RADIO & MODEL ENGINEERING

A Magazine for the Experimenter who builds his own Equipment.

Edited by M.B. SLEEPER

COMMERCIAL TYPE
SETS AND CIRCUITS

EXPERIMENTAL DATA AND DIAGRAMS FOR THE TUSKA SUPERDYNE, AND FOUR-TUBE MONOTROL.

A SIMPLE WAVEMETER WHICH CAN TELL YOU ALL KINDS OF INTERESTING THINGS ABOUT YOUR RADIO SET.

BOILERS AND BLOW TORCHES FOR MODEL ENGINES—THEIR CONSTRUCTION, CARE, AND USE.

10¢ a Copy-In England Sixpence

Vol. 4 No. 1

Equal to All Demands

THIS IS NUMBER FOUR OF A SERIES

Every tube you add to your receiver makes it just that much more important for you to use Eveready "B" Batteries, for each additional tube increases the work the "B" battery has to do. It demands a more capable, long-lived battery.

Here is a table that shows just what each type of receiving tube draws from your "B" battery. The current is measured in milliamperes, or thousandths of an ampere.

Current (in milliamperes) Taken from the "B" Battery by Various Tubes

"B" VOLTS	WD-11 WD-12	UV-199 C-299	UV-201 C-301	UV-201-A C-301-A
22½	0.5	0.5	0.5	0.5
45	1.5	1.4	1.5	1.5
67½	2.5	2.4	2.5	3.5
90	4.5	4.0	3.9	6.0

Above figures are at zero grid bias

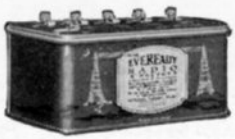
The table shows that the "B" battery current drain increases much more rapidly than the increase in voltage. For example, if the voltage doubles from 45 to 90, the current drain increases three-fold in one case and four-fold in another case. This all means that the life of the "B" battery may be materially lengthened by not using a higher voltage than is necessary to obtain the desired results.

The most popular type of receiver today has at least three tubes, operating a loud speaker. As ordinarily employed, it places a fairly heavy drain on the "B" battery.

Under light and heavy service, Eveready "B" Batteries prove up. More and more fans buy them every day because they are the most economical. According to the work they have to do, so is their life.

You get most energy for your money in Eveready "B" Batteries —They last longer.

"the life of your radio"



The Metal Case Eveready "B" Battery No. 766. The popular 22½-volt Eveready Battery in a *new*, handsome, durable, waterproof metal case. At all dealers, $3.00.

Eveready "B" Battery No. 767. Contains 30 large size cells, as used in the popular No. 766. Voltage, 45. Made especially for sets using detector and one or more stages of amplification. The most economical "B" Battery where 45 volts are required. At all dealers, $5.50.

Eveready Radio Battery No. 771. The Eveready "Three," the ideal "C" Battery. Voltage, 4½—three terminals permitting the use of 1½, 3, or 4½ volts. The correct use of this battery greatly prolongs the life of the "B" Battery. At all dealers, 70 cents.

Manufactured and guaranteed by

NATIONAL CARBON COMPANY, INC.
Headquarters for Radio Battery information
New York, N. Y.

EVEREADY
Radio Batteries
–they last longer

NOTE—This is No. 4 of a series of informative advertisements, printed to enable users to realize the utmost in battery economy. If you have any battery problem, write to G. C. Furness, Manager, Radio Division, National Carbon Co., Inc., 130 Thompson Avenue, Long Island City, N. Y. Ask for special booklets on "A," "B" and "C" batteries.

The Most Important of All Announcements for 1924

DURING the three years that Radio and Model Engineering has been published, over fifty types of radio receiving sets have been described. From the first number, consisting of only eight pages, Mr. Sleeper has steadily developed the art of showing experimenters how to build successful radio equipment, so designed that it can be assembled in the kitchen table workshop, of parts available in any store, equal in results to commercial apparatus.

From the beginning, R and M was without a competitor. Today, with R and M still far in the lead, its influence can be seen in departments of almost every other publication which carries radio articles for Experimenters.

It is interesting to note that R and M is the fourth oldest of radio magazines of which there are about fifty published in this country, that Mr. Sleeper has been in the service of Experimenters longer than any other author, and that his writings exceed in volume those of any three other men. In fact, the paper required to print them, if cut into a tape one-half inch wide, would extend around the world more than sixty times!

AND IN 1924

R and M starts off by increasing its lead, for, in the next issue there will appear the first design of a super-heterodyne set employing transformers which are correctly designed to give the marvelous efficiency of which this circuit is capable.

For several months Mr. Sleeper has delayed in the publication of a super-heterodyne set because no transformers, other than improvised makeshifts, could be purchased. At last, however, the Acme Apparatus Company has put on the market a 30 K. C. transformer which is exactly suited for this wonderful set, a receiver, operating with UV199 tubes, which surpasses in results all other types.

Reasonable in cost, simple to assemble, easy to operate, it can be used either on a loop or short in-door antenna to bring in stations you have never heard before with a volume and purity and tone impossible with any other kind of receiver.

A SPECIAL OFFER

Is made to you, so that you can get a set of full-size blue prints giving every detail of construction and wiring without any cost to you. These prints, sold separately, will cost a dollar and a half. However, if you will send in your name and address accompanied by two new subscriptions to R and M, these prints will be mailed to you without charge. Any two of your Experimenter friends will be glad to pay a dollar each to get R & M for a year, and we will start their subscriptions with the next issue, in which the super-heterodyne article will appear.

Some of the important features of radio design introduced by Mr. Sleeper, now widely used by Experimenters and manufacturers, are listed below. Look in the window of a radio store, or glance thru the pages of any magazine and you will see what a powerful influence R and M has in the radio industry.

Square Tinned Bus Bar

In Vol. 1, No. 2, square tinned bus bar, now universally used for connections, was first shown. To-day, bus bar is sold at the rate of hundreds of thousands of lengths per month.

Back of Panel Connections

This method was first shown by Mr. Sleeper in March, 1919. On almost all good sets the binding posts are at the rear of the cabinet, leaving the panel free of wiring.

Base Panel Mounting

Appeared first in R and M Vol. 1 No. 4, where it was used in the very popular 150 to 2600-meter receiver, the first longwave, single circuit receiver.

Moisture-Proof Transformer

Of the dozen transformers sealed in molded cases, the first design appeared in Vol. 1 No. 5, later revised into a type which has been a standard for four years.

Symmetrically Designed Controls

A feature of sets shown in R and M is the design of the controls, always attractive because of their symmetry of design. This method was introduced in Vol. 2, No. 1.

Picture Wiring Diagrams

In R and M alone appear the picture wiring diagrams, by which all the circuit guess work is eliminated. First shown in Vol. 2, No. 8, they are of tremendous help to Experimenters.

Step-by-Step Instructions

With the picture wiring diagrams, make radio construction so simple and safe that no experience is necessary to successfully make up the most elaborate sets.

Magazine Laboratory

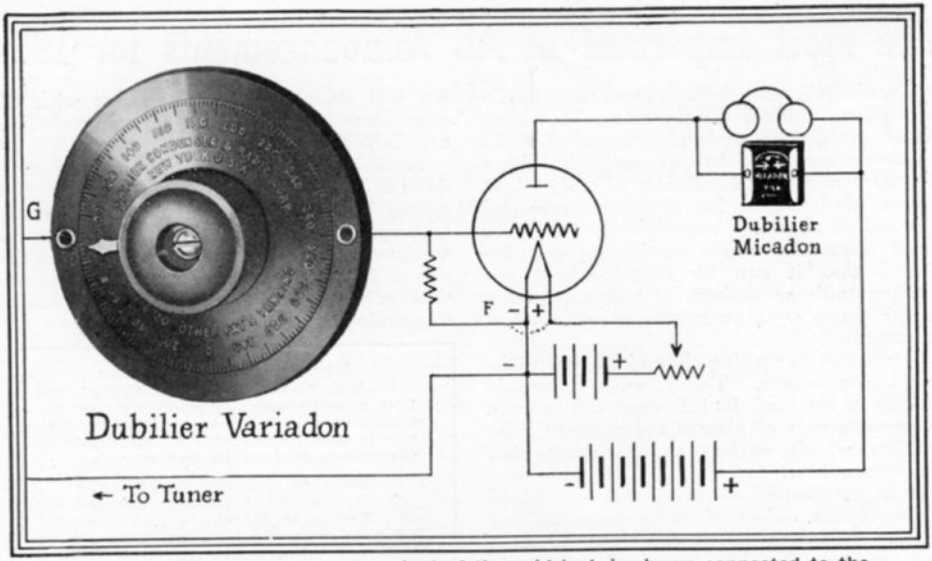
Of the magazines which have their own laboratories, in which sets are actually designed, built, and tested, R and M leads by two years in thus assuring the accuracy of data published.

The Fixed Coupler

Was brought out by Mr. Sleeper in Vol. 3, No. 4. This instrument has superseded the variocoupler, as it requires no taps, switches, soldered connections or coupling adjustment.

