV-201A tubes, with a rated ampere drain of $1\frac{3}{4}$, and "A" battery of 115 amperes (at one ampere drain) will give 22 days of service without recharging when used for an average of three hours daily; while with the same tube combination, a battery of 80 amperes will have a recharging interval of 15 days. Similarly, for a set having three UV-201A tubes at $\frac{3}{4}$ ampere drain, a battery of 65 amperes insures 29 days' service while the smaller 47 ampere battery gives 22 days' service between rechargings.

By calling attention to the types of tubes that are interchangeable, it will be noted that the accompanying chart gives practically every combination of 5-volt tubes in general use.

A Simplified Portable Super

By A. J. HAYNES

Here is
An Outfit
Whose Cost
Can Be
Kept Well
Below
\$130 by
the Careful
Home-
Builder



The set described by Mr. Haynes, wired and ready to go into the cabinet.

A Popular Receiver That Will Give Dependable Loud Speaker Results in Summer Up to 1,000 Miles

FOR the past three years, portable radio sets have been built in great profusion—in Winter conversations. When the good old Summer time rolls around, however, rarely does a radio set accompany Dad in his jaunt to the Maine woods or the family on their annual flivver trip.

This lack of enthusiasm in the past can be attributed to a number of real reasons. There were only two or three broadcasting stations with sufficient power to make reception pleasant through static disturbances a year ago, many portable sets were "portable" only because the case was leather, and sometimes the batteries were enclosed, and finally, the cost of a good portable receiver was almost prohibitive for the average family.

This year these faults have been remedied to a great extent. Stations have increased their power until the "static level" has been pushed some hundreds of miles into the sticks. There are now a number of factory built portables which can be classed as real sets, and what is more important to most of us, the cost of both parts and accessories has moved downward in a very satisfactory manner during the last year.

The design of the set shown in this

article has been thought out with complete portability, low cost and good performance as the primary considerations. The set is completely self-contained. Although the loop is built in the case cover, it will be found as efficient as the ordinary loop of approximately the same dimensions. The cost of the outfit can be kept below \$130.00 for the complete units and this price includes all the necessary tubes and batteries. Even this comparatively low price can be cut considerably by judicious shopping.

Same Constants

IF YOU substitute parts other than those shown in the material list, be sure that the new parts have constants exactly similar with those specified.

The circuit employed is a conventional "regenerative loop" affair. The only change which you might notice is the fact that the pickup coil is placed in the filament lead instead of in the grid lead of the first detector tube. This was done to reduce body capacity effects, which are often severe in supers using a grid pickup with regeneration.

The battery supply indicated is wholly adequate for the drain put on it. Our test set ran almost continually for two weeks while we were making tests and

the batteries still have lots of pep. The "What will it do?" club is probably becoming quite anxious by now, and it is fair that they be answered. First, claims of the "coast-to-coast-on-the-loud-speaker-in-daylight" type are ruled out. The set will give dependable loud speaker results in the Summer time on stations up to a distance of 1000 miles. This means results which you can enjoy and, if you are listening to music, dance to it without having to imagine half of the tune. On nights that are favorable to reception, you can make a very comfortable and thorough tour of the country via the loud speaker.

Most of the tests run on this set were made in Chicago, which is notorious for the difficult receiving conditions caused by the numerous and powerful stations there, and the results were highly satisfactory. The set was tried in the North, West and South sections of the city—each with its own particular set of problems, and in no test was the set unable to pull in fewer than fifteen out-of-town-stations. These tests were all made while the local stations were broadcasting.

You can have the carrying case constructed by a local firm or a suitable



The socket strip for the simplified portable super-heterodyne, showing one filament lead and method of binding lugs for other filament lead.

case may be purchased from one of a number of firms advertising them. Owing to the chance for confusion, it is best to cut the leads only as needed and to mark the drawing as they are used. In this way a double check is kept on the work as you go along.

Assembling and Wiring the Set

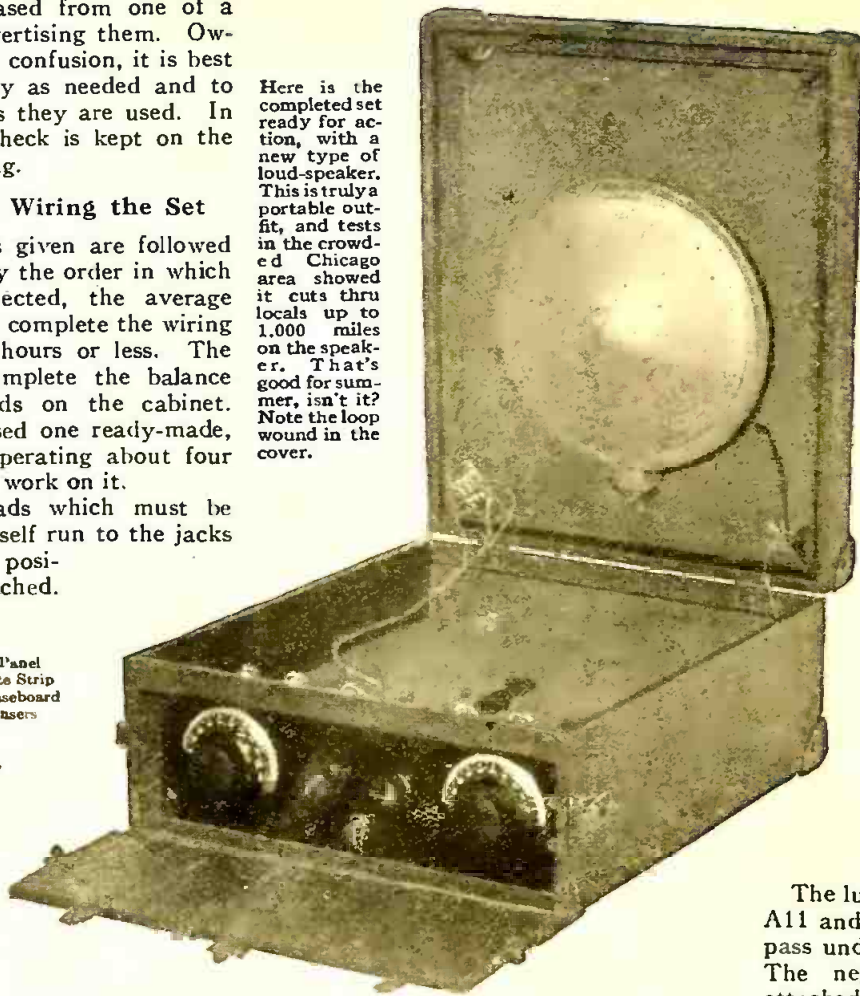
If the instructions given are followed carefully, particularly the order in which the leads are connected, the average fan should be able to complete the wiring of the set in three hours or less. The time required to complete the balance of the work depends on the cabinet. If you have purchased one ready-made, the set should be operating about four hours after you start work on it.

The only two leads which must be soldered in the set itself run to the jacks and, owing to their position, are easily attached.

Material List

- 1 5"x16 1/2"x3/16" Bakelite Panel
 - 1 1 3/4"x16 1/2"x3/16" Bakelite Strip
 - 1 7"x16 1/2"x3/16" Veneer Baseboard
 - 2 .0005 mfd. Variable Condensers
 - 1 Set I. F. Transformers
 - 1 Oscillator Coupler
 - 1 3 Plate Condenser & Knob
 - 8 UV199 Sockets
 - 2 Audio Transformers
 - 1 400 Ohm Potentiometer
 - 1 Filament Switch
 - 2 Jacks
 - 1 Turnit Condenser
 - 2 .006 mfd. Condensers
 - 1 .005 mfd. Condenser
 - 1 .002 mfd. Condenser
 - 2 .00025G mfd. Condens-
- ors
- 13 Megohm Grid Leak
 - 15 Megohm Grid Leak
 - 1 10 Ohm Type 301 Rheostat,
 - 50 ft. Hookup Wire
 - 3 ft. 5-conductor Battery Cable
 - 29 6-32x5/16" F. H. Brass Machine Screws
 - 12 6-32x3/4" F. H. Brass Machine Screws
 - 7 6-32x1 3/4" F. H. Brass Machine Screws
 - 40 6-32 Brass Nuts, 1/4" Across Flats
 - 12 6-32 Brass Nuts, 3/8" Across Flats
 - 2 Brackets No. 1509
 - 2 Brackets No. 1506
 - 3 Brackets No. 1505
 - 3 Brackets No. 1476
 - 9 Doz. Small Lugs
 - 4 Lengths Rosin Core Solder
 - 18 Brass Washers for 6-32 Machine Screws
 - 12 3/4" Brass Wood Screws
 - 5 Rubber Buiding Posts
 - 4 Bakelite Loop Support Strips
 - 100 ft. Stranded Loop Wire
 - 1 Portable Cabinet
 - 1 Loud Speaker

Here is the completed set ready for action, with a new type of loud-speaker. This is truly a portable outfit, and tests in the crowded Chicago area showed it cuts thru locals up to 1,000 miles on the speaker. That's good for summer, isn't it? Note the loop wound in the cover.



place a lug under each nut which locks both a socket and condenser in place. This is done at points A10, A11, and A12.

Before attaching the .00025G condenser in place, put a 6-32x5/16" machine screw through the condenser at H5. Lead No. 35 is now cut to length and attached under the nut at L and the other end secured at L1, the Grid of the first detector tube.

Lead No. 1 is attached at the end of the 5" section to the first grid condenser at H5.

Leads are now partially completed to each of the by-pass condensers on the socket strip. Lead No. 25 is soldered to the .006 condenser at G4. Solder one end of lead No. 22 to the other .006 condenser at D6. One end of lead No. 26 is soldered to the .005 condenser at C4. At L2 of the .002 condenser solder lead No. 23 and attach the other end to the plate of the second detector tube, L.

The lugs which were left at points A10, A11 and A12 are now turned until they pass under the nuts at A6, A8 and A13. The negative filament lead is later attached to these points and the lugs form a very convenient method of making short leads.

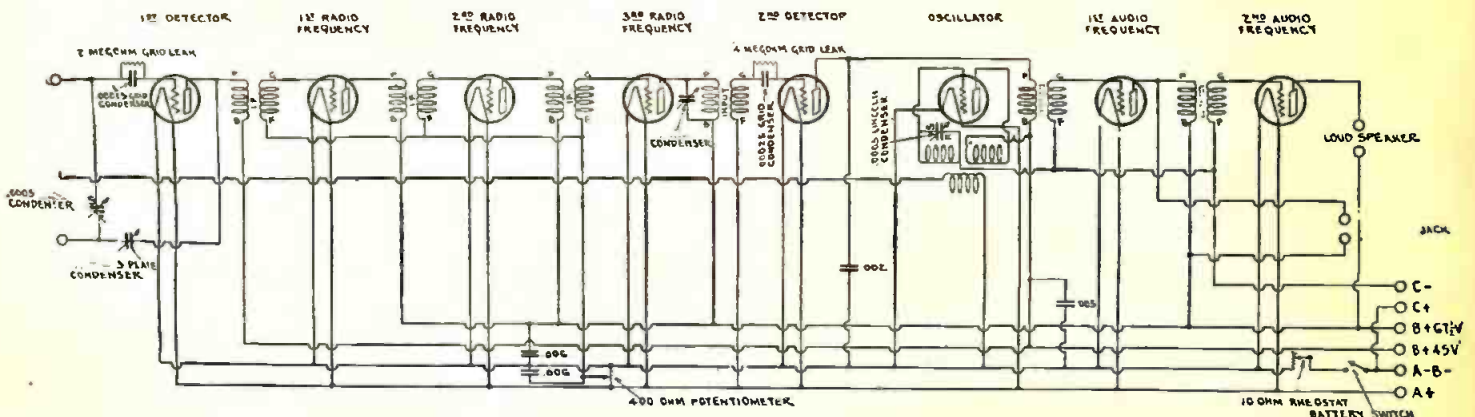
Leads 8 and 9 are now cut from two pieces of round bus bar and form the two filament bus lines on the socket strip. Place a lug under each of the filament terminals on the sockets projecting at right angles to the socket strip, bend the tips to right angles, insert and solder the bus bar and finally bend the completed leads as close to the sockets as possible. No identifying letters have been placed on the diagram to show the position of these leads but as the sockets are marked, you should have no difficulty in doing the job correctly. These last operations complete for a moment the work on the socket strip and we shall turn to the wiring of the oscillator coupler.

When the panels have been drilled and countersunk, mount the proper parts on the panel and baseboard. Do not mount the oscillator coupler on the baseboard at this time, as there is some preliminary wiring on it which can be done more easily if it is not mounted. 6-32x5/16" machine screws are used to secure the instruments to the board.

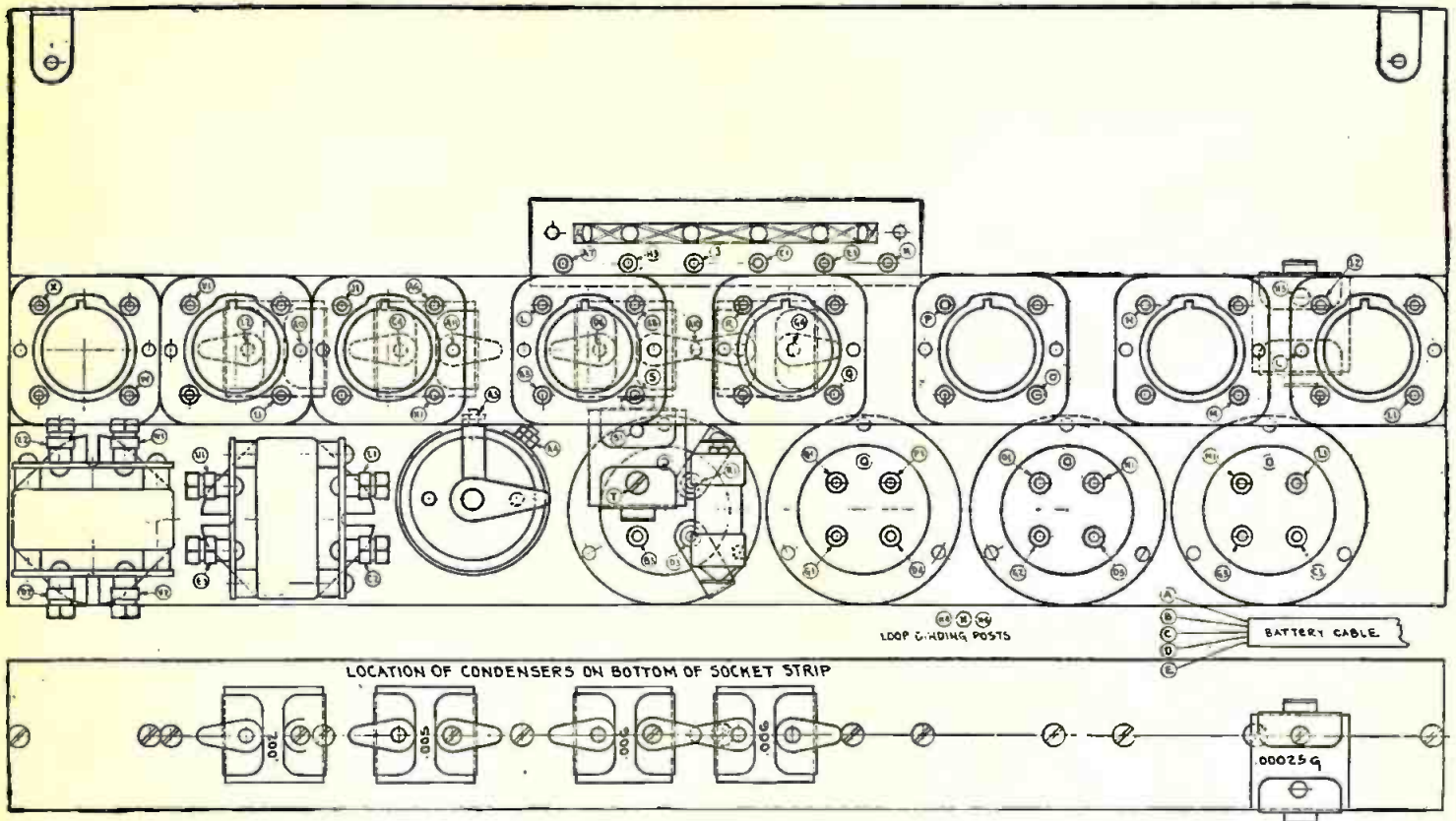
The Socket Strip

THE assembly and partial wiring of the socket strip should now be undertaken. Where a bolt is used to attach only the socket to the strip, use 6-32x5/16" machine screws. Where a bolt attaches both a socket and a condenser to the strip, use 6-32x1 3/4" machine screws and cut off the extra length. Be sure to

SCHEMATIC DIAGRAM



The schematic wiring diagram of Mr. Haynes' receiver. By following this layout the beginner should have no trouble in building the portable super.

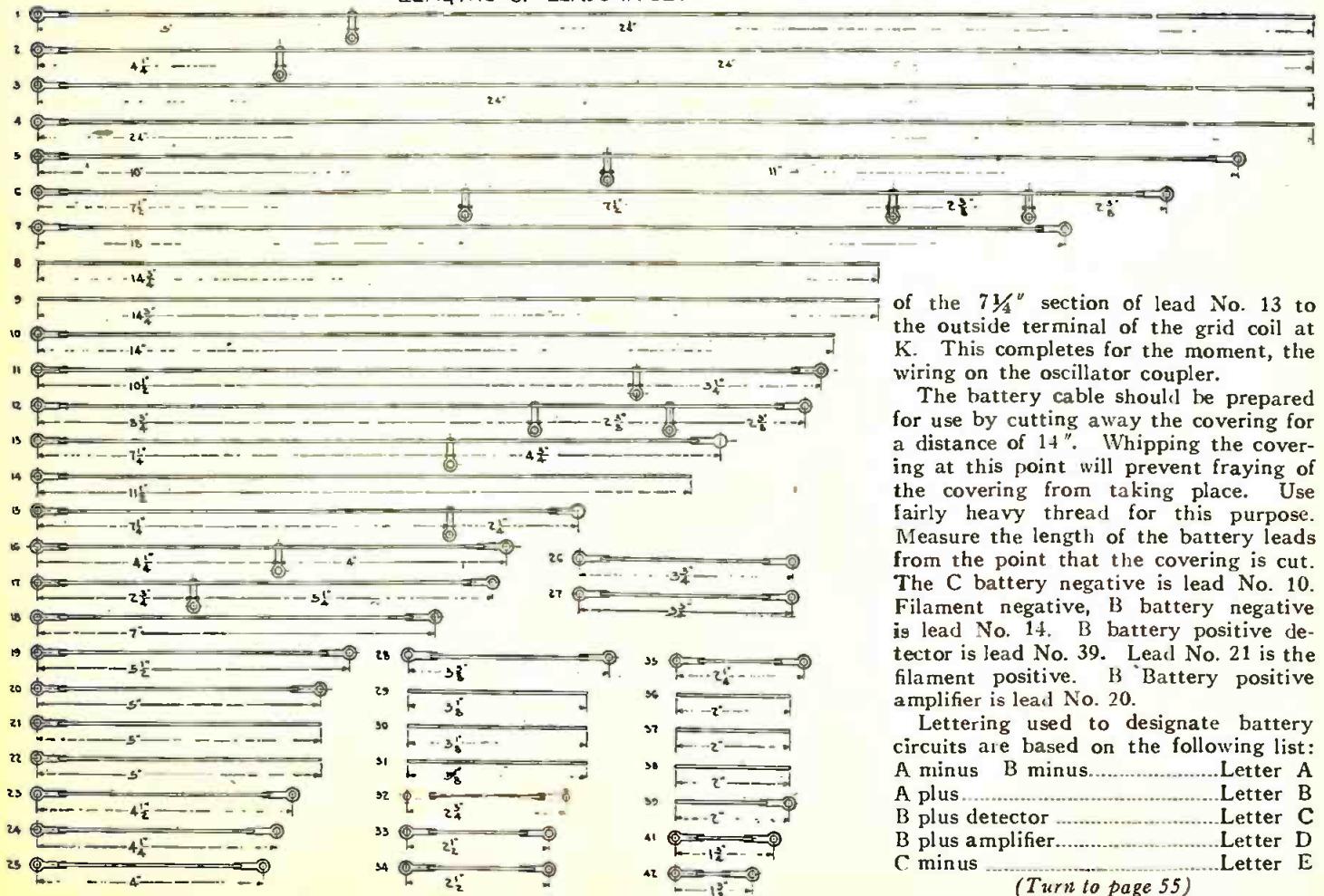


The oscillator coupler consists of three separate windings: the pickup coil, the grid coil and the plate coil. In referring to the "inside" or "outside" connections to a section of the coil, the tap nearest the center or furthest from the center

is meant respectively. Attach one end of lead No. 32 to the inside terminal of the pickup section at A7. Lead No. 3 is attached to the outside terminal at H3. Lead No. 19 is attached at J to the inside terminal of the plate section.

Attach the lug at the end of the 10" section of lead No. 5 to the outside terminal of the plate section at C1. Fasten lead 11 with the tap at the end of the 10 1/2" section to the inside terminal of the grid coil at E1. The lug at the end

LENGTHS OF LEADS IN SET



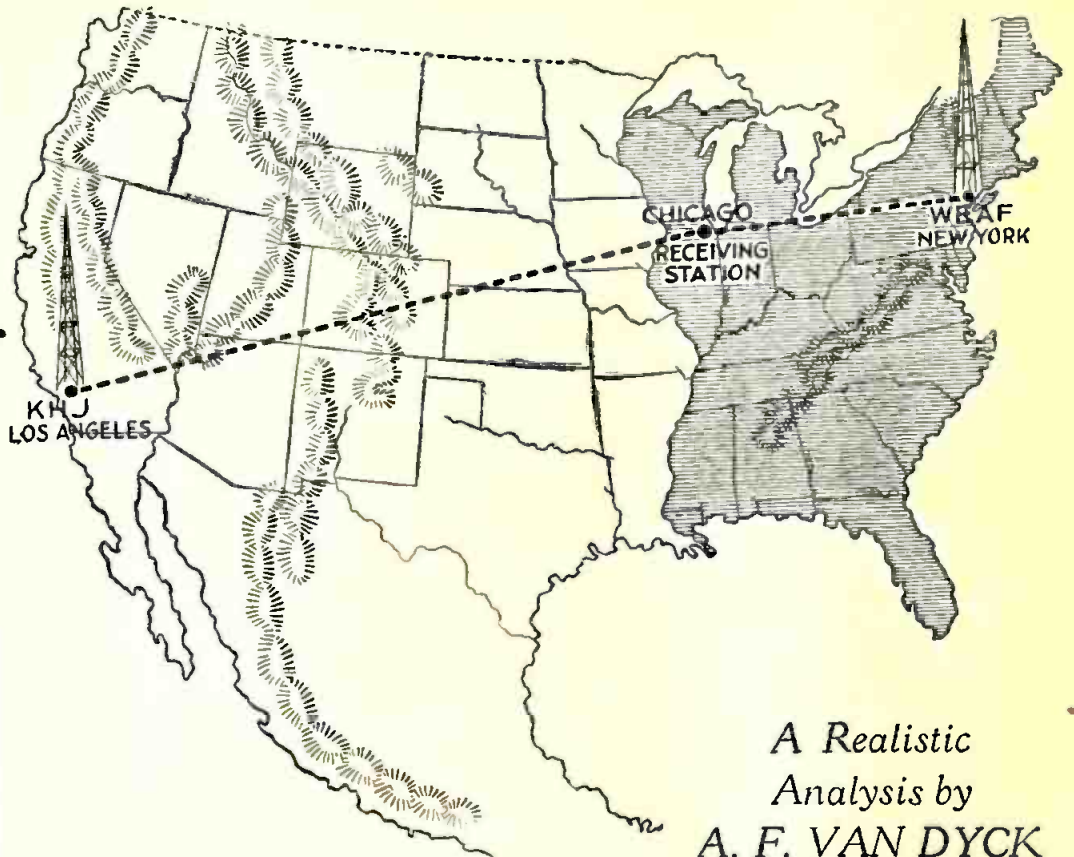
of the 7 1/4" section of lead No. 13 to the outside terminal of the grid coil at K. This completes for the moment, the wiring on the oscillator coupler.

The battery cable should be prepared for use by cutting away the covering for a distance of 14". Whipping the covering at this point will prevent fraying of the covering from taking place. Use fairly heavy thread for this purpose. Measure the length of the battery leads from the point that the covering is cut. The C battery negative is lead No. 10. Filament negative, B battery negative is lead No. 14. B battery positive detector is lead No. 39. Lead No. 21 is the filament positive. B Battery positive amplifier is lead No. 20.

Lettering used to designate battery circuits are based on the following list:
 A minus B minus.....Letter A
 A plus.....Letter B
 B plus detector.....Letter C
 B plus amplifier.....Letter D
 C minus.....Letter E

(Turn to page 55)

Tricks of Summer Radio



D Suppose a receiving station in Chicago is receiving both from New York and Los Angeles. A patch of radio fog might appear between New York and Chicago and weaken the New York signals, while the signals from Los Angeles remain unchanged. The map shows how we sometimes receive signals from the West better than those from the less distant East.

A Realistic
Analysis by
A. F. VAN DYCK

EVERYONE who has a radio receiving set has met the atmospheric nuisance called "static." It comes in, especially during the warm months, and interferes with clear reception. A particularly pleasing musical number may be on, but that makes no difference to Old Man Static.

So many inquiries have been received at the General Electric station, WGY, at Schenectady, that A. F. Van Dyck, a radio engineer, has prepared the following paper, explaining some things that are known about static and what is being done to get rid of it. Mr. Van Dyck's explanation follows:

IN THE letters which WGY has received from listeners, certain questions have been asked by many different inquirers. Some of these questions involve radio phenomena which are not completely understood by scientists today, and the answers and explanations which we shall give should be understood to be the ones which are believed to be nearest the truth, although they are not subject to rigid proof.

First, let us consider what radio transmission is. We know that a radio sending station sends out from its antenna in all directions, a disturbance of electric forces. We cannot see or hear or otherwise observe with our senses just how this disturbance behaves, as we can with light waves and sound waves. We consider it quite natural that a stone wall stops the light beam from a searchlight, or that a bugle call can be heard much farther over water than through a forest, or that under certain air conditions on a desert, the mirage phenomenon is observed; and to know what to expect in radio, we need only to remember

that some things in space will stop, or reflect, or perhaps absorb the travelling radio waves, just as some other things in space stop or absorb or reflect light waves, or sound waves. We must not expect radio waves to travel out from a transmitting station, over some enormous distance to a receiving station, without encountering some obstacles somewhere in its path.

How Radio Pierces Walls

SUBSTANCES which are obstructions to light or sound waves are not necessarily such to radio waves. For example, we know that radio waves pass through the walls of a house with only slight loss. But there is some substance in the space around the earth which does have effect upon radio waves. This substance is not uniformly distributed through space, but is present here and there, and is continually changing location and magnitude, and consequently has very erratic effects on the passage of radio waves.

The condition is quite similar to the use of a searchlight in a fog, which might be varying rapidly in density or location, or both. This radio fog is commonly supposed to be made of ionized air; that is, air which by some influence has become a partial conductor of electricity. Of course, this radio fog never stands still and is changing from moment to moment under the influence of the complicated conditions of our atmosphere, and so the radio wave passing through space surely has an adventurous journey because it meets electrically charged clouds, patches of ionized air, and perhaps other obstacles of which we know nothing.

It is a fact often observed that it is

possible to work radio communication over much greater distances at night than in the daytime. This may be explained by the effect of the sun upon the air, which causes ionization of it, and is most active in the daytime and practically absent at night. The sun seems to be responsible without question, in view of the fact that very erratic results in long distance reception are always noticed at sunrise and sunset.

Wave Power Varies

WITH the preceding statements in mind, it should be clear that when one is receiving over long distances—several hundreds of miles—it is natural for the waves to come through strong at one moment, and to fade away considerably the next moment, as some obstacle to radio waves comes between the transmitter and receiver. This explains, too, why one transmitting station, of two or more which are being heard, may get weaker, while the others do not. For example, suppose a receiving station in Chicago is receiving from New York and also from Los Angeles. A patch of radio fog might appear between Chicago and New York and weaken the New York signals, while the signals from Los Angeles remained unchanged. Whenever in reception over a considerable distance, one observes a variation in the intensity of the signals, it is most likely due to so-called "fading," caused by some obstruction to the traveling waves somewhere between the two stations, and not to any fault of the transmitting station itself. These effects are much more frequent in the Summer than in the Winter, presumably because of the greater influence of the sun on the earth and

(Turn to page 60)

Gloria Confesses



Gloria Swanson, who since her marriage to a dashing Frenchman is Marchioness Something-or-Other, made her first broadcasting appearance under her new name from WGN, located on the Drake Hotel, Chicago. Seated before the "Mike," she answered several exceedingly personal questions put to her by Announcer Quin A. Ryan of WGN. The questions, by the way, had been sent in by inquisitive listeners who had been notified of the famous "Radio Interview" with Gloria as the interviewee, who seemed willing to tell all her deep secrets for her radio and movie admirers.

(Photo Copyright by Drake Studio, Chicago)



What the Broadcasters are Doing



Portable "Pick-up" Station for KDKA

TO TAKE care of the ever-increasing "pick-up" situation that has confronted Westinghouse station KDKA, at E. Pittsburgh, the Westinghouse engineering department detailed Engineer Carrol J. Burnside to construct a portable short wave sending station, to permit the immediate and practical broadcasting of various interesting and important events, as they take place in their vicinity, despite the fact that location may not permit telephone wire connection with KDKA.

A one-ton truck chassis was purchased and suitable house-body built, wherein the pick-up apparatus was constructed. The requirements of this transmitter were that it be absolutely dependable at all times, in any location, and make use of a low wavelength, which is free from interference. The equipment must be compact and its personnel small and upkeep low, to justify its use. The body of the truck is 5 ft. wide by 9 ft. long and is 6 ft. high inside, solidly built to withstand the jar of movement of the truck in motion. All equipment is cushioned to minimize the jarring of apparatus.

The transmitter is a quarter-KW set, using 110V from lighting circuit where program is being broadcast, and a power transformer in the truck is used to step up to the high voltage required to operate the set. Power at this high voltage is passed through a vacuum tube rectifier using two quarter KW air-cooled rectifier tubes, which gives single phase full wave rectification. The output of the tubes is passed through a brute force filter of choke coils and condensers, which delivers 2000 volts DC power to the transmitter, which makes use of the standard Hartley oscillator circuit with Heising modulation.

The equipment used in this portable set is capable of wavelengths varying from 20 to 100 meters, although the set will ordinarily be operated on about 53 meters—KDKA to pick up its broadcast and rebroadcast on their standard wavelength of 309 meters.

Because of a likelihood of broadcasting from some downtown section of the city, where it would not be practical to operate a regular antenna, a vertical oscillator type is used. A copper pole of three sections, of the telescoping type was constructed, which is folded and stored in the truck when not in use.



Iris Virginia Gruber has the distinction of broadcasting more than any artist in Philadelphia and is the winner of the Radio Cup presented for singing the greatest number of times during the concert season from January 1st to May 1st.

"Ford and Glenn" to Tour U. S.

FORD RUSH and Glenn Rowell, the "Lullaby Boys," whose songs and bed-time stories during "Lullaby Hour" and "Ford and Glenn Time" over WLS, the Sears-Roebuck station, Chicago, have endeared them to the hearts of kiddies and their parents throughout the nation, will start on a transcontinental tour of the United States June 2. The WLS favorites will broadcast their most popular features over nineteen of the principal radio stations clear to the Pacific Coast.

The journey from station to station will be made in their new sedans, in which they will carry complete camping outfits. In many of the places they will live out in the open with their families, who will accompany them.



Above is "Si" Berg, nationally known ukelele artist and songster, who has appeared all over the country before prominent microphones. He is now appearing consistently from WHT and KYW, Chicago, having contributed recently to the success of many RADIO AGE programs from the latter station.

McNamee of WEAF Chosen Best Announcer

GRAHAM McNAMEE of WEAF was selected as the best all-round local announcer by the Radio Voice Technique Committee of New York University at a meeting held recently, according to announcement made by the committee. McNamee nosed out Brockenshire of WJZ by the small margin of four-tenths of a point, the scores being 87.3 for McNamee and 86.9 for Brockenshire.

This committee meeting terminated the series of three which were held during the past four months under the direction of R. C. Borden and A. C. Busse, voice experts of New York University, to determine the ideal qualities to be looked for in radio announcers. The aim of the committee, which is composed of radio editors, dramatic critics and members of the faculty of New York University, is not to standardize the voice and art of broadcasting, but to point out faults to be avoided and to determine what the public prefers to hear.

