RADIO & MODEL ENGINEERING

A Magazine for the Experimenter who builds his own Equipment.

Edited by M. B. SLEEPER

SPECIAL GRIMES INVERSE DUPLEX ISSUE

THE FIRST AUTHORIZED INFORMATION GIVING COMPLETE CONSTRUCTION DATA FOR TWO-TUBE AND FOUR-TUBE RECEIVING SETS.

EACH DRAWING BEARS THE O. K. AND SIGNATURE OF MR. GRIMES.

July-August 1923

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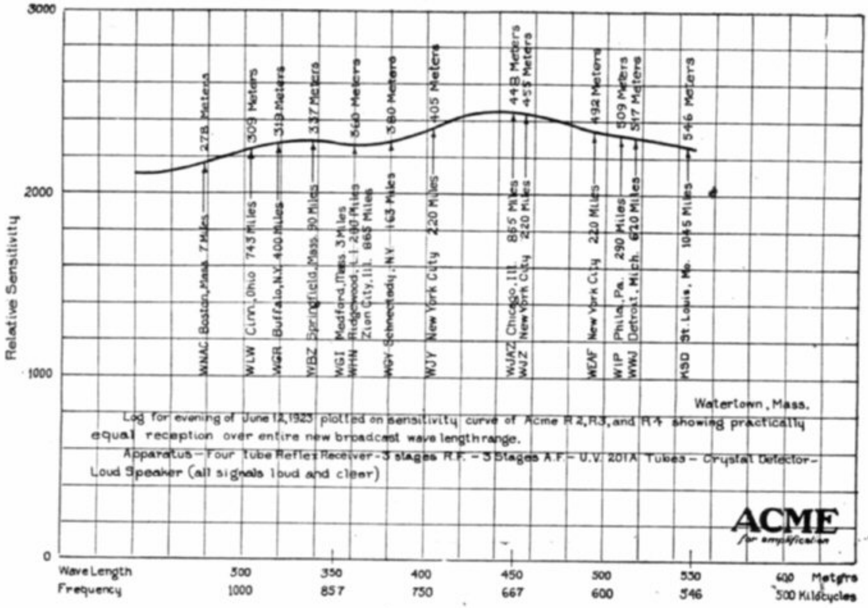

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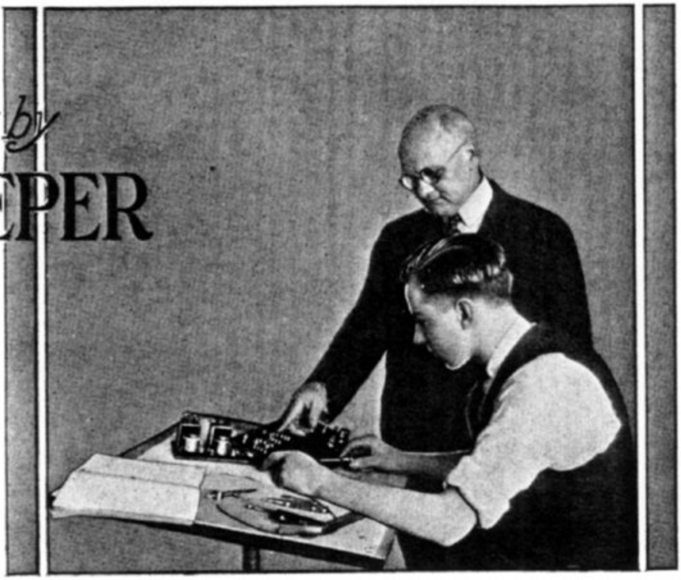

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Mr. David Grimes has authorized M. B. Sleeper, Inc., exclusively to publish construction data on the Grimes circuit, and the designs shown are personally endorsed by him.

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A LIST OF CHAPTERS

1. One-Tube Reflex Set—the best one-tube reflex circuit ever shown, simple and easy to construct. 2. One-Tube Tuned R. F. Amplifier—the only type of R. F. amplifier sets satisfactory for regenerative receivers. 3. Two-step R. F. amplifier—a set for 200 to 600 meters equipped with a 2-step amplifier and detector. 4. Two-Tube Grimes Set—two-tube loop set for portable and station use. 5. Grimes Super Set—a loop set with a range practically unlimited, designed for loud speaker reception.

