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RADIO AGE

The Magazine of the Hour

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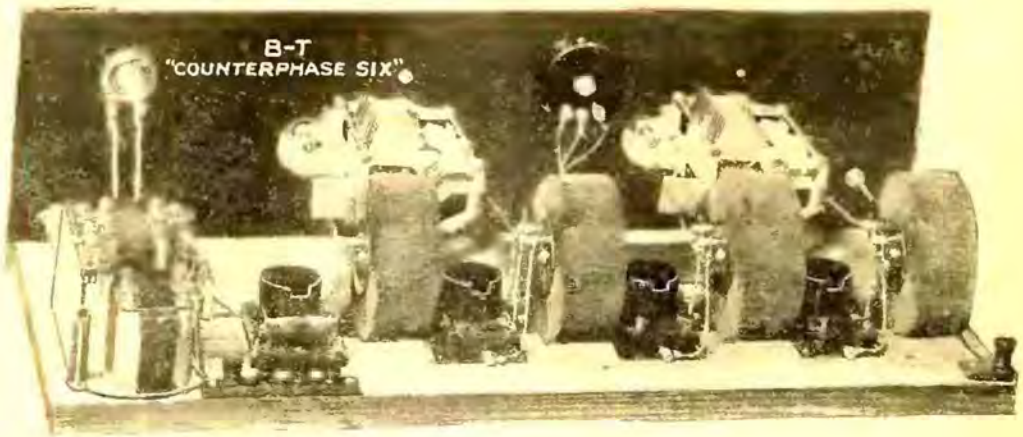

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RADIO AGE
The Magazine of the Hour
Established March, 1922
WITH WHICH IS COMBINED RADIO TOPICS

Volume 4 *September, 1925* *Number 9*

CONTENTS

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A Chat With the Editor

OUR readers gave us a surprise last month. They bought the August issue in such numbers that the stock held by dealers in many of the larger cities was practically exhausted a few days after the big blue print number went on sale.

It was a remarkable evidence of technical radio interest at a season of the year when that interest is presumed to be at its lowest point. Newsdealers, realizing that the early sales meant disappointment to those who might be a bit late in seeking their August number, wired, telephoned and wrote to our circulation office, asking for additional copies. Some of these orders were filled but the majority of them were not. It was too late to put the August forms back on the presses for an additional run, as that would have interfered with the preparation of the September book.

Therefore this magazine occupied the interesting and perhaps unique position of being one radio enterprise that could not fill its orders in the midst of the dog days.

We hereby express our regret to the newsdealers whom we were forced to disappoint. At the same time we believe it to be a good opportunity to say to our readers once more that the safest way to be sure of getting RADIO AGE is to subscribe for the magazine and have it delivered to your door each month.

This is not one of those left-handed advertisements. It is merely a statement of fact and, after last month's experience, we are confident it will carry conviction.

There will be a few unsold copies of the August issue returned from remote points. We have arranged to put them aside for the disappointed ones who may obtain them at the special price of 50 cents each. Stamps will do.

Frederick Smith

Editor Radio Age.

NEW! *Radically different!*

No. 486 Eveready Layerbilt "B" Battery. 45 volts. Length, 8 3/16 inches. Width, 4 7/16 inches. Height, 7 3/16 inches. Weight, 14¼ pounds. Price, $5.50.

It's all battery. With every cubic inch packed to capacity, it contains about 30 per cent more electricity-producing material. All chance of loose or broken connections avoided by contact of full area of carbon plate against zinc plate. The scientifically correct construction.

The greatest improvement ever made in "B" Batteries

ABSOLUTELY new in construction—perfected through years of research, the new Eveready Layerbilt "B" Battery is as superior to the old type "B" Battery as a tube set is to a crystal.

Heretofore, all dry "B" Batteries have been made up of cylindrical cells —no one knew how to make them any other way. The new Eveready Layerbilt is made of *flat* layers of current-producing elements compressed one against another, so that every cubic inch inside the battery case is completely filled with electricity-producing material. Layer-building heightens efficiency by increasing the area of zinc plate and the quantity of active chemicals to which the plate is exposed.

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On 4-tube sets, 16 mil drain, it lasts 35% longer.
On 5-tube sets, 20 mil drain, it lasts 38% longer.
On 6-tube sets, 24 mil drain, it lasts 41% longer.
On 8-tube sets, 30 mil drain, it lasts 52% longer.

The new Layerbilt principle is such an enormous stride forward in radio battery economy that we will bring out new sizes and numbers in this Layerbilt form as fast as new machinery is installed. For the present, only the extra-large 45-volt size will be available.

Buy this new Eveready Layerbilt No. 486 for heavy drain service. It far exceeds the performance for which Eveready Radio Batteries always have been famous and is, we believe, by far the most economical source of "B" current obtainable.

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RADIO EDITORIALS

THE radio public is growing wise in its modern day and generation. No longer is it possible for an imaginative individual to make a great stir by announcing that he has discovered that "they are working on something right now that is going to revolutionize radio." Set buyers, in the early years of broadcasting, were inclined to believe from the miraculous development of radio communication were to result other miracles. Rapid, revolutionary changes in the methods of transforming radio impulses into sound signals were promised by irresponsible individuals in 1921, in 1922, in 1923, in 1924 and occasionally even now we read or hear the well worn statement that new and marvelous things are soon to stun the public.

We venture to say that the number of persons who hesitate today about buying radio equipment for fear that they will find their receivers obsolete in a short while is smaller than it ever was and growing smaller each day. Radio fans have come to the conclusion that there is no more sense in deferring buying a radio set because sets may be changed considerably in the years to come than there is in refusing to buy automobiles at this time on the presumption that motor cars two years hence will be superior to those of today.

Figures given out by an official of the United States Bureau of Standards recently estimated that from one third to one half of the people of this country now have access to radio programs through receiving apparatus. Those who have not installed radio equipment in their homes would better hasten or they may find that they have rejected from their lives a new social factor which is one of the amazing developments making it so worth while to live in this age of progress.

DR. J. H. DELLINGER, able engineer who is chief of the radio laboratory of the Bureau of Standards, says:

"We now have not so much the invention of devices but the perfection of them. This statement is very general. Nevertheless, broadly speaking, radio engineering has now taken definite form and is the tool by which progress in radio is being wrought."

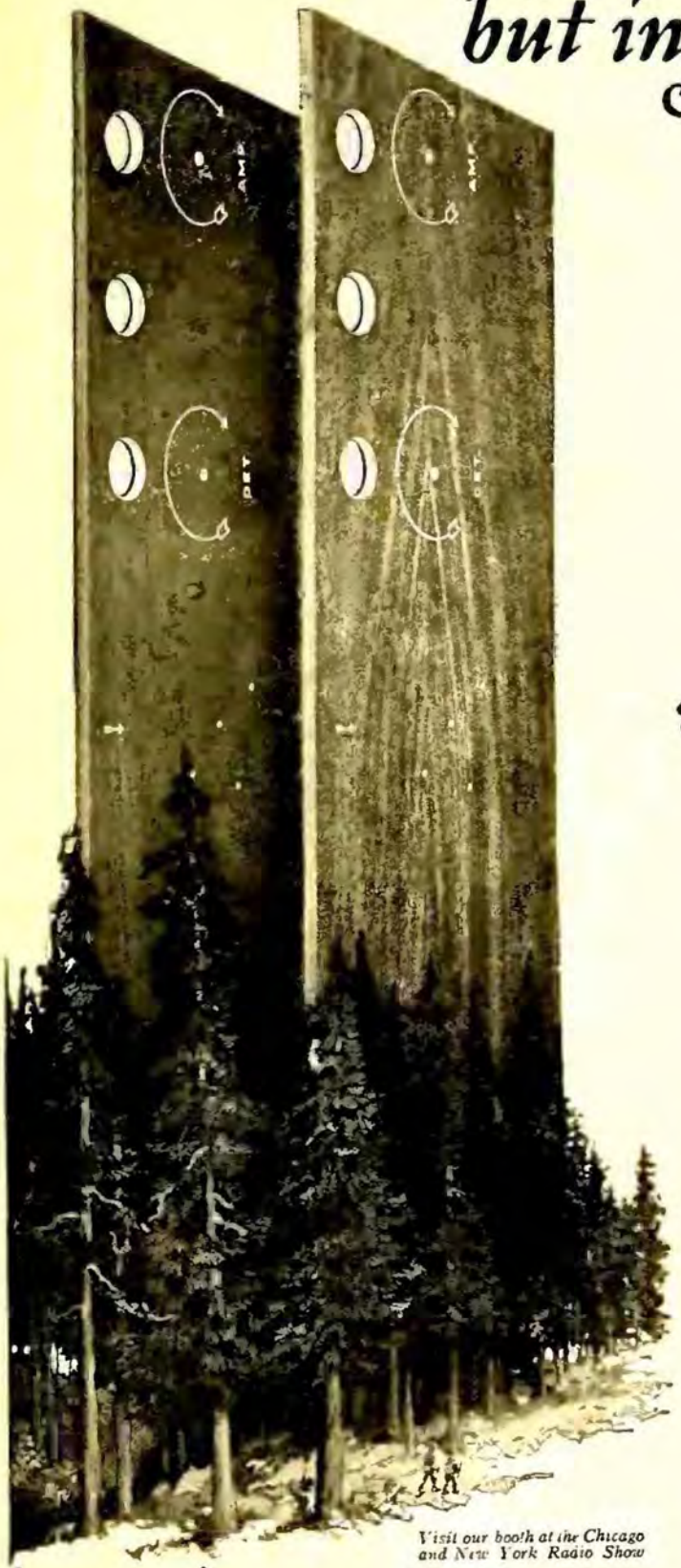
Then Dr. Dellinger makes the following clear statement of the progress radio has made:

"Substantial progress has been going on all along the line of radio engineering. Thus, in the development of new and improved radio communication methods or systems, we have great extension of the available frequency range, marked improvements in directive radio transmission, advances in the perfection of selective radio systems, and engineering development of line-radio or carrier-current communication. Among radio devices and applications of radio there is outstanding progress on radio beacons, on the uses of radio for aircraft navigation, on direction finders, and on radio picture transmission and vision. In the field of research and study of the problems of radio, we have important progress going on in radio measurements, in standardization of apparatus, in the study and mitigation of the vagaries of wave propagation and atmospheric disturbances, and in the wide reaches of the interference problem."

IT WILL be observed that there is no prediction in the foregoing that even suggests "revolutionary" changes in radio. We would suggest that those who have been disturbed by sensational forecasts of radio give ear to Dr. Dellinger's views. He is a scientist who is not personally interested in the commercial aspects of the new art and his statements may be accepted as sound and unbiased.

It's mahogany to the eye-

but in fact it's Bakelite



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Be sure to ask your dealer to show you these wood finish Bakelite Panels —obtainable under any of the following trade-names:

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A Bakelite Panel on a set is an indication that the manufacturer has used the best.

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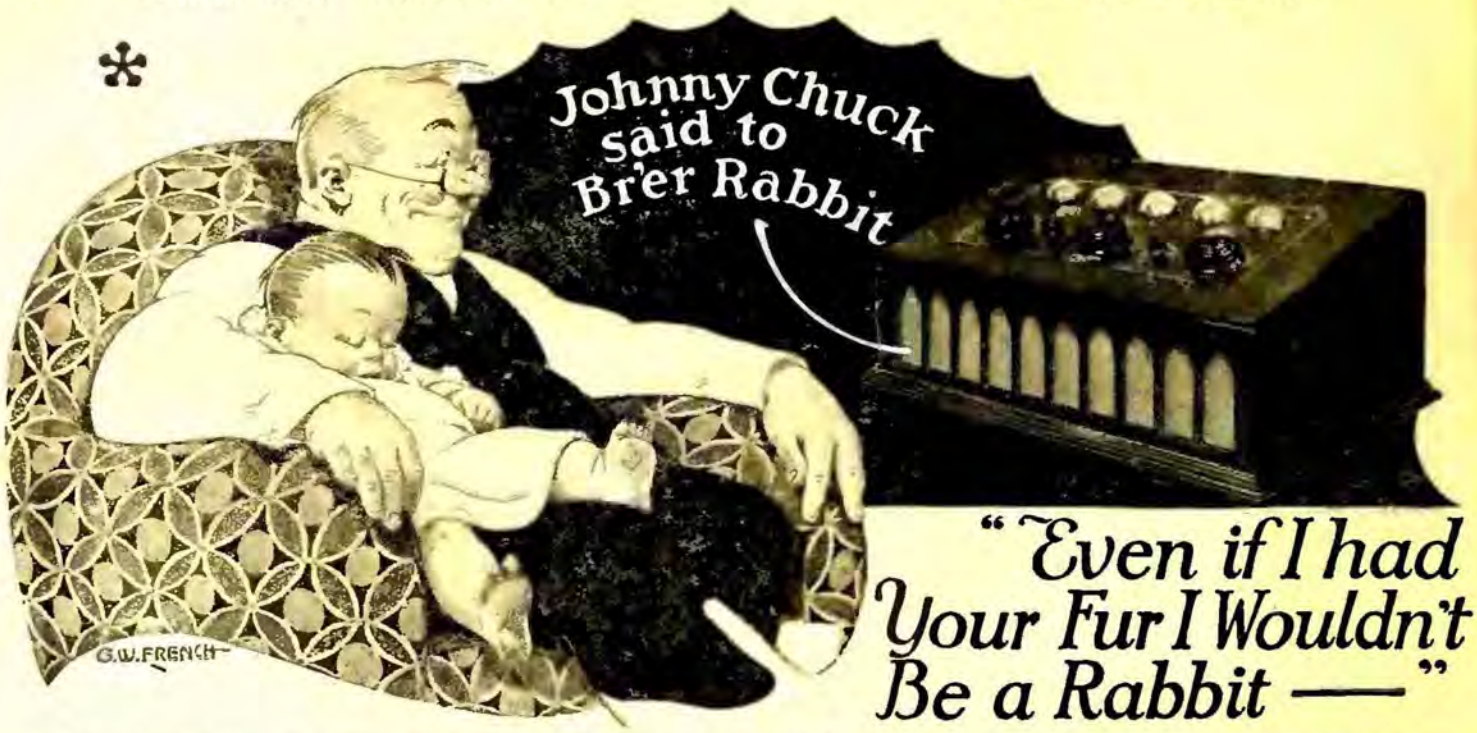

"Even if I had Your Fur I Wouldn't Be a Rabbit —"

AN attractive cabinet can never make an Ozarka out of any other radio. Far too many radio buyers pay more attention to the outer appearance and not enough to the inside. The service behind the radio you buy is even more important than the inside or outside—your satisfaction depends on it. Let us see just what radio service is.

When your automobile runs as the manufacturer intended it should, it is a real pleasure to drive it. But what do you do when something goes wrong? Do you immediately condemn the car?—no. Do you call in some handy man who can fix anything?—no.

You send for a service man who is trained in repairing your make of car. To correct the fault is easy for him because he knows. Some other mechanic might have to tear the car apart to locate the trouble.

The same is true of radio, no matter what price you pay—you will sometimes need the service of a service man. If he is factory trained and experienced he can and will deliver the kind of service you know you ought to have.

Ozarka instruments are only sold by direct factory representatives who are required to take a complete course of instructions of Ozarka service directly under Ozarka engineers. By so doing we are assured that every purchaser of an Ozarka will have an experienced service man within his reach at all times. 3100 such men today comprise the Ozarka service organization—more are being added daily. Ozarka service does not add a single cent to the price you pay for your radio—then why not benefit by it?

And remember, Ozarka is a radio instrument built of the finest units, carefully and correctly designed exteriorly and interiorly. Cabinets are ultra modern, finely finished—a most attractive addition to the appointments of the beautifully furnished home.

Ozarka circuits have proved themselves for four years by comparison with other high grade receiving sets. Whether you plan on installing a radio in your home, now or later, you deserve to hear the Ozarka. The Ozarka man will demonstrate the Ozarka to you right in your own home—under exactly the same conditions you will continue to use your set. Then there can be no disappointment later.

Ozarka instruments are only sold in competition side by side with others—you do your own tuning and therefore decide for yourself just what an Ozarka will do for selectivity, distance, volume and above all, tone.

Send for the book Ozarka Instruments No. 200; please give name of your county and we'll gladly have our Ozarka representative arrange a demonstration for you in your own home.

We Need a Few More Ozarka Representatives

RADIO offers a wonderful opportunity to men who wish to get into business for themselves. It is work that can be done, at the start, in the evenings and in your spare time. You can hold your present position and learn radio under our plan.

Ozarka instruments have been on the market for four years—they have successfully met all competition. Ozarka representatives have made good, not only because Ozarka Instruments are right but because our training in both selling and service is the most complete possible.

All we ask is that you are willing to purchase your demonstrating instrument and willing to learn what we are willing to teach you.

We have proven with 3100 men that with this training *you* can make good in radio. The Ozarka sales course consists of twelve lessons—a real course in salesmanship that costs you nothing—our training in service is so complete that you will know Ozarka Instruments in every detail.

The man we want is somewhat mechanically inclined—he is steady, industrious, has lived in his community some time. He stands well, not because he has money but because he has conducted himself in a manner to gain the respect of his fellow men. He may not have much money but he is not broke. He has a job but may still be having trouble in making both ends meet. He really wants a business of his own.

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To such a man, who will freely tell us something about himself we will gladly send a copy of the Ozarka Plan No. 100, a rather unusual book. You'll find it interesting because it proves why some men are millionaires and how others made them so—why some men get to the top while others don't—best of all it will show you how you can make more money and become really independent. Send for it today, but please mention the name of your county.

OZARKA INCORPORATED

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Chicago, Illinois

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Chicago, Illinois

Gentlemen: Without obligation send book "Ozarka Instruments No. 200" and name of Ozarka representative.
9-25-122A

Name.....

Address..... City.....

County..... State.....

Gentlemen: I am greatly interested in the FREE book "The Ozarka Plan" whereby I can sell your radio instruments.
9-25-122A

Name.....

Address..... City.....

County..... State.....

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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

Thirty-One Proven Ways to
PREVENT Self-Oscillations

By ROSCOE BUNDY

A Detailed Analysis of R. F. Stabilizers

SUPPRESSING self-oscillations or audio oscillations in the radio frequency stages of reflex or radio frequency circuits is a problem of the first magnitude. The efficiency of the stabilizing devices used to accomplish this result determines the efficiency of all circuits employing radio frequency amplification, the tone of the receiver and its tuning ability. In fact, the principal difference between the many "dynes" now on the market lies in the method of suppressing these audible oscillations rather than the means of procuring amplification or tuning. Unfortunately, no two circuits employing different units will act the same with a given type of stabilizer and as a result we must try out the various systems experimentally until we find the one best suited to the particular conditions at hand—a tedious and nerve racking trial to say the least.

Excessive regeneration in the radio frequency stages, due to stray magnetic fields or audio frequency feedbacks, are the most frequent causes of free oscillations. Again, highly efficient tuning units with a very low resistance will also allow free oscillations to take place which would be damped down completely in less efficient circuits having higher resistance. Sharp tuning inductances are more prone to the trouble than coils having higher losses and less selectivity, while inductances generating eddy currents in adjacent metal parts may be perfectly stable because of the absorption of the excess energy causing the oscillations. Conditions which favor distance reception do not tend to result in stability, hence a circuit with pronounced DX qualities is more generally noisy than a "dud" due to the strong regenerative factor existing in the DX circuit. Perfect stability means the sacrifice of other qualities as a rule, for stability requires "lossing" in the circuit and a minimum regeneration. All of us who have attempted experimental work with radio frequency or reflex circuits have at some time experienced the terrific howls due to audio frequency oscillations, or have noted the sudden blocking and grid "flopping" that is due to self-oscillations at frequencies approaching the frequency of the incoming radio waves. The tube oscillations under these conditions can no longer be controlled by the tuning devices with the result that the signals are much weakened or entirely eliminated. In other words, with excessive regeneration, the radio frequency tubes act as independent oscillators, oscillating at their own particular frequency without regard to the frequency of the incoming signals. They are "out-of-step" with the impressed oscillations; hence no amplification is performed. The signals may come in strong up to a certain position of the tuning controls, and then without warning the tube "flops" and the signals entirely disappear or else violent shrieking and howling take place.

Where excessive regeneration is caused by stray magnetic fields acting on the tuning unit (See Fig. 1), radio frequency transformers or wiring, conditions can generally be improved by a re-arrangement of the apparatus and wiring so that it is not cut by the stray magnetic field or else we can employ the so-called "fieldless" coils of the circloid type which do not cause interstage coupling. In many cases the trouble may be minimized or eliminated by a slight change in the angles of the couplers and radio frequency transformers, by separating the grid wires from the plate circuit wires, or by introducing resistances into the circuit. With receiving sets having closely crowded apparatus such procedure is not always possible, and we must therefore fall back on some independent or external stabilizing device that will absorb the excess energy.

The Feedback Problem

FEED-BACK through the "grid-to-plate" capacity of the tube is productive of oscillations, and as this capacity cannot be altered within the tube itself, it generally requires some sort of neutralizing scheme by which the internal capacity of the tube is opposed by an external balancing condenser as in the Neutrodyne, or else by some other arrangement which opposes the transfer of energy taking place between the grid and plate. Condenser action between parallel grid and plate wires causes the same effect as the grid-plate—capacity for these wires are simply continuations of the grid and plate elements. Very frequently the trouble is charged to the tube when

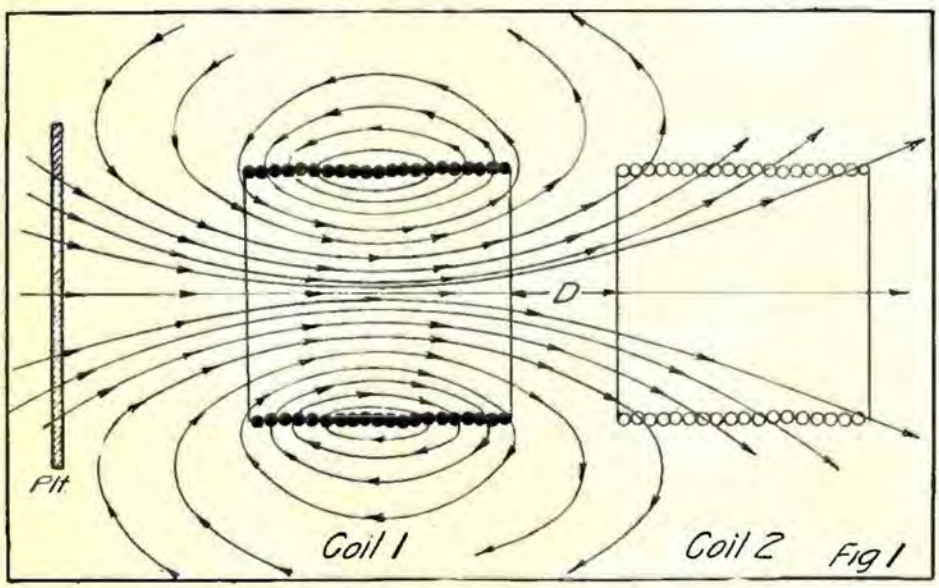


Fig 1

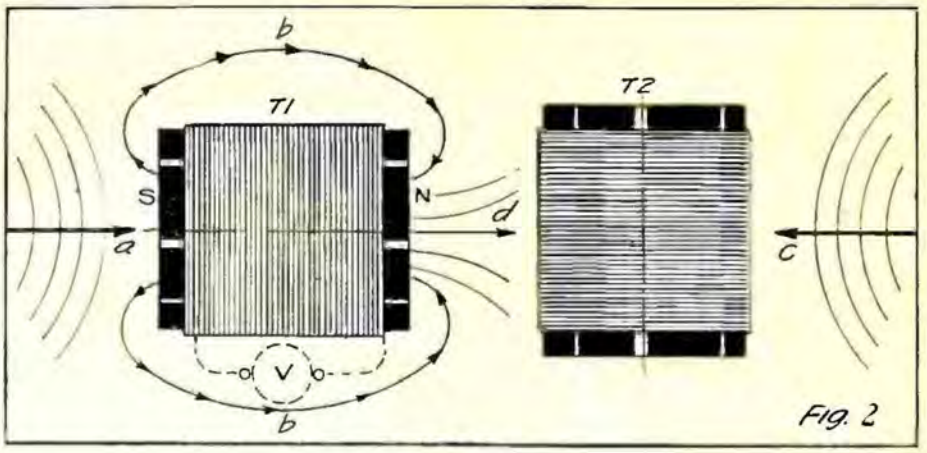


Fig. 2

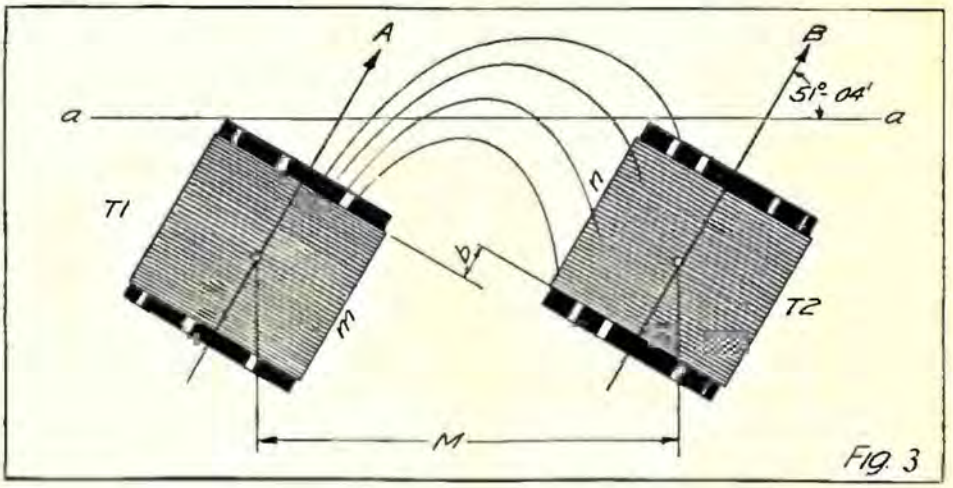


Fig. 3

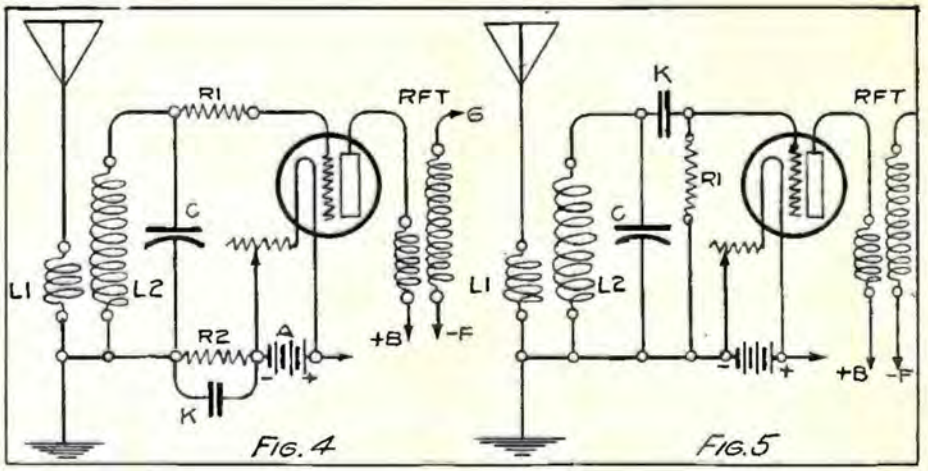


Fig. 4

Fig. 5

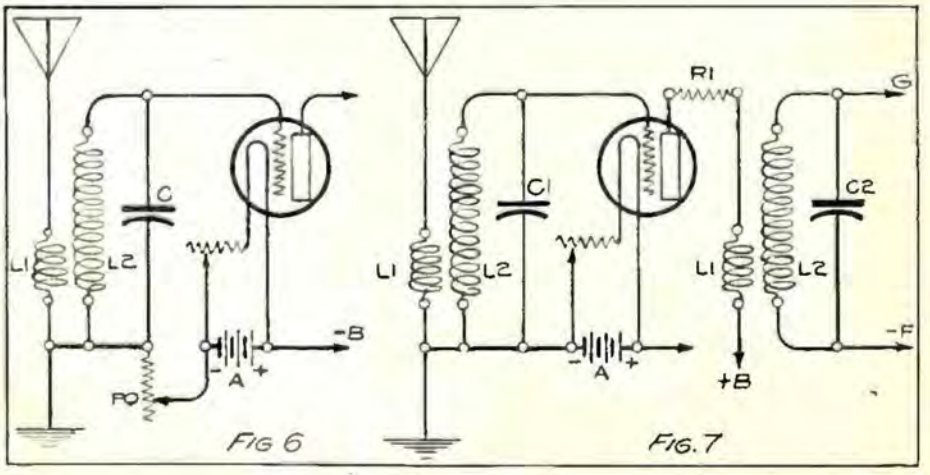


Fig 6

Fig. 7

the wires leading to the tube or the socket are really to blame. A neutralizing condenser having ample capacity for neutralizing the grid-plate capacity of the tube may not be large enough to take care of the additional capacity of the wiring; hence we often meet with circuits which cannot be neutralized by the commercial neutrodons or condensers.

Probably the simplest test for determining regenerative feed-backs and self-oscillations is to remove one or more of the radio frequency tubes from its socket without disturbing or shutting down the rest of the circuit. If the signal still keeps coming in with the R. F. tubes removed, it is certain that energy is being coupled back to the detector tube by stray magnetic fields or by capacity-coupling through the circuit or tubes. Under such conditions, the radio frequency tubes have but little effect when replaced in their sockets, and the rheostat must be turned full on before there is any appreciable increase in signal strength through the tubes. Up to a certain point this back-coupling may not produce noise or audible oscillations, but if it is carried far enough with strong enough coupling, we will be certain to hear the characteristic howls and shrieks. With a perfectly neutralized circuit without interstage feed-back, the signals will cease instantly when either of the radio frequency tubes is removed from its socket.

Even with a very slight feed-back, free oscillations will persist in a low resistance circuit, and if the resistance is reduced to zero the oscillations will continue indefinitely without the application of further external energy. Resistance or electrical friction damps down oscillations in the same way that mechanical friction brings a swinging body to rest, hence some resistance must be present in a stable circuit even though it does reduce its efficiency as a receiver of radio waves. It is here that regeneration produces a secondary effect favorable to the establishment of free oscillations, for regeneration reduces the resistance of the circuit even to the point where we may obtain "negative resistance." With negative resistance, where the resistance is "less than nothing," the oscillations not only persist but they actually increase in amplitude until they build up to the saturation point of the tube and cause spilling.

To gain an idea of the magnetic coupling between adjacent coils we will return to Fig. 1 where the transformer coil (1) generates a magnetic field which cuts through the turns of the coupler coil (2), inducing a current in the latter coil. This magnetic coupling effect is at a maximum when the axes of the coils are parallel as shown. At the left is a plate (PLT) which is cut by the stray field, causing eddy currents to be generated in the plate just as currents are generated in the coupler coil (2). With the coils in this position, excessive regeneration will be produced in the coupler coil (2) which will set up free oscillations. An energy loss will take place in the plate (PLT), and so much energy will be transferred between the coils that the radio frequency tubes will be practically short circuited and rendered ineffective.

In Fig. 2 the coils are turned at right angles, and if the magnetic lines were perfectly straight instead of being curved as shown, the transformer coil (T1) would not couple magnetically with coil (T2) for the field would pass along the wires and not cut across them. In the same way, a stray field (c) would not generate a current in coil (C), but a wave or field (a) passing along the axis will generate

and couple in coil (T1). However, the magnetic lines are curved, hence there is always a component that will cause a slight coupling. Again, the two coils act like the plates of a condenser so that there is a "capacity coupling" in addition to the slight magnetic coupling noted. To prevent trouble, we must either turn the coils at some angle where the coupling is practically zero, or else separate them sufficiently so that the coupling will be feeble.

In Fig. 3 we have the familiar arrangement of the coupler (T2) and the transformer (T1) as used in many radio frequency sets. The coils are turned at such an angle that the magnetic lines of (T1) cause the least possible induction in (T2). At the same time, the spacing (M) is such that the coil sides (m) and (n) do not face each other, thus avoiding capacity coupling. If (m) and (n) were opposite and parallel, instead of being offset by the distance (b), we would have troublesome capacity coupling between the two circuits which would be almost as bad as the magnetic coupling.

Classification of Stabilizers

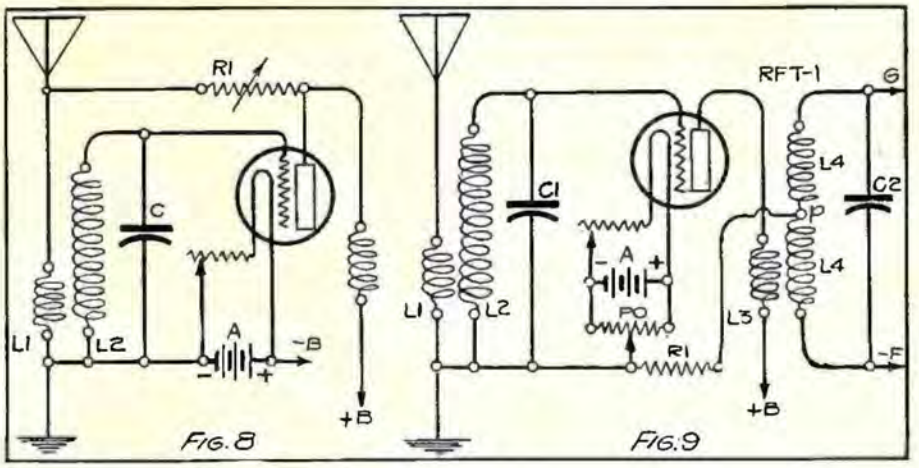
IN GENERAL, radio frequency stabilizers can be classified under the following heads. In some cases the stabilizers are purely "lossers;" that is, suppress oscillations by introducing direct losses into the circuit while others oppose the amplitude without actual resistance losses introduced into the incoming signal waves.

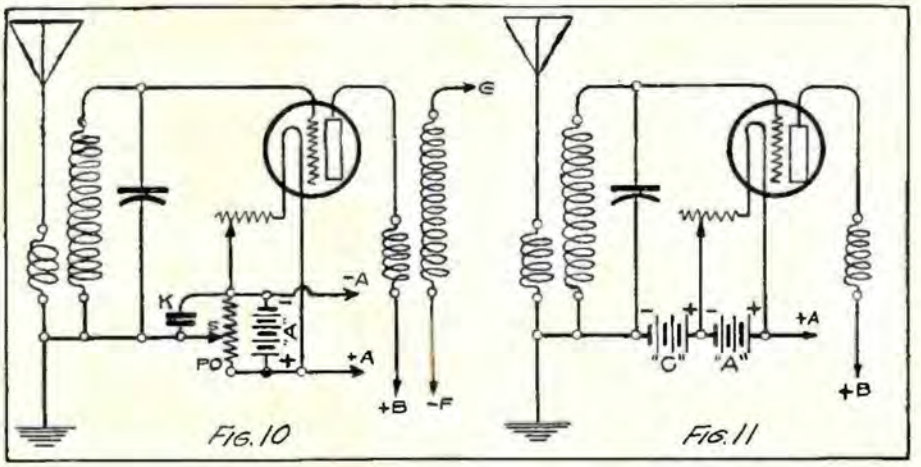
1. **RESISTANCE STABILIZERS** where control is had by the introduction of resistances in the plate or grid circuit.
2. **GRID POTENTIAL STABILIZERS** by which a constant or variable negative charge is applied to the grid of the tube to reduce its tendency toward oscillation. Often called "Biasing."
3. **ANTENNA COUPLER ARRANGEMENT** by which the tendency to oscillate is subdued by the use of single circuit antenna couplers or by capacities introduced into the antenna circuit.
4. **ABSORPTION STABILIZERS** consisting of an inductively coupled control circuit in which losses or opposing currents may be produced.
5. **EDDY CURRENT STABILIZERS** in which the excess energy is dissipated by the generation of eddy currents in metal plates.
6. **INDUCTIVE REVERSED FEED-BACK STABILIZERS** where a reversed tickler feed-back coil inductively controls the amplitude of the oscillations.
7. **CAPACITY FEED-BACK STABILIZERS** in which a reversed feed-back is had through a condenser, the plate being connected to the grid circuit through the condenser so that opposing wave systems are produced.
8. **BALANCING STABILIZERS** in which the tendency of the inductance to cause oscillations is reduced by intermediate balancing taps in the coils.
9. **GRID NEUTRALIZATION STABILIZERS** using a grid to grid capacity which opposes the grid to plate capacity of the tube.
10. **CHOKE COIL STABILIZERS** consisting of an inductance or choke which damps down the oscillations.
11. **CAPACITY BRIDGE STABILIZERS** using balancing condensers for the grid return or other parts of the circuit.

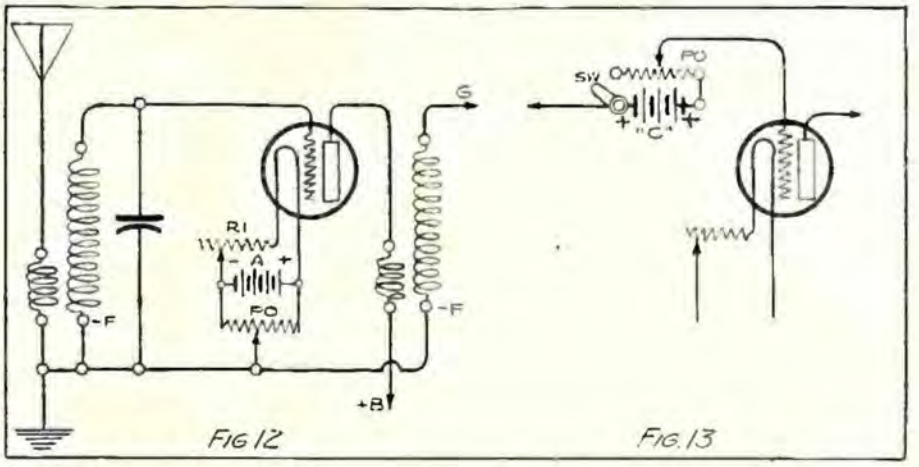
Resistance "Lossers"

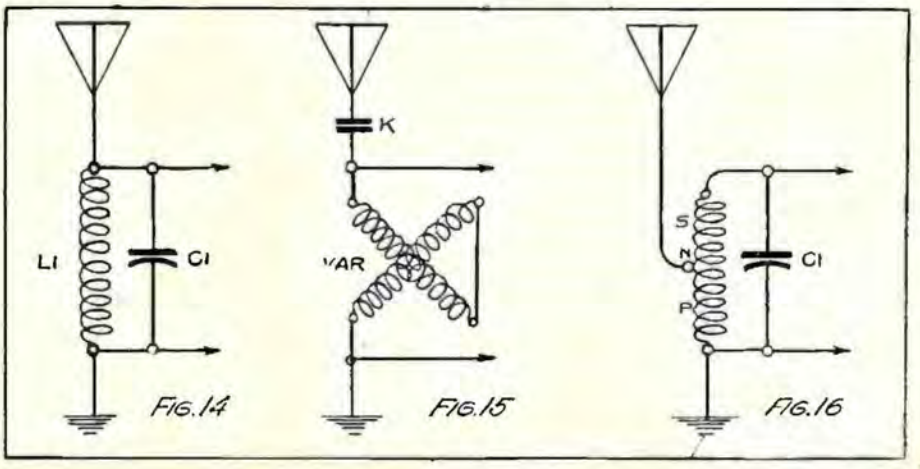
BY THE introduction of relatively high ohmic resistances in various parts of the circuit we can often damp down the free oscillations by virtue of the electrical "friction" introduced, but this leads to losses in sensitivity and volume so that the resistance "lossers" are not always desirable. Further, they generally reduce the selectivity when used in the grid circuit unless they can be varied accurately to meet changes in wavelength, and this is another serious objection. The various methods of introducing resistance are as follows:

FIG. 4. RESISTANCE IN GRID CIRCUIT. By introducing the fixed resistances (R1) or (R2) into the grid circuit we can sometimes damp down









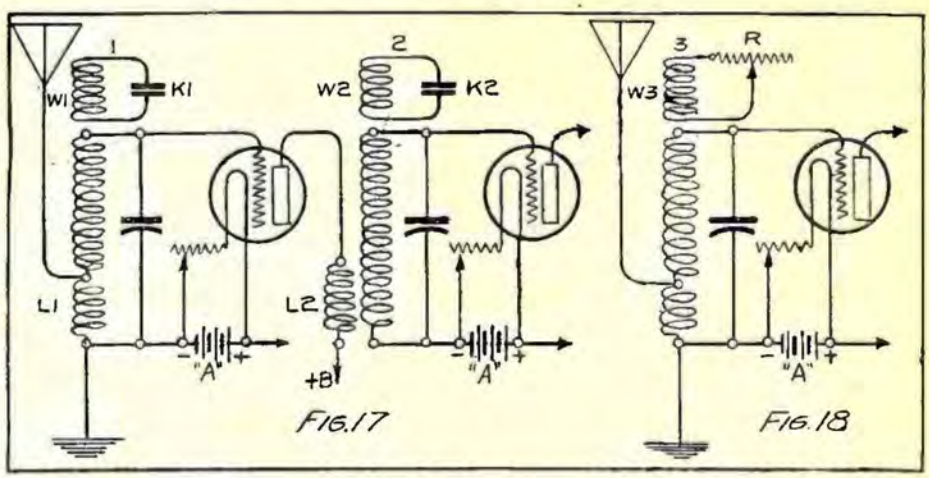


FIG. 17 FIG. 18

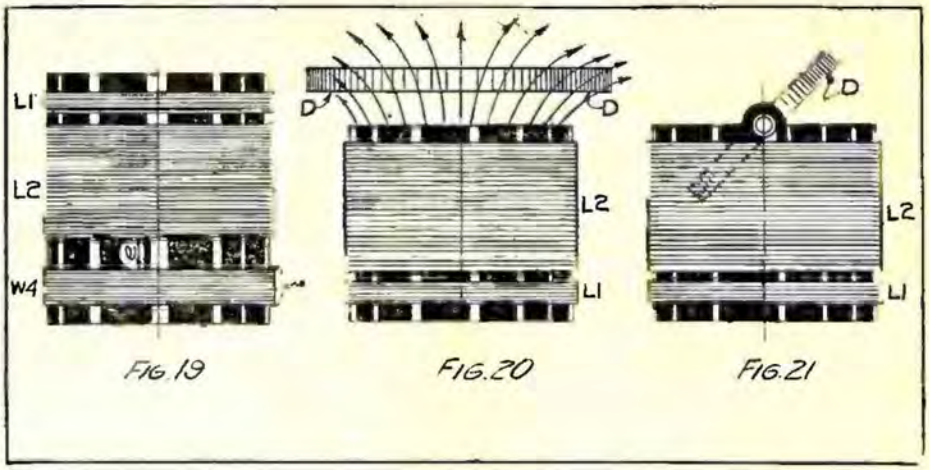


FIG. 19 FIG. 20 FIG. 21

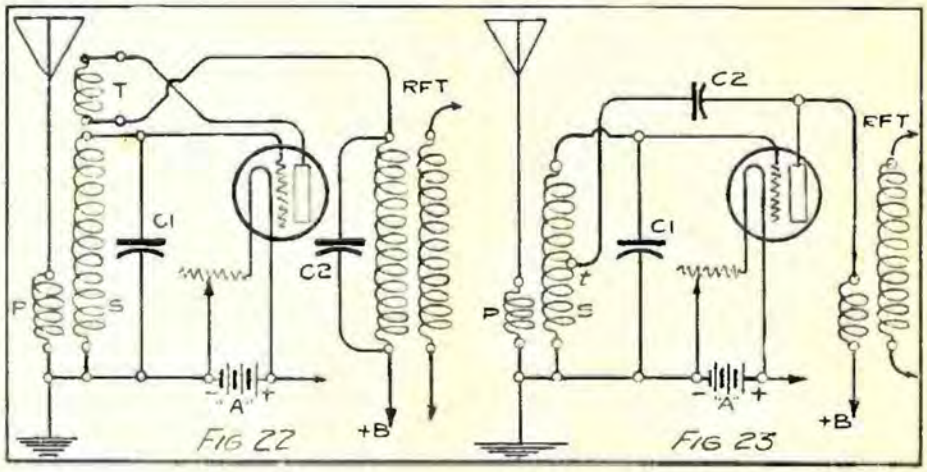


FIG 22 FIG 23

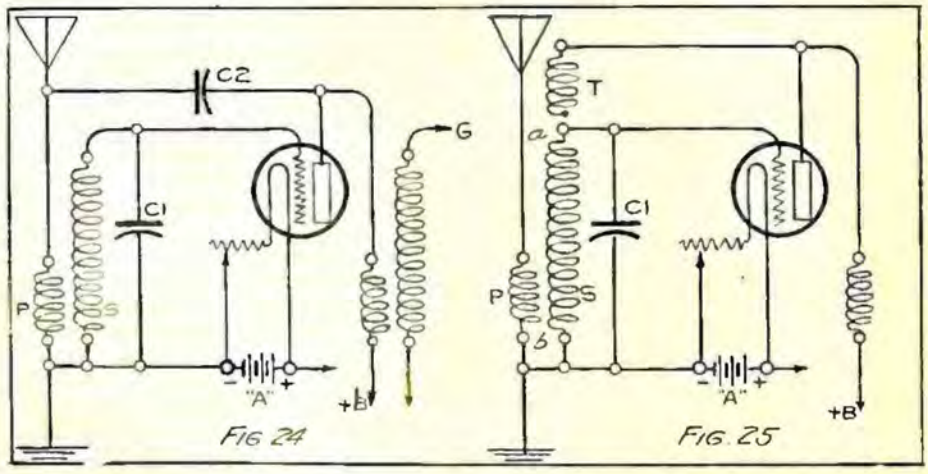


FIG 24 FIG. 25

oscillations if they are not too severe, but at the same time we lose sentitivity and volume. Such resistances will vary from 5,000 to 20,000 ohms and are of the grid leak type. By connecting a small fixed condenser (K) across the resistance (R2) in the grid return we can sometimes work a decided improvement in the sensitivity. Here we have the usual coupler with the primary (L1) and secondary (L2) tuned by the variable condenser (C). This may be applied to the first or second stage or to both.