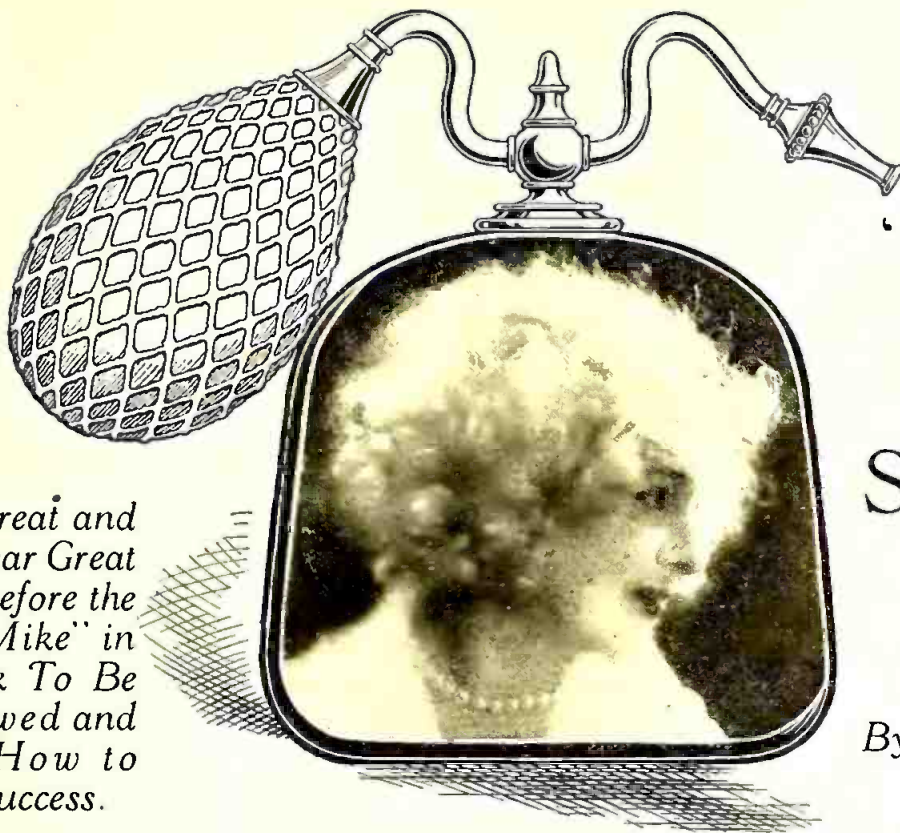
Special phonograph records were made by Mr. Borden and Mr. Busse of representative announcers from the following nine New York stations:—WJZ, WEAF, WGBS, WHN, WEBJ, WOR, WAHG, WMCA, and WBBR. Each announcer passed upon his own record and all those entered in the contest had been accepted by the makers as fairly representative of their work.

Ten men out of the number considered were chosen as the best local announcers. In addition to McNamee and Brokenshire they are Barnett of WOR, Reed of WJZ, Carlin of WEAF, Squires of WMCA, Granland of WHN, Haupt of WEAF, Cross of WJZ and Morgan of WGBS.

The committee rated the records upon the points which were decided upon at earlier meetings as those most desirous for radio announcing. They are as follows: (1) Average rate of speaking—175 words a minute. (2) Pitch of voice—low middle range. (3) Announcements should be made with variation of rate, pitch and stress. (4) Manner of announcer—formal but friendly. (5) Distinctness and enunciation.

A summary of the comments made by the committee during the course of the meeting has been arranged by Mr. Borden and Mr. Busse for public distribution.

THE alluring Miss adorning the perfume bottle is none other than Mlle. Rosario Duprez, prominent New York fashion queen, who is telling the flappers and gay matrons in the East how to achieve personality by means of perfume. Needless to say, she has a large feminine (and masculine) following, both for her radio as well as her pulchritudinous attainments.



Radio's "Interview Lady" Scoops the World!

By MILTON
LIEBERMAN

THE Great and the Near Great Appear Before the WGBS "Mike" in New York To Be Interviewed and Reveal How to Achieve Success.

A WOMAN has brought the newspaper to the radio world. She has woven the two together and has brought shortcomings of one to be valuable features of the combination.

She is Terese Nagel, the "Interview" lady of WGBS, the Gimbel Brothers store, New York City. A newspaper woman of ten years experience, Miss Nagel, just a short time ago, brought that most famous of newspaper features, the interview, within reach and audibility of every radio fan.

The scheme is clever. Nearly everyone wants to become as nearly acquainted as possible with famous people, but it seemed a difficult matter to bring the celebrities to the public through radio. Those who could sing or play an instrument, of course, were immediately brought on the air, but it remained for Miss Nagel to bring those who conquered art in its more inaudible forms before the microphone in a satisfactory manner.

She Gets the Celebrities

ALMOST every person of importance in New York and visiting the city has spoken before the WGBS microphone through the efforts of Miss Nagel. She takes them there, and then, with her newspaper instinct and ability, draws forth their thoughts, their hopes and ambitions for all the world to hear. Fay King has called Miss Nagel the "newspaper woman of the air."

She got a "scoop" the day that I visited her for an interview on her work. When I approached the beautiful studio on the seventh floor of Gimbel Brothers, having passed a group of people who were standing outside of the glass-windowed studio, I found that Miss Nagel was on the radio.

She finished her interview and dashed for the telephone. "A scoop," she said,

and I waited until she had finished her call.

"I just did a good piece of newspaper work," she told me. "I was just interviewing Mrs. Anna Norton, who was chairman of the democratic party during their national convention, and found that she is going after a big political job here in New York. I rather think that she let it slip unintentionally, but I found out that she will run for the nomination for registrar of the city. It pays \$12,000 a year. I just finished speaking to the city editor of the New York American, and he has congratulated me.

"That just goes to show," she continued, "that the radio has unlimited possibilities. Just at present knowledge of who will run for registrar is very important, and the fact that a woman will do it makes the scoop valuable."

How She Does It

SHE then told me about her job of interviewing celebrities, and how, by her clever questions, she draws information from them which they probably would never divulge in another way.

"I have interviewed hundreds of famous people. I can tell you some of

them. There was Rube Goldberg, Miss Oliver Herriman, Jane Cowl, Tony Sarg, Victor Depew, the cartoonist, Willem Van Hoogstratten, conductor of the New York philharmonic orchestra, Fay King, several actresses, including Miss Blanche Yurka and Miss Mary Mellish. The Hamilton brothers, Cosmo Hamilton and Hamilton Gibbs, were very interesting. There was also Countess Caroli, whose husband was first president of the Hungarian Republic.

"It is very interesting, and I think I shall bring more newspaper features to the air. I plan to start a radio column and become the first radio columnist. The public will be asked for a name for the column and contributions like those used in newspapers will be accepted."

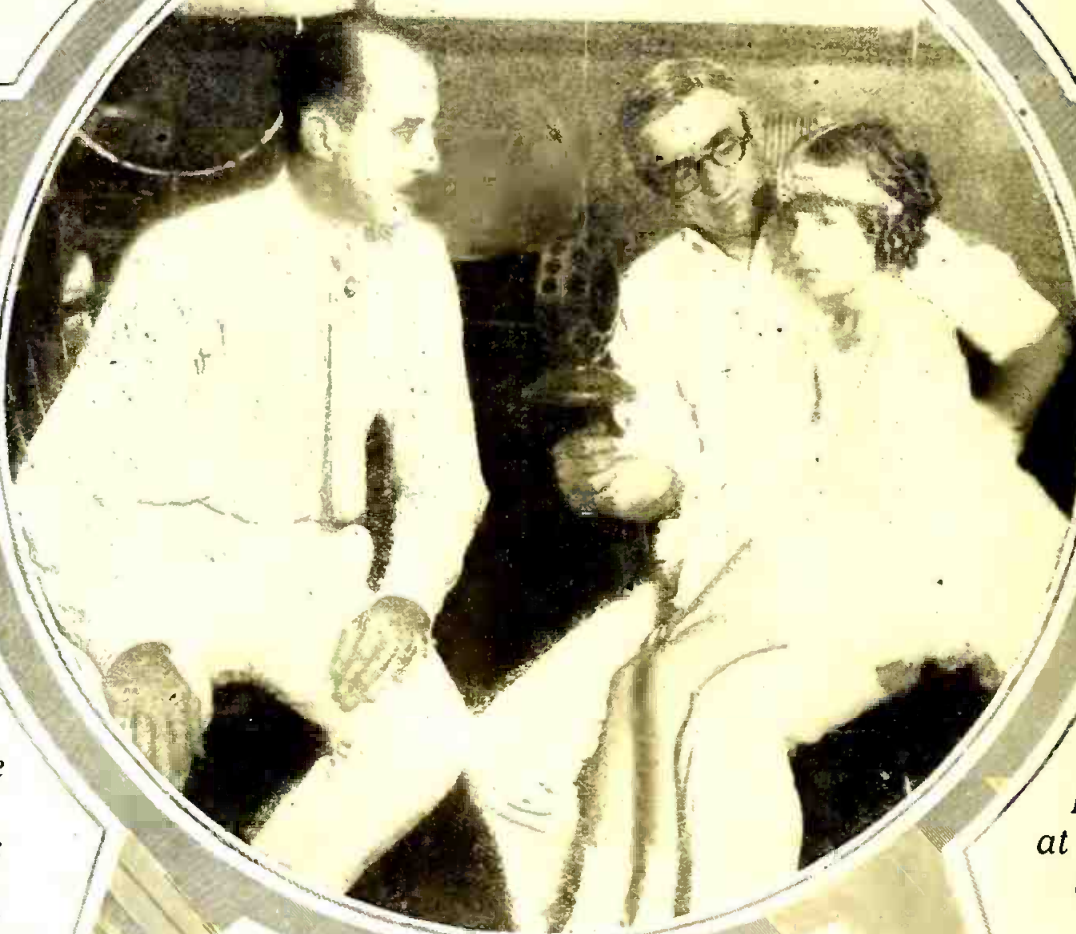
Rosario Duprez is another favorite from WGBS. She is the "Perfume and Personality" lady who believes that perfume, properly used, will enhance the personality of any woman. Miss Duprez, unfortunately, cannot be seen on the radio. Unfortunate it is, for she is the essence of charm and personality. WGBS, however, has many other ambitions, besides linking newspaper work and perfume with radio.



MARY MELISH, famous Broadway stage star, was one of the first celebrities to be interviewed by Miss Nagel from WGBS. The radio audience enjoyed her demure confessions of stage life, but they would have enjoyed them much more if they could have seen the lady in question. (M. Kessler Photo.)

A Station Broadcast

Where They "Personality"



By C. Clyde
Cook, who
Knows His
Hollywood
as Marconi
Knows His
Radio

Real Joy
Dispensers
at KHJ Keep
the Home
Fires
Burning in
California

Three of KHJ's scintillating stars are shown above, in their proper atmospheric setting. From left to right they are "The Sandman," who lulls the children to sleepy land, "Uncle John" Daggett, the Good Samaritan of KHJ, and on his knee, the little Queen Titania, who is a fairy optimist for thousands of hard-working Californians.

WHEN Signor Marconi invented the Wireless Telegraph, little did he think that in the near future this same great invention would advance with such strides that Personality should some day be broadcast to the inhabitants of this universe.

Although it may sound like another Hollywood Press Agent's stunt, this phenomenon has certainly been accomplished at station KHJ, The Los Angeles Times, Los Angeles, California, where none other than John S. Daggett, affectionately known to Radio fans as Uncle John, works this miracle with a resonant voice which, according to motion picture standards, registers "personality plus." Personality, some great philosopher

has epitomized, is that intangible and indescribable force which, of necessity, must come from within. Which, reduced to understanding English, only means that, to possess Personality in a marked degree, one must radiate that magnetic force or power from a most dynamic source—the heart! And that is the sole reason why Uncle John, directorial wizard of KHJ, has such a wonderful personality—he has a magnanimous heart, and his Radioland converts are becoming legion.

KHJ'S "Father"

THIS famous broadcasting station owes its existence, perhaps, to Uncle John's genius, for it was he who dedi-

cated KHJ to the horde of inhabitants of Radioland on April 13th, 1922. Like Aladdin's magic lamp, Uncle John has wrought miracles with this magnificent broadcasting station. KHJ has brightened more homes of sorrow, brought more harmony and joy into homes of discord, than any other three stations combined. And this is because his attitude towards his duties as an announcer has been that of a minister of humanity, and his cheery voice has come to mean as much in the home as the teachings of the scripture.

Bringing to this position of announcer a splendid college education and the invaluable experiences of a successful newspaper man, there is little wonder that Uncle John's name has virtually

become a household term in the Southwestern United States, and wherever the powerful KHJ broadcasting station can be heard. For Uncle John has seen fit to arrange programs which appeal to every member of the family, with a view to entertaining and enlightening his great following of Radio fans, for he has a penchant for broadcasting the best talent obtainable anywhere.

Thanks to KHJ and its progenitor, Uncle John, concerts of the highest type can be heard in one's home. KHJ is probably the only station which has on its staff an accomplished and famous musician.

In the person of Claire Forbes Crane, Radio Editor of the *Times*, KHJ boasts a pianist who has been soloist with such large musical aggregations as the Boston Symphony Orchestra, the Los Angeles Philharmonic Orchestra, and others. With the technique acquired as associate artist of Madame Melba, Arthur Hackett and other renowned artists, she brings to Radioland a veritable "Open Sesame" to shut-ins with musical longings. Under her artistic guidance the musical programs of KHJ have thrilled music lovers throughout the nation.

His Universal Appeal

BUT Uncle John's magical Radio wand is not confined to classical music. His musical programs are so arranged as to carry the universal appeal, running the gamut of musical emotions in the human race. Just to prove how broad a scope and range these musical entertainments cover, permit me to quote verbatim the mutterings of an alkali-coated miner from the great open spaces:

"Out on the Mojave Desert we gets mighty lonesome; times we don't keer if we live or die, and along comes Uncle John with one of his side-bustin', gun-totin' musical fests which makes us plumb ashamed of ourselves for even thinkin' of kicking off!"

And through all this good samaritan work of broadcasting cheer and entertainment runs that indescribable force—Personality. Why, the entertainers selected by Uncle John's inborn genius fairly exude it. So thoroughly saturated with it are these skilled entertainers and educators that they proceed to broadcast it to the many radio fans with astonishing results. You can feel the personality of various musicians, vocalists as well as pianists, in your very home. Most miraculous and yet a pleasant possibility in this day and time, with such a genuinely human announcer at the



G. Allison Phelps is known as the Radio Philosopher of KHJ, Los Angeles. Usually philosophy is either dry or preaching. But not the way "Al" tells it. He makes you cry for more.

helm of the good ship Broadcast! And not all of Uncle John's programs are solely entertainment. Professor Sylvester Hertzog lectures to the youngsters, in the

language with which they are familiar, upon subjects which stimulate thought action, compelling them subconsciously to master precepts and quotations which they thought impossible before. This is conducted during the "Children's Hour," from 6:30 to 7:30 p. m., a time which all children in homes equipped with radio sets hold most sacred. They are also treated to special readings from the Bible by

Uncle John, in that inimitable voice which children recognize as readily as they do their parents.

Another feature of KHJ, which has aided people in solving their daily problems, is the weekly lectures by Fred C. McNabb on the "Care of Gardens." In over fifty-two weeks of constant broadcasting, Mr. McNabb has done such creditable work that his bulky daily mail from grateful housewives attests the results obtained. Then Harold Swartz, one of America's most promising sculptors, delivers a weekly lecture on "Art." "Care of the Body" talks are broadcast by Dr. Philip M. Lowell, a recognized authority on this subject, while Captain Salisbury and other well-known globe-trotters tell of their thrilling experiences in foreign countries.

Talks Easily Understood

DR. MARS. BAUMGARDT, noted astronomer, delivered a lecture every Wednesday evening for over a year upon astronomical subjects, couched in such simple language that the layman could acquire a fair working knowledge of the rather mysterious science of astronomy. The "Radio Philosopher," G. Allison Phelps, has written and broadcast over thirty-six essays on momentous subjects, which are troubling people in the ordinary walks of life. Taking the smudgy commonplaces of life, this wise phil-

osopher animates them with his magic flow of metaphors and similes, so that grim bugbears and obstacles are soon converted into scintillating rays of sunshine.

Queen Titania

AND last but not least of the legion of KHJ broadcasters is the famous Queen Titania, who broadcasts the innermost workings of Fairyland every Tuesday night. In conjunction with her father, The Sandman, who also writes and directs these unique sketches, Queen Titania and Uncle John broadcast the most instructive of juvenile programs, accompanied with the most melodious of music.

Hundreds of children, ranging from five years to fifty, throng the auditorium on these nights and are taken for a pleasant journey through the mystic realms of Fairyland, under the personal guidance of the diminutive Queen Titania.

During its brief existence KHJ has been responsible for more innovations, perhaps, than any other station on the Pacific Coast. In addition to the aforementioned features, Uncle John has inaugurated Saturday morning broadcasting classes. All persons are eligible, providing they register in advance. This novel Radio instruction is deemed one of the greatest constructive influences toward a better understanding of radio.

While performers appear before the microphone, Uncle John stations himself down in the operating room the better to judge of the pupil's aptitude at broadcasting, and at its conclusion he lectures to the class upon their broadcasting from a radio point of view. This constructive criticism is also broadcast, making it possible for all members of radioland to learn the profound secrets of broadcasting.

When we radio converts shuffle off this mortal coil, we no doubt will consult the Recording Angel to ascertain our respective positions on the great list of those who served their Master well in radioland. If so, we no doubt will find that Uncle John's name, like Abou Ben Adhem, heads the list.



E. K. Barnes is assistant manager of KHJ and the boy who helps keep the wheels moving day and night at this ever-popular haven of "Kindness, Happiness and Joy."

(The foregoing account is the second of an interesting series of articles on California radio stations, which are known from coast to coast for their excellence. The first of this series appeared in the June RADIO AGE, and other equally interesting stories will be published in an early issue.)

Ten Commandments for the Broadcast Listener

While excellent radio reception is frequently possible during the warm months, the best long distance records come in the Winter. A reasonable attitude will help the listener here. He should remember that he cannot expect every act in even the best vaudeville performance to be tremendously amusing and just what he wants, nor can he expect the weather every day to be clear and pleasant.

Similarly he must not expect every day to be just right for long distance radio reception. Now and then a Summer storm may interfere with both radio and picnics. The listener should become acquainted with his local stations and enjoy them during the Summer, and be satisfied with the long distance records he has made, or will make, in the Winter. In other words, he should get the best there is in radio during all seasons, and above all he should be reasonable.



If the listener lives rather far away from all radio broadcasting stations which he wants to hear, there are several things he can do. He can lengthen his aerial wires and increase their height from the ground. Both of these measures make the signals louder as a general rule. He can add an audio frequency amplifier unless, of course, he already has this instrument. He can also increase the voltage of his "B" battery or plate battery up to 90 or even 112 volts (that is, to four or five of the usual 22½-volt units or blocks). He can use a more sensitive loud speaker, or content himself with head set operation. He should also tune more carefully so as to get the very loudest signal which his set is capable of giving. If there is a tickler adjustment on his set, he should learn how to use it so as to get full volume of signals. And he should remember that the good results he will then get are going to be even better results in the Winter.

If the listener is very near a powerful broadcasting station, he may get excessively loud signals from that station and have difficulty in picking up other stations when the nearby station is in operation. In extreme cases it is not possible to get the distant station at all under such circumstances any more than it is possible to hear a whisper from a distance when someone else is shouting nearby. Still a good deal can be accomplished.



There are ten good rules for broadcast listeners:

1. Don't try to hear Australia in mid-summer. Be satisfied to enjoy the nearer stations most of the time.
2. Don't be disappointed if an occasional storm interferes with your radio evening. There are many fine concerts coming. You can't expect to find a pearl in every oyster nor to receive a record-breaking concert every night.
3. If you want louder signals, use a longer aerial, more tubes, higher plate voltage, more sensitive loud speakers and more careful tickler and receiver adjustment.
4. A pleasant signal filling a moderate size room should be enough to give satisfaction. It is not worth while producing signals which deafen the neighbors. It is wasteful to insist on tremendous signals which are generally less pleasant than moderate signals.
5. If your local station comes in too loudly and drowns others out, a smaller aerial will help in tuning him out, with a smaller condenser connected between aerial and ground. And if all measures to get rid of the local station fail, why not enjoy his concerts? He is working hard for you and it is nobody's fault that you are so close to him that you are bound to hear him. Broadcast stations have to be closer to some people than to others.
6. For the new longer waves above 450 meters, use a condenser connected between the aerial and ground terminals of your set.
7. A little patience in learning to handle your receiver yields rich returns in satisfaction from fine signals. Remember that "Rome wasn't built in a day" and keep on getting more and more familiar with your set and how it works.
8. It is a good idea to read the radio column of a newspaper or a good radio magazine or two. It helps you to know how your set works and keeps you up-to-date in radio. Information of this sort is an aid in getting the concerts loud and clear.
9. Ask your radio dealer for advice; he can probably tell you what you want to know and will be glad to do so. The manufacturer of your set is also willing to help you get the desired results from its use.
10. Do not throw away the direction sheets or booklet that came with your set and with the tubes. Read all such material carefully now and then. If you have lost the direction sheets write to the dealer or manufacturer for another. The direction sheets answer most of the questions which have been puzzling you and preventing you from getting the best out of your set.

Favorites of MOVIEDOM Give Snappy Show at WIP

Fans Get Real Insight Into Adventures of Famous Stars

PHILADELPHIA:—One of the most unusual gatherings of famous stage and screen folk was held last month. Moving picture stars of the Metro-Goldwyn picture corporation, together with such famous men as Marcus Loew and noted stage stars, gathered around the microphones in the Studio of Station WIP, the radio broadcaster of the Gimbel store, to entertain the radio public and to answer all personal questions sent in to the station.

It was a real party—the stars sang, dined, danced to two orchestras; and the microphones did full duty all the while.

Lillian Gish, Jackie Coogan, Barbara LaMarr, Johnny Hines, Mae Busch, Dorothy Mackaill, Marion Davies, Anita Stewart, Harry Morey, Dagmar Godowsky, Louise Glaum, Fritzi Brunette, Ben Finney, Flora LaBreton and many more screen players.

Raymond Hitchcock, Eddie Cantor of "Kid Boots" fame, with Mary Eaton and her sisters, Doris and Pearl, Cecil Lean and Cleo Mayfield who made "No, No, Nanette" famous and the leading men and women of the two "Music Box Revue" shows represented the stage and Broadway. Nils T. Granlund,



Above, Jackie Coogan in a speculative mood before appearing before the WIP "mike" and telling his innermost secrets to a host of radio admirers. Mae Busch, popular leading lady, is the demure miss at the lower left. She was one of the principal speakers on this all-star movie program from the Philadelphia station.



famous "N. T. G." of Station WHN in New York City; Marcus Loew, president of the Metro-Goldwyn Picture Corporation and head of the Loew chain of theatres, and the great "Sir Joseph" Ginzburg, Broadway's biggest "nut."

Plenty of Humor

ELI M. OROWITZ, the famous "Emo" whose weekly movie broadcasts from Station WIP have created a sensation all over the country, arranged the party and was the announcer for the evening. "Emo's" witty remarks, aided by those of Johnny Hines, to say nothing of the other comedians present, made the radio sets bulge with laughter.

The party was strictly informal. Most of the stars spoke on the impulse of the moment. The movie fans who have seen their favorite screen star as many times as they possibly can, had the opportunity to hear their voices.

And if you wondered why Dorothy Mackaill bobbed her hair, or just what Barbara LaMarr thinks of vamps, or any of a thousand questions that run through movie fan's heads, you found out if you heard this unique program.

This idea of having movie stars speak from big broadcasting stations is meeting with more and more favor every day. For instance, at WGN, Chicago, recently, according to dispatches received at WIP, Gloria Swanson, the prominent Hollywood resident and fashionably cinema actress, consented to be "interviewed" by the Announcer, the questions in the interview having been sent in by interested listeners. This is but one example of how movie stars are gaining wonderful publicity for themselves as well as providing more or less amusement.

Look Out for "THE RADIO SPIES"

By **FREDERICK A. SMITH**
Editor, Radio Age

IT IS somewhat noticeable that in spite of the sensational nature of charges made against the Radio Corporation of America in the New Jersey Courts, comparatively few radio publications and newspapers gave publicity to the astonishing accusations made by the De Forest Radio Company. RADIO AGE is publishing these facts for the reason that both parties to the prosecution are big factors in the radio industry. We believe that it is due our readers to tell them the truth about this industrial scandal, not permitting the fact that the Radio Corporation of America is the biggest radio advertiser in the field to deter us from adhering to the straight line of editorial responsibility.

Among publications which have given space to this situation are The New York Times, New York Herald-Tribune, Chicago Herald and Examiner, Radio Retailer and Jobber, and Radio Guide. There are a few others, but the publications named have come to our hands and we know that many publications did not make room in their columns for a line of this publicity. While it may be extremely unpleasant to the Radio Corporation of America to have these court proceedings reported to the public, we will assume that the Corporation will welcome a full investigation of the charges and will be willing, as a Corporation admitting it was organized for patriotic purposes, to accept the judgment of the American public as to whether it has done wrong.

Briefly, the De Forest Radio Company, on May 1, 1925, obtained an injunction in Trenton, N. J., restraining the Radio Corporation of America from attempting to steal business and scientific secrets from the De Forest Radio Company. The injunction was granted after Vice Chancellor Backes had read affidavits and other documents tending to support the charge that the Radio Corporation of America had introduced spies into the plant and offices of the De Forest Radio Company and that the Radio Corporation's secret agents had, with bribes of money, seduced employees of the De Forest Radio Company into acts of treachery.

We publish the following from the New York Times of May 5, 1925:

The Radio Corporation of America maintained secret offices at 25 Beaver Street, where its special investigators, known only by code numbers, reported the results of their espionage on the De Forest Radio Company and other concerns, according to affidavits filed yesterday in the Chancery Court of New Jersey. The papers were filed to support the injunction suit of the De Forest Radio Company against the Radio Corporation of America, brought last week at Trenton.

The affidavits alleged that agents of the Radio Corporation of America in the De Forest Radio Company's plant furnished John S. Harley, chief special agent of the Radio Corporation, with valuable information concerning secret methods of manufacturing radio apparatus, as well as the names and addresses of employees, the number of radio tubes produced, addresses of persons and concerns dealing with the De Forest Company, notices posted in the various departments, changes in the personnel, efforts made to speed up production, and especially what took place in the power tube department.

The information alleged to have been passed on to

the Radio Corporation of America also included drawings of machines and samples of products made by the De Forest Company.

Details of how Harley is alleged to have placed his agents in the De Forest establishment and of his employment of De Forest employees to furnish him with stolen information are also contained in the affidavits.

General Electric Accused

President Theodore Luce of the De Forest Radio Company, in an affidavit, alleges that the General Electric Company, with which, he asserted, the Radio Corporation was in combination, had succeeded in buying up the Electron Relay Company of Toledo, and cut off from the De Forest Company its source of filament wire.

"If the defendant and its associates, the General Electric Company and the Westinghouse Electric and Manufacturing Company, can control the filament wire output, they can, of course, prevent competition in vacuum tubes," he adds.

No statement was forthcoming yesterday from the Radio Corporation of America in connection with the filing of the affidavits. General J. G. Harbord, President of the corporation, declined to comment. Vice President David Sarnoff was out of town.

The charges of commercial espionage and theft of valuable business information are contained in great detail in the affidavit of Charles F. Bowlby, cost accountant of the De Forest Company, employed by them between 1921 and 1923, who worked for the Radio Corporation from the early months of 1923 until April or May, 1924. Since Feb. 23, 1925, he has again been employed by the De Forest Company.

Bowlby's employment by the Radio Corporation came about in this way, he says:

Prior to leaving the De Forest concern he was told by his fiancée, Mildred Michael, a co-employee, that a man who gave the name of "Jameson," and who claimed to have met her at a radio dinner, had telephoned her for an appointment. Bowlby met "Jameson" at his fiancée's home. Her sister Madeline was present.

"Jameson" said he knew nothing about the details of the radio business but was devoting himself to the merger of various radio companies. He said he had been informed that there was some relation between the De Forest Company and the Radiocrafts Company, and asked Bowlby and his fiancée many questions about the De Forest Company, how it kept its books, cost records, production records, stock records, payroll and other records, saying that such information would be useful to him in connection with the enterprise on which he was engaged.

Hears More of "Jameson"

Two weeks after the meeting with "Jameson," Bowlby was told by William W. Buckbee, an employe in the De Forest laboratory, that he had been asked by an employe of the Radio Corporation of America, calling himself "Hurley," for information regarding instruments made by the De Forest Company; that he had been asked to furnish drawings of such instruments; that he, Buckbee, several times met a man who called himself "Hurley." The latter was accompanied by a young woman called "Miss Johnson." Buckbee said he knew her to be a De Forest employe. Buckbee's description of "Hurley" tallied with Bowlby's recollection of "Jameson," and Bowlby was satisfied they were the same person.

At that time, Bowlby called on Miss Johnson in the De Forest plant and questioned her concerning her relationship with the Radio Corporation of America. She denied she was in any way interested in the Radio Corporation, but Bowlby did not believe her and obtained her discharge.

In February, 1923, Bowlby married Miss Michael and the following April he left the employ of the De Forest Company. Subsequently his wife was discharged. Then he sought employment with the Radio Corporation. While calling on a friend at the 233 Broadway offices of the Radio Corporation, "Jameson" stepped into the room and recognized him, says Bowlby. He handed Bowlby a card on which was printed "John S. Harley, Chief Special Agent, Radio Corporation of America, 64 Broad Street." He called on Harley, and found Miss

Johnson in the office. Bowlby's affidavit reads as follows:

"She then admitted in the presence of Mr. Harley that at the time I had questioned her she was in the employ of the Radio Corporation of America, and that she had secured her position with the De Forest Radio Company under instructions from Harley. Harley confirmed her statement, and they joked about my catching Miss Johnson at the De Forest plant, and that I had procured her discharge, and now I was seeking employment with the Radio Corporation of America."

At Harley's request Bowlby took his wife to the Broad Street office of Harley, who said he had other operatives in the De Forest plants besides Miss Johnson. He offered Mrs. Bowlby a position, which she refused.

Offices Kept Secret

Bowlby was employed as special investigator under Harley from May, 1924, until January, 1925, and he reported regularly in writing to Harley in Rooms 301, 302 and 303, at 25 Beaver Street.

"These were secret offices," he says, "and, as I was informed, were known only to certain officers of the Radio Corporation of America. There was nothing on the doors of the offices or on the bulletin board of the building to indicate that Harley or the Radio Corporation of America had any offices in that building; in fact there was nothing upon the doors of those offices except the room numbers."

"While in the employ of the Radio Corporation, Harley asked him, Bowlby alleges, to purchase radio tubes and roll filament wire from the De Forest Company, and to obtain the names of persons or firms from which the De Forest Company was purchasing its filament wire. He had been unable to do so, and Harley said he was particularly interested in obtaining the names of the makers of the apparatus in the tube department, and of the high frequency bombarders used in the De Forest plant. He wished to have a diagram of the layout of the tube department, giving the names and locations of all the machines.

"He asked me to get a position with the De Forest Radio Company as a means of getting this information for him, at the same time continuing in the employ of the Radio Corporation of America," asserts Bowlby.

Continuing, Bowlby says he told Harley he could not obtain employment with the De Forest Company, but said that Henry Thies, a former De Forest employe might be able to get the information. Harley directed him to employ Thies for that purpose. He took Thies to Harley who told him what he desired. Two weeks later he met Thies in Room 217 of the secret Beaver Street offices, "the room where the investigators were accustomed to go when they came in from their work and where some of them wrote up their reports."

Bowlby says he suggested that Thies obtain re-employment with the De Forest Company. Harley thought it a good idea and directed Thies to make prompt application.

"During the whole time that I was working for the Radio Corporation of America I was under the supervision and direction of Harley, but I was always paid by the check of Radio Corporation of America," Bowlby's affidavit continues.

Known as "C-1"

"While I was employed by the Radio Corporation I was designated as 'C-1' and made all reports under that designation. I never signed my own name to any reports. When I telephoned to Harley, as I frequently did, I always identified myself under that designation, never by any name. I know, of my own knowledge, that all employes working under Harley went by initial letters and numbers, as I would meet them in the room where their reports were being made out and they would tell me their designations and I would see these designations on the reports which they were preparing.

"While employed by the Radio Corporation of America, I frequently met Cecelia Lambert at Harley's office and I knew her as 'C-3.' She was doing investigating work and reporting to Harley under that designation. Since my recent employment by the De Forest Company I have on several

(Continued on page 51)



Dorothy and Marjorie Moline are determined to get across Jack Nelson's juvenile idea even if they have to dress the part, as shown in the photo. Naturally, they have succeeded.