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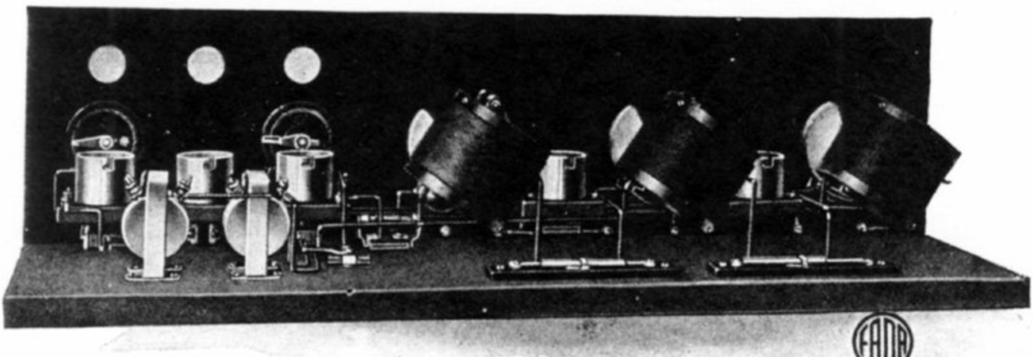

Showing the rear view of a five-tube Neutrodyne circuit radio receiver constructed according to information in the booklet "How to Build Hazeltine Neutrodyne Circuit Radio Receivers."

A Simple Type of Grimes Inverse Duplex Set

This outfit is designed for either portable or stationary use, and is arranged so that the receiving set and the loop antenna comprise a single unit

Features of the Grimes Set

SO much has been written in various publications about the features of the Grimes Inverse Duplex Receiver and the theory by which it operates that little space will be taken here to go into those details but, instead, will be given to the design features—many of which are disclosed in RADIO AND MODEL ENGINEERING for the first time.

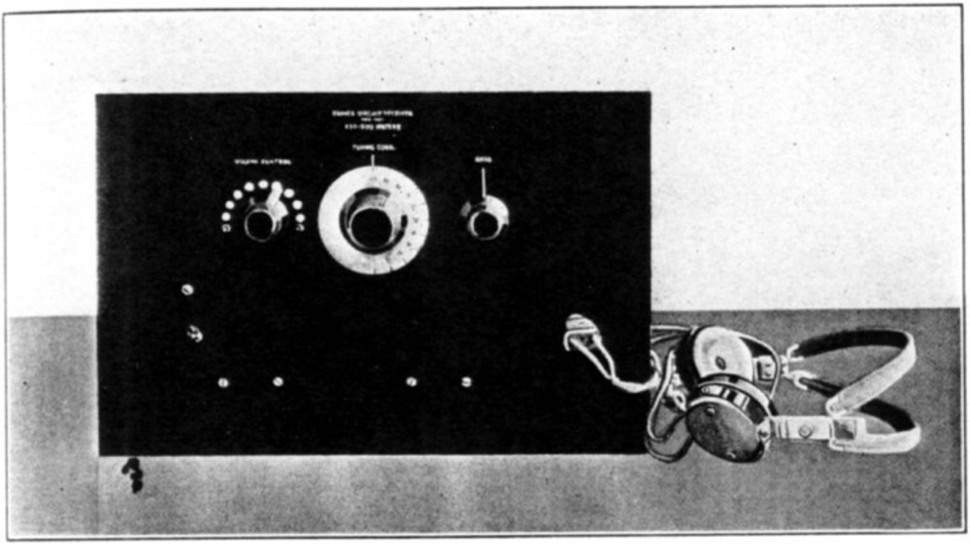

Fig. 1. The set ready to operate. Since the loop can be mounted directly behind the panel this makes a most convenient table unit

Essentially the Grimes Circuit is made up of radio and audio frequency amplifying circuits, using the same tubes for both radio and audio frequency amplification.

This, in itself, is not new, for in the familiar reflex sets the same action is employed. In the reflex set, however, the incoming signals are applied to the first tube and amplified at radio frequency. The second tube also acts as a radio frequency amplifier. The twice-amplified radio frequency current is then detected, and amplified at audio frequencies by the first and then the second tube. There are three disadvantages encountered in the ordinary reflex circuit. While the signals are amplified at four stages, the majority of the amplifying being done at audio frequency, the static is amplified at two stages of audio frequency so that there is little gain in signal amplification over static amplification. The second tube, carrying the radio and audio frequency currents already amplified by the first tube carries a much greater load than the first tube. Consequently the circuit is easily overloaded, causing serious difficulty from signal distortion. The third trouble comes from the necessity of using a potentiometer to apply a positive voltage on the grid of the first tube. This is used to prevent the set from oscillating, but, unfortunately, it at the same time reduces both the sharpness of tuning and the signal strength.

In the Grimes Inverse Duplex set the signals are amplified at radio frequency by the first tube; again, at radio frequency by the second tube; then at audio frequency by the second tube and audio frequency by the first tube.