The Fixed Leak

FIG. 5. FIXED LEAK. Here we connect a fixed resistance (R1) of from 10,000 to 40,000 ohms resistance between the grid and the —A. This gives a negative bias to the tube, but as it also grounds an appreciable percentage of the grid charge, it weakens the signal strength and reduces the selectivity. Condenser (K) is a stop condenser which reduces losses to ground. Its use is not advised.

FIG. 6. VARIABLE RESISTANCE. A variable resistance placed in the grid return circuit is sometimes effective, but as this calls for another control in addition to the regular control it is not the best proposition on earth. It is far more effective than the fixed resistances, however, and is really quite critical to wavelength. Either a 200 or a 400 ohm potentiometer can be used at (PO), connected up like a rheostat, but the 400 ohm potentiometer is sometimes made necessary when there is a particularly strong tendency toward free oscillations.

FIG. 7. RESISTANCE IN PLATE CIRCUIT. Here a fixed or variable resistance (R1) of from 10,000 to 50,000 ohms is inserted into the plate circuit of the tube and in series with the primary winding (L1) of the radio frequency transformer. It is fairly effective if the oscillating tendency is not too great and causes less loss in sensitivity and selectivity than when such resistances are inserted in the grid circuit. For the best results it should be individually adjusted to each circuit.

FIG. 8. REVERSED PLATE RESISTANCE. Here a portion of the plate current is fed back into the coupler primary by the variable resistance (R1), the feed-back current opposing the establishment of the free oscillations. The resistance will vary between 50,000 and 100,000 ohms in the majority of cases, but has the objection that it is critical to wavelength and must be tuned with the main controls. However, it is usually quite effective even when the tendency to oscillate is strong.

FIG. 9. BALANCED GRID RETURN. In this case we connect the grid return line of the first tube to the midpoint (P) of the secondary coil (L4) of the second radio frequency transformer. A fixed resistance (R1) is in series with the return, and the potentiometer (PO) assists in maintaining stability. It is quite effective and loses less energy than most of the resistance systems.

Grid Biasing Methods

AMONG the most popular of the stabilizers, as well as among the oldest, are those which function by controlling the potential on the grid of the tube. By giving the grid a negative charge or "bias" we increase the sensitivity, stability, and clearness of reception, but such methods alone are not always sufficient to stop free oscillations. By maintaining a negative bias on the

tubes, the "B" battery consumption is also reduced.

FIG. 10. POTENTIOMETER METHOD. Here we have the old and much used potentiometer system of grid potential control with the potentiometer (PO) connected directly across the "A" battery, and with the slider (S) connected to the grid return. By means of the potentiometer we can vary the grid potential continuously from the maximum negative value to the maximum positive value by moving the slider (S) to different points along the coil. This control is very marked in most circuits and causes less loss than the pure resistance control shown in the first three figures, but it adds another critical tuning control to the list.

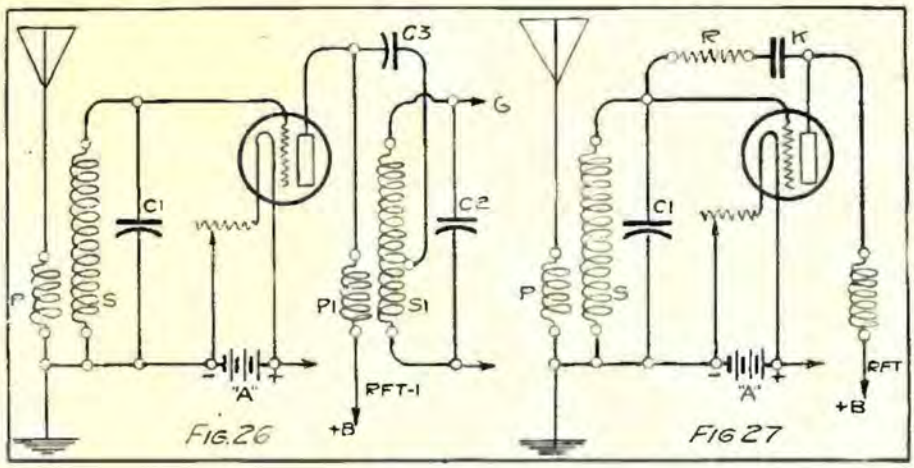
In addition to its use as a stabilizer its marked effect on the tone has led it to be marked "Clarifier" on the panels of commercial radio sets. By its means we can clear up any distortion or "mush" that may be due to the radio frequency stages, but of course this has no effect on the distortion caused by the audio amplifying transformers. About the only objection to this device is the fact that it permits the operator to put a positive bias on the grid, and thus may cause excessive "B" battery consumption if not carefully handled. The resistance averages from 200 to 400 ohms in the commercial types with an occasional example of from 1,000 to 1,500 ohms. The higher the resistance the more accurate will be the control.

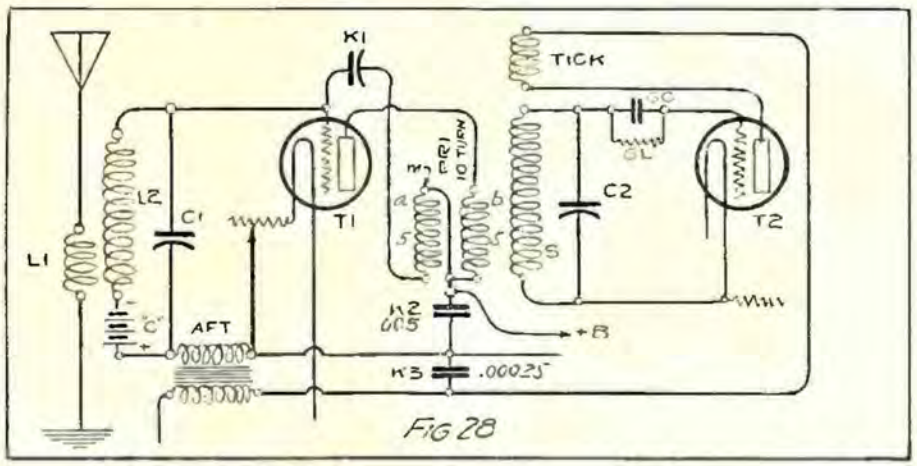
It is usually advisable, although not absolutely necessary, to connect a fixed bypass condenser (K) between the potentiometer slider (S) and the (−A) line. This reduces the resistance to the radio frequency current due to the inductance of the resistance coil and also to its ohmic resistance. The value of (K) is not critical, but it is generally a 0.005 mf. or 0.006 mf. condenser. The maximum biasing voltage that can be applied to the grid is equal to the voltage of the "A" battery.

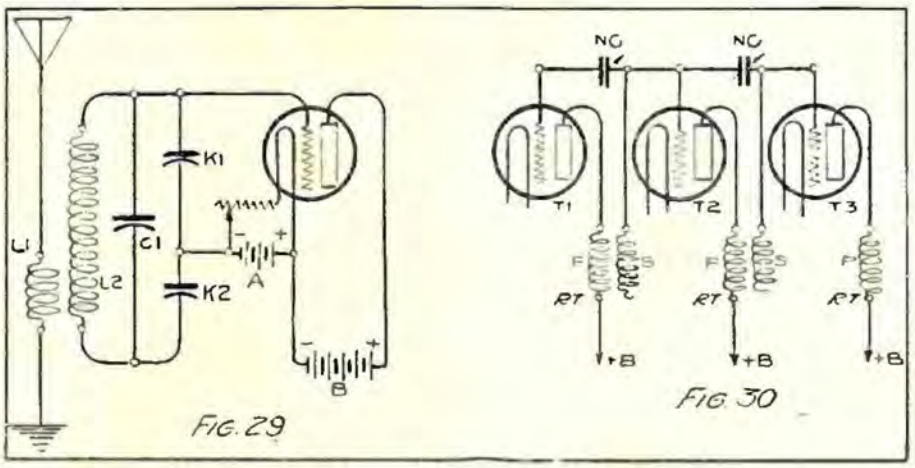
FIG. 11. BIASING "C" BATTERY. Another method (not so good) is to apply a constant negative bias to the grid by means of a "C" or "biasing battery" as shown by Fig. 11. This consists of from one to three cells of small dry battery connected to the grid by their negative leads. The trouble with such an arrangement is that the voltage cannot be varied to meet the requirements of strong and weak signals, but it is simple and cheap and sometimes is very effective in reducing free oscillations and of increasing the volume of strong local stations. With 90 volts on the plate of the tube, it is usual to employ a maximum of three cells (4.5 volts) on the grid for local stations, this giving a maximum volume. However, it reduces the distance and sensitivity to weak signals, and for distance this should be reduced to about 1.5 volts or a little more. There is no drain on the "C" battery for it dies of old age rather than wears out.

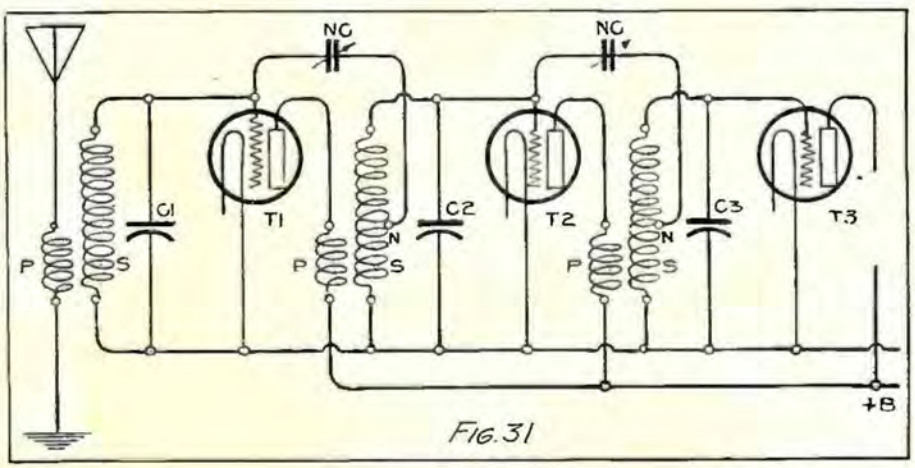
FIG. 12. DOUBLE BIASING POTENTIOMETER. We can place a variable bias on both tubes of a two tube radio frequency set by the potentiometer method of Fig. 12. Here the (−F) posts of both transformer secondaries are connected to the potentiometer slider, and thus both tubes receive an equal bias. This is usually the best method, for both tubes are then fully controlled directly.

FIG. 13. CONTROLLED "C" BATTERY. Here a potentiometer (PO) is connected across the "C" battery so









that the bias can be accurately controlled. The potentiometer slider goes to the grid of the tube. This is rather complicated, and a switch (SW) must be opened when we are through with the set so that the battery will not be run down by discharging through the potentiometer coil when idle. The method of No. 12 is preferable.

Antenna Coupler Methods

GENERAL. The tendency toward free audio oscillations in the first radio tube is greatly influenced by the method adopted in coupling the circuit to the antenna. Up to this point we have shown the conventional aperiodic type fixed coupler in which the primary is inductively coupled to the secondary coil, but this is not the only method available when more than one radio frequency tube is employed. A coupler of this type, while possessing the virtue of selectivity, offers little resistance to free oscillations. A single circuit type is more resistant to free oscillations.

FIG. 14. SIMPLE TUNED INDUCTANCE. Here we have the single coil (L1) tuned by the variable condenser (C1). This is not at all selective, and cannot be used in places where a sharp tuning outfit is necessary unless we have at least two stages of radio frequency and three tuned inductance controls in the circuit. It retards oscillations, however, and brings in better distance and louder signals than the aperiodic type when properly used in the circuit. It may be a honeycomb of 50 turns, a spiderweb, or simple solenoid coil.

FIG. 15. VARIOMETER TUNING. The variometer (VAR) is a variable tuning inductance with which no variable condenser is required. Its tendency toward oscillation is even less than with the plain inductance as there is no condenser, and further, better signal strength is had for the reason that higher grid potentials are possible with a pure inductance than with a capacity and inductance combined. As an aid to selectivity, a fixed condenser (K) of from 0.0001 mf. to 0.00025 mf. may be inserted in the aerial, but this is not necessary nor always desirable.

To establish oscillations we must have an inductance (L) and a capacity (C), and as (C) is entirely lacking when the variometer is used without a condenser, it is evident that the only tendency toward oscillation will be due to the exceedingly small grid plate capacity in the circuit and to the equally small distributed capacity in the windings of the variometer. As with the other inductance in Fig. 14, the variometer can be used only with two or more radio frequency stages where there are at least three tuning controls. Fewer stages or controls will not give the required selectivity.

FIG. 16. AUTO-TRANSFORMER COUPLER. A single circuit tuner which is more selective than either of the two just mentioned, yet one which also has a pronounced effect in suppressing self-oscillations is the type shown in Fig. 13. This is simply a continuous single winding, tapped for the aerial connection at the point (N). This divides the coil into a virtual primary (P) and virtual secondary (S) which are electrically identical. This is strongly recommended where there are two or more radio frequency stages or at least three tuning controls.

Absorption Systems

GENERAL. In the absorption systems the excess energy tending to set up free oscillations is "absorbed" by producing losses inductively in closed auxiliary circuits. In fact, this is the method adopted in wave-traps where the weakened signals are obliterated by the introduction of eddy current losses or similar magnetically induced counter-currents.

FIG. 17. CAPACITY ABSORPTION. Here we have small auxiliary coils (W1) and (W2) placed in inductive relation to the secondary coils (L1) and (L2) of the coupler and first radio frequency tuner respectively. The coils and the fixed condensers (K1) and (K2) form a closed circuit in which currents are induced by the magnetic coupling with (L1) and (L2). By varying the coupling between the absorption circuits (1) and (2), and the coils (L1) and (L2), we can absorb the excess energy which tends to cause free oscillations. The energy loss is due to the idle currents circulating in the small absorption circuits. From four to eight turns of wire are used for (W1-W2) while the capacity of (K1-K2) is from 0.00004 mf. to 0.00006 mf. The distance between the coils or the coupling must be found by experiment.

FIG. 18. RESISTANCE ABSORPTION. In this arrangement we have the same small absorption coils, but instead of using fixed condensers we have the variable resistance (R) used for varying the magnitude of the induced current. As in the case of the former absorption circuit (Fig. 17), this is very effective and is under close control. The resistance of (R) is approximately 200 ohms.

FIG 19. SHORTED TURN ABSORPTION. A very simple, and usually effective method when carefully adjusted, is the "shorted-turn" or ring absorber of Fig. 19. Here we have the main secondary coil (L2) wound on a tube, and the absorption coil (W-4) located a short distance from it. The coil (W-4) consists of a few turns of insulated wire with the ends twisted together and soldered so as to form a complete circuit. Excessive energy in the main coils (L1-L2) is absorbed by the inductive coupling with (W-4), and by careful adjustment of the distance (C), we can dissipate just as much energy as we may wish. The same effect can be produced by short-circuiting two or three turns of wire in the coil (L1-L2), but the control is not so accurate. Coil (L1) is the primary.

FIG. 20. EDDY CURRENT ABSORPTION. It is a well known fact that electrical "eddy" currents will be induced in metal parts when these parts are in the path of the magnetic flux, and that the energy loss in the inducing coil is in proportion to the eddy current strength. In Fig. 20, we place a disk of sheet metal (D) at one of the solenoid coil poles and at such a distance that the eddy currents are just sufficient to absorb the excess energy in the coils which tend to cause oscillation. This method is effective and is utilized in at least one make of radio frequency apparatus. In this well known receiver, the metal back plate of the low-loss condenser serves as the plate (D), the coil being mounted on the condenser and just far enough away from the back plate to absorb the excess oscillations. Care must be taken so that the plate is far enough away prevent weakening the signals by excessive absorption.

FIG. 21. VARIABLE PLATE ABSORPTION. This is simply a special and convenient application of the above principle where a rotative plate (D) is placed within the bore of the coil and mounted on pivots so that it can be easily adjusted. The nearer the plate is turned at right angles to the axis of the coil, the greater will be the absorption.

Reversed Feed-Back Systems

FIG. 22. INDUCTIVE FEED-BACK. In this system the plate current is fed back inductively into the secondary coil (S) of the tuning unit by means of a reversed tickler coil (T) so that the amplitude of the oscillations is controlled by the opposition of the induced current. This is exactly the opposite condition to a tickler regenerative system, for instead of the feed-back current augmenting the signal oscillations it tends to suppress them. This is an exceedingly effective system which has been applied with great success to several well known commercial tuned radio frequency sets. When the tickler (T) is a stationary coil, wound in fixed relation to the secondary (S) and the primary (P), it is controlled by the variable condenser (C2) connected across the primary of the first radio frequency transformer (RFT).

FIG. 23. RICE CAPACITATIVE FEED-BACK. This is an exceedingly effective yet simple system of the reversed feed-back type in which the compensating plate current is fed back into the secondary coil (S) of the coupler by a very small variable condenser (C2). The plate current being in phase with the grid must be led near to the grid return end of the secondary coil (S), preferably at a tapped point (t) rather than to the extreme end of the coil. Very close control of the regeneration is had by the use of the condenser (C2) so that the circuit can be held closely to a condition of maximum sensitivity. The condenser (C2) should have a maximum capacity of not more than 0.00006 mf. and about 0.00045 is generally better.

FIG. 24. CAPACITATIVE FEED-BACK TO AERIAL. This is about the same thing as Fig. 23 in general principles, but instead of feeding back to the grid return end of the secondary (S), we feed the opposing plate current straight to the antenna end of the primary by the small variable or fixed condenser (C2). This is not quite so critical as the former method, and very frequently a very small fixed condenser can be employed instead of the variable, thus doing away with one control.

When a fixed condenser is used its value is generally less than 0.0001 mf., but the actual value must be determined by experiment. In many cases a neutralizing condenser will prove of sufficient capacity.

FIG. 25. COIL CAPACITY FEED-BACK. This is a simple and effective system to use when the tendency toward self-oscillation is not too great. It consists of a coil (T) having four or five turns of wire connected at one end to the plate of the tube. The opposite end remains unconnected. The coupling is partly inductive and partly capacitative, but it very often proves to be an excellent stabilizer and needs no controls. We can find by experiment whether to place it at the end (a) or (b) of the secondary coil. The distance between (T) and the secondary should just be sufficient to suppress the free oscillations and no more.

Balancing Systems

FIG. 26. FEED-BACK SYSTEM. In this system a part of the plate current is fed back to a tap in the secondary coil of the following transformer

(Turn to page 18)

Practical Application of the Series Resonance Formula

Solving Inductance, Capacity, and Wavelength Problems

By E. E. GRIFFIN

THE formula for series resonance or wavelength is the most commonly used calculation in radio frequency measurements, and forms the basis of most all construction and experimental work. The average experimenter and constructor, however, is not interested in its derivation nor the whys and wherefores; he is interested only in the practical application of the formula to each individual problem arising in the course of work. Mathematical solution of each individual application involves loss of time and some figuring, with the result that "cut-and-try" methods are generally resorted to.

With the accompanying chart, instant solution of the numerous applications of the formula as applied to broadcast work may be obtained. In general, our capacity ranges are from .00001 to .001 microfarads; and our wavelength ranges from 125 to 600 meters, which includes the most used amateur bands. Applying these values to two proper sized logarithmic scales and working out a few reference problems, we may add a third log scale giving inductance values, and thus graphically solve any problem that may arise in future times. Our inductance values so obtained will cover a range from less than 5 to over 10,000 microhenries, which will more than cover the values in present day broadcast use.

Using the Chart

THE use of such a chart is quite simple, requiring no ruler or straight edge, although a right angled marker of some sort is helpful in maintaining the vertical and horizontal scales. In reading the various scales, it is well to interpolate between captioned lines, since the various lines in between are necessarily of varying spacing, owing to the exigencies of drafting and reproduction. At the intersection of any three lines of the scales, we have an individual solution of the resonance problem. Thus, if any two values are known, we may read the third unknown from the third scale. As an example, assume we have a .0005 mfd. condenser connected across a coil of unknown value, and the circuit thus formed is found to tune to a wavelength of 600 meters. Following the .0005 mfd. capacity line vertically until it crosses the 600 meter line, we then read diagonally on the inductance scale where we find approximately 204 microhenries, which we may assume to be the inductance of the coil. Likewise, we may determine wavelength if the capacity and inductance are known; and capacity, if the inductance and wavelength are known. Such inductance determinations will be the apparent inductance, since we have neglected the distributed capacity of the coil itself.

The Honeycomb Coil

AS another example, let us take the case of the well known honeycomb coil. The 50 turn coil is listed by the manufacturers as having a pure inductance of 149 microhenries, a distributed capacity of .000031 mfd. and a natural period or wavelength of 128 meters. Here we have all three values given, and we may check against our chart. (The 150 microhenrie line gives approximately 128½ meters at .000031 mfd.) Now assume that we connect across this 50 turn coil a condenser having a maximum capacity of .0006 mfd., and we desire to know the wavelength of the circuit thus formed. Our inductance is known to be 149 mh. and our total circuit capacity will be the distributed capacity of the coil plus that of the condenser, a total of .000631. Finding the intersection of these two values on our chart, we read horizontally on the wavelength scale and find 550 meters, the wavelength of our circuit.

If the condenser be a variable one with a known minimum capacity of .00004 mfd., the shortest wavelength to which this circuit would be capable of tuning would be 195 meters, our minimum circuit capacity in this case being .00004 plus .000031, or .000071 microfarads. In all cases of series resonance where we have a coil and condenser, the distributed capacity of the coil is added numerically to the capacity of the condenser.

The foregoing examples are given simply in explanation of the use and application of the chart, and it is believed they are sufficient for proper understanding in its many-fold uses. To the advanced broadcast fan, no more explanation will be needed, but for the amateur in the formulation of transmitting circuits where larger capacities than those given are used, further application of the chart will be discussed.

For Larger Capacities

THE chart may also be used for larger capacities than those given by multiplication and division of the inductance and capacity values. Since the wavelength of a circuit is proportional to the product of the inductance and capacity, we may multiply one scale by a certain number, dividing the other scale by the same number, and our solution on the chart will still hold.

As an example, assume that we have a condenser of .0012 mfd. capacity and desire a wavelength of 200 meters. The chart does not give .0012 mfd., so we use the value .00012. The intersection of this line with the 200 meter line gives us an inductance of 95 microhenries. Now our actual capacity is ten times the chart value, so we must divide the inductance value by ten, which gives an answer of 9.5 microhenries. Thus for a wavelength of 200 meters, using a condenser of .0012 capacity, we will require an inductance of 9.5 mh. Just so, if our inductance and wavelength are known, we may determine the required capacity by using the reverse operation. For calculations on the 90 to 80 meter band, the chart may be extended beyond the present limits, which are necessary for the size of a printed page. Better and more rapid, simply divide all scales as given by 2. Thus, 80 meters wavelength would require a capacity of .0001 mfd. and an inductance of 18 mh.; which is represented on the chart in the double values of 160 meters, .0002 mfd and 36 mh. Likewise, using the same value of inductance, for 90 meters we would require a capacity of .000125; which values on the chart would be represented by 180 meters, 36 mh. and .00025 mfd.

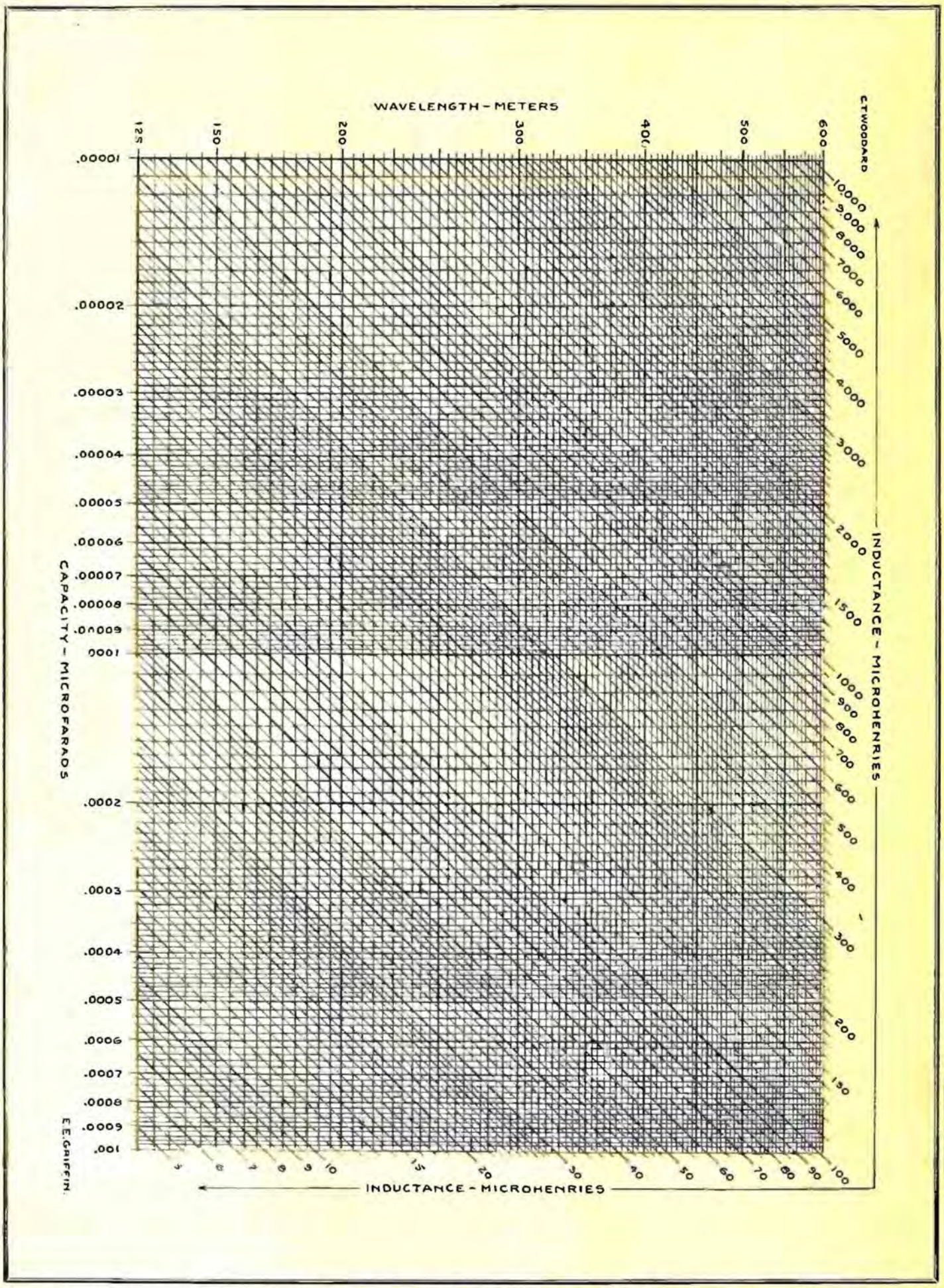
Such a chart is a valuable addition to any reference or notebook, and the experimenter and constructor are advised to cut out the page and place it by for future use. It is also an indispensable time and labor-saver for the user of a wavemeter or oscillator, enabling rapid measurements in all radio frequency work.

Many an experimenter has often wanted a means of determining the constants of coils or condensers. The foregoing article by Mr. Griffin, together with the chart on the following page, should appeal to every radio fan with curiosity along the lines of inductance and capacity.

In the event you do not desire to mutilate your September issue of RADIO AGE, send thirty cents in stamps to our office and we will supply you with another copy of the September number from which you may clip the chart and save for future reference.

Mr. Griffin is now making intensive experiments in wavelength formulae and other interesting problems. His work will be recorded in an early issue of RADIO AGE.

Chart for Instant Solution of Wavelength Formula on Next Page



Here is the chart explained in the article on the preceding page, by which applications of the wavelength formula as applied to broadcast work may be solved with little trouble. In reading the scales, it will be advisible to interpolate between captioned lines, since the various lines in between are necessarily of varying spacing.

"Going Down" to Lower Waves

¶ Crowded Wave Bands May Force Search for New Radio Channels

HOW different things might be if they wasn't as they is " sang one of the actors in a comic opera that was popular a generation ago.

That's the way it is with radio. If the whole range of wavelengths that could be used for transmission had been known ten years ago, today's problems would be less complicated. As it is, the wavelengths from 600 meters up are occupied by government and commercial stations and the wavelengths from 200 meters down are looked upon by amateurs as their territory by right of discovery. This leaves a band of 400 meters available for broadcasting.

Broadcasting stations are increasing so rapidly, however, that they cannot all squeeze into this band. Moreover, they are increasing power to such an extent that it is hard to shut them out, even with highly selective receivers.

It looks as though broadcasting wavelengths were going down. If they try to push the upper limit higher, broadcasters will have to buck the well-entrenched commercial companies, which have large investments in stations and plenty of ammunition for fighting interference. It will be much safer to poach on the amateurs' preserve, below 200 meters. It is predicted that in the near future broadcasting wavelengths will go as low as 150 meters. It may not disturb the amateur very much anyhow, for the up-to-date brass pounders are already working down below 100 meters.

Some of the Problems

SOME of the set manufacturers are worried, because practically all broadcast receivers have been designed for waves between 200 and 600 meters.

Some of the radio users will be worried, too, if stations open up that they cannot hear, before the final instalments are paid on their expensive sets.

However, it is not time yet to junk receivers, even though they are not built to receive the low waves that come rippling along at the rate of two million per second. The wavelength that a receiver will bring in at any given moment depends upon the inductance and capacity in its tuned circuits. Inductance and capacity can be added to or subtracted from the circuits. Sometimes it is possible to change the tuning range of a receiver at small expense and without any danger of injuring the apparatus.

The wavelength of a circuit is the product of its inductance and its capacity. Inductance is expressed in centimeters and capacity in microfarads. If the product is large when these two are multiplied together, the wavelength is long; if the product is smaller, the wavelength is shorter. Nothing complicated about that. The inductance is mainly in the coils and the capacity is largely in the condensers. More turns in the coils or more plates in the condensers increase the wavelength. Less turns or less plates mean lower wavelengths. Sometimes there are other factors, such as wider spacing between condenser plates, but the principle is the same. The tuning devices in the receiver are devices for increasing and decreasing the inductance and capacity.

A fixed condenser placed in series with the antenna of a single-circuit receiver, to reach down to the lower wavelengths.

By ARMSTRONG PERRY

It is possible for even the novice to find out roughly how much inductance and capacity there are in all his circuits. In the antenna, however, there is a value of capacity that is unknown as a rule, for the antenna and the earth form an unmeasured condenser. Radio textbooks such as "The Principles Underlying Radio Communication," used by the United States Signal Corps and sold at one dollar a copy by the Superintendent of Documents, Government Printing Office, Washington, D. C., contain tables simple enough to be understood by the average mind. They show that a wavelength of 300 meters means a frequency of 1,000,000 per second. When one million waves per second oscillate in a circuit, the length of each wave is 300 meters.

It is impossible to get the full benefit of 300-meter waves in a 400-meter circuit. A nearby and powerful broadcasting station might force its waves through your set and into your phones or loud speaker even when you are not tuned to it, but to bring in 300-meter waves from a distant station you must tune your circuit to 300 meters. This means that the product, when the capacity in the circuit is multiplied by the inductance, is 25.33, according to the table.

¶ How You Can Change Tuning Range of Your Set *Sans* Trouble

Now, this product, 25.33, may be obtained in several different ways. If your inductance is represented by 5, capacity of approximately 5.07 would give the circuit the proper wavelength. If your inductance were 1, then you would need capacity of 25.33.

Value of Inductance

THE value of the inductance in a circuit may be hard to find, for the size of the wire, the diameter of the coil, the number of turns and the space between them all have their effect. The instruments needed for measuring inductance are found only in the laboratories as a rule. The capacity of a condenser is easy to find, usually, for it is marked on the apparatus. Also you can easily find the wavelengths of the stations you can hear, for they are published in the newspapers. The indicated capacity of the condenser is its maximum, so if you turn the dial to its maximum position, or near it, and use your maximum inductance, and note the wavelength of the station you bring in at that setting of the dials, you can figure out approximately what inductance you have in the tuned circuit.

For example, at maximum setting, you bring in a 600-meter station. Your condenser is marked .0005. The table shows that the product of inductance and capacity in a circuit tuned to 600 meters is 101.4. The value of inductance, then, must be 101.4 divided by .0005, which is 202,800.

The ability to estimate, at least roughly, the capacity and inductance in a tuned circuit, is very useful when you want to change the tuning range of a receiver, either temporarily or permanently. However, it is possible for a novice to experiment with some hope of success, even though he does not study the matter deeply.

Suppose you want to get down to the 210 meter wavelength and your receiver tunes at present no lower than 300 meters. One simple principle helps materially; namely, the effective capacity of condensers connected in series is less than the capacity of any one of them. Since the antenna and the earth form one condenser in the antenna circuit, the capacity of that circuit can be reduced by connecting another condenser in series. This cannot be continued in-

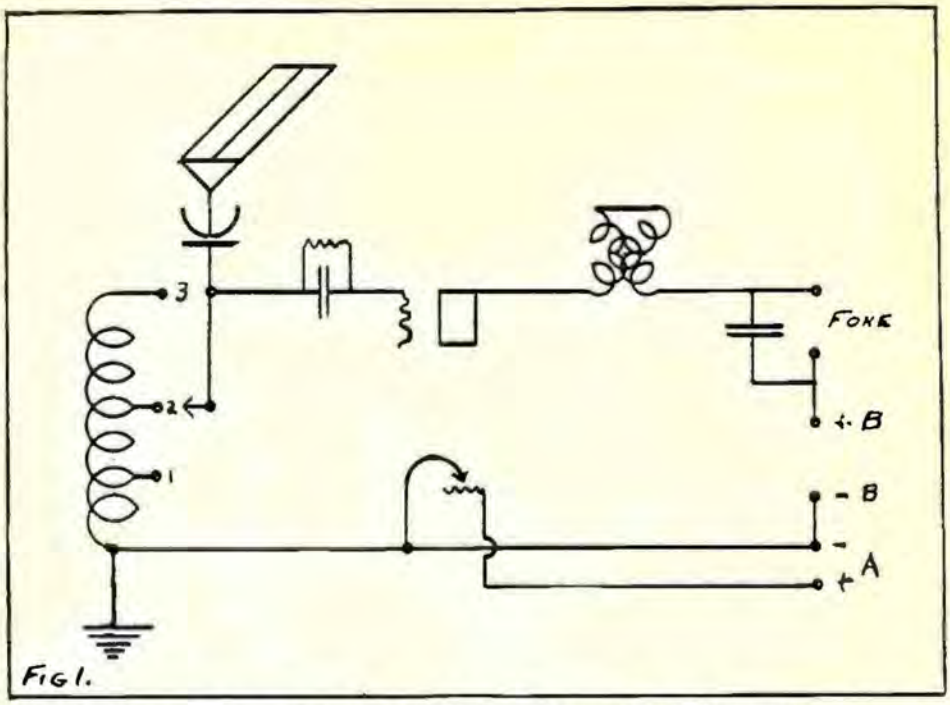


FIG 1.

In the diagram shown above the cutting down of wavelength of the receiver is accomplished by reducing the number of turns in the inductance. At No. 1 you have least number of turns and hence lowest wavelength. At No. 2 the wavelength is higher and at No. 3 it is at a maximum. For those who prefer low loss, the inductance can be made on separate forms and inserted in the set when it is desired to go down. The plate inductance is shown as variometer, but it may be any form of an inductance. By the method shown above, if the very short waves are desired it will by necessary to put a small condenser something like a .000012 in series with the antenna, but for ordinary low wavelengths on which phones can be found, the scheme as outlined will work.

definitely, because if several condensers are used the transfer of energy is reduced so greatly that the signals cannot be heard. A thirty-five cent fixed condenser, connected in series with the antenna, may be all that is necessary to bring a single-circuit receiver down to the lower wavelengths.

In the other circuits, the problem is harder. Theoretically, at least, the variable condensers may have zero capacity at the minimum setting. Adding another condenser will not, of course, reduce the minimum capacity below zero. If there are capacity effects in the circuit caused by something other than condensers, however, the addition of another condenser in series may lower the tuning range of the circuit. In most cases it will be found necessary to reduce the effective inductance of the circuit. Sometimes this can be done by tapping a fixed inductance, inserting a switch and making it a variable inductance.

Shortening the Aerial

REDUCING the length of the antenna tends to lower the wavelength. It also reduces the amount of energy picked up by the antenna, but that may not be serious.

Manufacturers may help users of their sets by providing instructions for making the alterations or additions necessary to reach the new wavelengths. Customers should be reasonable in their demands, for it is a very difficult matter to design a receiver that is highly efficient over a broad band of wavelengths. It is a still more difficult matter to alter a set, carefully designed for high efficiency over a specified range, so as to increase its tuning range without lowering its efficiency.

Paul Bunyan, the mythological lumber-jack whose exploits have been published recently, understood the desirability of specialization and developed side-hill chickens and a dog, half daschund and half greyhound, that never was tired because with its long legs behind and its short ones in front it was always running down hill. Perhaps the amateur radio constructors will do better if they build receivers for the shorter broadcasting waves instead of trying to make one receiver cover the whole range.

The exodus to the shorter waves will not be as rapid as one might be led to imagine. For one thing, there are undoubtedly many stations at present in operation who will succumb to the business disease, Overhead Expense, and with a high rate of mortality (such as has been the case since the beginning of the broadcast craze) the number of stations will probably be kept at a crowded but nevertheless fairly comfortable level.

Nor will the search for new channels at once invalidate the present receivers. These are as a rule excellent sets and with greater attention being paid to selectivity the crowded conditions of the air lanes need not occasion any great degree of anxiety on the part of the radio fans.

Of course, for a "broad" set even five stations would crowd the ether, but with manufacturers paying greater heed to requirements of selectivity for owners in the congested areas, the multiplicity of stations should not worry any one. Naturally a fan cannot expect to hear every one of the five hundred odd broadcasting stations in the United States. Many stations, separated by many hundred miles, are working on the same wave band and no receiver yet designed will separate the two. In those cases the listener must be satisfied with the nearest station and let the residents farther away from him take advantage of the station he seeks but cannot hear.

While it would be foolhardy to expect no change in the industry or the radio situation (for no change would denote stagnation), nevertheless any changes that may come will be of a gradual nature and not calculated to throw the game into a seething chaos in which millions of people would be involved.

The ideas expressed in this article are more applicable to the older-style sets than they are to the type that now tune from 220 to 550.

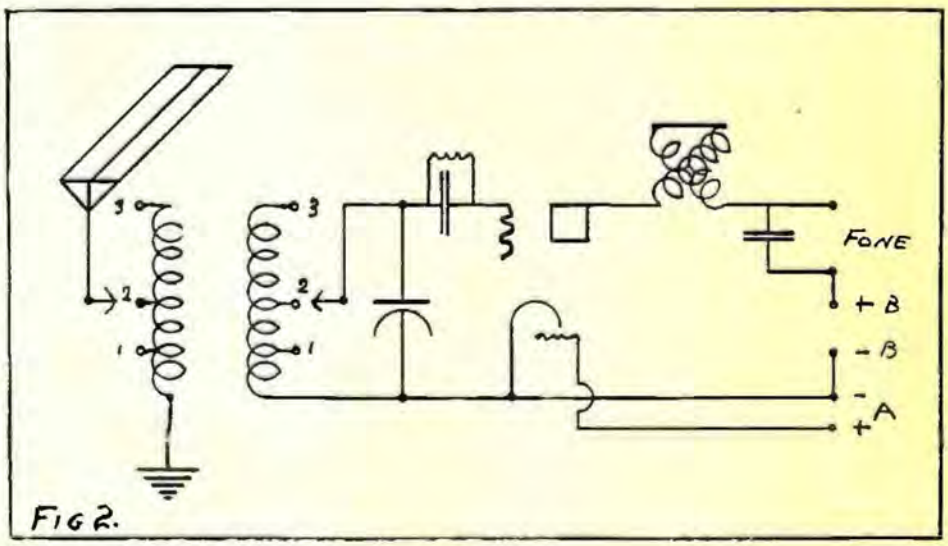


FIG 2.

Fig. 2. In the inductively coupled circuit shown here, to reduce the wavelength it is necessary to cut out primary as well as secondary inductance. The symbols are the same as in Fig. 1. Of course the plate inductance should be varied; that is, cut down, as the experimenter goes farther down on the wavelength scale. For best results the primaries and secondaries should be wound on separate forms and inserted for the desired wavelengths. Those interested further in short wave work may refer to the Pickups and Hookups Section this month where a short wave receiver is described.

TUNING *and Regeneration by* Separate Controls

Best Methods to Minimize The Detuning Effect of Tickler

By BRAINARD FOOTE

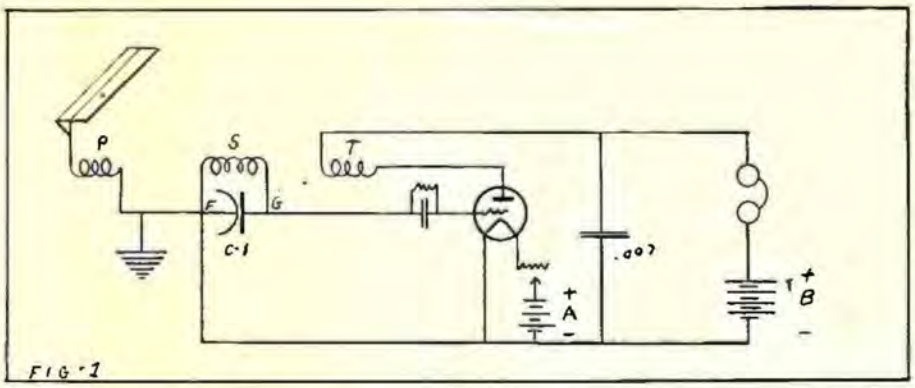


Fig. 1.—In the above circuit arrangement, the tickler detunes the secondary by the mutual inductance and capacity effects. These can be reduced by using fewer turns and smaller wire on the tickler.

THEORETICALLY, the adjustments for tuning and regeneration should be completely independent. Practically, however, these two essential controls interfere with each other more or less. Hence, when we attempt to tune in a very faint station, we find it necessary to "fiddle" with the tuning knob every time we approach more or less closely to the point of oscillation with the tickler.

If we observe carefully, we shall discover that a movement of the tickler coil such that the tube is brought nearer to the oscillation point calls for a decrease in the setting of the tuning condenser. The fact that the tickler adjustment *DOES* affect the tuning may be readily verified by noting that any motion of the tickler while the tube is oscillating changes the pitch of the whistle.

In an ideal set, the tube would go into and even past oscillation by the tickler adjustment, without any change in the wavelength. There are two outstanding causes for the detuning effect of the tickler coil. The first of these, and most serious, is due to the "mutual inductance" between the tickler coil T and the secondary coil S, Fig. 1. When the tickler is moved nearer to the secondary, or turned to have a greater inductive effect upon it, the mutual inductance is added to the natural inductance of the secondary. The result is to INCREASE the effective inductance of the secondary coil. This, in turn, requires a REDUCED capacity in the condenser C-1, to maintain the same wavelength.

Capacity Effect

THE small condenser caused by the metal in the tickler and that in the secondary coils acts in shunt to the tuning condenser and increases in capacity as the tickler is moved closer. This effect is most pronounced on short wavelengths, and to reduce it, the tickler coil should always be placed at the filament end F of the secondary, instead of at the Grid end G, as shown. The location illustrated is very common, however, even though it does cause detuning by capacity on the higher frequencies (shorter waves).

The mutual inductance effect is very marked. In the case of a loud local station, it is interesting to reverse the tickler and note how greatly the effective inductance of the secondary is REDUCED in this manner. It then becomes necessary to increase the capacity of the tuning condenser, to compensate for the reduced secondary inductance.

In any existing set connected as in Fig. 1 it is possible to minimize the detuning effect of the tickler coil in three ways:—

1. Using as few tickler turns as possible.
2. Using small wire in the tickler coil.
3. Making tube conditions favorable to oscillation.

Many sets oscillate readily with the tickler almost at zero coupling. Usually 15 to 20 turns on the tickler are sufficient. Small wire reduces the capacity effect and does not interfere with the efficiency of reception in any way. Many use wire as small as No. 30 or No. 34. To facilitate regeneration, the tube should, of course, be a good one. A by-pass condenser of .002 MFDS. is necessary, also. The grid leak should not be too low in resistance. A leak of 3 to 5 megohms is desirable for DX reception, although it is difficult to find such a leak that functions quietly. The plate voltage, in the case of almost all hard tubes, should be about 45.

Another System

FIG. 2 shows the old Weagant re-arrangement that eliminates in a most satisfying degree the tickler's detuning effect. In place of the movable tickler, a fixed tickler is adopted. The plate current from the "B" battery does NOT flow though this coil, as in Fig. 1, but is supplied to the tube by what is known as the "shunt feed" system. The audio frequency plate circuit may be followed from the filament through the "B" battery, the phones, the radio frequency choke coil X to the plate. Radio frequency impulses that provide the regeneration, pass through the variable condenser C-2, the tickler T and to the filament at F. The coil X does not allow the R. F. impulses to traverse the audio portion of the circuit.