How the Alert Jack Nelson is

Making Us CHILDREN Again

RADIO SHOULDN'T BE TOO SOLEMN, IS HIS DOCTRINE

JACK NELSON is a great favorite among the kiddies. His best claim to fame in that line lies in the fact that he has lived among thousands of orphan boys and girls at Mooseheart, Ill., the city founded by the Loyal Order of Moose to care for children of deceased members. In his capacity of director of the Mooseheart radio station, WJJD, Jack came in contact daily with these children, who formed a large part of the station's daily programs—and still do. Consequently he knows whereof he speaks in the juvenile line.

After several years of broadcasting experience, Mr. Nelson is prepared to announce that radio listeners, whether young or old, like to be reminded they were children once. They prefer this reminder more than they do solemn

speeches, sad music and uninteresting programs, according to Jack. He is an ardent believer in the policy that anything light-hearted and juvenile will "go over" with a radio audience much better than any other form of entertainment.

By this Jack does not advocate a continual round of bedtime stories, for he has never featured that sort of broadcasting. He does, however, believe in keeping people young—anywhere from 12 to 20, he says, and in the attainment of that ideal he has mapped out some wonderful programs that have won an instantaneous response among fans all over the country who have learned to listen regularly for the programs from WJJD every night after 10:30 o'clock, on a wavelength of 302 meters.

For example, the Moline sisters,

popular vaudeville artists, come attired as little girls when they enter Jack's studio in the Palmer House, Chicago. Not that the listeners can see them, but Jack describes them picturesquely and then lets them "do their stuff." They cut up for all they're worth, and the radio waves virtually ripple with laughter. The girls don't exactly act foolishly kiddish, but they are funny and light-hearted, and that's the kind of spirit Jack wants to send out from WJJD on his popular programs.

At other times the children themselves broadcast from Mooseheart, and sometimes little kiddies of 7 years of age make the announcements. All this makes a tremendous "hit" with the listeners, and no doubt in the near future WJJD will probably mean "Watch Jack's Joy Diggers."

Radio Age Institute

Manufacturers' Testing Service

MEMBERS of the staff of RADIO AGE will be pleased to test devices and materials for radio manufacturers with the object of determining their efficiency and worth. All apparatus which meets with the approval of various tests imposed by members of the technical staff of RADIO AGE will be awarded our endorsement, and the seal shown to the right will be furnished free of charge. Materials for testing should be sent to

RADIO AGE INSTITUTE

504 N. Dearborn Street,

Chicago, Ill.



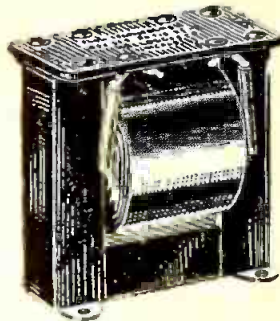
DEVICES

displaying this seal have been tested and approved by the RADIO AGE INSTITUTE.

Apparatus illustrated and described below has successfully passed our tests for July, 1925.



Test No. 70, WET "B" BATTERIES, submitted by the Kelman Electric Co., Rochester, N. Y. Consists of twelve cells in glass jars, set in a wooden frame. Tops are provided with vents for filling with distilled water. There is a sufficient plate area to allow a generous milliampere capacity for use in receiving sets where a wet B battery is desired. A card giving detailed instructions for filling the battery originally, and for watering and charging it, accompanies the battery, which arrived in good condition as a result of good packing. Tested and approved by RADIO AGE Institute.

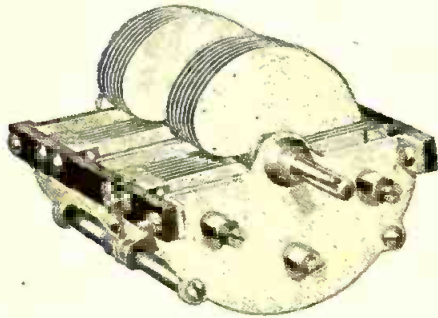


Test No. 73, KELLOGG SHIELDED TRANSFORMERS. Codes 503 and 504 were tested, having been submitted by the makers, the Kellogg Switchboard and Supply Company, 1066 W. Adams St., Chicago, Ill. These unshielded types of audio transformers are of 4:1-2 to 1 and 3 to 1 ratio respectively, and over a period of strenuous tests were found to produce a really distortionless amplification, consistently. The design is exceedingly simple, very high grade wire being used. The tops are of sheet bakelite. Satisfactorily passed the tests and requirements of the RADIO AGE Institute.

Test No. 76, STRAIGHT-LINE WAVELENGTH CONDENSER. Submitted by the manufacturers, Silver-Marshall, Inc., of 110 S. Wabash Ave., Chicago, Ill. This condenser is a new low loss condenser designed for perfect S-L-W tuning. It is of the single-bearing type, equipped with a long cone brass bearing, adjustable, and tension adjustment mounted on, but independent of, the bearing. All plates are of heavily hardened and flattened brass, entirely silver-plated, as are all current-carrying surfaces. This feature, in conjunction with the use of a minimum of high-grade insulation well out of the electro-static field, results in this condenser having even lower losses than many laboratory standards. The single end-plate, as well as the shape of the plates, is responsible for the very low minimum capacity and the exceptionally high capacity ratio.



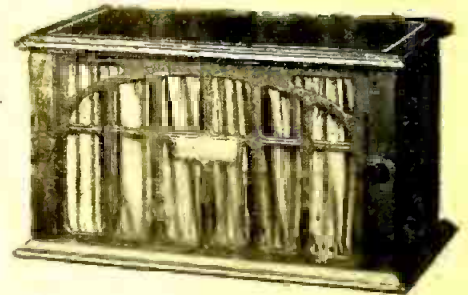
Instead of separating by wavelengths, with this new S-L-W condenser it is possible to separate stations by kilocycles, thus insuring greater selectivity and more separation of stations. Comprises latest design in low loss construction. Tested and approved by RADIO AGE Institute.



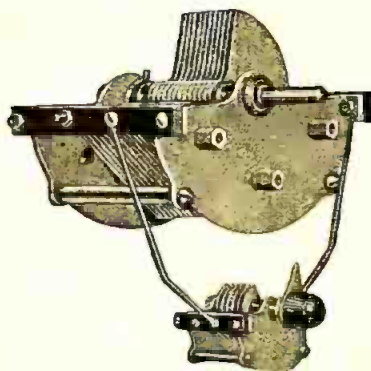
Test No. 71, CONTINENTAL 2-GANG CONDENSER. Submitted by Gardner and Hepburn, Inc., 2100 Washington Ave., Philadelphia, Pa. Consists of a two gang variable condenser, well made and suitable where tuning of two inductances simultaneously is desired. Or it can be used with the two halves in series to decrease the capacity of the condenser. Tested and approved by RADIO AGE Institute.



Test No. 74, FILAMENT WARNING SWITCH. Sample submitted by The Yaxley Mfg. Co., 1103 W. Monroe St., Chicago, Ill. Consists of a single hole mounting filament switch and socket for a miniature light, the light in parallel across the A battery switch so that while current is on the light is illuminated, giving warning current is being used. This light sits back of the panel and a bezel of colored glass permits the set-owner to see it. It serves as a warning to the radio fan who gets ready to turn in after a strenuous DX chase that his filaments are still lit, and should be extinguished in the interest of battery economy. Tested and approved by RADIO AGE Institute.



Test No. 77, JEWETT SUPERSPEAKER CONSOLE. A quality loud speaker, submitted by the Jewett Radio and Phonograph Company of Pontiac, Mich. The horn in the Superspeaker console is made of the same materials as the super-speaker horn, with the exception that the final finish coats being enclosed, are not necessary. The horn floats within the cabinet, and is thoroughly padded on three sides with piano felt, there being a resonance chamber below the horn, which adds greatly to the excellent tonal qualities produced by this speaker. The unit is of the Jewett Vermo Design. Tested and approved by RADIO AGE Institute.



Test No. 72, CONTINENTAL LOW LOSS AND JUNIOR CONDENSER. Submitted by Gardner and Hepburn, Philadelphia, Pa. It is known as the Continental lo-loss condenser, with the vernier arrangement consisting of the Junior condenser shown at the bottom of the above illustration. It can be used separately or in parallel with the lo-loss as a means of fine tuning. Tested and approved by RADIO AGE Institute.

Test No. 75, REMOTE CONTROL LIGHT. Also submitted by the Yaxley Mfg. Co., of Chicago, Ill. This device consists of a single hole mounting brace and socket for miniature light, for use at a point other than right on the battery switch. It is known as a remote control light. It also serves as a warning that filaments are lighted. Tested and approved by the RADIO AGE Institute.

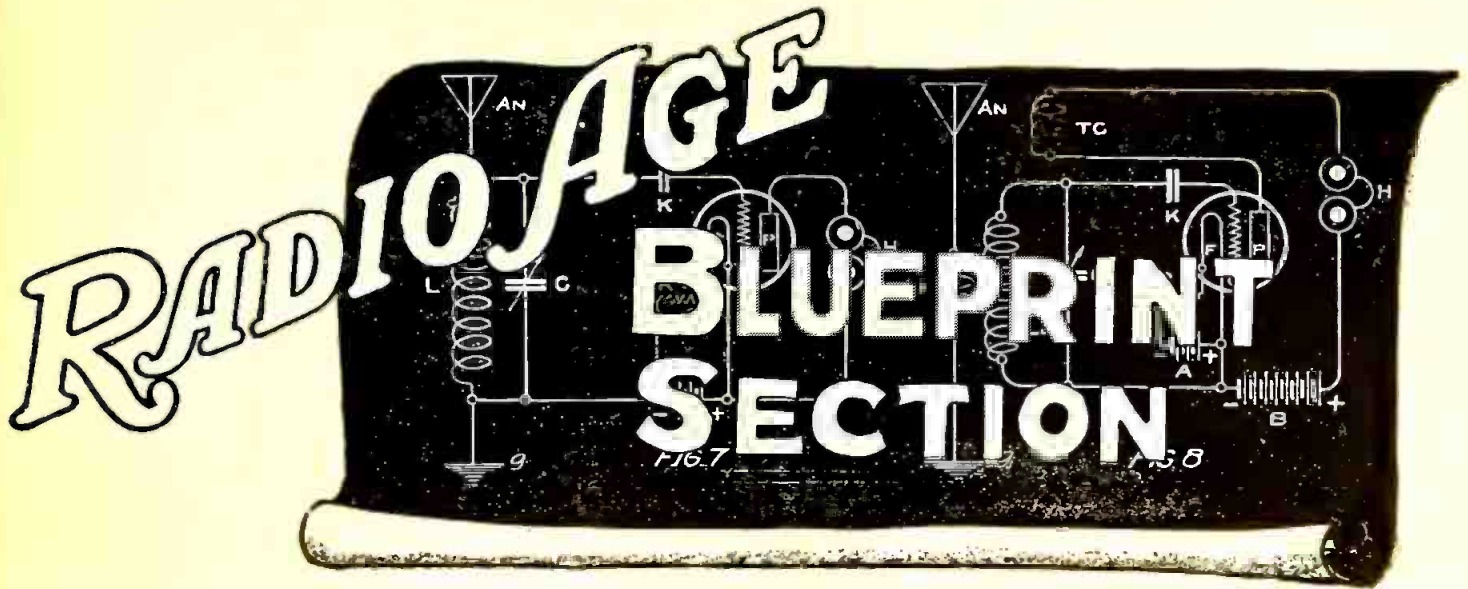


A ROUNDUP OF HOOKUPS—

Something you've never seen before
in the August
RADIO AGE



Test No. 78, REMO RADIO TUBE REVIVER. Submitted by the manufacturers, the Remo Corporation, of Meriden, Conn. This device was put on the market in response to the popular demand for a tube reviver. The Remo reviver has two sockets, for large and small tubes, and tests showed that tubes waning in efficiency, if placed in the Remo reviver, would practically regain their old life. Certain periods of time, according to the degree of age in the tube being tested, were necessary. The reviver connects to the electric light socket. Tested and approved by RADIO AGE Institute.



A Timely Discourse on

Conventional Radio Symbols and Crystal Detector Sets

By JOHN B. RATHBUN

Copyright: 1925

How to Understand All Radio Symbols; Giving the Crystal Its Merited Attention

CONVENTIONAL radio circuit diagrams, the short-hand of radio, have always proved a sticker to the tyro in this science, and it is certain that many a prospective builder has contracted a bad case of cold feet and quit the game when he was brought face to face with the curley-cues and zig-zag lines of the technical diagram. Not being very familiar with the apparatus itself, it is no wonder that the prospect of learning still more of the technique filled him with dismay.

However, when these symbols are once understood, they are more easily read and understood than the picture diagrams for they show the functioning and general principles of the circuits far more clearly to the experienced eye than pictures of the apparatus. You can see the course taken by the current in the different branches of the circuit at a glance, and can immediately classify the circuit with little chance of error; something that I have never yet been able to do with the picture type. However, the picture diagram has its place in the scheme of things where the reader is not interested in theory, but simply in building something that will bring in the voice and music with the least delay and study.

For the benefit of those who have not yet become familiar with the standard conventional symbols used in radio circuit diagrams, I have prepared the accompanying two pages of blueprints in which the more common symbols and abbreviations have been defined. In addition to the listing of the symbols, I have taken up a short description of the various parts used in the receiving circuits so that the subject will be more easily followed.

Circuit Symbols (Sheet No. 1)

1. **INDUCTANCE (Air Core Type).** The hollow coil of wire or other inductance coil with an air core is shown by a continuous scroll or helix as in Item No. 1. Its purpose is to choke back or impede the flow of radio frequency current or for tuning radio circuits to the wavelength of the

transmitting station. The abbreviation is the letter (L) and its magnitude is generally expressed in millihenries, or by the number of turns of wire.

2. **IRON CORE CHOKE.** This consists of a great many turns of wire wound around a core of soft steel wire or thin steel sheets called "laminations." It is used when a greater retardation must be had than is convenient with an air core choke, and can choke back audio as well as radio frequency currents. Values in henries or millihenries.

3. **TRANSFORMER-COUPLER (Air Core Type).** This transformer for radio frequency currents consists of two coils of wire called respectively the PRIMARY (PRI.), and the SECONDARY (SEC.) coils. Radio frequency currents passing through the primary induce similar currents in the secondary coil, thus affording a means of "coupling" two circuits together magnetically. In our diagrams the primary coil (PRI) is shown with fewer turns than the secondary and is shown on the end opposite to the grid connection (G). The other connections are the filament (F), the plate connection (P), the positive "B" battery connection (B) and the neutral tap (N) used for certain neutralized circuits. The abbreviation is (RFT), and it may be tuned or untuned, the former by a variable condenser.

4. **VARIOMETER.** This is a form of variable inductance used in place of the air core choke, and consists of a movable member (The Rotor) which turns inside of a stationary coil called the "Stator." The abbreviation is (VAR). By this means the inductive or choke effect can be varied through a wide range without condensers and the device is frequently used for tuning a circuit inductively. It may be tapped at the mid-point as shown at (Q).

5. **ANTENNA-GROUND-ARRESTOR.** At the right is shown the symbol for the antenna or aerial, abbreviation (ANT). In the center is the symbol for a ground connection (GND), and at the right is the convention for a lightning arrester (LA).

6. **OUTPUT - PHONES - SPEAKER.** The symbol for the beadset or phones is shown at the

left, which may indicate the output of any radio receiving circuit. Abbreviation (PH). The polarity may be marked by (+) or minus as shown, or this may be omitted at will. The positive connection of the phone cords is colored red and this red strand should be connected to the (+) connection of the circuit. At the right is the symbol for the horn or loud speaker which can also be marked with the polarity.

7. **CONDENSERS.** A "fixed" condenser consists of alternate sheets of tinfoil and paper or mica compressed into a compact pile, and adds "capacity" to the circuit, an effect opposite to that of an inductance coil. The symbol for a fixed condenser is at the left where the abbreviation is shown as (K) and where the capacity in microfarads is also added where advisable. A VARIABLE CONDENSER used for tuning inductances is shown at the right, where the rotor plates are indicated by the curved line and the stationary or stator plates are shown by the short straight line. The Stator (Straight line) should go to the grid of a tube, while the rotor is connected to the ground side or (-A) side of the circuit. This condenser is also rated in microfarads (m. f.).

8. **RESISTANCES—RHEOSTATS.** A fixed or unvarying resistance is shown by the zig-zag line which distinguishes it from an inductance. For low resistances used for controlling the filaments of the tubes, its magnitude is given in terms of ohms. For very high resistances, as used for grid leaks, the resistance is given in terms of MEGOHMS, abbreviated (MEG).

A RHEOSTAT or variable resistance is shown at the right and is usually employed for controlling the filament current of tubes. The letter (R) is used for a rheostat, or resistance.

9. **BATTERIES.** An "A" or filament battery or a "C" battery is shown by the symbol at the left which consists of alternate short heavy lines and longer light lines. The short heavy lines indicate the negative (-) plates while the long lines are the positive plates (+). Each pair of these lines represents one cell, and it is the best practice to mark the voltage below it as at (6v.) and the letter (A), (B) or (C) above it to designate the type of battery. A "B" battery is at the right where the dotted line indicates a number of omitted cells, there being too many cells in a "B" battery to draw them complete. When the battery is tapped at some low voltage, as at (+22), the voltage of the tap is marked in this way.

10. **POTENTIOMETER.** This is a device which looks much like a rheostat used for the accurate control of voltages, generally the biasing voltages applied to the grid of a vacuum tube. It consists of a fixed resistance of from 200 to 400 ohms connected across the battery and a sliding contact which taps off the drop of potential at any point of the resistance. The polarity of the slider also

(Turn to page 38)



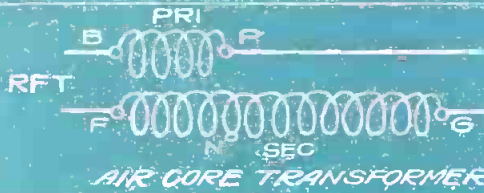
AIR CORE CHOKE

2



IRON CORE CHOKE

3



AIR CORE TRANSFORMER

4



PLAIN
SPLIT
VAR
VAR
TERMINALS
MID-TAP

5



ANTENNA
GROUND
ARRESTER

6



PH
PHONES
(OR OUTPUT)
LOUD SPEAKER
(HORN)

7



CONDENSERS

8



RESISTANCES—RHEOSTATS

9



BATTERIES

10



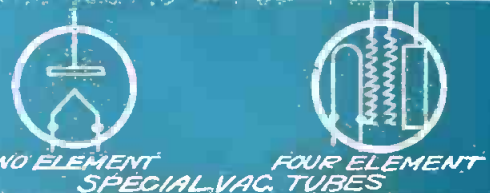
POTENTIOMETER

11



HARD OR AMPLIFIER
SOFT DETECTOR
VACUUM TUBES

12



TWO ELEMENT
FOUR ELEMENT
SPECIAL VAC. TUBES

13



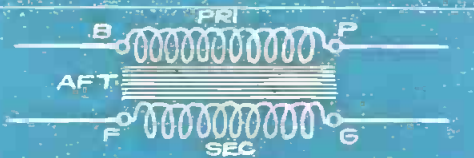
GRID CONDENSERS AND GRID LEADS

14



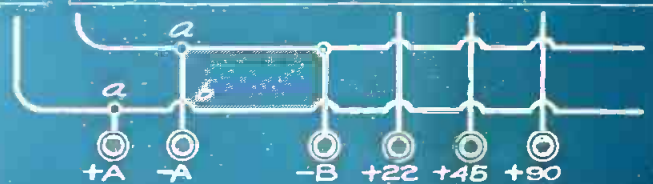
CRYSTAL DETECTOR

15



AUDIO FREQUENCY TRANSFORMER

16



+A -A -B +22 +45 +90

17



SLIDER

18



INSTRUMENTS

19



SINGLE CIRCUIT
TWO CIRCUIT
PHONE JACKS

20



SWITCHES

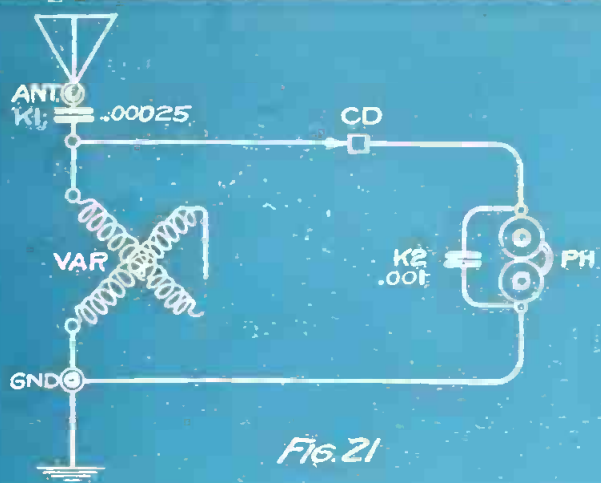


FIG. 21

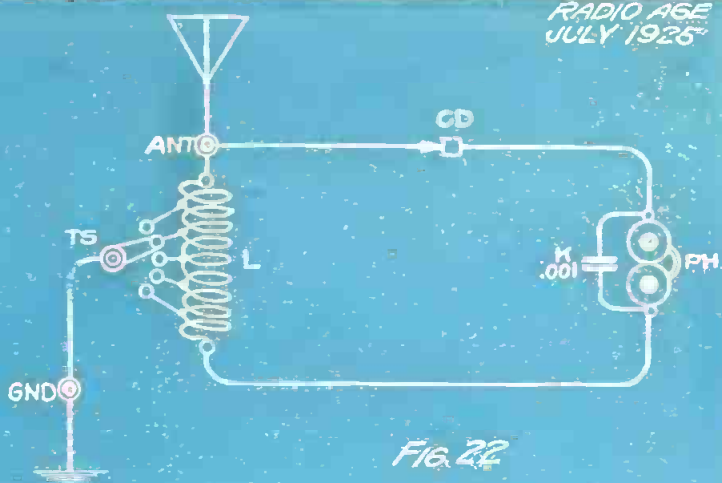


FIG. 22

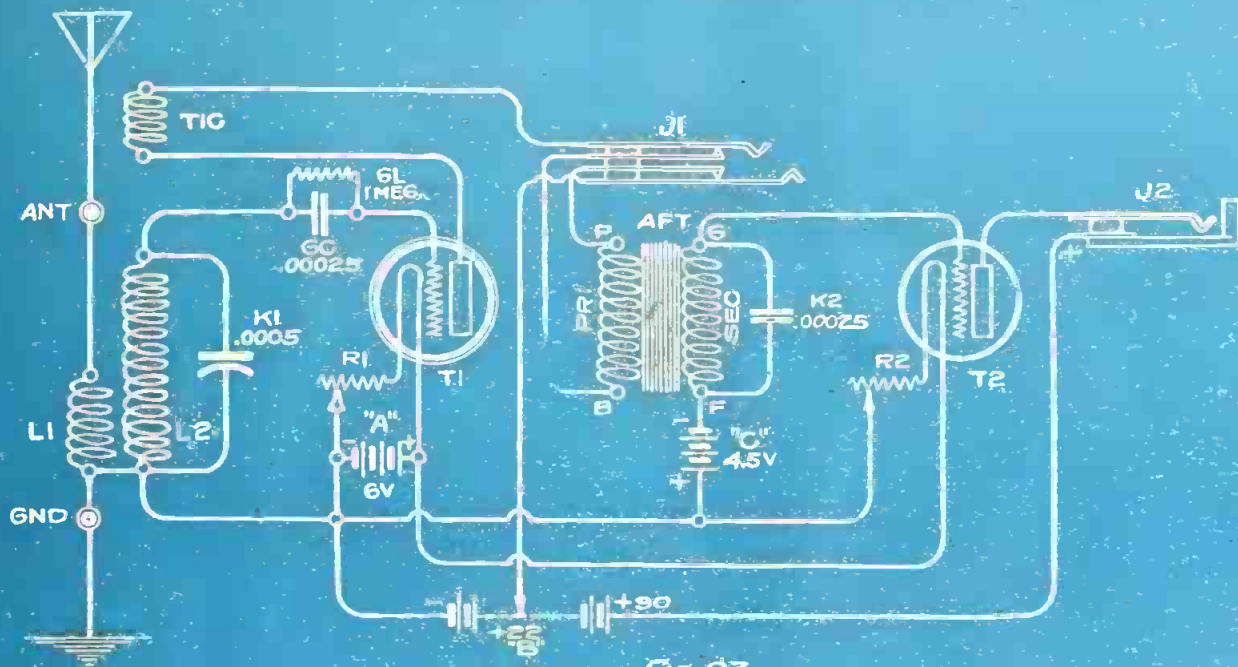


FIG. 23

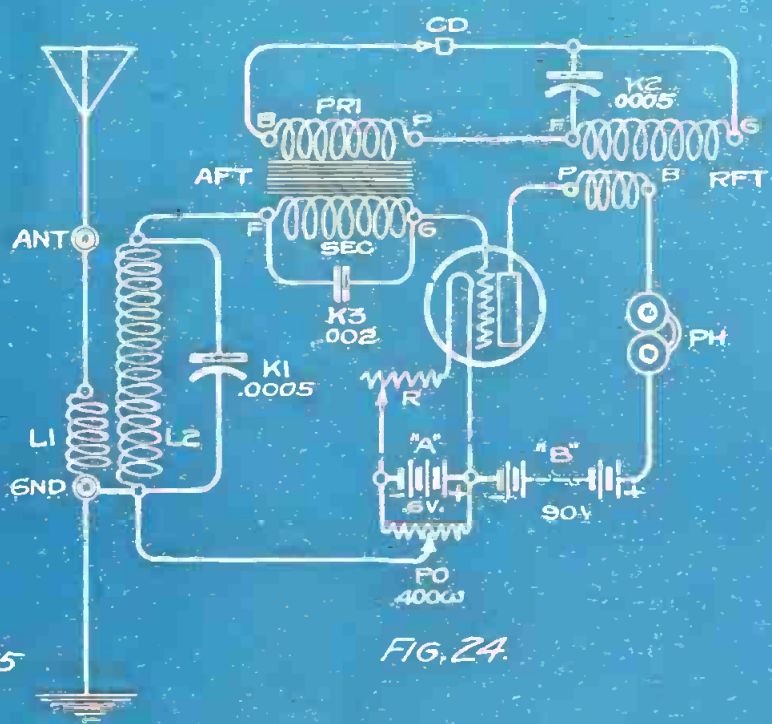


FIG. 24

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(Continued from page 35)

varies with its position, becoming negative at one end and positive at the other.

11. **THREE ELEMENT VACUUM TUBES.** The three elements of a vacuum tube are the filament (F), the grid (G) and the plate (P), although these parts need not be marked as shown. A "hard" amplifying tube is indicated by a single heavy circle drawn around the elements and as a hard tube is much used at present for a detector as well as for an amplifier. When a soft detector tube must be used, two circles are used, as at the right. The word amplifier is abbreviated (AMPL) and detector by (DET).

12. **TWO AND FOUR ELEMENT TUBES.** A two element tube or Fleming valve is indicated at the right and has the filament and plate but no grid. This is most generally used as a rectifier for charging storage batteries from alternating current, but is also used as a detector. The four element tube at the right has two grids.

13. **GRID CONDENSER AND LEAK.** This symbol used with detector tubes is simply a combination of the symbol of a condenser and that of a resistance (The leak). The leak abbreviation is (GL) and the grid condenser is (GC). If either of these items is variable, then this fact is indicated by drawing a slanting arrow across it as at the right.

14. **CRYSTAL DETECTOR.** A crystal detector is indicated by an arrow head for the cat-whisker and a small block for the crystal. Abbreviation is (CD).

15. **AUDIO (IRON CORE) TRANSFORMER.** An iron core transformer, commonly known as an audio frequency transformer, is used for increasing the voltages of currents approximating voice frequencies for audible frequencies. It consists of a primary winding (PRI) and a secondary winding (SEC) with a few parallel lines drawn between the coils to indicate the iron core. The four connections are marked as follows: (G) for grid, (P) for plate, (F) for filament and (B) for "B" battery connections. These apply to vacuum tube connections with which the transformer is most commonly used. Iron core transformers of a special type are also sometimes used on radio frequencies, but when this is the case the fact will be particularly noted on the drawing. Ahr. is (AFT).

16. **WIRING AND CONNECTIONS.** In general, wiring is indicated by very heavy lines, and curved by an arc where a turn is made. Where two wires connect, a small OPEN circle is used to mark the connection as at (a). Where one wire crosses over another, the cross-over is shown as at (b). Connection posts or terminals for batteries, etc., are shown by a circle with a heavy black dot inside, as shown in a horizontal row. The letters indicating the "A", "B", and "C" batteries are marked at the terminals, together with their polarities. In the case of the "B" battery connections the various taps are marked by the voltages as at (+22), (+45) and (+90), but the letter "B" is not used.

17. **TAP SWITCHES.** Tap switches used for cutting out active turns in a coil should be connected so that the contact points go to the grid or aerial side of the circuit with the hinge connected to ground or on the far side from the grid connection to prevent body capacity effect.

18. **INSTRUMENTS.** Measuring instruments such as the voltmeter (VM), the ammeter (AM) or the hot wire ammeter (HWA) are shown in circles. The polarity should be marked, and also the range of volts or amperes at at (0-10) and (0-5).

19. **JACKS.** Jacks are specially arranged contacts used for making temporary connections by means of plugs and may be of many types. At the left is shown the single circuit jack (J2) generally used for the last stage connection and at the left is a two circuit jack (J1) used for plugging in between stages. These are by far the most common types.

20. **SWITCHES.** Different types of battery switches are shown, the left symbol being for symbolic diagrams while the second from the left is used frequently on picture diagrams. The switch at the right is a double pole knife switch used for heavy currents.

Sample Symbolic Drawings

ON SHEET No. 2 we show four representative circuit drawings which include most of the symbols tabulated. Each symbol is lettered with the standard abbreviation so that it will not be difficult to trace out the relation between the parts in the table and the corresponding parts in the diagram.

A simple crystal detector set, tuned by the variometer (VAR) is shown in Fig. 21. Here we have the symbols for the variometer, crystal, aerial, ground, phones and two fixed condensers. Note that when two condensers are shown that they are numbered as at (K1) and (K2). In Fig 22 we have another single circuit crystal set tuned by a simple tapped inductance (L), the tap switch

(SW) being used to vary the number of turns in circuit.

In Fig. 23 is a regenerative circuit with one stage of audio frequency amplification, a type of circuit, very commonly met with. The detector tube (T1) is a soft tube, while the amplifier tube (T2) is a hard tube, as will be seen from the circles. A coupler is used for tuning, having the primary coil (L1) and the secondary coil (L2), this being used sometimes instead of the abbreviations "PRI" and "SEC." The secondary is tuned by the variable condenser (K1). For regeneration we have the tickler coil (TIC) placed directly above the secondary coil (L2) and connected with it by means of an arrow. The arrow in this case indicates that the two coils are inductively coupled by a variable relation; that is, that the position of (TIC) can be varied in respect to (L2). The grid condenser (GC) and the grid leak (GL) are shown connected to the grid of the tube.

Current for lighting the tube filaments is supplied by the six volt "A" battery which is connected so that the negative pole goes to the detector rheostat (R1). The negative pole of the "A" battery connects with the negative pole of the "B" battery, and the latter is tapped at the (+22) volt point for the detector current. The total voltage of the "B" battery at (+90) goes to the last stage jack (J2). A two circuit jack (J1) permits us to plug in on the detector tube alone without amplification, or without lighting the amplifier tube (T2). Plugged in on (J2) we get the amplified or intensified current for the operation of a loud speaker.

An iron core audio frequency transformer (AFT) transfers the plate energy of the detector tube (T1) to the amplifier tube (T2), and it will be noted that the terminals of the transformer are marked in accordance with the points that they connect. Thus (G) goes to the grid of (T2), connection (P) goes to the plate of tube (T1), connection (B) goes to the (+22) volt tap of the "B" battery, and connection (F) goes to the (-A) through the "C" battery. A fixed condenser (K) is shunted across the secondary. A 4.5 volt "C" battery is used for biasing the grid of the tube (T2) and the negative pole (-) is connected to (F) of the transformer so that the current gets to the grid of the tube through the windings. Tube (T2) is controlled by rheostat (R2).

Fig. 24 is a typical reflex circuit with the radio frequency transformer (RFT) and the audio frequency transformer (AFT), the former being tuned by the variable condenser (K2). A coupler is provided with the primary (L1) and secondary (L2) by which the set is tuned to wavelength. The grid bias on the tube is varied by the potentiometer (PO). The rest of the parts have been explained before.

