Everyday Mechanics

RADIO AGE

May-June
1927

25¢

NEW YORK

LONDON

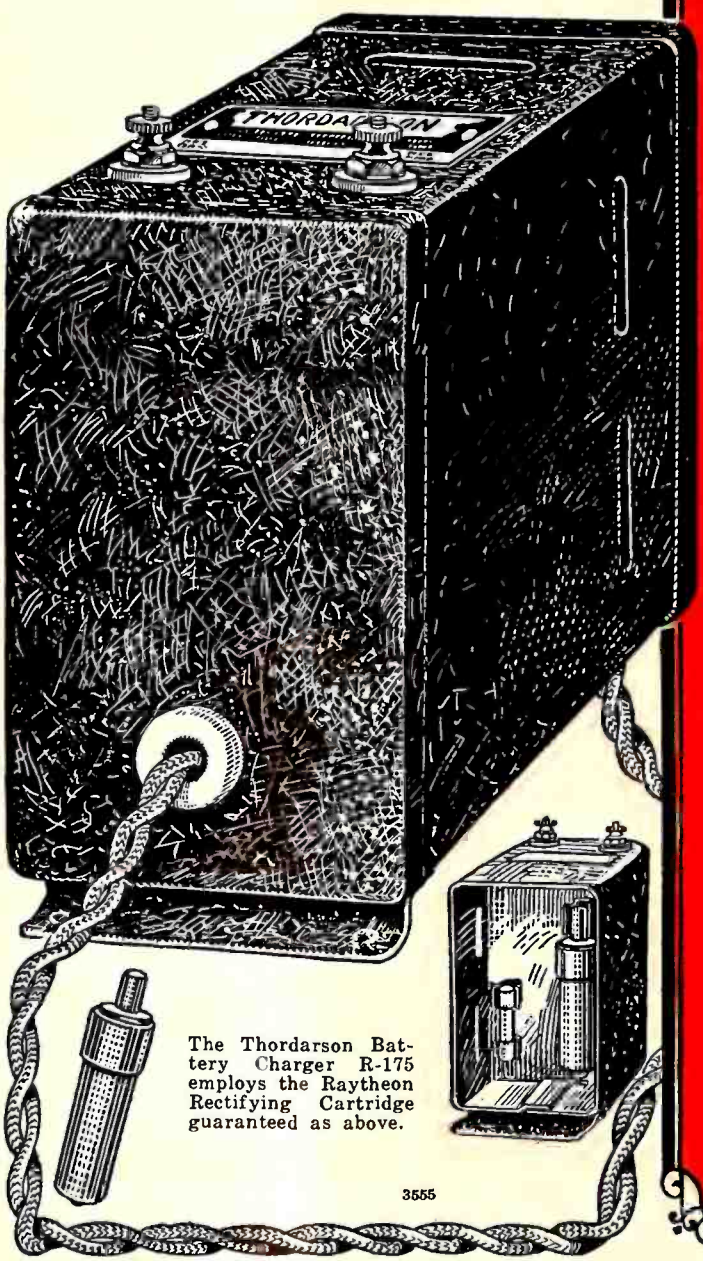
See Page 30

Trouble-Shooting on Supers

Current Science

New!

You don't have to be water boy to this battery charger



The Thordarson Battery Charger R-175 employs the Raytheon Rectifying Cartridge guaranteed as above.

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R-175

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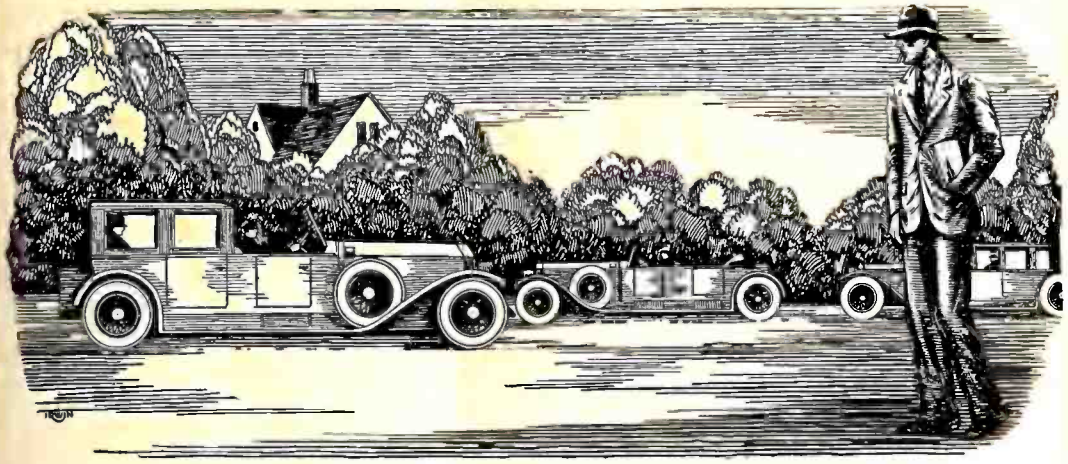

Many times in the old days, while I trudged home after work to save carfare, I used to gaze enviously at the shining cars gliding by me, the prosperous men and women within. Little did I think that inside of a year, I, too, should have my own car, a decent bank account, the good things of life that make it worth living.

I Thought Success Was For Others

Believe It Or Not, Just Twelve Months Ago I Was Next Thing To "Down-and-Out"

TODAY I'm sole owner of the fastest-growing Radio store in town. And I'm on good terms with my hanker, too—not like the old days only a year ago, when often I didn't have one dollar to knock against another in my pocket. My wife and I live in the snuggest little home you ever saw, right in one of the best neighborhoods. And to think that a year ago I used to dodge the landlady when she came to collect the rent for the little bedroom I called "home"!

It all seems like a dream now, as I look back over the past twelve short months, and think how discouraged I was then, at the "end of a blind alley." I thought I never had had a good chance in my life, and I thought I never would have one. But it was waking up that I needed, and here's the story of how I got it.

I was a clerk, working at the usual miserable salary such johs pay. Somehow I'd never found any way to get into a line where I could make good money.

Other fellows seemed to find opportunities. But—much as I wanted the good things that go with success and a decent income—all the really well-paid vacancies I ever heard of seemed to he out of my line, to call for some kind of knowledge I didn't have.

And I wanted to get married. A fine situation, wasn't it? Mary would have agreed to try it—hut it wouldn't have been fair to her.

Mary had told me, "You can't get ahead where you are. Why don't you get into another line of work, somewhere that you can advance?"

"That's fine, Mary," I replied, "but *what* line? I've always got my eyes open for a better joh, hut I never seem to hear of a really good job that I can handle." Mary didn't seem to he satisfied with the answer hut I didn't know what else to tell her.

It was on the way home that night that I stopped off in the neighborhood drug store, where I overheard a scrap of conversation about myself. A few burning words that were the cause of the turning point in my life!

With a hot flush of shame I turned and left the store, and walked rapidly home. So that was what my neighbors—the people who knew me best—really thought of me!

"Bargain counter sheik—look how that uit fits," one fellow had said in a low voice. "Bet he hasn't got a dollar in those pockets." "Oh, it's just 'Useless' Anderson," said another, called "Red" Smith. "He's got a wish-hone where his hack-bone ought to be."

As I thought over the words in deep humiliation, a sudden thought made me catch my breath. Why had Mary been so dissatisfied with my answer that "I hadn't had a chance?" *Did Mary secretly think that too?* And after all, wasn't it *true*, that I had a "wish-hone" where my hack-bone ought to he? Was that why I never had a "chance" to get ahead? It was true, only too true—and it had taken this cruel blow to my self-esteem to make me see it.

With a new determination I thumbed the pages of a magazine on the tahle, searching for an advertisement that I'd seen many times but passed up without thinking, an advertisement telling of big opportunities for trained men to succeed in the great new Radio field. With the advertisement was a coupon offering a big free hook full of information. I sent the coupon in, and in a few days received a handsome 64-page book, printed in two colors, telling all ahout the opportunities in the radio field and how a man can prepare quickly and easily at home to take advantage of these opportunities. I read the book carefully, and when I finished it I made my decision.

What's happened in the twelve months since that day, as I've already told you, seems almost like a dream to me now. For ten of those twelve months, *I've had a Radio business of my own!* At first, of course, I started it as a little proposition on the side, under the guidance of the National Radio Institute, the outfit that gave me my Radio training. It wasn't long before I was getting so much to do in the Radio line that I quit my measly little clerical joh, and devoted my full time to my Radio husiness.

Since that time I've gone right on up, always under the watchful guidance of my friends at the National Radio Institute. They would have given me just as much help, too, if I had wanted to follow some other line of Radio besides huilding my own retail business—such as broadcasting, manufacturing, experimenting, sea operating, or any one of the score of lines they prepare you for. And to think that until that day I sent for their eye-opening book, I'd heen wailing "I never had a chance!"

Now I'm making real money. I drive a good-looking car of my own. Mary and I don't own the house in full yet, but I've made a substantial down payment, and I'm not straining myself any to meet the installments.

Here's a real tip. You may not be as had-off as I was. But, think it over—are you satisfied? Are you making enough money, at work that you like? Would you sign a contract to stay where you are now for the next ten years, making the same money? If not, you'd better be *doing* something ahout it instead of drifting.

This new Radio game is a live-wire field of golden rewards. The work, in any of the 20 different lines of Radio, is fascinating, ahsorbing, well-paid. The National Radio Institute—oldest and largest Radio home-study school in the world—will train you inexpensively in your own home to know Radio from A to Z and to increase your earnings in the Radio field.

Take another tip—No matter what your plans are, no matter how much or how little you know ahout Radio—clip the coupon below and look their free book over. It is filled with interesting facts, figures, and photos, and the information it will give you is worth a few minutes of anybody's time. You will place yourself under no ohligation—the hook is free, and is gladly sent to anyone who wants to know ahout Radio. Just address J. E. Smith, President, National Radio Institute, Dept. E-91, Washington, D. C., and the hook will he mailed the same day your coupon reaches him—you can have it right in your hands in a few days if you'll mail the coupon *now*.

J. E. Smith, President,
National Radio Institute,
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Please send me your 64-page free hook, printed in two colors, giving all information about the opportunities in Radio and how I can learn quickly and easily at home to take advantage of them. I understand this request places me under no ohligation, and that no salesmen will call on me.

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Everyday Mechanics

RADIO AGE

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CONTENTS

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For New Readers

Coincident with an increase in the number of readers of this magazine there have been numerous requests for a complete treatise on the particular type of superheterodyne which we have found most popular in the past eighteen months.

As a consequence we have set aside a limited number of back numbers, those of most recent date having the greatest amount of data. Having gone through several models of the Worlds Record super we believe the following numbers will be of most interest to super prospects:

November, 1926
January, 1927
March, 1927
April, 1927
May, 1927

These numbers, which include the present issue, will form a complete library on the superheterodyne question, including that type using intermediates peaked so as to prevent repetition of stations at more than one point on the oscillator dial. In the present number there is an excellent trouble-shooting article on supers by E. H. Scott which should command the attention and commendation of every radio enthusiast who has ever built, experimented with or intended building a superheterodyne.

These back numbers may be secured for thirty cents each in stamps or coin.

Of all the circuits run in this magazine the series on the Worlds Record model drew the greatest amount of comment and by far the greatest number of letters from readers. Further work will be done along these general lines and for that reason the issues mentioned above should be particularly useful as the ground work for all readers interested in that type of receiver.

Frederick Smith

Editor of RADIO AGE.

Trouble Shooting On Supers

By E. H. SCOTT

MANY fans are now building supers and the majority of of these receivers are giving their owners every satisfaction. This is due to the fact parts or kits now available are properly designed and carefully made and tested by the manufacturers before leaving the factory. Constructional plans of thoroughly tested designs can be obtained through the leading magazines. These show you in detail how to build the set. If, however, you have had no previous experience in building a superheterodyne you will save yourself a great deal of trouble and disappointment by following exactly the design you select. After you have had some experience you can use your own ideas in designing, but until you have built a few sets, better stick to the design furnished by the magazines. The more experience you gain the more you appreciate the importance of placing certain parts in certain positions in relation to other parts. Many a super is performing poorly that could, by a rearrangement of the parts and the shortening of certain leads, be made into a receiver that would surprise its owner.

It is disappointing, but need not be discouraging, if when you connect up the batteries, insert the tubes and connect the speaker, that the set does not operate at all, or if it does, the noise that comes from the horn does not sound like music. In this article you will find a chart for trouble shooting which shows under the various headings, the principal reasons for that particular trouble.

AT LAST!

For some time past builders of superheterodynes have been desirous of having a manual on trouble shooting that would be simple enough to permit them to find their own errors and remedy them.

In casting about for an author we immediately thought of E. H. Scott, who has done nothing but play with superheterodynes for the past few years. Mr. Scott was approached on the subject, agreed to furnish an article, and we are printing it in this issue.

We frankly believe it is the most complete and simple trouble shooting article we have seen and know that it will be relished by all those who build superheterodynes.—Editor.

Forty possible troubles in supers are listed herewith in the order of the complaints. The numbers refer to the test methods outlined in the latter part of the article.

Set Dead. Just Hooked Up.

1—Wrong wiring.
2—Poor soldered connections or loose connections.
3—Connection shorting against other connection.
4—Poor tubes.
5—Batteries too low or dead.
6—A, B or C batteries wrongly connected.
7—Voltages on osc., detectors, I. F. or audio tubes not correct.
8—C battery reversed.
9—Oscillator tube not oscillating.
10—Short circuit in phone or speaker jack.
11—Primary or secondary of transformers open.

Set Dead, But O. K. Previously.

5—Batteries dead or too low.
4—Bad tube or tubes.
2—Loose or poor connection.
12—Broken connection in set, or between set and battery.
11—Open in transformer.
3—Short circuit.
16—Shorted bypass condenser.

Volume Poor.

5—Batteries low.
4—Poor tubes.
7—Wrong B battery voltages on osc., detectors, I. F. or audio.
8—Wrong C battery bias, or battery reversed.
9—Oscillator tube not functioning.
13—I. F. transformers not properly matched.
14—Poor audio transformers.
15—High resistance joints or connections.

Makes Crackling Noises.

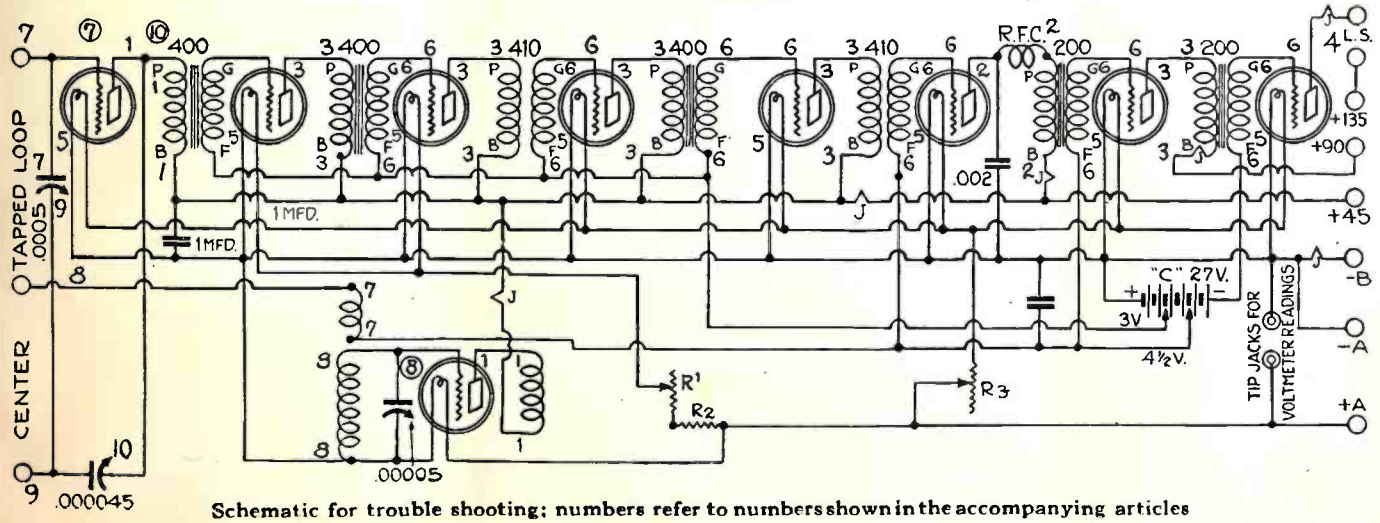
2—Loose or broken connection.
5—Batteries too low.
16—Leaking or shorted condensers.
17—Leaks caused by using soldering paste.
14—Bad audio transformers.
18—Static or outside interference.

Makes Howling Noises.

19—Microphonic tube or tubes.
20—Open grid circuit, either loop or C battery.
21—Open plate circuit in detector tube.
8—No bias on I. F. or audio transformers.
20—High resistance connection in grid circuit.
21—Excessive plate voltage.
22—Feedback between I. F. and audio stages.
23—Feedback between audio stages.

Oscillates Badly.

21—Voltage too high on I. F. stages.
24—I. F. transformers too close.
25—Poorly designed I. F. transformers.



Schematic for trouble shooting; numbers refer to numbers shown in the accompanying articles

26—Feedback condenser in plate of first detector too high capacity.
27—Loop leads too close to I. F. transformers.

Poor Tone Quality.

5—A or B batters too low.
28—Filaments on audio stages too low.
29—Tubes overloading.
7—Not enough B voltage on audio stages.
8—Wrong C bias on I. F., detectors or audio stages.
8—Reversed C battery.
30—I. F. transformers peaked too sharply, cutting side bands.
14—Poor audio transformers.
13—Intermediate transformers not properly matched.
25—Poorly designed I. F. transformers.

No Distance.

4—Poor tubes.
5—Batteries too low.
7—B batteries not correct voltage.
29—Tubes overloading.
13—I. F. transformers not properly matched.
25—Poor quality intermediate transformers.
31—Inefficient or shorted loop.
32—Loop not connected properly.
9—Oscillator not functioning.

Poor Selectivity.

13—I. F. transformers not properly matched.
33—Wiring poor, leads too long or too close together.
4—Bad tubes.
9—Oscillator not working.
34—Poor condensers.
31—Inefficient loop.

Oscillator Dial Does Not Tune.

34—Disconnected plate or grid lead to variable condenser.
9—No B battery on oscillator.
15—Shorted or high resistance connection.
9—Reversed connections on oscillator coupler.
9—Bad oscillator tube.
13—I. F. transformers not properly matched.

Loop Dial Tunes Broadly.

32—Loop wrongly connected.
31—Inefficient loop.
33—Poor wiring in set, leads too long, etc.

Dials Do Not Tune Together.

35—If oscillator dial tunes above loop dial the coupler has too many turns. If it reads below the loop dial it has not enough turns.
36—Wrong capacity variable condensers.
37—Loop may be too large or too small.

Will not Cover Wave Band.

32—Where center tapped loop is used, the center lead may be connected to an outside post instead of the center.
37—Loop too small.
35—Oscillator coupler does not have enough turns.

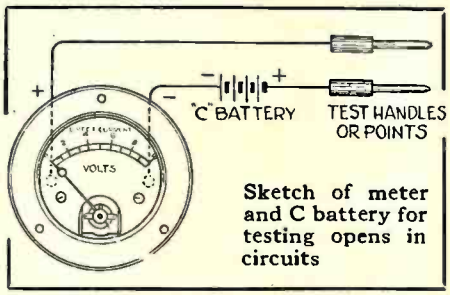
Body Capacity.

38—Wrong type condenser.
39—Grid connected to rotor of condenser.
40—Rotor not grounded to negative filament.

How to Make Tests

Experienced constructors will find the list of faults given under each heading a sufficient guide in locating the source of trouble. There are, however, many who are not familiar with the best methods in checking for wrong connections, and for the assistance of these I have placed opposite each fault a number. Below you will find instructions detailing just what to do to test for each kind of a fault.

The testing equipment required is a voltmeter, preferably one having a double reading, 0-7.5 and 0-150; two flexible rubber covered leads about three feet long and a C battery. If no voltmeter is available you can test with a pair of headphones in series with a C battery. (See illustration.)



Sketch of meter and C battery for testing opens in circuits

(1)

Wrong connections or wiring. Connect all batteries to the receiver, but do not insert the tubes. To trace through the B battery connections, connect the flexible lead from the negative side of the voltmeter to the common negative terminal (A-B-). Then with the lead from the positive side of the voltmeter, feel for the various voltages. Start by checking up the voltages on the oscillator and the first detector. Touch in turn each of the points marked 1 (on the schematic diagram shown with this article). Be sure to test through to the actual tube contact on the socket so you are sure the B battery voltage is actually getting through to the plate of the oscillator and detector tubes. Your voltmeter should read 22½ volts when each of the points 1 are touched. If, however, you are using 45 volts on these tubes, then these readings will be 45 volts.

Next check the B battery voltage on the second detector by touching the positive lead from the voltmeter to the positive B P posts on the first audio transformer and the contact on the socket. These are marked 2.

Check up each of the voltages on the intermediate transformers and the first stage of audio by touching each of the points marked 3. This will test out the primaries of these transformers and the wiring between them.

Now touch the voltmeter lead to the jack marked 4. This completes the checking of the B battery connections.

Next check up the filament wiring. To do this connect the positive post of the voltmeter to the positive side of the A battery and turn all rheostats on. Then touch the contacts on each of the tube sockets, shown at 5. The voltmeter should show 6 volts on each side if your wiring is correct. If the reading shows 22½ or more volts then you have a B battery wire shorted against one of your filament leads. If no reading at all is shown on one or more sockets then you have a wrong connection or a loose connection, or a bad socket.

Check up the secondaries of all I. F. transformers and the first and second audios and the wiring between them. To do this place the positive lead from the voltmeter on the plus post of the C battery and touch all points marked 6. In making this test use the 7.5 volt scale on the voltmeter. As long as the pointer moves at all the transformer is o. k.

Check out the coupler. First test out the pickup coil. For this test you require a separate C battery in series with the voltmeter and one of the flexible leads. Touch one lead to the point circled 7 and touch the other lead in turn to the points marked 7. To check up the grid coil and connections, place one lead on the circled 8 and then touch in turn the other parts marked 8.

Test wiring between loop and feedback condenser by testing between points marked 9. Then test between condenser and plate of first detector by touching leads between points marked 10.

If a B eliminator is supplying the voltages the reading will not be correct unless you are using a special high resistance voltmeter, but you will get a reading which will show if the connections are complete or not. All B eliminators will not work successfully on a super. If after you have checked up everything and can find nothing wrong, try a set of B batteries in place of the eliminator and note results.

(2)

Poorly soldered connections. A poorly soldered or loose connection will cause all kinds of trouble. Always use a good hot soldering iron leaving it on the joint for a second or so after applying the solder to make sure it runs into the joint thoroughly. Always use rosin core solder. Never use an acid flux for although this may appear at the time to make a better joint it will surely cause trouble later.

(3)

Connection shorting against another. If a wire runs within an eighth of an inch of another wire, use a piece of spaghetti to eliminate any chance of these wires touching. Only battery wires may be run as closely as this, all other leads being kept separated as far as possible.

(4)

Poor tubes. Very often a tube may appear to be o. k. The filament may seem as bright as a perfectly good tube, but it may not have sufficient emission. A simple check if you have one or two spare tubes, is to take out each tube in turn replacing it with one of the spares. Be sure your spares are good. (Or better still, read the article on testing your tubes in this issue and rejuvenate them yourself.—Editor.)

(5)

Batteries too low or dead. Check up B voltages with a voltmeter. A 45 volt battery should be discarded when it falls to 38 volts or less, and a 22½ volt battery when it shows 19 or less volts. Test the A battery with a hydrometer. It should read between 1250 and 1300 on the hydrometer scale. If you have a B eliminator the voltages must be checked with a high resistance voltmeter and the tubes in their sockets. An ordinary voltmeter will not give you a true reading.

(6)

A, B or C batteries wrongly connected. This fault should have been detected when checking up as shown in test 1.

(7)

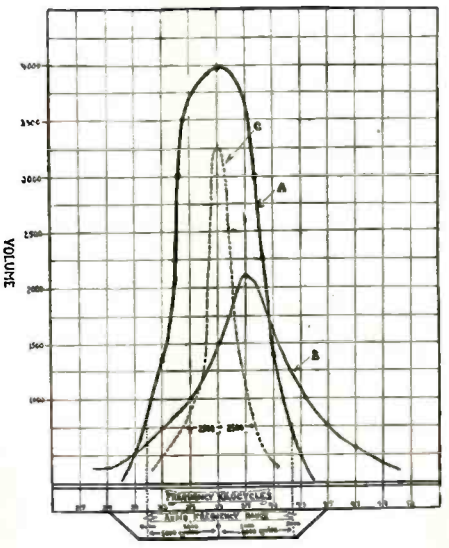
Voltages on oscillator, detectors, I. F. or A. F. transformers not right. Generally the voltages shown on the wiring diagrams are correct. It is sometimes a good idea to try the effect of varying your voltages. Never use more than 45 volts on the oscillator or first detector, or more than 67½ on the second detector. If more than 90 volts is used on the intermediates the tubes will tend to oscillate and the B battery drain will be excessive. If too much C battery voltage is used on the amplifier tubes they will start rectifying and cause distortion.

(8)

C battery reversed. If the C battery is reversed the tubes will take an excessive amount of B battery current, and amplification will be very low. C battery voltages required for the different plate voltages should always be as specified by the tube manufacturers.

(9)

Oscillator tube not oscillating. One of the simplest tests is to take a pair of pliers and touch the tip of the pliers to the grid of the oscillaor tube. A click in the telephones should result. Another is to tune in a station (if one can be heard) and pull out the oscillator tube. If the signal can still be heard the oscillator tube is not functioning. A more positive test which will indicate whether the first detector as well as the oscillator is functioning, is to insert a pair of phones between the P of the detector tube and the P terminal of the first intermediate. If the detector is working properly a local station can be tuned in on the loop dial. After the station is tuned in the oscillator dial should be turned and if the oscillator is working properly a series of whistles will blur the station to which you are listening. If the turning of the oscillator dial produces no whistles then the tube is not oscillating. The trouble may be caused by a poor tube. Try a spare and see if it makes any difference. Another possible source of the trouble is a reversed plate and grid coil. Both coils are wound in the same direction. Either the two inside terminals may be connetced to grid and to plate, and the outside terminals to the B positive and the filament; or the grid and plate may be connected to the outside terminals with the B battery and filament to the inside terminals. But in no case will an oscillator work if the grid terminal is connected to the outside winding and the plate to an inside winding. Shorted turns on either plate or grid coil sections will also prevent the tube from oscillating. Absence of voltage on the oscillator plate may be detected by the test method outlined in number 1.



Graphic illustration of band pass and amplification of I. F. transformers

(10)

Short in phone or speaker jack. Test across the jack with the voltmeter and C battery. If o. k. no reading will be shown. This trouble is generally caused by allowing some solder to run down and connect the contact blades.

(11)

Transformer primary or secondary open. Test with C battery and voltmeter. When leads are touched between P and B reading should result. A reading when G and F are touched will show the secondary windings are o. k. Absence of readings show open circuits.

(12)

Broken connection in set or between set and battery. Test out for this trouble as shown in 1.

(13)

Intermediate frequency transformers not matched. It is essential that the I. F. transformers be matched exactly if you are to get either distance or selectivity. In most cases poor selectivity is the direct result of transformers that do not peak alike. Fig-

ure 2 shows a series of curves illustrating the efficiency of an amplifier with four stages. Curve A shows the total amplification of the amplifier and the selectivity, or band pass, with four perfectly matched transformers. Curve B shows the effect on the amplifier when the filter transformer is taken out and another used which did not match the other transformers by a difference of only 5 kilocycles. It will be noted that the amplification dropped nearly fifty per cent and the selectivity was also considerably reduced.

(14)

Audio transformers bad. High grade audio transformers should be used if you expect good reproduction. When transformers having a poor frequency characteristic are used, it is impossible to get good reproduction regardless of how efficient the rest of the receiver may be. A good transformer cannot be put in a case the size of a match box. A transformer to reproduce the lower notes of the voice and musical range must have a large iron core in order to have a sufficient impedance at the lower frequencies. All of the present day transformers that are scientifically designed are twice as bulky as the transformers of a few years ago. The best guide in the selection of a transformer is to select one manufactured by a firm that has been in the transformer business for some years and has a reputation behind it.

(15)

High resistance joint or connection. Very often a joint or connection may appear to be O. K. but it is really touching only at one spot. When this happens the set may function but will operate very poorly. If you have tested everything and suspect this trouble the best thing to do is to go over every connection with a good hot soldering iron. It sometimes can be detected by testing each connection with the fingers. But be sure you do not carelessly short a filament wire against a B voltage wire in so doing. Listen to the signals while doing this, if signals are available.

(16)

Leaking or shorted condensers. Test small capacity condensers with a voltmeter and a 45 volt B battery. At first contact you will get a slight flicker of the meter needle. This is on discharge of the condenser. On second contact there should be not even a flicker of the needle. If the meter does register the condenser is either leaking badly or shorted. The test for bypass condensers is slightly different. Take two 45 volt batteries in series and apply across the terminals of the bypass condenser. Snap them two or three times to charge the condenser. Wait about two minutes and place the voltmeter terminals across the condenser. If a flicker ensues the condenser is o. k., having held its charge. If no flicker is noted the condenser has leaked its charge and its use in the set is not advised since its presence will gradually cause the B batteries to run down.