Non-Oscillating Tuned R. F. Transformer

Another R and M innovation, already in wide use. It is the only tuned R. F. transformer which does not produce oscillations, and in which the efficiency is not reduced by neutralizing condensers.



At F the filament terminal of the grid leak is shown connected to the negative side of the tube. Occasionally better results are obtained by connecting grid leak terminal to positive side of the tube

Better Than a Variable Grid Leak

BETTER than the average variable grid leak and a fixed condenser in a grid circuit are the Variadon, the Dubilier variable mica condenser, and a fixed grid-leak.

Better because it is difficult to control the resistance with the average grid-leak **but certain and easy to control the capacity** of the grid-circuit with the Dubilier Variadon and hence to prevent the accumulation of excessive negative charges on the grid.

Thus used with a fixed grid-leak the Dubilier Variadon greatly increases both the selectivity of the set and the volume of the signals. All the difficulties experienced when poor variable grid-leaks are used disappear.

Because of its compactness the Dubilier Variadon readily finds a place in the average cabinet. It is no larger than an ordinary dial.

Price 2.50. At all good dealers.

Dubilier Ducon (Socket-plug)

Dubilier Micadon (Fixed Condenser)

Dubilier Variadon (Mica Variable Condenser)

Write to Department III for a bulletin on the use of the Variadon in secondary circuits

DUBILIER CONDENSER & RADIO CORP.
48-50 West Fourth Street, New York City

DUBILIER DEVICES

Let the WAVEMETER Tell You

With a simple wavemeter you can easily calibrate your receiving set so as to tune immediately to any wavelength. Other interesting uses are also described

EXPERIMENTERS as a rule are not very familiar with wavemeters and their use, principally because they are expensive to buy and difficult to have calibrated when of the homemade sort. A wavemeter, however, makes radio work much more interesting, whether you are experimenting or simply operating a set to receive the broadcast stations. In fact, to work without a wavemeter is almost as bad as making drawings without a scale for, at best, it is only possible to guess at what the set is doing.

In the accompanying illustrations a very good wavemeter is shown of a type which can be made at home and does not require special calibrating for ordinary accuracy, provided the design data given is carefully followed. A chart is given here from which the wavelength can be determined at any setting of the condenser dial. Moreover, if you do want an accurate wavemeter, this type is thoroughly good in design and employs a condenser of the Malone-Lemmon type which can be depended upon to hold its calibration.

Uses of the Wavemeter

The exact methods of making tests are described later on but to show you what can be done with the wavemeter, the following suggestions are given:

With the wavemeter you can calibrate your receiving set so that, if you want to hear a particular broadcasting station, the wavelength of which you can determine from the programs or lists, it is only necessary to adjust your receiving set to the settings previously determined for that wavelength. Then you can be sure, if the station is not heard, that it is either out of range or not transmitting. In that way a great deal of the guess work can be taken out of tests for distant transmitters.

In designing radio sets to cover the broadcast wavelengths you can very quickly measure the set to tell if the coils and condensers are correct to give the range you expected.

When a set does not seem to give the proper results, the first thing to determine is whether or not it actually tunes to the wavelengths of the stations you expect to get. This can be very quickly settled if you have a wavemeter for testing.

In radio frequency amplifiers results sometimes are disappointing. With a wavemeter you can find out whether or not the transformers are responding to the full wavelength band that they are expected to cover.

Other uses will suggest themselves as you are carrying out experimental or testing work.

It is very easy to assemble the instrument shown in the accompanying illustrations for no machine work is required and the parts specified are readily obtainable.

Standard Parts Required

Altho in most apparatus, parts of various manufacturers can be often used interchangeably, in the wavemeter everything must be absolutely according to the specifications given here or the calibration curve will be inaccurate and useless. Even to the arrangement of the wires the original meter must be copied with the utmost fidelity.

The panels are 3/16-in. Formica. The front panel measures 7 by 10 ins., the base panel, 2½ by 5 ins., and the terminal panel on the coil measures 2½ by 3½ ins., cut from a 2½ by 5 in. panel.

A Malone-Lemmon condenser of 0.0005 mfd., without vernier, is required, a General Radio UV199 socket, two Carter closed circuit jacks and a Carter 2-spring jack switch. The binding posts are of Eby manufacture, standard on all R & M equipment. A 3¾-in. Kurz-Kasch knob and dial is used to control the variable condenser.

Laying out the Panels

Fig. 4 shows the panels and the coil at one-half scale. Dimensions are not given because they are apt to be confusing but you can very readily measure distances on the drawing and, doubling

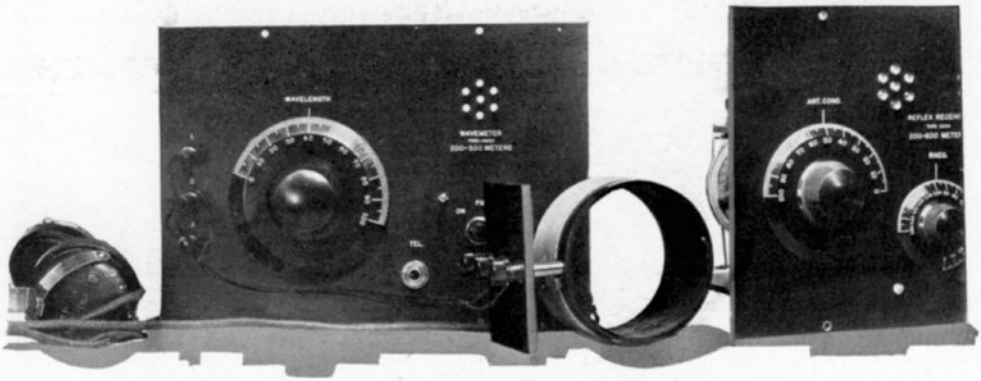


Fig. 1. This shows the wavemeter set up to calibrate the type 5500 receiver. Notice that the wavemeter inductance is coupled loosely to the first coil of the set. Be sure, when you cut off the leads from the meter to the coil that the outer ones are 12 ins. long and inner one 11 ins. long

them, transfer them to the panels. All the holes are made with a No. 18 drill except those for the condenser shaft, the jacks and the jack switch. The countersinking for the variable condenser mounting screws must be done carefully for otherwise it will mar the appearance of the front panel.

Engraving adds greatly to the appearance of the set and should be used if possible. At least it is necessary to scratch a line on the panel for the condenser dial to register against.

Formica comes with a very attractive polish but, if you prefer the dull finish, the panel can be rubbed down with No. 0 sandpaper and oil. Put the oil on the sandpaper and spread it all around with your finger. It cuts better than dry sandpaper. Put the sandpaper on a block and work carefully near the edges of the panel so that you will not round them off.

Winding the Coil

You cannot be too careful when you wind the wavemeter inductance coil to make it exactly according to the specifications, for a slight change, an extra turn, or loose winding, will alter the inductance of the coil and throw out the calibration.

The tube is of Formica 3½-ins. in diameter and 2½-ins. long. The winding starts ½-in. from one end of the tube and extends for exactly 1½-ins. This gives just enough space for 35 turns of No. 20 D.C.C. wire, (No. 18 S.W.G.). You must put on the wire very tightly and get the turns close together or they will extend over the 1½-in. limit. Two holes are drilled for the start and finish, one for the wire to go in and another for the wire to go out again. This will hold it tightly if the holes are made with a No. 50 drill. At the twentieth turn you must take off a tap by twisting the wires together. It is advisable to solder the wires together at this point before you proceed with the winding so that the tap will not become loose. In line with the terminals of the coil and ¼-in. in from each end you must have a No. 18 hole to take a ½-in. 6-32 R. H. screw, threaded into a coil mounting pillar. The shanks of the Eby binding posts are also threaded 6-32 so that they serve to hold the terminal panel to the coil mounting pillars. The terminal panel is made 3½ by 2½-ins. in order that it may act as a support to the coil when it is put down with the turns horizontal or vertical.

Assembly and Wiring

As you proceed with the wiring, check every connection carefully against the illustrations so as to make their arrangement and length as nearly the same as in the original wavemeter as possible. This precaution is necessary to maintain the accuracy of the calibration curve. Do not use soldering paste unless it is absolutely essential but, instead, dissolve a small piece of rosin in a little alcohol and let it stand until the solution has become fairly thick. Put a little of the rosin on each joint and heat it until the solder flows freely. More heat is required with rosin than with paste. Any leakages from soldering paste will be reflected in the broadness of the wavemeter tuning. Have the lugs pointing in the directions indicated by the heavy lines in Fig. 2. You will find the Spintite wrenches very convenient for tightening the nuts.

The inductance coil should be assembled first. Put a ½-in. 6-32 R. H. screw through the hole in the tube at one end, a soldering lug on the screw, and then turn down a coil mounting pillar on it. Do the same thing on the other side. Mount an Eby binding post with a soldering lug in the center hole of the terminal panel. Then put the terminal panel on the coil mounting pillars and turn down an Eby binding post at each end into the threaded holes of the coil mounting pillars, using them as screws to hold the panel to the pillars.