The insert gives a cross-sectional idea

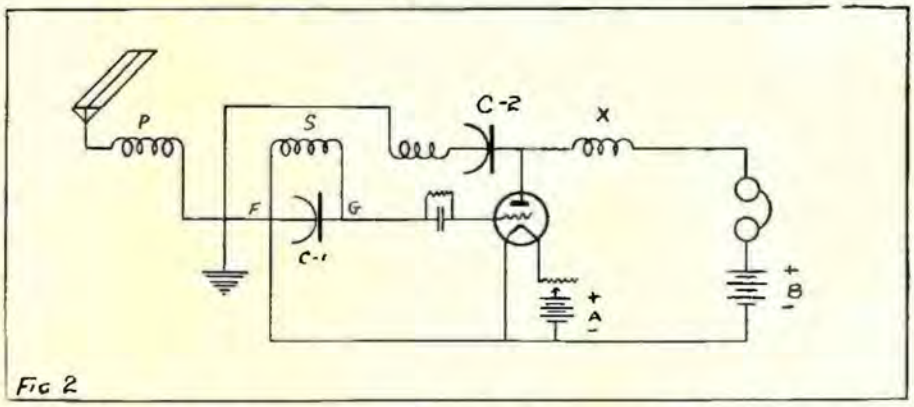


Fig. 2.—Here the plate circuit is "split" (a la Weagant) into its radio and audio frequency components. The tickler coil is fixed and regeneration is controlled by varying the strength of the feedback current with condenser C-2.

of the three-coil unit. The secondary coil S is wound on a length of dried and treated cardboard tubing about 4 inches in diameter. For utmost efficiency, this coil should be wound with No. 16 to No. 20 wire, spaced by the width of one wire and having 50 to 65 turns, depending upon the nature of the tuning condenser C-1. The primary P consists of 5 to 10 turns of the same size wire, wound on a tubing slightly larger than coil S. It is simple enough to place three or four wraps of paraffined paper over the end of coil S and wind P upon it.

Directly inside, on a slightly smaller tubing, the tickler T is placed. This consists of about 15 close-wound turns of any small size wire, No. 26 to No. 34. In this fashion, the coupling between the three coils is made close and both coils are located at the FILAMENT end of the secondary. Condenser C-2 may be of about .00035 MFDS. capacity. Choke coil X may consist of 100 turns of very fine wire, space-wound on a cardboard tube about 1 inch in diameter. This is not absolutely essential to the operation of the circuit, inasmuch as the headphones act as an R. F. choke fairly well. (No by-pass condenser is used). There is some body capacity effect introduced when omitting the coil X, not upon the tuning, but upon the setting of condenser C-2. A circuit of this character goes in and out of oscillation smoothly and with perfect control by C-2. The point of oscillation may be more or less closely approached without necessitating any change in the dial setting of C-1. As a result, tuning dial readings may be noted with extreme accuracy and even on the shortest wavelengths, a dial reading of 9¼, let's say, will always be 9¼ for a given station.

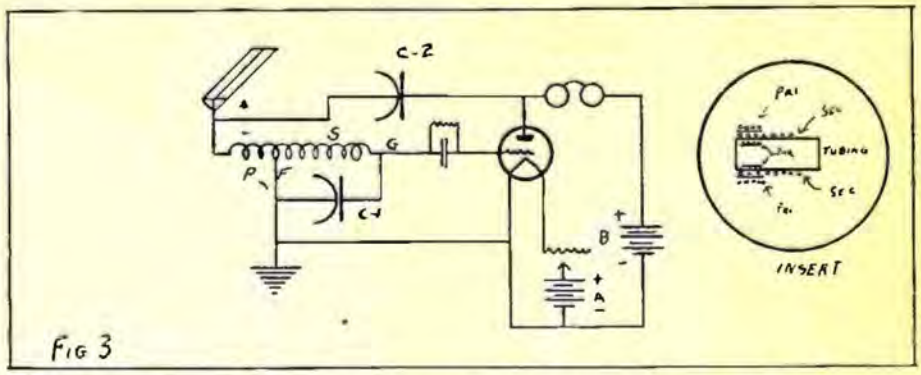


Fig. 3.—A simple modification of the circuit of Fig. 2 for those who wish to experiment with an independent form of tickler control.

Experimental Coil

A SIMPLER arrangement of the same hook-up appears in Fig. 3. Here a single coil, having one tap, is employed. The coil is 4 inches in diameter, being close-wound and having 55 turns in all, or space-wound and having about 65 turns in all. The filament tap F is taken at 10 turns from one end, with the grid connection at the other end. Thus F to G comprises the secondary and is tuned by a .0005 MFDS. variable condenser. P to F comprises the primary and also the tickler. C-2 is a .0005 MFDS. instrument also. The phones are placed to act as coil X in the previous discussion. This is a sure and simple circuit for experimentation—one in which tuning and regeneration are independent of each other.

The most successful long distance receiving set is one where the tuning dial may be carefully adjusted by one hand and the regeneration dial by the other with complete independence of action. No change in the tickler, made to add the final bit of sensitivity before the faint call letters are distinguishable, upsets the wavelength adjustment already made.

Thirty-one Ways To Prevent Oscillations

(Continued from page 12)

through a small variable condenser (C3). This is a critical adjustment for every wavelength and therefore demands a control dial on front of the panel, but it is very effective and adds to the signal strength and selectivity of the circuit.

FIG. 27. FERRAND SYSTEM. The Ferrand system not only suppresses free oscillations but it also broadens the tuning so that as many as six tuned stages of radio frequency amplification are possible without excessively sharp tuning. By ordinary methods it is difficult to handle two tuned radio stages, let alone five or six. A resistance (R) of from 5,000 to 10,000 ohms is connected in series with a fixed condenser (K) so that a limited amount of current is fed back into the grid circuit. The resistance damps down any tendency to oscillate while the condenser (K) stops the plate current and prevents it from putting a positive bias on the grid. The value of (K) is not critical and will average about 0.0001 mf.

FIG. 28. ROBERTS SYSTEM. The Roberts Reflex system employs a split primary coil which feeds back to the grid of the first tube (T1) through the small variable condenser (0.000045 mf.) marked (K1). Plate current passes through the primary half (b) and the grid current is induced in the half (a). The total number of turns in the primary is 10, with five turns in each half. The secondary (S) is wound in the usual inductive relation to the primary, and the detector tickler coil (TICK) is added for obtaining regeneration in the detector tube circuit (T2). The values of the bypass condensers are given on the drawing.

This is a very effective means of stabilizing a reflex circuit where an audio frequency transformer (AFT) is included in the grid return line. Further stabilization is obtained by the use of a "C" battery.

FIG. 29. BRIDGE BALANCE. In this circuit, the grid is balanced by means of two small variable condensers (K1-K2) the (-A) line being connected between them. When once adjusted, the condensers (K1) and (K2) need no further attention on any wavelength, and the main tuning condenser is in full control of the tuning operations. It is effective but somewhat complicated and difficult to adjust.

Grid Neutralization

FIG. 30. OLD TYPE NEUTRODYNE. In this popular circuit, the grid-plate capacity was formerly neutralized by the very small neutralizing condensers (NC) connected between the grids of the two radio frequency tubes (T1-T2) and the detector tube (T3). This was later succeeded by an alteration in the connection of the neutralizing condensers (NC) as will be shown in the following illustration.

FIG. 31. MODERN NEUTRODYNE SYSTEM. Instead of connecting the neutralizing condensers directly from grid to grid as before, one end was connected to a tap point (N) on the succeeding radio frequency transformer secondary. This gave better results and it was far simpler to make the neutralizing adjustments. The condensers (NC) are adjustable and have an exceedingly small capacity, a capacity approximately of the same dimensions as the grid-plate capacity. Once adjusted, they need no further attention until the tube wears down or until the tube is replaced by a new one.

This is very effective, but the adjustment should not be made with the intention of getting full neutralization. Regeneration must not be entirely suppressed, as this destroys the sensitivity of the receiver.

COILS WITH SELF-CONTAINED FIELDS. Excessive regeneration caused by stray magnetic fields has been largely eliminated by circular coils, thus reducing the duty on the stabilizer. However this does not eliminate the capacity feed, back between stages nor does it affect the grid-plate feed-back through the tube; hence some stabilization is generally necessary to take care of these effects. Owing to the fact that such coils are not affected by external magnetic fields, they are more selective than other types and pick up neither external waves nor internal strays.

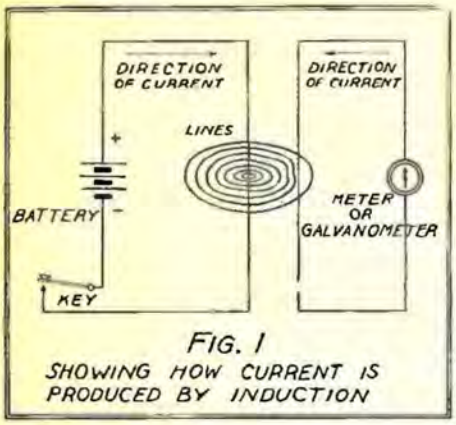


FIG. 1
SHOWING HOW CURRENT IS PRODUCED BY INDUCTION

Fathoming Radio's Deepest Mysteries

The Theory of Radio Transmission and Reception

By FRANK D. PEARNE

How Sound Travels from Microphone to Headphones is Explained By Expert

JUST how the radio program is carried through the ether to the millions of listeners is somewhat of a mystery to many. There are some listeners who do not care, th r interest being centered only upon ho they can hear these programs, what ind of a receiver is best for the purpo and how much it will cost to install sucl receiver; but for every one of this type listener, there are one hundred of the her type who want to know all about it ıd spend much of their time in trying to fathom the mysteries of the art.

The more study one gives to this subject, the more fascinating it becomes; how sound can be impressed upon the diaphragm of the microphone, changed into electrical energy and passed through thousands of miles of space to be transformed again into the same sounds which were produced before the microphone. How a wire, placed high in the air and connected through the receiving set to the ground, can collect enough of this energy to be again transformed into sound with even greater volume than the original sound at the microphone, is one of the seeming impossibilities which has been achieved by the science of radio. To fully understand how this feat is performed, one must refer back to one of the elementary laws of electricity which states that tiny lines of magnetic force surround any conductor through which a current of electricity is flowing.

Kinds of Conductors

IT matters not whether this conductor be a wire with current flowing through it, or an insulating medium, such as air, which has been broken down by a high electric pressure to such an extent that electric current is forced through it. The blaze which one sees between the carbons of an arch lamp is a flow of electrical energy made possible by so heating the air between the carbons, that it becomes a conductor instead of an insulator. Here we also find lines of magnetic force surrounding the flame although air is considered to be an insulator and therefore a non-conductor of electricity. In any event, when electricity moves, whether it be a static discharge or current produced by a battery, dynamo or any other source, these magnetic lines of force will be present.

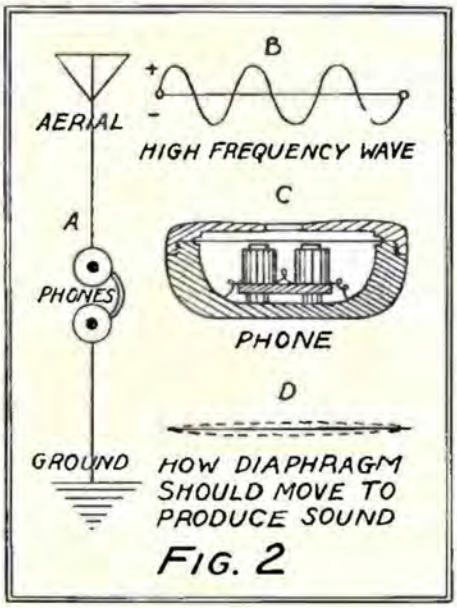


FIG. 2

According to theory, these lines are whirling around the current, the number of them, and the distance which they reach from the center of the charge, depending upon the strength of the current. Because they surround the current, they must be at right angles to the direction in which the current is flowing.

For example, if a conductor placed in a vertical position is traversed by a current of electricity, the lines of force will emerge in a horizontal plane. If another conductor having its circuit closed is placed near enough to the first one, so that it will be within the range of the lines of force, then at the time the lines move outward or fall back, they will cut through this second wire and produce a current in it. Such an action, however, only takes place while the lines are moving in or out.

Thus, as shown in Fig. 1, if the key is pressed, the circuit is closed and the lines come out in circles until they reach their maximum position, after which they cease to progress outward. If the key is released, they fall back again and disappear. Thus they only cut through the second conductor while they are moving in or out, and the meter in the second conductor will only show a deflection during this movement, which will only occur at the time the circuit is closed, or broken by the key. The current in the second wire is produced by INDUCTION. If this second circuit was not complete; that is, the electrical path was broken, then no current would be induced in the second wire because it would not have a complete path over which it could flow, and the meter would show no deflection.

Producing A. C.

WITH the circuit closed, however, when the lines move outward they cut through the second conductor in one direction and when they fall back, they cut through it in the opposite direction. Thus in one case the current produced will be in one direction and with the reverse of the cutting the current will be in the opposite direction, so that by rapidly closing and opening the key, an alternating current will be produced in the second conductor.

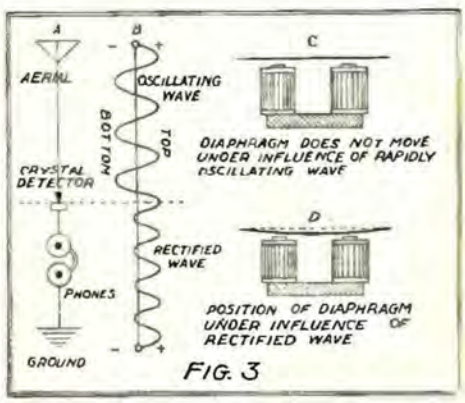


FIG. 3

So much for the elementary lesson in electricity. Let us leave this for a time and see how this principle is used in the transmission of energy from the broadcasting station to the receiving set. In the transmitter, large vacum tubes are used for setting up a stream of oscillations. An extremely high pressure is applied to the plates of these tubes and the grid and plate circuits are so arranged that one re-acts upon the other in such a manner that when this high pressure is applied to the transmitting aerial, it consists essentially of an alternating current of high pressure which alternates from several hundred thousand to a million or more times in a second. Where such high frequencies (number of

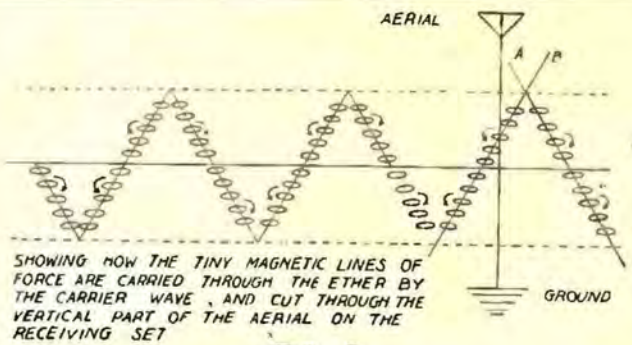


FIG. 5

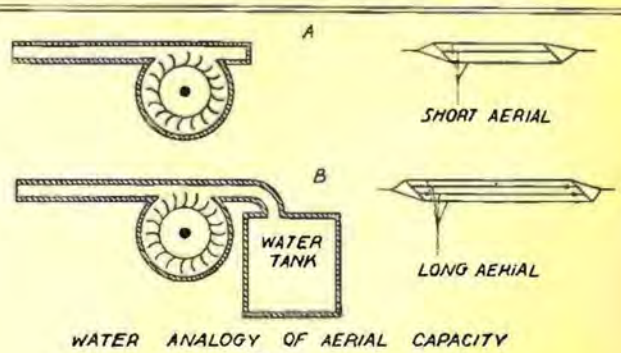


FIG. 6

alternations per second) are used, the term "alternating" is usually called "oscillating." This rapid changing of the pressure between the transmitting aerial and the earth, sets up a series of strains upon the ether, resulting in an electrostatic wave being set free from the aerial.

Such a wave is shown at "A" in Figure 4. The zero line passing through the center of the wave represents time and also the zero point from which the wave rises and falls at each time it changes direction. This is really what is known as the static component of the wave and the AMPLITUDE of the wave is the highest point which it reaches on either side of this zero line.

Now this static component is really a series of electrical vibrations which will travel freely for great distances through the ether, and by referring back to the elementary lesson, we must assume that each line of this wave is surrounded with magnetic lines of force, as shown in Figure 5. Those lines which represent one half of a wave are surrounded by lines which are whirling in one direction and those on the line representing the other half are whirling in the opposite direction. So by means of this static wave, we are able to hurl these magnetic lines through the ether for great distances. By again referring to Figure 5, it will be noted that the greater the amplitude of the wave, the more of these lines of force will be carried, and the more of them that will reach the receiving aerial. The greater the power applied to the transmitting aerial the greater will be the amplitude of the wave. To make matters easier to understand, let us consider that the greater the amplitude of the wave, the more of these lines of force will travel with it and consequently the more lines will reach the receiving aerial; therefore, in explaining the theory, we will merely refer to the wave in its two components; the static and the electro magnetic. Oscillating at such high frequencies, and if that part of the wave on either side of the zero line could be eliminated and only that on the other side was left, the time between the peaks of these oscillations would be so small that we would have practically a direct current which might be indicated by a line drawn along the peaks of the oscillations on one side of the zero line at "A" Figure 4, and eliminating the other half of the wave on the other side.

As it is, however, we might say that we have two sources of direct current, one above the zero line and another below it, but as they are opposite in direction, the direct current effect is zero, because one neutralizes the other. This is exactly the effect we would get if we connected a pair of phones between the receiving aerial and ground as shown at "A," Figure 2. The oscillations would be far too rapid to ever move a heavy phone diaphragm and if they did move it, the frequency would be entirely too high to be heard by the human ear.

It should be mentioned here that the current produced in the aerial of the receiving set is induced in it by the lines of force carried by the static component of the wave being made to cut through it, and naturally the characteristics of such a current will be the same as that which produced the wave; that is, it will be an oscillating current of the same frequency. Referring to Figure 2, ("A") shows the phone connected in the aerial circuit with no result. "B" shows the rapidly oscillating wave, changing too fast for the diaphragm to follow it. "C" shows the construction of the phones with the diaphragm stationary and "D" shows how the diaphragm should move to produce a sound which would be audible to the human ear. *(Turn to page 59)*

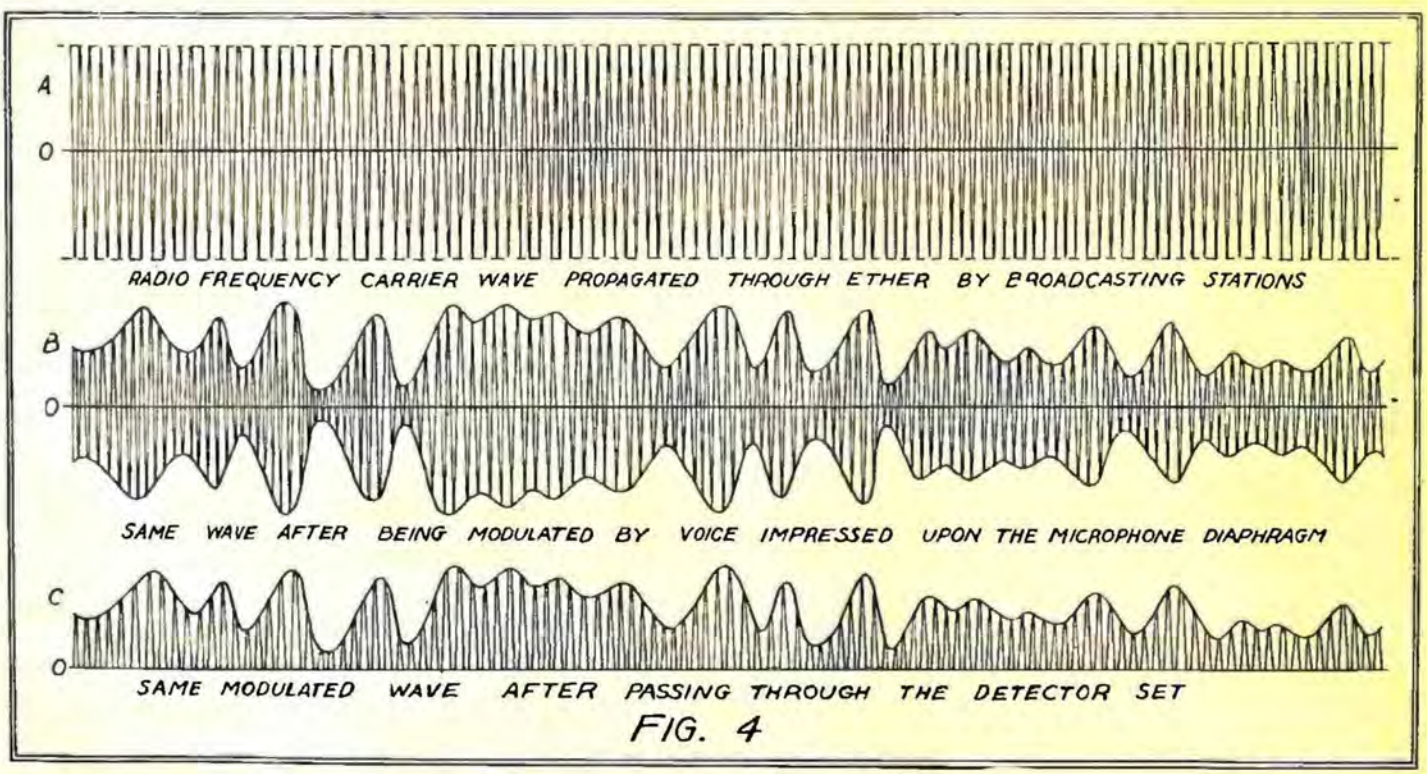
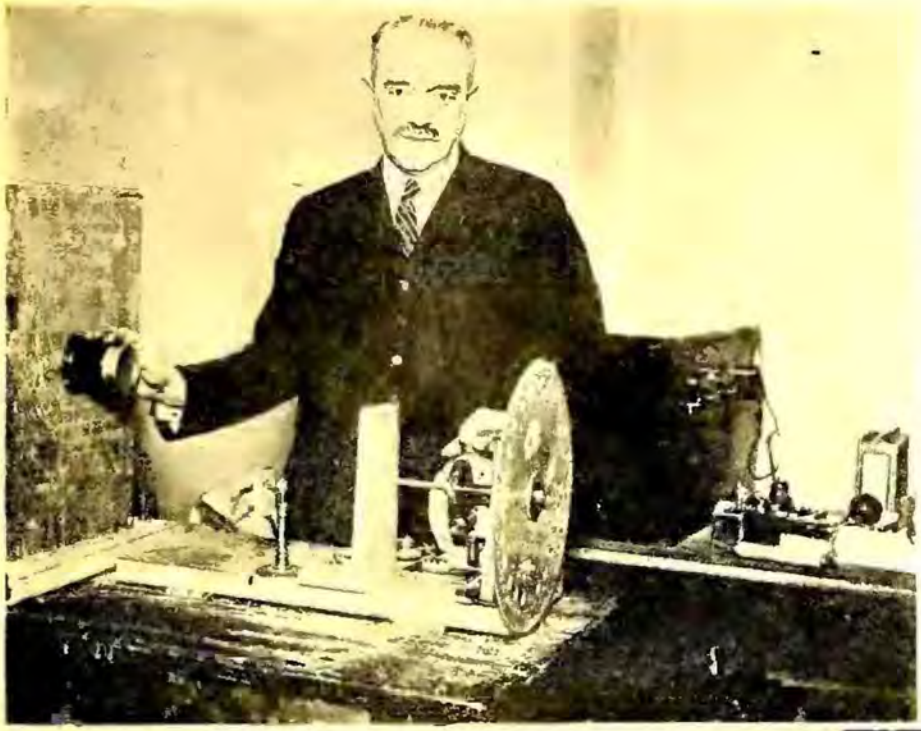


FIG. 4



C. Francis Jenkins and the prismatic ring of lens or disk whereby motion pictures were sent and received by radio.

It Now is But a Matter of Time Before the Latest in Receivers—the "Radio Vision" Outfit, Will Be in Every Home

"Television A Fact at Last," Says Jenkins

By S. R. WINTERS

This photo shows Mr. Jenkins and the motion picture projecting machine carrying a scene of a Dutch windmill, the first movie object sent and received by radio.

THE picture flashed on the screen in a motion picture theater is taken off and put back on 16 times a second, with the human eye unable to detect the rapid intermittent changes. Similarly, by means of a revolutionary invention of C. Francis Jenkins of Washington, D. C., motion pictures may now come into your home by the medium of radio waves, the picture being completed with the unbelievable swiftness of one-sixteenth of a second.

The first official demonstration was given by the Jenkins Laboratories on June 13 when the scenes of a dancing girl were transmitted to the homes of Hon. Herbert Hoover, Secretary of Commerce, and Colonel Paul Henderson, Second Assistant Postmaster General, respectively. The machines for receiving these moving objects, including views on a standard motion-picture film as well as the movements of a dancer, included a small mahogany cabinet, the lid of which contains a miniature screen. Besides this there are a small electric motor for revolving a combination of lens disk and prismatic rings, and a tiny lamp, which flickers one-half million times a second.

Radio and Sound United

THIS radio-movie set, of course, includes a radio receiving outfit, together with a loud speaker. That is to say, radio sound and radio vision have been joined together, thus giving reality to the term "radio vision" or "television." For instance, if a broadcasting station is transmitting "movies" taken from a theatre motion-picture screen, in the event that you are equipped with a Jenkins radio-movie set, in order to receive these pictures the lid of the mahogany cabinet is raised. The lid of this small cabinet or box contains a white screen upon which the motion picture appears as soon as a switch is pressed, which puts the instrument into operation. The closing of this switch not only places the radio receiving set in service but it starts the electric motor which drives the picture-receiving apparatus.

The mechanism for sending motion pictures by radio is not quite so simple as the radio-movie receiving station. First, there is the conventional motion-

picture projector, which may be found in thousands of "movie" theaters. Then there is a prismatic ring, which rotates in front of a lens, the purpose of this unit being to draw the lines which make up a picture. Of course, a picture is nothing more than lights and shadows. In line with this disk lens are two prismatic rings—a new shape in optical glass—which in revolving changes the angle of the prism. This action distributes the lights and shadows that make up a picture in successive adjacent parallel lines until the whole picture surface is covered. The process of sending a motion picture, however, requires the infinitesimal time of only one-sixteenth of a second.

Obviously, motion pictures as such are not hurled through space. The lights and shadows constituting a picture are first converted into an electrical value or current. This seemingly remarkable transformation is accomplished by a so-called light-sensitive cell, which consists of a substance (in this instance potassium), that actually changes the motion picture into an electric current. As such it is impressed on a radio-carrier wave, which is picked up by the distant radio-motion-picture receiving outfit. Then, of course, this electrical value has to be again converted into a picture value. This is done by mechanism similar to that at the transmitting station; namely, prismatic glass rings, an electric motor, and a tiny light, which is extinguished and lighted one-half million times a second.

THE whole picture surface is covered in one-sixteenth of a second; therefore, the persistence of vision of the human eye is sufficient to obtain a picture from the white screen on the lid of the cabinet of the receiving outfit. This obviates the necessity of using a photographic plate.

"When the machine is speeded up," explains Mr. Jenkins, "until the succession of lines recurs with a frequency which deceives the eye into the belief that it sees *all* these lines *all* the time, then a picture suddenly flashes on the white screen in all the glory of its pantomime mystery.

"When to this audible radio," continues Mr. Jenkins with picturesque descriptive terms, "we add visible radio, we may both hear and see great events; inaugural ceremonies; a football, polo, or baseball game; a regatta, mardi gras, flower festival, or baby parade; and an entire opera in both action and music.

"Educationally, the extension worker in our great universities may then illustrate his lecture, for the distant student can see as well as hear him by radio.

"To get pictures by radio, a sensitive cell converts light into electrical current, and at radio distances changes these currents back into light values, and one may see the distant scene; for light is the thing of which pictures are made, as music is made of sound.

"The attainment of 'television' or radio vision, as it is now coming more commonly to be called, requires that the sending shall be from a flat plane, and reception on a flat plane, and a modulation which will give not only the high lights and shadows but the half-tones as well.

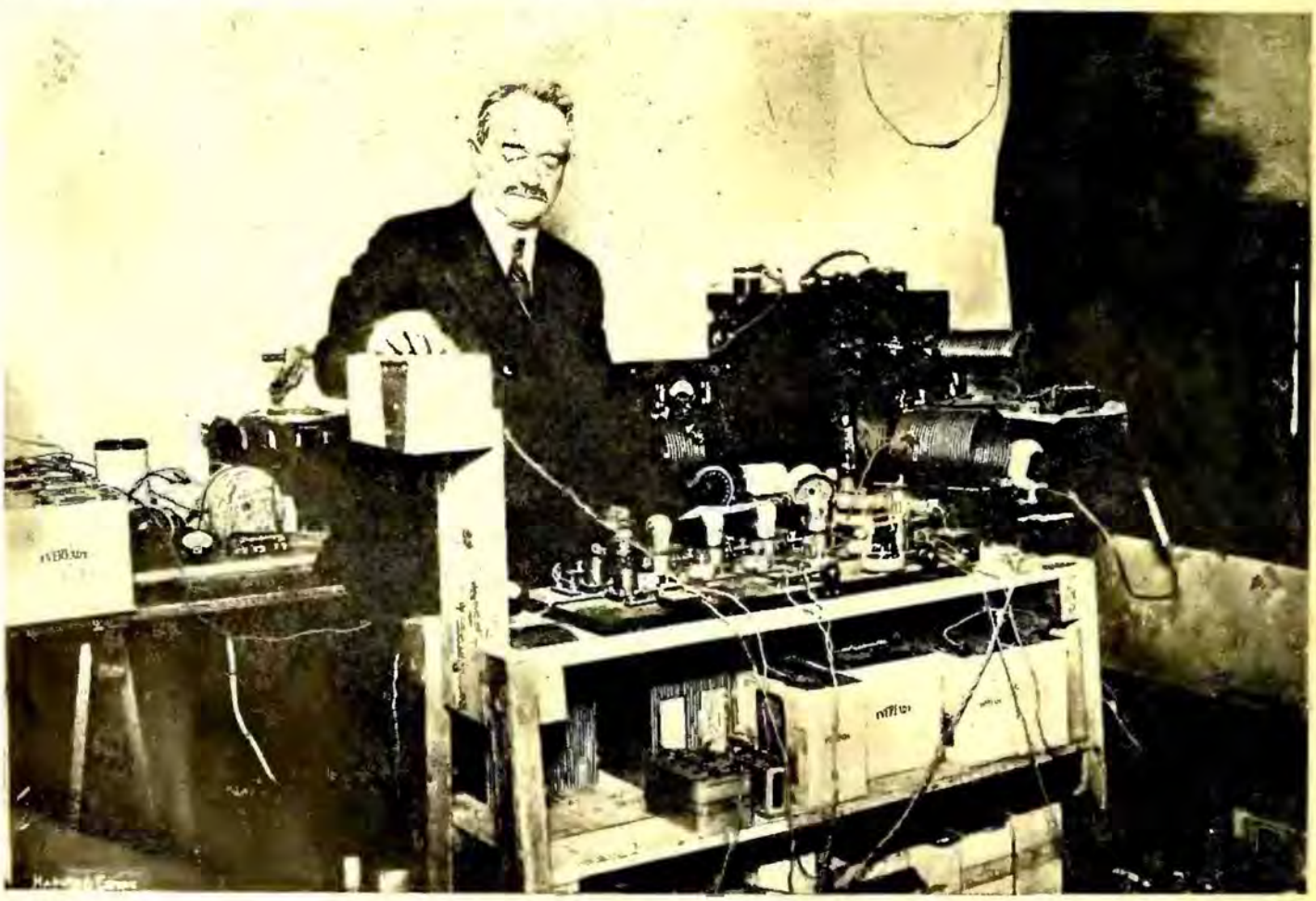
What the Future Holds

THESE flat planes may, of course, be the focal planes of the lenses employed at the receiving station, and from the focal depth of the lens at the sending station where the picture may perhaps be taken from living actors or from an outdoor scene.

"At the receiving station the flat surface may be a photographic plate, a white wall, or a miniature of the usual 'silver sheet' of the motion picture theater.

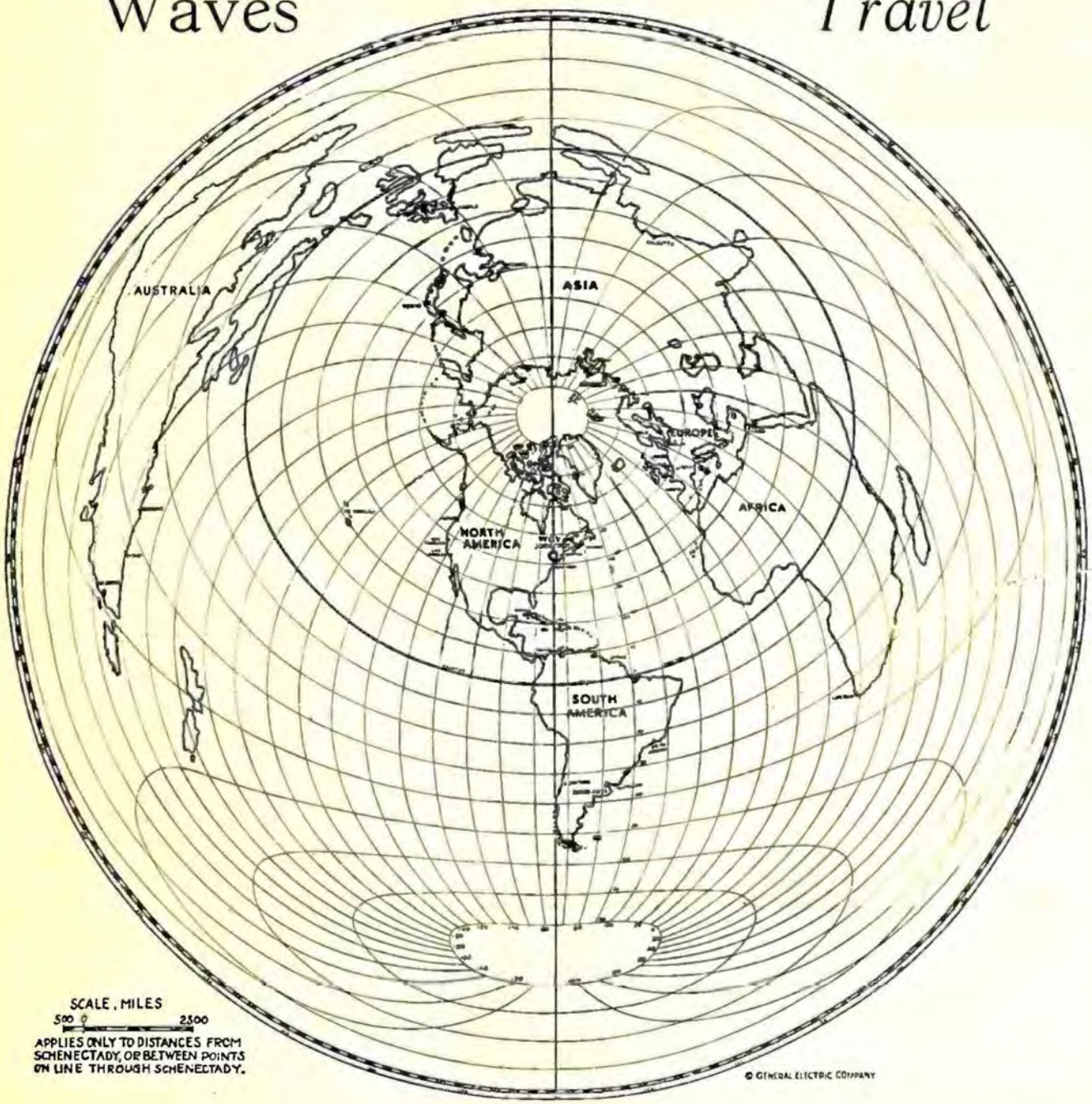
"When the 'teloramaphone' (name given radio vision mechanism) is made generally available, then pictures at the fireside sent from the distant world points will be the daily instructional class; and the evening's entertainment; and equally the long day of the sick and 'shut-ins' will be more endurable; and life in the far places less lonely, for the flight of radio is not hindered by rain or storm, or snow blockades."

Mr. Jenkins, whose ingenuity is responsible for this almost incredible scientific achievement, about thirty-five years ago invented the motion-picture projecting machines that are now used in theaters all over the world. For this lasting contribution, he was awarded a gold medal by the Franklin Institute.



The elaborate transmitting apparatus necessary to send movies over the radio waves is shown above. It is a scene from Mr. Jenkins' laboratory, which has been the home of these remarkable developments during the past year.

Unique Map Shows *How* Far *Radio* Waves *Travel*



IF YOU have ever tried to figure the distance between any point in North America and a city in Asia or South Africa, making due allowance for the curvature of the earth, you will appreciate this distorted map which was drawn for the convenience of radio engineers of the General Electric Company in interpreting transmission tests

It is known as an "equidistant zenithal projection," which means that you don't have to resort to spherical trigonometry or a slide rule to get either direction or distance between two points on the face of the earth, one point of which is the center of the map.

This map is drawn with Schenectady as a center and all measurements, to be accurate, must be from or to Schenectady. An entirely different distortion would be produced if the map were drawn with London or Melbourne as a center.

By W. T. MEENAM

The projection has three main uses. First, it gives the straight line distance between Schenectady and any other point on the earth's surface. This is obtained by measuring the distance from Schenectady to the point in question and converting this measurement in inches into miles by means of the scale at the bottom of the map.

The map is valuable, in the second place, as it shows the nature of the intervening territory between Schenectady and any other point. This is highly important for the radio engineer, for, as is well known, the distance over which radio signals can be transmitted depends, among other things, on the nature of intervening territory; that is, whether it is land or water. Distance transmission over territory three-fourths of which is water and one-fourth land is not so difficult as transmission over the same distance three-fourths land and one-fourth water.

In the third place, the map gives the exact bearing or direction from Schenectady to any other point on the earth's surface. This bearing is obtained by extending a straight line through Schenectady and the point in question to the scale on the periphery of the map which reads directly in degrees. It would not be supposed, for example, that radio signals from Schenectady would travel within a few degrees of the north pole to reach Manila.

The average person would not expect a radio wave, traveling in a straight line and the shortest distance to Calcutta, to take a north-easterly route.

Long-Range Daylight Radio Succeeds

First Results of MacMillan's Expeditions to the Arctic Really Prove Value of New Theory; Voice Reception Also Tried by Amateurs

John L. Reinartz, operator of the MacMillan Arctic Expeditions on board the schooner "Bowdoin," sitting at his short wave transmitter which is now cruising the polar regions. It is from this cabin that the radio fans of the world are receiving messages from the greatest of all Arctic exploration parties.

REPORTS received daily from the MacMillan Arctic Expedition by amateurs at various points throughout the country reveal the fact that daylight reception at long range has been proven an outstanding success.

The Reinartz short wave circuit marked a new era in radio engineering success and opens the way to enter the icebound Arctic Circle with greater safety during their long daytime of six months.

Long wave apparatus is also being carried by the MacMillan Expedition and has thus far produced satisfactory communication during darkness or night hours, but during the daytime only short range communication could be established.

U. J. Herrmann reports that the S. S. Peary received "voice" from amateurs located in the States of Alabama and Florida. Amateurs who constructed short wave receiving sets and transmitters from the diagrams of this low wave circuit report picking up messages at various intervals from the Peary and the Bowdoin signed by MacMillan.

By the first of August the Expedition was to reach and establish its principal base at Etah, Greenland. Further experimental work on both apparatus in communication with the United States will reveal a closer checkup on what may be termed consistent communication, which will then afford engineers a more comprehensive series of tests upon which to base their final conclusions. This will be followed by further tests on the part of the flyers who will leave the advance base and explore the unknown area which is expected to develop the discovery of a new continent.

The Navy-MacMillan-Zenith Radio Controversy

MUCH publicity has been given to the recent Navy-MacMillan Zenith controversy concerning the MacMillan Arctic Expedition sailing from Boston and Wiscasset without the Navy Department radio apparatus being carried and which, it has been said, was contrary to Secretary of the Navy Wilbur's instruction.

H. H. Roemer, associated with Commander McDonald's company of Chicago, gives out the following statement:

"The entire controversy, if it may be termed as such, grew out of a misunderstanding during a time when confusion prevailed at both Boston and Wiscasset when the S. S. Peary and schooner Bowdoin sailed for the Arctic.

"It was understood by Commanders MacMillan and McDonald that the Navy apparatus formerly used on board the U. S. N. S. S. Florida was to be carried by the Expedition as an additional measure of safety to the men—but, it was also understood that the Reinartz short wave transmitting and receiving apparatus was also to be included.

"The high power low frequency apparatus operating on 425 meters will function in daylight between the exploring parties when not far apart. But, on the other hand, the short wave apparatus, already a proven success in long range daytime reception, will carry farther and it is

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Commanders MacMillan (right) and McDonald (left) hold their last conference at Sydney, N. S., on board the S. S. Peary, prior to their long trek into the Arctic. McDonald, in command of the Peary, will follow a course best suited to her size and construction, while MacMillan will direct the course of the schooner Bowdoin likewise. The two ships will separate until they reach their main base at Etah, Greenland.

Presenting Radio's Most Original Program!

Jimmie Wilson's famous KFRU Catfish String Band presents a program every Tuesday evening by remote control from the banks of the old Pole Cat Creek about four miles from the station, and if you listen in on this program, you will hear the most unique and original presentation possible. For instance, you will hear the big bull frogs, the little frogs, tree owls, crickets, whip-poor-wills, hear the coffee boiling, hear the fish frying, and all of the different sounds natural to a real Summer-time fishing trip. Different, eh?

An INSPIRATIONAL *Studio*

By GALE HENRY

At the right is an artist's conception of the beautiful arrangement of Zenith's new WJAZ studio in the Straus Building, Chicago

Environment and Atmosphere Are Embodied in Elaborate New Studio Just Opened by Station WJAZ in Chicago; Impressive Scenic Effects Used

THE above picture illustrates one section of the new Zenith Broadcasting Station, WJAZ, located on the twenty-third floor in the tower of the new Straus Building, Chicago, Ill.

"Better broadcasting begins with better studios and that means environment and atmosphere"—said E. F. McDonald, President of the National Association of Broadcasters—"and we propose to prove the point."

Thus far quality reception has been considered purely a matter of acoustics, and with no thought of the more important question of environment essential to the artists' inspiration and atmosphere to excite quality rendition.

WJAZ abandoned completely the standard heavy dull drapes prevalent in almost all studios and through the country's highest rated acoustic and electrical authorities, have overcome all obstacles of echo and sound rebound without the use of the drapes and accomplished the one remaining necessity—local color and atmosphere.

Before entering the studio one comes into a reception room of unusually large dimensions—set with costly tapestries and carpetings and set in period furniture. To the right is an artistic archway within which a massive art metal gate fills in the enclosure. Flanked on either side by smaller archways are wrought iron gratings, beneath which artistically built-in benches are positioned, this room being given over exclusively as a lounge for visitors and artists.

Passing through a great archway and into the studio proper, one first comes upon a great wide veranda—giving the impression of having left the drawing room of a chateau and out into the garden.

Here the visitors are seated in exquisite lawn furniture and apart from the artists in the garden beyond. The studio proper is, in a sense, a garden surrounded by a massive wall with grilled openings and great gateways overlooking a vast area of country beyond, accomplished by certain scenic effects.

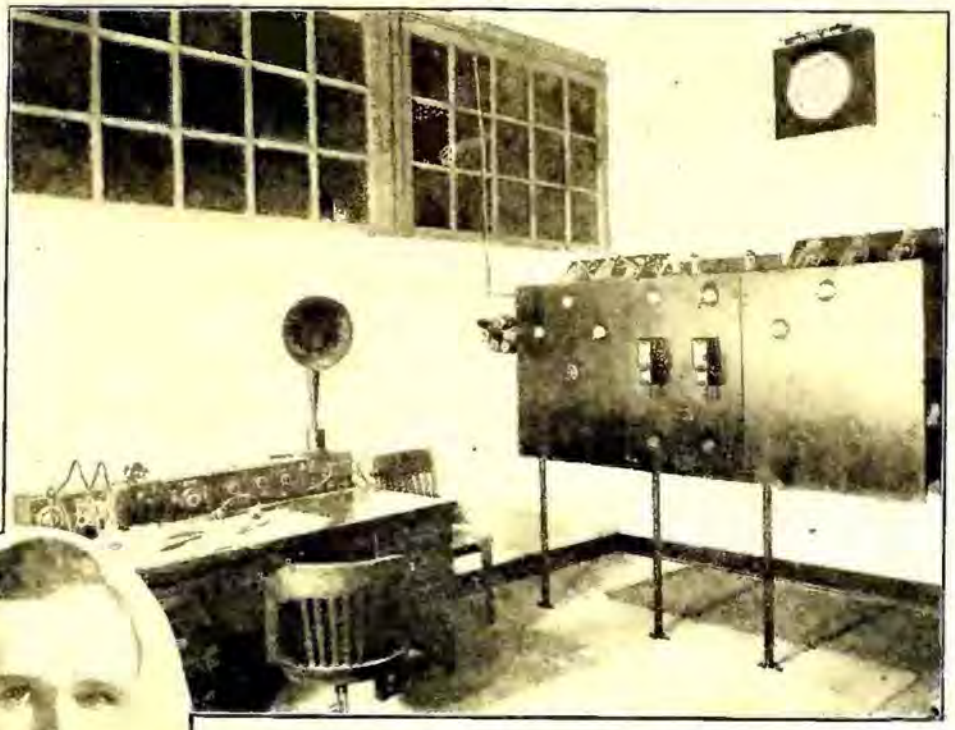
In the center stands a massive art fountain of stone which adds a touch of realism with its tiny spray of water noiselessly sparkling and enlivening the Japanese goldfish within its spacious reservoir.