(17)

Leaks caused by using soldering paste. All soldering pastes or fluxes (except the one made from rosin and alcohol) contain injurious acids and should never be used on any part of a radio receiver. Use nothing but a rosin core solder.

(18)

Static or outside interference. Very often defective connections are blamed for noisy reception when the trouble is due to atmospheric or electrical disturbances outside the set. To test whether the noise is outside the set, short-circuit the loop terminal posts and listen to the speaker. If the noises continue it is caused by bad connections or batteries. If it disappears when the loop terminals are shorted, the disturbance is outside of the set and you have no control of it.

(19)

Microphonic tubes. When the speaker is placed too close to a powerful receiver the vibrations emanating from the speaker will start the filaments of the tubes to vibrating and the result will be a continuous howl. This trouble can generally be cured by placing the speaker away from the receiver, or placing the receiver itself on a felt pad. Sometimes the rubber hoods now being sold to fit over the tubes will stop the howling. To test which of the tubes is the microphonic one, tune in a loud signal and grasp each tube in turn with the hand. Generally you will find tubes in the detector socket cause this trouble. If the howling is an audio one and very persistent, put the receiver in its cabinet and see if that stops the noise. In some cases the volume from cone speakers is sufficient to start the condenser plates on the oscillator vibrating at an audio frequency rate. Encasing the receiver in its cabinet and closing down the lid usually stops such a case of trouble.

(20)

Open in grid circuit. When you have an open grid circuit you will hear a constant spluttering or put-put-put-ing in the speaker. Look to see if loop is connected. If o. k. make sure your C batteries are properly connected. If o. k. examine all leads running from posts on transformers marked F (or the grid returns) to see that all are connected. Sometimes a high resistance joint at this point will cause the trouble. Also make sure it is not your regenerative midget in the loop circuit that is too far in, causing a spluttering noise.

(21)

Open plate circuit in detector tube. This trouble will often cause a howl in the speaker. Test with voltmeter for continuity of primary winding and connections.

(22)

Feedback between audio and I. F. stages. Sometimes the audio transformers will couple with the I. F. stages and amplify the intermediate frequency. This generally results in a set that has a tendency to squeal when the volume control is turned up too high. In almost every case it can be cured by grounding the metal case of the audio transformers to the next transformer and then grounding to negative filament. All good transformers are placed in steel or iron cases. Some times an 85 mh choke in series with the primary and bypassed with a .002 mfd condenser, will curb the howling tendency. (See schematic figure 4 in the blueprint section for the method used in the 9 tube model—Editor.) Never use impedance or resistance coupled audio amplifiers with a superheterodyne.

(23)

Feedback in audio stages. Unshielded audio transformers are likely to howl when closely coupled. Metally encased audio transformers may be connected together as shown in 22 if they howl. Grid and plate wires when too close together will encourage audio frequency howling. B battery eliminators of certain types are sometimes the cause of howls and squeals in a super.

(24)

Intermediate frequency transformers too close. In certain types of transformers too close proximity of one to another will cause howling. It is a safe rule to keep I. F. transformers at least an inch apart. Especially is this applicable to air core intermediates.

(25)

Poorly designed I. F. transformers. Transformers that are designed to operate with a stabilizer or "losser" have a tendency to oscillate when the amplification is increased. They will sometimes oscillate when the filaments are turned up to normal. This usually results in an unstable set. Transformers designed to operate on a high intermediate frequency will have a tendency to oscillate when the grids are operated at a normal grid bias and the filaments operated at a normal filament voltage. Tone quality will be poor when transformer is designed to give extreme selectivity. The higher audio frequencies are cut off so they are not present in the loudspeaker output and naturally the tone quality is poor.

(26)

Feedback condenser in plate of first detector too high capacity. When the receiver is first tested the small feedback condenser should be adjusted for minimum capacity (plates out of mesh) and capacity should be increased to point where signals are loudest and yet the detector tube will not slip into oscillation. This condenser should have a minimum capacity of not to exceed 15 or 20 mmf (.000015 mfd). If the set persists in oscillating after you are sure intermediate stages are not oscillating, feedback condenser may be removed altogether.

(27)

Loop leads too close to I. F. transformers. The wires leading from the loop binding posts to the variable condenser and tube should be well separated from the intermediates. When the loop leads are too close to the last I. F. transformer some energy from a local station will be induced in the transformers and associated wiring before going through the tuning net work and a loss of selectivity will result.

(28)

Filaments on audio stages too low. On some of the older types of receivers a separate rheostat on the panel was used to control the filaments of the audio stages and so control the volume. It is better to use a fixed resistor. (For controlling the volume see method used by our laboratory as shown in blueprint section—Editor). A high resistance (variable) across the secondary of the first audio transformer may also be used for audio volume control.

(29)

Tubes overloading. A receiver should not be crowded for volume as invariably the tubes will overload and cause distortion. When good loud speaker operation is desired use either a 171 or 210 power tube with the correct power voltages in the last audio stage. When the 201-A tube is used in the last stage and any volume desired, it will be found the quality is poor. Another cause of poor quality on the locals is the overloading of the second detector by running its filament at too high voltage. (See method of control in the blue print model in this issue—Editor).

(30)

Intermediate peaked too sharply. I. F. transformers too sharply tuned sometimes cut sidebands so greatly the quality will be poor. Such a condition is illustrated in Curve C in figure 2. It will be observed the frequencies are only amplified as high as 2500 cycles, just about half the range necessary to produce good quality. Such transformers, however, will be very selective.

(31)

Inefficient or shorted loop. A shorted loop will result in no tuning control on the loop dial. An inefficient loop might cause the same trouble. Poor insulation, shorted turns, open center taps, etc., might be considered as causes of trouble.

(32)

Loop not properly connected. When the loop has a center tap be sure the two outside leads are connected to the variable condenser. The lead from the center tap is connected to the negative filament or the negative of the C battery depending upon whether or not you are utilizing biasing for detection in the first detector.

(33)

Wiring poor—leads too long or too close together. Always make the grid leads as short as possible. Keep them well separated from other wires. (The scheme used by RADIO AGE in its 9 tube model does away with the grid and plate leads altogether—Editor). The plate leads are next in importance, should be kept as short as possible and away from other wires. Run leads from the variable condensers nears the front of the subpanel or baseboard and keep these leads away from the transformers.

(34)

Disconnected plate or grid lead to variable condenser. Disconnected plate or grid leads will prevent the oscillator functioning and may be located when wiring is checked as shown in 1.

(35)

Oscillator dial tunes above or below loop dial. If you have a rheostat controlling the oscillator tube, the dial reading on the oscillator dial will shift slightly as you vary the tube's filament voltage. If oscillator dial reads too high above the loop dial grid and plate sections have too many turns. Remove one turn at a time and see if dials match better. If the oscillator dial reads very much below the loop dial then turns should be added to the oscillator grid and plate sections, or take off a turn from the loop winding.

(36)

Wrong capacity variable condenser. Make sure your condensers are each .0005 mfd, if that is the value speci-

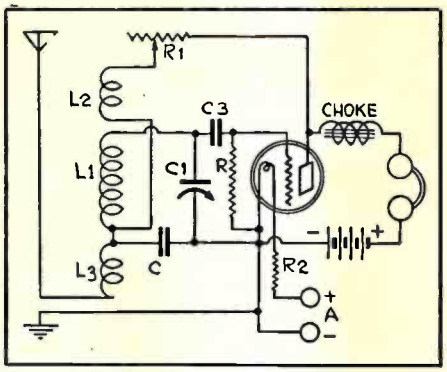
(Continued on page 45)

Try This Circuit With Some Old Parts

EXPERIMENTERS who have a number of coils and condensers lying idle on their hands may find in the following brief article a new outlet for some of their energy.

Diagramatically we are showing the simplified regenerative detector mentioned by Edward H. Loftin and S. Young White in their paper on "Combined Electromagnetic and Electrostatic Coupling and some uses of the combination" delivered before the I. R. E. June 30, 1926.

Quoting from their paper: "Here we use the grid circuit as the only tuned circuit of the system and couple the plate circuit to the tuned grid circuit with a combined coupling. The antenna may be coupled to the tuned grid circuit in any suitable way, but a combination of constant coupling as shown is preferable. The ordinary connection to the grid leak around the stopping condenser cannot be made as the tuning condenser on one side and the coupling condenser on the other effectively interrupt the grid circuit against a grid bias, so that the grid leak must be connected directly between grid and filament. By properly adjusting the combined coupling between the grid and the plate circuits constant regeneration or tickling with frequency is had, and by including a limiting element such as the resistance R1, it is easy to hold the system without repeated adjustment below oscillation for spark or broadcast work, or in oscillation for CW or heterodyne reception.



Schematic circuit of the Loftin-White system of simple regenerative detector

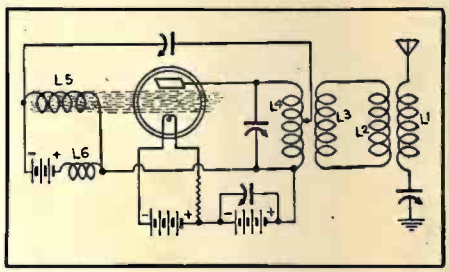
"It will be noted that the connection across the coupling condenser is in the opposite sense to that shown in previous figures, but this is necessary as the feedback must be such as to aid the current in the grid circuit. Care must be taken so as to pole the inductive coupling so it will aid this new arrangement of capacitative coupling. This alternative capacity connection permits of connecting the rotary side of the tuning condenser to ground. Such a connection becomes necessary in multiple tube receivers using single dial control where all of the rotary elements must be at the same potential, usually ground potential. There results a slight reduction in voltage applied to the grid, since grid and filament are connected across the tuning condenser alone, which connection divides the overall available potential in the inverse ratio of the tuning and the coupling condenser capacities."

An old three circuit tuner might be utilized in making up this set. Resistance R2 may be a fixed resistance for a quarter ampere tube; the grid leak may be some value from 2 to 5 megohms. The choke may be a secondary of an old transformer. The resistance R1 may be about 100,000 ohm variable. These values given are largely experimental and will depend upon individual results. The coupling condenser C may be tried at various values, 1 mfd, ½ mfd, etc. Inductance L1 is the secondary spanned by a .00035 mfd, L3 is the antenna coupling coil and L2 is the plate regenerative coupling coil.

Here's Way to Make 2 Element Tube Work

EVER since the invention of the Fleming valve (years and years ago) radio experimenters and scientists have been trying for some method of making a two element tube oscillate. Success seems at last to have crowned the efforts of J. Slepian, of Swissvale, Pa., who in a recently assigned patent to the Westinghouse interests, discloses his method, from which we quote:

"The object of my invention is to provide a system in which a two element vacuum tube may be employed as a generator of high frequency oscillations suitable for use in wireless transmission systems. The use of the three element vacuum tube as a generator of high frequency oscillations is well known. In such systems the vacuum tube may be brought to a condition of self oscillation by suitably coupling the plate-filament and grid-filament circuits through a so-called feedback or regenerative transformer. I have discovered that with a suitable arrangement of circuits, an efficient and reliable electron oscillation generator system may be constructed which will utilize the effect of a transverse magnetic field upon the path of an electron.



"In a vacuum tube comprising a filament and an adjacently placed anode the electrons emitted from the heated filament travel in substantially straight lines to the anode. Upon the application of a transverse magnetic field (see sketch) it is found that the path of the electrons become slightly curved and that the degree of curvature depends upon the intensity of the magnetic field. Thus with a magnetic field of sufficient intensity the electrons may be caused to curve backwardly toward the cathode in cycloidal paths but never are permitted to reach it."

The sketch shown herewith is a simplification of the patent application drawing. The application was filed on Feb. 26, 1921, and was granted Jan. 25, 1927. Its number is 1,615,660. In the event interested parties desire a copy it may be secured from the Patent Office in Washington

Loop or Aerial—and Why?

By H. MELCHIOR BISHOP

THIS question is one which has been asked by the set buyer and broadcast fan since the days, not so long ago, when the art of broadcasting was in its early but lusty infancy. It *is* an important question and it *is* a logical one—but—it also is one which *is* very difficult to accurately answer.

This difficulty of answering is due to the fact that this question, in common with many other queries pertaining to radio in general, must be answered not directly, but by asking certain other questions. Then, by properly balancing the answers—or near answers!—to these counter questions, it is possible to arrive at a compromise between the various different factors entering into the satisfactory operation of a radio receiver, and to tell thusly, with a marked degree of accuracy and certainty, just what type of receiver is most suited for use under the given conditions.

With a comprehensive understanding of these various "operation factors" as a basis for judgment it is possible for anyone, with or without technical radio knowledge, to make an intelligent and efficient selection of the proper type of radio receiver for his, or her, or anyone's else use; provided, of course, that the conditions under which the set is to be operated are reasonably well known.

It is the purpose of this paper to endeavor to discuss the various "operation factors" and their bearing on the performance of both loop and aerial type sets in such a manner as to serve as an effective guide to the inexperienced radio buyer, thus making an intelligent and thoroughly satisfactory choice possible.

In the first place, it is necessary to dispel the notion, if it still exists, that the antenna types of set are superior to the loop types, or vice versa. Accepting as a foregone conclusion that the receivers under consideration are equally scientific in design and equally excellent in workmanship, the selection of the proper one resolves itself into a question of expediency, rather than of superiority. In other words, the point to be decided is *not* which type of receiver is best, but which is most suitable.

Any good set will work in any location with a fair degree of success, but to attain really superlative results it is necessary to use the type of set which is best suited to the locality in question. While this statement is merely one of ordinary common sense, it is, however, overlooked entirely in the great majority of cases.

To get down to "brass tacks," let us see just what constitutes the principal differences between loop receivers and aerial receivers.

Loop receivers, as a class, are very sharp tuning; have great amplifying power; employ, relatively, a large number of tubes and many batteries; are moderately portable; are comparatively expensive to operate; but are very adaptable.

Aerial receivers, taking all types in general, are moderately sharp tuning; have a very fair degree of amplification, not needing as much power as a loop set, since more energy is "picked up"; employ comparatively few tubes, but just as many batteries as loop sets; are not portable, except in a few special cases; are rather inexpensive to operate, due to the small number of tubes and the consequent low drain of battery current; and are not so adaptable as loop sets, due to the necessity of erecting an antenna for successful operation of the set.

There are many places either type of set will give equally satisfactory results, and in these localities, which are usually in the suburbs or country. the selection of a suitable set is merely a question of personal preference.

Suppose a set is to be used in a place where there is a great deal of interference (man-made interference, such as that caused by leaky power-lines, rough street car trolleys, partly broken down transformers, radiating receiving sets, etc.) This, of course, is a very difficult condition to overcome, due to the fact that a radio set is the most sensitive detector of small electrical disturbances in existence.

If the interference is directional, however, a loop set can very often be employed with a very reasonable degree of satisfaction by attempting reception only from those directions which will tend to keep the loop at right angles, or nearly so, to the interference. The noise to signal ratio, when the loop is so positioned, will be such that the signal is so much stronger than the noise that the resulting tones will be fairly satisfactory unless the interference be uncommonly strong.

A modern apartment, fireproof house, or office building, with its steel skeleton and steel lathing tending to greatly damp down the signal, presents another great problem. A loop set to be satisfactory for use in such a location would necessarily need to be extremely powerful and this fact naturally leaves us an antenna set as first choice. Many of these apartment houses, however, prohibit the erection of aerials. In a case of this sort, it is necessary to employ a very sensitive radio frequency or superheterodyne loop set, and experiment with its placement in an endeavor to find the position in the apartment in question in which it operates with the highest efficiency. If the loop can be located near a plain brick wall or window it will be less shielded, and consequently more efficient, than if placed near a wall in which steel lathing is employed.

Another problem is the house located in a thick grove of trees. In the winter, when there are no leaves on the trees and the sap (which is the conducting medium) is down in the roots, practically no interference is caused by them.

In the summer time, however, these same trees cause a blanketing effect which is oftentimes almost as pronounced as that produced by a steel

(Please turn to page 43)

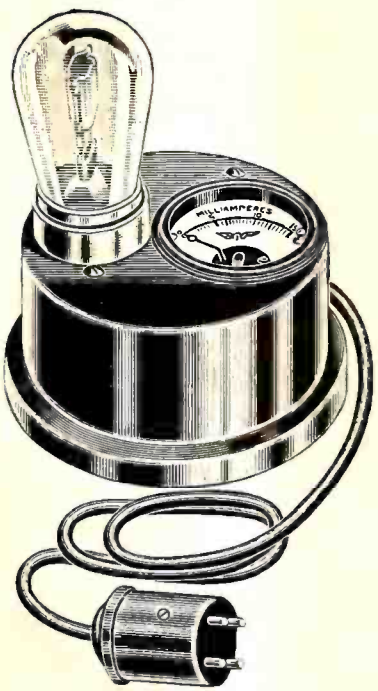
Man—Know Thy Tubes!

WERE it possible for all radio fans to heed the injunction at the top of this little article, many a magazine's technical department would heave a sigh of relief; many a set manufacturer would feel his product was being given a fair deal, and the fan himself might realize that at least he was contributing a little towards solving his own difficulties.

So many of the letters of complaint regarding a given set refer to the fact that reception gradually dimmed as the age of the set increased. The querulous one immediately opines it must be the set. He shies his complaint at the nearest radio magazine or dealer and then waits impatiently for an answer.

The funny part of it is (if there is any humor at all in such a situation) that the listener or fan does not stop to think he might find out the trouble through his own experimentation unless of course it is something deep-seated. And most of the fans seem to think it is deep-seated.

So if you would relieve the burden of the Question and Answer men scattered over this broad land, do a little checking on your own initiative before burdening others with your troubles. Take the little matter of tubes, for instance—



Inexpensive tube checker which will tell the actual condition of a fan's tubes. Use it and know your tubes

Nine out of ten listeners will assume that when reception drops off something must be wrong with the set. In nearly every instance it is with the tubes. Mr. Fan in his keen desire to log everything this side of Walla Walla, Wash., has kept turning up the faithful old rheostat until the tubes are as bright as possible. At first this worked out nicely, but after a while the same fan found that to keep up the level of reception he had experienced before, he required a rheostat with an endless turning ability. When all of the resistance was cut out of the rheostat, and the signals did still not come in with their usual volume, Mr. Fan went into executive session with himself and decided the set was on the blink.

Difference in Reading Milliamperes				
B Volts	201-A	112	199	120
90	4.2	8.2	1.4	1.8
67½	3.7	8.0	1.2	1.4
45	3.3	7.5	1.0	1.3
22½	1.6	5.2	.6	.9

In the table above are shown the difference in readings, shown in milliamperes, between plate current values obtained through use of the tube checker. Good tubes show the average listed; poor tubes show from a half to a quarter of these values and should be rejuvenated

As a matter of fact several things may have happened. The tube filaments may have become dethoriated through application of excessive voltage; the potential of the storage A battery may have dropped because Mr. Fan had been using the set too long without recharging; by the same token the voltage of the B batteries may have dropped to very low value. All three of these conditions could have caused a diminution in signal strength. Likewise a change in the weather might have been the cause. The last named cause is the only one over which the listener has no control. If his A battery is low he may charge it with a rectifier. If dry B batteries are used and their voltage is low, new ones may be secured. If wet B batteries are used, he merely has to recharge them. Thus only the tube is left to be accounted for.

Checking and reactivating tube filaments is such a simple process that we are surprised more of the fans have not made use of the scheme. For some time manufacturers have marketed tube checkers and tube reactivators or rejuvenators, both of which are available at a very reasonable price. Their use will save the average fan a great deal of expense in tube replacement as well as considerable time spent needlessly in trying to find a trouble.

You may check your tubes from the receiving set you are using and thus determine which of the tubes is poor. Nine chances out of ten the tube which you find in poor condition is responsible for the most of your trouble in getting good signals.

Vacuum tubes using the thoriated filaments, such as the 201-A, 112, 199 and 120 can readily be checked by the tube checker illustrated in this article. Also these same tubes, if found to be low in emission, may be reactivated by the tube rejuvenator shown.

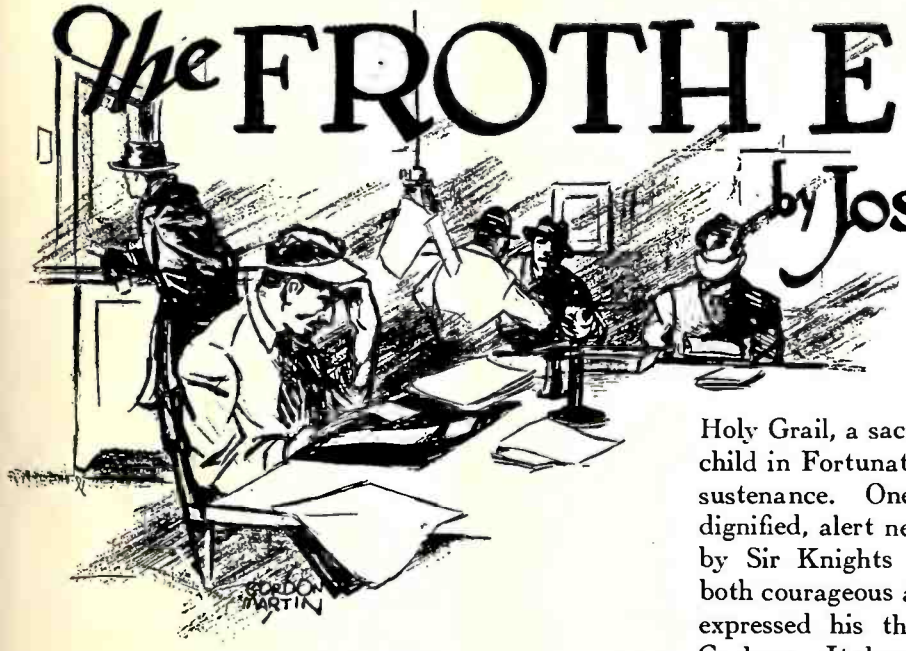
In the case of the tube checker, it consists simply of a socket, a DC milliammeter reading from zero to fifteen milliamperes, a plug and cord whereby the outfit may be plugged into a socket in your set, and a single pole, double throw switch, in the form of a button, which serves to alter the bias placed on the grid of the tube under check. Knowledge of vacuum tube characteristics has permitted the makeup of a chart showing difference in readings for a given tube. Thus with 90 volts on the plate of a 201-A tube, two readings of plate current may be secured one with a negative bias and the other with a positive bias on the grid. The difference between these two values is fairly indicative of the condition of that tube's filament emission. For

(Please turn to page 39)

With such a reactivator any tube may be returned to its pristine glory, all of which will help your reception

The FROTH ESTATE

by Joseph Balsamo



The story thus far

Col. Maximiliam Minimil sets $10,000,000 aside, out of his personally acquired colossal fortune, for the purpose of financing the Fortunatus Gazette for his son Daly. The younger Minimil, while the great project is being organized, has some difficulty in making other people believe he intends to publish a newspaper that is to be free from the smut and hysteria of certain other dailies. He believes a clean journal will win out. Bill Rossom, publisher of the Clarion, is a former movie actor. A horse stepped on his face and, although putting him out of the picture game, so transformed his countenance that he has the appearance of a super-man. People do what Rossom wants because of the compelling power of the Rossom face. Rossom tries to prevent the sale of the first issue of the Gazette. The Minimils win their circulation battle by a ruse and the Gazette is successfully launched.

IX

DALY MINIMIL'S first visit to the local room of the Gazette reminded him of the first time he made a flight in an airplane. The paper was taking off with a roar and a rush. Stub Graham, city editor, was superintending the assignment of reporters and photographers. Daly, attracting only casual notice from reporters and sub-editors, took a chair near Graham's desk and was fascinated by the sure precision of the city editor's methods. Telephone bells were throbbing with incoming calls and typewriters clicked on all sides. Copy for the early edition was being dumped on the city desk. Graham seemed to be able to talk to a reporter at his elbow, listen to another over the telephone and read a story and mark it for space and headline, all at the same time.

"Hey, there, Farnsworth," yelled Stub, as a photographer passed his desk on the way to the door, his camera slung over his shoulder. "Just a minute, Farnsworth, when you snap that dame tell her to pull her skirts down. She might have the idea you want a Hearst pose. Legs used to be news but those days are gone forever as far as this newspaper is concerned. That last society pic of yours should have carried two credit lines 'Legs by Farnsworth' and 'Underwear by Puresilk, Inc.' "

Daly could not entirely suppress a smile. He cherished the hope that he could make of the Gazette a Holy Grail, a sacred font from which man, woman and child in Fortunatus might quaff material and spiritual sustenance. One of his dreams was that his calm, dignified, alert newspaper might be written and edited by Sir Knights and Ladies of Journalism, captains both courageous and cultured. But he would not have expressed his thought quite so trenchantly as had Graham. It depressed him to reflect that the tall lady reporter, sitting over there by a window, was even now hoping that the next telephone call would bring a tip on a first-class murder, one with a sex angle which would require the expert touch of a lady reporter's skill. She yearned for a slaying that might enable her to visit the jail and write that she had loaned the fair, frail, little murderess a handkerchief and a powder puff after the fair and frail had confessed to the Fortunatus Gazette exclusively that she had shot her man in the back as a measure of self defense.

The chief of the office boys ushered a large blowsy woman into the local room. She had a story to tell and it mattered not to her that the confessor assigned to listen to her was the smallest and youngest reporter on the staff. He was Asbury Lunt, be-spectacled, spatted, combed-back. Diminutive as he was he calmly flapped one enormous pant-leg over the knee of his other limb and waited for the lady to announce. Mr. Lunt was a graduate of a school of journalism, a novitiate. He knew that for weary months to come he was doomed to sit about the office seeing those visitors whom nobody else wanted to see, listening to dreary stuff with an air of polite interest and throwing his memoranda on the floor the moment the visitor departed. Some day he would be a regular, journeyman go-getter. He would fare forth and cover big news events and some other youth would be sitting in his place in the local room, being polite to the bugs.

This particular caller seemed to be somewhat more balmy than the average, Mr. Lunt reflected. She had a fog-horn voice that rose triumphantly above all the other din of the local room as she broadcast the announcement:

"I want justice!"

As she made this time-honored declaration she leaned forward and glared right into the horn-rimmed spectacles of Asbury Lunt. That impeccable boy, whose soul had never yet been stung by the scourge of out-

raged love, but whose heart was rife with sympathy and a desire to understand, settled back in his chair.

"You have come to the right place for it, Mrs. Corridon. Tell me please."

"I helped that man through veterinary college and gave him his start," she boomed. "I took in washing and carried his meals to his office so that he could save time and restaurant expenses."

A lull in the noisy confusion made it evident that this woman's message was getting more than local circulation.

"When he got prosperous a lady barber vamped him." With this the great frame of the unhappy matron slumped forward and her tears fell unchecked on Mr. Lunt's serge shoulder. Suddenly she arose and into the far corners of the Gazette building the winds of vengeance carried a lusty shriek.

"Write her up, Mr. Reporter, and print my picture on the front page. A woman like that ought to be hung. A hussy barber! Steve was a good husband until she began to shave him!"

Stub Graham sent an office boy to tell Mr. Lunt that he was wanted at the city editor's telephone. As soon as Asbury was within confidential distance Stub said: "Take her back to the studio and have 'em shoot her picture just to stall her along. Then let her out the side door."

Mr. Lunt squired Mrs. Corridon to the rear of the big room. He had just stepped aside courteously to permit Mrs. Corridon to pass through the door, when a caliper-legged gentlemen with a Sir Thomas Lipton mustache backed excitedly away from a printing telegraph machine that was bringing in bulletins on the results of baseball games, horse races, hog receipts and stock movements.

"Monkeyface," yelled the bowlegged gentleman, who, as Daly learned later, wrote the Gazette's housekeeping column under the name of "Aunt Clarice," "Monkeyface!"

Mrs. Corridon hit Clarice once but footwork saved him from further punishment. Mr. Lunt stepped in between them and Mrs. Corridon's second swing caught him on what the sporting editor calls the button and Asbury went down. He sat in a waste basket waiting dazedly for the meadow larks to stop singing.

Dingle, head office boy, next squeezed into the sketch. "He wasn't calling you any names, lady," said Dingle, "he had two bucks on Monkeyface's beezer and the old goat staggered in first in the second at Jamaica."

By this time Mrs. Corridon was drifting far out beyond the safety-ropes. Lacerated in spirit she tossed a contemptuous glance at the staff of the Gazette.

"This newspaper's a fraud," she boomed. "I'm going to the Clarion where the place ain't filled with dudes and thugs."