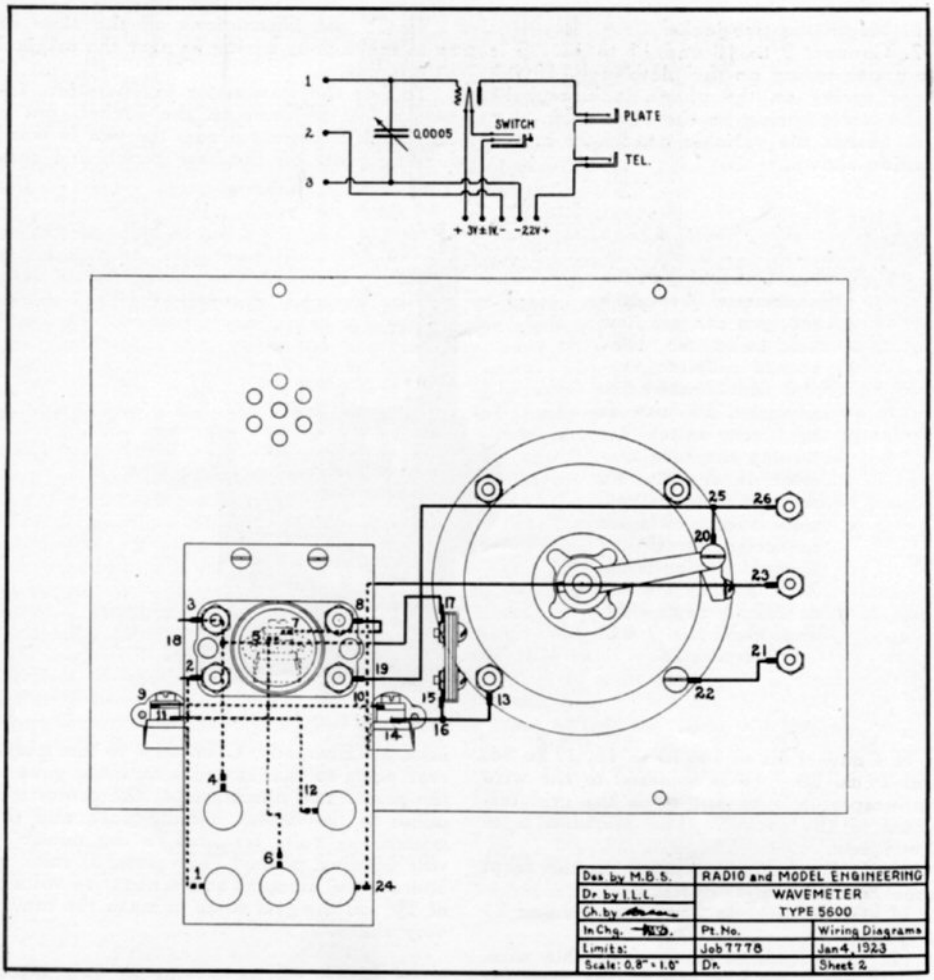


Fig. 2. Schematic and picture wiring diagrams of the wavemeter. The base panel is dropped down so as to show the connections as they are actually made in the original meter. Notice the new method for making contact in the rotary plates on the Malone-Lemmon condenser

Connect each end of the coil with the shortest possible lead to the lug on the adjacent pillar and the tap on the coil to the center binding post. The panel should be put on so that binding post 3 is connected to the end of the coil nearer the tap.

Then you will be ready for the assembly of the wavemeter itself.

1. Mount the binding posts and socket on the base panel. Have the holes in the three rear binding posts pointing front and back and in the two forward binding posts, sidewise. Remember to put lugs under the nuts.

2. Connect 1 to 2 and 3 to 4. The first wire runs along the under edge of the panel from + 3 volts to the filament binding post on the socket. The second wire is also close to the panel, running to the plate terminal of the socket.

3. Mount the base panel on the front panel using 1-in. lengths of $\frac{3}{8}$-in. angle brass, secured with $\frac{1}{2}$-in. 6-32 screws and nuts.

4. Mount the jack switch. The nickel plated handle unscrews so that the Bakelite knob can be taken off. Then the switch is held to the panel with a nut in the same way that a jack is secured.

5. Connect 5 to 6 and 7 to 8. 5 is the lower spring on the switch, 7 the upper spring, and 8 the filament terminal of the socket.

6. Mount the two jacks.

7. Connect 9 to 10 and 11 to 12. 9 is the upper spring on the plate jack, 10 the upper spring on the phone jack, and 11 is the lower spring on the plate jack.

8. Mount the variable condenser in the position shown.

Watch the illustrations all the time so as to make your wiring as near the original as possible.

To put the wavemeter in operation, insert a UV199 tube in the socket, put a 22½-bolt B battery across the two forward binding posts on the base panel, and connect an Eveready C battery to the three rear posts so that the plus terminal goes to the plus 3 volt binding post, the center terminal to the center binding post, and the minus 4½ volts terminal to the minus 1-volt binding post. This gives 3 volts to operate the filament and a negative voltage of 1½ on the grid so as to make the tuning very sharp.

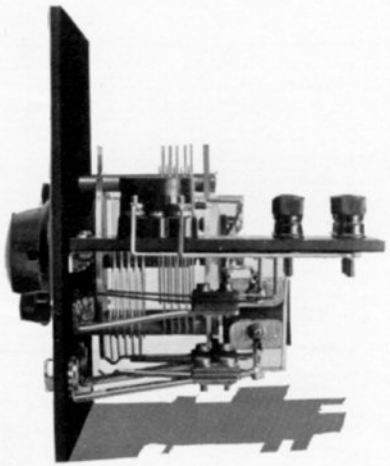


Fig. 3. Looking at the wavemeter from the end, you can see how the jacks for telephones or plate current milliameter are arranged, as well as the jack switch for turning the tube filament on or off. No rheostat is needed, since only 3 volts are connected across the filament binding posts. All the leads are run as directly as possible, and kept fairly well separated

9. Connect 13 to 14, 15 to 16, 17 to 18, and 19 to 20. 18 is soldered to the wire running from 3 to 4. 19 is the grid terminal of the socket. The Micadon is of 0.001 mfd.

10. Put the binding posts on the front panel with the holes horizontal.

11. Connect 21 to 22, 23 to 24, and 25 to 26.

12. Cut off three leads of flexible wire, two 12 ins. long and one 11 ins. long for connections between the panel and coil. The short lead is for the center. Bind the wires tightly together with thread.

Use of the Wavemeter

The circuit of this wavemeter is that of a standard oscillator. Therefore, when you turn on the switch to

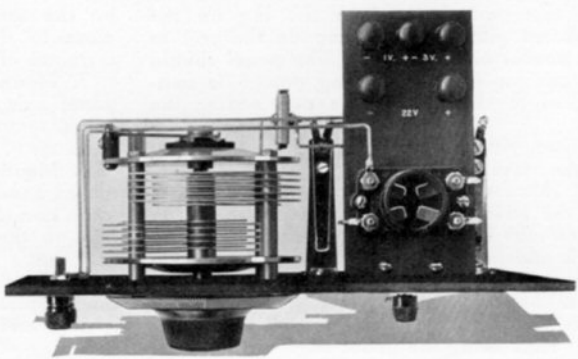


Fig. 5. A top view of the wavemeter. It is important to mount the instrument in a cabinet to prevent the accumulation of dust around the bearings and between the plates