The ancient tiled flooring is here and there offset by an occasional stone seat or other appropriate settings, all of which lends a touch of ancient days and a silent effect that plays upon the emotions. WJAZ, however, has not left any details to the artists' imagination. Elaborate electrical apparatus ingeniously concealed throughout the entire setting of both the garden and the veranda is operated by the property man in charge of lighting from his station, which is also hidden from view, but from which he can see the entire performance. Automatically controlled lighting apparatus is positioned scientifically to produce certain perfect effects—the operator follows the theme of the selection being broadcast, and with flood lights, fadeins and fadeouts, he produces the effect of sunrise, sunset and moonlight as in day and night—and likewise the calms and storms—all with such faithful effect and reality as start the emotions and inspires the artist's greatest effort.

One can readily picture the effect upon the artist as he feels the richness of such environment and is carried along with the theme of his role by the effect of such surroundings and lighting which so faithfully follow his emotions, while he also feels the intimate closeness of an audience actually sitting before him, midst all the richness of an ancient veranda and garden.

How Radio is *Breaking Down* Rural Isolation

By A. C. E. SCHONEMANN



The insert at left shows Prof. D. C. Faber, director of the engineering extension department at Ames (Ia.) College. He has charge of the short courses in radio at the college, which maintains Station WOI. The neat room in the picture above is the operating room at WOI.

RADIO is bringing about a social revolution in the United States, and there is no place where this is more apparent than on the farm. The farmer's life has been brightened, his interest has been increased and every member of the family circle has been enriched as a result of radio.

Of the half million or more radio sets being used on the farm today, most of them are home made. Some are crystal sets, and while there are a few with more than three tubes, the majority possess between one and three stages of amplification.

The interest in radio on the part of the farmer has been brought about largely through his own efforts. He has found in it a long sought opportunity to cancel the isolation that surrounds rural life. In radio he has an ally because through it the family relationship becomes greater, and consequently there is a common interest in the evening program, as it comes after the supper hour out of the night, via the loud speaker.

Regardless of the likes and dislikes on the part of the rural household, there is an appeal back of radio programs that extends from one end of the family to the other, and as a result radio has become firmly intrenched in the affections of young and old on the farm. Everyone, with all the diversity that taste can offer, has some feature that carries an appeal, and it is variety coupled with the personality back of the human voice, that has made radio something more than a passing attraction to the farmer. To him it is an hour of relaxation when the sweet amenities of the family are intermingled with the delightful and pleasing entertainment that radio provides.

How the College Helps

IOWA State College, which is located in the heart of the corn belt near Ames, Ia., has been a sort of evangel in carrying to the farmers of the Mississippi Valley a sense of appreciation of radio. Before the war weather reports were broadcast from the college and during the last few years the scope of its work as applied to broadcasting has increased until today Iowa State College operates Station WOI, which is a farmers' station, not only in name but in fact.

WOI is maintained for the farmer by men who have had practical farm experience. Further proof of the farmers' hold on WOI is that it functions daily "out where the tall corn grows" in central Iowa. Here farming and the kindred subjects that make for its success are taught and exemplified on a scientific basis.

The Iowa State College not only broadcasts for the benefit of the farmer, but it sponsors yearly a short course for Iowa radio amateurs. Further, it has provided a course in radio construction which has enabled the farmer and especially the boys and girls on the farm to build their own sets.

The studio of WOI is tucked away on the third floor in a brick building adjacent to Engineering Hall.

As is true of most studios, simplicity prevails at WOI. Heavy, gray draperies hang from the walls; there is a piano, several pieces of furniture, two microphones, a reception room and apartment which contains the electrical equipment of the station.

There are no great steel towers carrying the aerials of WOI, which has a wave length of 270 meters and power of 500 watts. The electrical engineering department of the college, whose members designed, built and now operate the station, have utilized a gigantic water tank which is located opposite the engineering building and a massive smoke stack situated 150 yards or more south, as towers for the aerials which carry the lead-in wires to the studio.

THE programs of Station WOI are prepared by a committee drawn from the faculty of Iowa State College, and since the opening of the station in May, 1922, schedules have been planned and carried out with but one thought in mind—the farmer. His problems and his needs have been given first consideration, the idea of the program committee being to make WOI an indispensable factor to the farmer in his work.

That WOI has carried the gospel of good farming via the ether to the farmer is evident from the thousands of letters that are received weekly from every section of the United States. While the greatest range of WOI has been 3,100 miles, and its programs have been picked up in Alaska, Samoa, Porto Rico and New Brunswick, the real interest in Iowa's 100 per cent farm station is in the Mississippi valley, where the various market reports and seasonal lectures are followed closely by the farmer.

The week-day schedule of WOI includes three weather reports presented at 9:30 a. m., 12:30 p. m., and 9:30 p. m. Another daily feature is the market reports, including grain and livestock; also various crop bulletins (state and national) together with lectures which are given by various members of the faculty at Iowa State College.

The lectures are presented in a series. They are educational and calculated to appeal to the farmer who operates on a large scale, as well as the man who maintains a garden in the back yard. Twice each week there are programs of music, one evening being devoted to the works of the masters and the other is given over to the presentation of popular music. Another feature sent out from WOI

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Everyone Tunes in California—*Because*

Distance *by Radio* Lends *Enchantment!*

By DR. FRANK L. POWER

HOLLYWOOD and Los Angeles continue to entertain radio fans all over the country with breezy chats from prominent film people and tuneful melodies from stage and screen stars who are fortunate enough to have the necessary talent.

Probably the radio programs from Southern California are no better than those in other parts of the country, but distance always lends enchantment. Then, too, so many radio enthusiasts are movie fans, also, that there is an added incentive to listen to radio programs from the Pacific Southwest.

Sylvia Breamer, talented film star, who has been charming the fans for years, has been discovered to have a "silvery voice" for radio. As a result she is in demand throughout California. She gives pleasing, interesting talks.

There's talented Sylvia Breamer, well known film star, for instance, who always enchants radioland with her silvery voice and she has taken part repeatedly in the film star program which the Wampus, official movie organization, presents on alternate Wednesdays from 9 to 10, Pacific time, at KFI.

Then, again, there's Lucille, who made countless friends in radioland by her singing, and hundreds who heard her sing have been to see her dance. When radio is developed to the extent where you can actually see the performers, then Lucille will receive many more applause cards.

Most people do not know it, but Hazel Brewster, famous harp soloist, is a sister of Victor Schertzinger, film director and composer of many popular song hits, the best known of which is "Marchetta." Hazel Schertzinger Brewster has taken part in many delightful musical hours from KHJ and KFI.

Stedman Gives Plays

MARSHALL Stedman, dramatic reader, has appeared at all of the radio stations in Southern California during the last three years, and his radio plays have won for him hearty applause cards from all corners of the globe.

With the erection of KFWB, owned by Warner Brothers motion picture studio, the raging controversy about radio displacing the films has received a sad jolt. There can be little doubt at this time but that radio will supplement and not displace the films, just as radio supplements the newspapers but does not displace them.

Carey Wilson has been giving a series of twelve radio talks on scenario writing, and he has this to say of the situation: "Radio does not endanger motion pictures any more than the present tendency toward short and skimpy skirts endangers the cloak and suit industry." Wilson, now scenario editor for the huge combine of Metro-Goldwyn-Mayer, has been in his chosen field for twelve years. He is the author of the "Ben Hur" scenario, "He Who Gets Slapped," and others, and speaks with considerable authority.

Another radio enthusiast in the ranks of the film industry is Milton Sills, who never misses an opportunity to give a little radio chat. When he was elected King of the Raisin Festival at Fresno, he accepted via radio, as did Lew Cody when he also was "King for a day."

Out in Hollywood, both KNX and KFWB are essentially film fan stations. In Los Angeles, KFI has the majority of movie celebrities on its programs, with KHJ a close second.

Bridging the Gulf

NATURALLY, the broadcasters of California during the past few months have been wondering with what success their offerings have been transmitted to the East. Several broadcasters have become discouraged and have claimed it was well nigh impossible to bridge the Rocky Mountains during the time when Static was at its worst.

So the surprise was most welcome when it was announced that several California radio stations which had trouble in being heard in their own neighborhoods were being received during the warmth of July with clear loud speaker volume, as far East as Chicago.

That is quite an accomplishment, although the type of circuit used had just as much to do with the records reported as did the power of the transmitting station.

Marshall Stedman, dramatist, has charge of radio playlets which he produces regularly from most of the Southern California stations.

Out on the West Coast There's No End to Supply of Radio Talent

Lucille, from the Turkish village in Los Angeles, has made a host of friends through California radio stations. Those who liked her entrancing voice were naturally agreeably surprised when they went to the "Village" and saw her in real life—all "dressed down" 'n everything!

The announcement that California was "coming in" with loud speaker force beyound the Rockies was spread all over the Coast, and as a result the old interest in broadcasting is being revived. It might just as well be Winter-time, judging from the number of applicants appearing at stations daily.

Recently several Eastern broadcasters decided to entertain the feasibility of broadcasting criminal and civil court trials by radio. Such a storm of protest greeted the proposal that it was hushed down before a plan could be materialized.

However, when it was learned that "Mary and Doug" of movie fame were going to testify in a kidnaping trial in Los Angeles, the Coast stations were besieged with requests to put their testimony on the air. The same requests were sent in at the opening of several other trials in California, of more or less importance.

Which all goes to prove that distance *does* lend enchantment, if it's by radio, and if the broadcaster is assured he's bridging the great open ethereal spaces.

Capturing the Artistic Spirit of France

Fine Programs from WMBB Carry Hint of Old-World Romance

By MILTON LIEBERMAN

"Get away from me, boys, you bother me!" made Clyde Hager, shown above, famous at WQJ, Chicago. Now he's equally famous as director and eccentric announcer from WMBB on the Trianon, Chicago.

Equally adept at classical or popular airs—is Miss Hazel O'Neill, the lass from Erin who enjoys the position as staff soprano for WMBB.

"WORLD'S Most Beautiful Ballroom" (that's saying a mouthful, isn't it?—but it's true) is the meaning of WMBB, the radio station on the Trianon Ballroom, Chicago, with which all mid-west radio fans have become familiar.

It's the home of Clyde Hager, the famous street fakir, and Dell Lampe and the Trianon Orchestra, of "Little Orphan Annie," "Uncle Tom's Tunes," the "Bandelero," and the most delightful entertainment that a fan has ever tuned his dial to.

The Trianon ballroom, with its wonderful elliptical dance floor, and magnificent decorations and appointments, is one of the most famous ballrooms in the world, and has made Chicago's south side renowned. The owner is Andrew Karzas, and on Cottage Grove and 62nd street, where it is located, the magnificent pleasure palace represents a dream come true.

Many years ago Andrew Karzas came from Greece, with a great deal of money to make, and very little in his exotic jeans. But it wasn't long until he built the first theater which healded the era of the gorgeous moving picture homes. It was the Woodlawn Theatre, and made of much more than seats and a screen. It was built with a grandiloquence of architectural execution, with famous paintings on the walls, and a unique lighting system, and frescoed ceiling.

His Dreams Visualized

WITH prosperity came new dreams, and the Trianon followed, designed after the style of the famous French Trianon, the pleasure palace of Queen Marie Antoinette, built by Louis XVI. It cost over a million dollars and is more magnificent than its prototype in France. And upon this palace of ballroom grandeur was constructed WMBB.

J. B. Lampe, director of the Trianon Orchestra, is director of the radio station, and Clyde Hager is announcer. Clyde Hager was taken from WQJ, where he entertained with Jerry Sullivan. His street fakir dialogue, in which he takes the part of a curb vender, selling a genuine rubber garter, and continually warning the crowd: "Keep away from me boys, you bothah me!" brought him great fame at WQJ and he frequently repeats it at WMBB, to the delight of the listeners.

WMBB, although located on the ballroom, broadcasting some of the finest jazz music which Dell Lampe and the Trianon orchestra can give, has also become famous for its classical and semi-classical music. The classical portion is given by Armin F. Hand and the Woodlawn Theatre concert orchestra which broadcasts by special wire from the Woodlawn, about three blocks away, to WMBB. The Trianon ensemble also takes part in the classical programs.

"Little Orphan Annie" has become a popular feature. It was inspired by Gray's cartoon in the Chicago Tribune, which tells the story of the little orphan of poetical fame, who "has come to our house

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The Trianon Ensemble is shown above in a jazzful mood, but jazz by no means controls their repertoire. They may be heard nightly in varied offerings from the "World's Most Beautiful Ball-room."

A Girl Reporter-Announcer Speaks Up:

RADIO IN DAYS OF YORE

Gwen Wagner, writer of this article, furnishes the above picture as ample proof that she was "Everything and a little more" in the early (and few) days of WPO, Memphis, Tenn. When she wasn't announcing she was doing 1,001 other things, a few of which are explained in this amusing article.

BY GWEN WAGNER

EVERY so often somebody feels it his bounden duty to come forth and announce sagely that radio is in its infancy.

I don't know whether people say this because they've studied the matter and have really estimated radio's possibilities, or whether they say it simply to have something with which to set their tongues in motion.

Anyway, it strikes me that the phrase is getting a bit timeworn. Radio may not have reached maturity as yet but it does seem to have at least got out of rompers.

It has been almost four years since I was radio editor, program director, studio manager, chief announcer and general roustabout for the first broadcast station in Memphis, Tenn. As I compare that first station with the ones that are now in use, it seems to me that there is nothing that has grown faster than radio in the last four years unless it be that eminent actor, Mr. Jackie Coogan.

The present-day radio stations have a staff of anywhere from 10 to 35 individuals. Our staff in those days consisted of two. My only assistant was a young chap by the name of Percy Root, who took care of the mechanical end of the station at night and, during the day, worked at something else, I don't remember just what.

So Little To Do!

FOR myself, I worked during the day as reporter on the newspaper which sponsored the station. In addition to my general assignments, I wrote all the material for the radio column, engaged the radio artists and arranged the programs. At night I went out to the studio and broadcast.

I'm not trying to steal anybody's thunder by boasting about how much work Percy and I could do. I'm merely pointing out that radio stations have, in the space of a few years, grown to where they require a staff of from 10 to 35 people, whereas in the beginning two could handle the work pretty easily!

These present-day studios have velvet hangings, deep, rich rugs, Baby Grand pianos, pipe organs, period furniture and a general air of elegance. Our station had none of these things. It was located in a stock room of the wholesale accessory house which provided our broadcasting set in return for publicity. We didn't have any rug on the floor. We didn't have any velvet hangings. All we had was a counter upon which our broadcasting set stood, an upright piano, a phonograph and a big horn. It was through the horn that we broadcast. Sometimes we had enough chairs to seat all the people who were kind enough to come up and appear on our programs, but more often we didn't.

I didn't happen to be the first radio editor and announcer in Memphis. A young man by the name of Coyle Shea, acknowledged one of the shining reportorial lights in our office, had the job for the first four weeks. At the end of that time he came into the office and announced to the publisher, editors, reporters, copy boys and the world at large that he'd be blamed if he were going to chase radio talent all day and then run out to the studio at night and tell bedtime stories to the kiddies.

A hasty survey of the rest of the staff was taken. Somebody had to be gotten in a hurry and nobody wanted the job. At last the eye of the managing editor fell upon me. I was the only woman on the staff and, I might add, the last resort in this time of trouble.

The managing editor advised me to take the job. He pointed out that I would not only meet the musical elite of the city but that I also would have $10 added to my weekly salary.

The musical elite didn't interest me but the $10 did. I took the job and thus became (as I was later exploited), "the second woman announcer in the United States and the only one in the South."

To this day I can't figure out how I ever got up nerve enough to stand in front of that gigantic horn for the first time and talk to what I fondly believed were millions of people. Had I known then what I did later, I certainly should not have been so perturbed. Our listeners could not have numbered more than a few thousand. The ones who tried to listen in on us and failed probably numbered more.

At first I didn't have much trouble getting talent. Folks were curious about radio. A good many of them were anxious to try it. What ruined us, though, was that the voices weren't received as they were sent out. In some cases I was glad they weren't. I can

remember programs when I all but prayed that the set would break down and I'd have to call off the events. In those days we didn't have the time, much less the nerve, to give trial performances. We simply had to depend upon what somebody said about Mrs. So-and-So's ability.

Wotta Life!

THE people who sang for us got it into their heads that if the horn were tipped a certain way their voices would go out better. Personally, I don't believe that anything but a complete new broadcasting set would have done any good. Nevertheless, Percy would tip the horn this way and that and the singers would teeter back and forth on their heels as they took their high notes or their low notes and it was pretty good fun to watch even if it didn't have any effect upon the way the voice was going out.

"Good-evening!" I would announce brightly, "This is radio station WPO broadcasting a program," etc., etc.

They used to tell me that the "O" sounded like a long drawn-out "ouw" coming through the air; something the way a dog howls at the moon.

If any present-day radio station would dare broadcast the programs that we used then, it would be run off the air in a week. I do not mean that we did not have any good talent. We did, but, as the late Bert Williams used to say about money, what we had was good but there didn't seem to be enough of it.

I have before me a copy of the newspaper containing a story about our station and also the first program that was broadcast from it. The story lays much stress upon the "modern equipment" of our station. Also, much seems to be made of the fact that we were broadcasting upon a wavelength of 360 meters and that we could be heard within a radius of 300 miles. The program reads as follows:

7 p. m.—Baseball results.

7:05 p. m.—News brevities.

7:20 p. m.—Cortese Bros. on harp and violin.

7:50 p. m.—Bedtime story.

8:10 p. m.—Selections on the reproducing piano.

8:30 p. m.—New records on the phonograph.

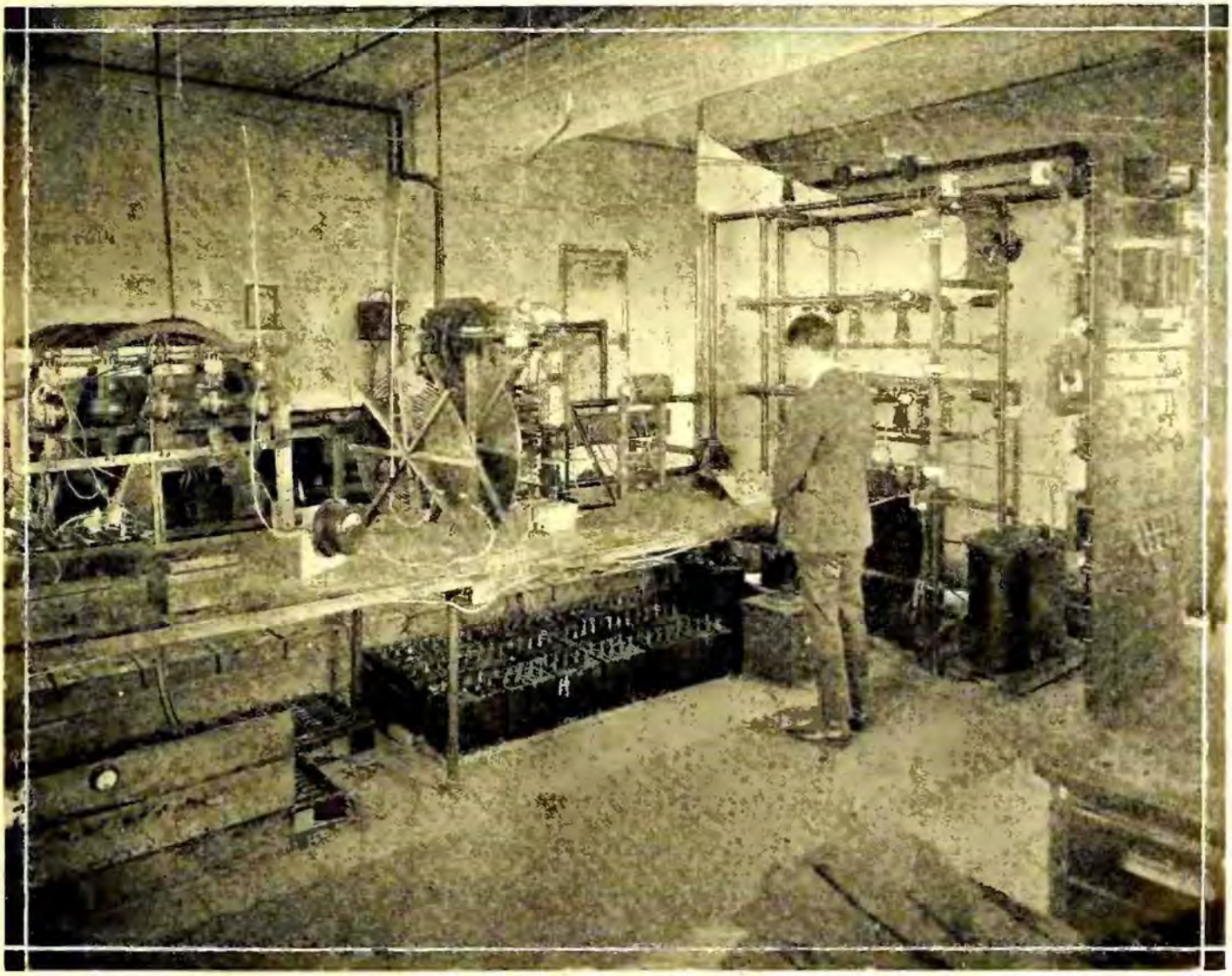
From this you can see that a large part of our programs was taken up with selections on the reproducing piano and records on the phonograph. I can remember working myself into a terrible state of nervousness one night because the music house which furnished the piano rolls and phonograph records had forgotten to change them and we had to give the same program that we had broadcast the night before.

After our station had been in operation several months, the other afternoon newspaper started a station. They profited by our experience. They fitted up a beautiful studio with thick rugs

(Tnru to page 65)

Gwen's manuscript was shown to Fred Hill, who has charge of the technical department of RADIO AGE, to see if he could better the two-people record in the operation of a broadcasting station.

Fred came back with his experience in the early days as the owner of station WHAO, at Savannah, Ga., where he performed the following functions: Owner, engineer, announcer, press agent, chauffeur, answerer of telephone, recipient of liq—— and conductor of the original "night-hawk session" which went on the air from WHAO several months before Leo Fitzpatrick came on with WDAF.



Interior of the radio broadcasting station at WGY, Schenectady, N. Y., one of America's most up-to-date radiocasts. Compare this equipment with Miss Wagner's "up-to-date" station of four years ago—and note the advance in radio during its comparatively small life.

Radio Age Contest Starts with Rush!

NEW PRIZES ANNOUNCED

Three Aero Coils to be Awarded Winner of Subscription Contest in September; Winners of August Contest to be Named in Next Issue

ALTHOUGH at the time this is being written concrete results from the prize contest announcement in the August issue have not fully materialized, nevertheless we are banking strong on the energy and persistence of those enthusiasts who have started off on the contest.

On account of the fact that material for publication in our magazine has to be prepared so far in advance, it does not seem possible to get into the September issue much data on the activity of contestants for the month of August. However, we will do our very best to print the results as quickly as possible.

As previously announced, the first prize for the radio fan sending in the largest number of annual subscriptions during the month of August is a .0005 mfd. Ultra-Lowloss Condenser made by the Phenix Radio Corp. It is pictured on page 1 of the August issue of RADIO AGE. The second prize is a year's subscription to this magazine and the third prize a six months' subscription.

For September the first prize will be a set of three Aero Coils manufactured by the Henninger Radio Mfg. Co., of Chicago, Ill. These coils are air spaced and well built. The second and third prizes will be the same as for August.

No Summer Slump

THE August number, which probably astonished you with its vast blueprint section, marks a new milestone in the journey of RADIO AGE toward higher levels in the radio publication field. That number shows both our readers and our advertisers that the deep declivity formerly noticed in Summer radio has been bridged and that instead of the proverbial Summer slump, radio activities go ahead just the same. The bulk of correspondence in the Dial Twisters and the Pickup and Hookups Sections show that our readers are not allowing Summer static to interfere materially with their pleasure. Some of the DX lists sent in during June and July would have been considered impossible two years ago. The increase in power of the many stations has brought the signal strength above the static level. Everything points to much better Summer conditions than ever before encountered.

RADIO AGE has kept pace and at times anticipated these conditions. Since the success of this Summer season is an accomplished fact, RADIO AGE is ready to go ahead with its help in making the coming Fall season the best that has ever been experienced. We are getting more readers every day; the new-stand sales are increasing; the subscriptions are coming in faster; more advertisers are taking advantage of the wonderful advertising value of our columns; altogether we are forging ahead at an exhilarating pace.

Naturally, our present subscribers and readers take pride in the prosperity and growth of our magazine, for it brings to them dividends in the form of better material, quicker access to technical data; first hand news of the broadcasting stations; and clear cut, simple and accurate blueprints from which even the rankest tyro can build a set. This pride is reflected in the activities of our readers who are taking part in this subscription contest with a view to winning some of the prizes offered every month.

The Best Is Coming

IT DOES not take much time or trouble to round up a subscriber to RADIO AGE. The August issue should alone be proof positive of our lead in the radio publication field, a lead which we intend keeping at all costs. The radio fans deserve the best in radio and as far as we are concerned we are going to see that they get it.

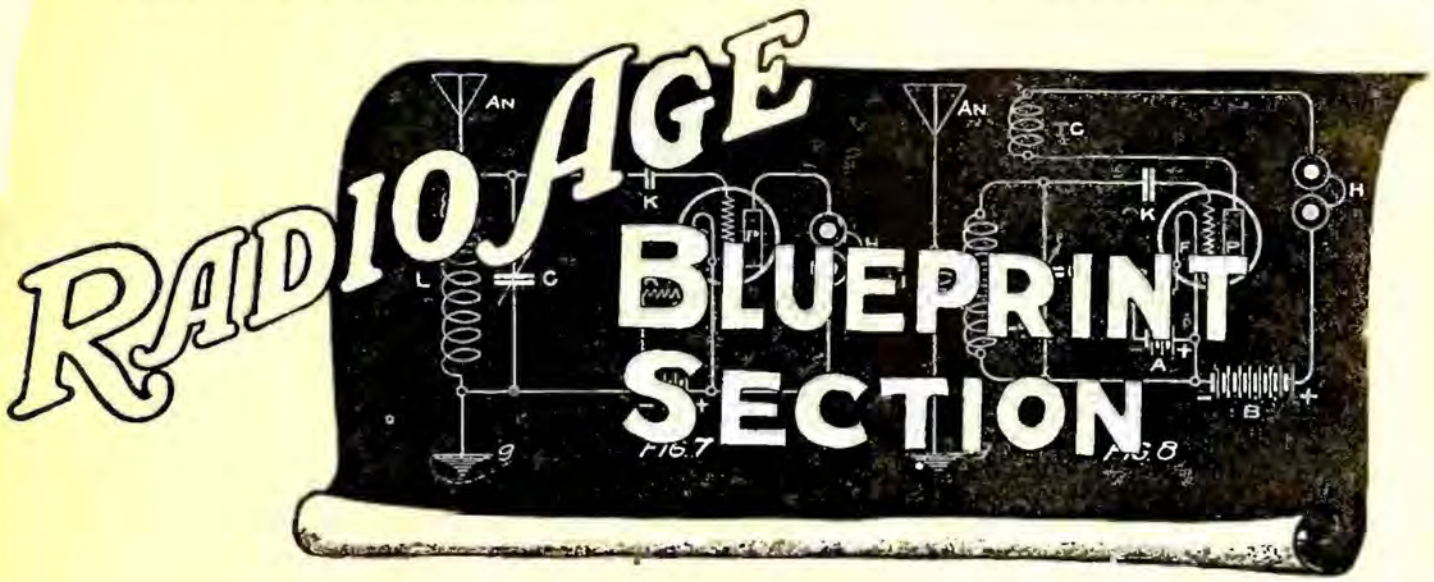
This magazine neglects none of the classes of readers, for there are classes of readers after all. The non-technically inclined can find plenty of interest in the feature articles. The tyro, by consulting our blueprints, may with ease construct a receiver of nearly any known type; the man who is unable to "roll his own" has before him in the pages of RADIO AGE a wonderful vista of the manufactured sets, the best the radio market affords. The man interested in receiving circuits alone can find them between our covers, while the transmitting amateur, known as the brass pounder, may also find solace in our pages. We serve all classes and ignore none. What better aim than that in radio?

There is no excuse for anyone holding back from participation in the most popular science of the day simply because he believes that tomorrow will bring some wonderful achievement that will nullify all the past work. Things do not come that way in the radio field. Ask some of the chaps who have been in the game since 1900 and they can tell you of the years which it has taken for radio to emerge from its chrysallis state. Of course, rapid strides are being made in the art; a poor art indeed if no progres were made.

But there would be just as much logic in refraining from buying an automobile, because it is not yet equipped with wings, as there would be to the idea that you should hold back your radio purchases for a time, because static has not been eliminated, or because you cannot have an eight tube super for $13.45, complete.

We trust some of our contestants may be imbued with some of the enthusiasm we feel for the future of the radio art and our own magazine. This same enthusiasm may be communicated to a prospective subscriber; the results will determine the depth of your own pride in RADIO AGE.

On the job, fans, let's see your stuff.



Clearing Up Difficulties in

Audio Amplifying Circuits

By JOHN B. RATHBUN

Some Very Efficient Circuits that Will Increase the Volume in All Classes of Sets

OUT of every three letters received at the offices of RADIO AGE, at least one letter reads, "Please send me a diagram showing how to add audio amplification to my present set." The audio amplification idea seems to be the most difficult of all radio stunts for the average novice, and it is for this reason that I have decided to devote this month's blueprint section to the subject of audio frequency amplification in its many branches and ramifications. With but few exceptions, these audio circuits can be applied to all types of receiving sets, increasing the volume and making loud speaker operation possible when the initial signal is strong enough in the detector stage. Except for making weak signals louder, they do not add to the distance getting qualities and therefore must not be confused with radio frequency amplification wherein the amplifying tubes are placed before the detector stage. Audio amplification simply increases the sound volume and does not increase the sensitivity of the receiver.

Before starting out with a description of the circuits, I wish to call your attention to the fact that the audio amplifiers are connected to the "output" of the detector circuit, or rather to the phone posts or jack of the detector stage. The weak signal from the detector, that would otherwise pass through your headset, now passes to the audio amplifier for amplification or "magnification." The headset is now transferred from the old detector output posts to the "output" of the audio amplifier, and at the latter point will receive the same signals greatly increased in strength. The output of the detector goes to the "input" of the amplifier, and the phones or loud speaker are then connected to the output of the amplifier.

After this connection is made to the amplifier, we then make the battery connections to the amplifier tubes in the usual way, and the job is completed. The same "A" and "B" batteries are used for both the detector and amplifier, so that no great complication is introduced at this point, but we should note that the tubes of the amplifier stages demand a higher plate voltage than is ordinarily applied to the detector tube, so that an additional block of "B" battery will be used, connected in series with the first "B" battery of the detector stage.

Single Transformer Coupled Stage

PROBABLY the simplest audio amplification unit is the single tube transformer coupled amplifier, shown in picture form by Fig. 1 of the blueprints. At the left, we have the radio receiver unit shown in dotted lines to distinguish it from the amplifier unit, and in the tuner-detector receiver is shown the single detector tube socket (D). This single "stage" of audio amplification will make the faint signals of distant stations much louder on the headset, and will permit of fairly good loud speaker volume on strong local stations, but of course is not the equal to the two stage amplifier used on the larger and more powerful radio receivers.

At the binding posts (p1-p2) we have the "output" of the detector tube (D), and this is the point at which we connect our headset with the single tube outfit. On looking carefully at the left diagram of the receiver, you will see that the post (p1) connects with plate binding post (P) of the detector tube socket (D) and that the output post (p2) connects with the (B) battery binding post. These connections are found on all single tube detector outfits and before making any connections we must find out which output post goes to the detector plate and which goes to the (+B) post. Where a jack is used for the output, we have two similar connections to the jacks which are made in the same way as to the posts.

Now we move to the right and note the first element of the amplifier, the audio transformer (AFT). This is provided with four connection binding posts, two of which connect to the ends of the primary coil (PRI), and two of which are terminals for the ends of the secondary coil (SEC). The primary posts, forming the "input" of the amplifier stage, are always marked (P) and (B). The secondary binding posts are marked (G) and (A) in this particular transformer, but the lower post may sometimes be marked (F) or (—F) with some makes. However, you may always be sure that the post (G) forms one end of the secondary in all transformers.

Now note carefully the connections

(Turn to page 36)

Blueprints of the Audio Amplifying Circuits on pages 34, 35, 38 and 39.

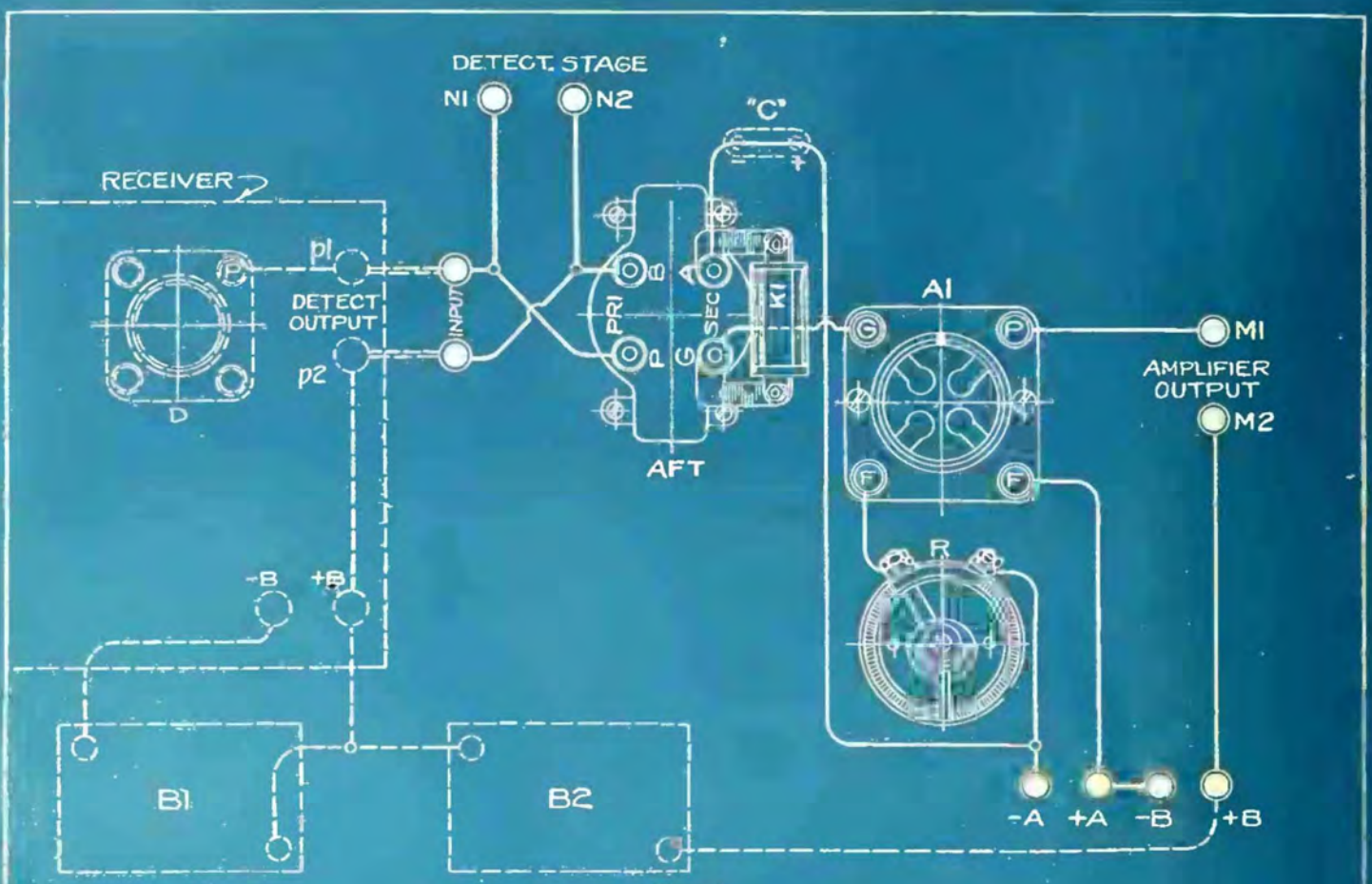


FIG. 1.

SINGLE STAGE AUDIO AMPLIFIER

THIS IS A SINGLE TRANSFORMER COUPLED AUDIO AMPLIFIER SHOWN ATTACHED TO DETECTOR (D).

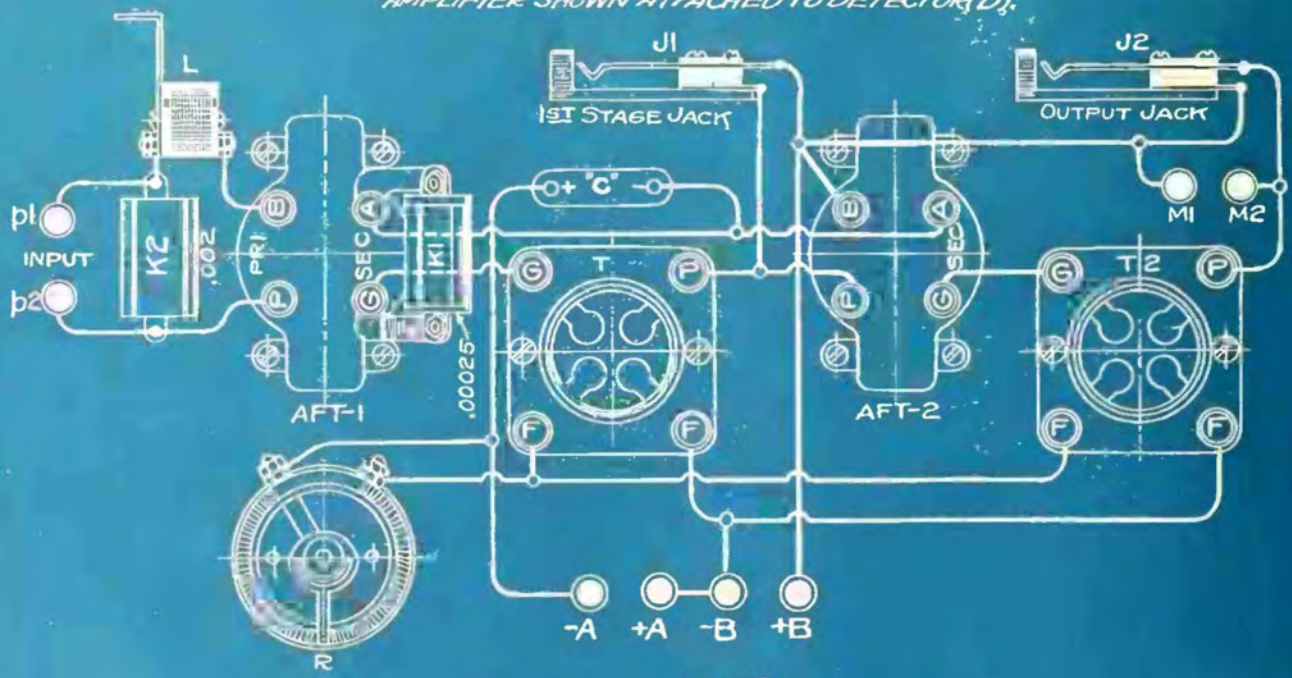


FIG. 2

TWO STAGE AUDIO AMPLIFIER

TRANSFORMER COUPLED AMPLIFIER USING A RADIO FREQUENCY CHOKE (L) AND "C" BATTERY FOR CORRECTING DISTORTION.

J.B. RATHBUN
AMP-10-12

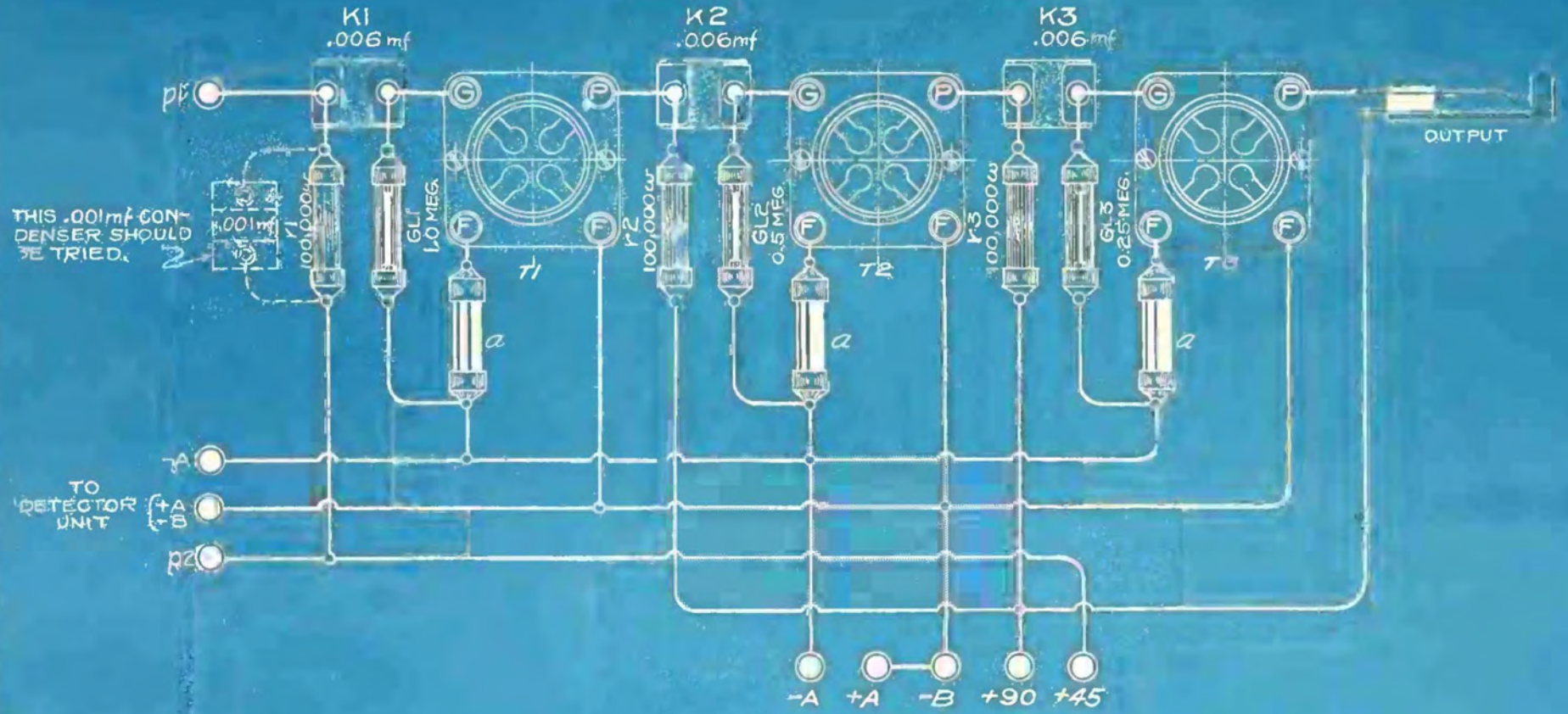


FIG. 3.

THREE STAGES OF RESISTANCE COUPLING

THE DETECTOR OUTPUT CONNECTS TO POSTS (p1 p2). THIS FIXED CONDENSER (SHOWN DOTTED) MAY OR MAY NOT IMPROVE THE PERFORMANCE OF THE AMPLIFIER; TRY IT ON TEST.

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AMP-200

(Continued from page 33)

made between the primary of the transformer and the receiving set. The transformer post (P) is connected to the phone post (p1) which in turn goes to the plate (P) of the detector tube (D). The primary transformer post (B) goes to the phone post (p2) which in turn goes to the (+B) post of the receiver. Never make the connections in any other way. Now carefully note that the (G) post of the transformer goes to the (G) of the amplifier tube socket (A1), and that (A) is connected to the (—A) filament battery line. This completes the transformer connections, and we will now complete the connections to the tube socket (A1).

A separate rheostat (R) or a fixed resistance will be required for the control of the amplifier tube (A1). One post of the rheostat (R) is connected to the left filament post (F) of the socket, while the other end of the rheostat goes to the (—A) battery post below. The right hand post (F) is connected directly to the (+A) post with the latter also connected to the (—B) battery post as shown. With some makes of sockets, the left filament posts is sometimes marked (—) or (—F), while the right hand post may be marked (+) or (+F). However, it is easy to identify the filament posts by the fact that they are opposite the (G) and (P) socket connections on all standard sockets. With the "199" sockets the arrangement is somewhat different, but the lettering is the same; hence, this should introduce no difficulties.

Saving Battery Current

AT (M1), connected to the amplifier socket post (P), and the output post (M2) connected with the (+B) battery post, we have the connections for the phones when the stage of amplification is included. It is at this point that we get the full amplification of the second tube. If we wish to listen in on the detector tube with strong signals, with the amplifier tube turned out, we then provide the detector posts (N1) and (N2) to which the phones are transferred. This saves battery current when strong signals are coming in, as we can cut out the amplifier tube, but the posts (N1-N2) are not absolutely necessary.

A small "C" battery can be connected in the (—A) line leading to the transformer if desired, and this is really of great service, as it clarifies reception, cuts down the load on the "B" battery, and somewhat increases the volume of the amplifier. In all cases, the negative (—) end of the "C" battery is connected to the (A) or (F) post of the transformer while the plus "C" goes to the negative filament line (—A). When 67.5 to 90 volts of "B" battery are used, the "C" battery should be a three cell 4.5 volt battery of the very small flashlight type or a standard small "C" battery made for this purpose. There is no current drawn from the "C," and it will last for many months without attention.