Crystal Detector Sets

TO ME, the crystal set has always seemed the most wonderful of all radio receivers, for with this device we employ the feeble energy of the radio waves alone to vibrate the diaphragms of the phones without aid or reinforcement from local sources of energy. After traveling fifty miles or so, there is still sufficient energy left in the waves to move a relatively stiff piece of metal and to produce the audible air vibrations known as sound. Further, it is an exhibition of the remarkable sensitivity of the modern headset which produces

understandable signals on so small an amount of current that it can be estimated in millionths of an ampere; and yet, with all of this delicacy, the apparatus is perfectly simple and so rugged that it can withstand a considerable amount of abuse at the hands of the listener.

To most of our readers who have had experience only with the cheap and simple single-slide, single-circuit crystal detector sets sold on the open market, the crystal detector is considered only in the light of a toy having only a very limited use in reception. This, however, is not the case, for with proper attention to the details of construction and with as much care taken with the tuning units as we pay to the construction of a tube set, the performance can be greatly improved in regard to distance range and signal strength. If we constructed our tube sets with the same lack of care and with the same primitive tuning systems that are used on commercial crystal sets, we would not get very much better performance. Single-slider, single-circuit tuners are not conducive of good results with either the crystal or tube detector, for they cannot be tuned accurately in resonance with the incoming waves, and there is always a considerable loss taking place that limits the distance and volume.

The Crystal Detector Circuit

OUR primitive crystal detector circuit consists of three principal units: (1) The tuning unit, by which it is brought into resonance with the incoming waves, (2) The crystal detector employed for rectifying the radio frequency impulses for the development of the audio waves, and (3) The audio output mechanism which converts the audio frequency electrical waves into mechanical sound vibrations (Phones). All three elements must be as perfect as possible if we are to extract the maximum output in the form of sound, for the incoming energy is exceedingly feeble and must be carefully utilized with the least possible loss. This means sharp tuning, a crystal having excellent rectifying qualities and an exceedingly sensitive pair of phones, none of which are in evidence in the usual \$2.00 crystal detector set. In reviewing the requirements, we must also remember to include an efficient antenna into the assembly, which should have greater length and capacity than the antenna commonly used with tube sets. The latter item is generally neglected in the installation of a crystal set, with the result that very little volume or distance is had. Conservation of energy is a prime requisite.

It is here that the low-loss coil and the low-loss condenser hold forth with particular advantage; spiderweb, honey-comb or barrel-wound coils being of great advantage in the construction of such a set. The phones should preferably be of the mica diaphragm class or with very thin flexible metal diaphragms so that the slightest current in the coils will give a maximum vibration. When we look at the cheap phones ordinarily supplied with crystal sets, with their thick cast-iron diaphragms and their weak magnets, it is no wonder that reception is limited to 10 or 15 miles. This would be almost the case with a tube set if it were supplied with the same sort of phones. The feeble impulses received demand the most sensitive and efficient equipment that we can supply if the crystal set is to be more than a mere toy for children's use.

Please don't infer that I am recom-

mending the crystal set as a substitute for the tube set, for I am not. I am simply bringing to your attention the fact that the crystal set performance can be wonderfully improved by a little care in the construction and that it is a most desirable proposition for local reception where we do not wish to go to the trouble of installing batteries and similar complications. The crystal set has a field all its own and is almost indispensable for certain purposes, and for this reason I believe that more attention should be paid to the development of its performance rather than to cutting down on the expense of construction, as has been done heretofore. You cannot get long distance consistently, nor can you get full loud speaker volume of the crystal alone, but you can get locals with good volume, clear and sweet, without the fuss attending the operation of a tube receiver.

When loud speaker volume is required on local, with particular attention to quality, we can add one or more stages of audio frequency amplification to the detector. Of course, we are now getting back to vacuum tube complications and batteries, but with very simple layouts we can obtain wonderful tone values on the loud speaker and a somewhat increased distance. Just as an experiment, it is very interesting to add resistance coupled stages to a crystal detector to discover what real tone purity is like. The natural tone and life-like quality will be a revelation to you, and if you live within 25 miles or so of a broadcasting station, I am sure that you will keep this circuit hooked up permanently.

Future of the Crystal Set

CONSIDERING the many 5,000 watt broadcasting stations now under construction, and the increasing practice of re-broadcasting, it is certain that the crystal detector receiver will find a more extended use than has been the case in the past. Increased power at the stations and the relaying of these stations at close intervals over the country will mean that the crystal will take on a new life. At least ten telephone companies have adopted local re-broadcasting systems as an additional service to their subscribers, and I do not believe that the telephone companies will be the only people to engage in this work. If the network of re-broadcasting stations is fully developed the use of the crystal set will be practical in almost any part of the United States.

One re-broadcast station equipped with a good receiving set and a transmitter of moderate power will easily cover a radius of 25 miles and will efficiently serve crystal detectors in this 50-mile circle. The expense of maintaining such a station is comparatively small and can be borne by the local Granges or community associations with a great saving to their members. The station receives the voice and music from distant stations and then broadcasts these signals through simple apparatus to local listeners, thus avoiding the expense and trouble of arranging programs. So far, this arrangement has increased the total number of listeners tremendously without appreciably affecting the sale of tube sets. On the contrary, one re-broadcasting station states that the interest aroused in radio via crystal sets has greatly increased the sale of tube sets in its territory, and that a great proportion of the listeners now have both crystal and tube sets in their homes. Tiring of the local re-broadcasts, and desiring different programs, they turn to their tube sets and tune in the distant stations for themselves.

While the complete theory of contact rectification is not yet well understood, I will explain the functioning and purpose of the crystal in a general way so that the beginner can at least get a working knowledge of its properties when installed in the receiving set. Mechanically it is very simple, consisting of a small piece of mineral called the crystal, and a thin wire making light contact with the crystal at a sensitive spot. In some cases, contact is had between two crystals instead of between the wire and crystal, but in any event the radio frequency current must pass through a high resistance contact of some sort before passing through the phones, so that the audio or "hearable" portion of the incoming waves can be developed.

Owing to the rapidity with which the radio wave oscillates back and forth, the diagrams of the phones cannot follow the radio frequency currents in the receiver

Galena, silicon, carborundum, cerusite, pyrites, perikon, radiocite, and hecrite are among the most commonly used simple minerals, and in addition to these are the numerous synthetic crystals that bear a multitude of trade names. A good galena crystal is probably one of the most sensitive crystals, but it is not stable and must be readjusted frequently. Silicon and carborundum do not require so frequent adjustment and are quite sensitive if carefully selected and mounted. The synthetic crystals are in most cases stable and sensitive, and have the advantage of having a greater effective area or more "hot spots" than the natural crystals, so that it is not so difficult to adjust them.

For the catswhisker wire, we require a metal that will not corrode under ordinary atmospheric conditions and one that will maintain a bright metallic contact area at the point where it rests on the crystal. A copper wire will work well with most crystals, but a silver or gold wire is better, as it does not corrode or get dull as rapidly. With the exception of the carborundum crystal, the catswhisker wire should make very light contact with the crystal, working best when only just barely touching the surface. With the carborundum detector a very heavy pressure is required, which in itself is one reason for the stability of the carborundum, as the heavy pressure prevents the displacement of the contact when subjected to vibration.

There has been a great deal of argument for and against the fixed crystal detector with the immovable catwhisker, but I believe that the fixed detector will prove best in the long run for the beginner, at least, as it avoids the necessity of constant readjustment and the detuning effect when these adjustments are made. It will perhaps be of interest to know that the crystal has a great deal of effect in the tuning of the circuit and very often we can tune a station in and out by means of the crystal adjustment alone. For the experienced crystal set operator, the adjustable crystal is therefore often an advantage, as it is an aid to selectivity and tuning, particularly where there are many strong local stations and other interferences.

It is a good plan to get a number of crystals and then select the best crystal by actual test. There is a great deal of variation among crystals even of the same make, and the only way that you can be assured of the maximum results is to select the best crystal from a number of samples.

The Hook-Up or Circuit

THERE are about a thousand different crystal detector hook-ups from which to make a choice, and all of them have their adherents, who believe that they have the only circuit worth using. Some employ variometers for tuning inductances, others use spiderweb coils, variocouplers, honeycomb coils and straight solenoid coils in all sort of combinations, but as a matter of fact, a close examination will show that most of these circuits can be boiled down to six distinct classes. The type of inductance does not change the characteristics of a circuit as a circuit; it simply adds or detracts from its efficiency by the sharpness of its tuning properties and the losses occurring within the coil. A variometer may show better results than a simple tuning coil, simply for the reason that it can be more closely adjusted to wavelength than the coil—not because it is a variometer. An inductance is an inductance no matter what form it may be used.

(Turn to page 42)

**A ROUND-UP OF
HOOK-UPS**
in the Deluxe AUGUST ISSUE OF RADIO AGE.

Never before have you seen such a galaxy of hookups, from the simplest though efficient crystal to the most recent simplified super-heterodyne receivers. Radio from its humble beginning to its present peaks of achievement in the Special Summer Number of RADIO AGE.

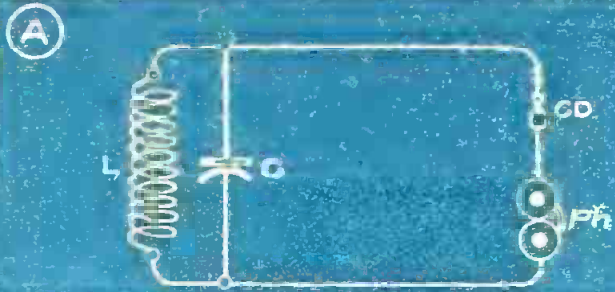
All basic Hookups.
THIRTY PAGES OF DELUXE BLUEPRINTS.
Order your Copy in Advance.
\$2.50 a year.
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directly and nothing will be heard in the phones if some sort of rectifier or "detector" is not inserted into the circuit. These waves are "alternating," that is, they flow first in one direction and then in the other, and before we hear the signals these waves must be made "unidirectional" so that they will flow in one direction through the phones but with an intensity that varies according to the sounds sent out by the broadcasting station. The crystal detector with its contacting "catwhisker" wire acts as such a rectifier and permits the passage of only one set of waves that are flowing in the same direction.

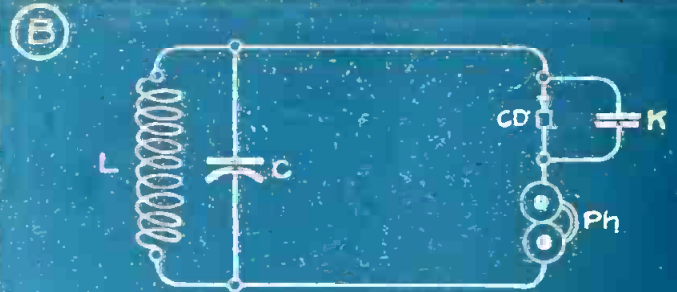
With the radio frequency current rectified, the "audio frequency" waves are developed so that the diaphragms of the phones follow the slower voice frequency pulsations, thus producing sound. Our station waves therefore consist of two components, the high radio frequency carrier waves oscillating at the rate of about 1,000,000 vibrations per second, and the audio frequency waves impressed on them that will range from a few hundred to an upper limit of about 15,000 vibrations per second. These latter waves are produced by varying the intensity of the radio waves by "modulation," and are not actually an independent series.

There are a great number of minerals that will act as detectors to some extent, but only a few that are effective enough to be used in the practical crystal set.

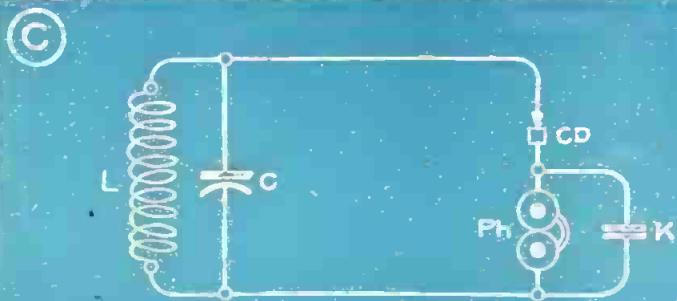
FIG. 1. BELOW



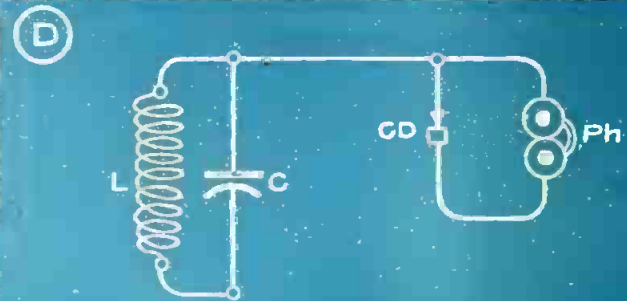
RELATIVE AUDIBILITY = 55



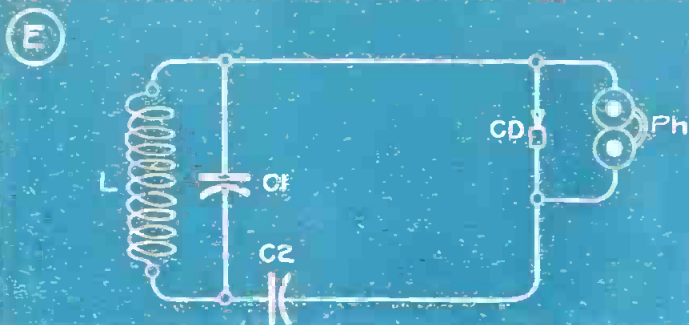
RELATIVE AUDIBILITY = 85



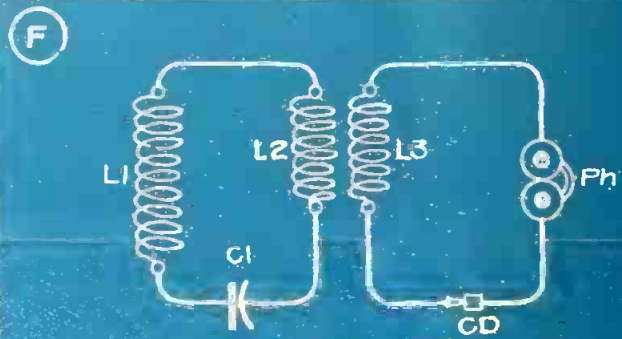
RELATIVE AUDIBILITY = 45



RELATIVE AUDIBILITY = 10



RELATIVE AUDIBILITY = 40



RELATIVE AUDIBILITY = 15

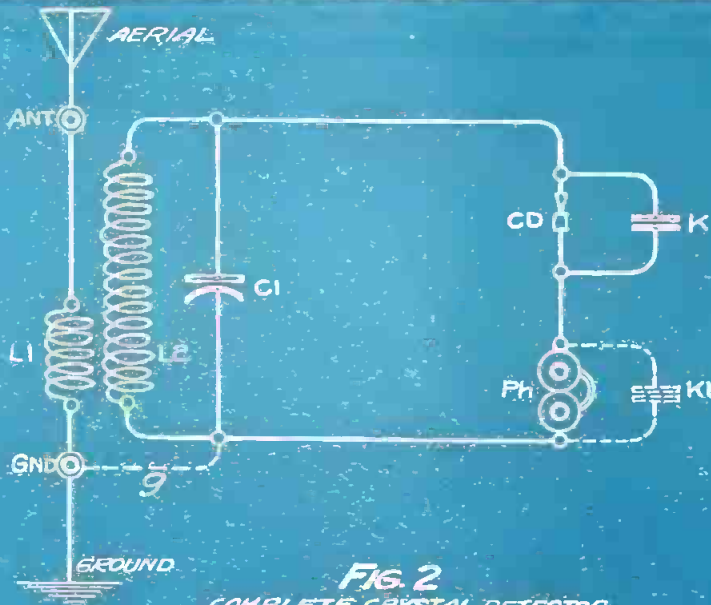


FIG. 2

COMPLETE CRYSTAL DETECTOR
CIRCUIT WITH ANT. COUPLER.

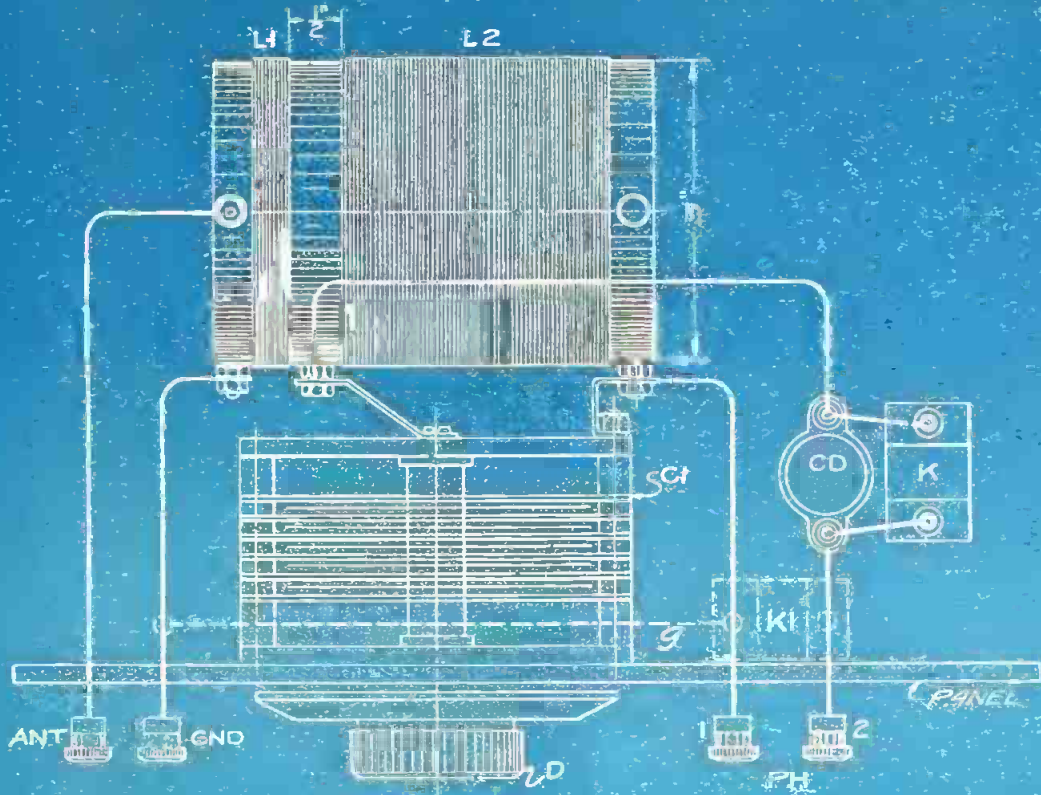


FIG. 3
PLAN VIEW OF CRYSTAL SET

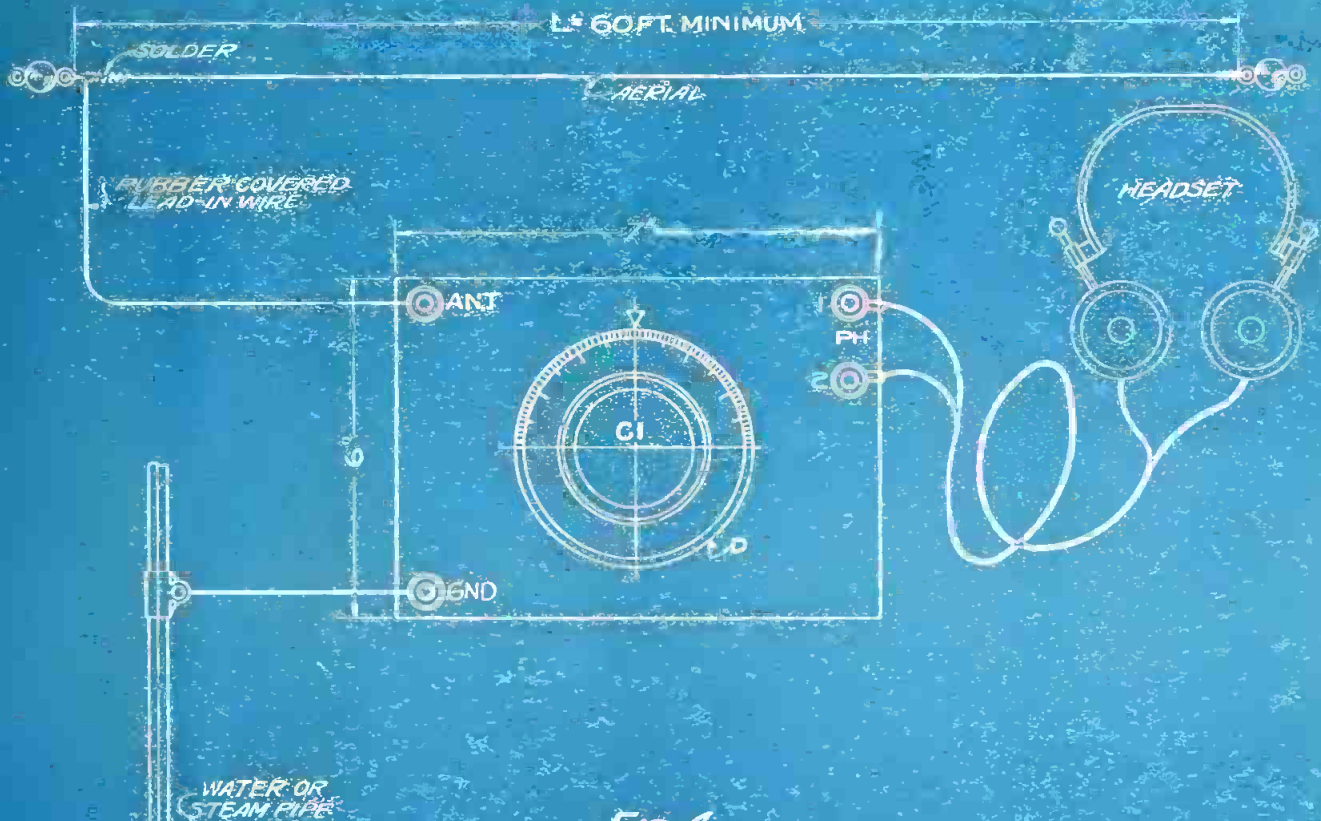


FIG. 4
INSTALLATION DRAWING

(Continued from page 39)

Fig. 1 shows the six basic circuits with their relative audibility value, as determined by the U. S. Bureau of Standards. The relative signal strengths are given in terms of percentages, and it will be seen that the hook-up has a great deal to do with the reception, varying as it does from 10 per cent to 85 per cent. These diagrams refer only to the detector circuit itself and do not consider the various methods of coupling or connecting the circuit to the aerial and ground. A variable condenser is used for tuning a fixed inductance in all cases.

Diagram (A) shows a simple form of circuit often used, which contains the inductance (L), the variable condenser (C), the crystal detector (CD) and the phones (Ph) all connected in series. For ordinary broadcasting wavelengths there will be about 55 turns of wire in (L) when wound on a three inch tube, and the capacity of the variable condenser (C) will be from 0.00035 m.f. to 0.0005 m.f. The audibility is 55 per cent.

In Diagram (B) we have the same circuit with the addition of the small fixed condenser (K) connected across the crystal detector. This fixed condenser acts as a storage capacity for the waves and adds considerably to the volume, as it supplies an additional current to the crystal. This addition has increased the audibility from 55 per cent to 85 per cent, the maximum value determined by the Bureau.

The capacity of (K) depends upon the nature of the crystal detector, but in any event the capacity must be small to prevent by-passing much of the current across the detector. With some detectors 0.00025 m. f. is about right, while with other types this may be as low as 0.0001 m.f. or even less. A small three-plate variable condenser will often prove of value in getting the adjustment correctly.

In Diagram (C) we have the same circuit as in Diagram (A), but a fixed condenser (K) is used to bypass radio frequency current around the phones. The average audibility under all conditions is reduced to 45 per cent; hence, this is not always an advisable addition. In many makes of phones there is a considerable amount of distributed capacity in the windings of the magnets and this frequently is sufficient to properly by-pass the radio frequency current around the inductance without the addition of external capacity. However, in case the phones have a high inductive value with little distributed capacity, a by-pass (K) may be necessary.

Diagram (D) is a type of crystal detector circuit often used on wave-meters and similar instruments where very sharp tuning is necessary. The audibility is so low (10 per cent) that it is impracticable for a receiver and therefore need not be discussed further. Its only virtue is its extreme selectivity.

Diagram (E) a second variable condenser (C2) is employed in addition to the original variable condenser (C1). This sharpens the tuning considerably and has a much greater audibility than the circuit in Diagram (D). The audibility is four times as great as with (D) and is almost equal to that of the first diagram.

Our last diagram (F) is the ultimate in selectivity but has a very low audibility factor. The circuit is split by means of the coupler coils (L2) and (L3) so that almost any degree of selectivity can be attained but at the expense of a great loss in signal strength. We can obtain

a good degree of selectivity by other means and without so much loss in signal strength; hence, this type or circuit can be neglected for the time being.

Circuit With Coupler

FOR the sake of selectivity we will connect our aerial and ground to the detector circuit by means of an aperiodic or semi-aperiodic coupler of the type so commonly used in tube sets. For the detector circuit we will adopt the circuit shown in Diagram (B) to obtain the greatest signal strength and will depend entirely upon the coupler construction for our selectivity and tuning. This combination will probably give us the best all-round combination for signal strength and selectivity and at the same time is simple to build and tune.

In Fig. 2 we have the schematic diagram of the complete circuit. The coupler consists of the primary coil (L1) connected at one end to the aerial and to the ground at the other end. The radio impulses from (L1) are communicated to the secondary coil (L2) which is identical with the coil (L) in Diagram (B). A variable condenser (C1) is connected across the secondary coil so that it can be tuned to wavelength. The fixed condenser (K) connected across the crystal detector (CD) serves the purpose already described. The phones (Ph) are in series with the crystal detector.

By means of the inductively coupled coils (L1) and (L2) we can obtain much better selectivity than with the aerial and ground connected directly to the detector circuit. The selectivity depends largely upon the distance between these two coils. The greater the distance the greater will be the tuning qualities where there are many strong local stations. Properly adjusted, it is possible to tune in and out on a difference of five meters wavelength, but with comparatively little loss in signal strength. With the aerial and ground connected directly to the detector circuit, it is probable that a nearby station will come in all around the dial, no matter how it may be turned.

In regard to a crystal detector, it may be said that it is much more difficult to get selectivity with a crystal than with a tube receiver and that greater care will be required in the adjustment. The crystal has the peculiar property of hanging on to a station even against powerful controls, and while it has not much distance or ability on weak signals, it will hold on like grim death to fairly strong signals.

Under some conditions it may be advisable to connect the lower part of the circuit to the ground connection (GND) by means of the short dotted wire (g). The rotary plates should also go to this side of the circuit (ground) as indicated by the curved line at (C1) and the stationary plates are connected directly to the crystal detector (CD).

With some phones, which have very little distributed capacity, it may help matters to connect the fixed condenser (K1) across the phones (Ph) as indicated by the dotted lines. This is best determined by actual test, after the set has been built and connected up to the aerial. This may be a 0.001 m.f. fixed condenser.

Picture Diagram of Set

A complete drawing of the circuit with all of the parts in place is shown by Fig. 3, the letters in this drawing corresponding with similar letters in the schematic diagram of Fig. 2. A detail view of the coupler coil is shown which is connected to the variable tuning condenser (C1), the latter being connected directly across the secondary coil (L2) of the tuning in-

ductance. The crystal detector (CD) is best placed as shown and should not be mounted on the front panel where it is likely to be thrown out of adjustment by the jar of the hand every time we move the tuning dial.

The tuning inductance (L1-L2) is wound on a cardboard tube three inches in diameter and about 4 1-2 inches long. The primary winding consists of 12 turns of No. 24 D.C.C. wire, and a space of about 1-2 inch is left between this coil and the secondary coil (L2). Starting coil (L2), we wind on 55 turns of the same size wire, and fasten the ends of the coil securely by passing them through holes punched in the cardboard tube. For strong local stations, it may be necessary to increase the distance between coils to 5-8 inch or 3-4 inch to obtain the required selectivity, but this space should be no greater than actually required for the complete tuning out of the strongest station. If the gap is much greater than this, the signal strength will be reduced. The tentative wire (g) and the experimental fixed condenser (K1) are shown in dotted lines as they may not be needed with the combination of parts used in your set.

The condenser (C1) can be either a 17 plate or .23 plate variable condenser having a capacity of 0.00035 m.m. to 0.0005 m.m., but the latter is preferable. If you do not wish to wind the coil yourself, you can use a neotrodyne transformer which can be purchased complete and mounted on the back of the variable condenser. Such combinations cover a wavelength band of from 200 to 600 meters, the range of the average broadcasting stations.

It is most convenient to mount the apparatus on a 6 in. x 7 in. x 3-16 in. panel as shown by Fig. 4 with the tuning dial (D) appearing on the front of the panel as shown. The aerial binding post is at ANT, the ground connecting post at GND, and the phone posts at PH. The method of connecting to the aerial and ground is also shown in this view, the ground being a connection to a water or steam pipe.

The aerial should not be less than 60 feet in length, and more than this is desirable where the necessary room can be obtained. With a crystal detector set, the more aerial wire that we hang up, the better will be our reception, and any length (L) can be used up to 150 feet.

With two wires placed side by side, 150 feet long and with the set located in the open country, quite long distances can be covered. However, with a 60 foot aerial in a good locality, we can get good reception with fair distance, providing that the aerial is not screened by steel structures such as steel factory and office buildings, bridges, etc.

Higher Power Licensed To Beat Static

THE Department of Commerce has announced that favorable consideration will be given to applications from owners of Class B broadcasting stations for permission to use higher power without requiring the increases to be made in steps of 500 watts as has been the practice heretofore, provided the stations are situated outside of congested receiving centers.

In taking this action the Department is endeavoring to satisfy the demand of broadcast listeners that the use of increased power be permitted in order to overcome the existing static conditions which are making reception difficult.



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.

IF THE filaments of your vacuum tubes begin acting as you feel during the Summer, it is not necessarily an indication that their span of life has been bridged, for rejuvenation of tubes seems to be as welcome to inanimate thoriated filaments as it is to those who have sought the fountain of eternal youth.

Tube manufacturers have cautioned their customers, via the literature accompanying the tubes in the cartons, that a paralyzed tube may be restored to its pristine activity by leaving it lighted in the set for ten minutes with the "B" battery shut off, this process apparently bringing the thorium from the filament center and giving the tube new life.

One of our prominent manufacturers has come forward with a tube-rejuvenator on which radio fandom's interest seems to have centered.

It consists primarily of a small step-down transformer, similar to the toy transformers used for running toy railroad trains, etc., being made in two types, one for 110-20 volt primary with ten, four, sixteen and eight volt secondary sections, and the other for the 220-230 volt circuits with the same secondary outputs. This, together with a socket for each size of tube, comprises the layout, to which the owner adds his timepiece.

For the UV 199 tubes the tube is placed in the socket after the transformer has been plugged into the lighting mains. It is given ten volts on the filament for 30 seconds, then the voltage is cut to four volts and the tube is allowed to remain for ten minutes. The first voltage is known as the shocking charge and serves to drive the thorium from the filament center. The ten minute lighting of the filament at four volts is known as the baking charge and serves to solidify the thorium on the filament so its electronic emission is again at a maximum.

For the UV201-A type the shocking voltage is sixteen volts for a period of 30 seconds, and a baking charge at eight volts which lasts for ten minutes. The same action takes place as with the 199.

One Need Remains

As a result the owner of emaciated tubes need no longer worry about a means of bringing back their life. However, neither the tube manufacturers' method of restoring life by allowing the tubes to remain lighted without the B battery on, nor the transformer method

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Down with regeneration? No! Emphatically no! Let's keep it, but not abuse it.

"This is merely a suggestion and many an old shoe will be shied at me, I'll venture, yet I hope it may stimulate others to give their views."

The writer of the above, R. S. Parks, 1419 Cleveland Boulevard, Caldwell, Idaho, seems to put the case up not so much to this department but to fandom, since it has been the policy of RADIO AGE to give its readers what they desire. If there has been a desire for DX lists, it is simply because the burden of the Editor's mail has been of that type. If the single tube regenerative has been unduly touted in these columns, it is merely because so far the majority of the contributors seem to have been most impressed with it. We realize there is a growing demand for the experimenter's section in this department, but so far the genius experimenter has not made his voice heard.

Perhaps the publication of the above letter and the comment made will serve to stir up interest. Perhaps it will lead to the creation of a band of experimenters who have passed the one tube stage and wish eagerly for more experiences, although RADIO AGE cannot very well afford to forget the beginners who have many more problems than those who have already taken the dive into the pool of radio and have learned to swim.