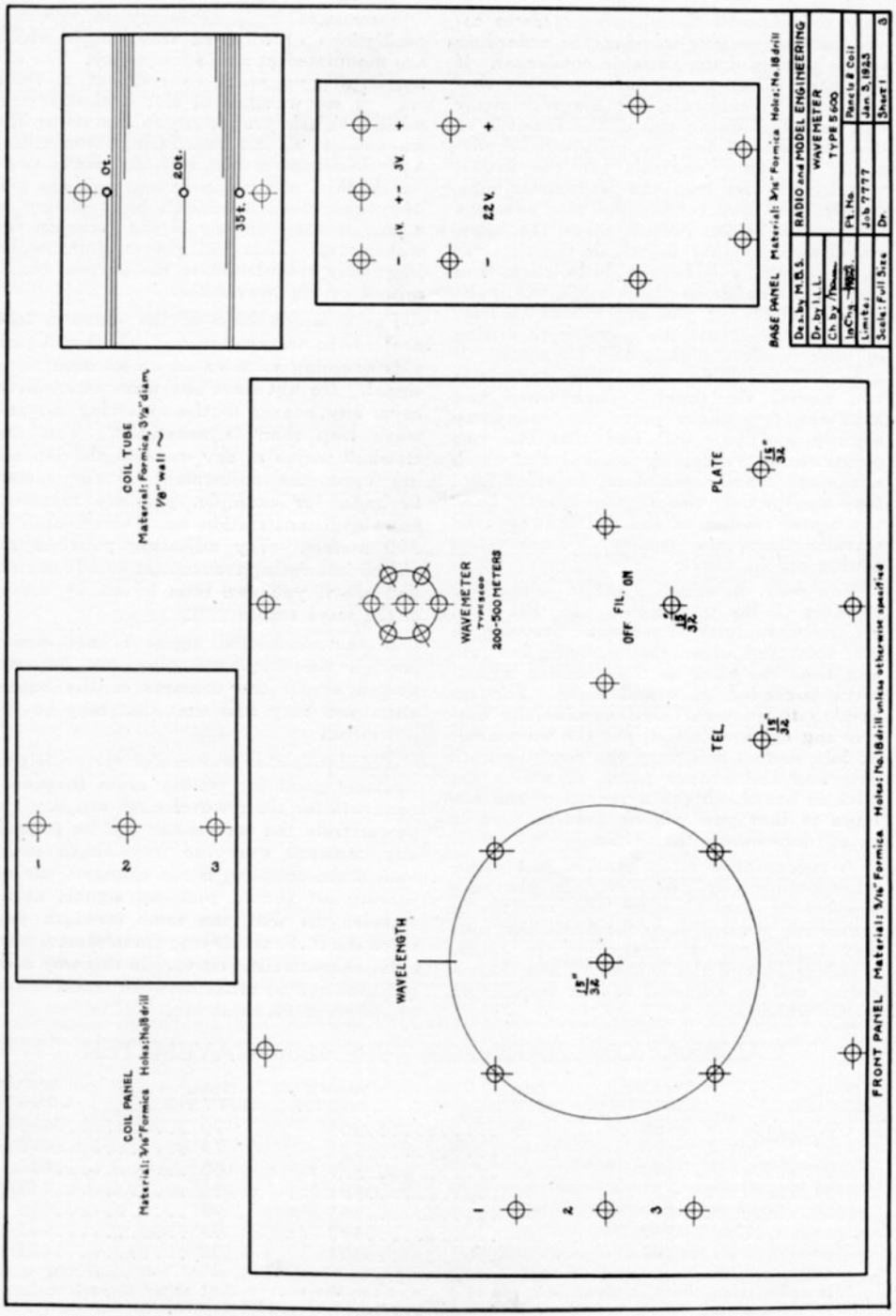


Fig. 4. One-half scale drawing of the front, base, and coil panels, and of the wavemeter inductance

light the filament the circuit generates oscillations of various wavelengths according to the setting of the variable condenser. If you have a non-regenerative receiver that you wish to calibrate, set the wavemeter coil near the tuning coil of the receiver so that the axes of the two coils will be parallel. Set your controls for the lowest wavelength and turn the wavemeter condenser back and forth. As you pass the wavemeter setting which gives the same wavelength as that to which the receiver is tuned you will hear a little click, and turning the condenser back again will make another click. If you are unable to hear this sound, increase the wavelength setting of your receiver slightly and try again. If it is still inaudible, move the wavemeter coil nearer the tuner. Then when you hear the two clicks move the coil away slightly and you will find that the two points on the wavemeter condenser at which clicks are heard come closer together until they may be only two degrees apart. Then the center reading of the dial indicates the wavelength of the receiver. Locate this setting on the chart.

You may, however, want to adjust the receiver to the wavemeter. In that case, set the wavemeter at whatever wavelength you want and adjust the receiving set until you hear the click as the receiver adjustment is moved back and forth. For example, if you want to determine the correct settings for KDKA, put the wavemeter at 326 meters and vary the controls until you find the proper place at which the click is heard. Make a record of the settings so that you will be able to turn to them immediately thereafter.

A regenerative set is handled in a somewhat similar way. However, as you vary the tuning control when the receiver is oscillating you will hear the usual beat note squeal. Adjust the control to the center or silent part of the squeal. Then the receiver will be adjusted to the wavelength of the wavemeter.

Sometimes it is necessary to transmit oscillations of a given wavelength which are modulated at audio frequency. For example, if you want to test out a wave trap to see whether or not it absorbs unwanted signals properly, you can set up the wavemeter as an interfering transmitter and then tune it out with the wave trap. To do this, wire up a buzzer and dry cell and connect the terminals of a battery to a plug inserted in one of the jacks on the wavemeter. This will give a slight audio frequency modulation to the current transmitted by the wavemeter.

Put a single loop of the antenna lead around the wavemeter coil. This will provide coupling so as to set up an interfering signal. Do not have the wavemeter, however, any nearer to the receiving set and wave trap than is necessary. You can transmit waves at any wavelength, depending upon the adjustment of the meter. Perhaps, for example, you are receiving from a distant station on a wavelength of 360 meters. Try adjusting your improvished interfering transmitter to 390 meters and see if you can tune it out by means of the wave trap.

If the modulated signal is not strong enough the telephone plug can be connected across the contacts of the buzzer altho you may find that that may be too powerful.

This modulated wavemeter system is particularly good for testing radio frequency receivers for their wavelength range. The power from the wavemeter will be practically constant over the wavelength range and, if the coupling is not changed, the receiving set should pick up signals at all wavelengths with the same strength provided the R. F. amplifying transformers have a flat characteristic curve. In this way comparisons can be made between transformers of different manufacture.

CALIBRATION CHART FOR TYPE 5600 WAVEMETER

DIAL SETTING	WAVE LENGTH	DIAL SETTING	WAVE LENGTH	DIAL SETTING	WAVE LENGTH
0°	160	35°	303	70°	405
5°	170	40°	322	75°	418
10°	199	45°	337	80°	430
15°	221	50°	351	85°	443
20°	245	55°	365	90°	455
25°	267	60°	379	95°	465
30°	287	65°	392	100°	475

This calibration chart is given in place of a curve for the reason that some Experimenters have trouble in reading curves. However, if you want to read intermediate settings, you can make your own curve from the calibration given. This calibration is not altered by the connection of phones or plate current meter

RADIO & MODEL ENGINEERING

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Vol. IV JANUARY, 1924 No. 1

EDITORIAL

LAST week I went to see a man employed as an engineer by one of the smaller radio companies. He apparently tried to make up for falling short of a real radio engineer by talking very loudly and very positively. He waved his hand with a motion of finality and said, "You're done, you're thru! This new stuff every month is all over. There's nothing to it. Nobody wants it any more!"

I guess he expected me to go back to the office and tell everyone not to come in the next day, that the Magazine had appeared for the last time.

Every once in a while someone crops up—probably you have had the same experience—who is so positive that there is no future in radio that he is almost convincing for the moment. Or the argument may be that the day of the home made set is over, for complete sets can be bought so cheaply that there is no reason for making them.

"He who knows not, and know not he knows not—pity him." He just doesn't understand us Experimenters. He thinks we're building sets to hear radio signals. So let's tell him our story:

What we're really doing is building things that work. If it were not radio, it would be something else. But we like radio because it gives us something to make, something that is scientific and mechanical that appeals to us thru its appearance, and because it has controls which do things. We choose it particularly because it gives us results to work for. Altho we love to build apparatus, the climax of completion is dependent upon the anti-climax of operation. We don't mind if we can't make everything work right the first time every time. In fact, trouble hunting is a part of the fun, but we must make it work finally, always.

If they think we'd buy a set because its cheaper than building one, its because they haven't our way of looking at things. They can't see the beauty of good mechanical design, feel the thrill of smooth controls. They don't know why we always look inside every new set we see. Probably that third-rate engineer who said everyone had stopped building sets was the kind of a man who would turn a hand drill backwards, and wonder why he couldn't make a hole in a panel.

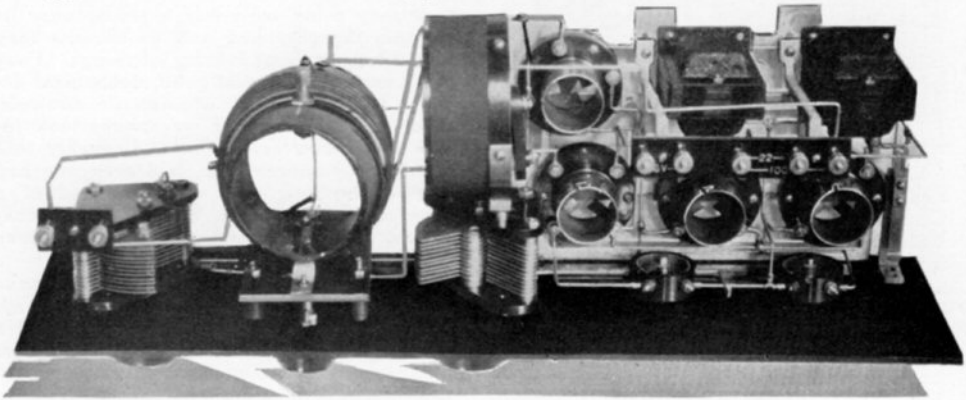
But as long as there is radio we'll make new sets and try new experiments. Why, that's part of our being Americans! When we stop, the United States will no longer be the leading nation in science, in education, manufacturing, invention, indeed, leading in the development of radio. From the Experimenters came the steam engine, the electric light, the phonograph, automobile, airplane—radio itself.