Distortion, due to the audio transformer (AFT) can usually be cleared up by connecting a small fixed condenser (K1) across the secondary posts (G-A). This should not have a capacity exceeding 0.00025 mf. or 0.0005 mf., for greater capacities cut down the volume. This condenser also eliminates many of the tube noises and the hissing and frying sounds that usually are in evidence when the output of the detector tube is amplified.

As a higher plate voltage is required for the amplifier than with the detector, we must connect in a second "B" battery (B2) in series with the original detector "B" battery marked (B1). The maximum volume is attained when the voltage applied by (B2) at the amplifier connections is 90 volts.

Two Stages of Audio

WITH two stages of audio amplification, employing two amplifier tubes and two audio frequency transformers, the volume is enormously increased over that obtained by a single stage, and loud speaker volume is had even on distant stations. So great is the amplification that we can operate a loud speaker with good volume on local stations with only a crystal detector.

The output of the detector tube of the receiver is connected to the input posts of the amplifier transformer at (p1) and (p2) as described above, always taking care that the transformer post (P) goes to the plate (P) of the detector tube, and that the (B) post of the transformer goes to the (+B) post of the detector tube. The signals from the detector enter the first stage audio transformer (AFT-1) where the voltage is increased, and the induced current is then led to the first stage amplifier tube (T-1) where the first amplification is performed. The output of the first stage tube then goes to the second stage transformer (AFT-2) and thence to the second stage tube (T-2) and to the output.

A phone jack (J1) connected across the primary of the second transformer allows us to tap in so that we obtain one stage of amplification. Plugging into the output jack (J2) or connecting the speaker permanently with the output posts (M1) and (M2) gives us the total amplification of both stages. With some local stations the volume is too great with both stages running; therefore the first stage jack (J1) is often very convenient.

A single rheostst (R) controls both amplifier tubes. This is more economical and simpler than when a rheostat is used for each stage, although the latter arrangement can also be used. By similar cross-connections between the two stages, a single "C" battery is used for biasing both tubes. The fixed bypass condenser (K1) connects across the primary of the first stage transformer only, and is of great assistance in obtaining a clear tone and noiseless operation. The value of (K1) should not exceed 0.00025 mf. or 0.0005 mf., as higher values deaden the signals and also reduce the volume. When the transformers are such that there is little distortion or noise, then it is best to avoid loss by omitting (K1) altogether.

At (L) is shown a "radio frequency choke" which does much to clear up noises and which may also increase the volume by choking back signals that would otherwise pass to the "B" battery through the capacity of the transformer primary. This choke can be a standard choke or filter coil made for this particular purpose, or it can be made at home by winding from 50 to 100 turns of No. 30 D. C. C. wire on a one inch diameter spool or tube. The choke is not absolutely necessary, but it is a protection against the howling that sometimes is started in the audio stages by radio frequency currents. The addition of a second radio frequency bypass condenser (K2) across the primary of (AFT-1) will help things still further, and when this condenser is installed, it is often possible to eliminate (K1). The capacity of (K2) is not critical and will range from 0.001 mf. to 0.0025 mf. according to the characteristics of the transformer.

The ratios of the transformers now become of importance, for they greatly affect the volume and clarity of the reception. High ratio transformers may give greater amplification on certain notes in the musical range, but they introduce much distortion and "razzing" to the detriment of the signal purity. By using a low ratio transformer (AFT-1) in the first stage, such as a 3 to 1, or 4 to 1 ratio, and a higher ratio for the second stage (AFT-2), we get the best combination of volume and tone quality. The second transformer (AFT-2) can be a 5 to 1, or 6 to 1 type, but seldom higher than the latter if excessive distortion is to be avoided. Having both transformers of a 3 to 1 ratio gives very good tone quality but the results are somewhat deficient in regard to volume.

At this point I wish to call your attention to a trouble that is generally due to carelessness in the manufacture of the transformers. In making the internal connections of the transformers, the assemblers sometimes reverse the connections to the transformer posts and this causes a continuous howl that is exceedingly annoying. This audio frequency howl can be located by touching the transformer posts with your finger. If the howl stops when you touch one of the

posts, you have located the transformer in which the wires have been reversed. The only remedy will be to reverse the connections to the primary posts of that transformer; that is, to disconnect the wire from the (P) post and connect it to the (B) post, and then connect the wire formerly attached to the (B) post to the (P) post. The outside turn of the secondary coil should always be the (G) connection, and if this is not the case, we must reverse our outside wiring to compensate for the error. Do not meddle with the internal wiring of the transformer.

Resistance Coupled Audio

RESISTANCE coupling is now becoming very popular because of its freedom from distortion and the clear, bell-like tones obtained at all points in the musical scale. The deep notes of the cello are given an amplification equal to the high pitch of the flute; a condition that does not always obtain with many commercial transformers of the cheaper makes. Of course, there are many high grade transformers that amplify without much distortion, but such transformers are rather high priced. On the other hand, the resistance coupled amplifier is open to the objection of requiring a higher plate voltage for equal amplification and usually an extra tube in the audio stages if this 135 volts plate voltage is not employed.

In Fig. 3 is shown a typical three tube resistance coupled amplifier which gives a somewhat greater amplification than obtained with two stages of transformer coupled audio on 90 volts potential. With two stages of resistance coupling the volume is usually less than with transformer coupling unless the full 135 volts "B" battery is used. In any case, the amplification is exceedingly clear and noiseless, and for the reason that the resistance units have no natural period, the circuit is not subject to the howls and shrieks sometimes met with in transformer coupled audio stages.

The plate current from the "B" battery is fed to each tube through the high resistance units or "resistors" shown at (r1-r2-r3), one resister being connected to each plate. The amplification is due to the drop of potential over these resistances when variations in the plate current take place, and as this drop is exactly proportional to the plate current regardless of the frequency, all notes in the musical scale are equally amplified. This is truly straight line amplification. The fixed coupling condensers (K1-K2-K3) are used to keep the positive "B" potential off the grids of the tubes. The values of the resistors and condensors are given on the blueprints.

As a negative bias must be given to the grids of the tubes for proper audio frequency amplification, each grid is supplied with a grid leak as at (GL1-GL2-GL3), these leaks connecting with the (—A) line of the battery circuit. The values are rather critical and the units shown in the blueprints should be closely followed for the best results. Connection to the detector stage is made by the usual input posts (p1-p2) at the left, but unlike the case with the transformer coupled stages, it does not matter which post goes to the detector plate or plus "B" post.

As supplied to the market, the resistors and grid leaks are of the cylindrical type mounted in spring clips so that they can easily be changed in experimenting and adjusting the circuit. The arrangement can be made very compact and there is a complete absence of interstage coupling by stray magnetic fields, no matter how close together the resistances may be packed. The resistors can be purchased separately and mounted on a bakelite baseboard or they may be mounted in the convenient bases specially prepared for this purpose by our advertisers.

To complete the cartridge construction, I have shown the "amperites" marked (a) which are used for the control of the filament current. The tubes are not critical to rheostatic control and therefore these fixed filament control devices can be used to great advantage instead of the usual rheostats. When the amperites are used, a battery switch (SW) must be used, but as this is also desirable with rheostats, it offers no special complication or expense.

Biasing the grids by a "C" battery adds greatly to the volume and tone, just as it does with transformer coupled amplifiers. It stabilizes the grids of the tubes, cuts down the "B" battery consumption and in many ways is a very desirable addition to the circuit. In Fig. 4 we show a resistance coupled amplifier biased by the "C" battery connected to the grid leaks of the various tubes. The negative potential imposed on the grids causes the tube amplification factor to follow the same straight line gradient as the drop of potential over the resistors; hence, we have the utmost in tone purity and a considerable effect on tube stability. Almost any voltage between 90 and 135 volts will produce terrific volume when biased in this way, and without any danger of the tubes "flopping."

Audio Amplification "De Luxe"

IN spite of the refinements mentioned in the foregoing, a further improvement can be made in the audio stages which will attain a natural quality of tone as yet unapproached by any audio amplifier described. We can obtain window rattling volume without the slightest distortion, outside of the distortion in the horn itself, by avoiding an overload on the last tube of the amplifier. With two or three stages, the last stage tube is worked up to the limit on strong incoming signals, and as a result the tube is so near its saturation point that it does not respond properly to the tone gradations imposed on its grid.

In Fig. 4 is shown the improved audio frequency amplifier. The third stage is a transformer coupled stage in which a low ratio transformer is employed. This transformer is one of the large core type now placed on the market by a number of manufacturers which introduces practically no distortion on any ordinary sound frequency. The first two stages are resistance coupled biased stages. To avoid overloading the last tube, two tubes are connected in parallel in the last stage, thus making four tubes in all. The last two tubes (T-3) and (T-4) are coupled together, plate-to-plate and grid-to-grid, so that in effect they are like a single tube. To fully appreciate the advantages of this amplifier, you must hear it in operation.

The resistance stages, together with the transformer coupled stage, just seem to afford the proper balance and give all of the amplification that can be desired even for out-of-door speakers or large halls. Even with forced amplification, the parallel tubes function perfectly without introducing "mush" and there seems to be no limit to the proper straight-line functioning of the resistor and transformers. It is more expensive than the usual layout, but then we must always expect to pay the price for perfect reception.

As both the tubes (T-3) and (T-4) must be perfectly synchronized, it will be necessary to shift the tubes about or use matched tubes so that they will work together perfectly. It is also necessary to carefully adjust the filament current to these tubes so that they will match under all operating conditions. All tubes are biased by a "C" battery or rather by two "C" batteries so that they will have perfect straight line characteristics throughout their range and also to reduce the "B" battery consumption. One "C" battery is used for the resistance coupled stages and a second "C" for the parallel connected transformer coupled stages.

In general, this adds two tubes to a receiver already equipped with two stages of audio. Thus, a conventional five tube radio frequency receiver will have seven tubes when equipped in this manner; an added expense, but well worth it when the receiver is ordinarily worked at a great volume. The primary of the transformer is equipped with the choke coil (L) for reasons already explained, and bypass condensers of the capacity noted on the drawing are also added to insure purity of tone. The casing of the transformer should be thoroughly grounded and it should be installed well away from the other tubes and apparatus so that there

(Turn to page 40)

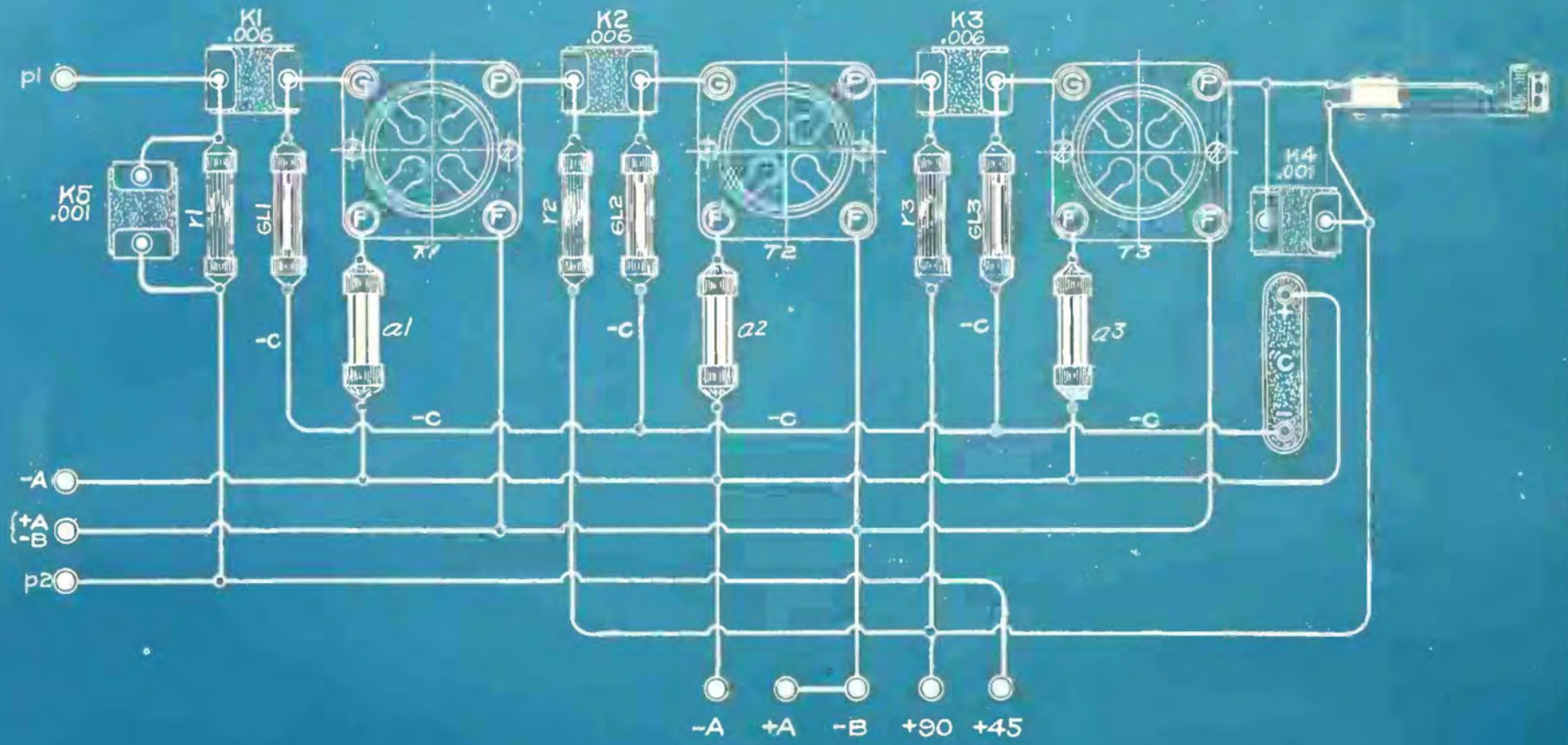

FIG. 4.

BIASED RESISTANCE COUPLING

SAME AS **FIG. 3** EXCEPT FOR THE "C" BATTERY, THE "C" BATTERY WIRES "C", AND THE FIXED CONDENSER MARKED "K4", THE LATTER BEING A .001 mf. PHONE BYPASS. CONDENSER K5 IS PERMANENT.

J.B. RATHBUN
AMP-201

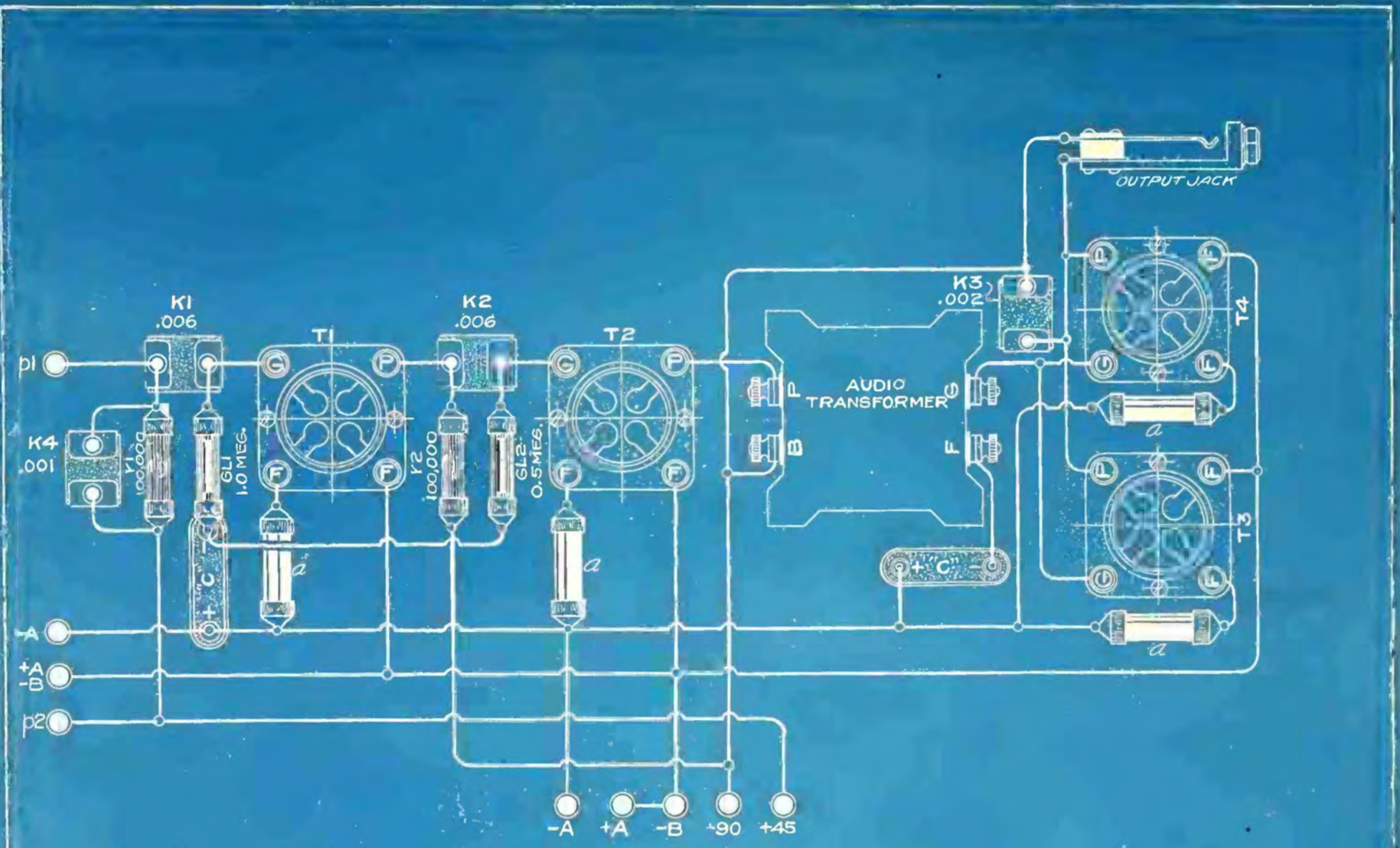

FIG. 5

FOUR TUBE COMPOSITE AUDIO AMPLIFIER

TWO INDEPENDENT "C" BATTERIES ARE USED FOR THE RESISTANCE AND TRANSFORMER COUPLED DIVISIONS.

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AMP-302

(Continued from page 37)

will be no danger from stray fields. A wet "B" battery is practically a necessity for the supply of plate current to so many tubes. A dry "B" of the largest size will soon become exhausted if the set is used to any extent. Primarily this is intended for use in halls, dancing schools and similar places where continuous service and heavy duty are the rule. For home use, the small "199" tubes will give excellent service, but they must be used with a storage battery in place of the more usual dry cells.

For the best results an independent "B" battery should be used for the four tube audio amplifier with an independent "B" battery for the detector and radio frequency tubes. This is not absolutely necessary, but it is desirable. With the same "B" for both the detector and audio amplifier, there is always some radio frequency current flowing in the audio stages which may cause disagreeable oscillations to take place in the last stages. This can be avoided to some extent by placing a radio frequency choke in the (+B) line of the common "B" battery, but even then independent "B" batteries are the best.

Audio Amplifier Troubles

The following troubles apply to all amplifier circuits as noted, and the data will be of service to those who experience trouble at this point.

1. A loud continuous, thin humming noise may be due to an open connection in the grid circuit of the tubes, or to poor contact between the tube prongs and socket springs.

2. A defective transformer winding may cause the humming above or it may cause a regular popping, knocking noise. Test out each transformer before installing it by connecting your head set and a dry battery in series with each of the coils, primary and secondary, and listening for the sharp click that denotes an unbroken coil.

3. Howling, shrieking or mushed up and distorted signals can usually be cured by applying a fixed condenser across the primary or secondaries of the transformers. The values of these condensers will depend upon the make and type of the transformers and must be determined by experiment. Try connecting the plate (P) of the last tube to the (−A) line through a 0.002 mf. or 0.006 mf. fixed condenser.

4. A crackling crashing noise, much like static, is frequently caused by an exhausted "B" battery. Better form the habit of testing these batteries occasionally with a voltmeter.

5. A continuous howl that persists regardless of the signals passing through the set, can be cured by reversing the primary wires of the first transformer. This has been suggested before. An "audio howl" can be detected by touching the transformer posts with the fingers. When the howl stops on touching the post lightly, reverse the leads of that transformer as above.

6. A ringing sound caused by striking the set may be due to imperfect socket contacts. Bend up the springs so they bear with more force against the tube prongs or else clean the socket springs with a piece of sand paper. Dry battery tubes, such as the WD-12 or the "199" will always ring or roar when vibrated. These tubes should always be provided with rubber cushioned shock absorbers to eliminate the so-called microphonic noises.

Tube Ballot Results and What They Mean

By Roscoe Bundy

WHILE our readers responded nobly in the "Tube Ballot Contest" started in the July issue of RADIO AGE, yet we would like to have a few more expressions of opinion on the subject of the number of tubes that you prefer in a radio receiving set. The more answers, the more representative will be the choice and the nearer we will come to the truth. To form any opinion on this subject, we should have at least 500 replies and we are still a long way from this number.

When I first started this contest, I rather had doubts as to the honesty of the replies, but since the ballots have started coming in I believe that they actually express the correspondent's true opinion on the subject. If they "could only afford a three tube set," they said so frankly and without any attempt at "four-flushing." This restores one's confidence in human nature. The fact that the four tube set stands high in the regard of the radio public is quite interesting to me, particularly as it overshadows the assumed leadership of the five tube receiver. If we had some more votes we could settle down on a more definite conclusion as to the relative popularity of the various circuit combinations.

Up to date, the votes give the following results:

Summary of Results

Two tubes	**00.00 Per cent**
Three tubes	**10.00 Per cent**
Four tubes	**40.00 Per cent**
Five tubes	**25.00 Per cent**
Six tubes	**15.00 Per cent**
Seven tubes	**5.00 Per cent**
Eight tubes	**5.00 Per cent**
Total	**100.00 Percent**

Our old friend, the three tube regenerative, still has its adherents. but so far we have had no entries on the one or two tube receiver, either of the regenerative or reflex type. The six, seven and eight tube super-hets have many friends, but of course this appeals to rather a limited field, principally because of the cost. One remarkable point in the compilation is the popularity of the four tube reflex, which far overshadows the popularity of the five tube radio frequency receiver. Whether this is due to our striking a big bunch of reflex fans, or whether it is really representative of popular opinion, it is difficult to say, but the ballots count out in this way in any case. Is the five tube receiver slipping or are the four tube enthusiasts recruited from the ranks of former one, two and three tube owners?

R. C. Audio is Popular

ANOTHER interesting fact was discovered, and that was, that resistance coupled audio stages have some very warm adherents. Those of the voters who had actual experience with resistance coupling were enthusiastic, and one or two devoted several pages of comments on this subject, which were highly interesting and illuminating. We invite more letters on resistors, letters giving results in full detail, and particularly information on the application of resistance coupling to reflex circuits. We rather suspect that J. H. L. of Detroit is one of these professional kidders that we meet with now and again. His choice was a fifteen tube resistance coupled super-heterodyne! Good night!

Six tube receivers show up fairly well, but not so prominently as I once thought they would. So many different combinations of coupling are possible with this number of tubes that it is impossible to analyze the votes here, but it goes to show that six tubes mark the practicable limit for quantity production, no matter what the circuit may be. Of the six tube votes, the greater number specified six tube super-hets with only a sprinkling of radio frequency circuits, and in nearly every case "199" tubes were chosen for the six tube outfits. The importance of battery current consumption is being realized, and when we get over four tubes we start to notice a prevalence of "199" tube requests.

With the "199" type tube, a four tube receiver takes 4x0.06-0.24 ampere, or a little less than the rated economical capacity of a No. 6 dry cell "A" battery. Three such dry cells in series give sufficient voltage and current for the operation of a "199" tube receiver, and this may be one reason for the popularity of this type of radio set. It has good performance and yet is within the confines of a portable set in size. Another arrangement, aside from the four tube reflex, is the three tube regenerative preceded by a stage of radio frequency amplification. The latter arrangement also seems to be in accord with the idea of many of our readers.

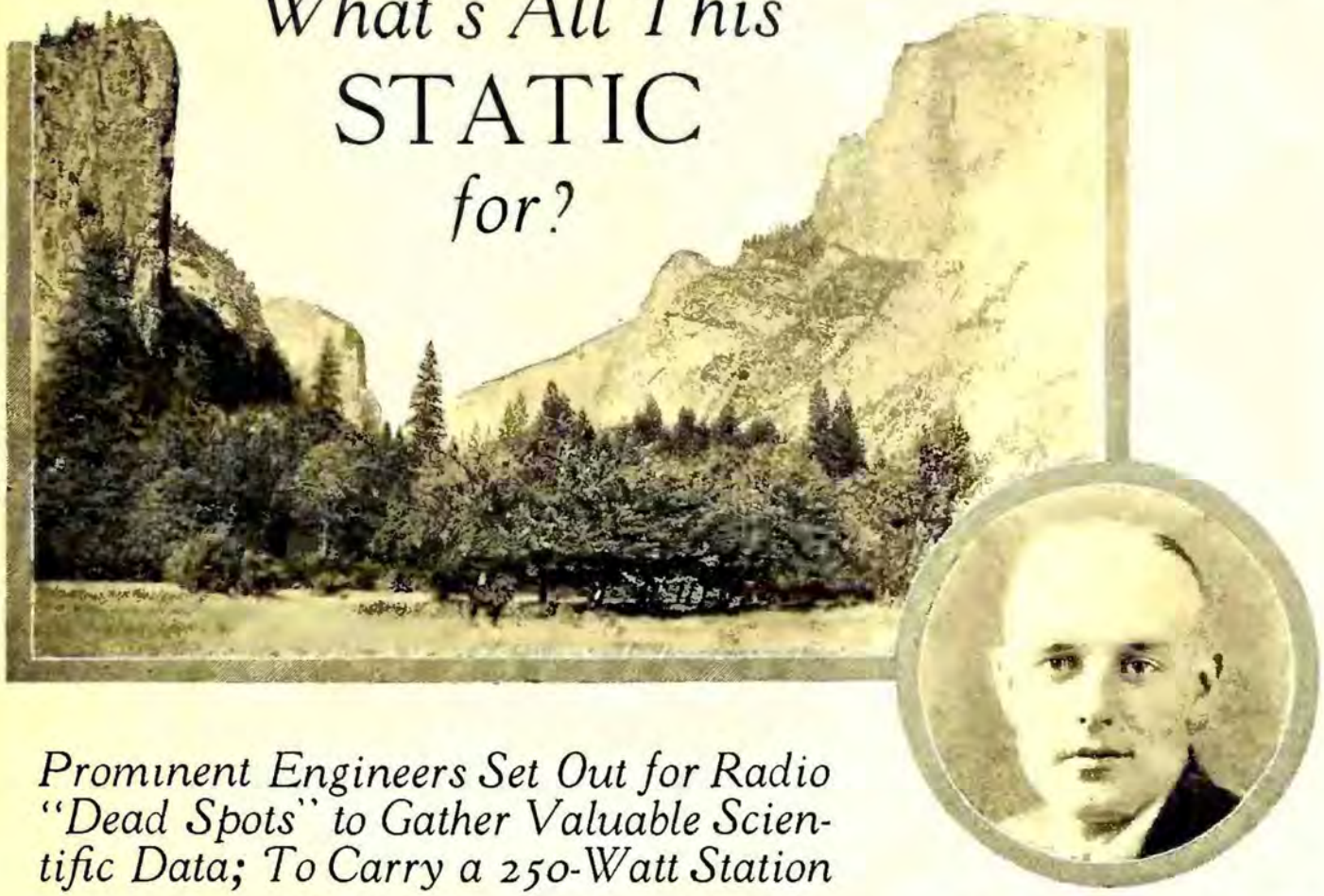
There are five tube receivers employing "199" tubes, but they are not representative of this class. The great majority use two stages of radio, detector and two stages of audio with all tubes of the 201A type. Such an arrangement gives good volume and distance, and with a storage "A" battery is economical to run, but there seems to be no real reason why it cannot also be produced for use with "199" tubes, for the current consumption of all five tubes will be only 0.30 ampere, or a little more than the rated economical load for a series of No. 6 dry cells.

When we get to the city radio owner where there are many powerful local stations, selectivity becomes the most important factor. It does no good to have a receiving set of tremendous amplifying power and sensitivity unless the tuning is sharp enough to let us slide out through local broadcasting waves. As one of our readers states, "If my three tube set gives perfectly satisfactory loud speaker volume on locals, then why should I employ a five tube set unless the 'five' tunes sharp enough to get through the local stations? If neither set is selective to get out of town, then common sense tells me that the three tube set is the logical answer for the city dweller."

In Chicago, with its fifteen local stations, this comes nearly to being the truth, for it is seldom that we can get any real distance this Summer with any sort of set with four or five stations on at one time, so why use a five tube receiver that will accomplish no more than a three tuber?

(Turn to page 61)

What's All This STATIC *for?*



Prominent Engineers Set Out for Radio "Dead Spots" to Gather Valuable Scientific Data; To Carry a 250-Watt Station

Harvey T. Kelley, Assoc., I. R. E., and one of the engineers on this interesting trip, is shown above. At the left is a scene from one of the typical canyons in California, 4000 feet high, where the expedition intends to pause for extensive tests. This region is known as a "dead spot" for radio reception.

IT has been pretty generally conceded throughout the country that this has been a real "static Summer." Of course, the super-power stations have been a boon to reception, using their increased wattage to pierce the static belt that appeared late in May and was still going strong in August.

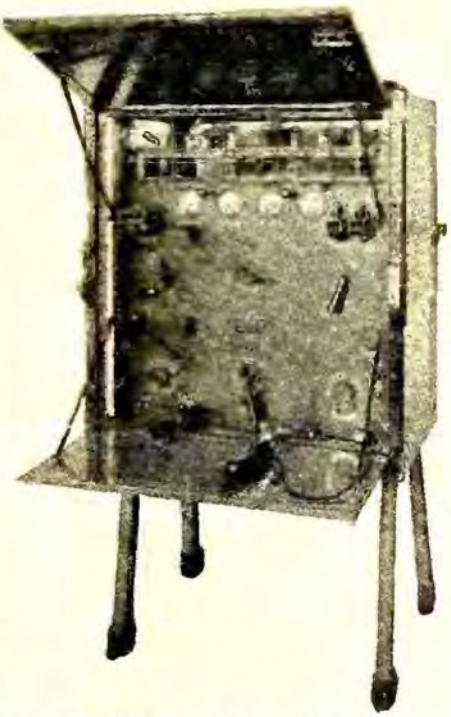
However, all the radiocasters were not super-power stations, and the smaller ones had to content themselves with being heard over a range of only a few hundred miles. In other words, the radio science seems to be no farther advanced in conquering static this season that it was a few years ago.

While Mac Millan is cruising the Arctic and attempting to establish voice communication with American amateurs during the daytime, an energetic pair of Chicago radio engineers are being original in another way; they have set out for the hot spots of America in an attempt to establish clear broadcast reception at night-time, in those portions of America where it's always warm and where static never ceases.

Off for the "Dead Spots"

THESE two engineers, Harvey T. Kelley and H. Frank Hopkins, built themselves a broadcasting station last month and are now on their way to the West; Arizona, the Great American Desert, New Mexico, and other localities where radio "dead spots" abound and where the natives who are radio fans (and there aren't many yet), have to content themselves with listening to stations within a radius of 200 miles; and it is safe to say there are not many stations within that range when you get out in the desert territory.

Financed by leading scientific and manufacturing agencies, Mr. Kelley and Mr. Hopkins set out with one avowed purpose; to find out whether it is possible in this world to develop a receiver that will pierce static, or at least minimize it. If that is impossible, they hope to learn just what circuit—not necessarily what set—performs best under such adverse conditions as they expect to encounter. It will take time, patient research and miles of weary travel to determine these objectives; but once discovered, they should be of invaluable aid to the radio world.



The engineers will take with them a 250-watt portable broadcasting station very similar to the model shown above.

Their travels will take them into the most beautiful mountain and desert countries of Western America. The portable broadcasting station is one of the most efficient of its kind ever built, containing all the latest developments in broadcast transmission. Already it has been tested with amazing results insofar as quality, distance and modulation are concerned.

Several scientific clubs have announced their intention of recording the results of this research trip in their annual reports, while many Chicago and outlying broadcasting stations will broadcast the results of the trip as it progresses, even attempting communication with the engineers from time to time.

All Set for New York Radio Fair

NEW YORK.—In the greatest city and in the largest hall in the world, the people of the most densely populated and prosperous region and thousands from distant points will pay tribute to the most marvelous of inventions, Radio, on the occasion of the second Radio World's Fair, September 14 to 19.

Who, a decade ago, dreamed of the spectacle that will greet the visitors to this tremendous exhibition? Here will be shown a thousand different conceptions of that mysterious assortment of, wires and tubes that is revolutionizing the world in the education and entertainment it is daily bringing to enthusiastic millions,—all manner of receiving sets, from the most expensive, in masterpieces of the cabinet makers' art to the little crystal sets, hardly bigger than a finger, yet large enough to stir the pride and imagination of many a future great in the field of wireless engineering.

It is an evidence of radio's unparalleled growth that the management of the World's Fair had to engage the 258th Field Artillery Armory, a Titan of space, the auditorium of auditoriums, in order that these exhibits might be housed in adequate and attractive fashion,—and all will be on a single floor. Last year Madison Square Garden, of lamented memory, was not big enough, so the Sixty-ninth Regiment Armory had also to be reserved, and now, in what will be the greatest year of radio development, five Madison Square Gardens in one,—the size of the Field Artillery Armory—have to be used. As a result, the patrons will view an amazing picture, a seemingly endless sweep of handsomely decorated booths, flashing lights, and fluttering flags, while music is played by a leading band and comes through a series of loud speakers from broadcasting stations near and far.

And right in the center, in a glass-enclosed room, will be seen a modern broadcasting room, from which will be sent before the eyes of the public, brilliant programs of vocal and instrumental music as a daily afternoon and evening compliment to the absent fans of radiodom, some of whom may be listening in a thousand miles away, catching the spirit of the occasion but bemoaning their inability to view the row upon row of new sets, loud speakers, and the various parts that go into the making of receivers.

Perhaps some of the music will reach foreign shores, for that would be appropriate, indeed, as foreign inventors will be represented with their devices, about which little is being said now but about which much may be stated when the story of the science's progress is being written. Japan and England, in addition to the leading manufacturers of America, will furnish exhibits, and more reservations from foreign shores are being made.

Befitting the international significance of the exposition and particularly in the light of radio's influence as a world factor in the cause of harmony and understanding, the fair will open with the greetings of high officials from twenty countries, which messages will be flashed through the ether as the doors are opened. These expressions frrom abroad will emphasize the service that radio is already rendering to mankind.

Public presentations of prizes to the leading announcers, to popular entertainers, and, above all, to America's Miss Radio, whoever she may be, will attract applause from watching thousands. "Miss Radio" is the girl fan of the United States who writes the best letter about her experiences in radio reception and gives the best log of stations. As soon as this contest was announced, the directors of the World's Fair learned that the country was certainly filled with feminine devotees of radio, and the idea of such a feature to the exposition aroused their commendation. "Miss Radio" will be the guest of the management in New York during the exhibit.

The Radio World's Fair headquarters are at 1475 Broadway, with U. J. Herrmann as managing director.

Now Comes the Pedigreed Radio Tube

THE buying of radio tubes has been accompanied by an almost complete absence of exact data on individual tube characteristics. Those who required matched tubes, or whose sets would not function properly unless tubes were shifted or juggled from one socket to another, as well as the thousands who have bought many tubes in order to get a few good ones, will welcome the news that it is now possible to obtain tubes accompanied by individual characteristic curves.

A. J. Musselman, well known Chicago inventor and radio engineer, working in conjunction with the Van Horne Company and its laboratories, Franklin, Ohio, has brought out a certified tube which is not only superior as to manufacturing details, but which carries with it this characteristic curve or "pedigree." The curve is packed with the tube at the factory, and is sealed into the carton, so that if the seal is unbroken the buyer may be sure he has a perfect tube, whose curve gives all of the essential details of the operating characteristics. The readings on the curve are above the standard set by leading radio engineers on high grade tubes.

Uncle Sam Coil for Low Wave "Bugs"

A recent addition to the line for the benefit of fans who desire to tune in the lower wavelength stations and the amateurs has been made by the Uncle Sam Electric Co., 214 E. Sixth St., Plainfield, N. J., in announcing their Uncle Sam low wave coil.

With a .0005 mfd. variable, the coil will tune from 37 to 150 meters. It is 2 7-8 inches by 2 1-2 inches in size and well built, using the popular space winding.

This coil has been tested in the RADIO AGE institute and was found to be satisfactory.

Pick-ups and Hook-ups by our Readers

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

Conducted by Fred Hill

WITH the departure of the MacMillan expedition for the second voyage to polar regions, interest on the part of our readers is being directed toward the shorter waves and in response to many requests for a simple circuit for the short waves, we are showing in Fig. 1 such a means.

Although it is the intention of the expedition to communicate with voice, those who rely upon telegraphic signals will probably be more fortunate in the end, and the receiver in question which is a detector and one stage is worked out on the idea of a telegraph rather than a broadcast receiver. However, it may also be used for speech if distortion of the audio transformer is not to be considered as a deterring factor.

The circuit is the familiar old Weagant circuit, about which you have undoubtedly heard considerable, although perhaps under another name. For the purpose intended, it is made capacitatively coupled to the antenna through C1 which consists of two sheets of brass or copper about half inch by half inch square with an air or mica dielectric of about one-eighth of an inch.

The secondary circuit is tuned by a .00012 mfd. low loss condenser, while the plate circuit is tuned by means of C3 which is a .00025 variable condenser, also of the low loss type. C2 referred to previously will probably be somewhat the order of a five plate condenser. The audio transformer is preferably a high ratio one peaking around a thousand cycles, with plenty of distortion and no biasing arrangement, so maximum signal strength will result.

The inductances should be wound a la Lorenz. The circle may be 3¼ inches with 11 dowel pins. For the range from 15 to 25 meters, L1 should be three turns on the form mentioned, and from 2 to 3 turns on L2. The wire is No. 18 paraffined annunciator.

For the 25 to 45 meter range 6 turns on L1 and 4 turns on L2.

For the 35 to 75 meter band 10 turns on L1 and 4 on L2.

From 60 to 115 meter band about 20 turns on L1 and 4 to 5 turns on L2.

The inductance L2 should be arranged at the filament end of L1 and after experimentation can be permanently fixed, all the regeneration and oscillation being accomplished with the variable C3, while the capacity C2 takes care of wavelength changes.

CONTRIBUTORS

Name	Address	City
Paul M. Hayes	918 Bell St	Pasadena, Calif.
L. V. Davenport	383 West 14th St	San Pedro, Calif.
Harold W. Chandler	520 Wayward Bldg	Victoria, B. C.
R. A. Ganatt	17 Lorne Rd., Stroud Green, N. 4, England.	

DIAL TWISTERS

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J. Robert Chandler	Arcade Box 1004	Los Angeles, Calif.
B. Odell	270 Ogden St	Orange, N. J.
G. L. Overton	Station G	Memphis, Tenn.
Mrs. O. E. Titus	285 School St	Berlin, N. H.
J. H. Kirkpatrick	6250 Berri St	Montreal, Que., Can
Russell J. Schembs	509 7th Ave	Peoria, Ill.
Luther Raine		Blythe, Calif.
Douglas Black		Penetanguishene, Ont., Can.
W. E. Millard	811 Kains Ave	Albany, Calif.
Frederick Greger	409 South River St	Sheboygan, Wis.
Frederick H. Pollard	85 Hawthorne St	Brooklyn, N. Y.
Frederic H. Perau	210 East 7th St	Oswego, N. Y.
Karl Hayden	Osborne Harbor, Skel Co.	Nova Scotia, Can.
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James Licitris	644 Baird St	Akron, Ohio.
D. Thompson		Galilee, Sask., Can.
George Clark	1822 N. 47th St	Seattle, Wash.
F. R. Fravel		Bollston, Va.
Anthony D. Cesare	435 Monroe St	Phoenix, Ariz.
Fred Kesemeyer		Bay City, Mich.

The grid leak should be anywhere from 6 to 8 megohms, and several should be used to make sure of getting a good one. The capacity of C4 is around .00025 or .00012 mfd. Also make sure you have a good grid condenser. Don't use a cheap one. The tube should slide into oscillation with a faint hiss instead of a plop. Change voltages on the detector B and change leaks until you arrive at this condition.

It may be of advantage to insert a choke coil in series with the plate at the point marked X in the diagram to help make the set oscillate easier. Try an air core choke of about 100 turns of No. 30 wound on an inch mailing tube. Place this tube so it does not have any inductive effect on the other inductances.

Use a UV200 for a detector and a 201-A for an amplifier. A thirty to forty foot antenna will do. Be sure to get a good ground, preferably a water pipe or else a long copper rod driven into the ground. Gas, steam, and radiator pipes are not so good, but better than nothing. A single wire counterpoise might help too.

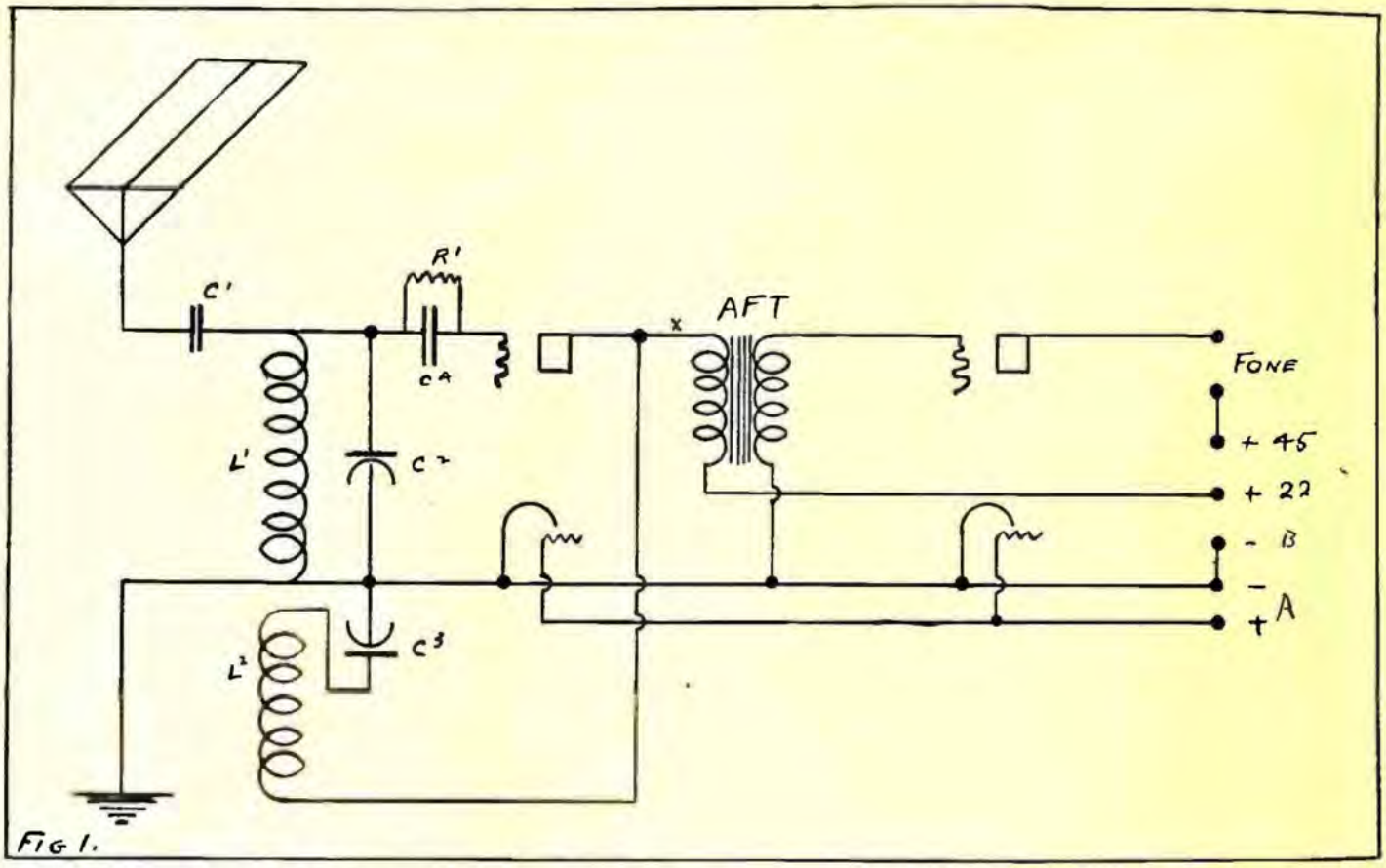
Let use know some of your results. Ninety-nine per cent of your results will probably be code stuff, although there is a possibility that the expedition will be able to shove the human voice back across the frozen expanses to civilization.

Riding the Pacific on the KDIV, known as the SS Olympic, L. V. Davenport, radio operator, at 383 West 14th St., San Pedro, Calif., hearkened to our call for dope from experimenters and sends in his pet circuit, a variant of the Weagant, which he describes as follows:

"It does not howl. I have not been able to beat note on any station with it but seem to have plenty of regeneration. In tuning the regenerator capacity, C3, is set at zero and then increased to bring up signal strength. With the values used there seems to be a point where they start to fall off again and that point is well under the point of free oscillation. This point of reception also varies with different stations and wavelengths.

"The coils were wound low loss fashion (Lorenz probably) on a four-inch form. All coils were made of No. 18 DCC and wound in the same direction, but coil L1 is connected reverse to the others. The condensers were just common good condensers without any verniers. Coil L1 20 turns; L2 45 turns; L3 10 turns and L4 45 turns. Condensers: C1 and C2 .0005 mfd variable; C3 .00025 mfd variable, C4 .00025 fixed; C5 .005 fixed bypass; grid condenser .00025 fixed. C6 is a neutralizing condenser which has not been necessary.