X

NOW Daly Minimil's knowledge of how news was developed from the crude state to the finished product had been vague indeed, and he was not prepared for the revelation that the city editor's department of a daily paper resembles an internal combustion engine more than it resembles a drawing room occupied by earnest young persons engaged in transforming today's chronicles into the literature of tomorrow. Daly was surprised and not altogether pleased at the discovery that the handling of spot news had an obligato of noisome pops from the exhaust pipe. Looking about the office at the Sir Knights and Ladies of Journalism he was forced to the conclusion that, so far from being litterati, some of them were devoted students of but one volume—the telephone book. Of course Daly did not know that no inconsiderable portion of the modern newspaper's local staff do little or no writing, but limit their efforts to obtaining facts which they turn over to rewrite men or other reporters to be "whipped into shape" as the saying goes. Unhappy the fact that comes to this whipping post under the suspicion of being unimportant, uninteresting, lacking in imagination, devoid of humor or of human interest. Such an unworthy fact, seized by the rewrite man, is tied to the whipping post and lashed with typewriter key-bars until it either writhes in pain and dies or until it heaves amain and, breaking its bonds, stands forth transformed. No toilet preparation can do so much toward helping women to keep that schoolgirl complexion as can the rewrite man who makes all the women attractive, demure, pretty, beautiful and vivid. No promoter of real estate values can so magically transform a residence district of mediocre houses and Group II citizens as can the rewrite man. His heroes and heroines always live in exclusive districts, regardless of the price of vacant per-front-foot property. No tailor could clothe so well the speak-easy bartenders who are found dead in the tonneau of the high powered and generally black touring car. Until it is disclosed that the victim of the mysterious murder is only another rum-running gangster it seems inevitable that his clothing shall be of excellent material, even his linen indicating great wealth and culture. The coroner, rushing forth to hold an inquest, finds that the shoes of the corpus delicti have not been polished since Maine went democratic, his pants have not known the smoothing influence of a goose since they were marked down to $4.98. And the lady murderess! How kind the reporter and the artist! "Dramatize her," says the city editor to the reporter, and "Touch it up to make it look like something" says he to the art department director who is to superintend the making over of the lady's photograph into a worthy slab of etched zinc.

"So this is journalism," reflects Daly as he watches his own show from back stage.

Stub Graham, sensing the chief's feeling, turns to say:

"Readers like it and we gotta give 'em what they want."

"I wonder," said Daly, making mental note of the desirability of a long talk with his editorial chief, Mr. Dana Greely Franklin.

At a desk somewhat removed from the milling group about the city editor sat a sad faced man. Daly had observed that this individual had seemed bored by the adventure of Mrs. Corridon and Mr. Asbury Lunt. He raised gloomy eyes only once to see what all the commotion was about and then returned to grief-stricken contemplation of his lower waistcoat button. A lady reporter stopped near the shrine of sorrow and said something in a small voice. "Hell's delight," exclaimed the melancholy one, "don't you ever buy any cigarettes of your own?"

"That's what they all ask me," piped the lady over a pert shoulder as she seized the churlish gift and made off for the rest room.

"Who is he?" asked Daly.

"Conductor of the humorous column," replied Stub.

Daly started with surprise. So this misplaced mortician was the famous "H. A. W."

Near the copy desk lounged the religious editor of the Gazette. As a side line he was pastor of a church and he still believed in hell and sideburns. "Doc," as all religious editors are called in newspaper offices, was trying to convince a half-jingled copyreader that prohibition prohibits. The h. j. copyreader was giving only indifferent attention for he was concerned at the moment in trying to devise some new and unusual reason for applying to the city editor for an order on the cashier. It was the copyreader's day off and he had not the wherewithal to finance certain activities which, to copyreaders, bring happiness. The Doc was saying:

"It's harder to find liquor than it ever was and it's getting scarcer every day. And it's a lot more expensive and not so good."

"Lordy, yesh!" agreed the copyreader, "so you've notished it, too."

* * *

XI

Presently, after reporters and photographers had gone their ways, the local room of the Fortunatus Gazette assumed that atmosphere of pregnant quiet which marks the interval between the assignment of the staff and the arrival of the first bulletins from the news front. Typewriters were deserted, paper littered the floor, telegraph keys rattled pleasantly in some distant room, the cop's traffic whistle sounded clearly from the street far below. The column conductor was mournfully reading over a bit of verse which would make thousands laugh next morning. The city editor was making up his preliminary news schedule for the early make-up man and his assistants were cutting up the afternoon papers.

Only one girl remained of the crew that had so noisily swarmed about the rows of desks occupied by the reportorial staff. Daly had been studying her and had come to the conclusion that she had no business there. He felt reasonably confident that she had no business anywhere except on a Sargent canvas. An exquisite being! Daly arose and yawned. He had had his eyeful and his earful and now he would go back to his own sanctum and ponder there the things he had seen and heard. Changes would be necessary undoubtedly. It was not conceivable that his newspaper could achieve its high purpose with such a local staff and such a lack of ethical niceties. He would have Franklin in and they would thrash it out.

He nodded at Stub Graham as a perfunctory signal of departure. As he did so he glanced again at the girl, He sat down again. After all Daly was a human being. And he was not 24 years old. Nor was he blind.

"Who is that young lady?" he asked.

"A new reporter," said Stub. "Haven't tried her out yet. Ought to be the berries with that face and those clothes. She can crash in anywhere."

"Discharge her," said Daly.

Stub looked up in amazment. "Do you mean that I am to fire her?"

"Yes."

"It's all right, of course. She came here with dandy recommendations but if there is something about her that I hadn't——"

"Not at all," said Daly, "I know nothing against her but she will have to go."

"All right, Mr. Minimil." Stub said no more.

Daly glanced about the big room. He was visualizing the scene of a few minutes before. He was rebuilding the structure of sophistication and disillusionment which was the Gazette's local staff. This flower against such a background! He looked at her again. Impossible! He must give Graham a reason for his instructions to discharge her. What reason could he give that would not sound ridiculous, quixotic?

"She is entirely too beautiful," he said at last. Stub looked at him again, not concealing his surprise. "Too good-looking," went on Daly. "She'd disorganize things here. The city hall reporter would be holding her coat and helping her on with her rubbers. The financial man would be asking her out to dinner. Dingle would be forever doing just what he is doing now, looking up telephone numbers for her or some such nonsense. The rewrite men would be using her as a pattern for fair fiction characters. They would be in competition for the honor of fetching her copy paper and ribbons. It wouldn't work, Graham. I know you'll see it my way. If she wants the reason tell her the truth. She's entitled to that, anyhow."

Stub Graham smiled quickly and nodded in acquiescence. He watched the figure of the publisher recede into the shadows of the corridors leading to the inner sanctum. Then he looked at the girl reporter and after a moment of thought he uttered softly a deep truth.

"The higher they get the harder they fall. Holee Mackerel, how am I going to get this bad news across to her?"

(To be continued.)

Ontario Power Commission Adopts Short Waves

By JAMES MONTAGNES

SHORT wave radio now links the Toronto offices of the Ontario Hydro Electric Power Commission with the generating station at Cameron Falls on the Nipigon River, and other parts of the Commission's Thunder Bay System, north of Lake Superior.

During the winter months of 1926 the engineers of the Toronto laboratories with the co-operation of several of the Canadian amateurs, investigated the possibilities of communicating directly between Cameron Falls and Toronto by means of short waves. These tests showed the proposition to be quite feasible and the Commission then authorized the construction of the two radio stations.

The stations have been in constant communication since last autumn, work being carried out every night. The Department of Marine and Fisheries, Radio Branch, granted the use of two special wavelengths—29.94 meters for daylight and 50.0 for night transmission—and the sets are in operation under experimental licenses by operators who have first class commercial certificates.

The Toronto station, 9AI, is installed on the sixth floor of the Administration Building, with the aerial on the roof. The station at Cameron Falls, known as 9AQ, is temporarily located in a school house building on the west side of the Nipigon River. The two stations are approximately eight hundred miles apart, the distance between being for the greater part thinly inhabited.

Messages are sent in Morse code only and loud clear signals are received in either direction. A very considerable saving in time is effected through the use of radio equipment as messages are received at their destination three or four days earlier than by the usual mails. It is for this reason mainly that these stations are in existence.

The transmitting and receiving apparatus was designed by the Commission's engineers and built in the laboratories at Toronto.

The transmitting equipment is mounted on the rear of an upright hardwood frame, the panels of which have been boiled in paraffin to improve their insulating properties, thus forming a material which is recognized as superior to the usual materials supplied for radio-frequency insulation.

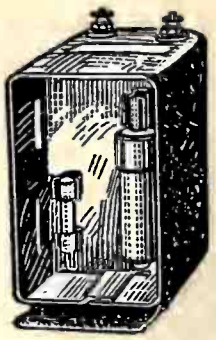
The power tube, type UV-204-A, having an output rated at 250 watts, is mounted on a horizontal panel. Above the tube are the inductances and condensers, forming the radio-frequency circuits, and below are the filters and control equipment.

Everything has been done to make the apparatus safe for the operator, one of the features of construction being the connections of the condenser shafts, as well as those of the rheostats and the cases of the instruments which are at ground potential.

The keying system in both transmitters employs a small adjustable condenser, which is connected in parallel with the main grid-turning variable condenser whenever the key is pressed. This causes a slight variation in the wavelength of the radiated waves, the longer wave being the true one, and the shorter one being the spacing wave. The receiving operator tunes to the true wave and does not hear the spacing wave at all. The receiving apparatus is similar to that found in most amateur short wave stations, that is, a regenerative receiver using two tubes, detector and one stage of audio.

The operation of these transmitters since their installation has aroused favorable comment from the executives of the Ontario Hydro Electric Power Commission. Stations work each other on prearranged schedules, calling in the usual way, and handling messages relating to operation of the power system.

Dry Rectifier



ABOVE is shown the latest release in the rectifier field announced by the Thordarson Electric Manufacturing Co., embodying a Raytheon rectifying element and a Thordarson transformer. The sketch shows the inside of the new device which is marketed as R-175 of the Thordarson line.

Several features will at once be appreciated by radio enthusiasts. First the rectifier delivers 2 amperes; it is dry, has no moving parts or liquids. It is also small and compact. Tried out in the laboratory of this magazine it made an ideal 2 ampere charger which could be put to work and forgotten.

New Tube Out For Resistance Coupling

BECAUSE of the widespread interest of fans in resistance coupling a high mu tube especially designed with a view to providing high amplification, and suitable as a detector as well as an amplifier, has been announced by the Radio Corporation. This is the UX-240 which in general appearance and physical dimensions is similar to the well-known UX-201-A.

It is a storage battery tube, with a one-quarter ampere filament of the thoriated tungsten type. A standard UX base is provided. This tube is intended to provide the highest practicable voltage amplification so essential in resistance-coupled amplifiers. This method of amplification, in contrast with the transformer-coupled method, depends entirely upon the tube for the step-up effect. The UX-240 has been designed to provide an amplification factor of 30.

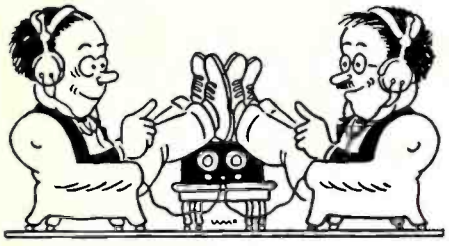
PICK-UPS *and* HOOK-UPS *by our Readers*

FANS who may have a good collection of old issues of this magazine and who wish to help the New York public library will confer a favor on that organization by sending the library a copy of the July, September, October and December issues of the year 1923. These issues are out of print. If any reader happens to have one of these issues the library would appreciate having it if the reader no longer cares for it. Address Director New York Public Library, 476 Fifth Ave., New York, N. Y.

THE broadcast listener usually complains that he is unable to hear a certain station because it is too far away; the amateur radio telegrapher, on the other hand, ofter makes the complaint that he cannot hear another amateur station because it is too near! A striking example of this is furnished in the story of a radio message that a San Jose amateur wished to send via short waves to his friend at Carmel, California. The distance between the two points is slightly more than fifty miles, but due to the habit that short waves have of angling into the upper atmosphere before being reflected back to earth, the two stations were unable to hear each other at all. Finally, the San Jose station, 6HB, recollected that 6HM, at Carmel, kept a regular schedule with an amateur in Singapore, Asia, and, since this point was quite easy for each to reach, he sent the message to the Sinapore amateur, [illegible] the

Front view of the latest model super

ANOTHER slant on readers' wishes is contained in a letter from Carl L. Streich, R. F. D., Miamisburg, Ohio, who says: "I have been a reader of your magazine for several years and I notice you want comments on what interests us radio fans. I live on a farm and read all the radio magazines. I like things like the Browning-Drake layout and the articles about McNamee and the prize fight (Dorothy B. Stafford). I like these articles in preference to the pictures. I pass my magazines around after I read them and everybody likes Radio Age." Thanks, Mr. Streich; we are recording all opinions so we can determine the very best possible content of each issue. Who will be next to state their preferences?



"Do you believe Joe's DX reports?" "Hardly! Joe's one of those fellows who tunes in Hawaiian guitar music and imagines he's got Honolulu."

JOHN A. PENFIELD, Box 108, Beamsville, Ont., Canada, writes us his preferences in Radio Age. His first choice is the blueprint section; (from which he built a dandy three circuit set on which he pulls in considerable DX) next comes this department, then articles by Dorothy B. Stafford and Armstrong Perry. Scientific features he prefers to the fiction. We would like to have the opinions of our readers as to their preferences. Mr. Penfield finds that by inserting a 40 turn coil in series with the antenna and inductively to the secondary it greatly increases his plume on the locals.

PETER FARMER, Blairmore, Alberta, Canada, tells us he finds a balancing condenser from the filament to the plate of his r. f. set (the Haynes r. f. set) helps him control volume. The placing of the condenser in this position, from plate to filament, acts as a regenerative condenser in part, both on the r. f. tube and the detector tube. However, it will only increase oscillation but will not reduce it unless the condenser is removed.

A. G. BRUBAKER, Denver, Pa., tells us he prefers the broadcast list which we publish each month but would like to have us add a column giving the wattage of the various transmitters. At the present we cannot do this on account of the chaotic condition of the broadcast game, but later on when matters begin functioning in an orderly manner it might be possible to include that data.

ANOTHER fan would like data on short wave receivers; also a list of the few stations that broadcast on short waves. Information is also wanted by John F. Illick, 1336 Lehigh St., Easton, Pa., on the construction, use and abuse of the choke coil; likewise the fixed condenser, blocking, bypassing, etc. Our correspondent is also a regular reader of this magazine, having a complete file from May, 1924, up to the present date.

HERALD LAWRENCE, Box 186, Parry Sound, Ont., Canada, using a four tube Regenoflex tuned in 206 stations to say nothing of 16 short wave amateur sets on phone work in an incredibly short time. His DX list was so good he is being awarded one of the D. T. buttons.

FOR the past few weeks the high-powered transmitter of WGY, at Schenectady, N. Y., has been using a 100 kilowatt vacuum power tube. This marks the first practical use of a tube of this size by any broadcasting station. The tube, which takes the place of eight 20 kilowatt tubes in WGY's transmitter, is a development of the General Electric Company and engineers are now securing data on its performance. With its water jacket the tube stands seven and one-half feet high and weighs 100 pounds, or one pound per kilowatt. With such a tube available radio engineers of the General Electric Company will be able to carry on their investigations in broadcasting on higher powers than have heretofore been possible. Up to the present time 50 kilowatts in the antenna has been known as "super-power," but with tubes of an output of 100 kilowatts at hand investigations will be possibly up to 500 kilowatts or even more.

DO NOT be too greatly impressed with press reports heralding the arrival of an A. C. tube which eliminates the use of all batteries, for such is not the case. Any A. C. tube so far developed (and there have been several) is called an A. C. tube because its filament is either directly heated by alternating current from the socket, or a special heater coil (run by alternating current) is used which transfers heat by conduction to a regular filament for electronic emission. Regardless of the method used for the operation of the tube's filament, there still remains the necessity for the plate potential which is furnished either by batteries or by an eliminator. So do not worry about your present tubes becoming obsolete over night.

ANOTHER reader comes forward with a letter of appreciation for the 4 tube Counterphase receiver which we published in the January, 1926, issue of this magazine. A. DesRosiers, 256 Bridge Ave., Windsor, Ont., Canada, built the set and gets fine DX with it as well as excellent quality. That particular receiver was very popular with our readers as is indicated by the number of letters on that subject.

DURING the summer months will be a good time for those desirous of entering the amateur game to get their start. Especially when a 201-A and a B eliminator will do for a short wave set there is no excuse for not getting into the transmitting game. Those interested should consult an article on page 17, May, 1926, RADIO AGE, giving data on application for transmitting licenses. In our next issue we will have a short wave transmitter and receiver shown in the blueprint section; it will be a simple and inexpensive crystal control outfit. Watch for it.

STATION WLW, at Cincinnati, now is on the air regularly with broadcasts on a 52.02 meter wave length in addition to its standard wave length of 422.3 meters. Both programs are broadcast simultaneously.

These short wave broadcasts were instituted by Powel Crosley, Jr., as an experiment in the development of the high frequency channels.

These tests have revealed a number of interesting things. For example, the short wave broadcasts are heard with ease in distant countries but it is quite a trick to pick them up near Cincinnati, in the neighborhood of the transmitter.

This is due to the "skip distance" characteristic of short waves. In the case of WLW, it is approximately 70 miles. It can be overcome by an increase in power, which strengthens the ground wave and overlaps with the sky wave.

method of amplification, in contrast with the transformer-coupled method, depends entirely upon the tube for the step-up effect. The UX-240 has been designed to provide an amplification factor of 30.

Using 9 Tubes on Worlds Record Super

By F. A. HILL
Associate Editor

HAVING covered practically all of the combinations of the Worlds Record superheterodyne using eight tubes, in this article we will concern ourselves with the nine tube model which we are content to call the best arrangement yet constructed both for simplicity of operation, long distance ability and quality output. These three essentials have been approximated in the previous models but in the one to be described they have been completely fulfilled.

Those interested in the super question should refer to the November, 1926, January, 1927, and March, 1927, issues of this magazine for the ground work on the Worlds Record series. In this issue is the culminating achievement, together with an excellent trouble-shooting article which appears in the fore part of this magazine.

On account of the lack of space we will not be able to devote a great deal of text to the description of the set but would instead refer the reader to the previous issues mentioned above. Therefore in this article we will confine ourselves to the enumeration of the features which this receiver possesses as contrasted to the previous models.

Primarily it was our intent to work out a super design in which there would be sufficient intermediate amplification to bring the signal level up to a point where it would cover both the winter and summer season. Ordinarily the 8 tube model would handle the good reception season in a fine manner, but when the signal level begins to fall there would be a drop in the reception value. To counteract this condition we decided upon the addition of the ninth tube, this being the insertion of an additional iron core intermediate stage. The presence of this extra intermediate permits a higher amplification of the desired signal without the necessity of forcing the long wave stages to a state bordering on the regenerative. In practice the added intermediate stage brought in same stations as eight tube model but accomplished this feat without strain or distortion which might creep in on a smaller model when long wave stages are forced.

Another feature of this model is the economy of controls. Where in other models there were numerous controls, in this nine tube job we reduced controls to one. The two condensers, one for the loop and one for the oscillator, are the major controls, while the rheostat governing the filament of the second and fourth tubes, acts both as a volume and sensitivity control. The X-L balancing condenser is located on the subpanel where it is removed from the temptation of the owner to be constantly changing it. Another feature which has been incorporated is the fact that with the voltages as given it will not be possible for the operator to make the intermediate stages squeal. The inclusion of these features is a direct result of the many letters received by the staff in which readers wished to have a further simplified super. The log shown on these pages will give an idea as to the selectivity of the set —ten kilocycle reception every night.

Blueprint figure one shows the top view of the subpanel. On page 24 will be found the drilling template for the subpanel. Blueprint figure two shows the bottom view of the same receiver. Blueprint figure three shows the pictorial representation of the complete A, B and C elimination sys-

The following parts were used in the Radio Age Worlds Record Super Nine model. Other parts of equal merit may be used if desired.

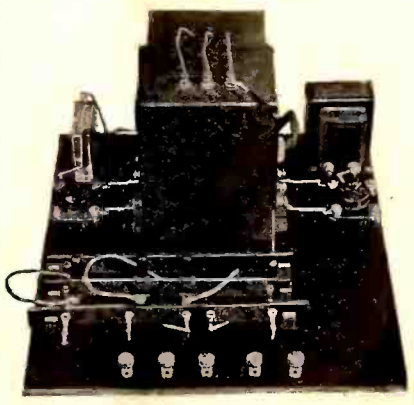
Receiver

- **1 Panel 7x26x3/16**
- **1 Subpanel 7x25x3/16**
- **1 Pair Benjamin adjustable brackets**
- **9 Benjamin UX cushion sockets**
- **3 Selectone R400 long wave transformers**
- **2 Selectone R410 long wave transformers**
- **1 Silver-Marshall 515 coil socket**
- **1 Silver-Marshall 11-A plug-in coil**
- **1 Silver-Marshall 275 RF choke**
- **2 Thordarson R200 audio transformers**
- **1 Frost 20 ohm bakelite rheostat**
- **1 Frost 2½ ohm bakelite rheostat**
- **1 X-L type N variodenser**
- **2 Remler .0005 mfd condensers**
- **2 Karas micrometric dials for same**
- **1 Jones base mounting plug**
- **5 Carter tip jacks**
- **1 Carter imp pilot switch**
- **1 Sangamo 1 mfd condenser**
- **1 Sangamo .002 mfd condenser**
- **1 Bodine loop**
- **1 Eveready 7½ volt C battery**
- **1 112 Amperite**

Power Compact

- **1 Thordarson 210 power compact**
- **1 Potter condenser block for same**
- **1 Set Carter resistance strips for same**
- **2 Frost sockets**
- **5 X-L pushposts**
- **1 Balkite type AJ rectifier**
- **1 Abox filter**

Front view of the latest model super



Photographic view of the 210 power compact

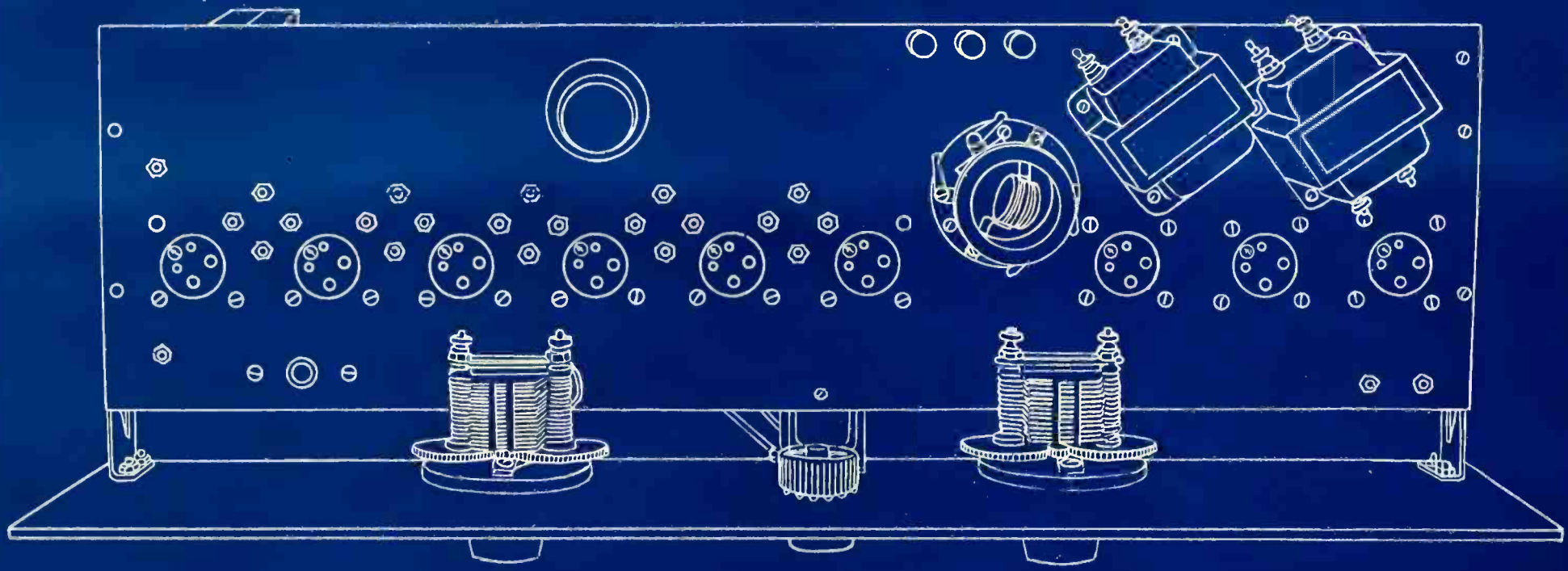


FIG.1
TOP VIEW RADIO AGE
WORLDS RECORD SUPER 9 MODEL

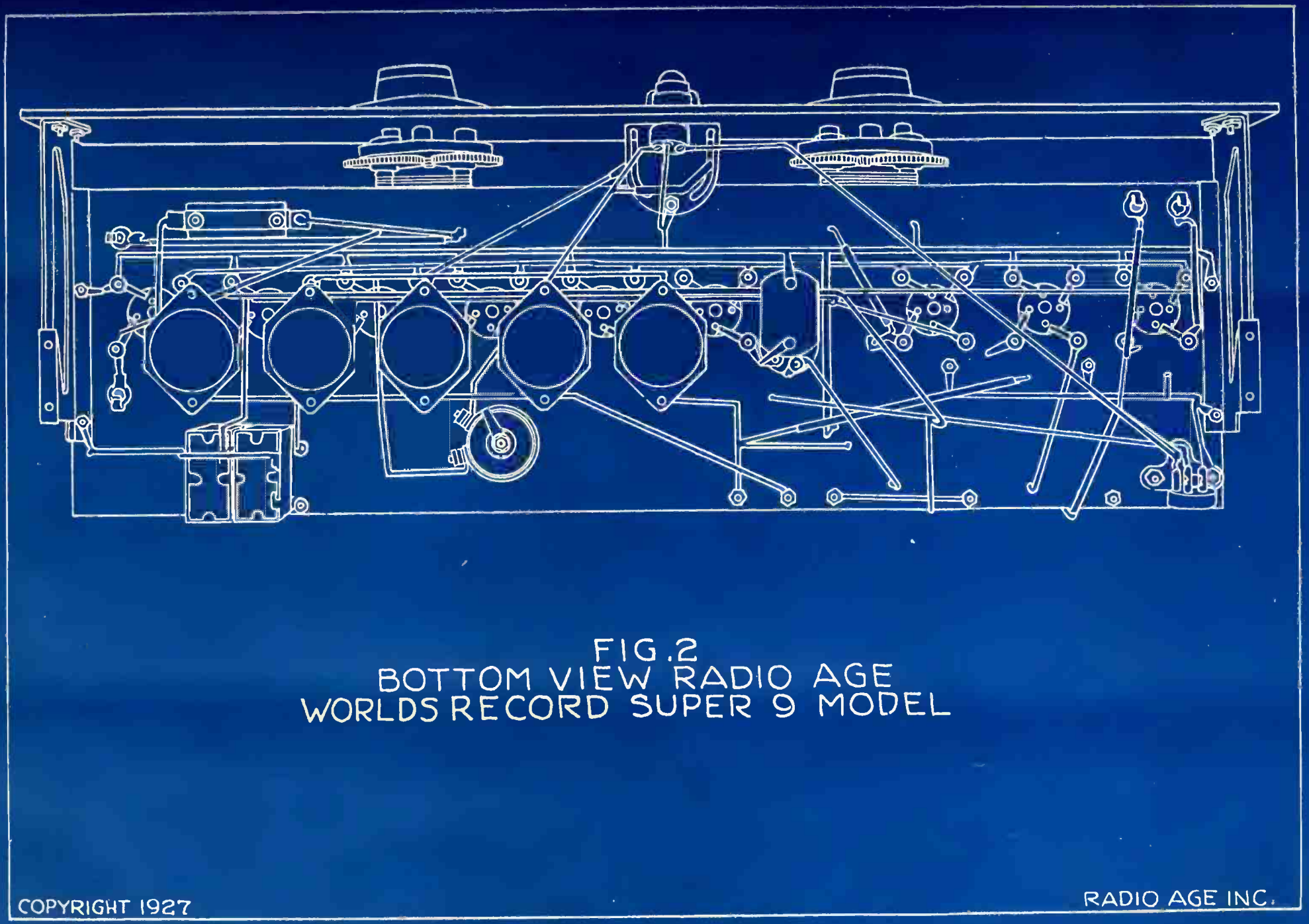
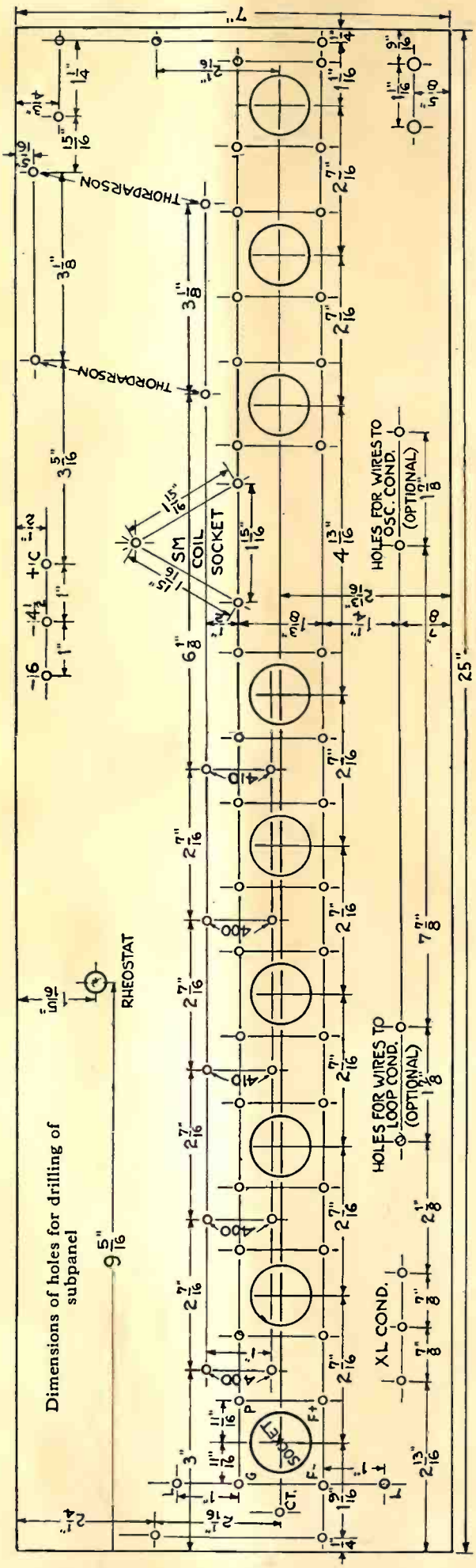
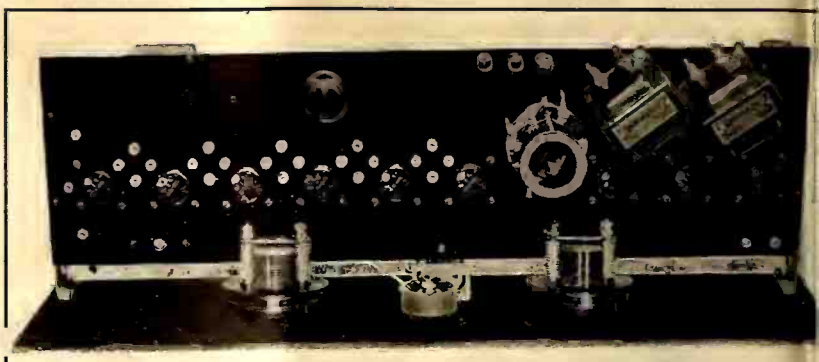


FIG.2
BOTTOM VIEW RADIO AGE
WORLDS RECORD SUPER 9 MODEL





Top view of the subpanel and back of front panel

tem used with the nine tube model. Blueprint figure four shows the schematic diagram of the set by means of which it should be wired.