Yet some manufacturers of complete sets want to discount us. They tell their dealers that we don't amount to anything—just a few nuts. They have forgotten that we were the only customers they had before broadcasting, that we interested enough others in radio to make a broadcast audience at the time of the Dempsey-Carpenter fight, and that every single day we are doing their field work for them in helping people operate sets they have bought.

Who are the engineers but advanced Experimenters? Look back a few years and you will see Al Grebe tinkering in his barn, Bill Priess wondering what made it work, Dr. De Forest burning his fingers in a bunsen burner, Charlie Logwood trying to do the same thing twice, Marconi himself wondering if the V's would hold out until they got across the Atlantic. To-day, Dr. Goldsmith doesn't feel sure that it will until he tries it! It seems weeks ago instead of years that Bowden Washington was inspecting Wireless Specialty sets at Cambridge, Claude Cairns making transformers in a little upstairs shop, and Melville Eastham showing boys how to wind tuning coils with thread to separate the wire.

I am glad to say that these men have never forgotten us Experimenters, nor do they feel that they have grown too far beyond us. They know, too, how rapidly our number is increasing, and they realize that we are the best friends they have, for upon us depends the future of the radio industry, just as we are responsible for its past.

M. B. SLEEPER, Editor.



The Tuska Superdyne

Altho a tuned impedance circuit is used for radio frequency amplification, this set does not oscillate because a reverse feed-back is employed

EVERY once in a while someone surprises us by doing a perfectly obvious thing that all of us should have thought of doing long ago. The last example of this sort is the Tuska Superdyne circuit which has been brought out recently.

The accompanying illustrations show the circuit of the Superdyne and the rear view of the assembled set. The idea behind the arrangement is to provide a receiving set which will have the efficiency of a regenerative receiver combined with the advantages of a radio frequency amplifier and yet will not oscillate. This seems like quite a problem, but it is accomplished in a simple and very interesting way.

Actually, the Superdyne is made up of two types of oscillating circuits, in which one prevents or neutralizes the tendency of the other to oscillate.

If you go over the wiring diagram carefully you will see that the tickler coil is connected in the plate circuit of the first tube, coupled back to the secondary of the fixed coupler. In addition, a tuned impedance circuit is connected in the plate. The first tube is for radio frequency amplification. The tuned impedance circuit provides the coupling between the R. F. amplifier and the second tube, which is the detector.

If you have used the tuned impedance type of circuit you know that it oscillates so strongly that it is useless in speech reception. That is where the tickler coil comes into action.

Have you ever noticed, in a regenerative set using a tickler coil, that when you turn the coupling ball from zero coupling in one direction the signals become stronger until oscillations start? Turning it from zero in the other direction, however, the signal strength is decreased. In the first case, the feedback coupling is positive and in the second negative. In other words, with positive feedback part of the plate circuit energy is fed back to the grid with the result that the resistance in the grid circuit is reduced and the signals come in with greater strength. With negative feedback, however, energy is absorbed from the grid and the resistance of the tuning circuit increased. Consequently, when the impedance circuit for the R. F. coupling to the detector is tuned to the incoming signals and the R. F. amplifier starts to oscillate the negative feedback increases the resistance of the tuning circuit to a point where it is just high enough to prevent oscillations from taking place.

In this set fixed coupling is employed between the untuned primary circuit and the secondary. The primary winding consists of four turns, spaced one-fourth inch apart, wound directly over the secondary. This provides more of a capacity coupling than an inductive coupling, as is the case when the primary turns are wound close together. It is generally considered that

the inductive coupling is more efficient altho opinion varies considerably on this point. No tuning adjustment is provided for the antenna circuit as that is not necessary.

In the illustration of the receiving set you will see the variable condenser for tuning the secondary mounted at the left, then comes the coupler carrying the primary and secondary windings on the tube and the both for negative feedback. On the right is an inductance mounted on a condenser. These are connected in the tuned impedance circuit. One of the sockets is for the R. F. amplifier tube, which should be a UV201A, another socket for the UV200 detector, and two more for the UV201A amplifier tubes.

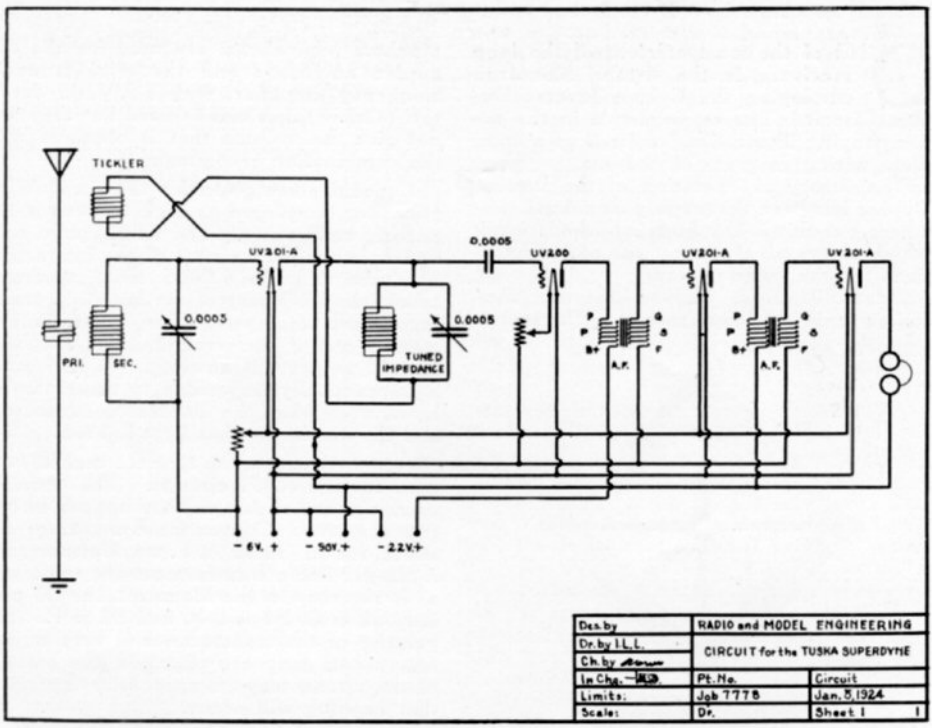
For the Experimenter who wants to build one of these sets, the following data is given on the condensers and inductances:

The coupler should be made up on a tube 3½ ins. in diameter and 2½ ins. long. The secondary winding starts ¼ in. from the end and has 39 turns of No. 24 S. S. C. wire (22 S. W. G.). The primary winding, separated by ⅛ in., has eight turns of the same wire. Arranged at the end of the secondary connected to the grid is a coupling ball 3 ins. in diameter wound with No. 24 S. S. C. wire. This comprises the tuning unit.

The secondary coil is shunted by a variable condenser of 0.0005 mfd. maximum capacity.

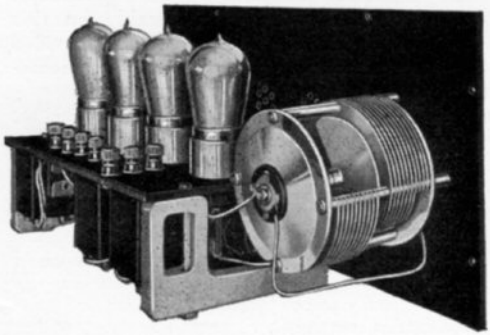
The inductance for the impedance circuit is identical to that for the secondary of the tuning unit, and it also is shunted by a 0.0005 mfd. variable condenser. The rest of the parts for the circuit may be of any good design.

To operate the Superdyne, after the tubes have been approximately adjusted, set the tickler at about zero coupling and tune both variable condensers at the same time. The readings of the condenser dials should be very nearly the same. As soon as signals are heard and the condensers adjusted exactly, change the tickler coupling coil until the circuit does not oscillate. Readjust the filament controls. That will clear up the speech or music and, of course, prevent re-radiation. Be careful that you do not keep the circuit in oscillating condition for any length of time so that it would interfere with reception at other receiving stations.



The Superdyne receiver equipped with a two-step audio frequency amplifier. Primary, secondary, and tickler are combined in one tuning unit. The impedance circuit coil should be mounted at right angles to the secondary winding, to prevent coupling between them. Do not put a grid leak across the grid condenser, for then the voltage on the R. F. amplifier tube would be applied to the grid

The 4-Tube Monotrol

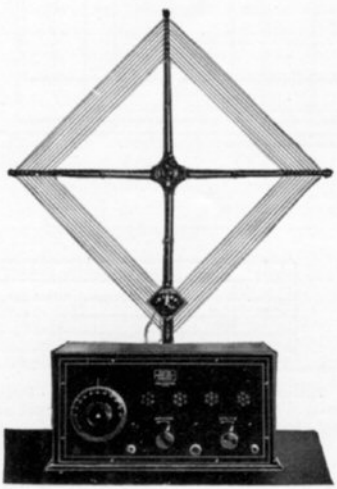


At last the complete wiring diagram and constants of the 4-tube Monotrol are now available for publication

ONE of the most efficient of the loop receivers is the 4-tube Monotrol, employing the Grimes Inverse Duplex Circuit. The set is shown in the accompanying illustrations, as well as a complete wiring diagram of the set.