"The set was put together with the



Back again with the old reliable Weagant circuit, this time adapted for very short waves. The amplifier is arranged for maximum distortion so as to get strongest telegraph signals. Will do for voice if not too much attention is paid to quality. The inductances are wound a la Lorenz.

idea of controlled regeneration in both the radio frequency and detector tubes and no neutralizing. I have found that a good regenerator in the hands of an experienced operator would get about all there is to be found. Some of the so-alcled neutrodynes were not in the running at all. If any other fans try my circuit I would like to know how they make out. Ia m well satisfied with it."

Many of our readers have inquired as to the possibilities of the inside antenna. This brings back the age-old axiom that there is nothing as good as a good antenna. But if you cannot get a good antenna, there are several possibilities left for you. The attic of your house would make an ideal spot for an indoor antenna providing you have a fair length in which the wires can be strung. If you have a poor ground connection, you can experiment with a counterpoise. In the apartment buildings where an attic is not available you will find a picture moulding which can be used to anchor an inside aerial.

While it is true that your signal strength is lessened under interior conditions, nevertheless the strength of disturbing influences is generally less, too, and you may make up for lower signal strength in increased audio amplification, or if you desire, radio frequency amplification.

Gas jets, radiator pipes and other metal lines in your house are seldom as good as a water pipe which runs down into the ground and makes contact with the main. Of course, there is the loop but, as a rule it is associated with super-hets, and thus it does not always become a playmate of the one, two, and three tube owner. The advantages of the loop lie in its directional properties, which often help considerable in eliminating an undesirable station. Even tin roofs have been used for aerials and with some success where there is a considerable area of tin that is not imperfectly grounded. An inside aerial under a tin roof is not so good.

In selecting antenna wire, whether for inside or outside, a type should be selected which will not oxidize under climatic and smoke conditions. Enamel covered wire is good for this purpose if there is not to be too much strain imposed on the wires.

Writing from 2258 Bedford Ave., Brooklyn, N. Y., James R. Hartshorne sends in a list of summer reception stations, forty in all, which testifies rather eloquently to his disregard of static in the good old summer time.

Just as we were wondering whether the feminine readers of this section would ever equal in numbers those of the opposite sex, we found a letter from Mrs. O. E. Titus, 285 School St., Berlin, N. H., who relates her experiences with a set with which she has logged sixty stations. Here is her letter in full, printed to show other feminine readers of this magazine that there are some who are really interested in the game:

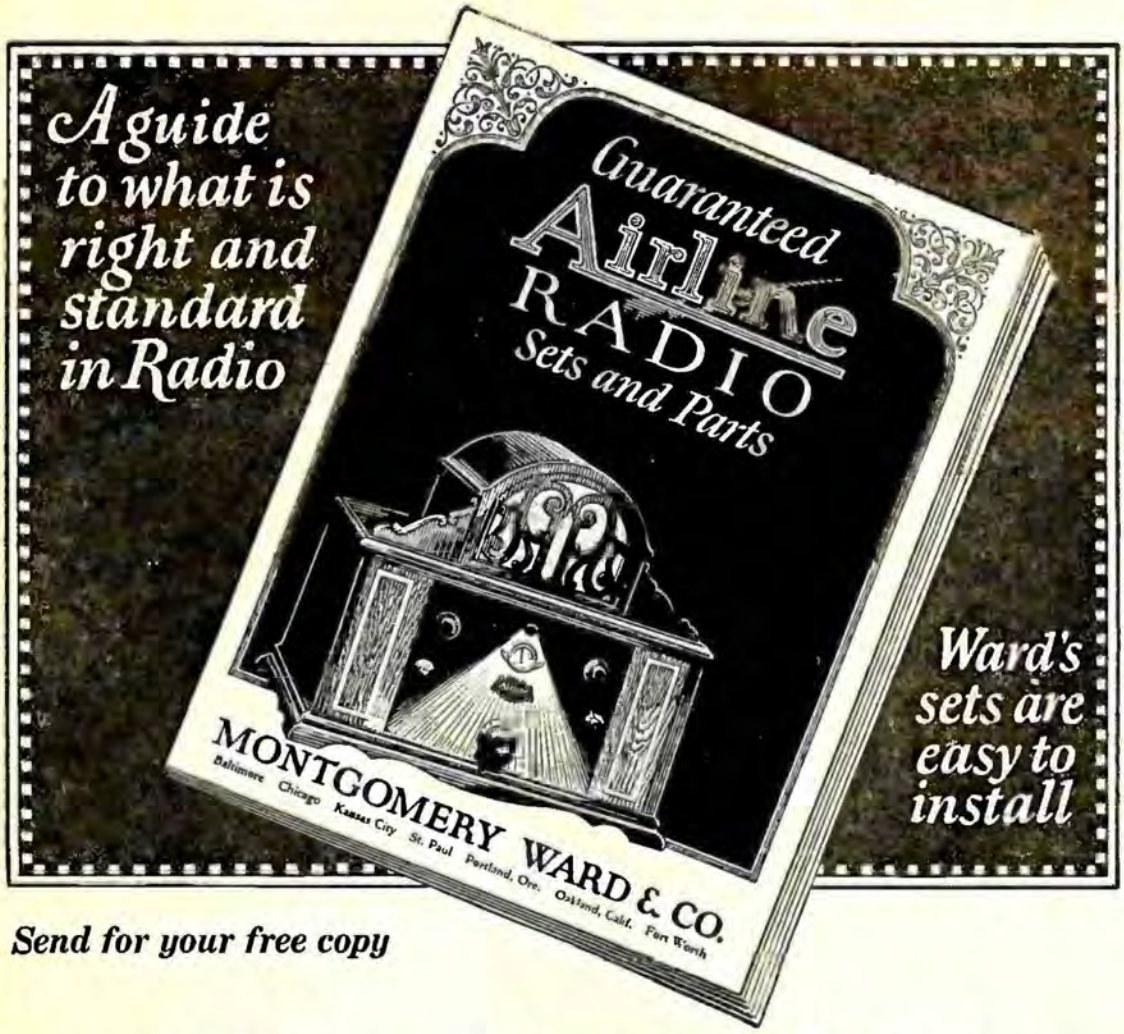
"Am wondering if the men are the only ones that have a part in the Pickups and Hookups department of RADIO AGE. About November 15 last year I began turning the dials on a Radiola III-A, the first receiver I ever used. Since that date I have been a constant reader of RADIO AGE and think as Mr. McLaughlin—

" '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.'

"Am sending a list of stations I have logged since last November. If it is of sufficient length to earn a Dial Twister's button, shall give the credit to your magazine."

It is not the length of the list which aspirants send in covering their labors that determines the award of the DT button. Rather, it is the DX work from the place in which the writer is located, and the variety of stations logged. For example, a radio fan in Chicago could get up a pretty good list of stations using the Chicago stations alone, since there must be nearly two dozen of them. But such a list would hardly win a button. On the other hand, if the same individual were to send in a list showing one of the furtherest Canadians, a Mexican, a Cuban, couple of Californians, and the East Coast, he would stand a much better chance of getting the button. So it's not the length of the list, but rather the amount of energy and initiative in going after the elusive ones. We hope there are more letters from readers like Mrs. Titus.

According to advices from the Department of Commerce, a Mr. Midali, of Italy, who has been working on trans-



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mission of electrical energy for power purposes for the last five years, has developed his findings to such a point that the experiments are a laboratory success and only await commercial adaptation.

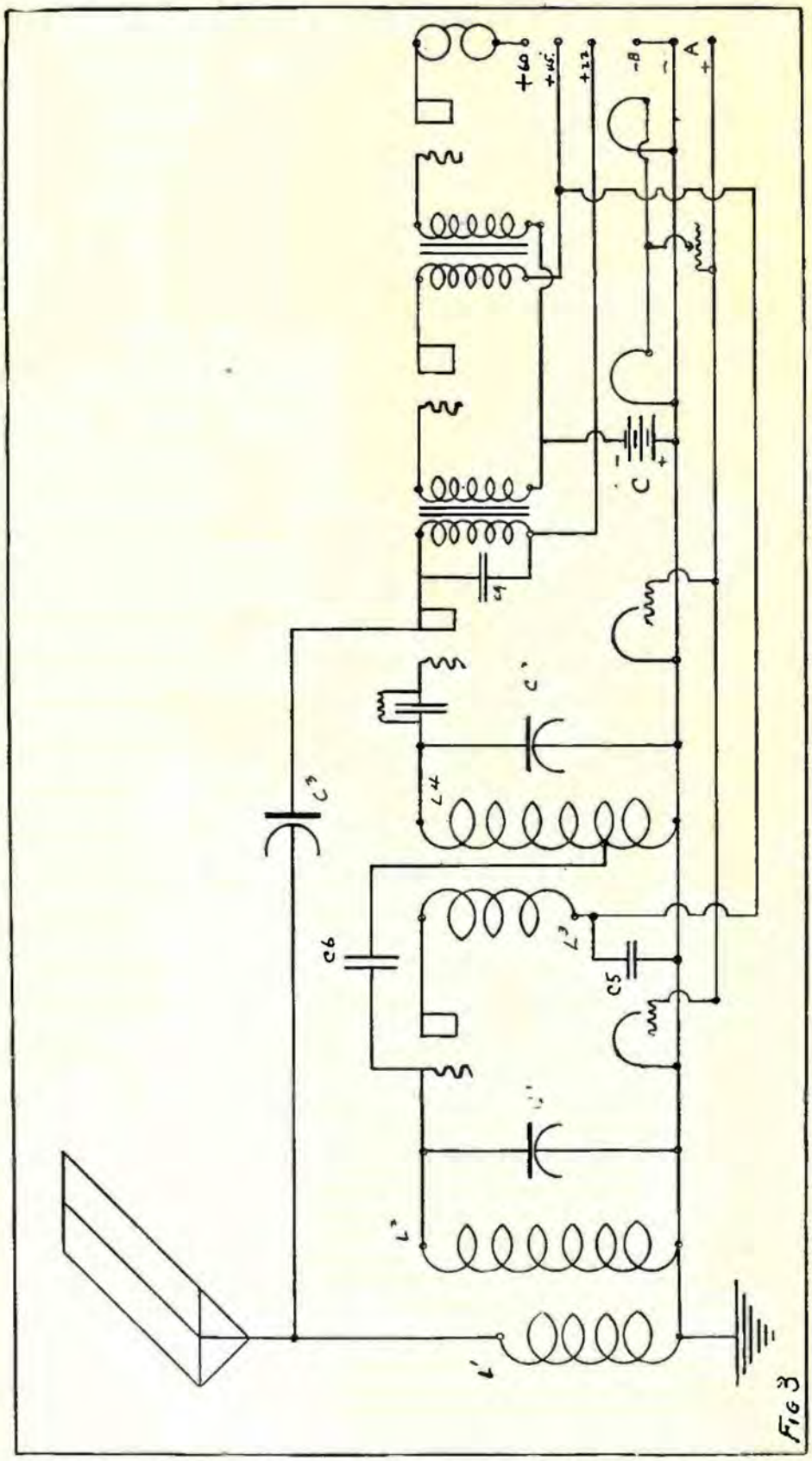
An article in "La Stampa," an Italian journal which has been translated by the Department of Commerce says:—

"The result obtained is that of transmitting electric energy in the form of alternating current without excessive losses, but in reality the electric energy is not transmitted as such. Instead, the system transforms the electric energy into very short electro-magnetic waves of about one-millionth of a centimeter. These waves must be about the size of light waves and have nothing in common with the Hertzian waves used in radio communication.

"These extremely short waves, literally called vibrations of the electrons, constitute the means by which the electric energy is transmitted to a distant receiving set which in turn transforms them into electric current of identical characteristics of that used in the transmitter."

The report further states it is noted in the experiments no difference of potential exists between the antenna and the ground despite the utmost efforts to detect such potential by means or electrodynamic, electro-magnetic or electrostatic devices of a sensitive nature. It is also claimed by this means polyphase currents may be transmitted.

Further reports are awaited with considerable interest in the United States, where the power transmission scheme of Tesla, years ago, excited wide interest from its novelty. So far all schemes have depended upon resonance of the transmitter and the receiver, whereas in the Italian report it is stated the system does not depend upon resonance between two circuits as the word resonance is understood in radio circles.



L. V. Davenport, radio operator on the KDIV, SS Olympic, on the Pacific, sends in his contribution for the benefit of RADIO AGE fans. It is a variant of the Weagant and is arranged so no neutralizing capacity is required, although one is shown in the drawing. The coils are wound Lorenz fashion on a 4-inch form and wound with No. 18 DDC wire. Regeneration is controlled by means of capacity C 3 which is a .00025 variable condenser. With this set the tendency to oscillate is held in subjection and with the values given, Mr. Davenport gets excellent results on all waves within the broadcasitng band.

Anthony D. Cesare, 435 East Monroe St., Phoenix, Ariz., sends in a list of stations received on a two tube reflex, more or less destroying the fallacy that desert countries are not good for radio communication.

Harold W. Chandler, secretary of the Victoria Radio Club at Victoria, B. C., sends us a copy of a letter from the club in which it goes on record as favoring the abolition of all radiating receivers. The letter is in the form of a memorial to the Dominion government of Canada, and reads as follows:—

"Whereas in the opinion of the members of the Victoria Radio Club the use of radiating sets had become a public nuisance, it is the opinion of this Club that government action should be taken.

"We believe the manufacture and sale of radiating sets in Canada should at once be stopped by law, that on all licenses the type of receiving sets should be specified and in a reasonable time the use of radiating sets absolutely prohibited by law. Also that all radio inspectors be given full power to act at once in cases of persistent interference."

From the above it is not hard to see the effect which the "blooper" has had on our Canadian friends.

Being desirous of out-logging one of his friends who possessed a factory built set, George Clark, 1822 North 47th St., Seattle, Wash., proceeded to make the two tube ultra-audion described in the March RADIO AGE with which he brought in all manner of stations which his friend could not do. The list is an

Prest-O-Lite

There are many improvements in the new Prest-O-Lite Battery

In this new battery you'll find all the good points and high quality that have made Prest-O-Lite an unfailing aid to better radio. And in addition there are many important refinements and improvements that make it the most attractive, most convenient battery you can buy.

This new battery has a beautiful stippled finish hard rubber case that blends with any furnishings. The case is molded in one piece, giving sturdy, leak-proof strength.

To make the battery convenient to carry, the handle has been given a comfortable rubber grip.

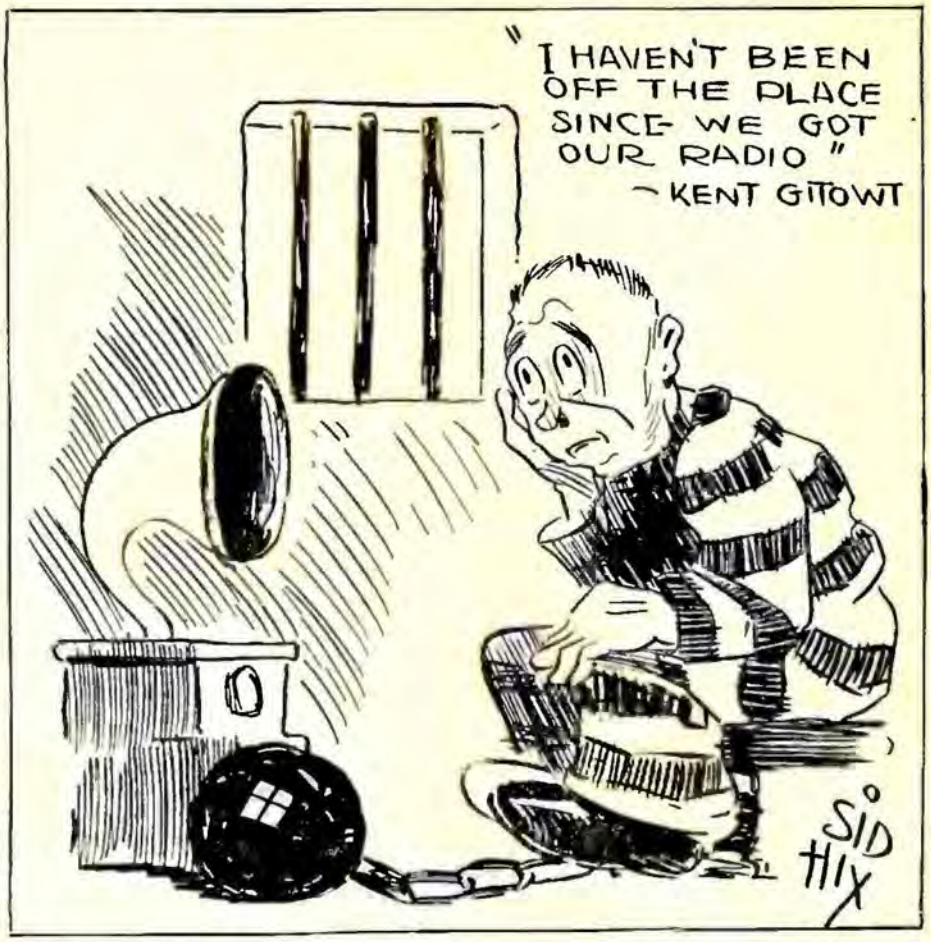
The oversize terminal nuts on the binding posts are easy to turn and insure perfect contacts.

Novel rubber insulators completely cover the tops and sides of the cell connectors, preserving the original fine finished appearance at all times and giving protection against accidental short circuits.

No effort has been spared to make this a battery you will be proud to own. Yet, like the rest of the Prest-O-Lite line, it is priced to offer you the biggest value of the day. Ask your dealer to show you this battery and the Prest-O-Lite Chart that helps you select the right battery for your set. Or write Indianapolis for a copy of our interesting handbook on radio storage batteries and how to charge them.

THE PREST-O-LITE CO., Inc.
INDIANAPOLIS, IND.
New York San Francisco
In Canada: Prest-O-Lite Company of Canada, Limited, Toronto, Ontario

* *Tested and Approved by* RADIO AGE *



(Continued from page 46)

excellent testimonial of the sturdiness of the ultra-audion.

F. R. Fravel, Bollston, Va., compliments us upon the crystal description in the July issue and thinks that too little attention is paid to the lowly mineral. He gets KDKA and others of the higher powered class up to a distance of about 1,100 miles when he is not disturbed by the locals in Washington, D. C.

James Licitris, 644 Baird St., Akron, Ohio, a 13 year old fan, has been plugging away for a button with a single tuber. His list seems to represent a good deal of midnight oil burned so we are going to forward him an emblem.

D. Thompson, Galilee, Sask., Canada, has written asking for a circuit by means of which the 20, 40, 80, and 100 meter bands may be spanned. The circuit in question is being printed in this section, being a detector and one stage amplifier, suitable for telegraphic and phone reception on these lower wavelengths.

J. Kinsella, 57 Crowland Ave., Welland, Ont., Canada, using a Flewelling super, reports great success with his new set. He is an ardent RADIO AGE fan and opines that if the magazine were selling for a dollar a copy he would get his just the same.

Karl Hayden, Osborne Harbor, Skel Co., Nova Scotia, Canada, using a one tube set, furnishes us with a good list of stations heard, going so far as to pick up PWX from way up north.

Here's another fan who finds that RADIO AGE sets *work*. He is Fred Kesemeyer, proprietor of the O. K. Garage at Bay City, Michigan. He says:—"I have made a set like yours on page 18, March RADIO AGE, and it works fine."

Frederic H. Perau, 210 East Seventh St., Oswego, N. Y., is quite a stamp fan besides being a radio listener, although his flair for stamps is of the broadcasting station type instead of postage. He believes the stamp collecting fad is the one way to make sure of your reception. Incidentally he sends in a list of stations that would stagger the linotype operator, but certainly deserves the button.

Using a two tube set Frederic H. Pollard, 85 Hawthorne St., Brooklyn, N. Y., gets 'em from the Atlantic to the Pacific and insures his getting one of the DT buttons.

Further ahead in this column we seemed to be having a run on Canadians. Now we seem to be doing the same thing on Frederics, for this is the third gentleman by that first name who has written this department. This one is Frederic Greger, 409 South River St., Sheboygan, Wis., who related his experiences with a two tube ultra-audion with which he is having great success.

W. E. Millard, 811 Kains Ave., Albany, Calif., using one stage of radio frequency ahead of a detector, reports fine results. The layout is a semi-toroid coil and a three circuit tuner, all built along low loss lines.

Douglas Black of (go easy now, Mr. Printer)—Penetanguishene, Ontario, Canada, sends in a good list of stations picked up on a crystal detector. There are 14 stations in all and most of them represent distances in excess of 500 miles.

Using a Weagant circuit one tuber, Luther Raine, at Blythe, Calif., tells us that it brings in the stations fine with ease of control. He also reports hearing two Italian stations.

Russell J. Schembs, 509 7th Ave., Peoria, Ill., built over a factory set into a non-radiating type and with it has listened to 65 stations in five hours. In all he heard 193 stations in seven countries and 48 amateurs in the United States and Canada. A ship in distress off the coast of Ireland is also advanced as a reason for the award of the DT button.

J. H. Kirkpatrick, 6250 Berrie St., Montreal, Que., Canada, using an ultra-audion, sends in such a formidable array of stations that he is automatically awarded the button. The set is the one described by Brainard Foote in the September RADIO AGE.

A bulletin "Joining the Electric Wave and Heat Wave Spectra" by E. F. Nichols and J. D. Tear, has just been issued from the Smithsonian Report for 1923, and is available from the Govern, ment Printing Office at Washington-D. C.

Roscoe Bundy seems to have stirred up at least one bornet's nest on the subject of resistance coupled amplification, according to the way we dope out a letter received from J. E. Roberts, engineer, residing at 14724 Detroit Ave., Lakewood, Ohio.

Mr. Roberts takes exception to Roscoe's statement that resistance coupled amplification, stage for stage, does not equal transformer coupling.

Feeling that our readers are interested in anything bearing on this subject we are printing Mr. Roberts' letter in full:

Good Dope

"I have just finished reading the July issue of RADIO AGE, from cover to cover, and was particularly interested in the able article on the coming set—the initial article by Mr. Roscoe Bundy—which was fine, until it was spoiled by a wild misstatement which took all the good out of the balance of the article.

"Mr. Bundy was good till he got to the paragraph on page 10, headed 'Resistance coupling' and there he went all to pieces when he stated that three stages of resistance were necessary to equal two stages of transformer coupling in 'degree of amplification.' If by 'degree' he means volume only, he is wrong decidedly—and if in that term 'degree' he includes clarity of reproduction and faithfulness of reproduction he is wrong again and then some.

"I imagine that Mr. Bundy has never made any direct comparison of resistance coupling with transformer coupling under parallel conditions or, if he has, the comparison was made some time ago, when his statement might, and probably would have been true—but methods change rapidly in radio as you know.

"If that is not the case, then he must have been repeating, without personal knowledge, statements that have been in print repeatedly, to the same effect, and which are equally in error, or, to put it more smoothly, equally behind the times.

Are Equal

"The facts are, today, that a resistance coupled set, of a quality of material and workmanship equal to a transformer coupled set, will give fully equal volume, stage for stage, of any transformer coupled combination—in other words, a stage of resistance

(Turn to page 50)

New Crosley Radio Ideas for 1926

Radio with all its romance knows no more magic name than Crosley. With the improvements Powel Crosley, Jr., presents in his line for 1926 he makes his greatest stride forward in the development of radio for the millions.

Again he demonstrates the value producing economies of gigantic production. Again he demonstrates that all you can expect from radio can be secured through Crosley apparatus.

Add 10% To All Prices West of Rocky Mountains

The Crosley "Pup"

A genuine Armstrong regenerative double circuit receiver for $9.75. A refinement of the one tube set with which Leonard Weeks, of Minot, N. D., heard the MacMillan polar expedition while the rest of the world listened in vain. One dry battery, one B battery, tube, phones, and antenna only accessories needed Price without accessories, **$9.75**

Super-Trirdyn Special with matched console table and Musicone De Luxe, $112.50. Table separate, $25.00.

The New 1926 SUPER-TRIRDYNS

DURING the past three years Crosley engineers have developed a wonder circuit—the Super-Trirdyn. This combines tuned radio frequency amplification, regeneration, reflex audio amplification, *making three tubes do the work of five.* There is saving both in first cost and upkeep. Batteries last longer. There are less tubes to replace.

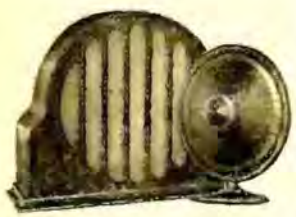
Competitive tests reveal that no present day set, regardless of price, is capable of out-performing these 1926 *improved Super-Trirdyns.* They give all the volume possible with the best of existing vacuum tubes.

By its superlative performance, the original Trirdyn model quickly built up a world-wide reputation. Yet these newest models incorporate vital improvements which are immediately apparent in the vitally finer results they give.

Coupled with their improved performance, the Trirdyn presents a new appearance that recognizes no peer in the quality radio field.

The Super-Trirdyn Special

The famous Crosley Trirdyn greatly improved New Crosley designed low loss Vernier Condenser—new worm rotary type tickler control. Wiring concealed under subpanel. In this model all dry batteries are contained in the cabinet. Price quoted is without accessories..... **$60**



The Musicones

The first loud speaker to reproduce the full tonal range of voice or instrument without distortion. Superior to all others regardless of cost. Investigation will prove this. Rapidly replacing other types of speakers. 500,000 in use by January 1st. Crosley developed unit secret of its remarkable success. De Luxe Model, mahogany cabinet, $27.50, Regular, **$17.50**

The Super-Trirdyn Regular

Crosley Trirdyns have been the marvel of the radio world. No radiation. This model is a simple, richly finished cabinet of solid mahogany. Same performance as the "Special" at $60. Price is without accessories, **$50**

Crosley manufactures receiving sets which are licensed under Armstrong U. S. Patent No. 1,113,149 and prices from $9.75 to $60.00 withous accessories.

New 2-tube 51

Improved popular Crosley 2-tube No. 51, Special De Luxe. Double circuit; New Crosley Vernier condensers; worm type tickler; cabinet will hold all dry batteries. Price without accessories **$23.50**

New 3-tube 52

Another popular Crosley model — the 3-tube 52 Special De Luxe. Redesigned with new Crosley Vernier condensers, rotary type tickler and beautifully finished cabinet. Price without accessories **$32.50**

CROSLEY

BETTER—COSTS LESS RADIO

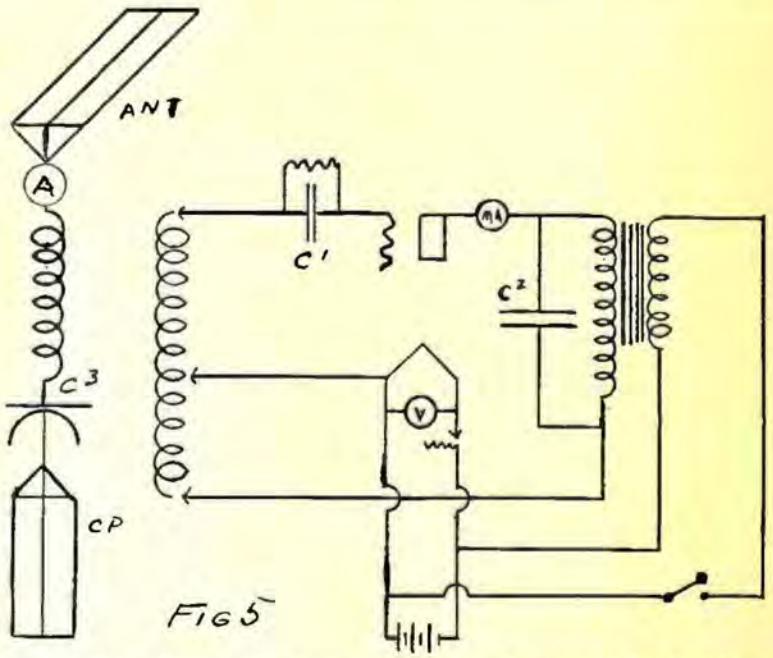
The Crosley Radio Corporation—Cincinnati

Crosley Owns and Operates Super Power Station WLW, Cincinnati

* *Tested and Approved by* RADIO AGE *

Pickups and Hookups

(Continued from page 48)



The above figure 5 shows the diagram of a 5 watter sent in by Paul M. Hayes. It is loose coupled to the antenna and counterpoise for the reason that all amateurs should by now use this type of coupling to do away with harmonics, key clicks and other interferences more or less attributed to the conductive coupled set. C3 is a .0005 variable in the counterpoise lead while A is the r. f. ammeter. C1 is .002 mfd. and R1 is 10,000 ohms. C2 is the glass pack condenser described by Hayes in this section. The spark coil is operated off the same battery as the tube. The MA (milliammeter) and V (voltmeter) are not absolutely essential, but they come in handy. If you have any trouble with the set, look up some transmitting amateur in your neighborhood. Doubtless he will be interested in the conversion of a BCL into a brass pounder.

coupling, today, is the equal of any stage of transformer coupling. This is in *volume* only—in perfection of reproduction and the absence of distortion, there is no comparison possible, for the resistance coupling does not distort.

"Further—the suggestion that three stages of resistance MUST be used to replace two stages of transformer coupling is also misleading. In three separate instances, occurring within the past month, an attempt has been made to replace two regular stages of transformer amplification, with a well known 3-tube resistance unit, with the uniform result that the third stage of resistance was not practical, except for auditorium reproduction, the resultant volume being too great for comfortable reception in the home. In one case an extra output was arranged for after the second AF stage for regular use—in the two other cases, the last or third stage was removed, leaving two stages of resistance coupling—the same number of stages as the transformer coupling which had been removed, with an increase in volume and absolute absence of distortion.

"In addition, it has been found that there are few loudspeakers of any quality, which can hold the full output of three stages of resistance amplification, without 'blasting' or excessive diaphragm vibration.

"Again, a properly built resistance coupled set does not need more than 90 volts of 'B' battery for ordinary reception—the addition of another 45 volt block does not help matters materially, and often interferes with the quality of the output.

"Still again, the matter of voltage is not important, for the draft on a 'B' battery, of a resistance coupled set is vastly less than a similar set, transformer coupled, in 'B' amperage, and the 'A' battery consumption is also reduced to a minimum. The writer has a 4-tube fully resistance coupled set, working on 4 201-A tubes, and the readings of the meters at the best point of operation show an A battery consumption of .7 amp. at 3.9 volts, B battery, 90 volts and less than 7 milliamps draft on the four tubes.

"The above statements are not to be considered as other than a criticism of a friendly and constructive nature. The statements are open to verification, or proof, either by tests in your own laboratory, or I can submit proofs of same in any form that you may find proper—the point is, that I believe that you are endeavoring to broadcast the most recent facts in your publications, and the remarks in paragraph on page 10 referred to were an oversight, in view of present day accomplishments, no matter how true they may have been a year ago."

Mr. Roberts did not state in his letter whether the resistance coupled outfit to which be refers is biased or not. If it is not biased then comparison against transformer coupling is out of the question. If it is biased then the resistance coupling more nearly approaches the standard of the transformer coupled set. It is rather strange too that manufacturers of resistance units do not claim stage for stage parity with transformer coupling.

In this connection we note that Rathbun in this issue has a set of blue prints and a descriptive article on "audio amplification" in which he touches upon resistance coupling. His resistance stages are biased for maximum clarity. There is no question but that resistance coupling does not distort of itself, but unbiased tubes will. Hence the bias.

This is a subject that could be fought over for years. Frankly we would like to have our Pickups family go into the subject and let us have their opinions. Some of you will agree with Mr. Roberts. Others will disagree. Let us know your verdict.

Paul M. Hayes, 918 Bell St., Pasadena, Calif. who is quite anxious that some of the receiving fans should come into the dot and dash game, sends in a diagram of an inexpensive five watter making use of spark coil potential applied to the plate of the tube. The circuit is given elsewhere in this column and the description follows:

"This is for the beginning brass pounder and is inexpensive. It is a 5 watt I. C. W. set, using a six volt storage battery for both the filament and plate supply. The panel is 7 by 12; the parts: a zero to two and a half ammeter, one 4 terminal spark coil, a glass plate condenser, a 5 watt tube (UV202) socket, rheostat, inductance, .0005 variable condenser, 10,000 ohm grid leak, and a .002 fixed condenser.

✻ *Tested and Approved by* RADIO AGE ✻

AMSCO
ANNOUNCES A
SPACE-SAVING
S.L.F. CONDENSER

AMSCO

✻

Solved! The space problem of the straight-line frequency condenser. The new AMSCO *Allocating Condenser* is ingeniously designed to save room in the cabinet—yet spreads the stations evenly around the dial, according to frequency. Greatly improves the selectivity of the set and simplifies tuning. Three sizes—Single or Siamese.

Ask your dealer—or *write* Dept. P

AMSCO PRODUCTS, INC.
Broome and Lafayette Streets, New York City
MAKERS OF MELCO *SUPREME* RADIO RECEIVERS

Half a Heart is the secret. Half a Heart is the shape of the rotor plates.

Half a Heart is the new symbol for efficient S. L. F. variable condensers.

✻ *Tested and Approved by* RADIO AGE ✻

WITH THE MANUFACTURERS

Mohawk Speeds Up Production

Steam has been ordered up at the two large manufactories of the Mohawk Electric Corporation, makers of the Mohawk single dial 5-tube radio receiver, it was announced by Gustave Frankel, president. With the letting of several large contracts for raw materials and various accessories, including 20,000 Vesta Storage Batteries, the work of turning out the first quota of the new model to be released soon is about to get under way. According to Mr. Frankel, preparations are nearly complete.

At the large plant in Chicago, where the general offices of the Mohawk organization are also located, the decks have been cleared for action. According to Douglas De Mare, general manager and factory superintendent, actual manufacturing is expected to begin some time this month. The factory personnel has already been increased, and more men will be employed as the work progresses.

"The new Mohawk will be in every way as distinctive as the old," Mr. Frankel declared in discussing the latest model.

"When we came out with our set last fall we entered a field in which single dial control was looked upon with skepticism by fans and many experts alike. As pioneers of one dial control, it was our aim to demonstrate to the public the efficiency and practicability of a 5-tube tuned radio frequency receiver operated by only one knob. Figures now show that we have been successful beyond our expectations. The resistance to single control has been greatly decreased, and it is recognized in almost every quarter as thoroughly practical. It is evident that the day of single control is at hand. This is sustained by the increasing number of one dial sets coming on the market, and by the dozens of different gang-condensers now being offered to the fan who desires to build a one dial receiver."

Thordarson Announces the "Autoformer"

The low notes of the organ, base viol, tuba, English horn and of other instruments below 100 cycles are said to be amplified as perfectly as high notes by the latest Thordarson development, the Autoformer All Frequency Amplifier. The Autoformer is an adaption of capacities, impedances and resistances, developed in the Thordarson laboratories at Chicago. It is similar in principle to the line amplifiers now in use at the more recently installed stations.

Three stages of Autoformer amplification are reported to amplify with even magnitude and beautiful clarity all notes within range of the human ear and to deliver more amplification than two stages of audio transformers.

An Autoformer hook-up bulletin is just off the press. Copies may be had by writing to Thordarson Electric Mfg. Co., 500 W. Huron St., Chicago.

Phenix Radio Corporation Re-Incorporates

Phenix Radio Corporation, 114-116 East 25th Street, New York City, announces a re-incorporation with an active capital of $215,000.00. W. A. Eisenhauer, formerly in charge of advertising with Radio News, remains President of the Corporation; R. E. Lacault, E. E., formerly associate editor of Radio News and Radio Research Engineer with the French Signal Corps Research Laboratories, is Vice President; Ernest Willvoseder, formerly treasurer of American Chicle Company, is Secretary. Henri Conrad, famous musical director, is among the Board of Directors.

This new capital was secured for the further promotion of the Corporation next year in the manufacture of its Ultra-Vernier Tuning Control, Ultra-Lowloss Condenser (both a straight-line wavelength and a straight-line frequency), designed by R. E. Lacault. Also the production and distribution of a new radio receiver, the Ultradyne Model L-3, a 6-tube receiver with built-in loud speaker but without panel, dials or knobs. The new receiver will be very compact and a beautiful instrument for the home.

Buys Control of Radio Company

Controlling stock in the Veri-Chrome Laboratories of Cincinnati, Ohio, has been purchased by officers of the Formica Insulation Company.

The Veri-Chrome Laboratories developed and put on the market last year a method of marking radio panels which is a big step in advance over the engraving methods previously used.

The company has numerous contracts with leading radio set manufacturers all over the country for decoration of their panels. The process permits the use of high grade Formica panels, beautifully decorated at no greater cost than for inferior materials.

With the financial and production resources of the Formica Insulation Company behind the company, a large extension of its business will be possible. The business, however, will remain under the management of the men who originated the process and who have developed the business.

The process is one of lithography which makes rapid decoration of panels possible. Tuning scales may be placed directly on the panel—eliminating the use of dials and making it possible to use pointers—this making important economies possible.

Several leading set makers in Cincinnati and Dayton are already using the process.

RADIO AGE is an independent magazine.

Young Engineer Designs Jewett Set

Not so long ago public interest became attracted to the plan fathered by Edward H. Jewett of encouraging youthful inventive interest in the radio world. Somehow or other it became known that at the Jewett plant there was always a sympathetic hearing of the young idea.

As always, in the discussion which attaches to such news, a good deal of sentiment was mixed in with opinions. Mr. Jewett protested that there was nothing sentimental about it, nor philanthropic; that it was simply practical encouragement to youth with the certainty of yielding profitable discoveries.

How right he was is illustrated in the case of the new Jewett receiving set, which takes its place among his factory's products for the forthcoming radio season. The engineer who did nearly all of the major development work on the set—an eighteen months' job, is Edward H. Clark, one of the youngsters who found encouragement at the hands of Mr. Jewett's staff. As yet there has been no opportunity for a public verdict of the set, but the trade opinion is said to be very high: It is a 5-tube tuned radio frequency set; two radio, detector and two audio. It has 2 controls. Several of the features are announced as new and covered under special patents. Mr. Clark is only one of several engineers who are producing new things in radio under the protective encouragement of the Jewett people.

Products from the same source this Autumn will also include the familiar Superspeaker in conventional and console types; the Vemco-Unit, the Micro-Dial, the Parkay Cabinet and the Highboy with built-in horn.

"Public Is Going to Buy With Its Ears"—Priess

"Radio this coming season will be competitive on performance. It will be an engineer's year. Every so-called selling point will be subordinated to what the set actually can do."

Such is the statement of William H. Priess, president of the Priess Radio Corporation, and a widely known personality in the technical ranks of radio. He explained further:

"The determining marks of desirability in a radio receiving set have come to be volume and distance. These qualities have risen above all others in the list of desirable attributes a receiver should have.

"The emphasis which has been placed on 'distance' has put a great strain on radio engineering talent; the required development was out of all comparison with the speed that has marked progress in other phases of the electrical industry.

"Nevertheless, the demand has been met, as the forthcoming season will prove."

Bristol Loud Speaker Tester

THE Bristol Loud Speaker Testing Apparatus, known by trade name as Comparaphon, was designed to enable the radio dealer to demonstrate various types of horns for the prospective customer, and to demonstrate under approximately the same conditions as when used on a radio receiver. It is not often possible to demonstrate horns on a receiving set under usual broadcast conditions.

The apparatus consists of a specially constructed double button microphone, arranged to be used in conjunction with a phonograph. The microphone takes the place of the usual sound box. The record groove actuates the electrode between the buttons instead of the usual arrangement of allowing the electrode to be operated by a diaphragm from voice impulses.

The control box contains a step-up repeater coil having a split primary winding, which is to allow both sides of the microphone to be used. This primary winding is so designed that it matches the impedance of the microphone at approximately 1000 cycles. The secondary of the repeater coil is wound to have an impedance approximately equal to that of a 201-A Tube operating 100 volts which is about 2 1-2 Henrys.

A three point switch is placed on top of the test set and so connected that the output from the repeater coil can be instantly shifted to any of three horns. The test set requires 4 to 5, or a 6 volt storage battery for its current supply.

USL "Broadcast Receptor" Features Simplicity

USL Radio, Inc., Niagara Falls, N. Y., has just placed on the market the USL Broadcast Receptor, a moderately priced 5-tube tuned radio frequency receiver. This set is attracting considerable attention due to its attractiveness, simplicity, selectivity, range and its unusual tone qualities.

By arrangement with U. S. Light & Heat Corporation, manufacturers of USL storage batteries, the distribution and sale of the USL Broadcast Receptor is offered to USL battery distributors.

Following is a description of the USL Broadcast Receptor:

Trade name—USL Broadcast Receptor.

Model Number—RC-5.

Type—One stage tuned radio frequency amplication, detector and three stages resistance—coupled audio frequency amplification.

Number of tubes—Five.

Type of tubes—Hard amplifying.

Number of controls—Tuning, two—Volume, one—Antenna, one.

Batteries—"A" storage; "B" 90 volts storage or dry.

Dimensions—23 3-4 in. long x 10 3-8 in. deep x 9 1-2 in. high.

Finish—Cabinet—two-tone American Walnut. Panel—Aluminum finished stump walnut and gold.

Price—$80.00 less accessories. Pacific Coast, $85.00.

Beg Your Pardon

In the comment on the method of overcoming oscillations in receivers touched upon by Frank D. Pearne in the June Radio Age, the Roberts receiver was not credited to Radio Broadcast as it should have been, since the Roberts circuit was first published by that magazine.

New DeForest Tube is Marketed

JERSEY CITY.—The history of the radio art is interwoven with intriguing romance in the various stages of its advancement, unparalleled by that of any other industry, and this consistent phase is given a startling proof in the latest masterpiece of the DeForest Radio Company's new vacuum tube, now on the market.

Termed Type DV-5—its creators have taken the somewhat accidental discovery of a biological chemist and merged with it new inventions of the DeForest "audion" laboratory, in the construction of what is said to be the long-sought Utopian tube—one of perfect insulation.

Isolantite, or synthetic quartz, is used for the base of this tube, and the romance of its discovery dates back to the first years of the World War.

Chief Engineer Roy A. Weagant of the DeForest Radio Company found that an Isolantite based tube decreased grid plate capacity from twelve micro microfarads to eight or less at frequencies from 100,000 to 10 million; while the tone quality remained practically constant, regardless of variations in frequency.

The DeForest DV-5 is a standard base, 5 volt storage battery tube, and said to be unsurpassed as an audio frequency amplifier and regenerative detector. It is said to be exceptional equipment for reflex and non-oscillating radio frequency circuits. It is designed, Mr. Weagant said, "to use high plate voltage in conjunction with C battery." With plate voltage of from 135 to 270, and the corresponding C voltage, the DV-5, used as an audio frequency amplifier, will give approximately double the volume of any present tube, with the sole exception of the power amplifier, at little or no increased plate current consumption.

All Radiodom Behind Los Angeles Show

NEARLY 175 locally and nationally known leaders in the radio industry have joined hands here for the purpose of making a resounding success of the Third Annual National Radio exposition, to be held from September 5 to 12 in the new Ambassador auditorium.

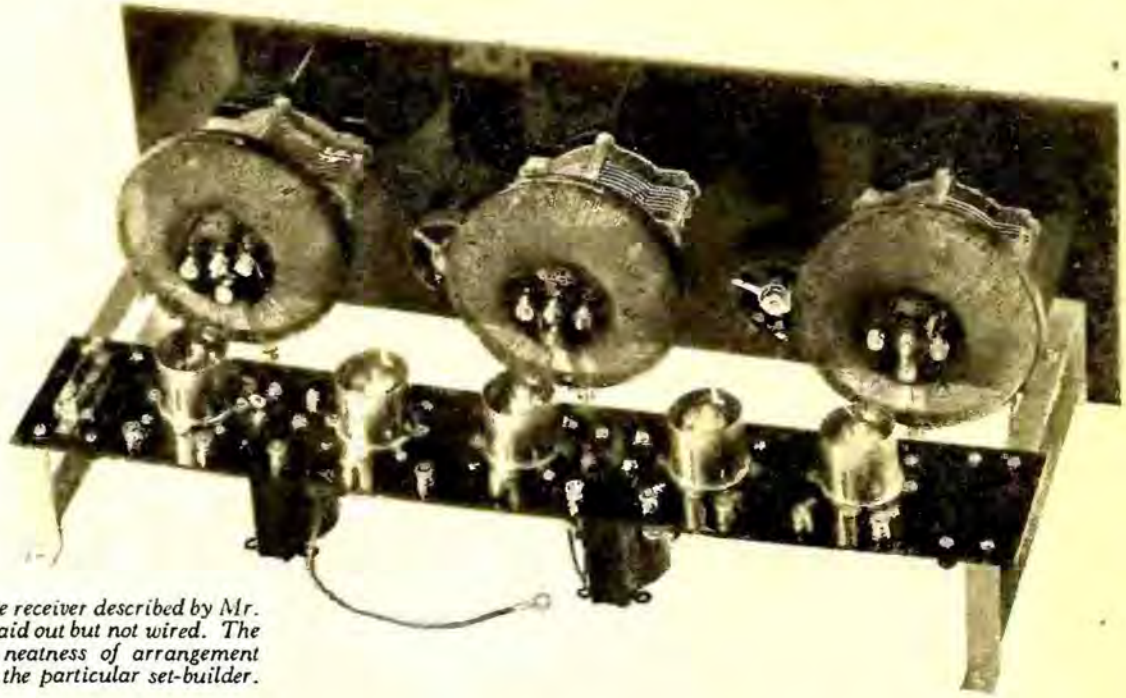
In number of exhibit spaces, it is announced the show will be almost in the New York and Chicago class. To insure that 175 exhibits could be entered, Waldo T. Tupper, who is producing the event under auspices of the local Radio Trades' Association, just has completed remodelling a heretofore unfinished wing of the auditorium.