Henceforth, we will watch the mail very carefully, and the tenor of the department will be merely a reflection of the contributions received. It is up to readers like Mr. Parks to sound the call to arms to his fellows; then let the station list enthusiasts marshal their forces. May the better man win; we feel our readers will always wish us to abide by the desires of the majority.

Old timers will readily recognize the circuit in Figure 1 as the inductively or loose-coupled crystal set, with an arrangement for switching from the use of carborundum and a potentiometer to galena and other types of crystal on which no battery current is used. In the old days the carborundum was considered good because it was fairly stable and rugged and would stand the lurch of the ship and the pound of the engines at sea.

It is sent in by Clement Hampton, 427 Jeanne Mance St., Montreal, Que., Canada, who says his old friend, W. J. Featherstone of 213 Ella St., Hull, East York, England, passed it on to him.

The antenna variable is a .001 and the secondary a .0005 mfd. The inductances can be either honeycombs, a loose coupler, two spiderwebs, or almost any form of good inductance. A fixed condenser across the phones would do no particular harm and might help a little.

This circuit is popular in England where no one is allowed to use a regenerative set capable of feeding energy into the antenna, and where the distances are not great, as is the case in the British Isles and continental Europe.

Known under seventeen or eighteen different names, the circuit shown in

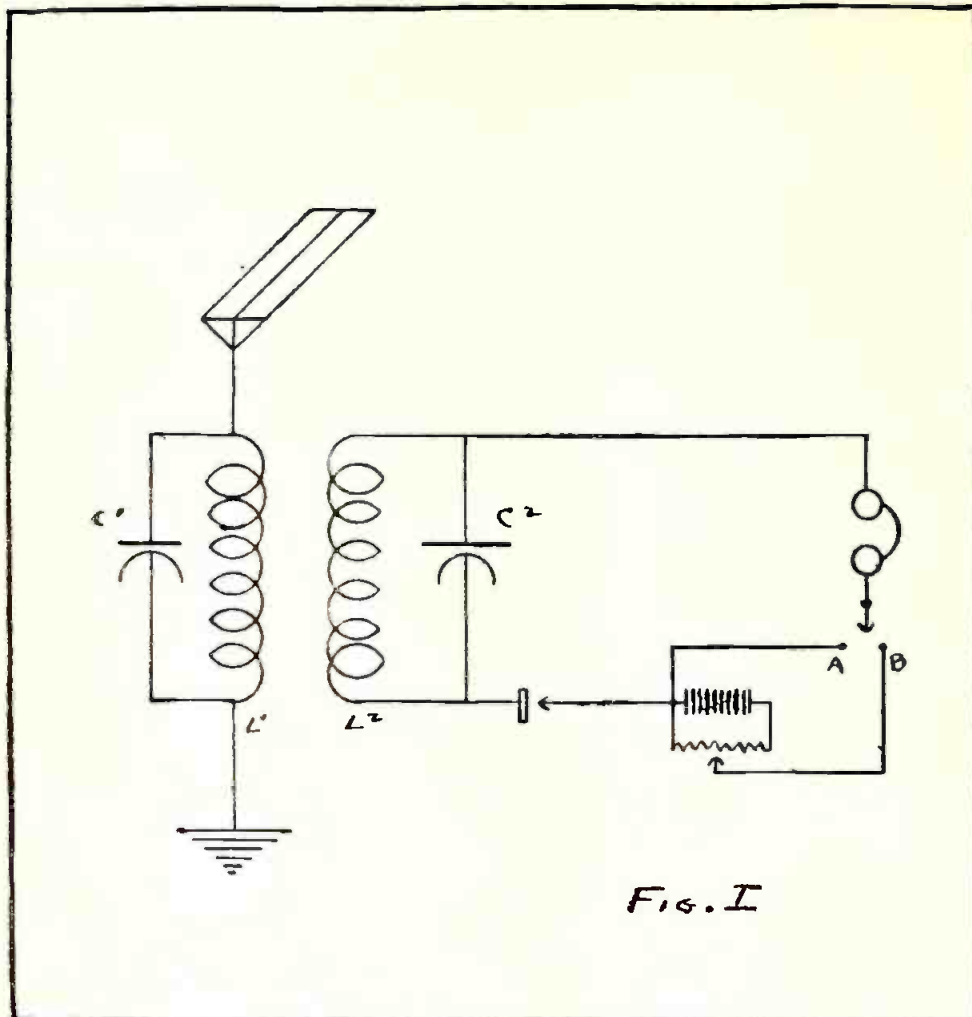


FIG. I

An old reliable crystal circuit, one of the early types used in the U. S. and still popular with those who do not care for the expense of a tube set for short distance reception on headphones

mentioned before, will restore a filament from which the spark of life has departed due to a breakage. When someone invents a filament restorer for burned out filaments he will be kissed on the brow by all the broadcast listeners, the amateurs, and the owners of broadcasting stations, although doubtless the tube manufacturers would chase him into the wilds of Patagonia with a sawed off shotgun.

At the last moment in our June issue we were able to get together interesting data on the binocular and toroid coils which are designed to eliminate the necessity for neutralization in radio frequency amplifiers. The Pickups Editor will be glad to hear from readers of RADIO AGE as to the success encountered with these new types of fieldless inductances.

Here's a fan who is even willing that shoes should be shied at him, but he has the courage of his convictions and writes us as follows:

"An interested observer may be intimidated many times before making his debut into a certain field; but there comes a time when he can restrain himself no longer, and makes a headlong dash by giving his views on a subject. His suggestions may be of little benefit and then again they might open up a way for something better. It is with the latter in view I write this.

"Possibly you have meant the Pickups

and Hookups Department to be what it is —no more, but personally I believe that you gave this section of your magazine to the experimenter for a means of radio development. If so, then it is up to the contributor to use it and use it widely.

Dx Lists?

"DX lists do not occupy a seat of honor in my household simply because I do not invite them, or to put it in the words of an amateur, 'I didn't get the Pacific Coast because I was not fishing.' To me the logging of numerous stations merely for a long list is a waste of time. The logging of twenty-nine stations in so many minutes as given by one of the contributors is laughable. May I ask how many of us today would know anything of radio and its possibilities if the early experimenters spent all their time at such foolish toying? Wouldn't it be of more interest and of more educational value if the contributors to this department gave discussions of different circuits, as many are doing, effect of weather conditions, code interference and most of all, receiver interference?

"You will also notice that this section contains hookups, nine-tenths of which are of the regenerative, one-tube type.

"Fine, I say, in the hands of one who knows how to use them without spoiling half a dozen neighbors' good natures. But how few of us there are who are ideal.

Figure 2, and sent in by Walter E. Fee, of 115 Beecher St., Atlanta, Ga., is the single circuit Armstrong, noted for its ability to squeal, and one of the oldest regenerative sets known to experimenters. L 2 is inductively placed against L 1 for feedback.

In Atlanta this circuit works out quite nicely (though we hardly dare think what the neighbors have to say on this subject when the tube is oscillating). It tunes in the long distance stuff while WSB is batting out flies, and for a change Mr. Fee hooks it on a loop and goes fishing for distance, with results as follows: WSMB, WOC, WEAf, WCCO, KDKA, KSD, WOAW and WQJ. Of course, this is used on head phones only. It is one of the tried and true types of receivers, although not recommended for congested areas where your neighbor might have one too.

Here's another one familiar to the fellows who have been following the game for longer than a couple of years. The circuit sent in by Carl Wininger, 20 William St., St. Catherine's, Ont., Canada, was originally published by Weagant shortly after Armstrong gave the world his regenerative circuit. Later Weagant's circuit was taken up and popularized by Reinartz. It has masqueraded under a thousand different names, but the circuit fundamentally is the same which is the point in which most experimenters are interested.

Instead of using a variable regenerative coil for control of oscillation, the Weagant circuit, alias Reinartz, alias et al, uses a variable capacity in series with an inductance, the two paralleling the plate and filament. The control of oscillations seems easier with this type of receiver than with the straight variable plate coil.

The receiver shown in Fig. 3 happens to be the single circuit Weagant, which can be made up with honeycombs, spiderwebs, straight winding on a tube, or any other form of inductance. While it is good for excellent work on distant stations, for the sake of other listeners it would be best to loose couple it, by having an untuned primary in inductive relation to L 1. The condensers in the circuit shown are .0005 mfd. Reinartz found that oscillations could be better controlled by inserting a small choke in series with the phone lead at the point marked X in the diagram.

In the inductively coupled receiver the condenser C1 spans L1, while the antenna comes down through a fifteen turn coil to ground. The secondary is then removed from direct contact with the aerial and if the receiver does feed back into the aerial it will be with lessened energy.

L1 can be approximately fifty to seventy-five turns, while L2 can be somewhere between thirty-five and fifty turns, the condenser C2 making it unnecessary for the exact number of turns to be found for the inductance L2.

Another form of the Armstrong regenerative is sent in by Joseph A. Smith, 723 Wallace Ave., Wilkensburg, Pa., who tells of the good work it has done for him. He says it is good away from con-

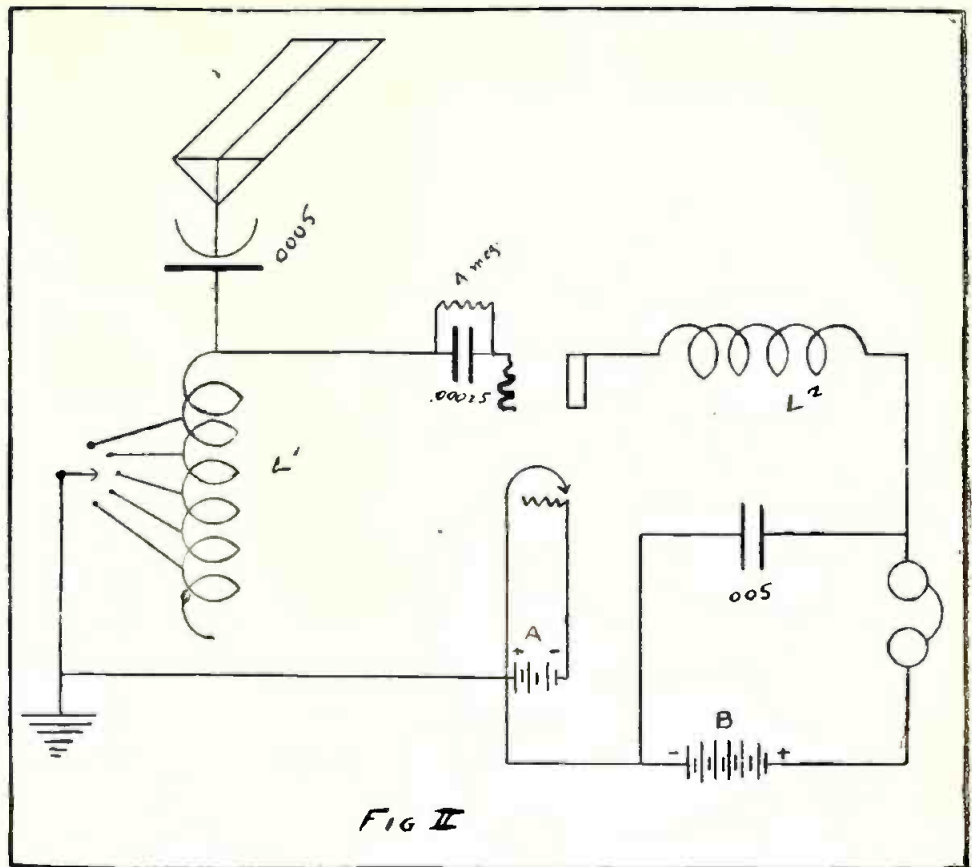


FIG II

This is the single circuit Armstrong. L 2 is inductively coupled to L 1 for feedback purposes, and its relationship is variable. The inductance change in L 1 is by means of taps and the condenser in the antenna circuit. Good for results but hard on your neighbor if you let your tube oscillate

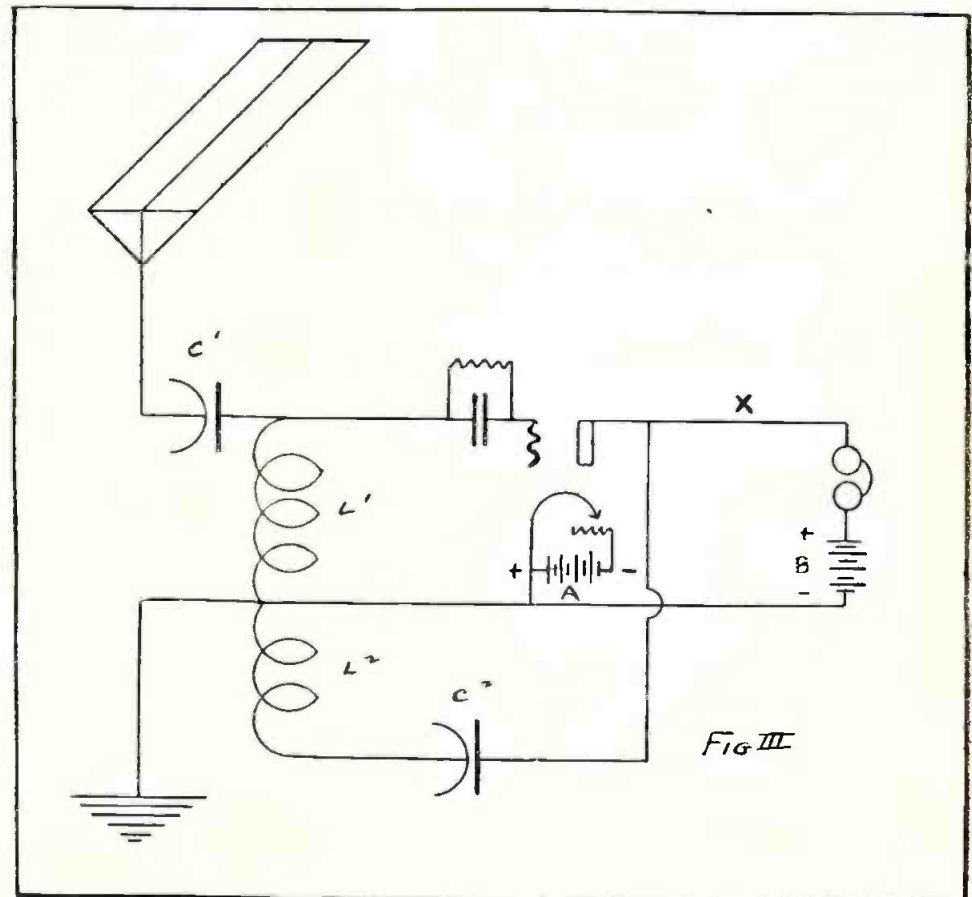


FIG III

Another popular type of receiver in which regenerative control is by a variable capacity in series with an inductance paralleling the plate and filament. Known years ago as the Weagant circuit, later popularized by Reinartz and others. Better build it loose coupled for the sake of the neighbors, unless you happen to live out in the exact geographical center of the Gobi desert

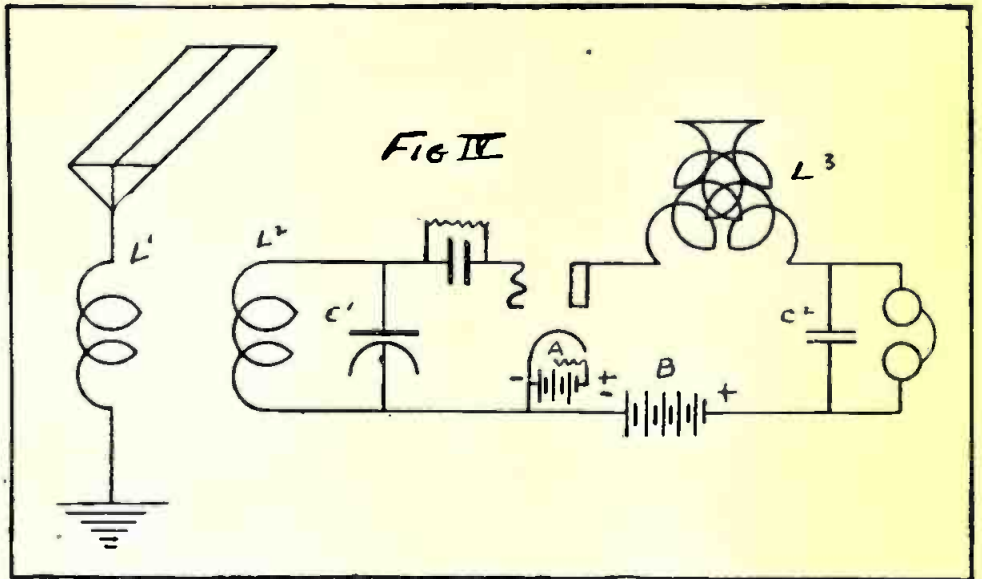
gested districts. His coils are wound as follows: L2 52 turns 18 or 20 DSC on a three or three and a half inch form. Around center of winding one layer three quarters inch cambric. Stick 8 pieces of hard rubber 3-4 by 3-16 by 1-4 placed equidistant around the piece of cambric, fastened with collodion. Coil L1 is wound on these blocks and consists of 3 to 10 turns of the same wire. An ordinary plate variometer is used for L3. C1 is .0005 and C2 .001 mfd. This circuit is inductive and even if oscillating would not cause the same amount of annoyance which a single circuit would. He submits a list of DX stuff that certainly entitles him to the DT button.

Another circuit which has proved very popular with those who wished to economize on tubes and material, is the reflex circuit, originally attributed to Latour, the Frenchman, who gave it to the Allied communication authorities during the early part of the war and which was immediately pounced upon by everyone on this side of the water as an excellent circuit from an economical standpoint. It has been rearranged countless times and additions and deletions made to the original.

This circuit, Fig. V, is sent in by Francis Davis of Cushing, Okla., who tells us L1 is wound on a 3 inch tube with 15 turns of No. 22; L2 same size tube with 50 turns; L3 is the same as L1 and L4 is the same as L3. The variables C1 and C2 are .0005 mfd. C3 is .00025 and C4 is .001 mfd.

Davis' list of DX stations also gets him the DT button.

Looks like the ladies are not to be prevented from having equal rights in radio as well as economics, for in this week's mail come two letters from



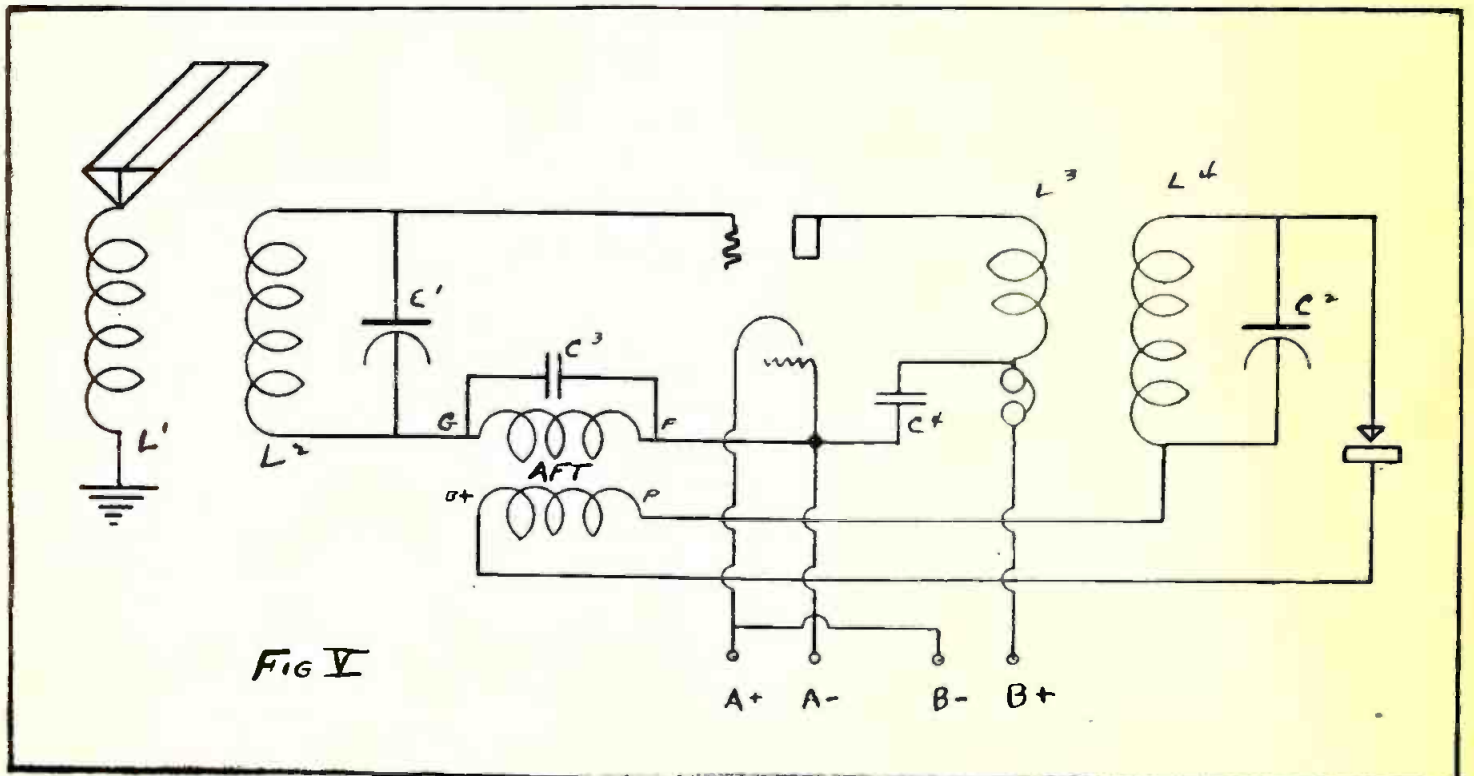
An inductively coupled Armstrong regenerative. Coils L1 and L2 are wound by the contributor, while L3 is an ordinary plate variometer. He gets good results on it, as he should with a loose coupled regenerative set.

feminine fans, the first from Floid Omond, 16 Alsace Ave., Buffalo, N. Y., who finds RADIO AGE interesting in every way, and specially the Pickups and Hookups. She has built a one tube and a three tube set and has received fine DX stuff with these. So we will send her a button, but regret we haven't a little wisp of ribbon to send along with it; we used up the last piece in winding a coil.

The other feminine ether chaser is Mrs. Eva A. Taylor, 69 Murdock St., Youngstown, Ohio, who reads RADIO AGE with a great deal of interest, especially since she ran across one of the Youngstownian names in the magazine. She has qualified for the button by sending in a list of stations she has

received on a manufactured four tube set with built in loud-speaker. She wonders if there is anybody in Chicago who does not own a broadcasting station, as her experience on the air seems to show that nearly everybody in Chicago is broadcasting.

We got quite a laugh out of a letter from Albert C. McKee, 2306 Seminary Ave., Chicago, Ill., who says his set is in a second edition of "Hell's Kitchen" where he has to contend with regenerative squeals and howls. In his letter he tells of making a crystal detector out of an old mouse trap but fails to tell whether he was bothered with squeaks on account of this fact. He (Turn to page 48)



Another popular circuit, the reflex which sprang from Latour, the Frenchman, during the war. It is simple, effective and economical. What more can the fan ask? This one was sent in by Francis Davis, of Cushing, Okla.

RADIO AGE

The Magazine of the Hour

*Offers to Its Readers the
First Feature of Its Kind Ever Published in
a Radio Magazine*

A Round-up of Hook-ups

ALL Basic Circuits from which ALL Radio Hook-ups
are Developed Described and Illustrated with

62-Page Blueprint Section

FOR the first time in any radio magazine, RADIO AGE is publishing in its August, 1925, issue, an array of radio hookups that will impress and delight every lover of technical radio information and accuracy.

In this big number, which is to be our "Deluxe August issue," RADIO AGE will prove its superiority in the technical field by giving its readers, at no additional cost for the magazine, many pages of hookups, from the early diagrams to the very latest developments in multi-tube design.

Because of the inevitable popularity of this number, and the demand its publication will cause, readers are asked to order copies in advance.

In the
"De Luxe"
August Issue
of RADIO AGE,
Out July 15

THIS unusual number will sell for the usual price of 25c a copy. Of the pages in this number, fully 56 will contain actual constructional articles, of which THIRTY OR MORE pages will be typical RADIO AGE blueprints, which have made the "Magazine of the Hour" distinctively famous the world over.

From the simplest crystal set, the articles in this number will enable the reader to travel by an orderly process to the super-heterodyne, taking in every popular type of receiver introduced since the advent of the radio science.

Where improvements have been made, the latest technical explanations will be given. Everything will be strictly up-to-the-minute, and written so clearly and simply that either the rawest novice or the most seasoned technical expert will understand the articles almost at a glance.

Order Your Copy of This Wonder Issue In Advance!

25 CENTS A COPY,
\$2.50 A YEAR

RADIO AGE, Inc.,

500 N. DEARBORN ST.,
CHICAGO



(From page 46)

thinks J. B. Rathbun, who makes up the blueprints for the various hookups appearing in RADIO AGE, is to be complimented on their uniform accuracy and efficiency. He is using a five tube reflexed radio frequency set recently described by Rathbun and gets wonderful results with it. His list of stations entitles him to the button all right.

A. C. Taylor, Steele, North Dakota, says he finds there is no other publication that deals with radio that has such a vast amount of good reading matter as RADIO AGE has. He says he was surprised to see the circuit used by E. H. Jones in the April number, and feels that too much cannot be said for such a circuit.

P. E. Chapman, 805 North Preston St., West Philadelphia, Pa., thinks RADIO AGE is the best on the market and reads it with great interest. He thinks our invitation to readers and experimenters to forward their results with new circuits is certainly a boost to the amateur and a great help to all who are interested in radio. He is still using the four-tube circuit published by RADIO AGE in September, 1924, and with it has logged 167 stations; three Europeans, two Cubans, five Canadians, six Pacific coast and one Alaskan

P. French, 1209 Franklin St., Beaumont, Texas, took us at our word as to Spring cleaning referred to in the May RADIO AGE. He reports that Spring cleaning from aerial to ground clamps

did help his set to such an extent that he logged quite a batch of DX stuff, for which he is hereby awarded the D. T. emblem.

George D. Hillstrom, 10135 Lafayette Ave., Chicago, Ill., is a 14 year old youngster who is following RADIO AGE circuits with great success. His letter containing a DX list entitles him to one of the coveted buttons.

George A. Winkler, 902 South 15th St., Birmingham, Alabama, wants RADIO AGE to keep on pouring it into a certain radio octopus with which we are all acquainted. He sends in a diagram of an eight tube super which he is using with good results.

Charles Markarian, 110 Summer St., Worcester, Mass., gets fine results with the reflexed neutrodyne described by Mr. Hopkins in the January issue of RADIO AGE.

T. L. Kent, 721 North Ave., Waukegan, Ill., formerly 6US, is now out of the "ham" and into the BCL game, which he likes very much.

John Hogle, of 321 Selma Ave., Kenosha, Wis., says he is bothered by only one station, that being Zion. He asks for a wave trap that will obliterate that station. He has made up his set from RADIO AGE blueprints. He gets excellent results from his three circuit regenerative. A wave trap might be used on Zion with good results. Make it on a cardboard form about three inches in diameter, winding it with

about fifty turns of No. 18 bell wire (also known as annunciator wire), spanning it with one of the Remler condensers he uses. Insert in series with the aerial lead of your normal primary and tune to Zion's wave, leaving it there while you chase off in quest of other signals.

Roy R. Winder, Pedro Miguel, Canal Zone, sends word of his luck with radio in the land of static down around "Pete-Mike" on the Panama Canal. The first station he has a chance to pick up is PWX, Havana, about 900 miles to the northward. He is a regular reader of RADIO AGE, considering it one of the most valuable assets of radio.

Another fourteen-year-old radio fan is E. N. Girard, 715 South 58th St., Philadelphia, Pa., who uses RADIO AGE hookups as his guide. He gets out of town stuff without trouble from the locals and sends in a dandy DX list.

Kendall McNeil, of Ottawa, who neglects to send his address, writes interestingly of his excellent results with the improved three tube Reinartz described in the May RADIO AGE by Mr. Piety. He gets all the stations in the U. S. and also nabbed two or three of the Continentals, namely London, Newcastle and Aberdeen, all of which he has confirmed.

D. C. Atkinson, 788 Hohman St., Hammond, Ind., one day used his downspout on the eave-troughs of the house instead of an antenna, getting stronger signals. He used this on a crystal set, but says he has not tried it on a tube set yet. Let's hope his experience will not start an epidemic of down-spouting or else all the landlords in the country will be faced with the necessity of installing tinned copper downspouts with binding post connections for each experimenter. Many tin roofs have worked better than a poor antenna, but always remember there is NO substitute for a GOOD antenna.

How are
Your DX Lists
Coming This
Summer?
Let the
"Pickups and
Hookups"
Readers
Know About
Them!

DAVEN SUPER AMPLIFIER

It is a recognized fact, that only a Resistance Coupled Amplifier delivers perfect amplification. With the SUPER AMPLIFIER you are assured of ample volume, lower "B" Battery consumption, minimum of assembly labor, unimpeachable quality—an amplifier which makes any good set better.

The Sine of Merit

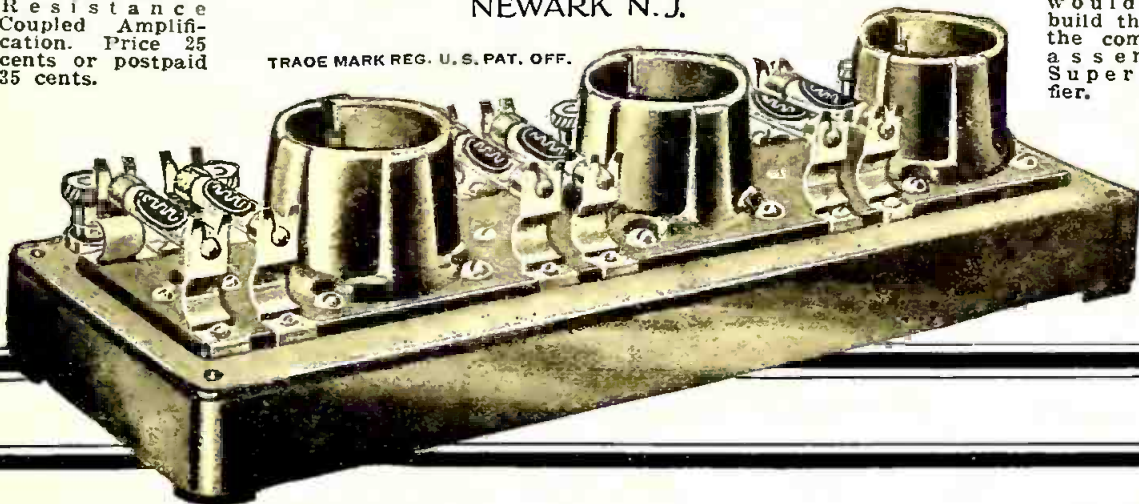
DAVEN RADIO CORPORATION

"Resistor Specialists"
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Obtain from your Dealer the Resistor Manual a complete handbook on Resistance Coupled Amplification. Price 25 cents or postpaid 35 cents.

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Amplifier Kits for those who would rather build than buy the completely assembled Super Amplifier.



Your tubes know

The Difference—
When Using AMPERITE

AMPERITE the "self-adjusting rheostat", automatically controls the flow of current, and makes hand controlled rheostats obsolete. Permits the use of any type of tubes or any combination of tubes. Specified in every popular construction set.

For perfect results you must use AMPERITE for filament control. Price \$1.10 everywhere.

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"means right amperes"

Sales Distributor Wanted

to start now in the fastest growing business the world ever knew—Three Million radio sets were sold last year—22 Million will be sold in the U. S. A.

THE MUSIC BOX RADIO RECEIVER

is the peerless seller of them all. Think! Only two orders weekly means \$600 per month. Four orders \$1200 per month. The Set with the Marvelous Tone and Volume Supreme, the Distance getter of them all. Write now, today, for our liberal 15-day trial offer and protected territory.

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Geared 80 to 1

Another important development in ACCURATUNE construction—the use of a full brass gear train, built exceptionally rugged and designed for Accurate Tuning. "Absolutely essential for sensitive sets."

1. Friction Clutch. 2. Long Center Bushing. 3. New Gear Mesh.

At your dealers, otherwise send price (\$3.50) and you will be supplied postpaid

MYDAR RADIO CO., 9-K Campbell St., Newark, N. J.

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REGISTERED GEARED 80:1 U.S. PAT. OFF.
MICROMETER CONTROLS

"The Roundup of Hookups!"—112 pages of every conceivable kind of radio hookups—will be the big feature of the "Deluxe" Edition of the August RADIO AGE. On the stands July 15, but order your copy in advance if you want to get this wonder issue. More than thirty pages of blueprints and scores of hookups! 25 cents a copy.