Reference to the schematic will disclose no great change over previous models other than simplification of control and economy of parts. The loop circuit is the conventional center tapped loop with a .0005 mfd Remler across the extremities of the loop. The X-L type N variodenser is used for making the loop semi-regenerative. For detection in the first detector the center tap in series with the pickup coil goes to the 4½ volt negative C battery terminal from where the second detector is also baised for detection. This value may also be used for the grid of the first audio. The bias on the intermediate stages is shown as 3 volts although in practice (and with 45 volts on the intermediate plates) it was found either that a zero bias or a 1½ volt bias was preferable. The bias for the grid of the last tube should be about 27 volts for a 171, or if the power compact scheme is used the power compact furnishes its own bias for the 210 power tube.

To prevent the intermediate stages from being thrown into oscillation the resistance R1 is a 20 ohm rheostat in series with R2 which is a half ampere Amperite. Resistance R3 is a 2½ ohm rheostat for master control of all the tubes except the second and fourth which are on R1. This system of rheostat control is necessary to insure five volts on the tubes, especially when using the A elimination system outlined in the third blueprint figure.

For convenience in knowing both your voltage and the current draw we recommend two meters, one a zero to eight volt dc voltmeter (Jewel) and the other a zero to fifty milliampere meter of the same make. The first one will give you voltage readings on the tubes while the second will permit your knowing the current drawn by each section of the receiver. The positions shown by a bent line and the letter J are jacks for plugging in the milliammeter. This will enable you to tell at a glance whether the different sections of the receiver are working properly.

It will be noted that two iron core stages are first used followed by an air core, then another iron core and finally the last air core. By using the filament control on the first iron and first air (the second and fourth tube) perfect stabilization of the long wave stages is possible. This is due to the use of 45 volts on all intermediate stages, and likewise simplifies the wiring. By the manner of placing the intermediate transformers under the subpanel with the grid and plate binding posts forming the connecting link between grid and plate terminals on the sockets there results a great saving in the number of leads that have to be run. It also simplifies the assembly of the units since the intermediates space the sockets exactly. The template for the subpanel is

shown in this article and dimensions are given for all necessary holes.

Only two bypass condensers are used, the first across the 45 volt line and the second across the C battery terminals. The .002 mfd bypass condenser is used across the rf choke coil used in series with the primary of the first Thordarson audio transformer. On account of using the series feed in the Silver-Marshall plug-in oscillator, no bypasses are required in that position. Also the grid to filament method of tuning is used on the oscillator instead of the grid to plate as is customary in the other models. The oscillator should be hooked up in conformity with the numbers shown in the schematic.

Using the Thordarson power compact (210 type) the connections are the same as those shown in the blueprint section of the April issue but without the voltage regulator tube, and using the Carter strip resistances instead of previous types. This particular compact will take care of all normal sets including the nine tube job. For those who wish a larger power plant we expect to have the 210 job in full wave form in a forthcoming issue.

Taking up the consideration of the log on the set we observe that ten kilocycle separation is secured on all portions of the wave band. The figures shown for the loop and the oscillator where a figure is repeated should be read as minus that figure and plus that figure. This was done to cut out fractional representation of dial settings. For example WGN shows at 35 on the loop and 26 on the oscillator. KOIL shows the same figures. Hence WGN would in practice be 35, while KOIL would be 35 plus. The same would hold true on all settings where values are repeated—otherwise with the Karas micrometric dials the columns would show a large number of quarter, half and three-quarter degree settings.

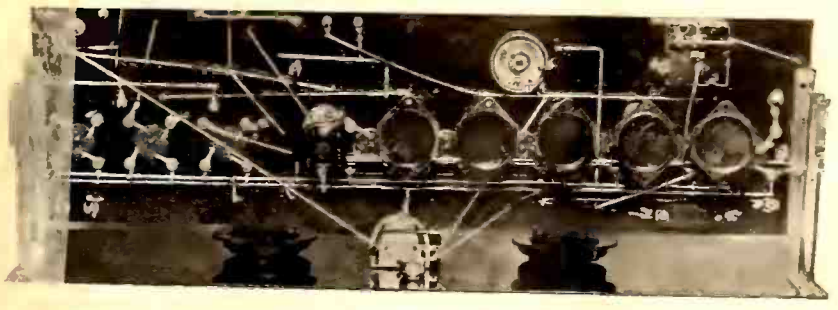
A great deal of credit for the performance of the set is due the designers of the long wave transformers, these units being so carefully matched and peaked at such a good frequency value that none of the usual trouble is encountered in undesired repeat points. The amplification of these transformers is at a value consistent with common sense. In other words all of the grief has been removed before the set builder starts to work; all he has to do is follow instructions faithfully and a corking good super will result. Frankly in reviewing our work on this series we find the present 9 tube model the best performer we have had in the laboratory, having been continuously operated both under good and bad conditions. In each and every case the 9 tuber delivered the goods. Tried side by side with the 8 tube set the new one delivered more volume on KFI with less side noise; it tuned easier and altogether presents a much more attractive and efficient appearance than its predecessor. We do not know of any stronger recommendation for the design than the foregoing.

LOG

KC	Station	Loop	Osc.
1010	KPRC	34	24
1000	WPG	34	25
990	WGN	35	26
980	KOIL	35	26
970	KDKA	36	27
960	CNRR	37	28
950	WGES	38	28
940	WSMB	38	28
930	KOA	39	29
920	WSAI	39	30
910	WJAZ	40	31
900	WBZ	41	32
890	WJAX	42	32
880	KFAB	42	33
870	WLS	43	34
860	WEEI	44	34
850	WWJ	44	35
840	KRLD	46	37
830	WRRS	47	37
820	WHB	47	38
810	WEBH	48	39
800	KTHS	48	40
790	WGY	49	41
780	WGWB	51	43
770	WTAM	51	44
760	WOAI	52	44
750	WHT	53	46
740	KSO	54	47
730	WCRW	55	48
720	WCCO	56	49
710	WLW	57	51
700	WSB	58	52
690	KFKB	59	53
680	WOS	60	54
670	WQJ	61	55
660	WJZ	63	57
650	KMA	64	58
640	KFI	65	58
630	WFAA	66	59
620	WOC	68	61
610	WCFL	70	64
600	WMC	72	64
590	KFQB	73	67
580	WJR	75	68
570	WHO	78	70
560	KYW	81	73
550	KSD	83	76

In operation of the set from the alternating current lines we found no difficulty. The rectifier used (Balkite) is a special unit made for use with the Abox filter. Its output is about three amperes. After passing through the filter there is sufficient filament current to operate up to eleven tubes, although this set only used nine. The power compact is arranged for plugging into the last socket and thereby taking the set output and running it through the 210 power tube. The variable resistances (Carter) permit the desired voltages being set for each individual receiver used. In this case the 45 volt tap was used for all stages except the second audio, while the 90 volt tap was used for the second audio; the plug-in arrangement of the power compact placed 400 volts on the 210 power tube. A tap was also made for the 22 volt section if desired. Part of the resistance strip containing 1000 ohms was used to secure the drop for the grid of the 210 tube.

To further reduce oscillator harmonics readers might try a 75,000 or 100,000 ohm resistance in series with the 45 volt line and the plate of the oscillator. In many instances too much oscillator energy is created at 45 volts, and the added resistance will serve to cut down the oscillator volume thus eliminating a number of harmonics. This scheme also reduces to a minimum amateur code interference where the short wave fundamentals beat with the oscillator harmonics.



Photograph showing under side of the 9 tube set

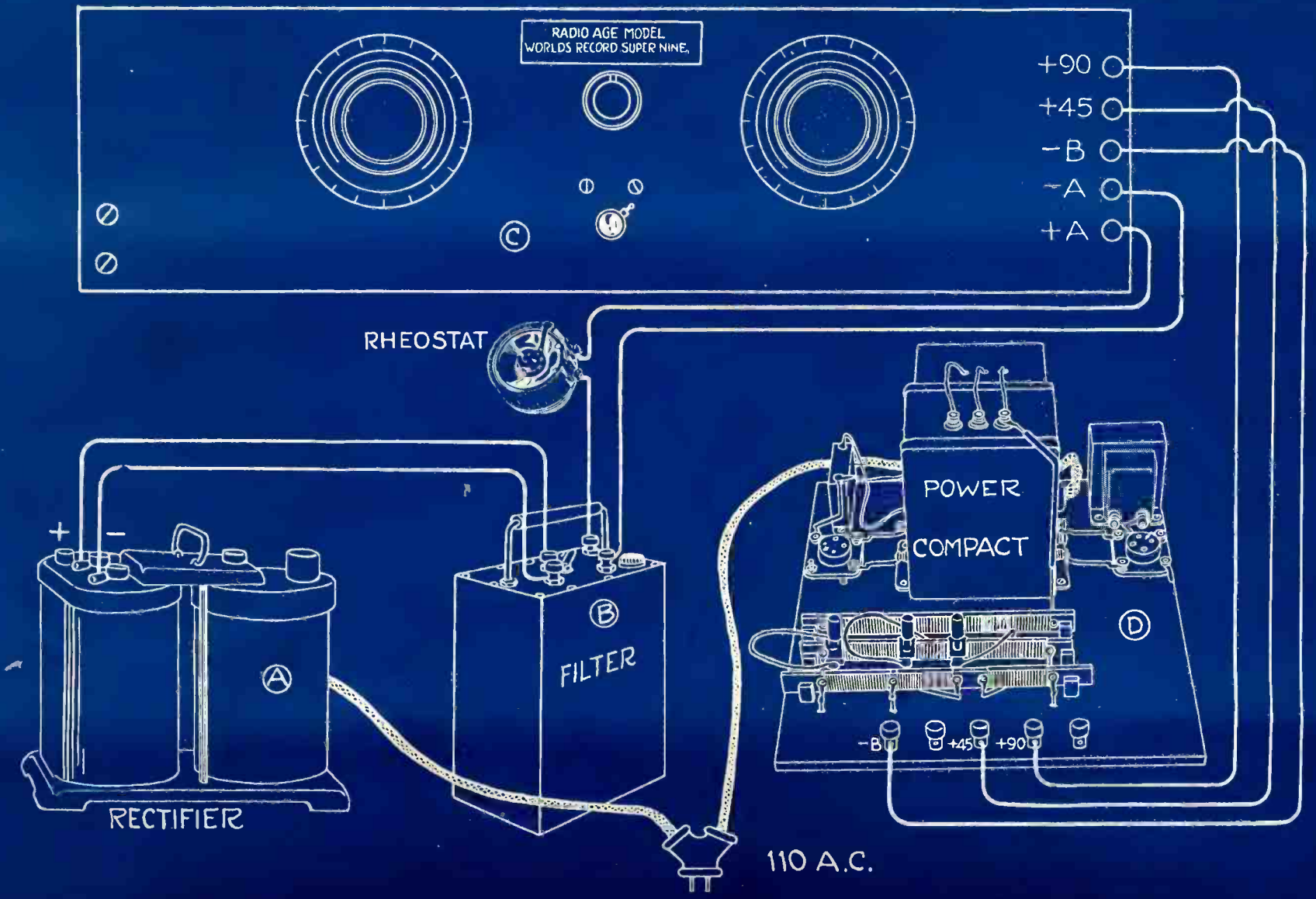


FIG. 3 PICTORIAL REPRESENTATION OF COMPLETE A, B, AND C, ELIMINATION SYSTEM USED WITH WORLDS RECORD SUPER 9

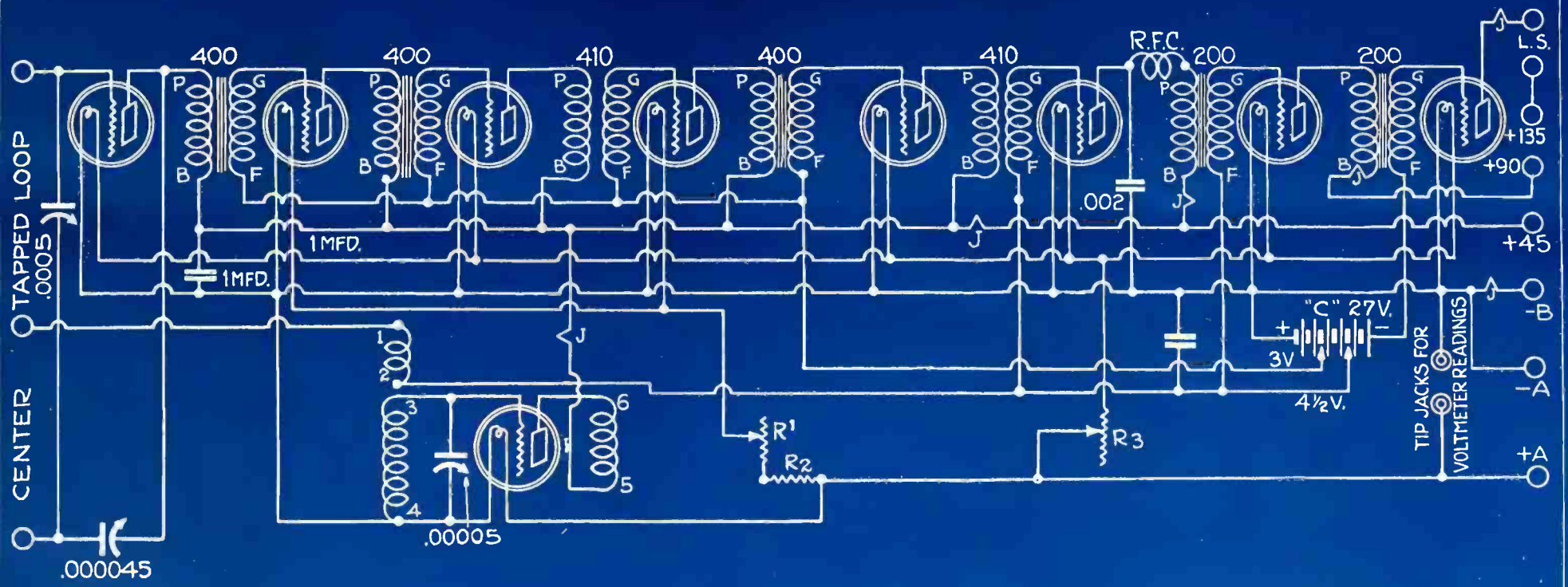


FIG. 4
SCHEMATIC CIRCUIT RADIO AGE
WORLDS RECORD SUPER 9 MODEL

RADIO AGE INC.

SELECTONE TRANSFORMERS

Designed by E. H. Scott whose famous receiver The World's Record Super established four verified world's records for CONSISTENT reception of stations 6,000 to 8,000 miles distant.

Selectone transformers cut through the local stations with ease and their tremendous amplification brings in the distant stations with ample volume and perfect tone quality.

Tested—Perfectly Matched—Guaranteed

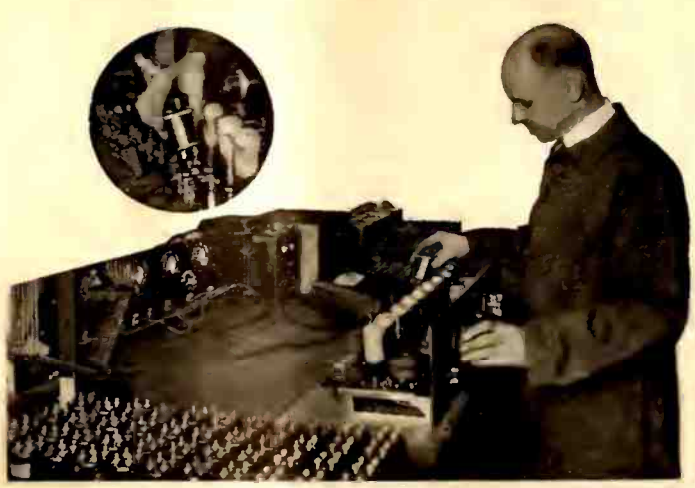
TYPE R.400. Has specially designed iron core which limits stray fields and makes it possible to place transformers quite close together without danger of coupling or causing instability. Coils before sealing in case are vacuum impregnated so that all characteristics of coil remain constant. Price $6.00.

TYPE R.410. A sharply peaked filter transformer that insures remarkable selectivity. The condenser used to tune the primary is sealed inside the case with the coils. This makes it possible to supply a filter that we KNOW is exactly tuned to the peak frequency. Price $6.00.

A Laboratory Product

TESTED AND MATCHED WITH PRECISION EQUIPMENT

To secure maximum amplification and fine tone quality all transformers must be perfectly matched. Selectone transformers are all tested with the finest of laboratory apparatus which enables the peak frequency to be accurately determined within 1-20 of 1%.



Special Testing Receiver

Apparatus for Matching Transformers

All Selectone Transformers Given Air Test

To make absolutely sure that every set of Selectone transformers are perfect in every way—high amplification, selectivity, tone quality—a special test receiver using the standard circuit is used. This is so constructed that a set of transformers can be plugged in as easily and quickly as you insert a tube in a socket.

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For Complete Information

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Kindly send illustrated literature describing in detail Selectone Transformers and tests they undergo, also list of World's DX Records established by World's Record Super 9.

Name.....

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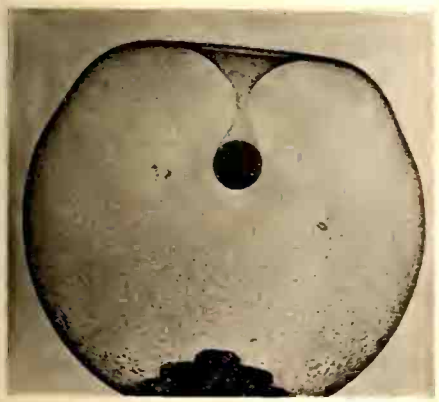
Current Science

Mining Gold With Bubbles

Children's Play-Thing Has Important Role in Mining Industry—Bubble Study Reveals Properties of Light

HAVE you ever studied a soap bubble? Perhaps when you were a child you were fond of playing with a dish of suds and a clay pipe, but the bubble is more than a toy, for grown up scientists at the U. S. Bureau of Standards in Washington have been studying them, even to the point of shooting bullets through them, and photographing them as they break.

The photographing has been done by Dr. Philip P. Quayle, and uses light furnished by an electric spark, so that the bullet and half broken bubble are photographed as clearly as if they were at rest. And from these photographs it has been found that the bubble is not the simple thing that we used to imagine it, but some very complicated processes go on within its walls. Some of these are of considerable practical use, as in the mining industry, where they are used to separate precious metals from the ore.



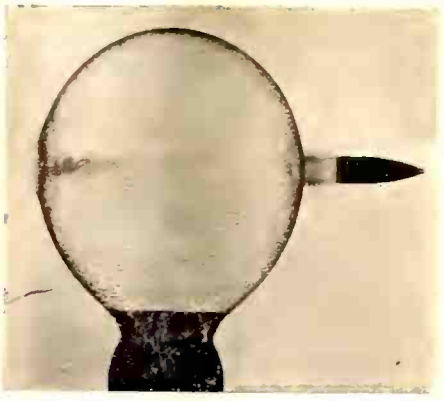
STEEL BALL DROPPED IN A SOAP BUBBLE. This photograph, made about a hundredth of a second after the ball first touched the bubble, shows that it has not yet begun to break, but extends down around the ball like an elastic membrane

DR. PAUL R. HEYL, head of the Sound Laboratory at the U. S. Bureau of Standards, in Washington, who tells of some of the wonders of the soap bubble. Dr. Heyl has also been engaged in a long series of researches to determine the exact force of gravity

Dr. Quayle's work has been in the sound laboratory of the Bureau, which is under the direction of Dr. Paul R. Heyl, whose studies along a different line in a subterranean vault under one of the Bureau's buildings have given a more accurate value of the mass of the earth.

"When a bubble once gives way its complete disappearance is so rapid as to lead to the common impression that it is instantaneous," said Dr. Heyl. "The very rapid spark photographs taken of a breaking bubble by Dr. Qualye shows that the bursting of a bubble is a progressive process, though a very rapid one. Photographs have been obtained of a bubble which has had a bullet fired through it. For a few millionths of a second (long enough to be photographed) the bubble stands as if in amazement with a hole in each side. The holes rapidly increase in size, the water film spraying off at the edges into fine drops, until in a thousandth of a second or so the bubble is gone.

"One of the first things to catch the attention when a bubble has been successfully blown is the shimmering play of colors reflected from its surface. These colors, we notice, are formed somehow in the act of reflection of the colorless light of day from the surface of the bubble. It is possible, with a little practice, to detach the bubble from the pipe by which it was blown, and to catch it upon a piece of cloth, where it may remain for some time. If we closely examine the distribution of colors on such a quiet bubble we may be fortunate enough to see colored bands moving downward from the top of the bubble to the bottom. The north pole of the bubble seems to be the storehouse whence the bubble draws these colors in succession. And if we are excep-



THE BULLET AND THE BUBBLE phtogr aph made in the sound laboratory of the U. S. Bureau of Standards by means of an electric spark, by Philip P. Quayle, showing a soap bubble through which has been fired a rifle bullet. The bullet has passed out of the bubble, but it still stands, with a hole in each side. The lines extending from the front of the bullet are sound waves

tionally lucky we may see at the north pole, just before the bubble breaks, a black spot. It is as if the store of colors had been exhausted.

"It may be perhaps a new idea that anything can be so thin that it cannot reflect light; but the study of thin films such as found in bubbles teaches us that light is not reflected strictly from the surface of bodies, but that it must penetrate a very little way into the substance of the body itself before it can be turned and sent back. Like a motor car, the beam of light requires a little room in which to turn. And if this necessary turning space is not to be found, the light will not be able to turn at all, but will pass through the film and out at the other side.

"This is true in the case of bodies ordinarily considered to be opaque, such as polished surfaces of metal. But even metals are transparent in thin enough layers, as is evidenced by ordinary gold leaf.

"In penetrating the reflecting surface to this minute depth certain qualities characteristic of the reflecting material are impressed upon the light, so that by examining the reflected beam, even many miles away from the reflecting body, we can tell something about the material of the reflector. In fact certain scientists have attempted to gain by this means some idea of the different materials composing the surface of the moon. The moon shines by reflected sunlight, and the idea is that the light reflected from different areas of the moon's surface may, by its characteristically altered quality, betray the nature of the material which has reflected it.

"How thin is this black spot in a bubble, and what sets a limit to it? Why cannot a bubble thin out indefinitely? These questions lead to one of the most interesting things which a bubble can teach us. Water is made up of molecules, particles so inconceivably small that a soap bubble when freshly formed may be many molecules thick. But as the film thins out it is gradually reduced to a thickness of but a few molecules; and obviously this process cannot go on forever. The film cannot be less than one molecule thick. Any further thinning out is bound to break it.

"Every liquid acts as though it were encased in a stretched elastic skin. Liquids in quantities such as are ordinarily handled do not show this property because so much of them is inside and so little on the outside, and the surface properties are masked by the properties characteristic of the inside. But a soap film is nearly all surface, and very little inside, and the contractile property of the surface becomes evident. This contractile property (surface tension is its scientific name) is responsible for a great many happenings in nature. It is the cause of the globular shape of a dew drop, of a rain drop, of water sprinkled on a dusty floor; it causes the ascent of oil in a lamp wick and is responsible for the absorbent property of a towel or of blotting paper. It governs the curious changes of shape in that wonderful little speck of protoplasm called the amoeba, and it is suspected of having much to do with the contraction of a muscle."

But bubbles are useful in everyday life. "They play an important part in modern mining industry," said Dr. Heyl. "Often the valuable mineral is mixed with much rock from which it must be separated. Various methods of concentration are employed to effect this purpose. One which has been developed in comparatively recent years makes use of bubbles to this end. The mineral bearing rock is crushed to a powder and stirred up in water to which a very small amount of a special oil is added. The agitation of this mixture produces a froth of bubbles which rises to the surface, each of these little bubbles bearing attached to itself a particle of mineral, while the worthless rock is left at the bottom of the liquid. This froth is skimmed off, and a valuable concentrate obtained from it. This process is called flotation, and is one of the most important of modern developments in the art of mining.

"And the moral of all this is, as the Duchess might have remarked to Alice, that there is nothing in Nature so simple and commonplace as to be unworthy of our serious attention."

Grid Control Tube Is a New Marvel

A DEVICE more sensitive than anything yet developed in electrical research, a grid tube that operates on an infinitesimal fraction of energy — approximately one-billionth of an ampere—was recently demonstrated.

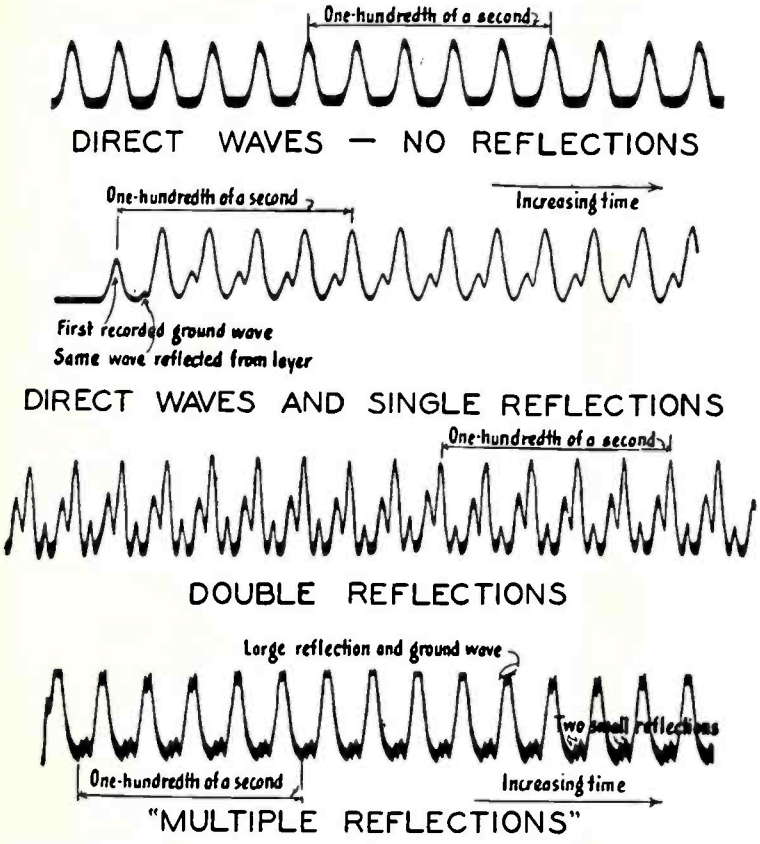
Termed the "grid controlled glow discharge tube" the device, perfected by D. D. Knowles, shown above, a young scientist in the research laboratories of the Westinghouse Company, is so sensitive that a human hand placed near a grid plate is sufficient to operate it. This act causes the tube to glow and discharge energy efficient to actuate a relay.

Analyzed briefly the apparatus consists of three electrodes—a negative electrode and a positive electrode, the latter being surrounded by a grid, which constitutes the third electrode. Differing from the ordinary vacuum tube, this glow tube has no heated filament and therefore does not consume any energy when not operated. If a voltage is applied between the positive and negative electrodes particles of electricity called "free electrons" attach themselves to the grid. When this grid is thoroughly insulated these minute charges of electricity cannot escape, thus preventing the tube from passing any current.

When a spectator's hand nears the plate a means is thereby provided for removing the small charges of electricity. The result is that the tube immediately passes a current large enough to operate commercial relays.

Some Light On Radio Transmission

INVESTIGATIONS conducted by Dr. Breit and Dr. Tuve, of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington, during 1926, throw much light on the peculiarities of radio transmission. For nearly a quarter of a century it has been supposed that there is a layer in the upper air that is a good conductor of magnetic energy. It is believed that the layer contains free ions and electrons which may have emanated from the sun, and that it is the presence of these that makes it a good conductor. Dr. Breit and Dr. Tuve have not only experimentally demonstrated that such a layer exists, but they have measured its effective height above the earth and learned somewhat of how it affects transmission. Other investigators also have obtained good evidence of the existence of the layer, for example, Messrs. Taylor and Hulbert, in the United States, and Messrs. Smith-Rose and Barfield, in England.