The theory of operation of the Inverse Duplex has been thoroughly explained elsewhere but this is the first published circuit which shows all the constants and connections for the transformers.

An 0.001 mfd. Malone-Lemmon condenser tunes the loop antenna. The switch



The loop is carried on a bracket secured to the rear of the cabinet. Thus the loop can be rotated without interfering with the operator

on the loop does not alter the wavelength but changes the number of turns of the loop which are connected across the grid and filament of the first amplifier tube, as you will see when you examine the diagram closely. UV201-A tubes, or the Cunningham equivalents, are used for the two duplex amplifiers and the straight audio frequency amplifier, with a UV200 detector. Other tubes can be used but they will not give the volume that is obtained with the combination recommended.

Capacities are given for the six Dubilier Micadons, employed as high frequency bypassing condensers. The 0.0025 mfd. condenser in the plate circuit of the first amplifier tube and the 0.0005 mfd. condenser across the secondary of the last A. F. transformer are employed to keep the radio frequency out of the straight A. F. amplifier circuit, to prevent howling. In this outfit it is practically impossible to make the set howl, even when the detector is turned out and the amplifier tubes kept lighted.

Acme transformers, type R2 and R3, are used for the R. F. circuits. The terminal markings are shown as they appear on the transformers. Conventional markings are shown for the three A. F. transformers, but if Sleeper Radio transformers are employed, as is the case in the Monotrol, the S1 post is F, S2 is G, P1 is B+, and P2 is P. The polarity of the transformers is very important for, if they are changed, the balance of the circuit may be upset with the result that howling will occur.

On the front of the panel are two jacks and a filament switch. Connections are not shown for them in the diagram but the left hand jack connects the telephones in the plate circuit of the first tube, cutting out the one stage of straight A. F. amplification. The second jack is connected as shown in the diagram. Altho the tubes can be turned out by the Cutler-Hammer rheostats a filament circuit switch is provided so that, when the rheostats are once adjusted, they can be left in position and the tubes turned off or on by operating the switch.

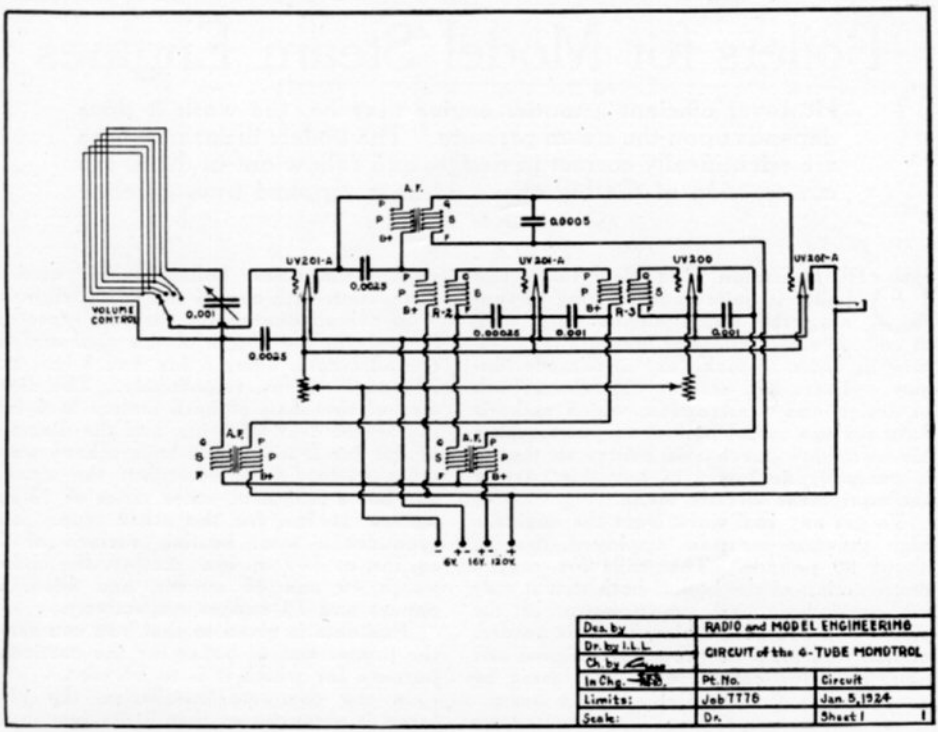
This circuit can be applied to the 4-tube

Inverse Duplex set described in Reflex and Radio Frequency and in Radio and Model Engineering Vol. 3, No. 6. If that set is changed in accordance with the wiring diagram given here no further difficulty should be experienced from howling.

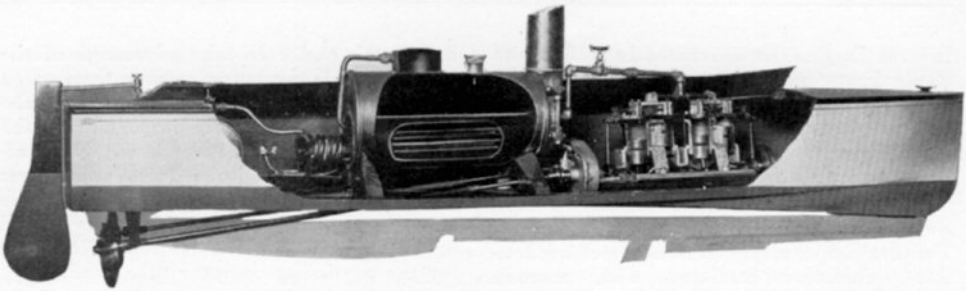
The loop measures approximately 20 ins. on a side, and is wound with 9 turns of Tautflex cable, a special non-stretching flexible conductor insulated with maroon colored silk. This is becoming the standard wire for loop sets because solid wire does not hold its shape. Tautflex, however, is made up of phosphor bronze wire and does not stretch even when heavily loaded.

This set is very easy to install and operate. The only serious difficulty that has been encountered with these sets is the failure on the part of the purchasers to follow exactly the instructions given. Every radio set has peculiarities of its own and it is much easier to take advantage of the experience of the manufacturer than to go ahead regardless and learn by making mistakes first. Particularly important is the correct voltage on the detector. With almost every UV200 tube 16½ volts gives the best results altho it is advisable to use a tapped battery, so that it can be varied up to 22½ volts to get the best adjustment for the particular detector tube used.

The design of the set is such that all the working parts are neatly concealed beneath the base panel. This provides mechanical protection and also prevents accumulation of dust. When the set is assembled screws are put through the bottom of the cabinet and into the cast aluminum frames under the base panel. These screws are then sealed, thus making it possible to absolutely guarantee the proper operation of the set as long as the seals on the screws are left unbroken.



The two left hand tubes are duplexed to give both radio and audio frequency amplification, then comes the detector and one stage of straight audio amplification. If you want to use telephone receivers, put a double circuit jack in the plate circuit of the first tube so as to disconnect the A. F. transformer when the plug is inserted



The Care and Use of Center Flue Boilers for Model Steam Engines

However efficient a model engine may be, the work it does depends upon the steam pressure. The boilers illustrated here are scientifically correct in design, and follow out in detail the construction of the big ones. Heat is supplied by a gasoline blow torch

THE operation of a blow torch and boiler is quite as interesting as running the steam engine itself and, of course, some source of pressure is necessary in order to make use of a model engine. There are certain difficulties, both of design and construction, which make it hard for the model builder to put together his own blow torch and boiler, so that it is generally necessary to buy this part of the equipment already made.

To get any real work from the engine a high pressure must be employed, that is, about 80 pounds. This calls for rugged construction of the boiler, both that it may withstand heat and the pressure of the steam. In addition, a blow torch is needed, and it, too, must be properly designed and assembled for considerable heat must be generated to produce high pressure steam.

In the accompanying illustrations two very interesting power plants are shown. In one case, the power plant is mounted for testing purposes on a stand. You will see the arrangement of the blow torch, boiler, engine, and propellor shafts. The other picture shows the power plant of a model boat, the side of which has been cut away. In addition, the boiler and pipes are open to show just how the arrangement appears inside.

These arrangements are shown so that you can see how the power plant should be put together, whether the engine is to operate a boat or some mechanical device. The larger engines generate sufficient power to run small dynamos and similar devices. The boilers are made in two sizes, altho either boiler can be used in connection with any of the small engines.

In overall dimensions the two types differ only in the length of the shell and the overall length, being 6 ins. and 8 ins., and 7¾ and 9¾ ins. respectively. The diameter of the shell of both boilers is 4 ins., the height over all 5 ins. and the diameter of the flue 2 ins. Both boilers have water tubes ¼-in. in diameter but the smaller size has a length of water tubes of 12 ins. against 16 ins. for the other type. This produces a total heating surface of 81 sq. ins. or 109 sq. ins. Empty, the boilers weigh 40 and 48 ounces, and filled, 60 ounces and 78 ounces respectively.