Before the work of remodelling was finished, nearly the entire exhibit space was contracted by wholesalers, retailers and jobbers, with the result that nearly the entire floor area of the exposition already has been subscribed.

With the previous Los Angeles radio show having but 107 booths, local dealers and fans are enthusiastic over the strides made by this one. It was pointed out by Les Taufenback, acting chairman of publicity, that the show reflected the popularity of radio in Southern California. He declared the home life here, coupled to the appreciation of music and the finer arts, noticeable throughout this locality, caused this district to be rated as one of the principal radio centers of the United States.

Watch for
RADIO AGE on the air again!
About September 20!

* *Tested and Approved by* RADIO AGE *



View of the receiver described by Mr. Pearson, laid out but not wired. The economy and neatness of arrangement will appeal to the particular set-builder.

A 5-Tube TOROID COIL *Receiver*

A SIMPLY BUILT SET WITH NO EXTERNAL INTERFERENCE

By GEORGE A. PEARSON

SO MUCH interest has been displayed in the application of the new self-contained field coils since the publication of an article on the theory and construction of the coils in the JULY issue of RADIO AGE, that a few words on the actual arrangement of the complete receiver would seem timely. As you will remember, the essential feature of the circloid or toroid type coil is the circular magnetic path which is contained entirely within the turns of wire so that no stray fields are generated to cause trouble through inter-stage coupling when used as transformers, and so that the coils are indifferent to external interferences, which commonly cause a loss of selectivity with the more common solenoid coils.

From a practical standpoint, as viewed by the constructor, the most important feature is the ability to closely space the coils on a short panel without causing feed-backs or excessive regeneration through stray fields. We do not need to accurately set the coils at some definite and usually inconvenient angle, to prevent coupling, nor do we require elaborate methods of controlling self-oscillations when the toroid coils are used, as is the case with the more common coils. Commercial five tube sets are in production in which the apparatus is mounted complete on a 7″ x 18″ panel, and as you all know, this is about as small a space as we can expect to use for a five-tube tuned radio frequency outfit. For the amateur, however, a 7″ x 21″ panel is advisable, not for fear of back-coupling, but for the reason that the parts are more accessible for wiring.

After many trials with various baseboard and sub-panel constructions, the arrangement shown by the accompanying photograph was found the most practicable and the easiest to wire up. Here, all of the parts are open to inspection or adjustment with the least loss of space and they also present a symmetrical and pleasing appearance to the critical amateur constructor who is as much concerned with the appearance as with the performance. Another feature of the layout, and by no means the least important, is the length of the wires, which is reduced to an absolute minimum in the case of the grid and plate leads, which are of such vital importance to the proper operation of a receiver. By far, the greater majority of the wires are from 4″ to 7″ long with only a few battery leads of greater length.

The "Chassis"

NO WOOD baseboard is used for the support of the apparatus. The three variable tuning condensers and the rheostats are mounted on the panel with the coils attached to the backs of the condensers by metal brackets which at once act as a support and as a means of completing one of the connections between the coils and condensers. All of the remaining parts such as the tube sockets, bypass condensers, and audio transformers are mounted on a bakelite sub-panel to the rear of the panel and coils. This is clearly shown in the photograph. The panel is 7″ x 21″ x $\frac{3}{16}$″ while the sub-panel is of the same length and only 3¼″ wide. Directly to the rear of the sockets and attached directly to the sub-panel in a row of binding posts used for the connection of the batteries, antenna, ground and loud speaker.

A rigid connection between the panel and the sub-panel is had by two simple brass brackets made of sheet brass $\frac{5}{8}$ inch wide and approximately $\frac{1}{32}$-inch thick. By making the height of the brackets equal to the height of the audio transformers, the latter can be made to support the sub-panel near the center, as shown. When in place in the cabinet, the transformers rest on the floor of the cabinet thus giving a rigid support at all points in the length of the sub-panel. The transformer terminals or binding post screws pass through the sub-panel and are capped by ornamental nuts which at one time hold the transformers in place and afford a means of making short connections between the tube sockets and the transformers. At the right, the output jack is supported from the right hand bracket.

A peculiar arrangement in the sequence of the sockets was made necessary by the spacing of the coils, and by the desirability of short wiring connections, Starting from the right end of the sub-panel, the first tube is the first frequency tube, then the second audio frequency tube, the second radio tube, the first audio tube, and then finally the detector tube socket at the extreme left where the grid leak and grid leak condenser will be seen. Arranged in this way, the grid post of each socket comes directly opposite to the grid post of the circloid transformers, and results in 3-inch grid lines.

Coil Connections

OWING to the extreme sharpness of the tuning, two circuit transformer coils cannot be used throughout. To reduce this extreme sharp tuning so that stations can be more easily picked up, it was found desirable to install a single circuit coil in the antenna circuit at the right hand end of the panel. This is simply a continuous winding, tapped at two points for the connection of the aerial, with connections from the taps brought to two antenna posts on the rear edge of the sub-panel. Connection

(Turn to page 64)

New Season to Start with Banquet

The Second Annual Banquet of the Radio Industries will raise the curtain on the new radio season on the evening of September 16 at the Hotel Commodore in New York City.

All arrangements are under way, committees are functioning, radio firms are engaging their tables and from all indications this banquet will set a standard as well as a record that will be unprecedented.

The banquet has a double significance and will attract a double audience. Actually present will be more than 1000 prominent members of the radio industry; officials of the great manufacturing and distributing corporations, the broadcasting stations and all the important business enterprises that have to do with radio. Figuratively present will be the great radio public, tuned in to the magnificent entertainment which will be brought.

Because of the great influence wielded by the members of the associated organizations under whose auspices the dinner will be given, the finest radio entertainers in the country will broadcast direct from the banquet hall. The entire program for broadcasting is being built on a basis of delighting the public which stays at home. It will be undoubtedly the sort of treat which only the combined efforts of the entire radio industry could possibly bring about. The speakers, like the entertainers, will all be nationally known figures.

The associations which are sponsoring the banquet include the National Association of Broadcasters, the Radio Manufacturers Association, the Independent Radio Manufacturers Association, the National Radio Trade Association, the Talking Machine and Radio Men, Inc., the Electrical Supply Jobbers Association, the Pacific Radio Trade Association, the Electric Club of Chicago, the Radio Magazine Publishers Association, the American Radio Association, the Radio Announcers of America, the Radio Tube Manufacturers Association, the Bakelite Moulders Association, the Wisconsin Radio Trade Association; the Central States Radio Jobbers Association, the St. Louis Radio Trade Association, the Radio Trade Association of Michigan, the Northwest Radio Trade Association and the Radio Writers League.

Radio Shows For This Fall

Aug. 22–29, Pacific Radio Ex.	San Francisco, Cal.
Sept. 5–12, National Radio Ex.	Los Angeles, Cal.
Sept. 6–12, National Radio Ex.	New York, N. Y.
Sept. 14–19, Second Annual Radio World's Fair	New York, N. Y.
Sept. 14–19, Pittshurgh Radio Show	Pittshurgh, Pa.
Sept. 14–19, Canada Radio Show	Winnipeg, Can.
Sept. 23–27, International Radio Ex.	Atlantic City, N. J.
Sept. 28–Oct. 3, National Radio Ex.	Chicago, Ill.
Oct. 5–10, Second Annual N. W. Radio Ex.	St. Paul and Minneapolis, Minn.
Oct. 5–10, Radio Show and Convention	Washington, D. C.
Oct. 12–17, St. Louis Radio Show	St. Louis, Mo.
Oct. 12–17, Boston Radio Show	Boston, Mass.
Oct. 17–24, Radio Show	Brooklyn, N. Y.
Oct. 19–25, 2nd Annual Radio Ex.	Cincinnati, Ohio
Nov. 2–7, 2nd Annual Radio Show	Toronto, Ont., Can.
Nov. 3–6, Detroit Radio Show	Detroit, Mich.
Nov. 9–15, Milwaukee Radio Ex.	Milwaukee, Wis.
Nov. 17–22, Fourth Annual Show	Chicago, Ill.

Detroit Radio Manufacturer Organizes in Canada

Announcement has just been made of the organization of the Dongan Electric Manufacturing Company of Canada, Ltd., with factory and offices at Walkerville, Ontario. This is an important step in Canadian electrical and radio circles and is one more evidence of the Dominion's consumption of high grade radio merchandise.

The Dongan Electric Manufacturing Company with headquarters in Detroit has been famous for fifteen years for its line of transformers and ammeters. Today this company is the largest manufacturer of bell-ringing transformers in the world. Low voltage transformers and, of recent years, oil burner transformers share a large portion of the company's production.

During the last few years a national reputation has been made for quality parts in the rapidly growing radio field. At present Dongan is supplying 35 different Receiving Set Manufacturers with audio transformers. In addition to audio transformers Dongan builds voltmeters both for the set manufacturers and the jobbing trade.

Lakeside Type M Loud Speaker

The most essential qualities of a loud speaker horn are: clarity, volume and faithful reproduction of tone. It is difficult to say which of these exceeds in importance but when using a Lakeside loud speaker, it is not necessary to solve the problem for all three are embodied in the same horn.

The volume obtainable is all that anyone could wish. Added to this is the fact that, while it gives a good loud tone, the cast aluminum goose neck preserves the natural quality and clarity prevents unnecessary vibration which would tend to distort it. In this way you are assured of faithful reproduction of each and every tone.

New Transformers Marketed by Silver-Marshall

An announcement to set-builders, experimenters and the trade, has just been made by Silver-Marshall, Inc., that henceforth their long wave transformers will be supplied in moulded bakelite cases rather than in the aluminum housings previously supplied. Not only is the appearance of the transformers greatly enhanced, but their efficiency has been very materially increased, according to statements made by McMudro Silver, designer of the Silver Supers and the Super-Autodyne.

The new transformers, still to be known as the 210 intermediate and 211 filter, given an amplification approximately 25 per cent higher for the intermediates, and 40 per cent higher for the filter, than did the older models. The manufacture of the 401 transformer unit, containing three transformers, has been abandoned, since due to its metal case, it was impossible to improve its efficiency to compare favorably with the bakelite-cased instruments, despite the fact that the transformer coils themselves in each case were identical.

All the Latest Twists in Radio Are Being Prepared for Introduction to RADIO AGE Readers During the Coming Season. Subscribe Now!

See Page 60

Standard Radio Receivers

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

New Pfanstiehl Line

ONE of the features of the new Pfanstiehl line of radio receivers for next year has just been completed by Carl Pfanstiehl.

This is a low priced five tube receiver, two dials, housed in a solid walnut cabinet with sloping panel.

Price will be $85.00 and delivery will be made at any time.

There are five outstanding features in the new receiver:

1. Two dial control was made possible through the development by Mr. Pfanstiehl, of an accurate thick plate straight-line-frequency condenser.
2. A small amber light will burn as long as the set is operating.
3. The large station-finder shows the dial readings for all wavelengths and makes tuning very simple.
4. Mr. Pfanstiehl has not employed the method of dampening oscillations through absorption of energy, common to low priced receivers, but has made use of a system which prevents the generation of oscillations in the first place.
5. Two control dials, or rheostats, one for volume and one for tone, make it possible with this receiver to secure long distance and yet maintain quality of tone. The verniers beneath the large tuning dial also contribute to accurate distance getting.

Type—Pfanstiehl non-oscillating system of tuned radio frequency.

Tubes—Radio Amplifier (2). U. V.-201-A and C-301-A. Audio Amplifier (2). Detector (1).

Battery—"A" Storage, 6 volts.

Battery—"B" 90 volts.

Controls—Tuning, (2); Tube (2).

Antenna—Indoor and Outdoor.

Dimensions—22x10x14.

Weight—16 pounds.

"Features"

Two dial control made possible through Mr. Pfanstiehl's newly designed 2 gang condenser, which is a scientific achievement in accuracy.

Orange light on panel which burns while set is operating.

A large and very easily read station-finder (5 1-2 inches long).

Both volume and tone control rheostats, which make possible greater distance than Pfanstiehl had last year.

Vernier control of tuning means accuracy, especially for distance.

Handsome cabinet of solid walnut with sloping panel (panel of walnut material—very stunning.)

All the low priced receivers, except this one, place the coils close to the condensers and stop oscillations through absorption of energy. *(Turn to page 57)*

In response to many requests, H. Frank Hopkins will tell you how to build an "Improved Slide Wire Bridge" for Measuring Capacity, Impedance and Other Formulae, in the All-Star October RADIO AGE. On the stands September 15 with an unusual array of features.

Miessner Bat-ry-less Receiver

(Continued from page 56)

NOT since the invention of the three-element vacuum tube that made present-day radio broadcasting possible has there been so much work, energy, and thought applied to the improvement of radio apparatus.

Engineers have applied themselves to sets that would give volume, get distance, tune selectively, and which would be simple to operate. They haveeliminated one after the other all of the little imperfections that stood in the way of perfect radio enjoyment, with the exception of battery elimination.

Batteries are not only a large cost in the original price of a radio outfit, they are also one of the largest expenses in connection with the upkeep, it is claimed. Hence, many have been the attempts to remove the need for batteries.

Due to the peculiarities the problem involves, it has been a greater task than anticipated by some of the largest laboratories of the country. True, battery-less receivers have been built, which eliminate batteries from the circuit. It is comparatively easy, for instance, to design a receiver that will work satisfactorily on direct current lines, for in that case, the electric current is already in a form suitable for use, and requires no conversion process. It is in the operation of radio sets from alternating current circuits that most attempts have failed. And 95% of the homes in the United States equipped with electricity have an alternating current supply. The A. C. power, if used directly on ordinary sets produces an extremely loud and disagreeable buzzing sound which bars quality, tone, and clearness, and destroys good reception.

In an effort to solve the troubles inherent in most of the sets using the electric light socket as a source of power, Benjamin F. Miessner, an acoustical and radio engineer with a record of achievements, has developed a battery-less receiver which is claimed to place this type of receiver in a class above the battery operated set.

Heretofore, there had been no thought of building the current conversion device in the same cabinet as the radio instruments, because this only added to the hum and noises caused by the use of socket current. Mr. Miessner's new set has been so thoroughly designed that he does not hestitate to locate conversion and radio circuits side by side behind the same panel. The user of this new set will not realize that special apparatus is required to accomplish this wonderful work of perfect conversion, as it has been reduced to such perfect and compact form. To all appearances, this six-tube set is no different from others, excepting that it requires no extra attachments for battery-elimination, no loud speaker, or batteries. In operation, it is no different, and possibly simpler than most sets. A loud speaker, which is acoustically perfect, is embodied in the set itself, thus making the receiver a complete unit.

The elimination process is so complete that the set not only operates with a built-in loud speaker, but is provided with a head-telephone receiver connection through which the listener may receive programs without the slightest trace of hum. This is not only a supreme test as to the perfection of the conversion system but is also a feat that has never been possible with a set operating without batteries.

Six standard commercial vacuum tubes perform the functions of current conversion, amplification and detection. The current consumption is eight watts. This brings the cost of operating this set down to one-tenth of a cent per hour,—a sum one-twentieth that of the cost of operating an ordinary electric iron.

Although the electric conversion system is built into the same cabinet as the receiver, it has nothing to do with the type of circuit used for radio reception. This set is equipped with a standard improved form of receiving circuit using four controls. Its selectivity, intensity, distance and volume are equal to, and in many cases superior to average receivers on the market. The quality is unsurpassed, the loud speaker volume being more than adequate, and perfectly controllable.

Everything needed for operation is contained in one small cabinet, which is battery-less, consequently without the cost and trouble that goes with battery operation.

Benjamin F. Miessner has long worked in radio and acoustics. He was formerly electrical engineer with John Hammond, of torpedo radio control fame. The set will be shortly placed on the market by the Miessner Radio Corporation.

(Turn to page 58)

Standard Radio Receivers

(Continued from page 57)

De Forest Claims Non-Radiating Circuit

THE long sought non-radiating and non-oscillating circuit—the goal of the greatest exponents of the radio art for the past five years, has finally been successfully achieved, it is said, in the new De Forest F-5 type that will be placed on the market soon in a portable model.

This circuit is a five-tube tuned radio frequency receiver of improved design with a wavelength range of 220 to 550 meters. It consists of two stages of tuned radio frequency amplification with tuned input to the detector and two stages of transformer coupled audio frequency amplification. Chief engineer R. A. Weagant of the De Forest Company has departed from usual practice in design of the radio frequency transformers to the use of Astatic Radio Frequency Coils, which confine stray magnetic fields to a minimum.

The new circuit, Mr. Weagant said, has great distance-getting qualities while at the same time preserving ample selectivity. Particular attention has been given to mechanical simplicity and ruggedness to attain what is believed to be an almost "fool-proof" set. In addition it is equipped with new shock absorber sockets to prevent damage to the tubes under "field" conditions.

The F-5 Portable is entirely self contained. The antenna and ground wires, the new De Forest cone loud speaker, which is said to give the most truthful reproduction of any on the market, and all batteries are compactly housed in an artistic and durable du Pont case fitted with a permanent carrying handle of convenient form.

The portable measures 15¼ inches deep by 14 inches wide and 11 high when closed for carrying and weighs but 37 pounds complete with batteries. 150 feet of flexible antenna wire are wound on a built-in aluminum reel of original design connected to the receiving circuit in addition to 15 feet of flexible ground wire conveniently assembled in a spring clip of original design.

Circuit of De Forest F-5 Portable

From the schematic diagram, it will be seen that the circuit consists of two stages of tuned radio frequency amplification, detector with tuned input and two stages of transformer coupled audio frequency amplification.

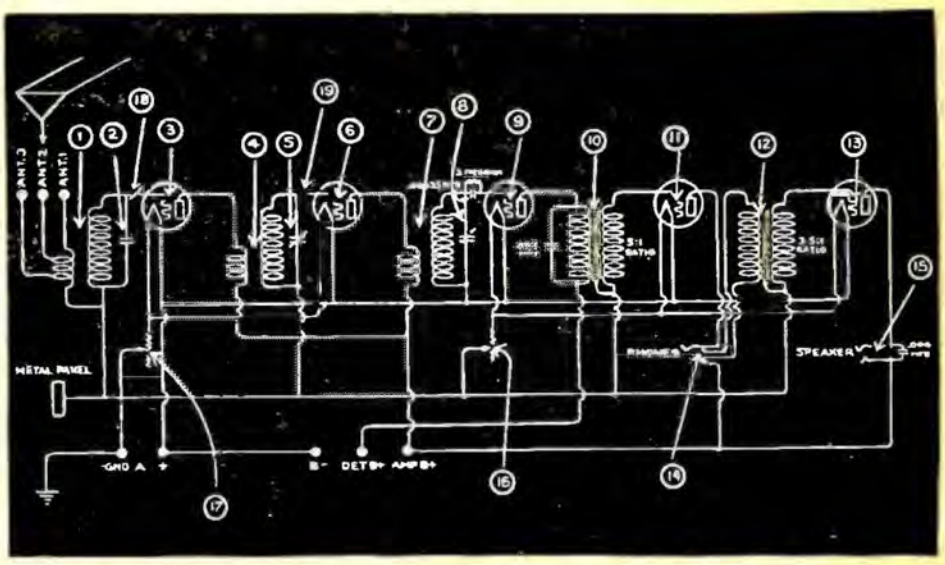
The incoming radio energy is intercepted by the antenna, which is connected to either of the binding posts marked: "Ant. 1," "Ant. 2," and "Ant. 3," as conditions call for.

The .0005 mfd. variable condenser No. 2 tunes the secondary of transformer No. 1 and the grid or input of first radio frequency tube No. 3 to resonance with the desired wavelength. From the plate or output of tube No. 3, the amplified energy passes through the primary of transformer No. 4, and is transferred by electro magnetic induction to the secondary winding, which is tuned to resonance by the .0005 mfd. variable condenser No. 5, whence it is impressed upon the grid of the second radio frequency tube No. 6. The further amplified energy then passes through transformer No. 7, the secondary of which is tuned by the .0005 mfd. variable condenser No. 8, to the detector tube No. 9, where it is rectified or changed into an audio frequency current. The audio frequency energy now passes to the primary of the first audio frequency transformer No. 10 and is transferred by induction to the secondary coil, whence it is applied to the grid of the first audio frequency tube No. 11. From the plate or output of tube No. 11, the amplified current passes through the second audio frequency transformer No. 12 to the grid of the second audio frequency tube No. 13. The greatly amplified current then passes from the plate or output of tube No. 13 to the loud speaker, which is connected to jack No. 15, where it is converted into an audible signal of great volume.

A jack No. 14 is provided in the first audio frequency circuit for the use of head-phones.

The "A" battery current to the filaments of the radio frequency tubes No. 3 and No. 6 is controlled by the rheostat No. 17, and to the filaments of the detector and audio frequency tubes No. 9, No. 11 and No. 13 respectively by the rheostat No. 16.

Bypass condensers are placed across the primary of first audio frequency transformer No. 10 and loud speaker jack No. 15.



The wiring diagram for the new DeForest Receiver, which, it is claimed, achieves the goal of Non-Radiation and Non-Oscillation.

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How the Carrier Wave "Does its Stuff"

(Continued from page 20)

Referring to Figure 3, at "A" a crystal detector has been inserted in circuit with the aerial, phones and ground. A crystal detector has the property of allowing a current in one direction to pass through it freely, but will not allow it to pass so easily in the other direction. The resultant change in the wave passing through it is shown to the right of it at "B." It will be noticed that the wave comes in its true form until it reaches the detector, at which point it is almost completely rectified; that is, the part on one side of the zero line is nearly eliminated, because that part is in the direction which will not pass freely through the crystal.

The result then is as before mentioned; a direct current, or nearly so, produced by the part of the wave which does not get through the crystal. "C" shows how the diaphragm refuses to respond to the unrectified wave and "D" shows how the diaphragm is affected by the direct current after it passes through the crystal.

Now we have caused the diaphragm to move, but still we get no sound because it remains in the position shown and nothing makes it vibrate. Now we know that the wave coming from the broadcasting station is as shown at "A," Figure 4. When a sound is produced in front of the microphone the peaks of some of the oscillations are varied, as shown at "B." A line now traced over the tips of the oscillations will make many strange shapes as shown. Just what shape of envelope, as it is called, will be produced, will depend upon the vibrations of the microphone diaphragm.

The wave shown at "B" is MODULATED, or changed in shape from its original shape shown at "A," and now takes on a form which is entirely controlled by the microphone and may now be as shown at "B," or any other of a million or more shapes. Now if this modulated wave is passed through the detector shown in Figure 3, it would keep the same form as shown at "B," Figure 4, up to the detector, and after passing through the detector, it would take up the form of one half of "B," Figure 4, and the diaphragm of the phones would vibrate according to the shape of the rectified wave shown at "C," Figure 4, because a line drawn across the peak of the wave would not be straight, indicating a direct current of unvarying strength, but would show an uneven line, indicating that the current varied and naturally the diaphragm would follow these variations.

The question may arise as to just how the shape of the wave can influence the diaphragm of the phones. As the strength of a current produced in a wire by lines of force cutting through it depends upon the number of lines cutting and the speed with which they cut, it is obvious that if the amplitude of the wave is reduced, that part of the wave will not carry as many lines as the part which has not been reduced. Therefore the amplitude of the different parts of a modulated

"Experiments With a Box-Kite Aerial"

An Interesting Account of Radio Studies in the North Woods—In October RADIO AGE.

wave will produce a current varying in strength according to the shape of the wave.

Another point which may not be clear, is just how these lines of force cutting through an aerial wire which is practically an open circuit, can produce a current when there is no complete circuit, for the aerial extends into the air and stops there. This is explained by the capacity of the aerial and ground. It will be remembered that the time of one oscillation is only a small part of a second so that the lines cut through the aerial in one direction for less than one millionth of a second before it reverses and the lines cut in the other direction.

This can be likened to Figure 7, which shows a water analogy. If a water wheel is enclosed as shown and the end of the pipe is closed as shown at "A" Figure 6, and water is passed into the pipe, the water would hardly reach the wheel before it lost its power due to the air pressure against it. However, if instead of sealing the end of the pipe, a large tank is attached to it, considerable water would flow past the wheel before the pressure of the tank would equal the pressure of the incoming water.

This arrangement is shown at "B," Figure 6. Thus the wheel at "B" would turn several revolutions before the capacity of the tank is satisfied.

The same may be said of the aerial. With a short aerial, only short impulses could be produced in it before it became charged, but with a long one, an impulse of longer duration could be effective.

As a matter of fact, the time of cutting in one direction is so small that almost any aerial has enough capacity to allow enough movement of current to affect the circuit and at each reversal, the capacity unloads and charges up again in the opposite direction, so then if an inductance is included in the aerial circuit, even though the circuit is open, a highly oscillating current of short duration can be made to move in it.

"Three Big Things"

The adjustable grid leak which the Colytt Laboratories of Chicago are putting on the market may have more than three things to commend it to the radio fan, but the manufacturers have not overlooked one big thing in merchandising, and that is the proper display of the article.

Put up as this grid leak is, it is convenient for the dealer as well as his customer. It helps the dealer, too, by telling, plainly and attractively, what it is and what it sells for. This in turn is a help to the customer, for it gives him the information he wants and which a busy clerk cannot always find time to do.

This grid leak, by the way, is adjustable and designed so that it tunes tubes of any kind, and maintains its calibration practically constant—only extreme disturbance will necessitate a readjustment.

This fact, coupled with its neat appearance and single hole mounting, with thumb nut, bids fair to make it a very popular addition to the panel.

What Kind of Sets Do the Fans Want?

(Continued from page 40)

Crystals Also Gain

SPEAKING of city receiving conditions makes me think of the increasing number of amplified crystal detector sets now in operation. They have but little radius of action, say 50 miles at the outside, but they bring in local signals with beautiful clarity and fidelity of tone. In general, the layout consists of a sharp tuning crystal detector with one, two or three audio stages added. Such a set with two transformer stages gives excellent results on a loud speaker, while three resistance coupled stages give better volume and better clarity, particularly when the resistance coupled tubes are given a strong bias by means of a "C" battery. If you are not a DX fan, and simply enjoy the perfect reproduction of local signals, then this stunt is well worth trying.

A sharp crystal tuner, a stage of low ratio transformer audio coupling, and two stages of resistance coupled with the last stage consisting of two tubes in parallel, will develop qualities in your loud speaker that you never would have considered possible. You will find that the loud speaker has been condemned for distortion that in many cases really exists in the receiver. It takes a circuit such as the above to show this up.

Another combination that gives good results consists of a stage of radio frequency, crystal detector, and one or two stages of audio. This is not quite so clear as the straight crystal detector system with added audio, but it has a greater range than the amplified audio system and tunes somewhat sharper.

We will ask all of you to send in your votes on this most important subject dealing with the number of tubes employed in your ideal receiver. Use the blank appearing in the July issue of RADIO AGE or else simply send us a letter with the advice. The final results will be printed in the October number of RADIO AGE, which will be in ample time for the coming season. Consider quality and tube economy as well as distance, volume and price.

Buy your RADIO AGE ANNUAL now! The edition is limited—$1.00 a copy.

A Touch of the Old World at WMBB

(Continued from page 29)

to stay." Clyde Hager takes three dialogue parts, the Irish policeman, the Irish washerwoman, and Pedro, the organ grinder. There is also Little Orphan Annie and Tony, the janitor's boy. The playlet, with music throughout, presents a quaint bit of humor which could appropriately take place in the Bowery.

"Uncle Tom" There, Too

THERE is also "Uncle Tom's Tunes," a musical feature, which portrays old Uncle Tom, of Harriet Beecher Stowe's play, sitting in front of his cabin, smoking a pipe, and thinking of the days before and after the Civil war. It provides excellent setting for old Southern melodies. "The Bandelero" is the story of a party of tourists, in the Pyrenees, which meet with a bandelero, a bandit, who holds them up, and very accommodatingly sings old French tunes for them.

Practically every fan on Chicago's south side sets a certain number of hours apart each night to listen to WMBB, for its entertainment is so excellent that the desire to tune in for distance fades away.

Long-Range Reception in Daytime Succeeds

(Continued from page 24)

particularly above 300 meters, has much less range than the extremely low or short wave circuit during the daylight hours.

"The Expedition carries a full compliment of the newly developed Zenith-Reinartz short wave apparatus to equip all three planes and both the Bowdoin and Peary, but the high power low frequency sets will also be installed, thereby doubly protecting the safety of the men, and insuring constant communication with the outside world.

"Commander MacMillan did not refuse to install the Navy radio apparatus, nor did Secretary Wilbur intend that the short wave apparatus be taken off. Recalling Commander Byrd's telegram to Secretary Wilbur, the Navy apparatus did not arrive in Boston in time to take on board the S. S. Peary, and although Secretary Wilbur was of the impression that his communications were not given attention, it later developed and as was further shown by Commander Byrd's telegram, not only were the Secretary's wires received, but they were answered by Byrd although they evidently did not reach the Secretary's office. However, as soon as wires at both ends did connect, MacMillan immediately issued orders to stand by and await the arrival of the Navy apparatus, and out of this situation many erroneous reports appeared in print throughout the entire country.

"With both types of circuits on board, Commander McDonald's facilities present even greater opportunity in his radio research and experimental work, aside from doubly insuring the safety of all men in the MacMillan Party."

Radio Breaks Down Rural Isolation

(Continued from page 27)

covers the athletic activities of the college. On Sunday during the school year the chapel serviceis sent out and the daily schedule includes the chimes.

D. C. Faber, director of the Engineering Extension department and in charge of the radio short courses, and H. B. Deal, instructor of electrical engineering, have been active in directing the work of Station WOI. Prof. Faber is a member of the program committee as is Mr. Deal, who is also engineer for WOI. The other members of the committee include Prof. R. K. Bliss, chairman, who is director of the Agricultural Extension Department; Prof. F. A. Fish, technical director and also of the Engineering Department; Prof. Tolbert McRae, Music Department; Charles Roach, program director and Blair Converse, Pubicity director.

Prof. Faber, in discussing the problems confronting the sponsors of WOI, pointed out that of first importance was the matter of "making WOI serviceable to the farmers so that they will derive all that the Iowa State College may have to offer to aid and assist them in their work."

Short Wave Training

THE radio short course which is open to amateurs has been offered at the college for four years. A veritable army of program listeners and amateurs who revel in wireless receiving and sending swept down upon the campus four years ago when the course was first offered. More than 500 were in attendance.

At the several courses presented many exhibits have been provided, and there have been technical talks, a series of round table discussions and an open forum for the manufacturers' representatives. Every phase of radio has been offered, the subjects being handled from the standpoint of the technical fan as well as the enthusiast who spends his spare time twisting dials.

Since the first two-day course was started, it has been an annual feature in April. On account of the drop in attendance on the part of the program listeners, this part of the course was abandoned. The registration this year indicated the presence of 100 or more, aside from the 35 or 40 drawn from the student body at the college.

There is no charge for the course, and students from Minnesota, Illinois and Nebraska, as well as Iowa, have taken advantage of the opportunity afforded to familiarize themselves with the problems radio has to offer. Stations WOI and 9LC, the last named a station built and maintained by the students at Iowa State College, are both available for inspection at the time the short course is held, one of the features of the course being the information supplied covering the experiments carried on at these two stations.

Order your August RADIO AGE now if you couldn't get one last month!—50c postpaid from RADIO AGE, Inc.

Your Favorite Hookup May Be in a Back Issue of RADIO AGE.
See Page 42

* *Tested and Approved by* RADIO AGE *

How to Build a 5-Tube Circloid Coil Set

(Continued from page 54)

to one of the tap posts gives sharp tuning for city use or in the vicinity of strong local stations, while the other post considerably broadens the tuning where extreme selectivity is not desirable, as in the open country or at great distances from the stations.

The two remaining coils are of the two circuit type, with independent primaries and secondaries, and act as the first and second radio frequency transformers in a conventional two stage radio frequency circuit. The windings are so adjusted that the coupler and transformer condensers "log" perfectly under all conditions, regardless of the difference in their construction. By connecting the antenna to the "sharp" post, local stations are tuned out completely within two or three dial divisions. Connected to the "broad post," local comes in and out within five to eight dial divisions, depending upon the strength and location of the station.

This may sound simple and of no particular consequence, but if you expect to use the set both in the city and in the country you will find that the tapped coupler is of the greatest convenience and assistance in obtaining the desired degree of selectivity and sharpness. If the set tunes very sharp, it will enable you to get through local traffic, but at a considerable distance from the stations this will make it very difficult to pick up weak signals. In fact, with a very sharp set you may skip over half a dozen stations without being aware of their existence at all. Broadening the tuning to twice the number of dial divisions or more gives you more leeway in the adjustments

Suitable Hook-Ups

With the receiver assembled as shown any five tube hook-up can be adopted, either of the radio-frequency type or reflex. I have worked it as a simple straight-line radio frequency circuit, as a radio frequency "Bridge" circuit and as a reflex with excellent results in all cases. Any five tube circuit shown in RADIO AGE to date can be used with great success with these self-contained field coils, much better results being obtained as a rule than with the solenoid coils originally recommended, for with the circloids we do not have to combat self-oscillations and the howling due to excessive regeneration. The selectivity is much improved because the coils cannot act as aerials within themselves and thus cannot pick up interferences that are usually out of control with solenoids.

Wiring the Receiver

For wiring the receiver outlined above, you will find that rubber covered flexible wire is far preferable to the ordinary soldered bus-bar wiring. Very small rubber covered strand is cut to length and then is provided with connection lugs or eyes at either end, which are clamped down firmly over the ends by means of your pliers. The eyes are then screwed under the binding screws of the apparatus and the wiring is completed without the use of a soldering copper and without the troubles that generally attend amateur soldering. It is not necessary to spend so much time and thought in arranging the runs of the flexible wiring, as with bus-bar for the rubber insulation affords perfect protection at all points and makes it possible to run straight between the two connection points instead of running all around the lot as is common with bus wiring.

A Radio Veteran Does Some Reminiscing

(Continued from page 31)

and velvet hangings. Also, the set they procured was just about four times as powerful as ours.

It didn't take long for the news to get about that the other afternoon paper had the better broadcasting set. It was then that the real fight for talent commenced.

In just one way were we superior to the other station. We provided taxicab transportation for our artists whereas the other station allowed them to get to the studio the best way they could. Even this slight edge proved our downfall in one instance.

As I remember it, the only person I had been able to book for this particular evening was a woman who had promised to sing several numbers, interspersed with selections on the phonograph and the reproducing piano. I was, of course, to send a cab for her. I was so desperate that I would have sent a brass band along as escort had she demanded it and had I been able to obtain it.

I telephoned the cab company and gave them the name, address and time of appearance of our lone entertainer. Then I went to the station, content that, for that evening at least, I was fixed for a program.

The singer was due to go on at 7:40 o'clock. We opened the program at 7:15 o'clock with baseball scores, news items and selections on the reproducing piano and the phonograph. Along about 7:25 we began to look for our artist. The cab company usually got our entertainers to the station 10 or 15 minutes before they were due to appear.

Seven-thirty and no singer had arrived. Percy began to get worried and every time he shifted the piano or phonograph in front of the horn he wanted to know where the singer was. By 7:35 I was worried and peevish myself and I snapped back that I wasn't any mind-reader and how should I know where she was?

Seven-forty and still no singer. Percy was downright belligerent. He was getting tired of shifting the piano and the phonograph. In our sweetest voice we informed the listeners that our artist had been delayed but that she had telephoned that she was on the way.

Seven-forty-five came and passed. Seven-fifty. Percy was ready to annihilate me, the station and the entire building. During one of the piano numbers he viciously picked up the head phones and tuned in on our sister station. The expression of his face changed. His eyes grew wild. Hastily he clapped the head phones over my ears.

In stentorian tones the young man at the other station was announcing the fact that Miss So-and-So had unexpectedly dropped into the station and that now the fans would have the pleasure of hearing her in a group of songs. The Miss So-and-So was our artist!

Of course the explanation was simple. A new cab driver had been given the

(Turn to page 69)

Diagrams for Intermediate Transformers

In the August RADIO AGE, on page 89, was printed a description of the construction of the ideal intermediate frequency transformer. For the benefit of readers desiring pictorial explanations, we are printing Figures 1, 2 and 3 to illustrate the description further.

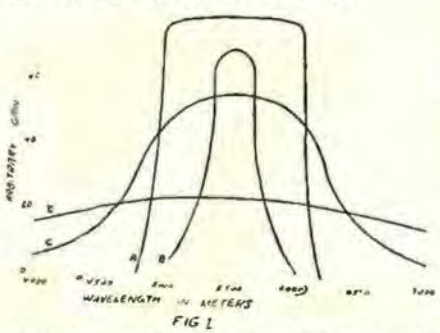
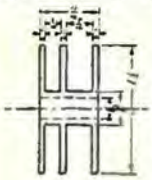


FIG 1

Looking at the curves of Figure 1, we see A, B, C and D. "A" represents the ideal transformer, giving infinite amplification over a 10,000 cycle band, yet at no other frequencies. "B" is an air-core transformer giving the highest possible amplification. It is useless, since it will not pass music and speech, and is subject to the physical limitations previously set forth. "C" is the practical ideal transformer, passing the desired frequency band with a gain variation insufficient to cause distortion, yet with a limited field and good stability. "D" is the extreme for perfect reproduction—but gives no selectivity and no amplification to speak of.

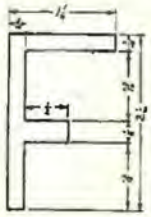
Suppose we wish to construct "C", which is the best transformer we can build practically. We will require a bobbin turned out of wood or built up of fibre, together with two pieces of core iron as shown in Figure 2. This bobbin is wound with 1,400 turns of No. 36 SSE in the smaller slot for the primary, and 3300 turns of the same wire in the larger slot for the secondary. The core is put in so that the air gap comes under the larger or secondary coil, and the ends of the laminations are bent over each other to hold them together. This transformer may be placed in a small metal can, with leads brought out as desired. It should first be boiled in a resin-bees-wax compound, with which the can should be filled.

This transformer, while selective, may best be used in conjunction with another type, which would be a compromise between "B" and "C".



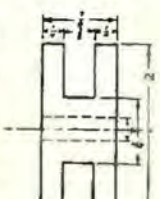
INTERMEDIATE TRANSFORMER.
PRIMARY 1400 TURNS
#36 SSE WIRE
INSIDE-"B", OUTSIDE-"PLATE"
SECONDARY 3300 TURNS
#36 SSE WIRE
INSIDE-"A", OUTSIDE-"GRID"

FIG. 2



CORE .007" SILICON STEEL
1 PIECE AS SHOWN, 1 PIECE
WITHOUT CENTER PROJECTION
MOUNT WITH PROJECTION
UNDER PRIMARY COIL
IMPREGNATE IN ROSIN-
BEESWAX COMPOUND

FIG 3



FILTER
PRIMARY: 250 TURNS
#36 D.S.C. WIRE
INSIDE-"B" OUTSIDE-"PLATE"
SECONDARY 1500 TURNS
#36 D.S.C. WIRE
INSIDE-"A", OUTSIDE-"GRID"
IMPREGNATE IN ROSIN-BEESWAX
COMPOUND.