The Highest Hump in Each of These Cases Is Made by Waves Along the Shortest Path; the Smaller Humps and some of the Irregularities Are Caused by Reflections

The Assumptions

It has been suggested that if there were such a layer, the upper portions of a given radio wave would move through the earth's atmosphere at a greater velocity than the lower portions of the same wave where conductivity is not so good. In consequence, it was thought, the top of the wave front would be accelerated beyond that of the lower part, causing the wave to bend forward, ultimately bringing it to the earth. Ocean waves toppling over forward as they approach the beach crudely illustrate what was thought to be one effect of this conducting layer in the upper air. According to theory, the layer acted as a "ceiling" bending or reflecting radio waves back to earth.

The investigators reasoned that if this theory were correct, then a receiver at a given point on the earth's surface would record at least two pulses for every pulse at the sending station. One of these would reach it by a direct horizontal path through the air; the other would travel by way of the "ceiling," reaching the receiving station as an "echo" or "reflection." They reasoned further that if this were the case then the reflected wave, since it traversed a greater distance, would reach the receiver a little later than the direct wave, and that this difference in time might be measured.

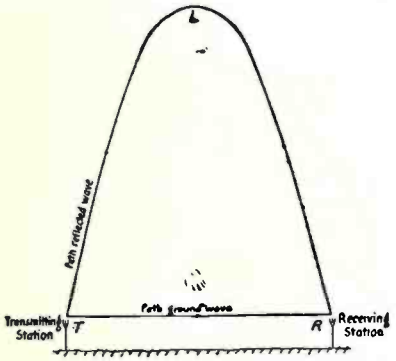


Diagram Showing How Existence and Height of Conducting Layer Were Determined

The Experiment

To test these assumptions the investigators set up a receiving station, R, 8 miles from the transmitting station, T. Interrupted trains of waves were sent from T, each train having a duration of about 1/1000 of a second. At the receiving end the signals were detected, amplified and recorded by photographing the tracings made by an oscillating marker.

The photographic records showed conclusively that under certain circumstances each signal was registered twice, and that, in accordance with the assumption, there was an appreciable interval of time between them. In this manner, through a series of experiments extending over many months, a technique was developed which enabled the investigators to demonstrate experimentally that a transmitted signal, depending upon conditions, reached the receiving station by two paths: the direct path, TR, and the path by way of the "ceiling," TLR. Furthermore, knowing the distance between stations and knowing the retardation of the reflection and the speed of radio waves, the height of the layer was readily computed and found to be

about 100 miles, though it appeared to rise and fall during the period observed within a range of from 50 to 130 miles.

Although these experiments do not tell whether radiowaves are actually reflected or refracted by the layer, they do explain some of the peculiarities of transmission.

"Fading," for example, one of the chief woes of the radio fan, is seen to be due not alone to interference between ground and reflected waves but to changes in the height of the layer and in its effectiveness as a reflecting surface. The measurements obtained by the investigators showed that these changes are often very sudden. They also indicated that variations may take place with the season and with the time of day, the layer probably being at a greater height in fall than in summer and in the afternoon than in the morning.

Again, the character of the reflecting or refracting surface would naturally affect the quality of the reflected waves. A bumpy or corrugated surface would tend to produce "multiple reflections," causing interference, confusion and even "fading" where waves happen to neutralize one another.

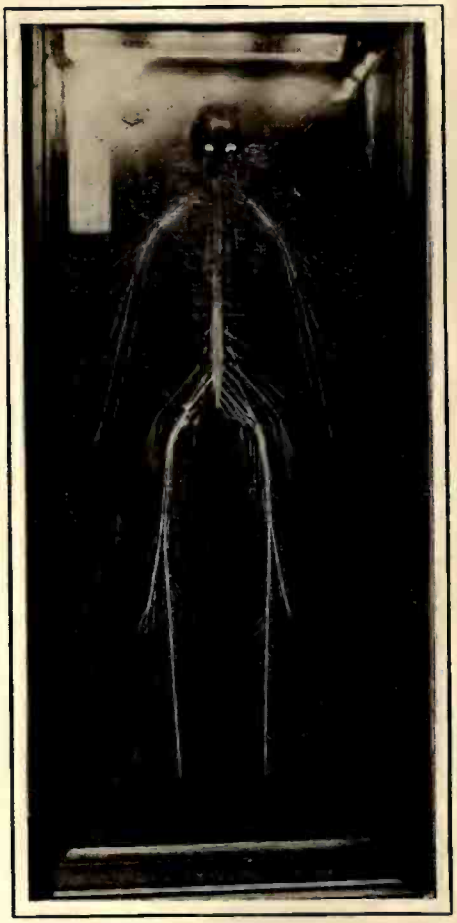
For a long time scientists have been trying to learn what the forces are which surround the earth, circulate within its interior, and penetrate its atmosphere. Gradually progress is being made. It is now clear, for example, that the earth itself is surrounded by a magnetic field. It has also been shown that the sun has a magnetic field similar to that of the earth. It is probable that all celestial bodies are surrounded by such fields. Indeed, it has been suggested that every large rotating mass, such as the earth, in a manner not yet determined, is an electro-magnet causing magnetic force. Verification of the existence of a conducting layer in the upper air is another notable step forward in man's effort to understand and master the Titanic forces which surround him.

The existence of this layer has additional significance in the possibility that its movements in the earth's magnetic field may induce electric currents which, in turn, may have far-reaching effects. Again, the motion of the layer as a whole may affect the condition of the lower atmosphere producing important changes in electric pressure. The Department of Terrestrial Magnetism of the Carnegie Institution of Washington, among other research agencies, is vigorously attacking these problems in its laboratories at Washington.

The experiments described herein were made with the cooperation of the Naval Research Laboratory, the Radio Corporation of America, the American Telephone and Telegraph Company, the Westinghouse Electric and Manufacturing Company, and the Bureau of Standards. The possibilities of the importance of the ionization of the upper atmosphere were pointed out first by Professor A. E. Kennelly, of the United States, and later among others, by Oliver Heaviside, of England.

Freezing Helium Gas

A DUTCH scientist has announced to the scientific world that he had at last succeeded in freezing the gas, helium, in the form of a transparent mass. At a temperature of 7 degrees F. above absolute zero (452 degrees below zero F.), and a pressure of about 150 atmospheres, or 2175 pounds per square inch, liquid helium solidifies. And at a temperature of about 2 degrees above absolute zero, a pressure of only 400 pounds per square inch sufficed. In all probability, helium would solidify at ordinary atmospheric pressure, about 14.7 pounds per square inch, at a still lower temperature. However, the temperatures attained in the above experiments were the lowest ever reached. Absolute zero has never been attained. There is good reason to assume that at that point the molecules of a gas would have no motion, and, hence, it is the coldest that it is possible for any substance to reach.—PETER J. M. CLUTE.



Model Nervous System

Rufus B. Weaver, former member of the faculty of the Hahnemann Medical College has just completed an outline of the entire human nervous system, requiring three months of intensive work. The white lines shown here in the model are the nerves and the major nerve centers of the human body are indicated

Automatic Aerial Camera

Developed by the Fairchild Aerial Camera Corporation and the United States Army Air Service principally for military purposes, the new automatic aerial camera which takes a continuous series of pictures, records the time they are taken, the angle of the camera to the ground, the altitude, the number of exposures and other particulars has just been completed. The great value of the camera lies in wartime in the fact that it may be placed in a fast single-seater plane, best suited to withstand attack, and automatically record enemy positions. It is able to map out 180 square miles of territory without reloading

Earth's Axis Wabbles 20 Feet Per Year

By S. R. WINTERS

THE earth's axis may shift or wabble from its mean position as much as a total of 30 feet during the course of a year, the Naval Observatory states as the result of observations of the variations in latitude, which studies have been in progress for eleven years. The shifting of the pole in the earth from its mean position, however, has averaged about 20 feet each year during the last ten years, with the greatest variation in latitude occuring in 1915.

A vertical photographic zenith tube, the only instrument of its kind in the world, is employed in determining the variations in latitude. These observations are made each cloudless night of the year, when the stars are exposed to view, this work being under the direct supervision of Capt. F. B. Littell, Mathematics, U. S. Navy. The observing instrument is housed in a small building on the grounds of the Naval Observatory, at 34th and Massachusetts Avenue, Northwest, Washington, D. C. This institution, where the time signals originate, is under the direction of Captain Edwin T. Pollock, U. S. Navy.

The variation of latitude observations are published annually in *The Astronomical Journal,* the compilation comprising about sixteen pages, in which is detailed the date of each observing night, the name of the observer, the number of stars observed, and the variations in latitude as noted by means of the observing instrument —the photographic zenith tube, which was designed by Dr. Frank E. Ross, a noted astronomer. These tables showing the variations of latitude for the last eleven years is the corroboration of a new theory, it is said. This theory, advanced by Captain E. J. J. See, an astronomer of the Navy at Mare Island, attributes the shifting or wabbling of the earth's axis from its mean position to tidal waves in the Pacific, Atlantic and Indian Oceans. The Naval Observatory tables, together with similar results obtained at other astronomical observatories, furnish corroboration of his theory which is said to explain the origin of

Capt. F. B. Litell, Naval Osbervatory Astronomer. operating the vertical zenith tube for observing wabbling of earth's axis

the displacements which cause them.

This novel theory, is supported by new proof, according to this naval astronomer, that the tides originating in the Pacific Ocean, and propagated as a world wave through the Indian and Atlantic Oceans, are the cause of the variation of the latitude with the observed circulation of the earth's pole about its mean position in 427 days. The Naval Observatory, it is pointed out, is not the father of this theory but its variation of latitude observations were used by Professor See, in his astronomy studies at Mare Island, for promulgating this new conception of the wabble of the earth's position. The shifting of the pole in the earth was originally discovered, it is stated, in 1890 at the Bonn Observatory of Germany, but during the intervening 36 years no scientist produced proof as to the cause of this wabbling.

Now, according to Professor See, his studies have traced the motion of the earth's axis to the tides originating in the ocean hemisphere with the pole at New Zealand—the tidal relief being through the passage south of Australia. This mystery, according to this Government astronomer at Mare Island, has challenged the scientists of the world for more than a third of a century. Furthermore, he contends, that his new theory gives plausible reasons for believing that the rigidity of the nucleus or center of the earth is three times as great as formerly thought. Its rigidity, he states, is twice that of the hardest nickel-vanadium steel used in the armor plate of a battleship. The text of Professor See's statement follows:

"It has not heretofore been given out that I found that the careful height of the tides, treated as world waves in motion, actually is over twice the average height calculated by the equilibrium theory of Newton. This great advance discloses to us a new law of nature, not heretofore even suspected to exist. Thus the new mathematical theory will mark a notable improvement in all directions, and clear up completely one of the most difficult of all the branches of physical science.

"One of the greatest improvements relates to the new method for calculating the rigidity of the earth, which at once supersedes the methods of Lord Kelvin, Sir George Darwin and S. S. Hough. Instead of the nucleus of our globe having a rigidity equal to that of standard steel, we find by definite and very exact calculation that the rigidity is three times that heretofore accepted. By carefully separating the yielding due to the tidal oscillations of the oceans from that of the nucleus of the earth, if any, we prove that the nucleus shows no yielding whatever so that its rigidity comes out twice that of the hardest nickel-vanadium steel used in armor plate.

"As the earth is now known to have existed in quiescent equilibrium for billions of years, with the internal particles everywhere adjusting themselves mutually under the enormous pressure acting on all sides, this great rigidity of the nucleus will not surprise the experienced natural philosopher, but it will forever put a stop to any further discussion of liquid in the interior of the globe. It is not only solid throughout, but twice as rigid as armor plate."

See Hoover at End of Telephone Line

ACTUAL television, several times attended with indifferent success, has become an established fact with the recent test between New York and Washington which enabled Bell Telephone engineers and executives to talk to and see Herbert Hoover, who was seated before one of the experimental television machines in Washington. The image cast, while not perfect in all respects, was clear enough to easily distinguish features. The apparatus is shown in the accompanying picture.

This feat, coupled with the recent inauguration of the trans-Atlantic

telephony system via radio, and the April 18 experiments at Whippany, N. J., when station 3XN, operating on 191 meters, transmitted voice and images over a single carrier, brings television to its highest form. The band of 20,000 cycles was used for the transmission of the image and a 5,000 cycle band for the speech.

Heretofore the chief obstacle in television has been the thought that perhaps it would not be possible to duplicate wire channel conditions over an ether wave, but the Bell Telephone experiments at Station 3XN seem to settle that question favorably. With the image and speech bands combined in a single carrier via radio the last barrier to the complete usefulness of television has been swept away.

Waste of Energy Reduced in New Power Plant

A REMARKABLE engineering accomplishment has been announced by the Columbia Gas and Electric Corporation, of Cincinnati. Electric power from the new power station of that city has been produced so efficiently that one kilowatt-hour of electric power is made, on the average, from a single pound of coal. Among the greatest wastes in the industrial world is the waste of the energy of coal in the course of transforming it into electricity or other useful forms. According to physical theory one pound of average coal contains enough energy to produce about four kilowatt-hours of electric power, which is enough to operate an ordinary electric lamp three hours each evening for about three weeks. Unfortunately, however, the best combinations of steam boilers and engines and electric dynamos which the world's engineers have been able to devise cannot save much more than one-fifth of this energy which theory indicates that the coal possesses. The remaining four-fifths goes off up the chimney as smoke or is wasted in other ways. Ordinary steam engines and small electric power plants do not save even as much as one-fifth of the coal's energy. A saving of one-eighth to one-tenth is much more common. The new Cincinnati plant, by its record of one pound of coal for one kilowatt-hour of power, shows itself to be saving about one-fourth of the theoretical energy of the coal.

Anger and Fear Make Blood Sweeter

THAT anger makes the human body sweet, not sour, is the conclusion of recent experiments by a German physician, Dr. W. M. Hackebusch. A very minute amount of the kind of sugar called grape sugar is usually present in human blood. Slight variations of the amount of sugar from time to time are now used by physicians as an aid in the diagnosis of disease. Dr. Hackebusch aroused various emotions, such as anger or fear, in the human subjects of his experiments. He then drew off a small sample of the blood for a sugar test. In all instances the amount of sugar was found to be noticeably greater during and after a fit of emotion than it had been beforehand. This fact supplies additional confirmation of the theory, now widely held by students of the human body, that such emotions as fear or anger are intended by Nature to prepare the body for either combat or flight. Sugar in the blood is known to provide a quick food for the muscles. The higher percentage of blood sugar during anger thus provides the muscles with more food in case it becomes desirable to fight or to run away.

"Spring Fever" Blamed on Lack of Vitamines

THAT minor diseases, like colds and mild fevers and rheumatic twinges, are much more frequent during the winter months than in summer is well known to all dwellers in the cooler parts of the earth. That this fact may be explainable by an absence of vitamines in winter foods was suggested to the British Science Master's Association recently by Dr. R. A. Peters. Vitamines are the mysterious substances which are present in green vegetables, fresh milk and some other fresh foods and which are known to be important to health, although none of them has been isolated, as yet, by the chemists. Some of these vitamines, notably the one present in cod liver oil, are now believed to be related to sunlight. There is apt to be a deficiency of vitamines during the winter, Dr. Peters told the Science Masters, both because there is less sunlight then and because fresh foods and green vegetables are then more difficult to obtain. This lack of vitamines may react on the general health, he thinks; producing the general debility which used to be called "Spring fever" because it began to be noticeable when the long winter was closing. In that weakened condition the body is more easily attacked by disease germs and by minor ailments of any kind.

WE ARE particularly desirous of calling our readers' attention to the leading article in this month's issue on the absorbing subject of "trouble shooting on a super." The article was written to cover almost every type of a super so no matter which type you built the hints on locating faults might be applicable. It might also be of interest to read the remarks on the testing of tubes to determine their emission value; that article is also in the forward part of this issue.

IF YOU want to add considerably to the appearance of your set, have the panel engraved after you have drilled all the necessary holes. The engraving adds materially to the looks of the set and gives a better impression to your visitors. You can even have your own name engraved in modest characters on the front panel—try it once and you'll be surprised at the difference.

K. Y. W. Adds Features

The Congress Carnival from KYW has recently taken on a new character, for the entire hour and a half is now presented as a production with new features each Saturday. John Clark, the chief announcer, in collaboration with Wilson Wetherbee, and Ed Barroff, writes a series of swiftly changing scenes with musical backgrounds, and highlights—and calling for many entertainers. The popular melodies are featured, together with a few classics by way of musical contrast, and this type of program is proving its worth. According to the KYW announcer, it takes a "little of this, and a little of that," and a high speed program to keep the dials from turning.

New Microammeter For Testing Lamps

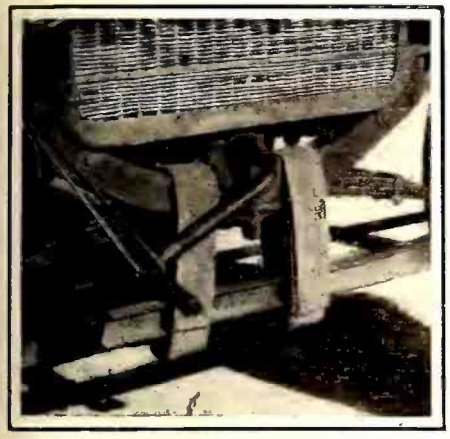
AN INSTRUMENT that indicates a change in current as small as a tenth of a thousandth of a millionth part of an ampere has been developed in the standardizing laboratory of the West Lynn works of the General Electric Company as a part of the equipment which replaces the human eye in making tests on incandescent lamps, currents in insulators, radio tubes, etc. The instrument, known as a thermionic microammeter, has a full-scale reading of a tenth of a millionth of an ampere, with subdivisions of one five-hundredth of this amount. It is the most sensitive instrument of such a long scale length working on jewel bearings that has ever been built.

The lamp divisions of the General Electric Company at Harrison, N. J., and Cleveland have combined this microammeter with the photoelectric cell in the development of photometric apparatus which is far more susceptible to variations in intensity of light than is the human eye.

A Quartz Crystal Motor Runs by Radio

A NEW variety of electric motor, of great scientific interest although not apt to prove revolutionary in practical power production, was described to the Institute of Radio Engineers recently in a paper by the distinguished German radio engineer, Dr. A. Meissner, of the Telefunken Company, in Berlin. The rotating part of the new motor is a small plate cut from a crystal of quartz, ordinarily called rock-crystal. When placed in a radio circuit, in which electric currents are surging back and forth many thousands of times a second, this small quartz plate is set into rapid rotation. Unless it is held in place by some kind of fixed axis, like the shaft of a flywheel, the crystal will jump entirely out of its socket. The effect is explained by Dr. Meissner as due to winds of air created by the vibration of the crystal. It is well known to radio engineers that small quartz plates like this are set into mechanical vibration when placed in radio circuits.

Everyday Mechanics



Expensive cars sometimes come equipped with snubbers which prevent the body of the car from bouncing too high. But the light, cheap car seldom knows them.

Tom Chase, who lives in the Rio Grande Valley of Texas decided that he could prevent excessive bouncing over the country roads in his Ford by putting homemade snubbers on the front end of the car. He found a piece of old thresher belt in the farm shop and split two strips from it, each two inches wide. The belt was 5 ply and good and stiff.

Each strip was long enough to run over the front end of the frame and under the front axle, with one inch to spare and allowance for a five inch splice. Ordinary harness rivets were used to hold the ends together.

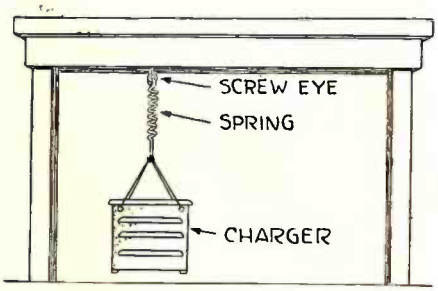
In two years of service, these snubbers have not given away and they do pay. They not only prevent broken front springs (before the snubbers were installed, three front springs were broken in 6 months) but they save wear and tear on the car and kill a lot of unwelcome jolting

Self Starter for Planes

An airplane engine equipped with a self-starter is the newest aid to the aviator. The apparatus, which was invented by C. F. Heywood, of Detroit, Mich., weighs less than twenty pounds and will enable the pilot to take off with the least possible delay and without necessitating an assistant to turn the prop. The engine is turned into firing position by compressed air and forces a properly carbureted mixture of gas into the cylinder. Mr. Heywood, the inventor, is shown demonstrating the device

STOPPING CHARGER VIBRATION

Battery chargers are often quite a nuisance because of the vibration from them being transmitted through the floor and walls of the house. By using the little scheme outlined above, you can take advantage of the very convenient "over night" charge, and be in no danger of disturbing anyone's slumber.



Secure a strong wire to each of the four corners of the charger case. These can be attached by running them through the ventilating holes. All four wires are joined and fastened to a door spring. The charger is then hung from a large screw eye under the table, it need not clear the floor by more than an inch or so. See illustration.—J. C. Heberger.

200-Pound Electric Roadster

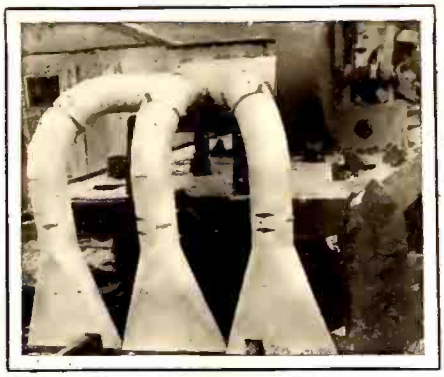
A light electric roadster, weighing 200 pounds and measuring 62 inches from hub to hub, is being exhibited at the New York Edison Company's show. The machine is designed for short trips about town and is equipped with wire wheels, balloon tires and is extremely easy to operate. A motor drives the rear wheels by a gear train and a storage battery supplies the power for a thirty mile run without recharging

This neat and tidy structure reposes beside the kitchen door of a home in Texas. It was built at the same time as the house and is integral with house and stoop.

The walk extends around to the right hand end of this structure and a door at this end opens upon a compartment two feet wide, four feet high and four feet long. It is ideal for keeping not only over shoes, rubbers and boots from weather, but also provides storage for small tools.

Care should be taken to concrete the floor and have this several inches above the surrounding ground so that it will always tend to remain dry. The roof slopes away from the house and the upper edge of the roofing paper sets under one of the siding boards so that no water can possibly drip inside.

Practically every farm home needs this sort of a small structure for taking care of the odds and ends that would otherwise accumulate around the kitchen door. The cost cannot be accurately estimated, but it should not run to more than $10 or $12 when made from new material entirely, whereas if built from scrap lumber or material at hand, it would cost only the amount of time required to build it



New R. R. Track Cleaner

Walter M. Spring, a research engineer, has invented a vacuum cleaner for trap-rock roadbeds which is said to save millions yearly for railroads. This machine mounted on a railroad car will clean a railroad bed of cinders and refuse at the rate of thirty miles an hour. It consists of three galvanized suction chambers, the bases of which run just above the rails and the ground. Photo shows the machine in action

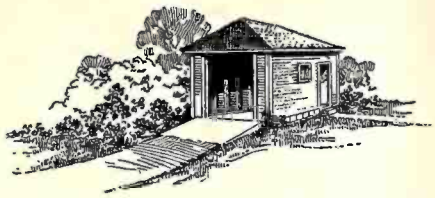
How To Build Your Garage

BILL HOLDEN insists that he got more fun and genuine "kick" out of building his garage than he did the day be beat his boss on the links. That may be a point which will vary according to individual standpoint. But Bill did save some money and if he enjoyed the work, why so much the better.

Although our profession may be far from driving nails, most of us do enjoy making something if for no other reason than to do something different. If you need a garage, there is no reason in the world why you can't arm yourself with a few tools (if you don't already have them) chat with the lumberman, spend a few dollars, then put those boards together yourself. You'll save approximately half the cost, and it will be fun. A garage, well made and of good appearance, is an asset to any home which adds much more than its actual cost to the value of the place.

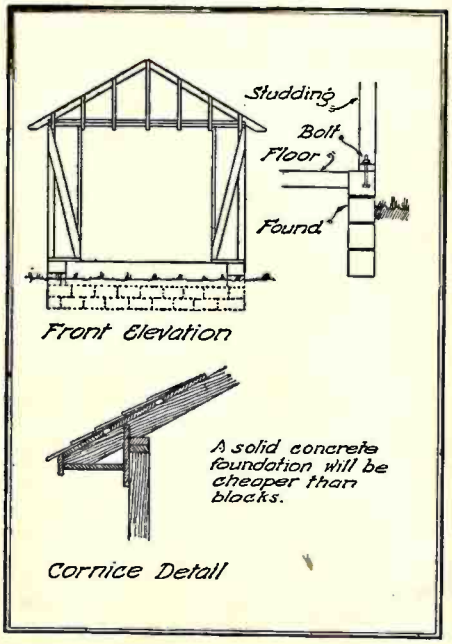
Space won't let us give you the bill of materials and caution keeps us from stating even the approximate cost of this garage, but you can get these figures from your local dealer. In most communities the materials for the garage shown will not exceed $125.00 and you may find that the total will be under this. Yet the structure would cost twice this to have done.

Except in unusual cases, all garages, regardless of exterior finish, are made of frame. First of all comes the foundation. This should extend to below the frost line. Dig your trench then set the blocks in line and cement them together with a mortar made of ½ part lime to 2 parts cement to 4 parts screened sand. Or you can save some of this expense and build forms of lumber (sheathing will do) spaced five or six inches apart and fill to the top, carefully leveled, with cement mortar mixed to the proportions of one part cement to three parts sand to four parts crushed rock. If the solid wall is used, be sure to reinforce the corners with woven wire or iron rods. Have the foundation top several inches above normal ground level.



The garage pictured on this page is twelve feet wide and eighteen feet long. If your car is small, this space will leave enough room for a small bench at the rear. If your car is large, by all means add two feet to the length so that the bench can be installed. Here you can make most of the home repairs as well as those minor ones required for the auto. The really ambitious home owner, craving the use of tools for spare time can well afford to even add enough to the length for a small room in which a small, but rather complete shop will be possible with an electric motor to turn the small machines. A small heater will come in handy during cold weather, or you can get a wash boiler, pipe it for the exhaust from the car and run the outlet outside. The engine exhaust then will in this way heat the room.

When the foundation is finished off, quarter inch bolts, eight inches long, should be set in the top, spaced four feet apart along the sides and where necessary at the ends. Otherwise the building may be shaken slightly ajar at some time.



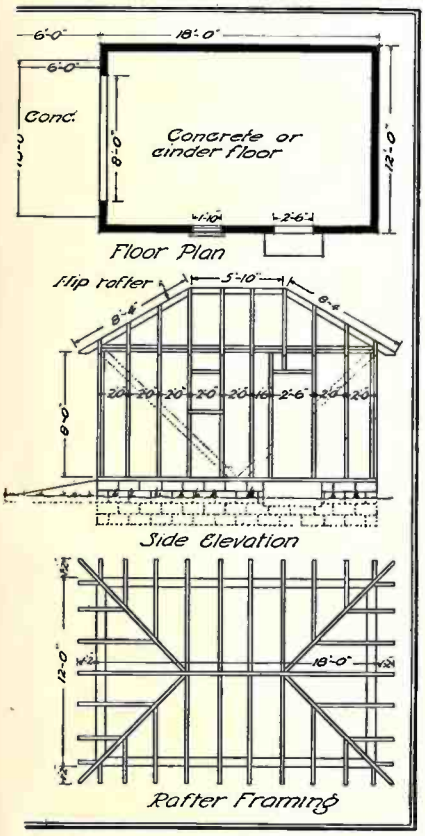
After the sills have been bolted down the studding, spaced two feet on center, are erected as shown, excepting the space for the front and side doors. The corner posts should be of doubled two by four inch pieces, nailed together. Note that in the front, bracing is accomplished by one by four inch boards, mortised into the studding flush with the surface. The dotted lines of the side elevation show how additional bracing can be used if deemed necessary.

The plates are also of doubled two by four inch pieces. The studding are eight feet long, giving a height of approximately eight feet, six inches from foundation top to the top of the wall. The type of roof shown required three kinds of rafters and several cuts which must be accurate, but this roof is one hundred per cent better looking than the regular roof and will cost only about $10 more. The pitch used is one third with the rafters spaced two feet on centers. You can tell just how these are cut and fitted from the rafter framing plan shown. The ends project fourteen inches past the garage walls and the cornice framing detail, also shown, shows how the finish pieces finally fit together to render a pleasing appearance.

Sheath the roof, spacing the boards one inch apart and cover with shingles or prepared roofing. The sides are sheathed and then covered with siding or stuccoed, depending upon the finish of the home. A novel and wholly suitable garage wall can be made by leaving off the sheathing from the sides, but bracing well and then covering with metal lath which are coated with two or three coats of stucco. Then the inside is finished with a gypsum product to render it fire-safe. This also makes the room as neat and tidy as you would wish at only a little greater cost. Moreover you now have a dead-air space in the walls which is important during cold weather. The inside will also be cooler in summer, particularly if you use the sheet product for the ceiling by nailing cross-members from one

side to the other at the top of the walls.