Thus the signals are amplified at four stages, but the static is amplified at audio frequency by only the first tube. Consequently far less interference from static is experienced with the Grimes Circuit. The load on the tubes is more evenly distributed, for the first tube takes the small radio frequency and the large audio frequency amplification while the second tube takes the large radio and small audio amplification. Moreover, the circuit shown here requires no potentiometer, so that the tuning is as sharp as in a well-designed wavemeter circuit.

The Type 4900 Grimes Receiver

The Inverse Duplex principle is adapted to a wide variety of circuits. It can be compared to a well-designed engine suitable for many types of motor cars. Unfortunately only a few applications of the circuit can be disclosed at the present time. Therefore, the set described here was chosen as one suitable for as wide a range of uses as possible. For portable work, dry-cell tubes can be used, and the set fitted in a cabinet which also encloses the batteries and the loop. A very neat arrangement is to mount the set on a camera tripod, so that it can be turned around in any direction to orient the loop. When the set is used for regular reception at home it can be turned around or the loop mounted separately, perhaps on the top of the cabinet, with leads brought down from the loop taps to the switch, or the switch can be put right on the loop and three leads brought off, one from each end of the loop and one from the switch. Although the circuit is particularly designed for UV 201-A tubes, UV 199 tubes can be used if it is necessary to cut down the current consumption. The rheostat is of the 8-ohm Fada 153-A type, but for UV 199 tubes it is better to use the 156-A 60-ohm rheostat.

It is difficult to give this outfit a definite rating as to receiving range, for the tests which have been conducted upon it were made in the summer time under most adverse conditions. Ordinarily, in the winter time, the range would be far greater. However, in the tests, it was found that stations fifty miles away came in with excellent signal strength in the telephones. With a step of straight audio frequency amplification, local signals can be brought up to loud-speaker strength. For station use, a loop 2 feet square, with 15 turns, will improve the results considerably, as the signal strength is very largely depended upon the loop area. With the Acme R2 and R3 radio frequency transformers, the greatest efficiency is achieved on wave lengths between 300 and 500 meters, although there is a generous extension beyond these limits at each end of the resonance curve.

Construction Work Required

In the accompanying photographs the panel is not shown with any special type of cabinet or mounting, as that will depend upon your particular idea as to the way you want to use the set. Therefore, it will be necessary to construct either a plain type of cabinet or one fitted to carry the batteries. The work of making the loop antenna frame, if you are going to use the type shown here, is not difficult, but it takes a certain amount of care so as to guard against breaking and splitting the pieces. There are, of course, the front and base panels to drill—although you can have this done for you—and the engraving also, if you do not want to tackle the job yourself. A small bakelite piece must be fitted to hold the crystal detector. This, however, is a very simple matter. The front panel is of Formica, $\frac{3}{16}$ inch thick, 15 inches long and 10 inches high. The base panel, of the same thickness, measures 5 by 10 inches. These are the standard sizes which can be obtained from your local dealer or ordered by mail.

Fig. 1, the front view, shows the arrangement of the controls, the volume adjustment switch at the left, the tuning condenser in the center, and the rheostat at the right. In the lower left-

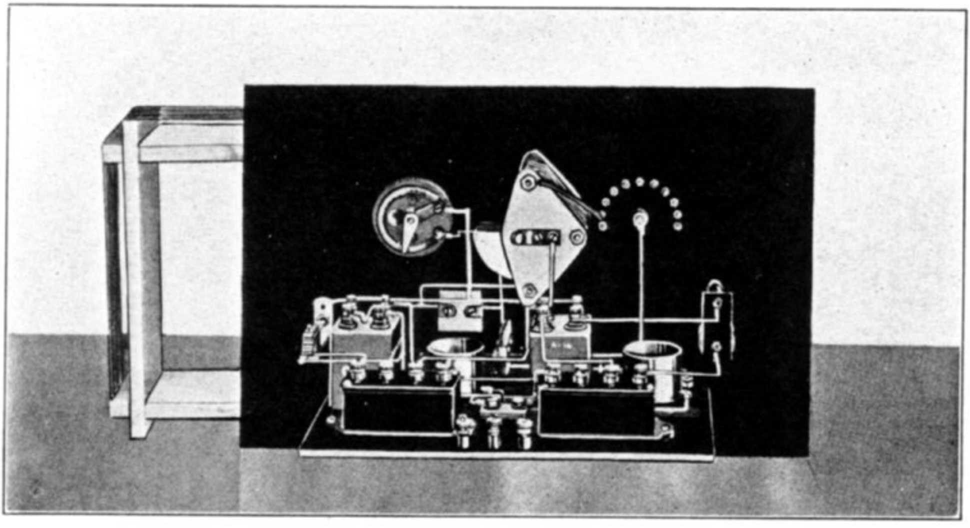

Fig. 2. The loop, shown at the left, fits right around the instruments which are mounted at the rear of the front panel