* Tested and Approved by RADIO AGE *

The Broadcast of Plays Written for Radio

By E. E. Mattson
Westinghouse K Y W

SINCE the advent of radio, its progress has brought many improvements, some of them expected and some not looked for. However, improvements from a technical point of view have not been the only goal sought in radio. From the beginning radio was popular because of its newness, its mysteries and seeming intangibility. A person bit by the radio bug soon became almost diabolical in his lust to grope into the distance, and spared no effort to purchase or build a set that brought him clear and distinct reception. Those were fascinations that led him on.

With the advance of radio activity, and the many angles taught its leaders by experience and study, it became apparent that the mere broadcasting of vocal or instrumental numbers accompanied by conventional announcing would not suffice. The rendition was heard well but it appeared automatic, it lacked the personality that would make it pleasing and beautiful. The artist was taught to impress the invisible listener-in by sound, what the stage artist did by pantomime. The announcer was given the idea of making his remarks fit the occasion and blending them into the program as part of it, thereby assisting the proper balancing of the act. These, and many other things were essential.

After about four years of radio activity, numerous ideas have presented themselves to radio directors, visualizing the need of a change of venue. Wilson Wetherbee, director of Westinghouse Station K Y W, has long felt this need and for some time past has been active in coaching the personnel of K Y W toward this goal. Radio broadcasting demands new things, and it will get it. The movie industry started with one-reel features, and during its evolution it grew until today the cinema features full plays brought out with a studied skill, wherein the personality of the actresses and actors, aided by elaborate stage settings, convey to the audience the same impressions that the spoken drama would. The success of the movie is evident by its popularity among all classes, the highly educated and those less favored.

A Radio Technique

Mr. Wetherbee's ideas have brought out that radio thirsts for something more than "one reelers." His experience has taught him a technique of radio more than the mere announcing of a selection and then putting it over clear and distinct. The announcer, the artists, the stage setting—all are unseen by the listener. The general atmosphere has to be impressed upon the listener by sound, and by the personality injected into the microphone in the studio. So far this policy has succeeded admirably. Now Mr. Wetherbee's plans bring forth radio's demand of short acts, in which several persons take part, and in which the scenes are laid with the same care and forethought as on the stage or in a photo-studio. With radio, however, technique finds employment in drawing

for the listener-in a vision of the layout concerning which he hears the spoken version. In the movie, the audience sees but does not hear. In the radio, it hears and will see by virtue of the impression that will be given the listener by the personnel of the act.

It is the purpose of Station K Y W to give life to this plan. Mr. Wetherbee will supervise the writing of plays to be used over K Y W. He has completed the first one act play, "The Fates Decide" which will soon be put on the ether. In this play he employs three people, Norman Landon, a wealthy newspaper owner, Marion Landon, his wife, and Franklin Ames, his life long friend. The entire plot is laid out with the same care and thought as given a play for the stage. It will be acted by three artists of the station, who have been coached in rehearsal until the effect intended has been brought out to a high degree.

Summer Radio Conditions To Be Surveyed

H. FRANK Hopkins and Harvey T. Kelley, Assoc., I. R. E., and well known radio engineers, plan to leave Chicago some time during August on an extended trip throughout the Western and Southwestern portion of the United States, to carry on an intensive survey of broadcasting conditions in so-called "dead spots."

Because radio reception is so difficult in the Summer-time, under most conditions, the two experts will endeavor to trace the causes and record them for public use. Their findings will be sent for publication in RADIO AGE as the trip progresses.

A 100-watt broadcasting station will be part of the equipment carried on this trip, and arrangements have been made to carry on tests in Colorado, Utah, Arizona, New Mexico, Southern California, and where static conditions at this time of the year are unusual. Under these extremely adverse conditions, an attempt will be made to determine just what kind of radio circuit performs the best. Several circuits will be taken on the trip and tested under varying atmospheric and geographic conditions.

Communication with Eastern and Pacific broadcasting stations will be maintained throughout the long trek, which will be made by automobile. Several stations have expressed a desire to broadcast the findings of the experts, to guide them in reaching districts and listeners in isolated parts of the world who at present encounter difficulties in maintaining consistent touch with radio stations throughout the year, and especially in the Summer-time.

Mr. Hopkins and Mr. Kelley intend to devise several new types of radio apparatus to meet the difficulties they expect will confront them. These varied types of apparatus, which will be designed after thorough tests, will be described to readers of RADIO AGE this Fall, thereby being of great value to those fans who live far from strong stations and who are bothered by static, fading and other unaccountable disturbances.

Both Mr. Hopkins and Mr. Kelley have long been identified in radio circles, having done much research and development work. Both are past masters in the transmitting and receiving art.

How Much Coupling is Necessary?

(Continued from page 14)

In making the final primary coil, it is best to allow taps at two or three turns more than necessary on long waves and at least two less than necessary to produce oscillations on short waves. This makes sufficient allowance for depreciating tubes and batteries.

The variable coupler makes up for lots of little differences in sets, such as aerials of different capacities, tubes of more or less oscillatory tendencies, batteries differing in voltage, detectors of more or less absorbing powers and the like. It avoids the necessity for variable feed-back coils like reversed ticklers, for inducing regeneration on some wavelengths and counter-acting it on others. And it permits long wave stations to come in as well as others; in fact, it makes reception uniform all over the dial's scale.

Phonograph Stores Are Handling Radio

NEW YORK—Radio parts are now being handled by phonograph stores throughout the country and on a growing scale, declared Ben Aplin, eastern sales manager for the Shaw Insulator Co., of Irvington-Newark, N. J. Mr. Aplin, who is one of the best known salesmen for molded radio materials in this country, has been deeply impressed by the increasing volume of sales being recorded by phonograph and music stores for small parts which hold such an important part in the radio industry.

"Hundreds of dealers throughout the eastern section of the country who previously handled musical instruments and records, and eventually added radio sets have been finding that small parts have been invaluable sources of profit to their sales total.

"This fact is more apparent as one, in travelling throughout the greater cities, finds that dealers everywhere are adding small parts as the direct results of demands made upon them by their trade. There are always some parts of their set which they desire to replace to add greatly to the efficiency of their sets.

"With that idea in mind they go to the music store which sold them the set and insist upon buying some particular part. If the dealer does not carry that part or for that matter any part in stock the customer goes elsewhere. The natural result is that the dealer, rather than see business going to another store, gradually stocks up new and small parts which he finds hold ready sales appeal to his customer.

"Many dealers were first of the belief that the carrying of small parts would be the means of cluttering up their stock. Instead they are gradually finding that by simplifying the arrangement of their merchandise they are able to fill the customers, demands at once.

"It is no longer necessary to spread these small parts in every section of the store. They are now systematizing their stocks of these small radio parts with the result that a show case or two in a particular section of the store carries the stock required.

The Radio Spies

(Continued from page 32)

occasions seen this same Cecelia Lambert at the De Forest plant in Jersey City. I was likewise told by another employe who was working under Harley, whose name I do not recall, that there was at that time another investigator stationed at the De Forest plant who was known as 'E-10.'

After saying that he arranged for Thies to procure certain information concerning the complainant, Bowlby declares he passed on Thies's written report to Harley, adding, "this report contained, among other things, a description of all the machinery used in the tube department of the De Forest Radio Company while he was working there, as far as he could remember the same, together with the method of operating these machines; also the information regarding filament wire used by that company in making its tubes and where they obtained the same."

Bernice M. Jennings, employed as typist by the Radio Corporation of America from November, 1924, to April, 1925, said an employment agency sent her to Room 301, 25 Beaver Street, where she asked for Mr. Harley. She was engaged by a Mr. Silverton. There were six girls under Mr. Harley in Rooms 301 and 302, she says. Harley's private office was Room 303. She alleges that Room 217 in the same building was also occupied by a girl under Harley's direction and was also used by Radio Corporation's investigators.

Instructed on Secrecy

Soon after she began work, alleges Miss Jennings, she was told by several other employes in the office not to give out any information regarding the people in the three rooms, or their business, and also not to let anybody know that there was any connection between the employes there and the Radio Corporation of America. Two weeks later she was transferred to Room 217. Once a man dropped in and asked for Mr. Harley. She directed him to Room 301. When Harley heard of the incident he is alleged to have said to Miss Jennings, "In the future, if any one comes here and asks for me, you don't know me nor anything about me, and no one here has anything to do with any radio business whatever."

Harley, the affidavit continues, received written reports from many investigators. They were usually stamped with Harley's initials and then went to Silverton, who stamped them with his designation, "C-2."

When she first began copying the reports, says Miss Jennings in her affidavit, they were headed by the name of the person or concern under investigation. For three months prior to April 10, 1925, she received almost daily reports from "C-3," Cecelia Lambert, reports headed "In re De Forest," but subsequently the heading was changed to "381" and that number was given to the file which contained matters relating to the De Forest Company.

The reports covered many things, the affidavit alleges, including the time employes began and quit work, whether there were few or many employes at work, whether they worked overtime or less than full time, whether business was brisk or slow, what employes were discharged and what new ones were taken on, the names and addresses of employes, so far as she was able to give them: instructions issued to foremen and persons in charge, notices posted in the departments governing the personnel of superintendents and foremen, why a foreman had been laid off, efforts made to speed up production, and especially what took place in the power tube department: on two or three occasions her reports contained attempted drawings of machines used in the department in which she was working."

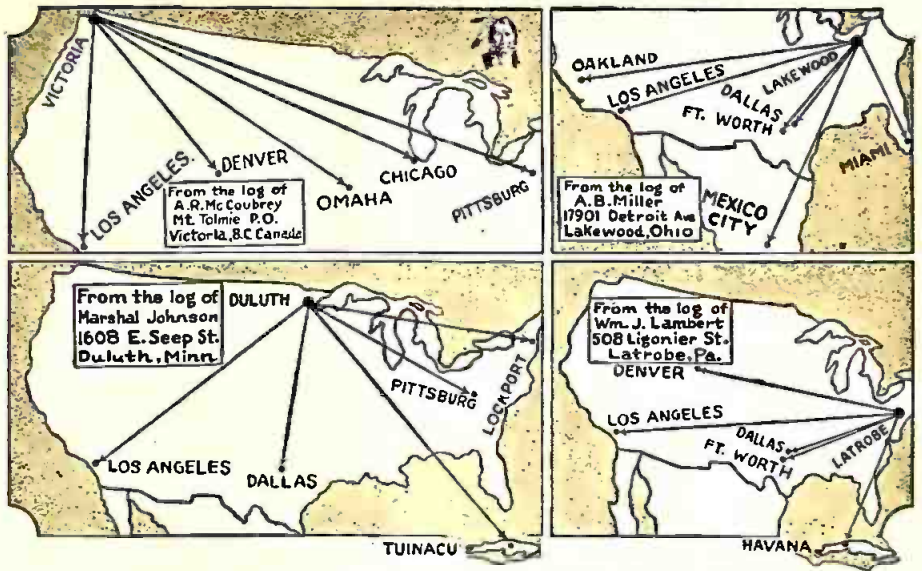
Several times Miss Lambert, it was alleged, sent in with her report some pieces of filament wire, and she also sent in what she designated as "gold seals," used in connection with the manufacture of power tubes.

Corroborates Bowlby

William Buckbee, a tester in the De Forest Laboratory, swears in an affidavit that in company with a young lady he met Harley, at the latter's suggestion. With Harley was Miss Johnson, whom Buckbee says he knew to be a De Forest employe. Harley, Buckbee asserts, told him that Miss Johnson was an investigator for the Radio Corporation and that she was one of five or six employed in the De Forest plant who were also employed by the defendant.

"At that interview," the affidavit continues, "Harley offered the young lady accompanying me a position as confidential investigator for the Radio Corporation of America and stated to her that as such confidential investigator he could get her a position with the De Forest Radio Company, as stenographer, and that he wanted her, after having

(Turn to page 60)



Through the Locals — ALL-AMAX Reaches Out

Every ALL-AMAX Set, wherever it may be, brings to its owner his choice of all the beauties in the air. Every day come more and more letters to our office, telling of the long distance reception, almost unbelievable on a three-tube set, which has rewarded the owners of ALL-AMAX.

Remember, too, that ALL-AMAX is completely mounted on panel and baseboard. You can wire it in one delightful evening, following simple photographic instructions.

- ALL-AMAX SENIOR, three tubes and detector . . . Price, \$42.00
- ALL-AMAX JUNIOR, one tube and detector Price, \$22.00

ALL-AMERICAN RADIO CORPORATION

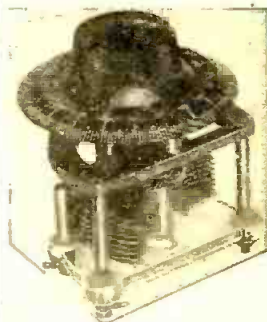
E. N. RAULAND, President

2680 Coyne Street

Chicago

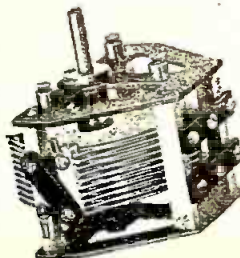
ALL-AMERICAN

Institute Correction



Through an error, the illustrations of Tests No. 47 and 49 in the RADIO AGE Institute for May, 1925, were reversed. The Quam Condenser test was illustrated by an engraving of the Duplex Condenser, and vice versa.

We are reprinting views of the two condensers with their proper identifications. The top view herewith shows the Quam condenser, and the cut at the bottom is a Duplex Matched Condenser.



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NEW 64 page log. Holds 400 stations. Shows calls, cities, wave lengths, dial settings, remarks, etc. TUNING SUGGESTIONS. Station list by wave lengths—by states, etc. Owners. Map. TROUBLE AIDS. Other valuable information. So convenient. Worth many times small cost. A joy to use. GENUINE De Luxe leather cover. Only \$1.

Send No Money Pay postman after log arrives. Post-FUNDED if not DELIGHTED. Order today—NOW. Postal will do RADIO PRINTERS, Dept. B202 * Mendota, Illinois

Standard Radio Receivers

Recently 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 an instantaneous response to this new feature, and accordingly it is continued and will be a feature of all forthcoming 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

Selectivity Paramount in Chelsea Sets

THE Chelsea Three and Five Tube receivers have been designed with virtually one end in view: that of attaining the ultimate in selectivity.

The Chelsea Super Five, just announced, is a five tube receiver embodying this selectivity with unusual volume. Distortion is minimized so it is unnoticeable, as is any annoying squealing.

The Chelsea Five has all the principles of the perfected non-regenerative set, including remarkable distance. The cabinet, of the sloping type, is finished in rich mahogany with shielded Bakelite. The retail price is now \$50.

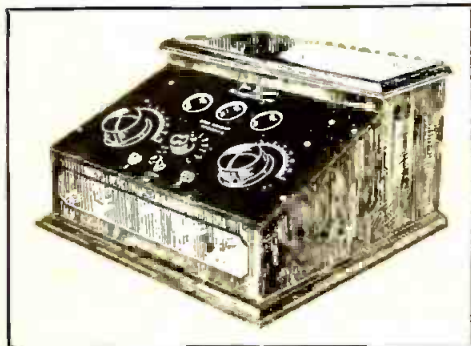
The Three Tube Chelsea

Clear volume on the loud speaker, with ability to bring in distant stations within reasonable range, is the feature of the Three-Tube Chelsea, Model 122. This set has been on the market for some time and has gained a reputation for its consistently remarkable performance. One station is received at a time, proving it is also selective.

The Chelsea 3-Tube Set is of the triple circuit type, controlled by a single tuner. No knowledge of radio is necessary to operate this simple receiver. The cabinet is slightly sloping, as in the Chelsea Super Five. It is of attractive finish. The price is now \$40.00.

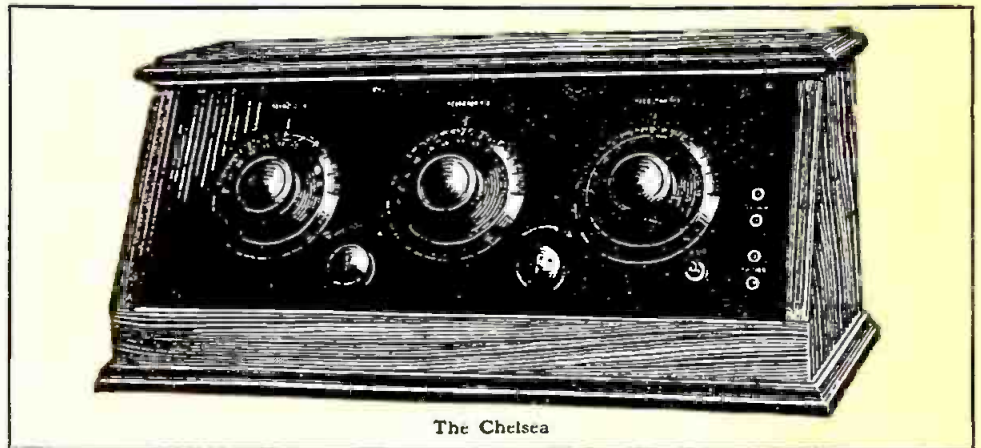
The Eaglet Receiver a "Prince of the Air"

THE EAGLET, a three tube dry cell neutrodyne, has been "weighed in the balance" of engineer's tests, and has proved that it possesses selectivity,



volume as well as simplicity, distance and tone volume. These qualities, coupled with good workmanship, finish and guarantee, constitute the last word in radio.

The Eaglet embodies the Eagle Balanced Neutrodyne circuit, using one



The Chelsea

step of tuned radio frequency amplification, vacuum tube detector and two steps of audio amplification. The first tube is reflexed; that is, it amplifies radio and audio frequency at the same time; making the Eaglet virtually a four tube receiver.

It gives reception equivalent to a four tube dry cell set, using only the current required by three tubes. The Eaglet is portable in the sense that it is light of weight, can be conveniently carried about the house and can be hooked up to different antennas, taken out in an auto, used on camping trips, Summer homes and hospitals.

For its operation it requires three No. 6 dry cell A batteries 1½ volt, and four No. 23½ B intermediate size or one 4½ volt unit C. The tubes are UV 199 vacuum tubes or their equivalent. The instrument can be operated with ear phones or loud speaker. The installation is the same as the Eagle model B; namely, approximately 100 feet antenna. Two antenna leads are provided, one for long and one for short aerial.

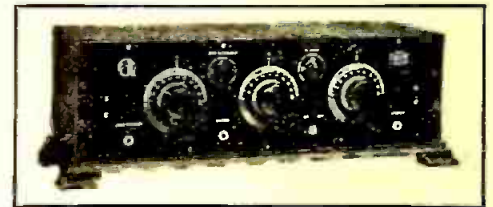
The receiver is a delicate, scientific instrument, and should not be tampered with by inexperienced people. The Eaglet has been welcomed both by the trade and the consumers and has already endeared itself to thousands of owners. Families spending the hot months in camps, mountains, or sea shore will find the Eaglet a source of great joy and will be able to keep in touch with the wonderful open air orchestra programs that are always broadcast during vacation time from the country's best stations. The water enthusiast can listen in and have a whale of a time with his Eaglet installed on yacht or motor boat, on account of its compact design and light weight.

The price is \$75.00.

"Tone Modulator" in Resas Receiver

THE perfected Resas Tone-A-Dyne receiver embodies every advantageous feature claimed for any five tube set, plus the Tone Modulator, a feature that is to be had only with the TONE-A-DYNE.

As its name implies, the Tone Modulator controls the tone and volume at all times and under all operating conditions. There is nothing complicated or difficult about it. Simply a turn of



the knob and the musical or vocal selection assumes its most pleasant volume.

The Tone-A-Dyne is non-radiating. Annoyance from squeals and howls is eliminated.

The selectivity of the Tone-A-Dyne is unusually satisfactory. With local stations broadcasting on a wavelength only 5 meters away, station WHAS (Louisville) has been readily tuned in without interference on a short indoor aerial.

The Tone-A-Dyne is so designed that it can be operated by anyone without previous experience. The three tuning dials are accurately calibrated and matched so that their settings practically correspond. There is only one filament control, and this can be set at the best operating point on reception of the first station. A snap switch controls all tubes. Clearly marked binding posts are provided in the rear for all connections.

The price is \$78.00. (Turn to page 54)

Learning the Various Tube Characteristics

(Continued from page 12)

operation. This condition usually comes suddenly; it is not spread out over the life of the tube as would be expected. It is sometimes caused by applying excessive voltage to the filament of an otherwise good tube. If such is the case, it is possible to restore the tube to normal by the rejuvenation process, or by applying the rated voltage to the filament with the plate voltage cut off, for about a half hour.

From the above it will be seen how an old or defective tube will cause the aging of the other tubes in a circuit. This condition is readily noted by the necessity of increased "A" battery voltage—but most fans just turn the rheostats on and let it go at that—paralyzing or otherwise decreasing the efficiency of all of the tubes, which is a rather expensive performance in the end.

Amplification Factor

TO DETERMINE the amplification factor of a vacuum tube experimentally, a high frequency current of about 1,000 cycles is necessary—along with a hot wire galvanometer and other associated equipment. However, it is possible to determine this factor by use of the plate current values of the tube under test, substituting approximate values for functions of the various voltages in the tube. Thus, $I = \alpha (\gamma E_b + E_c + \epsilon)^2$ in which I equals the Thermionic current in milliamperes, E_b equals the potential (voltage) difference between the plate and filament, E_c equals the potential (voltage) of the grid and ϵ is an arbitrary quantity representing the small differences of potential (voltage) existing in the tube under various conditions. α is a structural constant.

The quantity γ in this equation is as explained in volume 47—1918—"Physical Review" by Van der Bijl—"That for equivalent values of E_b and E_c , a change in the cinode (plate) voltage E_b produces γ times as great a change in the current to the cinode as an equal change in the grid voltage E_c "—or non-technically—a change in voltage on the plate would have to be γ times the voltage change on the grid that would be required to produce a given change in the plate current. The voltage amplification factor μ is the reciprocal of this quantity or $\mu = 1/\gamma$.

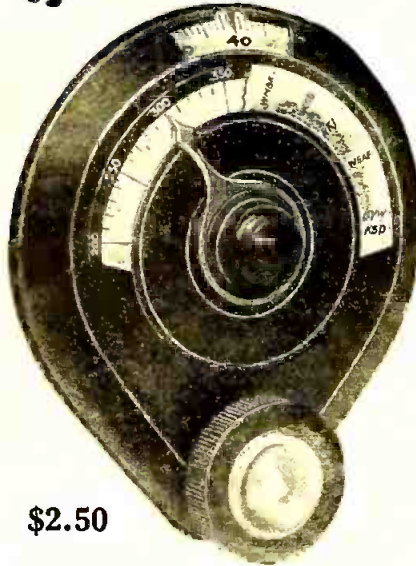
This is shown graphically in figure 2—where the grid and plate curves are drawn to the same scale on the same chart, indicating that a much smaller change in grid voltage will produce a greater change in plate current than a like change in plate voltage will produce.

The ratio of the two voltages required to produce a given change in plate current is the amplification factor (μ^2) on the chart; the ratio of the slopes of the straight portions of these curves is the amplification factor.

The amplification factor of the tube plotted on this chart will be between 6 and 6.25 or an average of 6.125. With this average factor we have $\gamma = 1/6125$
(Turn to page 56)

The "Better Tuning" Control

A New B-T Product



\$2.50

Exclusive features fully protected by patents pending.

Hairline Control, Easy Action, Simple Mounting.

No side strain or pull on shaft to wear out bearings or destroy alignment of your condenser or coil.

Reads 0 to 100 or 100 to 0,—settling the argument as to "clockwise" or "anti-clockwise" instruments.

Registers dial numbers, wave lengths, or call letters.

Improves the tuning as well as appearance of any set.

The new Tuning Control is distinctively a B-T product. It is of the same sensible design and careful construction that has characterized radio parts bearing the B-T name.

You should know about the new B-T socket. Send your name and address for circulars on this and other new B-T developments.

BREMER-TULLY MFG. CO.

532 S. Canal St., Chicago



\$3.50 Volume with CLEARNESS is obtained by using FLINT AUDIO Frequency Transformers We will supply if your dealer cannot FLINT RADIO CO. 1884 Wilson Ave. Chicago

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A MARVELOUS new way to chart your radio exploits—a beautiful Air Map, printed in three colors with every station clearly marked and Time zones outlined! Size 28x34 inches.

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You'll have no trouble getting station Z-I-F-F-S, because you'll find it is always tuned in to catch your funny bone's wavelength, and is more ticklish to your giggle box than the finest cat whisker!

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Pick This Out On Your Piccolo!

*Even tho' your set is growling
'Til you think a cat is howling
And the music comes in wailing, hissing sniffs,
You will giggle, grin and chuckle
'Til you hafta loose the buckle
On your belt, if you've the latest book of ZIFFS*

You wouldn't go fishing without bait, would you? Well, then, don't try to get Hong Kong on a stormy night with a crystal set, till you've put your John Henry on the tag below:

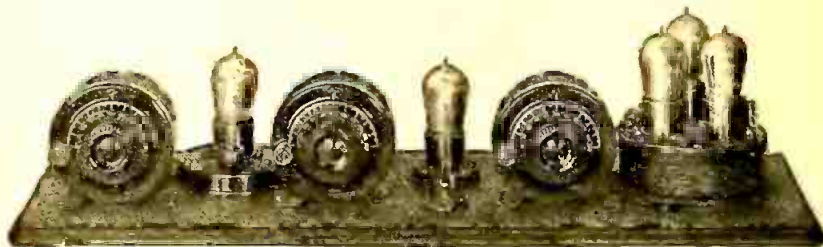
ZIFFS,
608 South Dearborn,
Chicago, Ill.

Dear Badzib:
I got a radio. I got Hawaii. I got drowned out. I got peeved.
I don't see nothin' to laugh at, you big bum! Here's two bits. Send me the July ZIFFS, and I will!

They Call Me.....
And I live at.....

Standard Radio Receivers; The Atwater Kent

(Continued from page 52)



Atwater Kent Carefully Designed

THE careful construction of Atwater Kent Radio is apparent to the most casual observer—the easy movement of the tuning dials; the absence of intricate wiring; the sturdiness and rigidity of the various parts, are but a few of its features. Other structural details worthy of particular note are:

Variable condensers: plates—counterbalanced; bearings—adjustable cone, machine ground; contact spring—phosphor bronze.

Dials: drilled and reamed after moulding, assuring balance and accurate fit on the condenser shaft.

Rheostats: phosphor bronze spring contact, sliding on spiral resistance coil, giving smooth and positive action.

Tube sockets: heavy brass set in moulded Bakelite base with phosphor bronze contact springs, corrugated to make good contact.

Transformers: special Atwater Kent design capable of receiving all broadcasting.

Grid leak: special cartridge type, absolutely quiet in operation.

Wiring: tinned copper with all joints firmly soldered, spaghetti covered where there is a difference in potential.

Shielding: a metal panel on the cabinet receivers and metal shields on condensers of the open models entirely eliminate all body capacity.

Loud speaker: fabricated entirely of metal, the same as the vast majority of the finest band instruments.

Diaphragms: of special alloy metal, unusually large in diameter, assuring great volume without distortion.

Magnets: special Atwater Kent, requiring no extra batteries.

Many types of radio receiving sets deliver a sufficient volume of sound from distant broadcasting stations, but they are not selective—that is, they cannot separate two stations, both broadcasting at the same time on waves of nearly the same wavelength.

Atwater Kent Receiving Sets overcome these difficulties to a marked degree, so that two or more stations broadcasting at the same time can be separated and the desired station tuned in clearly and without troublesome interference.

One of the most pleasing features of Atwater Kent receiving sets is their sureness of securing a desired broadcasting station.

A printed list is supplied with each set which gives the approximate dial setting of many of the well-known broadcasting stations. With this key list in hand, the owner of an Atwater Kent can tune in a series of desired stations, or stations operating on similar wavelengths. By writing down the dial readings opposite the names of the stations, make up a list or "log."

Model 20 is a powerful receiver capable of operating a loud speaker under all conditions where broadcasting is at all practicable—hence ear phones are unnecessary. It comprises two stages of tuned radio frequency amplification, a detector and two stages of audio frequency amplification with three tuning dials. It is non-radiating and non-squealing.

Dimensions: Height, 8 1-2 in.; length, 26 in.; depth, 8 3-4 in. Number of tubes required, 5.

Part No. 4640, Model 20 Cabinet Receiving Set, \$100.00.

Open receiver, same as Model 20 but without cabinet—\$85.00.


New Studios Ready for WCCO

Work has started on the new Saint Paul studios of the Gold Medal Station, Saint Paul-Minneapolis, WCCO. These studios will be among the most uniquely located in the world. They are being built in Saint Paul's new Union Depot, used by nine railroads. The studios, reception room, and executive offices, will be at the left of the concourse through which all persons pass going to and from the trains.

THE LATEST

parts and sets are always featured in our Salespeaker. If you are a live-wire dealer, write for your copy, now.

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Chicago**



A regular \$25 loud speaker for \$16. Loud, clear, mellow tone. Bell 13 3/4 in. diameter, horn 22 in. high, equipped with Lakeside Adjustable Unit. Agents wanted, write for particulars.

Lakeside Supply Co.*
73 W. Van Buren St., Chicago

A Simplified Portable Super-Het

(Continued from page 23)

Lead No. 14 of the battery cable is attached to A1 on the battery switch.

Attach the lug at the end of the 2 3-4 inch section of Lead No. 17 to the potentiometer at A2. The tap is attached to the battery switch at A3 and the last lug is attached to the rheostat at A4.

Lead No. 27 is now run between the rheostat at A5 and the negative filament line at A6.

Lead No. 18 runs from the potentiometer at B2 to the positive filament line at B3.

The lug at the end of the 8 3-4 inch section of lead No. 12 is attached to the center of the potentiometer at G. The other taps of this lead are attached to the terminals marked "F" on the third, second, and first intermediate frequency transformers. These are points G1, G2, and G3 respectively.

Attach the lug at the 4 1-4 inch section of lead No. 2 to the rotor plates of the loop tuning condenser at H1. The tap on this same lead connects to the stator plates of the balancing condenser at H2. The other end of this lead later connects to one side of the loop.

Attach the lug at the end of the 7 1-4 inch section of lead No. 15 to the rotor plates of the balancing condenser at I1. The tap in this lead connects to the plate of the first detector tube at I2 and the remaining lug attaches to the "Plus" terminal of the first intermediate frequency transformer at I3.

The lug at the end of the 7 1-2 inch section of lead No. 6 attaches to the lower Jack at D1. The next tap connects to the B Positive terminal on the second audio frequency transformer at D2. The remaining lugs attach to the "Plus" terminals on the fourth (or filter transformer), the third and second intermediate transformers respectively. These connections are made at points D3, D4, and D5.

The oscillator coupler should now be bolted to the sub base. Use 6-32x5-16 inch machine screws for this purpose.

Before attaching the socket strip be sure that all of the wires which you have attached so far are as close to the base board as possible. This is one of the few "don'ts" in these instructions and should be observed.

The socket strip is attached by means of 6-32x1 3-4 inch machine screws. Run the bolt through the base board, place a brass washer under a 6-32 3-8 inch nut and secure it firmly. Then run another 3-8 inch nut down the bolt about three quarters of the way. The socket strip is now placed in position and the loose nuts on the underside of the strip run up to the correct point. Fasten the strip firmly in place by nuts screwed on from the top and you are ready to resume wiring.

Lead No. 25 is now completed from G4 on the .006 to G1, the Filament terminal of the third intermediate frequency transformer.

Lead No. 22 is completed by connecting from D6 on the other .006 condenser to the "Plus" terminal on the fourth or filter transformer, D3.

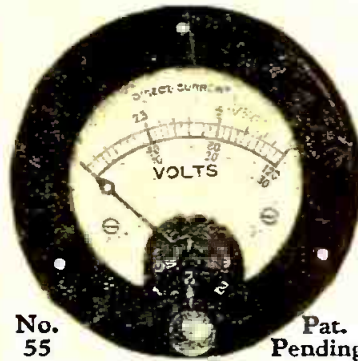
Connect lead No. 26 from C4 on the .005 condenser to the B plus terminal on the first audio frequency transformer, C2.

Now complete lead No. 32 from A7, the inside terminal of the pickup coil to the negative filament line of the socket strip at A8.