In placing the window, set the sill cut from a two by six inch piece, as shown, then fit the window between the studding. If you wish to be able to open the window, omit the upper two by four inch cross piece, and place stop strips with holes for the sash lock so that it can be raised or lowered.



Don't attempt to build your own front doors, unless you are skilled with tools and feel lucky. Instead, consult your hardware merchant and order through him a set of doors already built, together with the track and fixtures. The other door can be bought through regular local channels and should be hinged to open outward.

Build a concrete stoop or small platform outside the side door then build also the concrete approach with the top leading up to the floor line and the lower edge disappearing beneath the drive. This should be thick enough to prevent cracking and a few strips of woven wire for reinforcing will help a lot.

Cinders will do for the floor inside, but concrete will be much more satisfactory. Make the floor at least four inches thick and to prevent cracking, divide into six foot sections with lath on edge between. Later these lath are to be removed and hot asphalt poured in for expansion joints. Of course the ground must be well tamped down before the floor is placed, particularly if you have added any fill.

For only a little extra expense you can build a pit forward two feet of the center of the floor. Make the walls of concrete four inches thick and have the inside dimensions at least two feet wide by four feet long and three feet deep. A plank cover with cleats on the under side to fit over the opening will cover it up when not in use. This pit will help a lot when you are working under the car.

If finished in wood, put on a filler coat at once, then two coats of paint to match the house. A green stain on the roof, if it is of shingles, will, also help wonderfully.

Magnet Saves Eyesight

The ingenuity of Captain George W. Jansson and Radio Operator W. R. Walston, of the S. S. Tomalva, in making an improvised electro-magnet saved the sight of Sailor Peter Kruif's right eye. Kruif was suffering excruciating pain from particles of iron that had penetrated the iris of his right eye while he was using a drill and the only way to extract the iron particles was by using an electro magnet. The ship having no magnet aboard Captain Jansson and Walston made one by winding 150 turns of wire around an iron nail and charging the coil with electricity from the ship's radio set. With use of the improvised electro magnet the particles were removed and the sight of Kruif's eye saved. Dr. Carroll Francus, of the S. S. American, banker, also helped in the operation when he informed Captain Jansson of the Tomalva by radio to discontinue cocaine treatments that were being applied to Kruif's eye

How To Make that Garden Fence

THAT plot of ground may look desolate and unkempt as it is, but a nifty white garden fence, easily made and not very expensive, will make it look like a million dollars, more or less. Clever real estate men have spent a few dollars in this way and made a sale that represented ten dollars' profit for every dollar invested in lumber. Thrifty home owners, desiring a new location or a different home, have used the same idea and made it pay.

Whether you want to sell or not, you can enhance the appearance and increase the cold cash value of your place with a suitable fence around the garden plot. There are designs aplenty, and one which will fit the architecture of the house. But as important as the style of fence chosen, is the care to be taken in building it right—against rot, sagging, and depreciation.

The usual fence is held in place by wooden posts. These should be creosoted to at least five or six inches above the ground line. The creosote should be applied hot and if not dipped in the heated solution, several

while it is filled with a rather rich mixture of cement. By all means, reinforcing rods should be extended through the form from one end to the other. For a square post, four rods should be used. Triangular strips, nailed into the form corners will give the chambered effect shown, if this is wanted.

The combination pipe-and-concrete post is also desirable, and is neat and attractive. The pipe, of galvanized iron preferably two and one-half or even three inches in diameter, is set in a footing of concrete. The pipe can later be filled with concrete also. Before the pipe is set, you should know what type of fence you will build and then drill holes through the column where necessary for the supporting panel bolts.

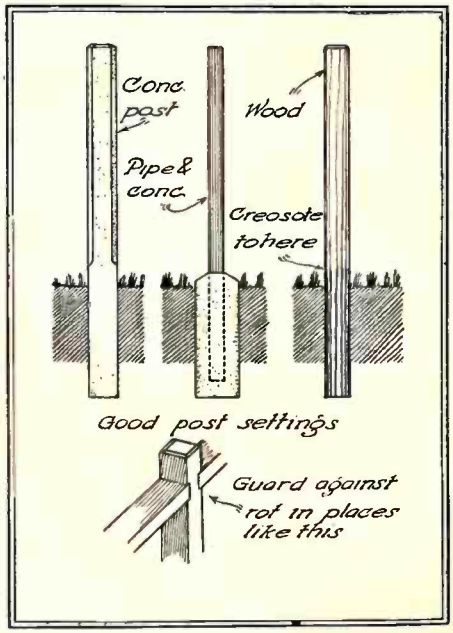
Figure1 1 also shows a common rot center. Paint protects against rot, but it is hard to get at places which retain moisture for a long time. The only real protection against rot in such places is to paint the pieces before assembly. If desired, creosote can be used instead, and then the whole painted after the fence has been completed.

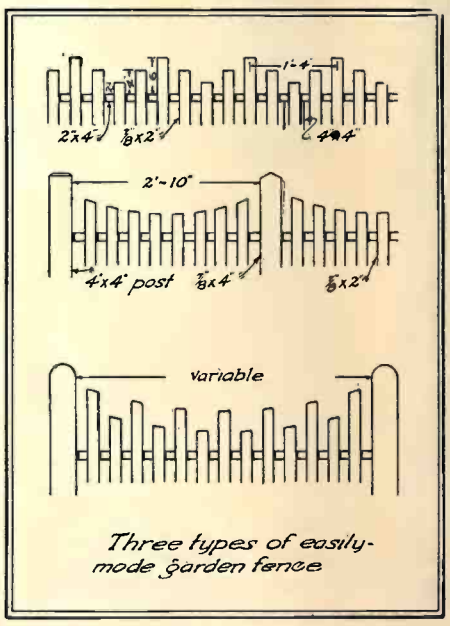
Figure 2 shows three popular and distinctive types of garden fence which can be achieved with a supply of pine strips, saw and hammer. With a little imagination you can evolve no end of designs from this one type of material. At the top we see a simple design consisting only of pickets of three different lengths. the lower ends all being on the same level. While the illustrations shows only a short section, each panel should be from ten to twelve feet long. Each panel then, will require enough of the pickets to cover the distance, plus two two by four inch pieces of the proper length, and two posts set in line.

These pickets are cut from 7/8 inch stock, are two inches wide and of the desired length. The width can be reduced slightly if you wish so two pickets can be ripped from a four inch board, or three from a six inch board.

The center design is more ornate and, besides the pickets, a four inch board is used at the center of each panel. The lower design is another variation with pickets of two heights forming a pleasing curve at the top.

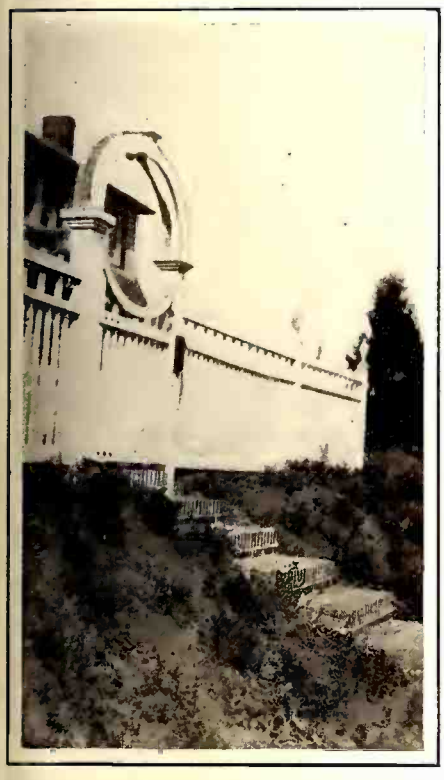
ber, squared and held in position





Three types of easily-mode garden fence

Although clear pine is the favorite garden fence material, pecky cypress is superior because it does, without the help of paint if necessary, withstand the inroads of rot. A home done in a gray stucco, or painted a neutral gray, will match ideally a pecky cypress fence because in a short time the wood, unadorned with paint, will assume a weathered gray effect, too. Of course the application of paint will give you any color you want.



Some very attractive fences are made from poles and saplings, with the bark left on. Figure 3 shows a detail of such a fence which has been in use seven years and is now almost buried with rambler roses. Yet here and there the rustic fence shows through, thus lending that much-to-be-desired effect. The pieces are mortised and tenoned together, a spoke shave having been used to form the tenons. Here, however, creosote or paint must be used, else the wood will quickly rot off at the joints.

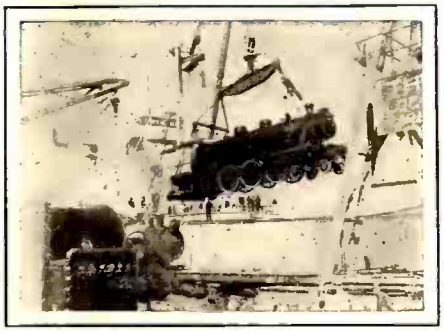
A more elaborate, and costly fence is shown at figure 4. The home is of brick, and the fence was made from brick which were left. It completely isolates the enclosure and gives a feeling of privacy from curious-minded folks. The walls are broken with posts at regular intervals and the top is finished with a simple design in brick that doubles its attractiveness.

Sketch out, if you will, your several choices of designs, then figure the length and breadth of the plot to be enclosed. These two dimensions will determine your panel width. Allowance must be made for one, or two gates. Figure five shows a simple but ornate gate which happens to be the entrance to the front of an exclusive Lincoln, Neb., home.

Just what type of fence you finally decide to build is not important. Making sure that you are protecting it against rot and depreciation, is. Now go ahead and enjoy making it!

Langley Joins Crosley

Powel Crosley, Jr., (left) President of the Crosley Radio Corporation and his newly appointed Assistant, Ralph H. Langley. Mr. Langley developed the first airplane transmitter several years ago and he is considered one of the leading scientists in radio industry. In his new capacity Mr. Langley will be Mr. Crosley's technical adviser. For the past six years Mr. Langley had been in charge of receiving set development for the General Electric Company



Locomotives on Vessel

The S S "Beljeane" at the Eddystone wharf of the Baldwin Locomotive Company at Philadelphia loading a cargo of 44 completely erected locomotives for shipment to Rio de Janeiro, the largest shipment of locomotives ever put on board one vessel. Three electric cranes are being used for the lifting of the engines from the rails to the deck of the steamer

Correct List of Broadcast Stations

KDKA	Westinghouse Electric & Mfg. Co.	E. Pittsburgh, Pa.	309
KDLR	Radio Electric Co.	Devils Lake, N. D.	231
KDYL	Intermountain Bdcstg Corp.	Salt Lake City, Utah	247
KELW	Earl L. White	Burbank, Calif.	535
KEX	Western Broadcasting Company	Portland, Ore.	447
KFAB	Nebraska Buick Auto Co.	Lincoln, Neb.	341
KFAD	Electrical Equipment Co.	Phoenix, Ariz.	273
KFAF	A. E. Fowler	San Jose, Calif.	217
KFAU	Independent School Dist.	Boise, Idaho	280
KFBB	F. A. Buttrey & Co.	Havre, Mont.	275
KFBC	W. Z. Azbill	San Diego, Cal.	380
KFBK	Kimball-Upson Co.	Sacramento, Calif.	535
KFBL	Leese Bros.	Everett, Wash.	224
KFBS	School District No. One	Trinidad, Colo.	238
KFBU	Bishop N. S. Thomas	Laramie, Wyo.	375
KFCB	Nielson Radio Supply Co.	Phoenix, Ariz.	238
KFCR	Santa Barbara Broadcasting Co.	Santa Barbara, Calif.	413
KFDD	St. Michael Cathedral	Boise, Idaho	275
KFDM	Magnolia Petroleum Co.	Beaumont, Texas	316
KFDX	First Baptist Church	Shreveport, La.	236
KFDY	South Dakota State College	Brookings, S. D.	300
KFDZ	Harry O. Iverson	Minneapolis, Minn.	231
KFEC	Meier & Frank	Portland, Ore.	252
KFEL	Eugene P. O'Fallon, Inc.	Denver, Colo.	254
KFEQ	Scroggin & Co.	St. Joseph, Neb.	268
KFEY	Bunker Hill & Sullivan	Kellogg, Idaho	233
KFFP	First Baptist Church	Moberly, Mo.	242
KFGQ	Boone Biblical College	Boone, Iowa	300
KFH	Hotel Lassen	Wichita, Kans.	268
KFHA	Western State College of Colo.	Gunnison, Colo.	252
KFHL	Penn College	Oskaloosa, Iowa	240
KFI	E. C. Anthony, Inc.	Los Angeles, Calif.	467
KFIF	Benson Polytechnic Institute	Portland, Ore.	248
KFIO	North Central High School	Spokane, Wash.	272
KFIQ	First Methodist Church	Yakima, Wash.	256
KFIU	Alaska Electric Light & Power Co.	Juneau, Alaska	226
KFIZ	Commonwealth Reporter	Fond du Lac, Wis.	273
KFJB	Marshall Electric Co.	Marshalltown, Iowa	248
KFJF	National Radio Mfg. Co.	Oklahoma City, Okla.	261
KFJI	E. E. Marsh	Astoria, Ore.	246
KFJM	University of North Dakota	Grand Forks, N. D.	278
KFJR	Ashley C. Dixon & Son	Portland, Ore.	263
KFJY	Tunwall Radio Co.	Fort Dodge, Iowa	246
KFJZ	W. E. Branch	Ft. Worth, Tex.	254
KFKA	Colo. State Teachers College	Greeley, Colo.	273
KFKB	J. R. Brinkley	Milford, Kan.	434
KFKU	The University of Kansas	Lawrence, Kans.	275
KFKX	Westinghouse Elec. & Mfg. Co.	Hastings, Neb.	288
KFKZ	State Teachers College	Kirksville, Mo.	225
KFLR	University of New Mexico	Albuquerque, N. M.	254
KFLU	San Benito Radio Club	San Benito, Texas	236
KFLV	Swedish Evangelist Church	Rockford, Ill.	229
KFLX	George Roy Clough	Galveston, Texas	240
KFMR	Morningside College	Sioux City, Iowa	261
KFMX	Carlton College	Northfield, Minn.	337
KFNF	Henry Field Seed Co.	Shenandoah, Ia.	461
KFOA	Rhodes Department Store	Seattle, Wash.	454
KFOB	KFOB, Inc.	Burlingame, Calif.	225
KFON	Nichols & Warriner, Inc.	Long Beach, Calif.	233
KFOR	Tire & Electric Co.	David City, Neb.	226
KFOT	College Hill Radio Club	Wichita, Kans.	231
KFOX	Tech. High School	Omaha, Nebr.	248
KFOY	Beacon Radio Service	St. Paul, Minn.	252
KFPL	C. C. Baxter	Dublin, Texas	252
KFPM	The New Furniture Co.	Greenville, Texas	242
KFPR	Los Angeles County Forestry Dept.	Los Angeles, Cal.	231
KFPW	St. Johns M. E. Church	Carterville, Mo.	258
KFPY	Symons Investment Co.	Spokane, Wash.	273
KFQA	The Principia	St. Louis, Mo.	261
KFQB	Lone Star Bdcast Co.	Fort Worth, Texas	508
KFQD	Anchorage Radio Club	Anchorage, Alaska	300
KFQU	W. E. Riker	Holy City, Calif.	231
KFQW	C. F. Knierim	Seattle, Wash.	216
KFQX	Alfred M. Hubbard	Seattle, Wash.	210
KFQZ	Taft Products Co.	Hollywood, Calif.	226
KFRB	Hall Bros.	Beeville, Texas	248
KFRC	Don Lee, Inc.	San Francisco, Calif.	268
KFRU	Stephens College	Columbia, Mo.	500
KFSD	Airfan Radio Corp.	San Diego, Calif.	246
KFSG	Echo Park Evan. Assn.	Los Angeles, Calif.	275
KFUL	Thomas Groggan & Bros.	Galveston, Texas	258
KFUM	W. D. Corley	Colorado Springs, Colo.	240
KFUO	Concordia Seminary	St. Louis, Mo.	545
KFUP	Fitzsimmons General Hospital	Denver, Colo.	234
KFUR	Peery Bldg. Co., Inc.	Ogden, Utah	224
KFUS	Louis L. Sherman	Oakland, Calif.	256
KFUT	University of Utah	Salt Lake City, Utah	263
KFVD	Chas. & W. J. McWhinnie	Venice, Calif.	208
KFVE	Benson Broadcasting Corp.	St. Louis, Mo.	240
KFVG	First M. E. Church	Independence, Kans.	236
KFVI	Headquarters Troop, 56th Cavalry	Houston, Texas	240
KFVN	Carl E. Bagley	Fairmont, Minn.	227
KFVR	Olinger Corporation	Denver, Colo.	244
KFVS	Cape Girardeau Battery Sta.,	Cape Girardeau, Mo.	224
KFVY	Radio Supply Co.	Albuquerque, N. M.	250
KFWB	Warner Bros. Pictures	Hollywood, Calif.	252
KFWC	L. E. Wall	San Bernardino, Calif.	291
KFWF	St. Louis Truth Center	St. Louis, Mo.	214
KFWH	F. Wellington Morse, Jr.	Eureka, Calif.	254
KFWI	Radio Entertainments, Inc.	San Francisco, Calif.	250
KFWM	Oakland Educational Society	Oakland, Calif.	326
KFWO	Lawrence Mott	Avalon, Calif.	211
KFWU	Louisiana College	Pineville, La.	238
KFWV	KFWV Studios	Portland, Ore.	213
KFXB	Bertram C. Heller	Los Angeles, Calif.	353
KFXD	Service Radio Co.	Logan, Utah	205
KFXF	Pike's Peak Broadcasting Co.	Denver, Colo.	430
KFXH	Bledsoe Radio Company	El Paso, Texas	242
KFXJ	R. G. Howell	near Edgewater, Colo.	216
KFXR	Classen Film Finishing Co.	Oklahoma City, Okla.	214
KFXY	Harry M. Costigan	Flagstaff, Ariz.	205
KFYF	Carl's Radio Den	Oxnard, Calif.	214
KFYJ	Chronicle Pub. Co. (Portable)	Houston, Tex.	238
KFYR	Hoskins-Meyer, Inc.	Bismarck, N. Dak.	248
KGA	Northwest Radio Service Co.	Spokane, Wash.	341
KGAR	Tucson Citizen	Tucson, Ariz.	244
KGBS	A. C. Dailey	Seattle, Wash.	227
KGBU	Alaska Radio Co.	Ketchikan, Alaska	229
KGBX	Foster Hall Tire Co.	St. Joseph, Mo.	348
KGBY	Dunning & Taddikon	Shelby, Nebr.	203
KGBZ	George R. Miller	York, Nebr.	333
KGCA	C. W. Greenley	Decorah, Iowa	280
KGCB	Wallace Radio Institute	Oklahoma, Okla.	331
KGCG	Moore Motor Co.	Newark, Ark.	234
KGCH	Wayne Hospital	Wayne, Nebr.	434
KGCI	Liberty Radio Sales	San Antonio, Texas	240
KGCL	Louis Wasmer	Seattle, Washington	238
KGGN	Concordia Bdcstg. Co.	Concordia, Kansas	210
KGCR	Cutler's Broadcasting Service	Brookings, S. D.	252
KGCU	Mandan Radio Ass'n	Mandan, N. D.	285
KGCX	First State Bank	Vida, Mont.	240
KGDA	Home Auto Co.	Dell Rapids, S. D.	254
KGDE	Jaren Drug Co.	Barrett, Minn.	232
KGDJ	R. Rathert	Cresco, Iowa	203
KGDM	V. G. Koping	Stockton, Calif.	217
KGDO	C. H. & Henry Garrett	Dallas, Tex.	285
KGDP	Boy Scouts of America	Pueblo, Colo.	261
KGDR	Radio Engineers	San Antonio, Tex.	240
KGDX	William Erwin Antony	Shreveport, La.	291
KGDY	J. Albert Loesch	Oldham, S. Dak.	210
KGDW	Frank J. Rist,	Humboldt, Nebr.	242
KGEF	Trinity Methodist Church	Los Angeles, Calif.	517
KGEH	Eugene Broadcast Station	Eugene, Oregon	236
KGEK	Beehler Elect. Equipment Co.	Yuma, Colo.	252
KGEL	Ernest W. Ellison	Jamestown, N. D.	225
KGEN	E. R. Irey & F. M. Bowles	El Centro, Calif.	281
KGEO	Raymond D. Chamberlain	Grand Island, Nebr.	271
KGEQ	Fred W. Herrmann	Minneapolis, Minn.	330
KGER	C. Merwin Dobyns	Long Beach, Calif.	326
KGES	Central Radio Electric Co.	Central City, Nebr.	205
KGEU	L. W. Clement	Lower Lake, Calif.	222
KGEW	City of Fort Morgan	Fort Morgan, Colo.	256
KGEY	J. W. Dietz	Denver, Colo.	204
KGEZ	Flathead Broadcasting Assn.	Kalispell, Mont.	352

Tyrman Branches Out

E. TYRMAN, formerly president of the High Frequency Laboratories of Chicago, has severed his connection with the old company, and organized the Tyrman Electric Corporation with headquarters at 208 South LaSalle St., Chicago, Ill.

Mr. Tyrman will be remembered as the sponsor of the Nine-in-line.

Man—Know Thy Tubes!

(Continued from page 10)

an average tube the difference in readings at the voltage shown above should be 4.2 milliamperes. Tubes giving this reading, or readings slightly under it, may be considered as A-1. If the readings fall much below that figure, the tube should be reactivated.

In this last process, the rejuvenator is plugged in the light socket; a tube inserted, the switch is thrown on the flashing voltage for 45 seconds, then turned to the baking charge for 10 minutes. At the end of that time the tube, if it is any good at all, will again have its emission restored to the average difference value shown in the table herewith.

Especially if the listener is using filament operation from the light socket, he should test his tubes at least once a month, or oftener if desired, to see that none have fallen by the way in the course of operation. Such a method will give the fan first hand knowledge on the condition of his tubes and will probably cut down to a great extent the volume of the "trouble shooting mail" with which the radio industry has had to contend since its inception.

Full directions for use of either the checker or the reactivator are furnished by the makers with their products. Users of super-hets of all classes and vintages would do well to spend a portion of their money on these two instruments which will help them keep the favorite receiver pepped up to its maximum all the time.

Radio on Trains

Time passes quickly on the trains of the Canadian National Railways. Forty parlor and observation cars operating from the Atlantic to the Pacific have been equipped with 800 sets of headphones and with loudspeakers. The number of headsets in a car ranges from 12 to 40, according to the type of coach. A new compartment car being built will have two sets of earphones in each compartment. A central radio receiver supplies them all with music from different cities in Canada and the United States

KGFB	A. G. Dunkel	Iowa City, Ia.	224
KGFF	Earl E. Hampshire	Alva, Okla.	205
KGFG	Full Gospel Church	Oklahoma City, Okla.	384
KGFH	Frederick Robinson	La Crescenta, Calif.	219
KGFI	M. L. Eaves	Fort Stockton, Texas	220
KGFJ	Ben S. McGlashan	Los Angeles, Calif.	218
KGFK	Kittson County Enterprise	Hallock, Minn.	225
KGFL	Trinidad Broadcasting Co	Trinidad, Colo.	222
KGFM	Geo. W. Johnson	Yuba City, Calif.	450
KGFN	Haraldson & Thingstad	Aneta, North Dakota	222
KGFP	Mitchell Broadcast Co.	Mitchell, South Dakota	263
KGO	General Electric Co.	Oakland, Calif.	361
KGRC	Gene Roth & Co.	San Antonio, Texas	315
KGRS	Gish Radio Service	Amarillo, Tex.	234
KGTT	Glad Tidings Tabernacle, Inc.	San Francisco, Cal.	207
KGU	Marion A. Mulrony	Honolulu, Hawaii	270
KGW	Oregonian Publishing Co.	Portland, Ore.	492
KGY	St. Martins College	Lacey, Wash.	278
KHJ	Times-Mirror Co.	Los Angeles, Calif.	405
KHQ	Louis Wasmer	Spokane, Wash.	395
KICK	Atlantic Automobile Co.	Anita, Ia.	273
KJBS	J. Brunton & Sons Co.	San Francisc, Coalif.	220
KJR	Northwest Radio Service Co.	Seattle, Wash.	384
KKP	City of Seattle, Harbor Dept.	Seattle, Wash.	260
KLDS	Reorganized Church of Jesus Christ, Independence, Mo.		441
KLIT	Lewis Irvine Thompson	Portland, Ore.	380
KLS	Warner Brothers	Oakland, Calif.	250
KLX	Tribune Publishing Co.	Oakland, Calif.	508
KLZ	Reynolds Radio Co.	Denver, Colo.	384
KMA	May Seed & Nursery	Shenandoah, Iowa	461
KMED	W. J. Virgin	Medford, Ore.	250
KMIC	J. R. Fouch	Inglewood, Calif.	387
KMJ	Fresno Bee	Fresno, Calif.	234
KMMJ	M. M. Johnson Co.	Clay Center, Nebr.	229
KMO	Love Electric Co.	Tacoma, Wash.	250
KMOX	Voice of St. Louis	St. Louis, Mo.	280
KMTR	Radio Corp.	Hollywood, Calif.	372
KNRC	C. B. Juneau	Santa Monica, Calif.	238
KNX	Los Angeles Express	Los Angeles, Calif.	337
KOA	General Electric Co.	Denver, Colo.	322
KOAC	Oregon Agriculture College	Corvallis, Oreg.	280
KOB	N. Mex. College of Agric.	State College, N. Mex.	349
KOCH	Omaha Central High School	Omaha, Neb.	258
KOCW	Oklahoma College for Women	Chickasha, Okla.	270
KOIL	Mona Motor Oil Co.	Council Bluffs, Iowa	306
KOIN	KOIN, Inc.	Portland, Ore.	319
KOLO	Gerald K. Hunter	Durango, Colo.	355
KOMO	Fisher's Blend Station, Inc.	Seattle, Wash.	306
KOWW	Frank A. Moore	Walla Walla, Wash.	285
KPCB	Pacific Coast Biscuit Co.	Seattle, Wash.	521
KPJM	Wilburn Radio Service	Prescott, Ariz.	215
KPNP	Central Radio Co.	Muscatine, Iowa	256
KPO	Hale Bros., Inc.	San Francisco, Calif.	428
KPPC	Pasadena Presbyterian Church	Pasadena, Calif.	229
KPRC	Houston Printing Co.	Houston, Texas	297
KPSN	Star-News	Pasadena, Calif.	316
KQW	First Baptist Church	San Jose, Calif.	333
KQV	Doubleday-Hill Electric Co.	Pittsburgh, Pa.	275
KRAC	Caddo Radio Club	Shreveport, La.	220
KRE	Berkeley Daily Gazette	Berkeley, Calif.	256
KRLD	Dallas Radio Laboratories	Dallas, Tex.	357
KRLO	Freeman Lang & A. B. Scott	Los Angeles, Calif.	440
KROW	Oregon Broadcast Co.	Portland, Ore.	231
KROX	N. D. Brown	Seattle, Wash.	265
KRSC	Radio Sales Corp.	Seattle, Wash.	500
KSAC	Kansas State Agricultural College	Manhattan, Kans.	341
KSBA	W. G. Patterson	Shreveport, La.	261
KSD	Pulitzer Publishing Co.	St. Louis, Mo.	545
KSCJ	The Journal	Sioux City, Iowa	444
KSEI	Broadcasting Association	Pocatello, Idaho	261
KSL	Radio Service Corp.	Salt Lake City, Utah	300
KSMR	Santa Maria Valley Railroad	Santa Maria, Calif.	283
KSO	Berry Seed Co.	Clarinda, Iowa	405
KSOO	Sioux Falls Bdcst. Ass'n.	Sioux Falls, S. D.	360
KTAB	Associated Broadcasters	Oakland, Calif.	303
KTAP	Robert B. Bridge	San Antonio, Texas	263
KTBI	Bible Institute	Los Angeles, Calif.	294
KTBR	M. E. Brown	Portland, Ore.	263
KTCL	Amer. Radio Tel. Co.	Seattle, Wash.	306
KTHS	New Arlington Hotel	Hot Springs, Ark.	375
KTNT	N. Baker	Muscatine, Iowa.	333
KTUE	Uhalt Electric	Houston, Texas	263
KTW	First Presbyterian Church	Seattle, Wash.	454
KUJ	Puget Sound Broadcasting Co.	Seattle, Wash.	352
KUOA	University of Arkansas	Fayetteville, Ark.	300
KUOM	University of Montana	Missoula, Mont.	244
KUSD	University of South Dakota	Vermillion, S. D.	278
KUT	University of Texas	Austin, Texas	273
KVI	Puget Sound Broadcasting Co.	Tacoma, Wash.	342
KVOO	Southwestern Sales Corp.	Bristow, Okla.	375
KVOS	L. Kessler	Seattle, Wash.	333
KWBS	Schaeffer Mfg. Co.	Portland, Ore.	200
KWCR	H. F. Parr	Cedar Rapids, Iowa	296
KWG	Portable Wireless Telegraph Co.	Stockton, Calif.	248
KWKC	Wilson Duncan Studios	Kansas City, Mo.	236
KWLC	Luther College	Decorah, Iowa	431
KWSC	State College of Washington	Pullman, Wash.	349
KWTC	J. W. Hancock	Santa Ana, Calif.	261
KWUC	Western Union College	Le Mars, Iowa	252
KWWG	Chamber of Commerce	Brownsville, Texas	278
KXL	KXL Broadcasters	Portland, Ore.	400
KYA	Pacific Broadcasting Corp.	San Francisco, Calif.	400
KYW	Westinghouse Electric & Mfg. Co.	Chicago, Ill.	535
KZM	Preston D. Allen	Oakland, Claif.	240
WAAD	Ohio Mechanical Institute	Cincinnati, Ohio	258
WAAF	Chicago Daily Drovers Journal	Chicago, Ill.	278
WAAM	Isaiah R. Nelson	Newark, N. J.	263
WAAT	F. V. Bremer	Jersey City, N. J.	235
WAAW	Omaha Grain Exchange	Omaha, Nebr.	384
WABB	Harrisburg Radio Co.	Harrisburg, Pa.	204
WABC	Atlantic Broadcasting Corp.	New York, N. Y.	316
WABF	Markle Broadcasting Corp.	Pringleboro, Pa.	411
WABI	1st Universalist Church	Bangor, Me.	240
WABO	Hickson Electric Co., Inc.	Rochester, N. Y.	278
WABP	Keystone Broadcast Co.	Philadelghia, Pa.	261
WABR	Scott High School	Toledo, Ohio	263
WABW	College of Wooster	Wooster, Ohio	207
WABX	Henry B. Joy	Mt. Clemens, Mich.	246
WABY	John Magaldi, Jr.	Philadelphia, Pa.	242
WABZ	Colis Place Baptist Church	New Orleans, La.	275
WADC	Allen T. Simmons	Akron, Ohio	258
WAFD	Albert P. Parfet	Detroit, Mich.	312
WAGN	R. L. Miller	Royal Oak, Mich.	275
WAGS	Willow Garage, Inc.	Sommerville, Mass.	250
WAIT	A. H. Waite & Co.	Taunton, Mass.	229
WAIU	American Insurance Union	Columbus, Ohio	294
WALK	Albert A. Walker, Portable	Bethayres, Pa.	285
WAMD	Raddison Radio Corp.	Minneapolis, Minn.	244
WAOK	A. H. Andreasen	Ozone Park, N. Y.	248
WAPI	Alabama Polytechnic Institute	Auburn, Ala.	461
WARC	American Radio & Research	Medford, Mass.	261
WARS	Amateur Radio Specialty Co.	Brooklyn, N. Y.	295
WASH	Baxter Laundry Co.	Grand Rapids, Mich.	256
WATT	Edison Elec. Illum. (Portable)	Boston, Mass.	244
WBAA	Purdue University	W. Lafayette, Ind.	273
WBAC	James Milliken University	Decatur, Ill.	270
WBAK	Pennsylvania State Police	Harrisburg, Pa.	275
WBAL	Consolidated Gas & Power Co.	Baltimore, Md.	246
WBAP	Carter Publication, Inc.	Ft. Worth, Tex.	476
WBAW	Waldrum Drug Co.	Nashville, Tenn.	236
WBAX	John H. Stenger, Jr.	Wilkes-Barre, Pa.	256
WBBC	Brooklyn Bdcstg. Corp.	Brooklyn, N. Y.	268
WBBL	Grace Covenant Presbyterian Church	Richmond, Va.	229
WBBM	Atlass Investment	Chicago, Ill.	225
WBBP	Petoskey High School	Petoskey, Mich.	238
WBBR	People's Pulpit Assoc	Rossville, N. Y.	416
WBBW	Ruffner Junior High School	Norfolk, Va.	222
WBBY	Washington Light Inf.	Charleston, S. C.	268
WBBZ	C. L. Carrell	(Portable), Chicago, Ill.	216
WBCN	Foster & MacDonnell	Chicago, Ill.	266
WBES	Bliss Electrical School	Takoma Park, Md.	222
WBET	Boston Transcript Co.	Boston, Mass.	384
WBKN	Arthur Faske	Brooklyn, New York	291
WBMC	Malbrook Co.	Woodside, N. Y.	294
WBMH	Braun's Music House	Detroit, Mich.	353
WBMS	G. J. Schowerer	North Bergen, N. J.	224
WBNY	Baruschrome Corp.	New York, N. Y.	322
WBOQ	Atlantic Bdcst. Corp.	Richmond Hill, N. Y.	236
WBRC	Birmingham Broadcasting Co.	Birmingham, Ala.	248
WBRE	Baltimore Radio Exchange	Wilkes-Barre, Pa.	231

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912.