This data is given so that you can select the proper size of boiler for the particular purpose for which it is to be used.

In the complete installation the blow torch is arranged so that it fits just inside the boiler as you will see from the illustrations. This directs the flame on to the water pipes which are brazed into the inner wall of the chamber which carries the water. As soon as heat is applied the water circulates automatically from the shell through the pipes. The water, heated almost instantaneously as it reaches the water pipes, passes out as steam through the connection provided to the engine.

At the end of the boiler is a casting which carries the water gauge, showing the amount of water in the boiler and also acts as an outlet for the burned gasses, to which a funnel can be attached. A safety valve at the top of the boiler prevents an explosion from excessive pressure. This safety

valve is carefully set and tested to release when the pressure starts to become dangerously high.

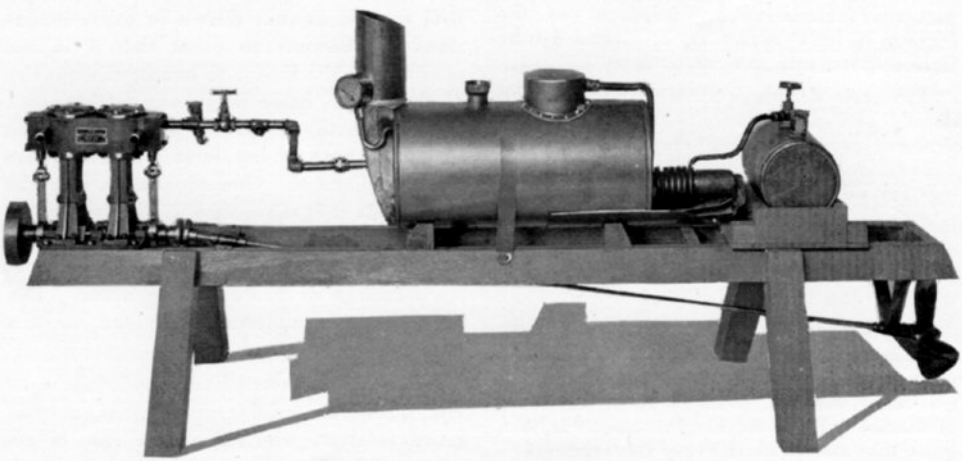
The operation of the boiler is simple enough, as it is only necessary to fill it and keep it full, pouring in water by hand or pumping it from an auxiliary water pump attached to the engine. The blow torch, however, must be carefully handled in order to get the greatest amount of heat from it. The tank should be filled about half full with strained gasoline. Then it must be pumped up to 15 pounds pressure by means of a bicycle pump attached to the connection provided. A little experience will very soon show you how many strokes are necessary to give the proper pressure. Then the vaporizing coils on the burner tube should be heated to the sizzling point, preferably from a can of Sterno. As soon as the needle valve, controlled by the small wheel at the top of the gasoline tank, is open the burner should give off an almost colorless flame accompanied by a loud roaring sound. The operation, you will see, is much similar to that of a plumber's gasoline torch. Open the needle valve very slowly so that the heater coils will not be cooled by an excessive flow of gasoline. The flames should be 6 or 8 ins. long.

Just back of the nozzle is a small asbestos filter which should be replaced occasionally. It can be reached by unscrewing the plug. The nozzle itself requires occasional cleaning with a very fine sewing needle or wire.

When you are ready to shut off the blow torch, cut off the gasoline supply by closing the valve. Remember, however, that the flame will continue to burn until the gasoline in the vaporizing coils is used up. While there is a prevailing objection to the use of gasoline, this blow torch is absolutely safe and cannot explode or do any damage.

A number of interesting tests and experiments can be made with the power plant set up on a stand as illustrated below. It is always advisable to arrange some kind of a load on the engine, either to extend the shaft far enough so that it can run in a bowl of water or to put on it a drum against which a friction device operates. Otherwise, when the steam is turned on, the engine will run wild. If you use a drum to which a string and weight are attached you can determine the work produced by the engine according to the weight of the load at the end of the string and the length of time required to raise the load a given distance.

The rate at which work must be done to produce 1 horse power is equivalent to raising a 1-lb. weight 33,000 feet in one minute, or 550 lbs. 1 foot in one second. On this basis you can tell exactly what fraction of a horse power is produced by the engine. If you set the power unit on a table so that the drum is 3 feet above the floor and it will raise a 10 lb. weight that distance in twelve seconds it will be producing 150 foot lbs. of work per minute. The horse power is determined by dividing 33,000 by 150. This gives a horse power rating of 1/222.



A two cylinder marine type engine set up with the boiler and blow torch. The tiny gauge on the boiler is accurately calibrated to show the steam pressure developed. By testing out the power plant on a stand of this sort, you can find out just what can be expected when it is installed in a power boat

Standardized Parts List

The materials used to make up the sets described in this issue were supplied by the following companies. The manufacturers whose names appear below will be glad to send you bulletins describing other products which they make. Please mention R & M when you write them.

PARTS FOR THE TYPE 5600 WAVEMETER

Carter Radio Co.
G-209 So. State St., Chicago, Ill.

Type	Name	Price
102	2—2-spring jacks	$1.60
2	1—2-spring jack switch	1.00

Dubilier Condenser & Radio Corp.
A-48 W. 4th St., New York City

601	1—0.001 mfd. Micadon	.40

H. H. Eby Mfg. Co.
X-701 Chestnut St., Philadelphia, Pa.

Ensign	11—Ensign binding posts	2.20

General Radio Co.
11-R Windsor St., Cambridge, Mass.

299	1—UV199 socket	.75

Kurz-Kasch Company
South Broadway, Dayton, Ohio

A-218	1—3¾-in. tapered knob and dial	1.20

Malone-Lemmon Laboratory
342-R Madison Ave., New York City

A-45	1—0.0005 mfd. balanced condenser	5.00

MISCELLANEOUS PARTS

153	1—Formica panel 7x10x3/16-in.	1.81
98	2—Formica panels, 2½x7x3/16-in.	1.06
58	1—Pkg. 25 tinned lugs	.25
47	4—2-ft. lengths sq. tinned copper bus bar	.20
22	1—Right hand nickeled angle bracket	.10
185	1—Left hand nickeled angle bracket	.10
63	1—Pkg. 10 ½-in. 6-32 R. H. nickeled screws	.12
143	1—Pkg. 10 1-in. 6-32 R. H. nickeled screws	.14
174	1—Formica tube 3½ ins. diam. 2½ ins. long	.56
43	1—½-lb. spool No. 20 D. C. C. wire	.80

AUXILIARY EQUIPMENT

National Carbon Company
Long Island City, N. Y.

763	Small 22½-volt B battery	$1.75
766	Large 22½-volt B battery	3.00
767	Large 45-volt B battery	5.50
771	4½-volt variable battery	.70
6810	50-amp. storage battery 6-volts	15.00

Stanley & Patterson
West & Hubert Sts., New York City

843	Deveau Gold Seal Phones, 2200 ohms	6.00
844	Deveau Gold Seal Phones, 3200 ohms	8.00

C. Brandes, Inc.
2327-M Lafayette St., New York City

	Brandes Table Talker	10.00

Pacent Electric Co.
A-22 Park Pl., New York City

40	Universal phone plug	.50
51	Twinadapter for two plugs	1.00

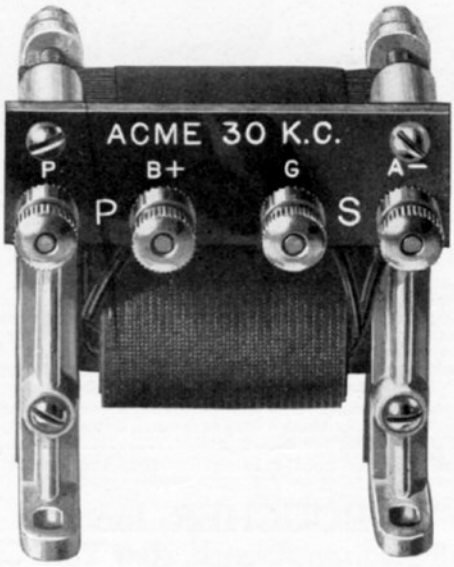
Stevens & Company
395 Broadway, New York City

	Set of 3 Spintite wrenches for nuts	1.00

RADIO QUESTIONS

The number of questions from Experimenters concerning radio apparatus described in RADIO AND MODEL ENGINEERING as well as that shown in other magazines has become so great that it is not possible for the Editor to handle the queries of those who come in person to the office and call on the telephone, and at the same time take care of letters to which answers must be dictated. Consequently a rule has been made that those who wish to ask questions in person must come between the hours of 11 and 12. For this personal service a charge of $2.00 will be made. The time for consultation is limited to ten minutes.

Altho we have tried to answer all written questions, preference is, of course, given to those who follow the rule of remitting 25 cents for each question asked. Unpaid inquiries must, naturally, be handled after those which are paid.