Corrected List of Broadcasting Stations

KDKA	Westinghouse Electric & Mfg. Co.	East Pittsburgh, Pa.	309
KDLR	Radio Electric Co.	Devils Lake, N. D.	231
KDPM	Westinghouse Electric & Mfg. Co.	Cleveland, Ohio	270
KDYL	Newhouse Hotel	Salt Lake City, Utah	250
KDZB	Frank E. Siefert	Bakersfield, Calif.	240
KDZI	Electric Supply Co.	Wenatchee, Wash.	360
KFAB	Nebraska Buick Auto Co., 13th & Que Sts.	Lincoln, Nebr.	341
KFAD	McArthur Bros. Mercantile Co.	Phoenix, Ariz.	273
KFAE	State College of Washington	Pullman, Wash.	348
KFAF	Western Radio Corporation	Denver, Colo.	278
KFAJ	University of Colorado	Boulder, Colo.	360
KFAN	University of Idaho	Moscow, Idaho	230
KFAU	Boise High School	Boise, Idaho	271
KFAW	The Radio Den (W. B. Ashford)	Santa Ana, Calif.	280
KFBB	F. A. Buttrey & Co.	Havre, Mont.	360
KFBC	W. K. Arbill	San Diego, Calif.	278
KF6G	First Presbyterian Church	Tacoma, Wash.	250
KFBK	Kimball-Upson Co.	Sacramento, Calif.	283
KFBL	Leese Bros.	Everett, Wash.	224
KFCB	Nielson Radio Supply Co.	Phoenix, Ariz.	238
KFCC	The First Congregational Church	Helena, Mont.	248
KFCF	Frank A. Moore	Walla Walla, Wash.	256
KFCZ	Omaha Central High School	Omaha, Nebr.	258
KFDD	St. Michaels Cathedral	Boise, Idaho	252
KFDH	University of Arizona	Tucson, Ariz.	368
KFDJ	Oregon Agricultural College	Corvallis, Oreg.	254
KFDM	Magnolia Petroleum Co.	Beaumont, Texas	315
KFDX	First Baptist Church	Shreveport, La.	360
KFDY	South Dakota State College	Brookings, S. Dak.	360
KFDZ	Harry O. Iverson	Minneapolis, Minn.	231
KFEC	Meier & Frank Co.	Portland, Oreg.	248
KFEK	Augsbury Seminary	Minneapolis, Minn.	261
KFEL	Winner Radio Corp.	Denver, Colo.	254
KFEQ	J. L. Scroggin	Oak, Nebr.	268
KFEY	Bunker Hill & Sullivan Mining and Concentrating Co.	Kellogg, Idaho	233
KFFP	First Baptist Church	Moberly, Mo.	260
KFFV	Graceland College	Lamoni, Iowa	280
KFGB	Heidbreder Radio Supply Co.	Utica, Neb.	224
KFGC	Louisiana State University	Baton Rouge, La.	254
KFGD	Chickasha Radio & Electric Co.	Chickasha, Okla.	248
KFGH	Leland Stanford University	Stanford University, Calif.	273
KFGS	Crary Hardware Co.	Boone, Iowa	226
KFHA	Western State College of Colorado	Gunnison, Colo.	252
KFHH	Ambrose A. McCue	Neah Bay, Wash.	261
KFHL	Penn College	Oskaloosa, Iowa	240
KFI	E. C. Anthony, Inc.	Los Angeles, Calif.	468
KFIF	Benson Polytechnic Institute	Portland, Oreg.	248
KFIO	North Central High School	Spokane, Wash.	252
KFIQ	First Methodist Church	Yakima, Wash.	242
KFIU	Alaska Electric Light & Power Co.	Juneau, Alaska	226
KFIZ	Daily Commonwealth	Fond du Lac, Wis.	273
KFJB	Marshall Electrical Co.	Marshalltown, Iowa	248
KFJC	R. B. Fegan (Episcopal Church)	Junction City, Kansas	219
KFJF	National Radio Manufacturing Co.	Oklahoma City, Okla.	252
KFJI	Liberty Theatre (E. E. Marsh)	Astoria, Oreg.	252
KFJL	Hardsaeg Manufacturing Co.	Ottumwa, Iowa	242
KFJM	University of North Dakota	Grand Forks, N. Dak.	280
KFJR	Ashley C. Dixon & Son	Stevensville, Mont.	258
KFJX	Iowa State Teacher's College	Cedar Falls, Iowa	280
KFJY	Tunwall Radio Co.	Fort Dodge, Iowa	246
KFJZ	W. E. Branch	Fort Worth, Texas	254
KFKA	Colorado State Teachers College	Greeley, Colo.	273
KFKQ	Conway Radio Laboratories (Ben H. Woodruff)	Conway, Ark.	250
KFKU	The University of Kansas	Lawrence, Kans.	275
KFKX	Westinghouse Electric & Manufacturing Co.	Hastings, Nebr.	288
KFLD	Paul E. Greenlaw	Franklinton, La.	234
KFLP	Everett M. Foster	Cedar Rapids, Ia.	256
KFLR	University of New Mexico	Albuquerque, New Mexico	254
KFLU	Rio Grande Radio Supply House	San Benito, Texas	236
KFLV	Rev. A. T. Frykman	Rockford, Ill.	229
KFLX	George Roy Clough	Galveston, Texas	240
KFLZ	Atlantic Automobile Co.	Atlantic, Ia.	273
KFMB	Christian Churches	Little Rock, Ark.	254
KFMQ	University of Arkansas	Fayetteville, Ark.	299
KFMR	Morningside College	Sioux City, Iowa	261
KFMW	M. G. Sateren	Houghton, Mich.	266
KFMX	Carleton College	Northfield, Minn.	336
KFNF	Henry Field Seed Co.	Shenandoah, Iowa	266
KFNG	Wooten's Radio Shop	Coldwater, Miss.	254
KFNV	L. A. Drake Battery and Radio Supply Shop	Santa Rosa, Calif.	234
KFOA	Rhodes Department Store	Seattle, Wash.	454
KFOL	Leslie M. Schafbush	Marengo, Iowa	234
KFON	Echophone Radio Shop	Long Beach, Calif.	234
KFOO	Latter Day Saints University	Salt Lake City, Utah	261
KFOP	Rohrer Elec. Co.	Marshfield, Ore.	240
KFOR	David City Tire & Electric Co.	David City, Nebraska	226
KFOT	College Hill Radio Club	Wichita, Kansas	231
KFOX	Board of Education, Technical High School	Omaha, Nebraska	248
KFOY	Beacon Radio Service	St. Paul, Minn.	226
KFPG	Garretson and Dennis	Los Angeles, Calif.	238
KFPL	C. C. Baxter	Dublin, Texas	242
KFPM	The New Furniture Co.	Greenville, Texas	242
KFPR	Los Angeles County Forestry Dept.	Los Angeles, Calif.	231
KFPT	Cape & Johnson	Salt Lake City, Utah	286
KFPW	St. Johns M. E. Church	Carterville, Mo.	268
KFPY	Symons Investment Co.	Spokane, Wash.	283
KFQA	The Principia	St. Louis, Mo.	264
KFQB	The Searchlight Publishing Co.	Fort Worth, Texas	221
KFQC	Kidd Brothers Radio Shop	Taft, Calif.	258
KFQH	Radio Service Co.	Burlingame, Calif.	231
KFQP	G. S. Carson, Jr.	Iowa City, Ia.	284
KFQT	Texas National Guard	Dennison, Texas	252
KFQU	W. Riker	Holy City, Calif.	253
KFQW	C. F. Knierim	North Bend, Wash.	248
KFQY	Farmers State Bank	Belden, Neb.	273
KFQZ	Taft Products Co.	Hollywood, Calif.	240
KFRC	City of Paris Dry Goods Co.	San Francisco, Calif.	268
KFRM	James F. Boland	Fort Sill, Okla.	263
KFRU	Ethereal Radio Co.	Bristow, Okla.	394
KFRW	United Churches of Olympia	Olympia, Wash.	220
KFRX	J. Gordon Klemgard	Pullman, Wash.	217
KFRZ	The Electric Shop	Hartington, Neb.	222
KFSG	Angelus Temple	Los Angeles, Calif.	272
KFSY	The Van Blaricon Co.	Helena, Mont.	261
KFUJ	Hopper Plumbing and Heating Co.	Breckenridge, Minn.	242
KFUL	Thomas Goggan & Bros. Music Co.	Galveston, Texas	258
KFUM	W. D. Pyle	Colorado Springs, Colo.	242
KFUO	Concordia Seminary	St. Louis, Mo.	549
KFUP	Fitzsimmons General Hospital	Denver, Colo.	234
KFUQ	Julius Brunton and Sons Co.	San Francisco, Calif.	234
KFUR	H. W. Peery and C. Redfield	Ogden, Utah	224
KFUS	Louis L. Sherman	Oakland, Calif.	233
KFUT	University of Utah	Salt Lake City, Utah	271
KFUU	Colburn Radio Labs.	San Leandro, Calif.	231
KFUY	Irvine M. Bouchard	Butte, Mont.	254
KFUZ	Y. M. C. A.	Virginia, Minn.	244
KFVC	Bensberg's Music Co.	Camden, Arkansas	248
KFVD	McWhinnie Electric Co.	San Pedro, Calif.	202
KFVE	Film Corporation of America	St. Louis, Mo.	245
KFVF	Clarence B. Juneau	Hollywood, Calif.	208
KFVG	First M. E. Church	Independence, Kansas	236
KFVH	Whan Radio Shop (Herbert Whan)	Manhattan, Kansas	218
KFVI	Headquarters Troop, 56th Calvary	Houston, Texas	248
KFVK	Sacramento Chamber of Commerce	Sacramento, Calif.	248
KFVL	Lt. Richard F. Lussier, 5th Inf. U.S.A., Vancouver Barracks	Vancouver, Wash.	231
KFVN	Carl E. Bagley	Welcome, Minn.	227
KFVO	F. M. Henry	Kirksville, Mo.	226
KFVR	Moonlight Ranch	Route 6, Denver, Colo.	246
KFVS	Cape Girardeau Battery Station	Cape Girardeau, Mo.	224
KFVY	Radio Supply Co.	Albuquerque, N. M.	250
KFVZ	Glad Tidings Tabernacle	San Francisco, Calif.	234
KFWA	Browning Bros. Co.	Ogden, Utah	214
KFWB	Warner Bros.	Hollywood, Calif.	252
KFWD	Arkansas Light & Power Co.	Arkadelphia, Arkansas	268
KFWF	St. Louis Truth Center	St. Louis, Mo.	214
KFWH	F. Wellington Morse, Jr.	Chico, Calif.	254
KFWI	Radio Entertainments, Inc.	South San Francisco, Calif.	220
KFWM	Oakland Educational Society	Oakland, Calif.	224
KFWO	Lawrence Mott	Avalon, Calif.	211
KFWP	Rio Grande Radio Supply House	Brownsville, Texas	214
KGB	Tacoma Daily Ledger	Tacoma, Wash.	252
KGO	General Electric Co.	Oakland, Calif.	361
KGU	Marion A. Mulrony	Honolulu, Hawaii, Waikiki Beach	370
KGW	Portland Morning Oregonian	Portland, Oreg.	491
KGY	St. Martins College (Reb. Sebastian Ruth)	Lacy, Wash.	253
KHJ	Times-Mirror Co.	Los Angeles, Calif.	405
KHQ	Louis Wasmer	Seattle, Wash.	273
KJR	Northwest Radio Service Co.	Seattle, Wash.	384
KJS	Bible Institute of Los Angeles, Inc.	Los Angeles, Calif.	293
KLDS	Reorganized Church of Jesus Christ of Latter Day Saints	Independence, Mo.	441
KLS	Warner Brothers Radio Supplies Co.	Oakland, Calif.	242
KLX	Tribune Publishing Co.	Oakland, Calif.	508
KLZ	Reynolds Radio Co.	Denver, Colo.	283
KMJ	San Joaquin Light & Power Corp.	Fresno, Calif.	243
KMO	Love Electric Co.	Tacoma, Wash.	250
KNX	Los Angeles Evening Express	Los Angeles, Calif.	337
KOA	General Electric Co.	Denver, Colo.	323
KOB	New Mexico College of Agriculture & Mechanic Arts.	State College, N. Mex.	348
KOIL	Monarch Manufacturing Co.	Council Bluffs, Iowa	278
KOP	Detroit Police Department	Detroit, Mich.	286
KPO	Hale Bros.	San Francisco, Calif.	428
KPPC	Pasadena Presbyterian Church	Pasadena, Calif.	229
KPRC	Houston Post-Dispatch	Houston, Texas	270
KQP	Apple City, Radio Club	Hood River, Oregon	270
KQV	Doubleday-Hill Electric Co.	Pittsburgh, Pa.	270
KQW	Charls D. Herrold	San Jose, Calif.	226
KRE	V. C. Battery & Electric Co.	Berkeley, Calif.	275
KSAC	Kansas State Agricultural College	Manhattan, Kans.	341
KSD	Post Dispatch (Pulitzer Pub. Co.)	St. Louis, Mo.	545
KSL	Radio Service Corp. of Utah	Salt Lake City, Utah	299
KTCL	American Radio Telephone Co., Inc.	Seattle, Wash.	306
KTHS	New Arlington Hotel Co.	Hot Springs, Ark.	375
KTW	First Presbyterian Church	Seattle, Wash.	455
KUO	Examiner Printing Co.	San Francisco, Calif.	246
KUOM	State University of Montana	Missoula, Montana	244
KWG	Portable Wireless Telephone Co.	Stockton, Calif.	248
KWKC	Wilson Duncan Studios	Kansas City, Mo.	236
KWWG	City of Brownsville	Brownsville, Texas	278
KYO	Electric Shop	Honolulu, Hawaii	270
KYW	Westinghouse Electric & Mfg. Co.	Chicago, Ill.	535
KZM	Preston D. Allen	Oakland, Calif.	242
WAAB	Valdemar Jensen	New Orleans, La.	263
WAAC	Tulane University	New Orleans, La.	275
WAAD	Ohio Mechanics Institute	Cincinnati, Ohio	248
WAAF	Chicago Daily Drovers Journal	Chicago, Ill.	286
WAAM	I. R. Nelson Co.	Newark, N. J.	263
WAAW	Omaha Grain Exchange	Omaha, Nebr.	285
WABA	Lake Forest University	Lake Forest, Ill.	227
WABB	Harrisburg Sporting Goods Co.	Harrisburg, Pa.	266
WABC	Asheville Battery Co., Inc.	Asheville, N. C.	254
WABI	Bangor Railway & Electric Co.	Bangor, Me.	240
WABL	Connecticut Agricultural College	Storrs, Conn.	283
WABN	Ott Radio, Inc.	LaCrosse, Wis.	244
WABO	Lake Avenue Baptist Church	Rochester, N. Y.	283
WABQ	Haverford College, Radio Club	Haverford, Pa.	261
WABR	Scott High School, N. W. B. Foley	Toledo, Ohio	270
WABU	Victor Talking Machine Co.	Camden, N. J.	224
WABW	College of Wooster	Wooster, Ohio	234
WABX	Henry B. Joy	Mt. Clemens, Mich.	270
WABY	John Masialdi, Jr.	Philadelphia, Pa.	242
WABZ	Coliseum Place Baptist Church	New Orleans, La.	263
WADC	Allen T. Simmons (Allen Theatre)	Akron, Ohio	258
WAFD	Albert B. Parfet Co.	Port Huron, Mich.	233
WAHG	A. H. Grebe & Co.	Richmond Hill, N. Y.	315
WAMD	Hubbard & Co.	Minneapolis, Minn.	244
WBAA	Purdue University	W. Lafayette, Ind.	283
WBAC	Clemso Agric. College	Clemson College, S. C.	331
WBAH	The Dayton Co.	Minneapolis, Minn.	417
WBAK	Pennsylvania State Police	Harrisburg, Pa.	275
WBAO	James Millikan University	Decatur, Ill.	360
WBAP	Wortham-Carter Publishing Co. (Star Telegram)	Fort Worth, Texas	476
WBAV	Erner & Hopkins Co.	Columbus, Ohio	292
WBAX	John H. Stenger, Jr.	Wilkes-Barre, Pa.	254
WBAY	Western Electric Co.	New York, N. Y.	492
WBBG	Irving Vermilya	Mattapoisett, Mass.	248
WBBL	Grace Covenant Presbyterian Church	Richmond, Va.	253
WBBM	Atlass Investment Co.	Chicago, Ill.	226
WBBN	Blake, A. B.	Wilmington, N. C.	275
WBBP	Petoskey High School	Petoskey, Mich.	246
WBBR	Peoples Pulpit Asso.	Rossville, N. Y.	273
WBBS	First Baptist Church	New Orleans, La.	252
WBBU	Jenks Motor Sales Co.	Monmouth, Ill.	224
WBBX	Ruffner Junior High School	Norfolk, Va.	222
WBBY	Washington Light Infantry Co. "B" 118th Inf.	Charleston, S. C.	268
WBCN	Foster & McDoland	Chicago, Ill.	266
WBDC	Baxter Laundry Co.	Grand Rapids, Mich.	256
WBES	Bliss Electrical School	Takoma Park, Md.	222
WBGA	Jones Elec. & Radio Mfg. Co.	Baltimore, Md.	254
WBOQ	A. H. Grebe & Co., Inc.	Richmond Hill, N. Y.	236
WBR	Pennsylvania State Police	Butler, Pa.	286
WBRC	Bell Radio Corporation	Birmingham, Ala.	248
WBRE	Baltimore Radio Exchange	Wilkes-Barre, Pa.	231
WBS	D. W. May, Inc.	Newark, N. J.	252
WBT	Southern Radio Corp.	Charlotte, N. C.	275
WBZ	Westinghouse Electric & Mfg. Co.	Springfield, Mass.	333
WCAD	St. Lawrence University	Canton, N. Y.	280
WCAE	Kaufmann & Baer Co. and The Pittsburgh Press	Pittsburgh, Pa.	461
WCAH	Entrekin Electric Co.	Columbus, Ohio	286
WCAJ	Nebraska Wesleyan University	University Place, Nebr.	283
WCAL	St. Olaf College	Northfield, Minn.	336
WCAO	Sanders & Stayman Co.	Baltimore, Md.	275
WCAP	Chesapeake & Potomac Telephone Co.	Washington, D. C.	468
WCAR	Alamo Radio Electric Co.	San Antonio, Texas	263
WCAS	W. H. Dunwoody Industrial Institute	Minneapolis, Minn.	280
WCAT	State College of Mines	Rapid City, S. Dak.	240
WCAU	Durham & Co.	Philadelphia, Pa.	278
WCAX	University of Vermont	Burlington, Vt.	250
WCAZ	Carthage College	Carthage, Ill.	246
WCBA	Charles W. Heibsehm	Allentown, Pa.	280
WCBC	University of Michigan	Ann Arbor, Mich.	280
WCBD	Wilbur C. Voliva	Zion, Ill.	344
WCBE	Uhalt Radio Co.	New Orleans, La.	263
WCBF	Paul J. Miller	Pittsburgh, Pa.	236
WCBG	Howard S. Williams (Portable)	Pascagoula, Miss.	268
WCBH	University of Miss.	Oxford, Miss.	242
WCBM	Charles Swarz	Baltimore, Md.	229
WCBN	James P. Boland	Ft. Benj. Harrison, Ind.	266
WCBQ	First Baptist Church	Nashville, Tenn.	236
WCBR	C. H. Messter	Providence, R. I.	246
WCBT	Clark University, Collegiate Dept.	Worcester, Mass.	238
WCBU	Arnold Wireless Supply Co.	Arnold, Pa.	254
WCBX	Radio Shop of Newark (Herman Lubinsky)	Newark, N. J.	273

Appearance and Correctness in B-T Control

An effort to combine a pleasing and attractive appearance with mechanical correctness and tuning efficiency is evident in the new B-T "Better Tuning" Control.

By the use of a unique mechanical arrangement, backlash is entirely eliminated. The action is smooth and even, and loggings cannot be "thrown off" by slipping of the mechanism.

Dial numbers are read from a scale passing under a window at the top of the instrument. The use of a special vernier device provides accurate readings to fractions of a degree, if desired. Dial graduations read 0 to 100 over 180° on one side and 100 to 0 on the other. This feature protects the purchaser who might wish to change from right hand to left hand condensers, or vice versa.

The large rotating pointer indicates wavelength readings, and the scale is calibrated for straight-line-wavelength changes in accordance with present broadcast station assignments. If desired the wavelength plate may be reversed for recording station call letters. The user is thus able to choose just about whatever combination or style of reading or logging he may desire.

Mounting is made by a single 5/32 in. hole through the panel. All pull or side strain on the condenser shaft is eliminated, as well as wear and tear on condenser bearings which might impair alignment, cause short circuits or destroy logging records by changing capacity.

WCCO	Washburn-Crosby Co.	Twin Cities, Minn.	416
WCEE	Charles E. Erbstein, Villa Olivia	near Elgin, Ill.	226
WCLS	H. M. Couch	Joliet, Ill.	214
WCSH	Henry P. Rines	Portland, Maine	256
WCTS	C. T. Scherer Co.	Worcester, Mass.	268
WCX	Free Press	Detroit, Mich.	516
WDAE	Tampa Daily Times	Tampa, Fla.	365
WDAF	Kansas City Star	Kansas City, Mo.	365
WDAG	J. Laurence Martin	Amarillo, Texas	263
WDAH	Trinity Methodist Church (South)	El Paso, Texas	268
WDAR	Lit Brothers	Philadelphia, Pa.	393
WDAY	Radio Equipment Corp.	Fargo, N. Dak.	244
WDBA	Fred Ray	Columbus, Ga.	236
WDBB	A. H. Waite & Co., Inc.	Taunton, Mass.	229
WDBC	Kirk, Johnson & Co.	Lancaster, Pa.	258
WDBD	Herman Edwin Burns	Martinsburg, W. Va.	268
WDBE	Cilham-Schoen Elec. Co.	Atlantic, Ga.	278
WDBJ	Richardson Wayland Electric Corp.	Roanoke, Va.	229
WDBK	M. F. Bros.	Cleveland, Ohio	227
WDBL	Wis. Dept. of Markets	Stevens Point, Wis.	278
WDBN	Electric Light & Power Co.	Bangor, Me.	252
WDBO	Rollins College, Inc.	Winter Park, Fla.	240
WDBQ	Morton Radio Supply Co.	Salem, N. J.	234
WDBR	Tremont Temple Baptist Church	Boston, Mass.	256
WDBV	The Strand Theatre	Fort Wayne, Ind.	258
WDBX	Otto Baur	New York, N. Y.	233
WDBY	North Shore Congregational Church	Chicago, Ill.	258
WDBZ	Boy Scouts, City Hall	Kingstown, N. Y.	233
WDOD	Chattanooga Radio Co., Inc.	Chattanooga, Tenn.	256
WDWF	Dutee Wilcox Flint, Inc.	Cranston, R. I.	441
WDZ	J. L. Bush	Tuscola, Ill.	278
WEAA	F. D. Fallain	Flint, Mich.	250
WEAF	American Telephone & Telegraph Co.	New York, N. Y.	485
WEAH	Hotel Lassen	Wichita, Kans.	280
WEAI	Cornell University	Ithaca, N. Y.	286
WEAJ	University of South Dakota	Vermillion, S. Dak.	283
WEAM	Borough of North Plainfield (W. Grayson Buttfield)	North Plainfield, N. J.	286
WEAN	Shepard Co.	Providence, R. I.	273
WEAO	Ohio State University	Columbus, Ohio	293
WEAR	Goodyear Tire and Rubber Co.	Cleveland, Ohio	389
WEAU	Davidson Bros. Co.	Sioux City, Iowa	275
WEAY	Iris Theatre (Will Horowitz, Jr.)	Houston, Texas	270
WEB	Benwood Co.	St. Louis, Mo.	273
WEBA	Electric Shop	Highland Park, N. J.	233
WEBC	Walter Cecil Bridges	Superior, Wis.	242
WEBD	Electrical Equipment and Service Co.	Anderson, Ind.	246
WEBE	Roy W. Walker	Cambridge, Ohio	248
WEBH	Edgewater Beach Hotel, Chicago Evening Post Station	Chicago, Ill.	370
WEBJ	Third Avenue Railway Co.	New York, N. Y.	273
WEBK	Grand Rapids Radio Co.	Grand Rapids, Mich.	242
WEBM	Radio Corporation of America	Portable	226
WEBP	E. B. Pedicord	New Orleans, La.	280
WEBT	The Dayton Coop. Industrial High School	Dayton, Ohio	270
WEBW	Beloit College	Beloit, Wis.	283
WEEI	The Edison Electric Illuminating Co.	Boston, Mass.	475
WEHS	Robert E. Hughes	Evanston, Ill.	205
WEMC		Harrison Springs, Mich.	285
WENR	All-American Radio Corporation	Chicago, Illinois	266
WEW	St. Louis University	St. Louis, Mo.	280
WFAA	Dallas News & Dallas Journal	Dallas, Tex.	472
WFAM	Times Publishing Co.	St. Cloud, Minn.	273
WFAV	University of Nebraska, Department of Electrical Engineering	Lincoln, Nebr.	275
WFBC	First Baptist Church	Knoxville, Tenn.	250
WFBD	Gethsemane Baptist Church	Philadelphia, Pa.	234
WFBE	Van De Walle Music and Radio Co.	Seymour, Ind.	226
WFBG	The Wm. F. Cable Co.	Altoona, Pa.	261
WFBH	Concourse Radio Corporation	New York, N. Y.	273
WFBJ	St. John's University	Collegeville, Minn.	236
WFBQ	Wynne Radio Co.	Raleigh, N. C.	255
WFBR	Fifth Inf. Md. Nat'l Guard, 5th Reg. Armory	Baltimore, Md.	452
WFBW	Ainsworth-Gates Radio Co.	Cincinnati, Ohio	309
WFBZ	Knox College	Caleshurg, Ill.	254
WFI	Strawbridge and Clothier	Philadelphia, Pa.	394
WFKB	Francis K. Bridgman	Chicago, Ill.	217
WFUV	C. Pearson Ward	Springfield, Mo.	252
WFUW	Earl William Lewis	Moberly, Mo.	233
WGAL	Lancaster Electric Supply & Construction Co.	Lancaster, Pa.	248
WGAQ	Youree Hotel	Shreveport, La.	252
WGAZ	South Bend Tribune	South Bend, Ind.	360
WGBB	Harry H. Carman, 217 Bedell St.	Freeport, N. Y.	244
WGBC	First Baptist Church	Memphis, Tenn.	266
WGBF	Fink Furniture Co.	Evansville, Ind.	217
WGBG	Brietenbach's Radio Shop	Thrifton, Va.	226
WGBI	Frank S. Mecargee	Scranton, Pa.	240
WGBK	Lawrence Cannubell	Johnstown, Pa.	248
WGBM	Theodore N. Saaty	Providence, R. I.	234
WGBL	Elyria Radio Assn. (Albert H. Ernst)	Elyria, Ohio	227
WGBQ	Stout Institute	Menominee, Wis.	234
WGBR	Marshfield Broadcasting Assn.	Marshfield, Wis.	229
WGBS	Gimbel Brothers	New York, N. Y.	315
WGBT	Furman University	Greenville, S. C.	236
WGBX	University of Maine	Orono, Mo.	252
WGBY	Progress Sales Co.	R. R. No.	218
WGES	Coyne Electrical School	Oak Park, Ill.	250
WGI	American R. & R. Co.	Medford Hillside, Mass.	261
WGMU	A. H. Grebe & Co., Inc., Portable	Richmond Hill, N. Y.	236
WGN	The Tribune	Chicago, Ill.	370
WGR	Federal T. and T. Co.	Buffalo, N. Y.	319
WGY	General Elec. Co.	Schenectady, N. Y.	379
WHA	University of Wisconsin	Madison, Wis.	535
WHAD	Marquette University and Milwaukee Journal	Milwaukee, Wis.	280
WHAG	University of Cincinnati	Cincinnati, Ohio	222
WHAH	Hafer Supply Co.	Joplin, Mo.	283
WHAM	University of Rochester (Eastman School of Music)	Rochester, N. Y.	278
WHAP	H. Alvin Simmons, 290 Flatbush Ave.	Brooklyn, N. Y.	240
WHAR	Seaside House	Atlantic City, N. J.	275
WHAS	Courier-Journal & Louisville Times	Louisville, Ky.	399
WHAT	Dr. George W. Young	Minneapolis, Minn.	231
WHAV	Wilmington Electrical Specialty Co.	Wilmington, Del.	360
WHAZ	Rensselaer Polytechnic Institute	Troy, N. Y.	385
WHB	Sweeney School Co.	Kansas City, Mo.	365
WHBA	C. C. Shaffer	Oil City, Pa.	250
WHBB	Hobel's Store	Stevens Point, Wis.	240
WHBC	Rev. E. P. Graham	Canton, Ohio	245
WHBD	Chas. W. Howard	Bellefontaine, Ohio	222
WHBF	Beardsley Specialty Company	Rock Island, Illinois	222
WHBG	John S. Skane	Harrisburg, Pa.	231
WHBH	Culver Military Academy	Culver, Ind.	222
WHBJ	Lauer Auto Co.	Ft. Wayne, Ind.	234
WHBK	Franklin St. Garage, Inc.	Ellsworth, Me.	231
WHBL	James H. Shisler	Logansport, Ind.	220
WHBM	C. L. Carroll, Portable Station	Chicago, Ill.	233
WHBN	First Ave. Methodist Church	St. Petersburg, Florida	258
WHBP	Johnstown Automobile Co.	Johnstown, Pennsylvania	256
WHBQ	St. John's M. E. Church South	Memphis, Tenn.	233
WHBR	Scientific Electric & Mfg. Co., 3664 Vine St.	Cincinnati, Ohio	216
WHBU	Riviera Theatre and Barr's Clothing	Anderson, Ind.	218
WHBV	Fred Ray's Radio Shop	Columbus, Ga.	244
WHBW	D. R. Kienzle	Philadelphia, Pa.	215
WHBY	St. Norbert's College	West De Pere, Wis.	250
WHEC	Hickson Electric Co., Inc.	Rochester, N. Y.	258
WHK	Radiovox Company	Cleveland, Ohio	273
WHN	George Schubert	New York, N. Y.	360
WHO	Bankers' Life Co.	Des Moines, Ia.	526
WHT	Wrigley Building, Chicago	Deerfield, Ill.	238
WIAD	Howard R. Miller	Philadelphia, Pa.	254
WIAQ	Chronicle Publishing Co.	Marion, Ind.	226
WIAS	Home Electric Co.	Burlington, Iowa	283
WIBA	The Capital-Times Studio	Madison, Wis.	236
WIBC	L. M. Tate Post, No. 29, Veterans of Foreign Wars	St. Petersburg, Florida	222
WIBD	X-L Radio Service	Joliet, Illinois	200
WIBE	Martinsburg Radio Broadcasting Co.	Martinsburg, W. Va.	210
WIBG	St. Paul's Protestant Episcopal Church	Elkins Park, Pa.	222
WIBO	Nelson Brothers	Chicago, Ill.	226
WIBH	Elite-Radio Stores	New Bedford, Mass.	209
WIBI	Frederick B. Zittell, Jr.	Flushing, N. Y.	219
WIBJ	C. L. Carrell (Portable)	Chicago, Ill.	216
WIBK	University of Toledo	Toledo, Ohio	205
WIBL	McDonald Radio Co., Portable Station	Joliet, Ill.	216
WIBP	First Presbyterian Church	Meiridian, Miss.	210
WIBQ	F. M. Schmidt	Farina, Ill.	205
WIBR	Thurman A. Owings	Werton, W. Va.	246
WIBS	New Jersey Nat'l Guard Hdqs. Co.	Elizabeth, N. J.	203
WIBT	Orlando Edgar Miller (Portable Station)	New York, N. Y.	211
WIBU	The Electric Farm	Poynette, Wis.	222
WIBW	Dr. L. L. Dill	Logansport, Ind.	220
WIBX	Crid-Leak, Inc.	Utica, N. Y.	205
WIL	Continental Electric Supply Co.	Washington, D. C.	360
WIP	Gimbel Bros.	Philadelphia, Pa.	509
WJAB	American Electric Co.	Lincoln, Nebr.	229
WJAD	Jackson's Radio Engineering Laboratories	Waco, Texas	352
WJAG	Norfolk Daily News	Norfolk, Nebr.	283
WJAK	Clifford L. White	Greentown, Iowa	254
WJAM	D. M. Perham	Cedar Rapids, Iowa	268
WJAR	The Outlet Co. (J. Samuels & Bro.)	Providence, R. I.	306
WJAS	Pittsburgh Radio Supply House	Pittsburgh, Pa.	286
WJAZ	Chicago Radio Laboratory	Chicago, Ill.	268
WJBA	D. H. Lentz, Jr.	Joliet, Ill.	207
WJBB	L. W. McClure	St. Petersburg, Fla.	207
WJBC	Hummer Furniture Co.	LaSalle, Ill.	234
WJBD	Ashland Broadcasting Committee	Ashland, Wis.	233
WJD	Denison University	Granville, Ohio	229
WJJD	Supreme Lodge, Loyal Order of Moose	Mooseheart, Ill.	303
WJY	Radio Corp. of America	New York, N. Y.	455
WJZ	Radio Corp. of America	New York, N. Y.	455
WKAA	H. F. Paar	Cedar Rapids, Iowa	278
WKAD	Chas. Looff (Crescent Park)	East Providence, R. I.	240
WKAQ	Radio Corp. of Porto Rico	San Juan, P. R.	340
WKAR	Michigan Agriculture College	East Lansing, Mich.	285
WKAV	Laconia Radio Club	Laconia, N. H.	254
WKBE	K. & B. Electric Co.	Webster, Massachusetts	231
WKBF	Dutee Wilcox Flint	Cranston, Rhode Island	286
WKBG	C. L. Carrel, Portable	Chicago, Ill.	216
WKY	Wky Radio Shop	Oklahoma City, Okla.	275
WLAG	Cutting & Washington Radio Corp.	Minneapolis, Minn.	417
WLAL	First Christian Church	Tulsa, Okla.	250
WLAP	Wm. V. Jordan	Louisville, Ky.	286
WLAQ	Arthur E. Shilling	Kalamazoo, Mich.	283
WLAX	Putnam Electric Co.	Greencastle, Ind.	231
WLB	University of Minnesota	Minneapolis, Minn.	278
WLBL	Wisconsin State Dept. of Markets	Stevenspoint, Wis.	278
WLS	Sears Roebuck & Co.	Chicago, Ill.	344
WLTS	Lane Technical High School	Chicago, Ill.	258
WLW	Crosley Mfg. Co.	Cincinnati, Ohio	422
WMAC	J. Edw. Page (Olive B. Meredith)	Casenovia, N. Y.	261
WMAF	Round Hills Radio Corp.	Dartmouth, Mass.	440
WMAK	Norton Laboratories	Lockport, N. Y.	273
WMAL	Trenton Hardware Co.	Trenton, N. J.	256
WMAN	First Baptist Church	Columbus, Ohio	286
WMAQ	Chicago Daily News	Chicago, Ill.	447
WMAY	Kingshighway Presbyterian Church	St. Louis, Mo.	280
WMAZ	Mercer University	Macon, Ga.	261
WMBB	Trianon Ball Room	Chicago, Ill.	250
WMBF	Miami Beach Hotel	Miami Beach, Fla.	384
WMC	Commercial Appeal	Memphis, Tenn.	503
WMCA	Hotel McAlpin (Greeley Square Hotel Co.)	New York City	341
WMH	Ainsworth-Gates Radio Co.	Cincinnati, O.	321
WNAC	Shepard Stores	Boston, Mass.	284
WNAD	University of Oklahoma	Norman, Okla.	258
WNAL	Omaha Central High School	Omaha, Nebr.	255
WNAP	Wittenberg College	Springfield, Ohio	271
WNAR	First Christian Church	Butler, Mo.	230
WNAT	Lennig Brothers Co. (Frederick Lennig)	Philadelphia, Pa.	254
WNAX	Dakota Radio Apparatus Co.	Yankton, S. Dak.	248
WNYC	Dept. of Plant and Structures	New York, N. Y.	526
WOAC	Page Organ Co.	Lima, Ohio	260
WOAE	Midland College	Fremont, Nebr.	280
WOAG	Apollo Theatre (Belvidere Amusement Co.)	Belvidere, Ill.	274
WOAI	Southern Equipment Co.	San Antonio, Texas	392
WOAN	Vaughn Conservatory of Music (James D. Vaughn)	Lawrenceburg, Tenn.	280
WOAO	Lyradion Mfg. Co.	Mishawaka, Ind.	369
WOAR	Lundskow, Henry P.	Kenosha, Wis.	225
WOAT	Boyd M. Hamp	Wilmington, Del.	360
WOAV	Pennsylvania National Guard, 21 Battalion, 112th Infantry	Erie, Pa.	242
WOAW	Woodmen of the World	Omaha, Nebraska	526
WOAX	Franklyn J. Wolff	Trenton, N. J.	240
WOC	Palmer School of Chiropractic	Davenport, Iowa	484
WOCL	Hotel Jamestown, Inc.	Jamestown, N. Y.	275
WODA	James K. O'Dea	Paterson, New Jersey	203
WOI	Iowa State College	Ames, Iowa	207
WOO	John Wanamaker	Philadelphia, Pa.	509
WOR	L. Bamberger and Co.	Newark, N. J.	405
WORD	Peoples Pulpit Assn.	Batavia, Ill.	275
WOS	State Marketing Bureau	Jefferson City, Mo.	440
WOWL	Owl Battery Company	New Orleans, La.	270
WOWO	Main Auto Supply Co.	Fort Wayne, Ind.	227
WPAB	Pennsylvania State College	State College, Pa.	283
WPAC	Donaldson Radio Co.	Okmulgee, Okla.	360
WPAJ	Doolittle Radio Corp.	New Haven, Conn.	268
WPAK	North Dakota Agricultural College	Agricultural College, N. D.	283
WPAL	Superior Radio & Telephone Equipment Co.	Columbus, Ohio	286
WPG	The Municipality of Atlantic City	Atlantic City, N. J.	300
WQAA	Horace A. Beale, Jr.	Parkersburg, Pa.	270
WQAC	E. B. Gish	Amarillo, Texas	234
WQAE	Moore Radio News Station (Edmund B. Moore)	Springfield, Vt.	275
WQAM	Electrical Equipment Co.	Miami, Fla.	283
WQAN	Scranton Times	Scranton, Pa.	280
WQAO	Calvary Baptist Church	New York, N. Y.	260
WQJ	Calumet Rainbo Broadcasting Co.	Chicago, Ill.	447
WRAF	The Radio Club (Inc.)	Laporte, Ind.	224
WRAK	Economy Light Co.	Escabana, Mich.	256
WRAM	Lombard College	Galesburg, Ill.	244
WRAQ	St. Louis Radio Service Co.	St. Louis, Mo.	263
WRAV	Antioch College	Yellow Springs, Ohio	242
WRAW	Avenue Radio Shop (Horace D. Good)	Reading, Pa.	238
WRAX	Flaxon's Garage	Gloucester, City N. J.	268
WRBC	Immanuel Lutheran Church	Valparaiso, Ind.	278
WRC	Radio Corp. of America	Washington, D. C.	468
WREO	Reo Motor Car Co.	Lansing, Mich.	286
WRHF	Washington Radio Hospital Fund	Washington, C. D.	256
WRNY	Experimenter Publishing Co.	New York, N. Y.	258
WRK	Doron Bros.	Hamilton, Ohio	360
WRL	Union College	Schenectady, N. Y.	270
WRM	University of Illinois	Urbana, Ill.	273
WRMU	A. H. Grebe & Co., Inc., Motor Yacht "MU-1"	New York, N. Y.	236
WRW	Tarrytown Radio Res. Labs.	Tarrytown, N. Y.	273
WSAC	Clemson Agricultural College	Clemson College, S. C.	336
WSAG	Loren Vanderbeck Davis	St. Petersburg, Fla.	264
WSAI	United States Playing Card Co.	Cincinnati, Ohio	325
WSAJ	Grove City College	Grove City, Pa.	258
WSAN	Allentown Call Publishing Co.	Allentown, Pa.	229
WSAP	Seventh Day Adventist Church	New York, N. Y.	263
WSAR	Daughty & Welch Electrical Co.	Fall River, Mass.	254
WSAU	Camp Marienfield	Chesham, New Hampshire	229
WSAV	C. W. Vick Radio Construction Co.	Houston, Texas	360
WSAY	Irving Austin (Port Chester Chamber of Commerce)	Port Chester, N. Y.	233
WSAZ	Chas. Electric Shop	Pomeroy, Ohio	258
WSBF	Stix-Baer-Fuller D. G. Co.	St. Louis, Mo.	275
WSBC	World Batley Co.	1219 S. Wabash Ave., Chicago, Ill.	210
WSB	Atlanta Journal	Atlanta, Ga.	428
WSKC	World's Star Knitting Co.	Bay City, Mich.	261
WSMB	Saenger Amusement Co. and Maison Blanche Co.	New Orleans, La.	319
WSMH	Shattuck Music House	Owosso, Mich.	240
WSMK	S. M. K. Radio Corp.	Dayton, Ohio	275

Little Gwen Ponders the Radio Situation

(Continued from page 65)

assignment and, when his fair passenger murmured "radio station," he took her to the only one he had ever been able to get on his set. When she got to the other station the announcer grabbed her because he himself was a bit shy on talent that night.

At another time we had a singer come into the studio chewing gum violently. When it came time for her numbers she took the chewing gum out of her mouth, parked it on the counter by the side of the microphone and then triumphantly stepped before the horn and began to sing. After her number was concluded she returned for her chewing gum, smiled ecstatically and departed.

All this time we were striving desperately to compete with the other station. When our fan mail dwindled (we never did get much, by the way) we faked letters.

Since, as I said before, I wrote all the stories that appeared in the radio section of the paper, the faked letters had to be put in and they had to be written by me.

I want it understood that I didn't actually write letters and sign names to them to put in the paper. I merely quoted excerpts from letters alleged to have been received. Often I would begin my story of the preceding night's program with a line from these letters.

I must have run out of original things to say for unconsciously I began using the phrase, "Fine, WPO!" at the beginning of the majority of my stories. It got to be a joke around the office. Every time I would come in in the morning a regular chorus would go up from the reporters and copy readers, "Fine, WPO!"

The Cruel Finish

TRY as I would, there was no way to stem the tide of artists that was constantly flowing to the other station. Too, rumors were rife that the morning paper was contemplating erecting a radio station that would rank with the best in the country. With these two stations in the field against us, our position was hopeless unless we installed a powerful set.

We closed the station a few days before Christmas. I wanted to give some reason for leaving the air and to tell our listeners (granting that we still had any), that we would be with them no longer.

However, the publisher of our newspaper did not want that. He instructed me to continue the final program in the usual manner, sign off in the ordinary way and then simply cease to broadcast.

We did not carry a line in the paper about our having closed our station. Few knew when we closed and still fewer cared.

Just the same, when I go into the beautiful studios that they have today I am not ashamed of that first station of ours. I am as proud of it now as I used to be when I would take the microphone in my hand and tell that part of the world that was able to get us, that radio station WPO was broadcasting.

WSOE	School of Engineering	Milwaukee, Wis.	246
WSRF	Hardem Sales and Service	Broadlands, Ill.	233
WSTA	Camp Marienfeld	Chesham, N. H.	229
WSUI	State University of Iowa	Iowa City, Iowa	498
WTAB	Fall River Daily Herald Publishing Co	Fall River, Mass.	248
WTAC	Penn Traffic Co.	Johnstown, Pa.	360
WTADJ	Robt. E. Compton	Carthage, Ill.	236
WTAL	Toledo Radio & Electric Co	Toledo, Ohio	252
WTAP	Cambridge Radio & Electric Co	Cambridge, Ill.	242
WTAQ	S. H. Van Gordon & Son	Osseo, Wis.	220
WTAR	Reliance Electric Co	Norfolk, Va.	280
WTAS	Charles E. Erhstein	Elgin, Ill.	302
WTAT	Edison Electric Illuminating Co.	(portable) Boston, Mass.	244
WTAW	Agricultural & Mechanical College of Texas	College Station, Texas	280
WTAX	Williams Hardware Co.	Streator, Ill.	231
WTAZ	Thomas J. McGuire	Lambertville, N. J.	283
WTHS	Flint Senior High School	Flint, Mich.	218
WTG	Kansas State Agricultural College	Manhattan, Kans.	273
WTIC	Travelers Insurance Co	Hartford, Conn.	323
WTX	H. G. Saal Co	Chicago, Ill.	268
WWAD	Wright & Wright (Inc.)	Philadelphia, Pa.	360
WWAE	The Alamo Ball Room	Joliet, Ill.	242
WWI	Ford Motor Co.	Dearborn, Mich.	273
WWJ	Detroit News (Evening News Assn.)	Detroit, Mich.	352
WWL	Loyola University	New Orleans, La.	260

Canadian Stations

CFAC	Calgary Herald	Calgary, Alta.	434
CFCA	Toronto Star Pub. & Prtg. Co.	Toronto, Ont.	357
CFCF	Marconi Wireless Teleg. Co., (Ltd.) Canada	Montreal, Que.	411
CFCH	Abitibi Power & Paper Co., (Ltd.)	Iroquois Falls, Ont.	500
CFCK	Radio Supply Co.	Edmonton, Alta.	517
CFCN	W. W. Grant (Ltd.)	Calgary, Alta.	434
CFCR	Laurentide Air Service	Sudbury, Ont.	410
CFCT	Victoria City Temple	Victoria, B. C.	329
CFCU	The Jack Elliott (Ltd.)	Hamilton, Ont.	341
CFHC	Henry Birks & Sons	Calgary, Alta.	434
CFKC	Thorold Radio Supply	Thorold, Ont.	248
CFQC	The Electric Shop (Ltd.)	Saskatoon, Sask.	329
CFRC	Queens University	Kingston, Ont.	450
CFXC	Westminster Trust Co.	Westminster, B. C.	291
CFYC	Commercial Radio (Ltd.)	Vancouver, B. C.	411
CHBC	The Calgary Albertan	Calgary, Alta.	434
CHCM	Riley & McCormack (Ltd.)	Calgary, Alta.	434
CHCS	The Hamilton Spectator	Hamilton, Ont.	341
CHIC	Northern Electric Co.	Toronto, Ont.	357
CHNC	Toronto Radio Research Society	Toronto, Ont.	357
CHUC	International Bible Ass'n.	Saskatoon, Sask.	329
CHXC	R. Booth, Jr.	Ottawa, Ont.	434
CHYC	Northern Electric Co.	Montreal, Que.	411
CJCA	Edmonton Journal	Edmonton, Alta.	511
CJCL	A. Couture	Montreal, Que.	270
CJGC	London Free Press	London, Ont.	329
CKAC	La Presse	Montreal, Que.	411
CKCD	Vancouver Daily Province	Vancouver, B. C.	397
CKCK	Leader Pub. Co.	Regina, Sask.	476
CKCO	Ottawa Radio Association	Ottawa, Ont.	434
CKCX	P. Burns & Co., (Ltd.)	Calgary, Alta.	434
CKFC	First Congregational Church	Vancouver, B. C.	411
CKLC	Wilkinson Electric Co., (Ltd.)	Calgary, Alta.	434
CKNC	Canadian National Carbon Co.	Toronto, Ont.	357
CKOC	Wentworth Radio Supply Co.	Hamilton, Ont.	341
CKY	Manitoba Tel. System	Winnipeg, Man.	384
CNRA	Canadian National Railways	Moncton, N. B.	312
CNRC	Canadian National Railways	Calgary, Canada	434
CNRE	Canadian National Railways	Edmonton, Alta.	517
CNRM	Canadian National Railways	Montreal, P. Q.	411
CNRO	Canadian National Railways	Ottawa, Ont.	434
CNRR	Canadian National Railways	Regina, Sask.	476
CNRS	Canadian National Railways	Saskatoon, Sask.	329
CNRT	Canadian National Railways	Toronto, Ont.	357
CNRV	Canadian National Railways	Vancouver, B. C.	411
CNRW	Canadian National Railways	Winnipeg, Man.	384

Cuban Stations

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

European Broadcasting Stations

British Stations

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

French Stations

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

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 October issue must be sent in by September 1.

ADVERTISING SERVICE

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

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

AGENTS WANTED

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

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

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

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

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

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

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

"B" BATTERIES

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

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

CRYSTALS

TESTED GALENA CRYSTALS, 50c pound bulk. Buskett, Geologist, Joplin, Mo.

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

HELP WANTED

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

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

INVENTIONS

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

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

PRINTING

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

RADIO

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

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

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

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

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

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

RADIO CIRCUITS

SPECIAL FOR SEPTEMBER

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

RADIO DEALERS

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

RADIO SUPPLIES

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

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.

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

VOCATIONS

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

WANTED

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

WIRELESS

WANT TO MEMORIZE THE WIRELESS CODE? The Coryden Snyder Code Method, Patented, is quickest. Send 50c coin, stamps or M. O. to C. G. Snyder, 1423 Elmdale Ave., Chicago, Ill.

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

WRITERS

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

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

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

Have you ordered your October Radio Age?

* *Tested and Approved by* RADIO AGE *

THE RADIO AGE BUYERS' SERVICE

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

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

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

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

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

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

My Occupation .....

My Name .....

Address .....

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

* *Tested and Approved by* RADIO AGE *

There Is No Substitute for Good Hookups

What You Get:

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

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

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

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

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

$1.00 a Copy **RADIO AGE ANNUAL FOR 1925** **$1.00 a Copy**

Some of the Features

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

RADIO AGE ANNUAL COUPON

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

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

Name.....
Address.....
City..... State.....
9-25

ZENITH RADIO

→LONG DISTANCE←

MacMillan Knew—

When Commander MacMillan chose Zenith radio for his latest North Polar Expedition, he knew from personal experience what Zenith would do—

MacMillan knew that Zenith—even one of the earlier models—would enable him to tune in stations all over the United States and Europe—even far-off Honolulu.

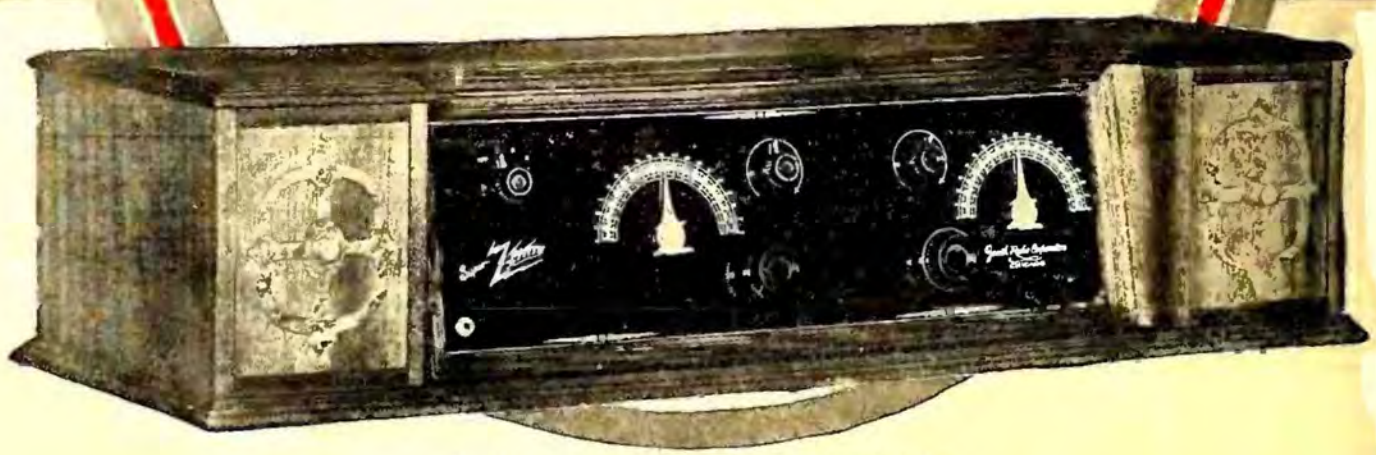
MacMillan knew that no other radio equipment would give him such extraordinary performance, such unfailing service.

When Arctic explorers of MacMillan's calibre stake their lives—repeatedly—on Zenith performance, one reason only can explain their choice—***Zenith has proved to be the best obtainable, at any price.***

Ask your nearest Zenith dealer for a demonstration.

Costs More—but Does More!

ZENITH RADIO CORPORATION
Straus Building, Chicago



* *Tested and Approved by* RADIO AGE *