Of RADIO AGE, published monthly at Mount Morris, Illinois, for April, 1927.

State of Illinois } ss.
Connty of Cook }

Before me, a Notary Pnblic in and for the State and county aforesaid, personally appeared Frederick A. Smith, who, having been duly sworn according to law, deposes and says that he is the President of the RADIO AGE, Inc., and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management(and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, RADIO AGE, Inc., Frederick A. Smith, President, 500 N. Dearborn St., Chicago, Ill.; Editor, Frederick A. Smith, 500 N. Dearborn St., Chicago, Ill.; Managing Editor, Frederick A. Smith, 500 N. Dearborn St., Chicago, Ill.; Business Manager, M. B. Smith, 500 N. Dearborn St., Chicago, Ill.

2. That the owner is: (If owned by a corporation, its name and address mnst be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member must be given.) RADIO AGE, Inc., 500 N. Dearborn St., Chicago, Ill; Frederick A. Smith, 500 N. Dearborn St., Chicago, Ill.; M. B. Smith, 500 N. Dearborn St., Chicago, Ill.; J. H. Lohbeck, 6429 Cates Ave., St. Louis, Mo.

3. That the known bondholders, mortgagees, and other secnrity holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and secnrity holders as they appear npon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fidnciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear npon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other secnrities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the six months preceding the date shown above is..... (This information is required from daily publications only.)

FREDERICK A. SMITH,
Editor.

Sworn to and subscribed before me this 1st day of April, 1927.
(SEAL) AMANDA FRIIS.
My commission expires Mar. 5. 1929.

Permanent Electrification

ELECTRIFICATION that lasts for years, perhaps indefinitely, has been achieved by a prominent Japanese physicist.

In his experiments, he has taken a simple wax mixture, melted it and allowed it to harden while in a strong electrostatic field between two metal plates, with the result that the wax cake retains a strong electric charge permanently. Some of these cakes prepared in this way have kept their charge nearly ten years, and show no signs of losing it. In some instances, a surface charge of 120,000 volts per square inch has been retained by the wax cakes.

A complete rearrangement of the atoms in the wax is believed to be the secret of this phenomenon, and further investigation and research may result in important changes in the theory of the atom.—Peter J. M. Clute.

WBRL	Booth Radio Laboratories	Tilton, N. H.	420
WBRS	Universal Radio Mfg. Co.	Brooklyn, N. Y.	394
WBSO	Babson's Statistical Org.	Wellesley Hills, Mass.	242
WBT	Charlotte Chamber of Commerce	Charlotte, N. C.	275
WBZ	Westinghouse Elect. & Mfg. Co.	Springfield, Mass.	333
WBZA	Westinghouse Elect. & Mfg. Co.	Boston, Mass.	333
WCAC	Connecticut Agricultural College	Mansfield, Conn.	275
WCAD	St. Lawrence University	Canton, N. Y.	263
WCAE	Kaufman & Baer Co.	Pittsburgh, Pa.	461
WCAJ	Nebraska Wesleyan University	University Pl., Nebr.	254
WCAL	St. Olaf College	Northfield, Minn.	337
WCAM	City of Camden	Camden, N. J	337
WCAO	Monumental Radio Inc.	Baltimore, Md.	275
WCAR	Southern Radio Corp.	San Antonio, Texas	263
WCAT	School of Mines	Rapid City, S. Dak.	240
WCAU	Universal Broadcasting Co.	Philadelphia, Pa.	278
WCAX	University of Vermont	Burlington, Vt.	250
WCAZ	Carthage College	Carthage, Ill.	246
WCBA	Charles W. Heimbach	Allentown, Pa.	254
WCBD	Wilbur Glenn Voliva	Zion, Ill.	345
WCBE	Uhalt Radio Co.	New Orleans, La.	263
WCBH	University of Mississippi	Oxford, Miss.	242
WCBM	Hotel Chateau	Baltimore, Md.	229
WCBR	C. H. Messter	Providence, R. I.	234
WCBS	H. L. Dewing, Portable	Providence, R. I.	242
WCCO	Washburn-Crosby Co.	Anoka, Minn.	416
WCFL	Chicago Fed. of Labor	Chicago, Ill.	492
WCFT	Knights of Pythias Home	Tullahoma, Tenn.	252
WCGU	C. G. Under	Lakewood, N. J.	351
WCLO	C. E. Whitmore	Camp Lake, Wis.	231
WCLS	WCLS Inc.	Joliet, Ill.	214
WCMA	Culver Military Academy	Culver, Ind	258
WCOA	City of Pensacola	Pensacola, Fla.	252
WCOC	Crystal Oil Co.	Columbus, Miss.	265
WCOM	172nd Field Artillery	Manchester, N. H.	252
WCOT	Jacob Conn	Olneyville, R. I.	265
WCRW	Clinton R. White	Chicago, Ill.	411
WCSH	Congress Square Hotel Co.	Portland, Maine	500
WCSO	Wittenberg College	Springfield, Ohio	248
WCWK	Chester W. Keen	Fort Wayne, Ind.	234
WCWS	Bridgeport Bdcst. Sta. (Portable)	Bridgeport, Conn.	232
WCX	Detroit Free Press	Pontiac, Mich.	517
WDAD	Dad's Auto Accessories, Inc.	Nashville, Tenn.	225
WDAE	Tampa Daily Times	Tampa, Fla.	273
WDAF	Kansas City Star	Kansas City, Mo.	366
WDAG	J. Laurence Martin	Amarillo, Texas	263
WDAH	Trinity Methodist Church	El Paso, Texas	268
WDAY	Radio Equipment Corp.	Fargo, N. Dak.	261
WDBE	Gilham Electric Co., Inc.	Atlanta, Ga.	270
WDBJ	Richardson Wayland Elec. Corp.	Roanoke, Va.	229
WDBK	Bdcst Co.	Cleveland, Ohio	227
WDBO	Rollins College	Winter Park, Fla.	239
WDBZ	Kingston Radio Club	Kingston, N. Y.	233
WDEL	Wilmington Elec. Specialty Co.	Wilmington, Del.	266
WDGY	Dr. George W. Young	Minneapolis, Minn.	263
WDOD	Chattanooga Radio Co., Inc.	Chattanooga, Tenn.	256
WDRC	Doolittle Radio Corp.	New Haven, Conn.	268
WDWF	Dutee Wilcox Flint, Inc.	Cranston, R. I.	441
WDWM	Radio Industries Broadcast Co.	Newark, N. J.	280
WDXL	WDXL Radio Corp.	Detroit, Mich.	297
WDZ	J. L. Bush	Tuscola, Ill.	278
WEAF	National Broadcasting Co.	New York, N. Y.	491
WEAI	Cornell University	Ithaca, N. Y.	254
WEAM	Bor. of N. Plainfield	North Plainfield, N. J.	261
WEAN	The Shepard Co.	Providence, R. I.	367
WEAO	Ohio State University	Columbus, Ohio	294
WEAR	Willard Storage Battery Co.	Cleveland, Ohio	389
WEAU	Davidson Bros. Co.	Sioux City, Iowa	275
WEBC	Walter Cecil Bridges	Superior, Wis.	242
WEBE	Roy W. Waller	Cambridge, Ohio	234
WEBH	Edgewater Beach Hotel	Chicago, Ill.	370
WEBJ	Third Avenue Railway Co.	New York, N. Y.	273
WEBL	R. C. A. Show (Portable)	New York, N. Y.	226
WEBQ	Tate Radio Corp.	Harrisburg, Ill.	225
WEBR	H. H. Howell	Buffalo, N. Y.	244
WEBW	Beloit College	Beloit, Wis.	268
WEDC	E. Denemark Station	Chicago, Ill.	250
WEEI	The Edison Elec. Illuminating Co.	Boston, Mass.	349
WEHS	A. T. Becker	Evanston, Ill.	242
WEKD	Foulkrod Radio Engineering Co.	Philadelphia, Pa.	250
WEMC	Emanuel Missionary College	Berrien Springs, Mich.	316
WENR	All-American Radio Corp.	Chicago, Ill.	266
WEPS	Matheson Radio Co., Inc.	Gloucester, Mass.	295
WEW	St. Louis University	St. Louis, Mo.	360
WFAA	Dallas News & Dallas Journal	Dallas, Tex.	476
WFAM	Times Publishing Co.	St. Cloud, Minn.	273
WFAV	University of Nebraska	Lincoln, Neb.	270
WFBC	First Baptist Church	Knoxville, Tenn.	255
WFBE	Garfield Place Hotel Co.	Cincinnati, Ohio	232
WFBG	The Wm. F. Gable Co.	Altoona, Pa.	278
WFBJ	St. John's University	Collegeville, Minn.	236
WFBL	The Onondaga Co.	Syracuse, N. Y.	252
WFBM	Merchants Heat & Light Co.	Indianapolis, Ind.	268
WFBR	Fifth Infantry National Guard	Baltimore, Md.	254
WFBZ	Knox College	Galesburg, Ill.	254
WFCI	Frank Crook, Inc.	Pawtucket, R. I.	258
WFDF	F. D. Fallain	Flint, Mich.	234
WFHH	Fort Harrison Hotel	Clearwater, Fla.	355
WFI	Strawbridge and Clothier	Philadelphia, Pa.	394
WFIW	The Acme Mills, Inc.	Hopkinsville, Ky.	357
WFKB	Vesta Battery Corp.	Chicago, Ill.	217
WFLA	Boca Raton Radio Corp.	Boca Raton, Fla.	440
WFRL	Flatbush Radio Labs.	Brooklyn, N. Y.	205
WGAL	Lancaster Elec. Supply & Const. Co.	Lancaster, Pa.	248
WGBB	H. H. Carman	Freeport, N. Y.	244
WGBC	First Baptist Church	Memphis, Tenn.	278
WGBF	Fink Furniture Co.	Evansville, Ind.	236
WGBL	Scranton Broadcasters, Inc.	Scranton, Pa.	240
WGBS	Gimbel Brothers	Astoria, L. I., N. Y.	316
WGBU	Florida Cities Finance Co.	Fulford By-The-Sea, Fla.	384
WGBX	University of Maine	Orono, Me.	234
WGCP	May Radio Broadcast Corp.	Newark, N. J.	252
WGES	Oak Leaves Broadcasting Corp.	Chicago, Ill.	316
WGHP	G. H. Phelps	Detroit, Mich.	270
WGL	International Broadcasting Corp.	New York, N. Y.	442
WGM	Verne and Elton Spencer	Jeanette, Pa.	269
WGMU	A. H. Grebe & Co.	(Portable) New York	236
WGN	The Tribune	Chicago, Ill.	303
WGR	Federal T. and T. Co.	Buffalo, N. Y.	319
WGST	Georgia School of Technology	Atlanta, Ga.	270
WGWB	Radiocast Corporation	Milwaukee, Wis.	384
WGY	General Elec. Co.	Schenectady, N. Y.	379
WHA	University of Wisconsin	Madison, Wis.	535
WHAD	Marquette University	Milwaukee, Wis.	275
WHAM	Stromberg-Carlson Tel. Mfg. Co.	Rochester, N. Y.	278
WHAP	W. H. Taylor Finance Corp.	New York, N. Y.	431
WHAR	F. D. Cooks Sons	Atlantic City, N. J.	275
WHAS	Courier-Journal & Louisville Times	Louisville, Ky.	400
WHAZ	Rensselaer Polytechnic Institute	Troy, N. Y.	379
WHB	Sweeney School Co.	Kansas City, Mo.	366
WHBA	C. C. Shaffer	Oil City, Pa.	250
WHBC	Rev. E. P. Graham	Canton, Ohio	254
WHBD	Chamber of Commerce	Bellefontaine, Ohio	222
WHBF	Beardsley Specialty Company	Rock Island, Ill.	222
WHBL	C. L. Carrell (Portable)	Chicago, Ill.	216
WHBM	C. L. Carrell (Portable)	Chicago, Ill.	216
WHBN	First Ave. Methodist Church	St. Petersburg, Fla.	238
WHBP	Johnstown Automobile Co.	Johnstown, Pa.	256
WHBQ	WHBQ, Inc.	Memphis, Tenn.	233
WHBU	Citizens Bank	Anderson, Ind.	219
WHBW	D. R. Kienzle	Philadelphia, Pa.	216
WHBY	St. Norbert's College	West de Pere, Wis.	250
WHDI	W. H. Dunwoody Institute	Minneapolis, Minn.	278
WHEC	Hickson Electric Co., Inc.	Rochester, N. Y.	258
WHFC	Triangle Broadcasters	Chicago, Ill.	258
WHK	The Radio Air Service Corp.	Cleveland, Ohio	273
WHN	George Schubel	New York, N. Y.	361
WHO	Banker's Life Co.	Des Moines, Ia.	526
WHOG	Huntington Bdcstrs. Assn.	Huntington, Ind.	242
WHT	Radiophone Broadcasting Corp.	Deerfield, Ill.	400
WIAD	Howard R. Miller	Philadelphia, Pa.	250
WIAS	Home Electric Co.	Burlington, Iowa	254
WIBA	Capital Times-Strand Theatre	Madison, Wis.	236
WIBG	St. Paul's Protestant E. Church	Elkins Park, Pa.	222
WIBI	Frederick B. Zittell, Jr.	Flushing, L. I., N. Y.	219
WIBJ	C. L. Carrell (Portable)	Chicago, Ill.	216
WIBM	C. L. Carrell (Portable)	Chicago, Ill.	216
WIBO	WIBO Broadcasters, Inc.	Chicago, Ill.	226
WIBR	Thurman A. Owings	Weirton, W. Va.	246
WIBS	T. F. Hunter	Elizabeth, N. J.	203

Loop or Aerial—And Why?

(Continued from page 9)

framed building. In this case, an aerial set will generally prove to be the best for the reason that it is usually possible to erect an aerial high enough to get it clear of the trees. Two of the tallest of these, in fact, or one of them and the building in which the set is housed can be used as supports for the antenna, always provided that one end of it is held by a weighted rope passing thru a pulley; or by a long, strong spring to take care of the tension strains produced by the swaying of the trees in the wind.

If a set is to be located very near to a broadcasting station the first requirement is selectivity. Here the loop sets reign supreme, with preference being given to the super-heterodyne. Even with a set of this high degree of rejectivity a wave trap may be needed for use in conjunction with it when it is desired to cut out the local broadcaster in favor of a distant station on nearly the same wavelength, but it is necessary in this connection to remember that a wave trap is far more effective when used in conjunction with a loop operated set than with one which employs an antenna for signal pick-up.

If a set is to be used by a person who does considerable traveling, and likes to carry his or her entertainment along, a loop set is of course most convenient, and undoubtedly most practical, especially if it be built to be strictly self contained; that is, with speaker, batteries, and set, all in one portable case.

It will be seen from the above illustrations that the selection of the proper type of set depends merely upon the application of good common sense to the task, and not upon any definite general superiority of one type of set above the other with respect to ordinary operation in a good radio location.

By a simple analysis of the preceding instructions it is possible for anyone, regardless of the extent of his or her radio knowledge, to select the particular type of set best suited to the conditions under which it is to be used.

WIBU	The Electric Farm	Poynette, Wis.	222
WIBW	C. L. Carrell (Portable)	Chicago, Ill.	216
WIBX	WIBX, Inc.	Utica, N. Y.	234
WIBZ	A. D. Trum	Montgomery, Ala.	231
WICC	Bridgeport Bdcst. Station	Bridgeport, Conn.	285
WIL	Benson Radio Co.	St. Louis, Mo.	258
WIOD	Earl G. Fisher Co.	Miami, Fla.	248
WIP	Gimbel Bros.	Philadelphia, Pa.	508
WJAD	Jackson's Radio Eng. Laboratories	Waco, Texas.	353
WJAG	Norfolk Daily News	Norfolk, Neb.	270
WJAK	Kokomo Tribune	Kokomo, Ind.	254
WJAM	D. M. Perham	Cedar Rapids, Iowa	268
WJAR	The Outlet Co.	Providence, R. I.	484
WJAS	Pittsburgh Radio Supply House	Pittsburgh, Pa.	275
WJAX	City of Jacksonville	Jacksonville, Fla.	337
WJAY	Cleveland Broadcasting Corp.	Cleveland, O.	436
WJAZ	American Bdcast Corp.	Mt. Prospect, Ill.	329
WJBA	D. H. Lentz, Jr.	Joliet, Ill.	207
WJBB	Financial Journal	St. Petersburg, Fla.	254
WJBC	Hummer Furniture Co.	LaSalle, Ill.	234
WJBI	Robert S. Johnson	Red Bank, N. J.	219
WJBK	E. F. Goodwin	Ypsilanti, Mich.	232
WJBL	Wm. Gushard Dry Goods Co.	Decatur, Ill.	270
WJBO	Valdemar Jensen	New Orleans, La.	268
WJBR	Omro Drug Stores	Omro, Wis.	227
WJBT	John S. Boyd	Chicago, Ill.	468
WJBU	Bucknell University	Lewisburg, Pa.	211
WJBW	C. Carlson, Jr.	New Orleans, La.	270
WJBY	Electric Construction Co.	Gadsden, Ala.	270
WJBZ	Roland G. Palmer	Chicago Heights, Ill.	420
WJJD	Supreme Lodge, L. O. of Moose	Mooseheart, Ill.	370
WJPW	J. P. Wilson	Ashtabula, Ohio	240
WJR	Station WJR, Inc.	Pontiac, Mich.	517
WJUG	U. B. Ross	New York, N. Y.	517
WJY	Radio Corp. of America	New York, N. Y.	405
WJZ	Radio Corp. of America	Bound Brook, N. J.	454
WKAF	WKAF Broadcasting Co.	Milwaukee, Wis.	261
WKAQ	Radio Corp. of Porto Rico	San Jaun, P. R.	341
WKAR	Michigan State College	East Lansing, Mich.	286
WKAV	Laconia Radio Club	Laconia, N. H.	422
WKBA	Arrow Battery Co.	Chicago, Ill.	210
WKBB	Sanders Bros.	Joliet, Ill.	283
WKBC	H. L. Ansley	Birmingham, Ala.	225
WKBE	K. & D. Electric Co.	Webster, Mass.	270
WKBF	N. D. Watson	Indianapolis, Ind.	244
WKBG	C. L. Carrell (Portable)	Chicago, Ill.	216
WKBH	Callaway Music Co.	LaCrosse, Wis.	250
WKBI	F. L. Schoenwolf	Chicago, Ill.	220
WKBJ	Gospel Tabernacle Inc.	St. Petersburg, Fla.	282
WKBL	Monrona Radio Mfg. Co.	Monroe, Mich.	250
WKBM	J. W. Jones	Newburgh, N. Y.	285
WKBN	W. P. Williamson, Jr.	Youngstown, Ohio	361
WKBO	Camith Corporation	Jersey City, N. J.	472
WKBP	Enquirer and News	Battle Creek, Mich.	265
WKBQ	Starlight Amusement Park	New York, N. Y.	285
WKBS	P. M. Nelson	Galesburg, Ill.	361
WKBT	First Baptist Church	New Orleans, La.	252
WKBU	H. K. Armstrong (Portable)	Newcastle, Pa.	238
WKBV	Knox Battery and Electric Co.	Brookville, Ind.	236
WKBW	Churchill Evang. Ass'n	Buffalo, N. Y.	362
WKBY	Fernwood Wuick (portable)	Danville, Pa.	220
WKBZ	K. L. Ashbacker	Ludington, Mich.	256
WKDR	Edward A. Dato	Kenosha, Wis.	428
WKJC	Kirk Johnson & Co.	Lancaster, Pa.	258
WKRC	Kodel Radio Corp.	Cincinnati, Ohio	422
WKY	Hull and Richards	Oklahoma City, Okla.	275
WLAC	Life & Casualty Ins. Co.	Nashville, Tenn.	226
WLAL	First Christian Church	Tulsa, Okla.	250
WLAP	Wm. V. Jordan	Louisville, Ky.	275
WLB	University of Minnesota	Minneapolis, Minn.	278
WLBC	D. A. Burton	Muncie, Ind.	224
WLBE	J. H. Fruitman	Brooklyn, N. Y.	231
WLBF	E. L. Dillard	Kansas City, Mo.	211
WLBG	R. A. Gamble	Petersburg, Va.	332
WLBH	Joseph J. Lombardi	Farmingdale, N. Y.	230
WLBI	Aloysius Yare	East Wenona, Ill.	297
WLBJ	Henry Grossman	Cleveland, Ohio	300
WLBL	Wisconsin Dept. of Markets	Stevens Point, Wis.	278
WLBM	Browning Drake Corp.	Boston, Mass.	480
WLBN	William Evert Hiler (Portable)	Chicago, Ill.	225
WLBO	Frederick A. Tribbe, Jr.	Galesburg, Ill.	243
WLBP	R. A. Fox	Ashland, Ohio	220
WLBQ	E. Dale Trout	Atwood, Ill.	231
WLBR	Alford Radio Company	Belvidere, Ill.	335
WLBY	Aimone Elec.	Iron Mountain, Mich.	250
WLCI	Lutheran Association	Ithaca, N. Y.	626
WLIB	Liberty Weekly, Inc.	Elgin, Ill.	303
WLIT	Lit Bros.	Philadelphia, Pa.	394
WLPP	Robert A. Fox	Ashland, Ohio	220
WLS	Sears Roebuck & Co.	Crete, Ill.	345
WLSL	Lincoln Studios	Cranston, R. I.	441
WLTS	Lane Technical High School	Chicago, Ill.	258
WLW	Crosley Radio Corp.	Harrison, Ohio	422
WLWL	Paulist Fathers	New York, N. Y.	384
WLBT	Harold Wendell	Crown Point, Ind.	230
WLBU	Matthew B. Greiner	Canastota, N. Y.	220
WLBV	John F. Weimer & D. A. Snick	Mansfield, Ohio	231
WLBW	Petroleum Telephone Co.	Oil City, Pa.	321
WLBX	John N. Brahy	Long Island City, N. Y.	231
WLBY	Aimone Electric	Iron Mountain, Mich.	250
WLBZ	Thompson L. Guernsey	Dover-Foxcroft, Maine	299
WMAC	C. B. Meredith	Casenovia, N. Y.	275
WMAF	Round Hills Radio Corp.	Dartmouth, Mass.	441
WMAK	Norton Laboratories	Lockport, N. Y.	266
WMAL	M. A. Leese	Washington, D. C.	294
WMAN	Haskett Radio Station	Columbus, Ohio	278
WMAQ	Chicago Daily News	Chicago, Ill.	447
WMAY	Kingshighway Presbyterian Church	St. Louis, Mo.	248
WMAZ	Mercer University	Macon, Ga.	261
WMBA	LeRoy Joseph Beebe (Portable)	Newport, R. I.	250
WMBB	American Bond & Mortgage Co.	Chicago, Ill.	250
WMBC	Michigan Broadcasting Co., Inc.	Detroit, Mich.	256
WMBD	Peoria Heights Radio Lab.	Peoria Heights, Ill.	279
WMBE	Dr. C. S. Stevens	St. Paul, Minn.	220
WMBF	Fleetwood Hotel Corp.	Miami Beach, Fla.	384
WMBG	Havens & Martin	Richmond, Va.	220
WMBH	Edwin Dudley Aber, Portable	Chicago, Ill.	280
WMBI	Moody Bible Institute	Chicago, Ill.	288
WMBJ	Wm. Roy McShaffrey	Monessen, Pa.	278
WMBK	John C. Slade	Hamilton, Ohio	360
WMBL	Bonford Radio Studios	Lakeland, Fla.	410
WMBM	Seventh Day Adventist Church	Memphis, Tenn.	245
WMBO	Radio Service Laboratories	Auburn, N. Y.	238
WMBQ	Paul J. Gollhofer	Brooklyn, N. Y.	210
WMBR	Premier Electric Co.	Tampa, Fla.	250
WMBS	Mack's Battery Co.	Harrisburg, Pa.	360
WMBU	Paul J. Miller	Pittsburgh, Pa.	236
WMBW	Youngstown Bdcstg. Co., Inc.	Youngstown, O.	279
WMBY	Robert A. Isaacs	Bloomington, Ill.	291
WMC	Commercial Pub. Co.	Memphis, Tenn.	500
WMCA	Greely Sq. Hotel Co.	Hoboken, N. J.	341
WMHA	Young Men's Hebrew Ass'n	New York, N. Y.	230
WMPC	First Methodist Church	Lapeer, Mich.	203
WMRJ	Peter J. Prinz	Jamaica, N. Y.	227
WMSG	Madison Sq. Gard. Bdcast. Corp.	New York, N. Y.	302
WMVN	Edward J. Malone, Jr.	Newark, N. J.	476
WNAB	Shepard Stores	Boston, Mass.	280
WNAC	Shepard Stores	Boston, Mass.	430
WNAD	University of Oklahoma	Norman, Okla.	254
WNAL	Omaha Central High School	Omaha, Nebr.	258
WNAT	Lenning Brothers Co.	Philadelphia, Pa.	250
WNAX	Dakota Radio Apparatus Co.	Yankton, S. Dak.	244
WNBA	M. T. Rafferty	Forest Park, Ill.	238
WNBF	Howitt-Wood Radio Co.	Endicott, N. Y.	205
WNBH	New Bedford Hotel	New Bedford, Mass.	248
WNBI	Wm. J. Romanouski	Peru, Ill.	357
WNBJ	Lonsdale Baptist Church	Knoxville, Tenn.	335
WNBK	Barton Electric Co.	LeRoy, N. Y.	354
WNBL	Harvey R. Storm	Bloomington, Ill.	495
WNBO	John Brownlee Spriggs	Washington, Pa.	215
WNBR	Popular Radio Shop	Memphis, Tenn.	250
WNBQ	Gordon P. Brown	Rochester, N. Y.	408
WNJ	Herman Lubinsky	Newark, N. J.	350
WNOX	Peoples Tel. & Tel. Co.	Knoxville, Tenn.	268
WNRC	W. B. Nelson	Greensboro, N. C.	224
WNYC	Dept. of Plants & Structures	New York, N. Y.	526
WOAI	Southern Equipment Co.	San Antonio, Texas	394
WOAN	J. D. Vaughn	Lawrenceburg, Tenn.	356
WOAX	Franklyn J. Wolff	Trenton, N. J.	240
WOBB	Longacre Eng. & Const. Co.	Chicago, Ill.	555

Trouble Shooting on Supers

(Continued from page 7)

fied for your particular circuit. Sometimes mistakes occur in packing and a .00035 mfd may be found in a .0005 mfd box, or vice versa.