(Turn to page 56)



Radio Fans



No. 55 Pat. Pending

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CHICAGO. WRITE FOR CIRCULAR

Some Sidelights on Tube Characteristics

(Continued from page 53)

or .16. Substituting the values of the co-ordinates of two points on the straight portion of the plate characteristic in this equation, and solving simultaneously—with E_c as zero—we get for the other constants— $\epsilon = 3.28$ Volts and $\alpha = .0134$ the equation of the curve is then $I = .0134 (.16 E_b + E_c + 3.28)^2$

For greater amplification, higher plate voltage will be necessary and a negative grid bias with a "C" battery in series will be used—the correct "C" battery for the desired amplification may be readily determined by use of the tube test set from experiment. The average grid voltages for the 199 type of tubes are:—

Plate Voltage	Grid Bias Voltage
45 Volts	0.5 to 1.0 volts negative
67½ volts	1.5 to 3.0 volts negative
90 volts	3.0 to 4.5 volts negative
112½ volts	4.5 to 6.0 volts negative

The output impedance of a tube may be taken as an average for solving this equation. The following values are as correct as necessary for this purpose and may be used with a close degree of accuracy.

Mutual Conductance

The mutual conductance is the usual average for each type shown. A tube should show close to that noted to operate efficiently.

Type of tube	Output impedance of tube	Average mutual conductance (micro-mohms) of tube
199	19,600 ohms	315
200 (detector)	10,000 ohms	Varies
201	22,000 ohms	273
201A	15,400 ohms	345
WD-11 or WD-12	17,500 ohms	290
VT or 215A	18,500 ohms	350
216A (power tube)	3,400 ohms	1360

The mutual conductance shown in the above table is the usual average for tubes of their type—a tube should show close to that to be in good condition.

To make it more easily understood, the type of tube in the table is the usual code number used by most manufacturers. However, to more clearly explain them, the following table shows the rated filament voltage—plate voltage, Plate R "B" battery current drain, and average amplification factor for each—

Type of Tube	Filament		Plate		Amplification factor
	Volts	Amperes	Volts	Amperes	
199	3.0	0.06	40	.0009	6.125
200	5.0	1.00	22.5	.0003	Varies
201	5.0	1.00	45	.0009	6.000
201A	5.0	0.25	45	.0007	6.500
WD11-WD12	1.1	0.25	45	.0012	5.200
VT or 215A	1.1	0.25	45	.0008	6.500
216A	6.0	1.10	125	.0110	6.000

The Chart shown in Figure four is an example of matching tubes graphically and is a good explanation of the plate current of two tubes under identical conditions. The curve No. 1 shows an efficient tube, to work well at normal filament current, while curve No. 2 shows a tube that is old or defective, producing about half as much as the other tube.

Simplicity of Construction is Vital in Portable

(Continued from page 55)

Lead No. 19 is completed from J, the inside terminal of the plate section to the plate of the oscillator tube, J1.

Complete lead No. 5 by running from the outside terminal of the plate section C1 to the B positive terminal on the first audio transformer, C2, and to the "Plus" terminal of the first intermediate transformer, C3.

Lead No. 11 is completed from the inside terminal of the grid section, E1, to the filament terminal on the first audio transformer, E3, and to the filament terminal on the second audio transformer E2.

From the outside terminal of the grid section, K run lead No. 13 to the grid of the oscillator tube, K1, and to the stator plates of the oscillator condenser at K2.

Lead No. 10 is attached from the battery cable to the filament terminal of the first audio transformer at E3. This is the C battery negative connection.

Lead No. 21 is the positive filament wire in the battery cable and attaches to the positive filament line on the socket strip. The second socket from the left can be used for this purpose.

The B battery positive detector line of the battery cable, lead No. 39, may now be attached to the "Plus" terminal on the first intermediate frequency transformer at C3.

Lead No. 20 is the B battery positive amplifier of the battery cable and attaches to the "Plus" terminal of the second intermediate frequency transformer at D5.

The tap on lead No. 1 is now attached from the first grid condenser at H5 to the stator plates of the loop tuning condenser at H6.

Lead No. 24 runs from the rotor plates of the oscillator condenser, E4, to the filament terminal of the first audio frequency transformer, E3.

Lead No. 16 is connected by the lug at the end of the 4 inch section to the upper Jack, V. The tap connects to the plate of the first audio tube, V1, and the remaining tap is connected to the plate terminal of the second audio frequency transformer, V2.

Lead No. 36 runs from the grid of the first intermediate frequency tube, M, to the grid terminal on the first intermediate frequency transformer, M1.

Lead No. 37 runs from the grid of the second intermediate frequency tube, O, to the grid terminal on the second intermediate frequency transformer, O1.

Lead No. 38, connects the grid of the third intermediate frequency tube, Q, to the grid terminal of the third intermediate frequency transformer, Q1.

Lead No. 29 connects the plate of the first intermediate frequency tube, N, with the plate terminal on the second intermediate frequency transformer, N1.

Lead No. 30 runs from the plate of the second intermediate frequency tube, P, to the plate terminal on the third intermediate frequency transformer, P1.

Lead No. 31 runs from the plate of the third intermediate frequency tube, R, to the plate connection on the fourth or filter transformer, R1.

Lead No. 33 connects the positive filament line at B3 with the filament

terminal on the fourth or filter transformer at B5.

Lead No. 28 attaches to the plate terminal of the first audio transformer at L1 and runs to the plate of the second detector tube, L.

Lead No. 34 connects the grid of the first audio frequency tube, U, with the grid terminal on the first audio frequency transformer, U1.

Lead No. 42 runs from the grid of the second audio frequency tube, W, to the grid terminal of the second audio frequency transformer, W1.

The grid condenser for the second detector tube is now mounted on the transformer as shown in the diagram and photograph. The easiest way to do this is to remove the regular nut from the grid terminal of the filter transformer and screw down tightly a small 6-32 nut. The regular nut is now replaced and as a sufficient amount of thread is now exposed the condenser can be fastened securely by a 6-32 machine screw which has been cut or filed to the correct length. Lead No. 41 is then attached to the grid condenser at S1 and to the grid of the second detector tube at S.

Lead No. 4 is then attached to the plate of the second detector tube and the wiring is completed in the set itself.

Lead No. 7 shown on the diagram is later used to connect one of the loud speaker terminals with the B battery positive amplifier and can be laid aside until it is needed.

Three 22 1-2 volt B Batteries, six ordinary dry cells, and a C Battery are the battery supply.

When the set is completed, pass the battery cable through a hole drilled in front of the battery partition and cut the covering of the cable until leads of suitable length are exposed. The battery layout shown in the sketch leaves everything snug but there are several combinations you might try. Lead No. 7 now comes in for a useful career as the connection from one loud speaker terminal to the B Battery positive amplifier.

Leads No. 1 and No. 2 are now connected to the outside terminals of the loop windings and Lead No. 3 connects with the center tap terminal of the loop.

When all the tubes are in the set, the batteries hooked up and the loud speaker connected, pull the filament switch and adjust the rheostat to a point about three quarters of the way on. This is probably a little too high but a few minutes of excess current won't hurt the tubes particularly and we are at least certain of having enough. Set the balancing condenser at its minimum capacity and advance the potentiometer until a slight hiss is heard in the speaker. If this control is advanced too far some very violent whistles which soon merge into a loud roar are likely to be heard. The loop dial and the oscillator dial both tube very closely together if the loop specifications have been followed and it is only necessary to run the two dials together from about five on the dials up to eighty. If no station is heard, advance the position of the balancing condenser slightly and again cover the broadcast range. When a station is tuned in, it may be brought maximum volume by continuing to advance the balancing

condenser and the potentiometer until the circuit "spills over." Selectivity in this circuit is governed chiefly by the amount of regeneration present in the first detector tube and by the position of the potentiometer. The more regeneration in these circuits, the sharper the set becomes. Excess regeneration in the first detector circuit will be recognized by the "mushy" quality of the received signal and by the fact that the oscillator dial becomes very broad in tuning, as the detector is then combining the functions of both a detector and oscillator.

The grid leaks recommended are 3 megohms in the first detector circuit and 5 megohms in the second detector circuit. If the circuit tunes too sharply or if volume is less than expected on local signals, substitute a lower value leak in the first detector circuit.

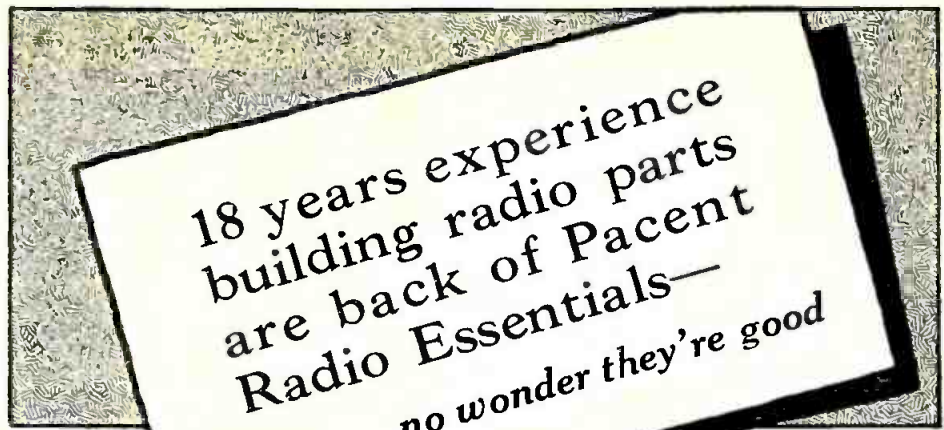
Body capacity should not be present on any of the controls except the small balancing condenser. Even here it will not be particularly noticeable except on distant signals. If body capacity exists on any of the other controls, look over all connections, particularly those of the bypass condensers.

5KW Power for Cincinnati Stations

WLW and WSAI, two broadcasters located near Cincinnati, have been authorized to use power as high as 5000 watts. This information may come as a shock to some skeptical fans who have feared any great increase in power, for they are the first two 5KW stations. The new licenses catalogue the power as "500 to 5000 watts." It is requested that they use discretion, observing suggestions of the district radio supervisor if interference is created by the increased power.

The main factor, which influenced the Department of Commerce to grant these licenses, was the fact that they are both located out of town where any reasonable interference would not be detrimental to the local reception of distant stations. WLW, the Crosley station is in Harrison, and WSAI, The U. S. Playing Card Station is in Mason, Ohio. Radio officials in Washington are disposed to grant qualified Class B stations similar authority for increased power, if their transmitters are set up outside the crowded urban districts.

WEAF, the A. T. & T. Co., station in New York has been authorized to increase its power to 2500 watts, being now the next highest powered station.



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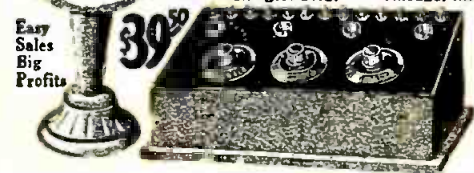
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Tracing the Interesting Ancestry of Your Receiver

By FRANK D. PEARNE

IT DOES not seem so long ago that we were listening to the now almost forgotten spark signals with the simple little crystal set, which at that time was considered one of the wonders of the age.

Interest in this, however, was confined to a few amateurs who studied the code and enjoyed an evening's chat with their friends. Then came the radio telephone, by means of which voice and music could be heard with these rudely constructed and inefficient sets. Two broadcasting stations began to send out musical programs and the amateur began to be popular. People began to call at his little station and marvel at this new scientific toy, to ask his advice as to how they, too, might build a set and enjoy this pleasure, not because of any particular desire to learn the principles of radio communication, but because they wanted to hear this music coming from the air and to entertain their friends with this newly found amusement.

More broadcasting stations began to operate and the fever spread until at the present time radio has grown to be one of the greatest industries in the world. In the beginning, it was difficult to construct even the simple crystal set, the parts having to be constructed by the operator himself. We hadn't a radio store on every corner as we now have. It was real work.

Improvement Arrives

WITH the opening up of more broadcasting stations and the increase in the number of fans, came the demand for something better in the way of a receiving set. Vacuum tubes began to replace the crystal, because by their use the signals were not only detected as they were with the crystal, but they were amplified also, this being made possible by the addition of the third element in the tube, called the grid, which was produced by the inventive genius of Dr. Lee De Forest. These vacuum tubes, however, were expensive in the old days and only those who could afford luxuries were lucky enough to possess them.

Today they may be had for the price of one dollar and up, and the simple little crystal has lost its prestige. With the advent of the vacuum tube more of these amateurs became interested in the actual science and as a result of their untiring efforts, we now have radio as it is today. They created the demand for better apparatus and improved upon the few basic circuits until we now have hundreds of circuits in use, with more coming all the time.

But what of these circuits? As a matter of fact, there are only a few of these basic circuits, most of the new

arrangements being only improvements which are bound to come from this vast army of experimenters. Before the World War, Major Armstrong announced his regenerative circuit, which was a basic idea, but since that time the only distinctive new circuit which has appeared is the reflex, the production of which is generally attributed to Prof. Marius Latour of France, and Armstrong's Superheterodyne.

Today there are hundreds of sets advertised, all of which are merely modifications and additions to these five or six basic circuits. Among these are the single-circuit regenerative, three circuit regenerative, superregenerative, and other forms of regenerative or radio frequency amplification. From this list many combinations have been made, radio frequency amplification has been added and hundreds of little kinks here and there have been incorporated, but a close analysis will reveal the fact that no radical changes in the old basic principles have been made. There are many people at the present time who want to purchase sets and who are holding off and waiting in the fear that something new is shortly going to develop which will make their selection obsolete.

A Foolish Idea

THIS is a foolish idea which is not borne out by the past. It is true, perhaps, and very probable that many new sets will appear on the market in the next year, but it is not at all probable that any radical change will take place. There is, of course, a possibility that the wave band of the broadcasting stations may be slightly increased, due to the fact that so many applications for licenses are being received by the Government that they find the present wave band too narrow to accommodate all of them and keep the proper separation. But one may rest assured that nothing will be done to make the present type of receiving set obsolete.

Experiments have shown that it is possible to broadcast on wavelengths as low as 100 meters, but it will probably be a long time before the wave band will be broadened to this point. The fact that so many stations are now in operation has made the question of selectivity one of vital importance. In the old days, when only a few stations were sending out their programs, it made little difference whether or not the set was selective, but today things are changed. Selectivity is the watchword. The question of distant reception has been well taken care of, and many of the present day receivers will pick up programs from coast to coast and from Alaska to South America, but if the set is not selective,

this great range is of no particular value.

Regeneration and radio frequency amplification have made distant reception possible. Here, again, we find that we are back to the old basic circuits. Radio frequency amplification is not new but the method of tuning it, the construction of the transformers, neutralizing the feed-back, and many other improvements are to be found in these improved circuits.

The one bad feature of radio frequency amplification has always been the tendency of one stage to feed back energy to another, thus setting up undesirable oscillations with the resultant howling and squealing. Different methods of overcoming this are found in many of the standard sets now in use. The neutrodyne, for example, overcomes this difficulty, by neutralizing the inherent capacity of the tube. By this means all the advantages of radio frequency amplification are realized and distant reception is easily obtained.

Importance of Selectivity

ON the other hand, this radio frequency amplification of the neutrodyne would be of little value if the set were not selective. The regenerative receiver, however, makes use of the feed-back method to gain amplification. It has the bad feature of radiation, which is one of the greatest troubles the broadcast listener has to contend with. Radiation from a nearby set will sometimes completely detune a receiver which is tuned to a distant station and will cause enough shrieks and howls to spoil a good program. This is not the fault of the regenerative set, but rather the carelessness of the person operating it, for it is quite possible to so adjust it that no radiation takes place.

Amplification by regeneration is caused by feeding back some of the amplified signal in the plate circuit to the grid. This builds up the strength of the signal and is really a method of amplification. When a signal strikes the grid, it is rectified and amplified in the usual way. A tuned plate circuit is employed and when part of the varying current in the plate circuit is fed back to the grid, the plate current is again varied. This in turn again increases the plate circuit current, which is again fed back to the grid. This process continues until the signal becomes stabilized and has the effect of prolonging and building up the signal. The time required for all of this building up is so short that it does not in any way distort the signal.

There are many types of regenerative circuits on the market today, but they all work on the same basic principle.

But many of them are better than others, due to the fact that different types of inductances are used, and varying methods of coupling the circuits. A loose coupling between the primary and secondary circuits will always give much better selectivity than a tight one. A fair example of this is seen in the ultra-audion receiver. Here there are many variations. Sometimes the tuning inductance consists of a variometer which is connected in series with a variable condenser. Both the inductance and the condenser are variable. The same circuit is often used with a fixed inductance and a variable condenser. Either of these work very well, but naturally a closer adjustment may be made if both the inductance and the capacity are adjustable.

Loses Its Selectivity

THIS type of receiver is known to have a long range, but because of the direct coupling between the primary and secondary circuits, it loses much of its selectivity. By using a single inductance in the aerial circuit, and placing it near the variometer so as to afford an inductive coupling, it still retains its long range and the selectivity is greatly increased. The super-heterodyne is well known for long range and selectivity. In this arrangement another bad feature of radio frequency amplification is overcome. This is the tendency of such transformers to work at their greatest efficiency at one certain frequency and the dropping off of this efficiency as the frequency varies from their natural frequency. In this set, a local oscillator is used, which sets up oscillations of nearly the same frequency as that of the incoming wave, causing a beat frequency which is the result of the two, to pass through the radio frequency transformers. As the local oscillator is under the control of the operator, this beat frequency may be made the same in any case, regardless of the frequency of the incoming wave, making it possible to always work the transformers at their natural frequency, regardless of what the frequency of the incoming wave may be. Thus the set is always working at its greatest efficiency and even the most feeble wave may be picked up and amplified to great volume.

The reflex set is peculiar in that it will produce more amplification with less tubes. This is done by making some of the tubes do double duty. After the radio frequency tubes have amplified the signal and it has passed through the detector and reduced to audio frequency, it is again passed through the radio frequency tubes at audio frequency, thus operating them at both radio and audio frequency. This is not only a saving in the original cost of installation, but less battery is also required to operate the filaments than would be necessary in other types of receivers. Many different reflex circuits have been devised, but while they differ in the apparatus used, they all come back to the same basic principle.

Because of the many deviations from these basic circuits, there are hundreds of different sets for sale and it is no wonder

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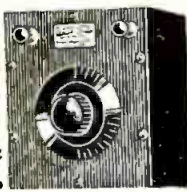
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Some of the Tricks Summer Static Plays

(Continued from page 24)

its atmosphere during that season. Unfortunately, no way of avoiding this difficulty is known today. The trans-oceanic radio stations have to be equipped with high power apparatus in order to work through the bad periods of the day and year, although at certain times of the year and day less power may be used, as evidenced by the successful trans-atlantic transmission by low power amateur stations.

For the sake of clearness, we have so far described the cause of fading signals as due to obstructions in the path of the radio waves. Actually, the radio clouds sometimes reflect the waves, much as a mirror does a light wave, and so very peculiar reception effects are sometimes noticed. Sometimes the signals are made stronger instead of weaker, sometimes they may be lost altogether, as the several effects of reflection and absorption combine.

And now, let us consider that arch enemy of radio—Old Man Static. When Marconi first began to receive messages over distances of a few miles, he noted, besides the signals he was listening for, noises which had nothing to do with the signals, and every receiving operator since that time has heard those same disturbing and interfering noises.

These noises have been called strays, or atmospherics, or static, and the elimination of them is the most important problem in radio communication today. There are at least two or three kinds of static, but the most troublesome kind is the one which is due to traveling electric waves, in nature just like radio waves, and caused by electrical disturbances somewhere in space.

A LIGHTNING flash produces a traveling electric wave, much like a radio wave, and if we can assume that lightning flashes, large and small, are occurring continuously somewhere, we have a reasonable explanation of static.

We know that static is worse in the Summer when variations in the atmosphere are greater and more frequent. Also, it is often observed in the Wintertime that the formation of snow causes static.

Without knowing definitely the origin of this disturbance, it seems safe to assume that the actions which take place in our atmosphere, due to the air, the sun, sun spots, water vapor, etc., are responsible for the creation of these irregular, irresponsible and very troublesome waves which we call static. Since they are so much like the radio waves in nature, no way has yet been found of eliminating them completely.

Progress has been made in the last few years, however, and the trans-oceanic stations are much more free of this interference than formerly. The problem of complete elimination of static is the most difficult one in radio, and if solved, we shall have a new epoch in radio because the power of transmitting stations can be greatly reduced and the reliability of communication increased.

The Radio Spies

(Continued from page 51)

such a position, to secure certain private papers, papers and specifications and other papers of the De Forest Company and deliver the same to him. She declined to take the position."

Sylvester W. Crowley, manager of the audio division of the De Forest Radio Company, said he employed Cecelia Lambert, mentioned in the Bowlby and Jennings affidavits. She was discharged April 16, 1925, "because it was discovered that she was employed by the Radio Corporation of America, paid a salary by them and was making reports of complainant's business secrets to that company."

Crowley says he was present on April 16, 1925, when Miss Lambert admitted having furnished confidential reports to Harley, who assigned her to work for various concerns, receiving wages from her employer as well as salary and expenses from Harley.

Mr. Luce, President of the De Forest Company, says that for eleven years his concern has been making, leasing and selling radio receiving apparatus and audio tubes. For several years the defendant has been carrying on the same business with the possible exception of manufacturing, he declares. While he has no definite information regarding the defendant's manufacturing business, he says that as a result of agreements between the defendant, the General Electric Company and the Westinghouse Electric and Manufacturing Company the defendant was required to buy part of what it sells from each company. These three companies, with the American Telephone and Telegraph Company have licensed each other under various patents. He adds, "the legality of this combination has been challenged by the Federal Trade Commission and is now under judicial investigation by it."

The temporary injunction, obtained by the De Forest Radio Company from Vice Chancellor John H. Backes of New Jersey, directs the Radio Corporation to appear in Chancery Chambers, Newark, on May 12, to show cause why a permanent injunction restraining it from obtaining information secretly from the De Forest plant should not be issued.

A recent issue of the Radio Guide publishes a full page editorial on the situation as outlined above. One paragraph from this editorial follows:

"Never in its palmiest days of throttling and cut-throat competition did the old Standard Oil Company of New Jersey, the original octopus, undertake anything as dastardly, as contemptibly criminal, as the "dirty work" which the Radio Corporation, already cited in a government antimonopoly suit, is now accused of."

Vacuum Tubes and How They Distort

(Continued from page 18)

grid increases, you will find that the line is not straight, but becomes steeper over quite a range, there being a definite curvature (See Fig. 1). Such a line or curve is spoken of as the plate current-grid voltage characteristic of the tube and circuit. The more nearly straight it is, the more faithfully does it repeat the impulses put on the grid; i. e., the less distortion does it introduce. This is a condition to be desired, then. However, the tube is to be used as an amplifier.

The curvature of the characteristic depends on the design of the tube, and in any given tube may be emphasized by the circuit with which it is associated.

Suppose we have a tube circuit which has curvature and we impress on the grid two electric currents of different frequencies. It can then be shown theoretically and is found experimentally that there are present in the plate circuit currents of the original frequencies and also currents of frequencies equal to the sum and equal to the difference of these frequencies. In other words, the

resultant current is not a faithful reproduction of the original impulses, but shows some distortion.

This is a very useful thing, as may be seen if we apply the principle to a broadcasting station. Suppose, for example, that we combine in a tube circuit the radio frequency of one million cycles with a musical frequency of one thousand. Then, in accordance with what was said above, we would have set up in the plate circuit the original frequencies and the sum and difference frequencies; i. e. we would have in the plate circuit frequencies of 1000; 1,000,000; 1,000,000 plus 1000 and 1,000,000 minus 1000. The first of these is of too low frequency to affect the radiating antenna of the station, but the other three, being of suitable high frequency, would be radiated. It is these three waves of slightly different frequency which would travel out to your receiving set. The middle one of these, one million, is called the carrier wave and the others may be called the upper and the lower side waves. The three together constitute the modulated wave; i. e. the wave on which has been impressed the message which is to be transmitted. The side waves or frequencies are the important ones, and it should be noted that they were not originally present, but were brought in only by the distorting effect of the tube. The mixture of the original frequencies is a very intimate one. It is more than a mere addition of the two, but a scrambling of the two.

LET us now go to the receiving set where these waves are picked up. They finally reach a vacuum tube. If this tube shows no curvature or distortion, it will merely repeat the high frequency waves which arrived, but these, in that form, are of no use, for they are inaudible. What is desired is a message of the same as the original frequency; i. e. *one thousand*. Obviously it is going to take something radical to get this from three frequencies, each at or in the neighborhood of *one million*. Suppose, however, the tube and its circuit has distortion then by the same principle as given before; there will appear in the plate circuit currents which are the same as the three high frequencies and in addition there will be all the possible combinations of sum and difference frequencies. If you will set these down yourself, as can be easily done, you will find quite an array; in fact, there will be twelve of them in the simplest case. Most of these will not be of use, but you will find two which are of the frequency 1000, the original signal frequency. They represent the difference between the carrier of 1,000,000 and the side waves of 1,000,000 plus 1000 and 1,000,000 minus 1000.

Thus we see that it is as a result of its distorting characteristic that a tube can first modulate a carrier frequency with a message frequency; i. e. "scramble" the two together so that one carries the other, and then at the receiving station "unscramble" them and give us the original message.

Haynes-Griffin

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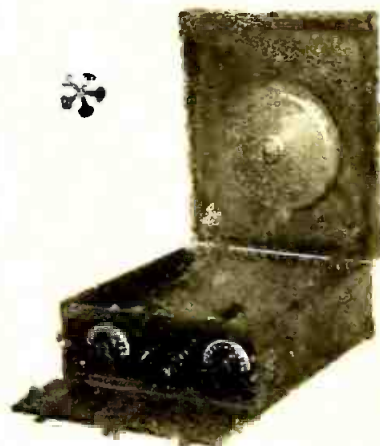
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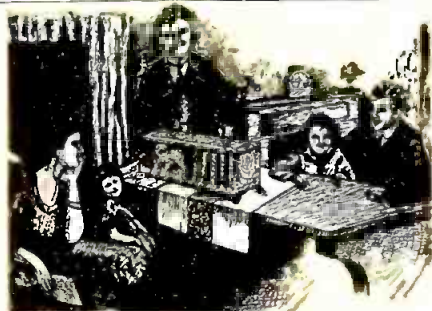
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Wherein One of Horatio Alger's Plots Comes True

By R. H. Hopkins

THE proper way to tell about McMurdo Silver would no doubt be to say "Once Upon a Time," or, to become somewhat more modern, we might head the dissertation "From Nothing to Something," or one might even resort to the time-honored, and (we hope) buried, style of Horatio Alger.

But none of these styles seems to fit properly, so we will confine ourselves (not the regal, but the editorial "we") to a plain statement of facts concerning the not altogether uneventful life of a young man badly bitten with the radio bug, who at the age of 22 is the president of a prominent radio concern and whose name is more than well known to many thousands of radio fans.

Born in a small college town in western New York, the son of a college professor, his early years were spent uneventfully in causing his fond parents just a little bit more than the usual amount of consternation, for at a very early age his thoughts turned to things mechanical. The result was no more than could be expected. Many peculiar and supposedly original contrivances made their appearance, most of them designed to provide a hearty and stimulating welcome for the college students who called upon his father in search of wisdom.

Frequently the searchers were discouraged, but it is interesting to perceive that these and sundry other arrangements most frequently resulted in the acquisition of wisdom.

Radio first entered McMurdo Silver's consciousness early in 1912. Someone, desiring to keep the young hopeful's mind well abreast of the times, read him an account of "Wireless Telegraphy" and how it enabled ships at sea to keep in unbroken touch with the world while they were out upon the bosom of the bounding brine.

At the same time an account was also read, with true relevance, of the Mexican Rurales, a troop of mounted police recruited from criminals by the simple and masterly expedient of catching one, putting a rope around his neck, placing him upon a horse all ready to be gently stroked with a whip, and asking the individual so situated if he wished to become a Rurale, or if he preferred to dismount from his steed post-haste and remain in the unenviable position of hanging by his neck to a nice tree limb, separated from it by several feet of rope, and from the ground by several more feet. The answer, unless choked off by the culprit's emotion, or

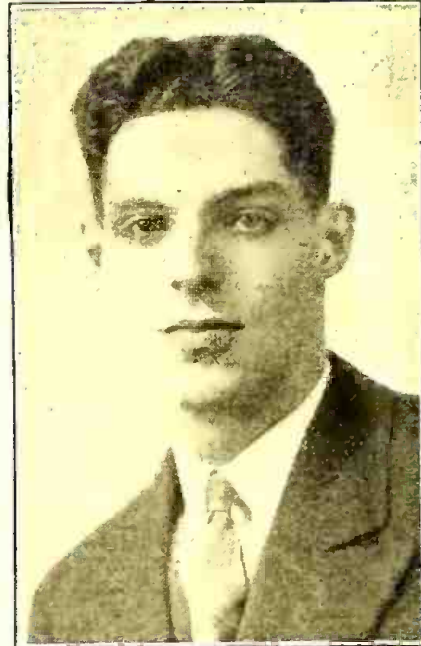
the executioner's desire for a negative reply, was invariably "yes."

Practice Makes Perfect

STRANGE as it may seem, these two bits of instruction stuck firmly in the young man's mind. The next day the cook, called to the back yard of the family residence by unearthly yells, beheld a strange sight. Sitting astride a saw-horse was a young Mexican boy hurriedly conscripted for the part of the convict.

His hands were tightly tied, and a very heavy rope, almost thicker than his pudgy arms, connected his unwilling neck with the limb of a small tree directly above him. He was calling loudly upon all the saints known to him in a somewhat unintelligible imitation of Spanish. Next to him stood one of the "Silver Gang," asking loudly and repeatedly whether he "joined or died." The executioner, in anticipation of the reply, held the nozzle of a length of garden hose in his hand.

Some distance away, in the wash-boiler, stood the instigator of this new game, holding the other end of the hose



McMurdo Silver

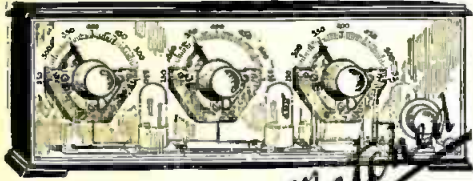
in one hand, while in the other was another piece of hose which reached back to the gibbet and terminated in the grimy grip of the assistant executioner. As the victim's cries were uttered, the executioner shouted them into one hose, through which they were presumably transmitted to the ship at sea, simulated by the wash-boiler. From there, through the other hose, the verdict was again shouted in a high falsetto to the assistant executioner, who in turn put the all-important question to the prisoner.

In this way, wisdom was assimilated by the analytical mind of the young; communication with ships could only be through rubber hose, since one couldn't shout several thousand miles. And to use "wireless telegraphy" one had to have a reason, which was opportunely provided by the recalcitrant son of a Mexican villager, who might even yet be reclaimed to the cause of the law by strong-rope methods and the marvels of radio.

Thus was the youth of this young man spent, alternating between the heights of the Sierras and the ordered calm of a college town, the main street of which was shaded by towering elms almost as drowsy as the village itself. But this was not for long, and the association of garden hose and radio having been demolished along with other illusions, the big city claimed our subject. There, more strenuous pastimes being taboo, radio was taken up with renewed vigor, and a posi-

(Turn to page 72)

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Underground Radio from Coast to Coast

By **JAMES E. SMITH**
President of National Radio Institute

Dr. James Harris Rogers, whose achievements with underground transmission are far famed, has climaxed all his tests by sending radio waves from Hyattsville, Md., to Los Angeles, Calif., a distance of 3,000 miles. Signals at Los Angeles, according to the report, "were coming in finely with little fading."

This record eclipses all previous underground records (these also having been set by Dr. Rogers' experiments), and opens the way, according to many leading scientists, to an immeasurable development and improvement in methods of radio transmission.

This achievement of coast to coast transmission through the ground crowns with success an undertaking which was first brought forward and attempted by Dr. Rogers in 1908. It overthrows the dicta of men no less eminent than Marconi, who scoffed at the proposal to radiate waves through the earth's crust.

As a direct result of Dr. Rogers' latest accomplishment, it is now possible that the broadcasting tower, the expensive aerial extending sometimes 400 to 600 feet in the air, may become in the near future as obsolete and unnecessary as cable connections between stations. The "aerial" will simply be taken out and buried.

The "aerial" which Dr. Rogers uses consists simply of 4 copper cables fifty feet long, extending toward the four points of the compass. Copper tubing, 3-4" in diameter, is laid inside eighteen inch terra cotta pipe, insulated and supported throughout by glass rods. The pipe is buried 3 feet underground outside the Rogers Research Laboratory at Hyattsville.

Through it the waves are radiated into the crust of the earth, and carried through the ground—without atmospheric disturbance, without diminishing in strength through the 24 hours of the day.

The earth's crust is the most efficient medium for radio waves, Dr. Rogers claims, and he believes his experiments now have disproved the Heaviside theory.