For Super Heterodyne Receivers

The new Acme 30 K. C. long wave transformer is the first R. F. transformer to be put on the market which is really suitable for super heterodyne receivers and which gives the full efficiency of that type of circuit.

If your friends use eight tubes, use only six in your set with Acme 30 K. C.'s and your set will be superior as to volume and distance.

Acme 30 K. C. transformers are in stock at DURRANT. You can get them at the DURRANT office, or they will be shipped immediately by mail. The price is $5.00 each, plus 10c. for insurance.

DURRANT can also furnish all parts and supplies required to build any set described in R & M. Note: Orders for C. O. D. shipments must be accompanied by a remittance of one-fourth the amount of the order.

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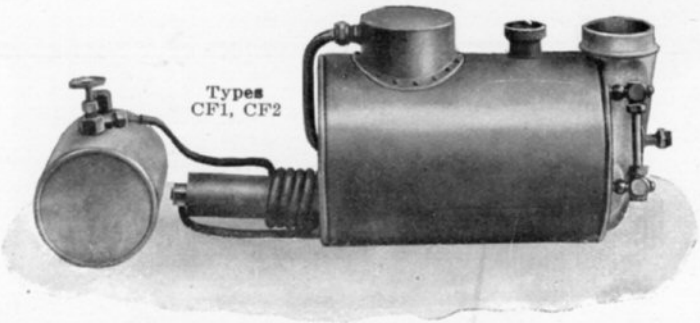

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Super-heated blow torch for either boiler.....Price $5.00

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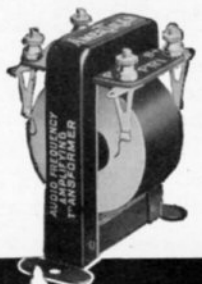

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American Transformer Co., 173 Emmet St., Newark, N. J.

Designers and builders of radio transformers for over 22 years

A Page Of Things For The Experimenter

Who Is Building His Own Radio Equipment

2-Step A. F. Amplifier.....3100
A distortionless audio frequency amplifier, equipped with jacks, which can be used with any of the receiving sets. Full size blue prints, 3 sheets.....$.75

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Designed in accordance with the original Reinartz specifications, this set is the most efficient of Reinartz receivers. Full size blue prints, 4 sheets.....$1.00

3-Circuit Regenerative.....X1900
Most famous of 3-circuit tuners is the X1900. It is still standard after three years' use. Full size blue prints, 3 sheets....$.75

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Non-regenerative receiver for local reception on a loud speaker. Can be made regenerative by adding a variometer. Half size blue prints, 2 sheets.....$.50

Sleeper Circuit Set.....4000
A most efficient 2-control regenerative receiver, very easily constructed at small cost. Full size blue prints, 3 sheets....$.75

1-Tube Reflex.....4200
The best type of 1-tube Reflex ever produced unsurpassed in quality of reception. Full size blue prints, 3 sheets.....$.75

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Radio Frequency Receiver.....4600
A 1-control receiver using two steps R. F. amplification and detector to which A. F. amplifiers can be added. Full size blue prints, 4 sheets.....$1.00

The Duotrol.....4800
A 2-variometer regenerative set using no inductance switches or coupling adjustment. 150 to 1000 meters. Full size blue prints, 5 sheets.....$1.25

Tuned Radio Reflex Set.....5100
2-tube reflex set giving sharp tuning and high amplification. Absolutely non-oscillating. Full size blue prints, 3 sheets...$.75

3-Tube Neutrodyne.....5200
A similar type of Neutrodyne in which one reflex step of A. F. amplification is used. Full size blue prints, 4 sheets.....$1.00

The D X Receiver.....5300
The set that takes the X out of D X. Can be used with UV199 tubes. Full size blue prints. 6 sheets.....$1.50

3-Tube Inverse Duplex.....5400
Most successful of all Grimes sets. Operates on antenna or loop. No howls or squeals. Full size blue prints, 4 sheets $1.00

UV-199 R. F. Receiver.....5500
1-step R. F. amplifier, crystal detector, and 1-step A. F. amplifier. Full size blue prints, 3 sheets.....$.75

T. C. Circuit Set.....X4000
The set that is known as "Twenty-five cities for twenty-five dollars." Very long range and very sharp tuning. Full size blue prints, 3 sheets.....$.75

Super-Heterodyne.....5700
The first real super-heterodyne receiver design, using Acme 30 K. C. transformers. Unlimited range and power. Full size blue prints, 6 sheets.....$1.50

Reflex and Radio Frequency
By M. B. SLEEPER. An Experimenters' book showing the construction of reflex, radio frequency, and Inverse Duplex sets. Picture wiring diagrams, step-by-step instructions and clear photographs which are given with each set. Twenty-two half tones, 19 scale drawings. Price post paid.....$.50

Radio Design and Construction for Experimenters
By M. B. SLEEPER. The only book giving complete tables for winding and tapping coils for all wavelengths, complete data for the Hazeltine Neutrodyne, tuned radio reflex and Duotrol. Twelve half tones, 12 scale drawings. Price post paid.....$.50

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Make it "REFLEX" *with* ACME

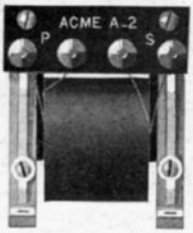
How to get distant stations loud and clear

What "REFLEX" is

The Reflex circuit is one which uses both vacuum tubes. It is the circuit which will give the best consistent results for the least expenditure, the least construction and tuning effort, and the least trouble. It is a circuit which will allow all the year round radio on a loop and loud speaker. When using an antenna, the only limit of reception is interference of all kinds.

What "REFLEX" will do

No circuit or set can be stamped with a distance guarantee, but the Acme Apparatus Company has found after two years of trial and experiment that the Reflex circuit will do more than any other employing the same number of vacuum tubes. It will bring in the distant stations loud and clear, and it won't annoy your neighbor.



ACME A-2 Audio Frequency Transformer

Covers the wave length band

The three and four tube Reflex receivers cover the whole new wave length band with equal amplification, which allow the listener to choose most of the broadcasting stations at will.

To build a "REFLEX" set

Get the Acme Diagram and follow it closely. It took the Acme Apparatus Company two years to get it worked out properly. This diagram is being published by Radio News. It is of a four tube set, three radio and three audio frequency amplification (equivalent to six tubes).

Precautions to observe

The Apparatus. Use only the best apparatus for best results. Lay out the apparatus on a board first, wire it up, and try it out. When you want to put it in a cabinet, you will then know how.

The Tuning Circuit. There are two tuning circuits which may be used, one for antenna, and one for loop operation. In either case, use a low loss Acme condenser. The antenna or loop receives only a little energy from the distant station, don't waste it. For a coupler in the antenna circuit, use a well made one, and for sharper tuning, use only a few turns on the rotor in series with a loud coil.

The Amplifier. Use Acme transformers, they are the product of pioneer transformer and radio engineers and manufacturers. The amplifying transformer is the heart of the circuit, and the "Reflex" has been worked out especially for Acme transformers.

The Detector. Use a crystal detector (preferably Brownlee Galena) to prevent distortion and howls. The crystal with three stages of radio frequency amplification will stay in adjustment for days, and you are sure that all the vacuum tubes are increasing the strength of broadcasting.

The Wiring. Keep all wires as short as possible. Use No. 14 bare wire if possible, and keep the general layout shown in diagram. If you solder, use ROSIN for flux.

The Tubes. All types of vacuum tubes are suitable for this circuit, but the 201A tubes are especially recommended.

The Loud Speaker. If the circuit is followed closely, a source of undistorted power will be available for any loud speaker. For reproduction of the broadcasting use an Acme Kleerspeaker.

The Acme Engineering Service. The Acme Apparatus Company is interested in anyone using its products, and wants you to get results. If you have any difficulties, write to our Engineering Department who are at your service gladly and freely.

FOR MORE INFORMATION USE COUPON. If YOU want more information on Reflex and Amplification, send 10 cents for the booklet "Amplification without Distortion" containing many wiring diagrams and helpful hints on construction and operation. Use the coupon. The book will be sent at once prepaid.

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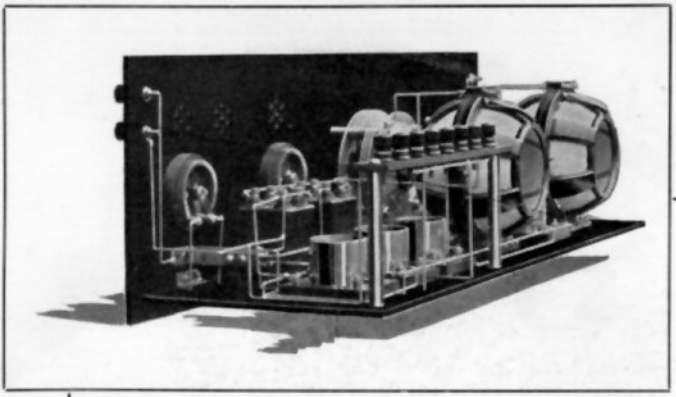

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