(37)

Loop may be too large or too small. If the loop is to large you will have trouble in tuning in stations on the lower waves if it has not enough inductance it will not tune up to the higher bands.

(38)

Wrong type condenser. If a condenser with a metal shaft is used in a super with an oscillator tuned from grid to plate, you will have trouble with body capacity. With this type; of tuning use a condenser having insulated rotor and stator so the shaft coming through the panel is not a part of the circuit. (See oscillator method used by RADIO AGE in its latest 9 tube design—Editor).

(39)

Grid connected to rotor of condenser. Always connect the grid to the stator of the variable condenser. If the grid goes to the rotor body capacity may be encountered.

(40)

Rotor not grounded to negative filament. The regular type of condensers can be used where the tuning is from grid to filament of the oscillator. In this case be sure to connect the rotor to the filament negative to eliminate body capacity when the set is being pushed for distance. Of course the grid goes to the stator as usual.

Notes On Above

Do not use the schematic in this article for wiring a set. It is only reproduced here for reference in trouble shooting. The test methods outlined here will help you considerably in solving your own problems. Many trivial mistakes made in originally building the set will show up under these tests and should serve as a guide for your construction of an excellent super of which you will be proud. Be sure to use quality material in a super. Its the best economy in the long run.

Radio Under Water

HARRY L. PAIGE'S business is going down to the sea in a diving helmet, but he insists upon taking his radio along—at least, he takes the ear phones with him below the waters of Corpus Christi Bay. Paige is a member of a crew running a barge and placing pipe for a sewer outfall on the bottom of the bay.

Harry's job is to go down and buckle the pipes together after they have been placed in their positions. He found after a while that the very programs he wished to hear usually were broadcast at those hours when he was engaged in diving operations.

He decided to remedy the situation. Others on the barge out in the bay, about a mile from the mainland, were skeptical about Paige's experiment. He procured some heavily insulated wire, ran it from the instrument to his sleeve and up to the ear phones. Then he tuned in on the particular station he wished to hear.

When he went down about fifteen feet to the place where he was working he found that he received the programs as clearly as if he were sitting on the deck of the barge. Now, whenever he has to wait for the heavy concrete piping to be lowered into place, he can while away the time beneath the waves by listening to jazzy tunes from far-away stations or he can take swimming lessons by radio from Gertrude Ederle.

Anyway, Harry says the radio adds to the companionship of the deep when the only visible animal life is jelly fish.—E. G. Fischer.

WOCB	Orlando Broadcasting Co.	Orlando, Fla.	294
WOC	Palmer School of Chiropractic	Davenport, Iowa	484
WOCL	A. D. Newton	Jamestown, N. Y.	275
WODA	O'Dea Temple of Music	Paterson, N. J.	391
WOI	Iowa State College	Ames, Iowa	270
WOK	Neutrowound Radio Mfg. Co.	Homewood, Ill.	410
WOKO	Harold E. Smith	Peekskill, N. Y.	232
WOKT	Titus-Ets Corporation	Rochester, N. Y.	340
WOMT	Mikado Theater	Manitowoc, Wis.	254
WOO	John Wanamaker	Philadelphia, Pa.	508
WOOD	Grand Rapids Radio Co.	Fernwood, Mich.	242
WOQ	Unity School	Kansas City, Mo.	278
WOR	L. Bamberger and Co.	Newark, N. J.	405
WORD	People's Pulpit Assn.	Batavia, Ill.	275
WOS	State Market Bureau	Jefferson City, Mo.	441
WOW	Woodman of the World	Omaha, Nebr.	526
WOWO	Main Auto Supply Co.	Fort Wayne, Ind.	227
WPAB	Radio Corp. of Virginia	Norfolk, Va.	319
WPAK	N. D. Ag. College	Agricultural College, N. D.	275
WPAP	(See WQAO)	Cliffside, N. J.	361
WPCC	North Shore Cong. Church	Chicago, Ill.	258
WPCH	Concourse Radio Corp.	New York, N. Y.	273
WPDQ	H. L. Turner	Buffalo, N. Y.	205
WPEP	Maurice Mayer	Waukegan, Ill.	213
WPG	The Municipality of Atlantic City	Atlantic City, N. J.	300
WPRC	Wilson Printing & Radio Co.	Harrisburg, Pa.	216
WPSC	Pennsylvania State College	State College, Pa.	261
WPSW	Philadelphia School of Wireless Tel.	Philadelphia, Pa.	236
WQAA	Horace A. Beale, Jr.	Parkersburg, Pa.	220
WQAE	Moore Radio News Station	Springfield, Vt.	246
WQAM	Electrical Equipment Co.	Miami, Fla.	285
WQAN	Scranton Times	Scranton, Pa.	250
WQAO	Calvary Baptist Church	Cliffside, N. J.	361
WQJ	Calument Rainbo Broadcasting Co.	Chicago, Ill.	444
WRAF	The Radio Club (Inc.)	LaPorte, Ind.	224
WRAH	S. N. Read	Providence, R. I.	235
WRAK	Economy Light Co.	Escanaba, Mich.	256
WRAM	Lombard College	Galesburg, Ill.	244
WRAV	Antioch College	Yellow Springs, Ohio	263
WRAW	Avenue Radio & Electric Shop	Reading, Pa.	238
WRAX	Beracah Church, Inc.	Philadelphia, Pa.	268
WRBC	Immanuel Lutheran Church	Valparaiso, Ind.	278
WRC	Radio Corp. of America	Washington, D. C.	468
WRCO	Wayne Radio Co.	Raleigh, N. C.	252
WREC	Wooten's Radio Shop	Whitehaven, Tenn.	254
WREO	Reo Motor Car Co.	Lansing, Mich.	285
WRES	H. L. Sawyer	Woloaston, Mass.	300
WRHF	Wash. Radio Hospital Fund	Washington, D. C.	256
WRHM	Rosedale Hospital, Inc.	Minneapolis, Minn.	252
WRK	Doron Bros.	Hamilton, Ohio	270
WRM	University of Illinois	Urbana, Ill.	273
WRMU	A. H. Grebe & Co., Inc.	Motor Yacht "MU-1"	236
WRNY	Experimenter Publishing Co.	Coyetsville, N. Y.	374
WRR	City of Dallas	Dallas, Tex.	246
WRRS	Racine Radio Corp.	Racine, Wis.	360
WRSC	The Radio Shop	Chelsea, Mass.	270
WRST	Radiotel Mfg. Co., Inc.	Bay Shore, N. Y.	216
WRVA	Larus & Brother Co., Inc.	Richmond, Va.	256
WSAI	United States Playing Card Co.	Cincinnati, Ohio	326
WSAJ	Grove City College	Grove City, Pa.	229
WSAN	Allentown Call Publishing Co. Inc.	Allentown, Pa.	229
WSAR	Daughy & Welch Electrical Co.	Fall River, Mass.	322
WSAV	Clifford W. Vick	Houston, Tex.	248
WSAX	Zenith Radio Corp. (Portable)	Chicago, Ill.	268
WSAZ	Chase Electric Shop	Pomeroy, Ohio	244
WSB	Atlanta Journal	Atlanta, Ga.	428
WSBC	World Battery Co.	Chicago, Ill.	288
WSBF	Stix Baer & Fuller	St. Louis, Mo.	273
WSBT	South Bend Tribune	South Bend, Ind.	316
WSDA	Seventh Day Adventist Church	New York, N. Y.	261
WSEA	Virginia Beach Broadcasting Co.	Virginia Beach, Va.	517
WSIX	638 Tire & Vulc. Co.	Springfield, Tenn.	250
WSKC	World's Star Knitting Co.	Bay City, Mich.	263
WSM	Nashville Life & Accident Ins. Co.	Nashville, Tenn.	283
WSMB	Saenger Amuse. Co.	New Orleans, La.	319
WSMH	Shattuck Music House	Owosso, Mich.	240
WSMK	S. M. K. Radio Corp.	Dayton, Ohio	275
WSOE	School of Engineering	Milwaukee, Wis.	246
WSOM	Union Course Laboratories	Woodhaven, N. Y.	288
WSRO	Harry W. Fahrlander	Hamilton, Ohio	252
WSSH	Tremont Temple Bap. Church	Boston, Mass.	261
WSUI	State University of Iowa	Iowa City, Iowa	484
WSVS	Seneca Vocational School	Buffalo, N. Y.	219
WSYR	Clive B. Meredith,	Syracuse, N. Y.	353
WTAD	Ill. Stock Medicine Corp.	Quincy, Ill.	236
WTAG	Worcester Telegram	Worcester, Mass.	545
WTAL	Toledo Broadcasting Co.	Toledo, Ohio	252
WTAM	Willard Storage Battery Co.	Cleveland, Ohio	389
WTAQ	C. S. Van Gordon	Eau Claire, Wis.	254
WTAR	Reliance Electric Co.	Norfolk, Va.	261
WTAS	Richmond Harris & Co.	Batavia, Ill.	275
WTAW	A. & M. Coll. of Texas	College Sta., Texas	270
WTAX	Williams Hardware Co.	Streator, Ill.	231
WTAZ	Thomas J. McGuire	Lambertville, N. J.	261
WTHO	W. J. Thomas Radio Co.	Ferndale, Mich.	407
WTIC	Travelers Insurance Co.	Hartford, Conn.	476
WTRC	20th Dist. Republican Club	New York, N. Y.	240
WTRL	Technical Radio Laboratory	Midland Park, N. J.	280
WWAE	I. J. Crowley	Chicago, Ill.	242
WWJ	Evening News Assn.	Detroit, Mich.	353
WWL	Loyola University	New Orleans, La.	275
WWNC	Chamber of Commerce	Asheville, N. C.	254
WWRL	W. H. Rouman	Woodside, N. Y.	258
WWVA	John C. Stroebel, Jr.	Wheeling, W. Va.	346

Dominion of Canada

CFAC	Calgary Herald	Calgary, Alta.	434
CFCA	Toronto Star Pub. & Prtg. Co.	Toronto, Ont.	356
CFCF	Marconi Wireless Teleg. Co., (Ltd.)	Ca. Mont., 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.	279
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
CKCL	Dominion Battery Co.	Toronto	357
CKCO	Ottawa Radio Association	Ottawa, Ont.	434
CKCX	Int'l Bible Students Ass'n.	Toronto	291
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.	322
CNRC	Canadian National Railways	Calgary, Alta.	435
CNRE	Canadian National Railways	Edmonton, Alta.	517
CNRM	Canadian National Railways	Montreal, Que.	411
CNRO	Canadian National Railways	Ottawa, Ont.	435
CNRR	Canadian National Railways	Regina, Sask.	312
CNRS	Canadian National Railways	Saskatoon, Sask.	329
CNRT	Canadian National Railways	Toronto, Ont.	357
CNRV	Canadian National Railways	Vancouver, B. C.	291
CNRW	Canadian National Railways	Winnipeg, Man.	384

Short-Wave Station 2AG Uses Crystal Control

IN A TALK given recently at Columbia University before a well-attended meeting of The Radio Club of America, C. R. Runyon, Jr., gave a detailed description of his short-wave radio station located at 544 North Broadway, Yonkers, N. Y.

Seven transmitting tubes are employed, as follows: one 7.5 watt UX-210 as a crystal-controlled amplifier tube; two more of the same type in the first intermediate amplifier: still greater amplification through the medium of two 50-watt tubes (UV-203-A) in a second intermediate stage of push-pull amplification; and a final stage of amplification employing two 250-watt tubes (UV-204-A) in a push-pull amplifier circuit.

The output of this powerful amateur short-wave transmitter is radiated from an antenna system which is suspended from the top of a 112-foot mast which is erected in the rear of Mr. Runyon's home. A counterpoise is employed to increase the efficiency of this station.

CLASSIFIED ADVERTISEMENTS

If you have anything to buy or sell, don't overlook RADIO AGE'S classified advertisements.

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

All classified ads for the July-August issue must be sent in by May 25.

AIRPLANES

SEND FOR free illustrations and plans of our wonderful two-piece, companion type, small, high lift wing monoplane, and information on how to build this ship, and be sure it will fly; also propeller literature. Crawford Airplane Manufactory, 2225 American Avenue, Long Beach, California.

BOOKS AND MAGAZINES

3 MAGAZINES, 30c. "Judge Lindsey Refuted" Debates. "Enigma of Life" theses. "Orthodox Hell" discussions. Interesting! Expenent, Orlando, Florida.

FREE—Two big New Magazines and information worth hundreds of dollars to you. Enclose 2c stamp. Salesmanager, Box 74-R, Beaver Dam, Wisconsin.

What could be better than magazine subscriptions for gifts. Send stamp for our special list of subscription bargains. Midland Products, Dept. R. A., 524 Courtland Ave., Park Ridge, Illinois.

Twentieth Century Book of Receipts, Formulas and processes, an 807 cloth bound book containing 18,000 proven formulas for the manufacturer, workshop, laboratory, office and home. Sent prepaid upon receipt of $4.00. Send dime for our 48 page catalog of latest and best practical, scientific mechanical and industrial books. Midland Products Co., Dept. RA, 524 Courtland Ave., Park Ridge, Ill.

BOYS

RADIO SET FREE, form magazine clubs among friends. Club list free. Spenserian Agencies, Los Angeles, Brentwood Heights, California.

BUSINESS OPPORTUNITIES

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

LAND FREE If planted to bananas. Bananas bear a full crop the second year. $5.00 monthly will plant five acres, which should pay $1,600 profit annually. Reliable Companies will cultivate and market your bananas for 1/3. Bananas ripen every day and you get your check every 90 days. For particulars address Jantha Plantation Co., Empire Building, Block 766, Pittsburgh, Pa.

Get radio dealers discounts. Save money. Make money. Detailed instructions $.20. H. W. Ross, 41 Highland Ave., Fort Thomas, Kentucky.

DOGS

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

ELECTRICAL

ELECTRIC FUN! Seventy stunts, 110 volts, $1. Cecutting, Campbell, Calif.

HELP WANTED

Firemen, Brakemen, Baggagemen, (White or colored) sleeping car, train porters (colored), $150-$250 monthly. Experience unnecessary, 278 Railway Bureau, East St. Louis, Illinois.

MEN, get Forest Ranger job; $125-$200 mo. and home furnished; permanent; hunt, fish, trap. For details, write Norton, 269 McMann Bldg., Denver, Colorado.

MISCELLANEOUS

"MUSIC Composed" to words. Bauer Bros., (formerly of Sousa's Band). Oshkosh, Wis.

GILLETTE STYLE Razor with 10 Blades 89c Prepaid. Loud Speaker $3.89, Speaker Unit $1.10 prepaid. Transformer 25c, Mele Station A, New Haven, Conn.

PANEL ENGRAVING

WE SPECIALIZE in high grade single panel engraving. Also quantity panel work and special machine engraving on small parts. The only panel engraver in Chicago devoted exclusively to engraving. A. L. Woody, 19 South Wells St., Chicago, Ill.

PERSONAL

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

RADIO

EXTRA HEAVY Antenna wire 7 lb. 18 $1.50 100 feet. 17 lb. 22 braided 3/8" wide $2.00 100 feet all prepaid. George Schulz, Calumet, Michigan.

MR. H. SADZECK, 1655 Addison St., Chicago, Ill., writes us as follows: "I bought one of your Radio Trouble-Shooters. Just the thing I have been looking for. Dandy. Please send me catalog or literature of other parts you carry. Thanking you for this favor, I am (Signed) H. Sadzeck." It will pay you to investigate at Universal Test Equipment Co., 2939 N. Oakley Ave., Chicago, Ill.

Build the Quadraformer Super VI. A real five tube set. Genuine Essential Kit, $17.50 including instructions. Booklet 25c. Literature on request. R. P. Tomamichel, 2244 Seminary Avenue, Chicago, Illinois.

Buyers Service for Readers of Radio Age. I will buy for you standard radio merchandise if you cannot obtain same in your locality. Remit list price of articles wanted, and if same are not obtainable by me I will make refund. R. P. Tomamichel, 2244 Seminary Ave., Chicago, Illinois.

Radio Books—Construction of a modern Super Heterodyne Type Receiver including Testing and Operation $1.00; Henley's 222 Radio Circuit Designs, 267 pages, $1.00; The ABC of Vacuum Tubes used in Radio Reception 132 pages, 75 cents; Henley's Workable Radio Receivers 196 pages $1.00; Experimental Wireless Stations 392 pages $2.00; Wireless Telegraphy and Telephony Simply Explained 154 pages $1.00. Sent prepaid on receipt of price. Send dime for our 48 page catalog of latest and best practical, scientific, mechanical and industrial books. Midland Products Co., Dept. RA, 624 Courtland Ave., Park Ridge, Illinois.

SILICON Transformer Steel cut to order .014". 10 lbs. 25 cents, 5 lbs. 30 cents, less than 5 lbs. 35 cents per lb., 4 cubic inches to the lb. postage extra. At least ½ cash with order—balance C. O. D. Geo. Schulz, Calumet, Michigan.

PURE ALUMINUM and lead rectifier elements, holes drilled, with brass screws and nuts per pair 1-18", 1"x4", 13c, 1x6, 15c, 1¼x6, 17c, 1½x6, 19c, single elements half price. Sheet aluminum 1-18", $1.00, 1-8" $1.90. Lead $1.00 square foot all prepaid. Geo. Schulz, Calumet, Michigan.

CONDENSERS. 800 VOLT FILTER, .1 mfd 45c, .25 51c, .5 60c, 1. 76c, 2. $1.20, 3. $1.80, 4. $2.40, 1500 VOLT FILTER, .1 51c, .25 60c, .5 75c, 1. $1.05, 2. $1.95, 3. $2.70, 4. $3.80. ELIMINATOR BLOCKS, 2, 2, and 8 $5.70, 2, 2, 8 and 1 $8.16, 2, 2, 8, 1 and 1 $6.60, .1 and .1 in series 90c. Many other capacities. Acme transformers and chokes. THE RADIO CLUB, INC., La Porte, Ind.

IVORY RADIO PANEL beats them all. Write for FREE Sample. Ivorylite Radio Panel Co., 3330 Ave. G. Fort Worth, Texas.

10% off all standard radio apparatus laboratory tested radiotron UV 201A's at only $1.70. Postage prepaid. Petsto Radio Laboratories, Wauwatosa, Wisconsin.

MONEX SHIELDED COILS, latest engineering advance in design of inductances. No interaction between coils possible, high voltage amplification, better quality. Price $3.50 each, $10 matched set of three, blueprint included. Sent C. O. D. (charges included) postpaid when cash accompanies order. Fifteen day trial, money back if not satisfied. Special offer to set builders. NATIONAL RADIOPRINT CO., Room 404, 200 Broadway, New York.

GUARANTEED RADIO PARTS—TUBES 98c and $1.23; 3½ or 5 to one Transformers $1.41; 13, 17, or 23 plate Variable Condensers $1.43, Tandems $2.47, Midgets 68c; 3 Circuit Tuning Coils $1.31; Rheostats and Potentiometers 34c to $1.89; CORNELL Bronze Verniers $1.37, (Worth $2.00); 7"x18" Black or Mettled Rubber Panels $1.32; Unpainted Knocked Down 18" or 21" Cabinets with subpanel and hardware $2.73 —POSTPAID—Cash With Order. GORDON G. ATWELL, Shreveport, La.

110-190-6 volt transformer for making a Trickle Charger for "B" Battery using 201A tube $2.00. 30H 85 MA. 28.0 Ohm. Choke $2.75. 110-420-8 volt transformer $4.00. All postpaid. Write for list of specials. We estimate on kits to your specifications. Radio Parts Sales Co., Orange, N. J.

WESTERN Electric power amplifier $19.00. Magnavox Three-stage power amplifier $14.00. Signal 1-plate condensers at 50 cents each. Get my bargain list for the ham. 9MV Stery City, Iowa.

60 page radio catalogue. Just off press. Popular prices. Get your copy at once. Enclose dime to cover mailing, etc. Radio Sales Company, P. O. Box 116, Oneonta, New York.

The Burgo-Equity 8 to 14 tubers, 44 stations one evening. Will play set for set with any radio in U. S. Get prices on parts necessary. C. C. Burgo, assembler of larger radios, 340 South Turner Ave., Chicago.

Ten Tube Navy Model (C-10) Superheterodyne. Specified parts all assembled. Engraved Panel. Excellent condition. Will sacrifice for $140.00 cash. Harold Sohnlein, 1011 Auburn N. W., Canton, Ohio.

Radio Consoles, Radio Tables. Send for booklet and special price. When writing give size of panel and base. J. A. Kelly Company, Clinton, Iowa.

RADIO STAMPS

WANTED—Radio Station Stamp Collectors Everywhere. Write Chas. A. Phildius, 510 East 120th Street, New York, N. Y.

SALESMEN WANTED

I AUTO GAS SAVER FREE
To Introduce. Amazing car performance. Doubles mileage. CRITCHLOW, Inventor, C-90, Wheaton, Illinois.

TYPEWRITERS

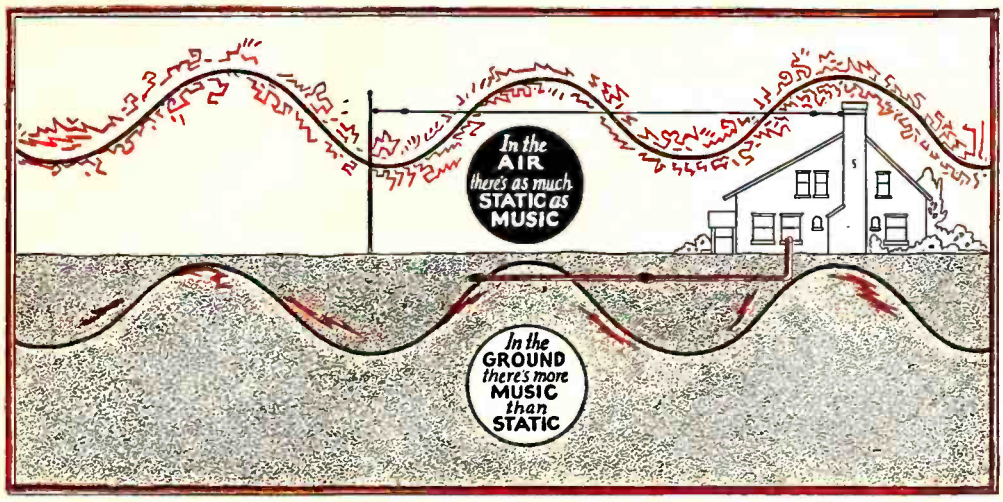
TYPEWRITERS, all standard makes, $10 up. Fully Guaranteed. Free Trial. Write for COMPLETE illustrated lists. Northwestern Typewriter Exchange, 121 N. Francisco Ave., Chicago.

WANTED TO BUY

Full value paid for old GOLD Jewelry, silver or platinum. Packages returned if our offer not satisfactory. Elaine Specialty Company, 3330 Ave. G, Fort Worth, Texas.

Radio Age Classified Ads Bring Results

Listen to Subantenna Static Eliminators over KYW, Chicago, 536 Meters, every Wednesday night, 7:30 to 8:00 P. M. Central Daylight Saving Time.



Use STATIC-FREE Ground Waves Get Distance Loud and Clear all Summer

SUBANTENNA—new underground Antenna System astounds listeners and laboratories with loud clear DX on hot summer nights when old style aerial gets nothing but unwanted noise

Imagine the intense pleasure of bringing in your favorite distant station loud and crystal clear—right through summer's curtain of static and noise! But, you don't have to be content with merely imagining it. Real DX in summertime—real big volume—amazing clarity—much better selectivity—all these are now available to you—and, with your present set. Simply connect your set to SUBANTENNA—the marvelous new underground antenna system that uses filtered ground waves instead of noisy air waves.

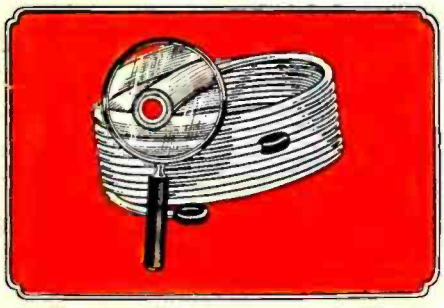
Read PROOF that SUBANTENNA is the Greatest New Thing in Radio

Says Static Is No More

"I have received the Subantenna. My grandson installed it. STATIC IS NO MORE. Am well satisfied. I can tune in stations I never could coax out of the air even though I had a long aerial."—A. E. F., Kans.

Better Selectivity—No Static

"It has always been impossible for me to eliminate the Drake Hotel. I was told that Subantenna would enable me to do this. Although skeptical, in view of many similar claims made by other manufacturers of radio accessories, I had one of the Subantennas installed. The results have been most satisfactory, in that I have not only been able



to get every station in Chicago of any consequence, when the Drake was on the air, but out-of-town stations as well. In addition I am able to report that static, which was a source of much annoyance before, has been entirely eliminated so far as I am able to observe."—R. L. P., Chicago.

Michigan Gets California

"I have had KFI, California, several time and go all over U. S. A. to Portland, Maine You have the goods. It is far better fo volume and tone on loud speaker than out side aerial."—C. J. S., Mich.

Why SUBANTENNA Makes Ever Night a Good Radio Night

In summer *air*, the ratio of static strength to signa strength favors static. The "noise" is so much greate than the broadcast signal that it hides the music you wish to hear. That's why you don't get distance in the summertime. But, when you use SUBANTENNA, the situation is just reversed. For, in the ground, the ratio of static strength to signal strength favors the latter. In fact, there is so little static in the ground that the broadcast signal easily dominates it, with the result that you hardly hear the static, even on the most distant stations. Radio research men have long known this fact, but no device had ever been perfected by which ground waves could be used. Now, however, you have SUBANTENNA—a great new device which makes radio, for the first time, an all year 'round pleasure.

Eliminates Lightning Risk

Not only will SUBANTENNA give you loud, clear DX in summer—not only will this remarkable invention better the selectivity of your set—but it also completely eliminates the lightning hazard. With SUBANTENNA you can go right on listening-in during the most severe electrical storm without noise, fear of attracting lightning or damaging your set.

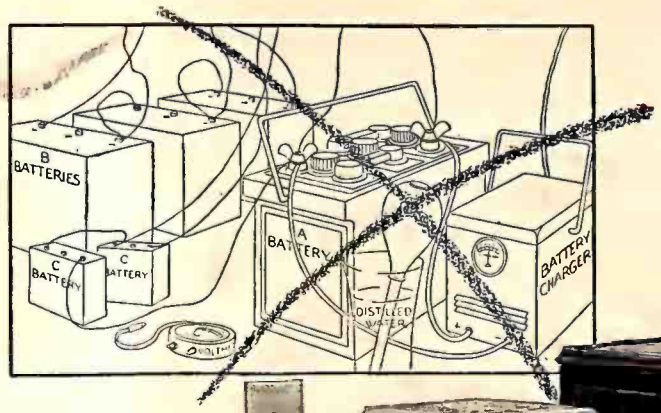
FREE TRIAL

SUBANTENNA

Underground Antenna System

CLOVERLEAF MANUFACTURING CO.

2715-B CANAL STREET CHICAGO, ILLINOIS



No batteries—

RADIO'S most revolutionary development! Run this radio direct from house current outlet. Ordinary 110 volt 60 cycle domestic electricity transformed mechanically into smooth, quiet radio, A, B and C power as you use it. Radio power supply annoyances ended for all time. A snap of the switch is the only demand radio will make upon you from NOW ON.

No more batteries to fuss with.
No more trickle chargers to watch.
No more keeping something filled with water.
...s to renew or recharge.
...g the home to have the radio serviced.

...derful sets at any Crosley dealers, or ... for descriptive literature.

...sley Radio Corporation
...Pres. Cincinnati, Ohio

Radio Energy Unit

Crosley Radio Energy Unit weighs only 13 lbs., is only half the size of an ordinary "A" storage battery—operates without interferring hum and with the certainty of an electric motor.

$50

6-tube AC Receivers

for use with Crosley Radio Energy Unit

Crosley radios designed for use with this marvelous power supply are the AC-7, a 6-tube table model at $70, and the AC-7-C, a 6-tube console at $95.

Crosley sets are licensed under Armstrong U. S. Patent No. 1,113,149, or under patent applications of Radio Frequency Laboratories, Inc., and other patents issued and pending.

Prices slightly higher west of the Rocky Mountains

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