"Radio waves transmitted through the atmosphere," says Dr. Rogers, "obey the laws of light—that is, travel in a straight direction—and these atmospheric waves are thus dissipated, not being reflected by the Heaviside mirror. The earth crust to a much greater extent retains the waves, and less power is required to transmit great distances."

During the war Dr. Rogers developed and placed at the service of the Government, applications of his theory which made possible communication not only between submarine and submarine, but also between submarine and shore. His private station at Hyattsville, using his own "underground," was pressed into secret service by the officials of the Government, and received messages clearly and strongly when the great station at Arlington was hopelessly deafened by static.

Should the day ever come when a few hundred feet of buried wire will supplant and replace the towering and costly aerials which now identify the radio station, all the laurels will be on the brow of this modest, indefatigable man of science, of whose sixty-odd patents surely none can be of more far-reaching importance than this discovery which brings the signals "in finely, at 4 in the afternoon"—across the continent!



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Corrected List of Broadcasting Stations

Table listing broadcasting stations with call letters, station names, and locations. Includes stations like KDKA, KDLR, KDFM, etc., across various states and territories.

Another Broadcasting Boom Opens

INSTEAD of quieting down for the Summer months, interest in radio broadcasting is reported as increasing by many exponents of this art. At least prospective broadcasting station owners are showing more activity than ever before, Department of Commerce records indicate. Although there are 566 stations on the air today, utilizing every available broadcast wavelength, there are at least twenty applicants for class B broadcast privileges and about a hundred individuals or organizations are said to be seeking licenses for class A operation. Not all these stations have made formal application to the Department of Commerce, however. This is not a requirement and is seldom the usual method of procedure. Ordinarily, a prospective broadcaster first leases a site, then buys expensive equipment and set it up before he asks the Department if there is a vacant air channel for him. No shipping company would buy its boats and equipment before it found out if it could get a route and a license to do business; neither would an auto bus line, but in this new game of broadcasting, some of the more practical essentials and necessary requirements seem to be neglected to the cost of the would-be radio-phone station operators.

Some citizens now seem to realize that there is no more room for Class B, high-power, stations, but the congestion among the smaller class A stations, in consequence of the few channels assigned to them, is worse. There are 468 stations now, 54 of them operating on 500 watts, the maximum power allotted to this class and there are dozens of them on the same wavelength. As the power increases, and there is rumor that many A's will be permitted to go up in power this Summer in an effort to overcome static, the situation becomes worse, from a reception point of view. With increased power, they cover more territory and therefore interfere with more stations, just as the higher-powered B stations do, even when there are but two or three to a wavelength. In the low A wave band of 226 meters for example, there are six-teen stations now operating.

There is no record kept of proposed stations until formal applications are filed with the district radio supervisor, but from one western supervisor comes the statement that there are 32 stations in California alone planning to ask for broadcasting licenses as soon as their stations are completed. This official can not possibly satisfy more than ten or a dozen of his prospective customers, many of whom are understood to have already bought or ordered their equipment, despite the reiterated statement that the broadcasting lanes through the ether are all crowded, and rights of way are no longer available except in some of the still "open spaces."

The fans seem to take the view that there are enough broadcasters now, and that no more should be permitted to come on the air unless they can guarantee unique programs. This, however, is just

what each potential radio entertainer is glad to assert, believing that he is telling the truth. Probably some of them could introduce new stars, but there are plenty as it is. They soon find that the field is pretty well covered by the 566 stations, which are all experienced and have their own talent well lined up and trained, not to mention a large following of regular fans. Every one of these stations in operation is trying its best to learn what the listeners want and to give it to them; many stations which failed so to do, have fallen by the wayside, their experiments constituting a considerable financial loss.

Some organizations believe they could serve a special group in the great radio audience not now furnished with what they desire. In a few instances this is true, particularly as some religious orders are not on the air in certain sections.

All Europe, it is pointed out, has not so many broadcasting stations as there are in the United States alone. When the question of international broadcasting comes up at the Paris or Washington conference, it may be that we shall have to release some of our much desired and used radio channels for inter-continental use, it will be pointed out, and rightly so, that we have no more right to the 205-545 meter band than other countries, and that we should share the wave lengths. If this is the case, the situation will become worse unless a number of our stations drop out of the game.

The increase in numbers, however, is continuing gradually; in April twenty-four stations, mostly smaller ones, ceased to broadcast, but twenty-seven new ones opened, increasing the total on the air May 1, by three over the figure on March 1st.

Russo and Fiorito Open WIBO

STATION WIBO came on the air last month, in Chicago. Harry Geise, Director and Announcer, promises the radio audience several new and novel surprises and features, and with the assistance of Dan Russo and Ted Fiorito, who have already gained a multitude of radio friends, will endeavor to please the radio audience with the best programs obtainable.



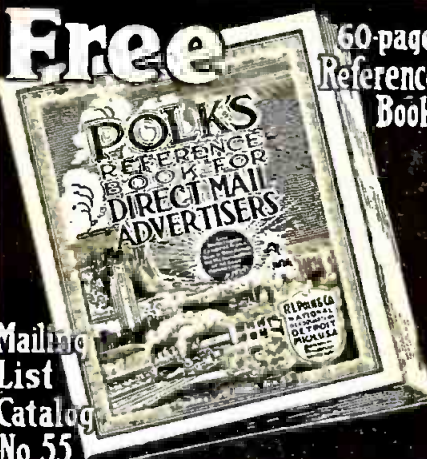
Harry Geise

Dan and Ted, co-conductors of the Oriole Orchestra, formerly playing at the Edgewater Beach Hotel, and Harry Geise, known as the "How-Do-You-Do Man," are on the air each night to answer requests. WIBO is located at 6310 Broadway, Chicago, the studio and reception room on the second floor, and the operating room on the third floor. The studio is equipped with Celotex walls, designed in rather a unique manner, handsomely furnished, with perfect acoustics for broadcasting. The eighty-foot towers are completed and Philip I. Latin, Chief Engineer, is working every effort to assure the public of successful broadcasting from this station.

* Tested and Approved by RADIO AGE *

60-page Reference Book

Free



POLK'S REFERENCE BOOK FOR DIRECT MAIL ADVERTISERS

Mailing List Catalog No. 55

POLK'S REFERENCE BOOK FOR DIRECT MAIL ADVERTISERS

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

Write for your FREE copy.

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

Get Cuba or Mexico City

While Big Local Stations Are Broadcasting, The New York Evening World got 46 stations in One Evening including Dallas, Los Angeles, and Porto Rico; while testing the wonderful sensitivity of the

New in Principle—New in Design

WERNER Radio Frequency TRANSFORMERS For All Circuits

Insist on getting them, if your dealer can't supply you, send your order to us.

Price \$4.00, All Types

Send for Diagrams

A wonderful interesting book "Radio Frequency Amplification" contains popular and technical information with many up-to-date R. F. circuit diagrams of greatest interest to both radio user and engineer.

25c postpaid

R. Werner Radio Mfg. Co.
204-206 Ninth St. Brooklyn, N. Y.

BAKELITE

Insulated condensers give lasting satisfaction. Write for booklet 31.



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

MARSHALL Radio Frequency Receivers

Embodying a marvelous New Non-Oscillating Principle
Sold Direct on Free Trial and Easy Terms
Write for catalog and Special Offer
Marshall Radio Products, Inc.
Dept. B-589 Marshall Blvd. & 19th St. Chicago

Advertising Takes Its Place In Radio Programs

WASHINGTON:—That advertising is insidiously creeping into broadcast programs and that radio "entertainment" will eventually become "thinly veiled publicity," is charged by some of the leading exponents of radio and advertising.

We have all heard what are virtually publicity talks on coffee, candy, flour, chewing gum and other commodities, through the air, and also enjoyed entertainment by playing-card quartettes, automobile-tire orchestras, safety razor and grocery store musicians. The butcher, the baker, the candlestick maker and the whole of industry has been broadcasting of late. What is it coming to?

The question "whether advertisers should pay for broadcasting" is causing concern among the broadcasters and national advertisers, as well as the radio industry itself, but since it will be up to the fans to decide eventually, a brief of a survey recently made by Albert E. Haase follows:

Radio and Business

"The radio industry is discovering that good broadcasting means good business, and extraordinary broadcasting, extraordinary business," Mr. Haase points out. "Conversely, poor broadcasting means poor business. Many who are in the industry realize that if the mad rush to get the advertisers' dollar for the support of radio continues, radio itself will suffer. Today, advertising agencies are offered 15% commission by a number of broadcasting stations for business. One salesman has secured the advertising rights from fifteen stations.

"On the other hand, stations which do not sell space on the air are besieged by publicity men who seek to talk on certain business and collect from the manufacturers.

"Overdoing advertising, will kill radio and at the same time hurt advertising, a representative of the Colgate Co., is quoted as saying. The whole problem of radio advertising is being studied by the Association of Advertising Agencies, which already has decided that the present methods of radio advertising are not agreeable nor desirable to fans, and that the unwise use of radio advertising will be bad for all advertising."

So far the American Tel. & Tel. Co., through WEAF and a chain of interconnected stations, appears to be the main channel for radio advertising. The charges according to Mr. Haase, vary from \$25 a minute for talks, and \$250 a half hour for entertainment, from one station, up to \$1,600 an hour for entertainment distributed through seven stations. The advertisers, of course, furnish all the talent. Circulation is part of sales talks, but figures are naturally only estimates. These rates are not guaranteed as fixed, but may be increased, unless

the Interstate Commerce Commission should take a hand, claiming that telephone lines are a public utility or that connecting lines are between states.

Statements from a number of the representative manufacturers show that there is no unanimity of opinion against paid radio advertising, but they all believe in good broadcasting.

Lee DeForest believes that as more concerns take up radio advertising, their programs become less interesting to the public, that advertising is insidious and becoming more flagrant; and he asserts that he has actually become prejudiced against several of the broadcasters' products. He looks forward to a time when the great majority of programs will be for "thinly veiled advertising purposes."

Secretary Hoover is opposed to censorship, but through the radio conferences it has been made known that "indirect advertising" only is permitted via broadcasts by The Department of Commerce. However, Mr. Haase sees possible Governmental intervention and ultimately a decision from receiving set owners.

Views of concerns which have tried paid advertising are interesting. The Eveready entertainers, considered unique by many, actually pay the National Carbon Co., in good will. One day 3,000 letters came in, according to J. R. Crawford of that company. But he does not think radio advertising, even indirect, would pay all types of manufacturers, except experimentally.

As a contrast, Stuart Peabody of the Borden Milk Co., claims that two broadcasting trials failed to bring adequate responses. The Macy Co. failed to derive substantial benefits from broadcasting. But Nat Lewis, owner of two gift and haberdashery shops, found fashion talks via radio, which he calls "publicity," better than some other forms of advertising. He received 5,000 letters following one talk.

Officials of the United Retail Candy Stores, backers of the "Happiness Boys," say after fifteen months of broadcasting entertainment stunts, that they feel it is "publicity" rather than "advertising," which they use simultaneously.

The Fisher Co., Astor Coffee manufacturers, continue radio programs after fifteen months' trial, having received over 100,000 communications from all parts of the country.

Through co-operation with the A. T. & T. Co., the Victor Talking Machine Co. is said not to pay for space, when its stars sing and play. It is studying the results, however, and will soon report on broadcasting. Advertising experts feel that radio has a time limit and that its circulation is uncertain, compared to other mediums; they believe it is probably an accessory.

* Tested and Approved by RADIO AGE *

FREE!

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

12-Cell — 24-Volt Storage 'B' Battery

Positively given free with each purchase of a WORLD "A" Storage Battery. You must send this ad with your order.

WORLD Batteries are famous for their guaranteed quality and service. Backed by years of successful manufacture and thousands of satisfied users. Equipped with Solid Rubber Case, an insurance against acid and leakage. You save 50 per cent and get a **2-Year Guarantee**

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

Solid Rubber Case Radio Batteries	
6-Volt, 100-Amperes	\$11.25
6-Volt, 120-Amperes	13.25
6-Volt, 140-Amperes	14.00
Solid Rubber Case Auto Batteries	
6-Volt, 11-Plate	\$11.25
6-Volt, 13-Plate	13.25
12-Volt, 7-Plate	16.00

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

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

World For **AUTO** and **STORAGE BATTERIES** **RADIO**

The Five Tube Set which startled the World!

FRESHMAN MASTERPIECE

The Greatest Value Ever Offered in A Radio Receiving Set

At Authorized Dealers

PWX

is easy to get with the right kind of set. Profits are easy to get with the right kind of goods. Dealers write for facts.

HUDSON-ROSS—116 S. Wells St. Chicago

A 62-page Blueprint Section in the August **RADIO AGE**

WITH THE MANUFACTURERS



Dry Cell Tests Held for First Time

ON May 10, from the Great Lakes Naval Training Station, Great Lakes, Ill., the first tests in history were made from an airplane in flight, using the new 37 meter radio transmitter and receiver operated by dry cells only.

Heretofore, all airplane radio equipment has had its source of power from a small generator which was driven through a fan-shaped propeller by the force of the wind. In other words, when the engine and the airplane were out of commission—so was the radio. This new transmitter which is being tested is the first of its kind and is one of the transmitters which will be used by the MacMillan Polar Expedition which sails from Boston, Bunker Hill Day, June 17, under the auspices of the National Geographic Society.

The value of this type of equipment can be immediately realized when it is remembered that the airplanes that are to accompany the MacMillan Expedition manned by U. S. Navy personnel, under the command of Commander R. E. Byrd, U. S. N., will fly over that great unexplored area lying between Point Barrow and the North Pole, in quest of new land. Should a landing be forced, this type of apparatus, if efficient, will be able to communicate after the airplane itself is out of commission, and the flyers will be able to call for help from the planes held in reserve back at the advance base of Axel Heiberg Land.

The Zenith Radio Laboratory announced that the tests made at Great Lakes Naval Training Station on 37 meters were not satisfactory, as the greatest distances at which they were heard were Newton, Iowa, and Minneapolis. Failure to reach greater distances is attributed to the fact that the amateurs of the United States were not properly advised of the time at which these tests would take place.

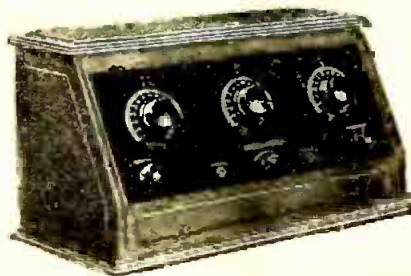
Campaign for Jewett

E. H. WILKINSON and T. F. W. Meyer, General Manager and General Sales Manager, respectively, for the Jewett Radio and Phonograph Co., Pontiac, Michigan, have returned to the factory after an extended trip through the East putting the finishing touches on the new distributors' and dealers' franchise plan in that territory which has been under way for several months.

The Jewett slogan, "Fair prices, rigidly maintained" must be very strictly adhered to under this new system, because every dealer handling Jewett products throughout the country must

Stewart-Warner Radio, Model 305

The Stewart-Warner Speedometer Corporation, 1826 Diversey Parkway, Chicago has placed on the market a complete ensemble of matched radio units. This ensemble consists of the line of Stewart-Warner Radio Instruments; the Stewart-Warner Reproducer especially built to give perfect harmony with Stewart-Warner Instruments; Stewart-Warner Radio Tubes, designed to give beautiful tone quality; Batteries, Aerial and Ground Equipment.



The Stewart-Warner Instrument shown is Model 305—a five tube set in which is incorporated the U. S. Navy Circuit. There are three tuning controls, mounted on a sloping front panel. The cabinet is finished in dark walnut.

In this instrument, the special Navy tuned radio frequency circuit has been developed to a high stage of perfection, and the set is especially suited to operation by men or women without technical knowledge or training.

The Stewart-Warner Reproducer is built by the Stewart-Warner Speedometer Corporation of Chicago, especially for use with Stewart-Warner Radio Instruments. This Reproducer is so designed and constructed that it covers the entire musical scale with full, rich tone volume and without distortion or scratching noises. The horn is made from fibre by special process and is vulcanized on its outer surface. The core of the horn is allowed to remain soft which absolutely prevents the horn from vibrating at any note.

The Stewart-Warner Reproducer is finished in a dark walnut, leather-like surface, and stands on a metal base which is deep green with gold-bronze highlighting. This Reproducer harmonizes perfectly with the walnut cabinet work of Stewart-Warner Radio Instruments.

come well recommended as to their stability by a Jewett Distributor, or one of the factory district representatives in the field, it is announced.

The dealer will be benefited in this same respect by knowing that his customer cannot buy a Jewett product from any but another authorized dealer who is holding to the standard Jewett prices.

Freshman Announces New Sales Policy

The Chas. Freshman Co., Inc. of New York has just announced its sales policy for the coming season. This concern, manufacturers of the line of Freshman Masterpiece Receiving Sets, has decided to eliminate the jobber and distributor in the sale of their products. Freshman Masterpiece Sets will be sold to Authorized Freshman Dealers, carefully selected, and granted an exclusive franchise in their territory. In towns of approximately 25,000 and under, one representative dealer will be appointed to exclusively handle the line, and in larger cities, additional dealers will be granted franchises in proportion to the population and trading area. A staff of salesmen is now at work signing up dealers to the Freshman Masterpiece Contract, which assures dealers of absolute protection, as far as stability of prices is concerned; also, all business from each individual dealers' territory will be credited to him. In this way, the appointed dealers will be practically direct factory representatives of Freshman.

The Freshman Company enjoyed remarkable success with their one model, the original Freshman Masterpiece, during the last year. The fact that with one model, priced at \$60.00, over 125,000 sets were sold from July 1924 until February 1925, speaks highly for the tremendous hold this product has taken with the radio public. With the realization that the trend in radio buying is leaning strongly towards furniture effects, the company has placed a complete line of Freshman Masterpiece Receivers on the market, ranging in price from a Five Tube Radio Frequency Set, in a massive cabinet with sloping panel at \$39.50, up to the Franklin Console, a dignified piece of furniture of vigorous lines and fine proportions, made entirely of genuine solid mahogany by the manufacturers of the highest class talking machine Company in the world at \$115. The Franklin Console is composed of two separate and distinct units, one of which is a receiving set with built-in loud speaker, and the other the console for batteries and accessories—everything being concealed.

New "Hercules" Masts

S. W. HULL & Company, 2048 East S. 79th St., Cleveland, Ohio, announce a new series of "Hercules" Aerial Mast. These masts are made in three standard lengths, 20 ft., 40 ft., and 60 ft., all steel construction.

All masts are made of a special angle construction that gives great strength and light weight, thus making a rugged mast easily erected, at the same time presenting a pleasing appearance by its graceful lines. (Turn to page 72)

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 August issue must be sent in by July 1.

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.

"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 OPPORTUNITY

MR. MANUFACTURER: Would you be interested in a national advertising campaign to reach more than two million prospective buyers of quality radio products—each week? Do you want to establish agencies in new territory and create national interest in your product—at a very conservative cost? It can be done. Let us explain our system without obligation to you. Drop a card to Radiograph Laboratories, 1234 Rosemont Ave., Chicago, Ill., Box 6.

CRYSTALS

TESTED CALENA CRYSTALS, 50c pound bulk. Buskett, Geologist, Joplin, Mo.

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.

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

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.

MAGAZINES

DREAMS. A magazine for all who dream. If you are interested in the subjects of science, sex, psychology, health, love and romance, you cannot afford to be without this magazine. Three dollars will bring this most fascinating monthly publication to your home for one year. M. B. Smith Publishing Co., 508 N. Dearborn St., Chicago, Ill.

MANUFACTURING FACILITIES

AN OLD AND WELL ESTABLISHED MANUFACTURING COMPANY IN THE MIDDLE WEST WITH LARGE WELL EQUIPPED PLANTS AND UNUSUAL FINANCIAL RESOURCES, DESIRING TO ENTER THE RADIO FIELD WILL CONSIDER THE MANUFACTURE AND SALE OF RADIO SETS OR DEVICES OF OUTSTANDING AND UNUSUAL MERIT ON A ROYALTY BASIS. ADDRESS BOX 1A, RADIO AGE.

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 Bug! 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 Phisiformers, each \$5.50, book of instructions included. F. A. Mail, Triplii, Iowa.

FOR SALE—3 Pfanstiehl tuning units, 3 Cardwell Condensers, 1 Bradleyometer, 2 Bradleystats. All goods New. Earl Price, Lodi, Wis.

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.

Maybe an
Opportunity
awaits You in the
Radio Age Classified
Section

* Tested and Approved by RADIO AGE *

RADIO CIRCUITS

SPECIAL FOR JULY

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. Rositer-Manning Corporation, Dept. D, 1830 Wilson Ave., Chicago, Ill.

RADIO SUPPLIES

Ten per cent discount on all standard radio parts, from condensers to transformers to tubes, etc. Send for our latest price list, with special bargains on Static-eliminators, portable loud speakers, Radiotrons, German silver wire, etc. RADIOGRAPH LABORATORIES, 1234 Rosemont Ave., Dept. 4, Chicago, Ill.

STAMPS AND COINS

158 Genuine Foreign Stamps, Mexico War Issues, Venezuela, Salvador and India Service. Guatemala, China, etc., only 5c. Finest approval sheets, 50 to 60 per cent. Agents Wanted. Big 72-p. Lists Free. We Buy Stamps. Established 20 Years. Hussman Stamp Co., Dept. 152, St. Louis, Mo.

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, Hellbrook, 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.

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," Willie 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
August Radio Age?

THE RADIO AGE BUYERS' SERVICE

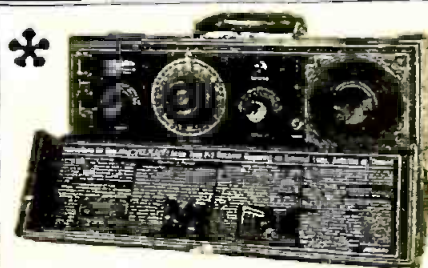
What do you want to purchase in the radio line? Let the staff of RADIO AGE save you time and money by sending in the coupon below. Enter the number of the article you would like to know more about in the spaces provided in the coupon.

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

WITH better and more powerful broadcasting—and with a sensitive, responsive Telomonic III receiver—the fascination of radio continues this year, regardless of the calendar.

Write to Danziger-Jones, Inc., Dept. C, 25 Waverly Place, New York, for booklet, "The Kit of a Thousand Possibilities." * * *

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The Famous Truly Portable TELMACO P-1 Receiver

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Dietzen, Inc., Dept. A5 71 Cortlandt St., N.Y.C.

The August number will be known as "A ROUND-UP OF RADIO," and, among other features, will contain a 62-page blueprint section.

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 Mfgs.' Rep. Manufacturer

Firm [If identified with Radio industry] _____

My Occupation _____

My Name _____

Address _____

City _____ State _____

Going Horatio Alger One Better

(Continued from page 62)

tion finally obtained in the tube laboratories of the Westinghouse Lamp Company. This was before the public ever saw even the old UV200 and UV201 tubes—when 199's were but a dream, and filament currents of one to two amperes were tolerated for receiving tubes.

From this Mr. Silver graduated to a large wholesale house where his alert mind quickly grasped the fundamentals of what was at that time the radio business of the booming early twenties. Then another change, this time to a concern which then consisted of but the chief and himself, but which soon grew to deserve the title of "New York's foremost radio shop," where he served as assistant to a prominent engineer, and contributed toward the design of what proved to be the first popular super-heterodyne receiver over offered for broadcast reception. Next, a trip to Paris, and meditation coupled with the salt sea air fired his never latent ambition.

"A New Era"

THUS, in the early summer of 1924, Chicago saw the retail store of silver-Marshall, Inc., with the erstwhile vigilante as its head. Events followed each other with a rapidity characteristic of the radio industry, and by fall the young concern marketed a line of products designed by Mr. Silver which met with instant favor. The old story was repeated—production could not catch up with demand, and winter saw Silver and his partner working shoulder to shoulder with the ever increasing force of the new growing concern. By spring the partners saw the rewards of their labors in the ever-extending business they had built up.

Mr. Silver is probably best known to the radio public as the designer of many pieces of radio equipment and a number of receiving circuits of exceptional merit, several of which have been described in this publication. In addition to his combination of business and engineering ability, his capacity for describing radio apparatus involving complex circuits in a manner so simple that the average layman can easily comprehend, is one seldom met with. His articles have appeared in practically every important radio publication and newspaper in this country.

Desiring to see the *genus homo* in his lair, we called upon Mr. Silver one day. We were ushered into the presence of a mere stripling seated at an unimposing desk, who, when he arose, proved to be over six feet. In the course of our getting several words in edgewise, telegrams flew out, apparently important matters were settled, and ideas evolved and rushed to the laboratory for immediate experiment.

From a shelf he selected one of a number of receivers, handed it to an assistant, and in an instant a volume of sound poured out of the loud speaker that was amazing, yet with perfect quality.

"What is it?" we asked. After a moment the answer came, briefly: "Just a six-tube super-heterodyne. I call it the 'Super-Autodyne,' because it uses an autodyne frequency changer."

"Autodyne frequency changers" not being in our vocabulary, we left after a few minutes conversation, impressed primarily with the sudden transition of the man from the capacity of executive to engineer and back again, and the sincerity, certainty and energy that seemed to pour forth with every word he uttered, either as president or engineer.

With the Manufacturers

(Continued from page 69)

Loop Set Preferable To Antenna, Says Priess

A RADIO statistician recently conducted a research among radio merchants and learned that approximately 53% of persons who enter stores to buy radio receivers indicate a preference for loop sets.

William H. Priess, a well known engineer and president of the Priess Radio Corporation, whose work for a number of years has been exclusively identified with loop reception, is naturally one of its strongest proponents. The percentage of favor toward the loop which the statistician's research showed did not surprise him.

"A loop set has a number of advantages," he said. "The set can be installed quickly and moved to various locations without entailing the services of a steeple-jack. It is the ideal set to take in the car on a day's outing or to the country on a week-end. It can be installed in places where the connection of antennae is forbidden or impossible.

"In addition to its inherent mobility, the loop receiver has the remarkable property of directional reception and freedom from certain types of 'static' disturbance. Two interfering signals of approximately the same strength and wavelength but coming from different directions cannot be separated by the ordinary antenna set. With the loop receiver, however, this separation can be made complete by turning the loop so that one of the stations disappears, and tuning in sharply on the other station.

"With the right set and the right loop, satisfaction over the antenna set is certain."

Gain in Squeals Very Small, Says Expert

THE GAIN in radio reception by making the single circuit receiving set oscillate and thus set up a discordant howl in all the other receiving sets in the neighborhood, is so very small that it does not begin to compensate for the added annoyance, L. W. Chubb, Manager of the radio engineer staff, Westinghouse Electric & Manufacturing Company, points out.

The gain in reception through setting up oscillation, when receiving from a one kilowatt station, actually is a small fraction of one per cent. The electrical engineers have determined an infinitesimal gain in comparison with the loss caused in the sets of peoples within a radius of two or three miles who are listening in on the station.

The remedy for the interference caused by single circuit radio sets is not in prohibiting the sale of these sets, as advocated in some quarters, but in proper use of the sets, according to Mr. Chubb.

"The situation is somewhat analogous to use of the automobile," Mr. Chubb says. "On occasion the automobile has destroyed lives of passengers and pedestrians, or otherwise caused great suffering and distress. To stop this, we might outlaw the use of the automobile, but this would deprive millions of people of the enjoyment of a perfectly legitimate pastime, that of automobile riding; would

Fall Radio Season Now On, Is Claim

THE FALL radio season will commence in June, as far as manufacturers of radio apparatus are concerned, declared E. Alden, general sales manager for the Shaw Insulator Co., of Irvington-Newark, N. J. Mr. Alden based his conclusions on a trade survey which he recently completed from coast to coast, during which he learned from manufacturers in every section that the demand for radio apparatus by the buying public has caused the manufacturers to advance their time for production on new equipment to the month of June.

"Strange as it may seem," declared Mr. Alden, "the new date will have a favorable reaction on the trade and will be the means of allowing the manufacturers to more properly gauge the buying demand throughout the country. At the present time it is apparent that there will be many new advancements made in set and parts construction during the coming season.

"Notable among these will be a greater standard of development, together with refinements in general construction calculated to make radio equipment have a greater appeal to the public, and, incidentally, be the means of giving radio its rightful place in the ranks of the world's greatest medium for good entertainment and instruction.

"The entry of many new and substantial concerns into radio fields during the coming season will be one of the greatest means of stabilizing the industry. From present indications there will be a variety of manufacturers sound financially, and with progressive ideas in manufacturing in mind, which will have a stimulating tone for the entire industry and be the means of placing it on a more substantial basis than ever before in its history.

"Parts will be again popular factors during the coming season," declared Mr. Alden. "One of the leading dealers in this country with whom I talked during my recent trip declared that the parts end of his business has been holding up as good during the early Spring season as it did during the past Winter. The trend during the coming season will be in the direction of better merchandise, appealing prices, and merchandise, which is calculated to bring radio to higher levels in the public's buying and mind, and consistent with the great appeal that radio has heretofore generally enjoyed."

deny them the pleasure of their present frequent visits with relatives and friends in distant locations, would slow down business and in numerous ways would be a drawback. The ideal remedy for the losses caused by use of the automobile lies in bringing the individual to so drive his machine that the losses will be eliminated and the gains conserved.

"So it is with the single circuit radio receiving set. This type of set represents the most for the money that the individual can buy. This simple device using one or two small tubes and inexpensive dry cell batteries, gets strong signals from the broadcasting station and is capable of getting great distances."

Is The "ANNUAL" on your Summer List?

IF YOU intend to take a trip this Summer, you're surely going to keep in touch with Radio, either by bringing a set along or building one during the dull afternoons, from parts you can take with you.

AND how are you going to build this set or study up on radio for the big season that is bound to come in September?

The answer is simple. All you have to do is to invest ONE DOLLAR in a RADIO AGE ANNUAL for 1925, the world's most complete and authoritative hookup book, and take it with you, whether you go to Eagle River or the River of Doubt.

Let the ANNUAL for 1925 be your Radio Companion this Summer! It will tell you whatever you want to know in the radio line—from troubleshooting of the little faults that may develop far from home—to the actual construction of simple portable sets or elaborate multi-tubers.

GET THE ANNUAL NOW—and THEN go on your vacation! It will be your radio safeguard!



A Big Blueprint Section for your Dollar!

How many blueprints could you buy for a dollar if you started out to buy them, one by one? Very few, you'll admit. Yet in the RADIO AGE ANNUAL for 1925 you'll find sixteen full pages of blueprints in actual color, explaining concisely every important simple and complicated hookup developed during the past year! The 32-page blueprint section of the ANNUAL is worth many times the purchase price of the book alone. Order the ANNUAL NOW—for the limited first edition is rapidly being bought up by eager radio enthusiasts.

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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.

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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.
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A 3-tube set that easily receives KGO on the loud speaker from Ohio.

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AND MANY OTHER UP-TO-THE-MINUTE HOOKUPS AND ARTICLES.

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Between Alaska and the North Pole stretches an unexplored area one million square miles in extent—the last remaining “blind spot” on the face of the globe.

Over this vast area will fly, this summer, two great planes of the amphibian type, piloted by U.S. Navy air pilots and equipped with the most highly perfected scientific apparatus obtainable by the United States Government. This entire expedition, which has rightly been described as the greatest expedition of modern times, is under the direction of Commander Donald B. MacMillan.

The purpose of the expedition is the study and photographic charting of this unknown area—and—new tests in radio transmission and reception of unparalleled importance. The section to be explored has never been heard from by radio. Communication will of necessity be *day-light* communication, for in this area the days are six months long.

On an expedition representing so

great a risk, both in capital and human life, only the *best* in radio equipment can possibly command a place. Once more, therefore, MacMillan chooses ZENITH exclusively, both for his ships and for the two great planes flying across uncharted seas of ice.

Thus, while the world awaits reports from this greatest expedition of modern times, it is worth remembering that the only way these reports can possibly be transmitted is by Zenith radio.

Never in all your life, it is safe to say, will you require of a radio set such *outstanding* performance as MacMillan requires of ZENITH in the Arctic. But can you imagine greater satisfaction than to know that your receiving set can *deliver* such performance, any time it's called upon to do so?

Call this evening at your nearest ZENITH dealer, and ask him for a demonstration.

Zenith Radio Corporation
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Costs More—But Does More

THE complete Zenith line ranges in price from \$100 to \$475.

With either Zenith 3R or Zenith 4R, satisfactory reception over distances of 2,000 to 3,000 miles is readily accomplished, using any ordinary loud speaker. Models 3R and 4R licensed under Armstrong U. S. Patent No. 1,113,149. They are NON-RADIATING.

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SUPER-ZENITH X—Contains built-in, patented, Super-Zenith Duo-Loud Speakers (harmonically synchronized twin speakers and horns), designed to

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