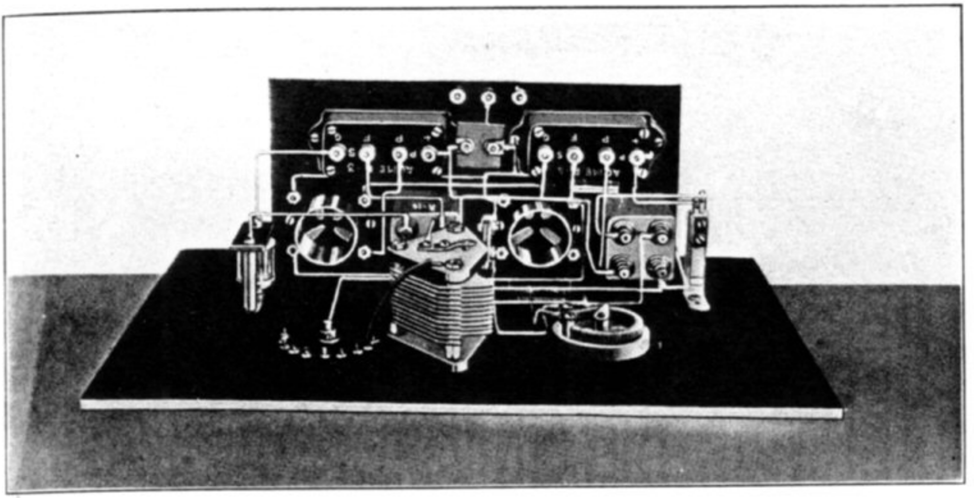

Fig. 4. From the top you can see just how the parts are arranged on the base panel

hand corner is the crystal detector adjustment, and, at the right, the jack for the telephones. For portable work, the Gold Seal type phones are recommended for their great sensitivity and ruggedness of construction, which are combined with light weight. The gold finish is particularly adapted for outdoor use, since it has no tendency to tarnish. In the side view, Fig. 3, the completed loop is shown, ready to be fitted to the rear of the panel. It was necessary to remove the loop for photographing, because it cast shadows on the parts. It fits snugly around the apparatus at the back of the panel. The top view, Fig. 4, illustrates the arrangement of the parts, and shows how the Fada crystal detector was changed for use on this set.

Laying Out the Panels

Because of its size, it was necessary to divide the front panel drawings in two parts. The left side is shown at Fig. 5, and the right at Fig. 6. Since they are exactly one-half scale, dimensions on the drawings should be doubled in transferring them to the panel. The panel measures 10 by 15 inches over all. Because of the weight of the parts it is necessary to use a thickness of 3/16 inch. For portable work, be sure to use Formica, for fibre or any of the other less expensive materials quickly absorb moisture when used outdoors or particularly near salt water. Fig. 7 shows the dimensions of the base panel—also at one-half scale.

Where the hole size is not given a No. 18 drill should be used. Clearance holes are indicated for the rheostat and condenser shafts to allow them to turn freely. It is particularly necessary to lay out the base panel accurately so that the holes will come just right, as there is not very much extra room on the panel.

Construction of the Loop

If the loop is to be mounted on the rear of the front panel the framework shown in Fig. 7, at one-half scale, should be cut out. In case you cannot obtain strips of the correct thickness you will have to alter the width of the slots, but do not change the inside dimensions of the frame, for, with the size shown, it just fits over the instruments.

Be very careful, when you cut the slots, that you do not split the outside pieces at the ends of the strips. The slots should not be loose, for the pieces may be broken when the wire is wound on; but they should not be tight, for then they may break when the parts are put together. After the framework is assembled, drill very small holes in the outside pieces and put two brads in each one to secure it in place. Then wind on 20 turns of No. 18 bell wire, or, better, Tautflex, a special non-stretching flexible conductor which is now widely used by commercial companies for loops. The turns should be spaced 1/8 inch, as shown in Fig. 7. Terminals can be fastened directly to the loop for the start and finish of the winding. Then taps should be taken off at the 1st, 2nd, 4th, 6th, 8th, 11th, 14th and 17th turns. The end of the loop provides the connection for the 9th tap.

Remember to arrange the connections so that, looking at the front of the set, the first tap goes to the left-hand switch point, the second to the next to right and so on. This will give an increased volume with a clock-wise rotation of the switch.

Assembly and Wiring

In Fig. 8 is a picture wiring-diagram, and, in Fig. 9, a schematic circuit, both of which should be carefully followed and checked during the process of wiring. It must

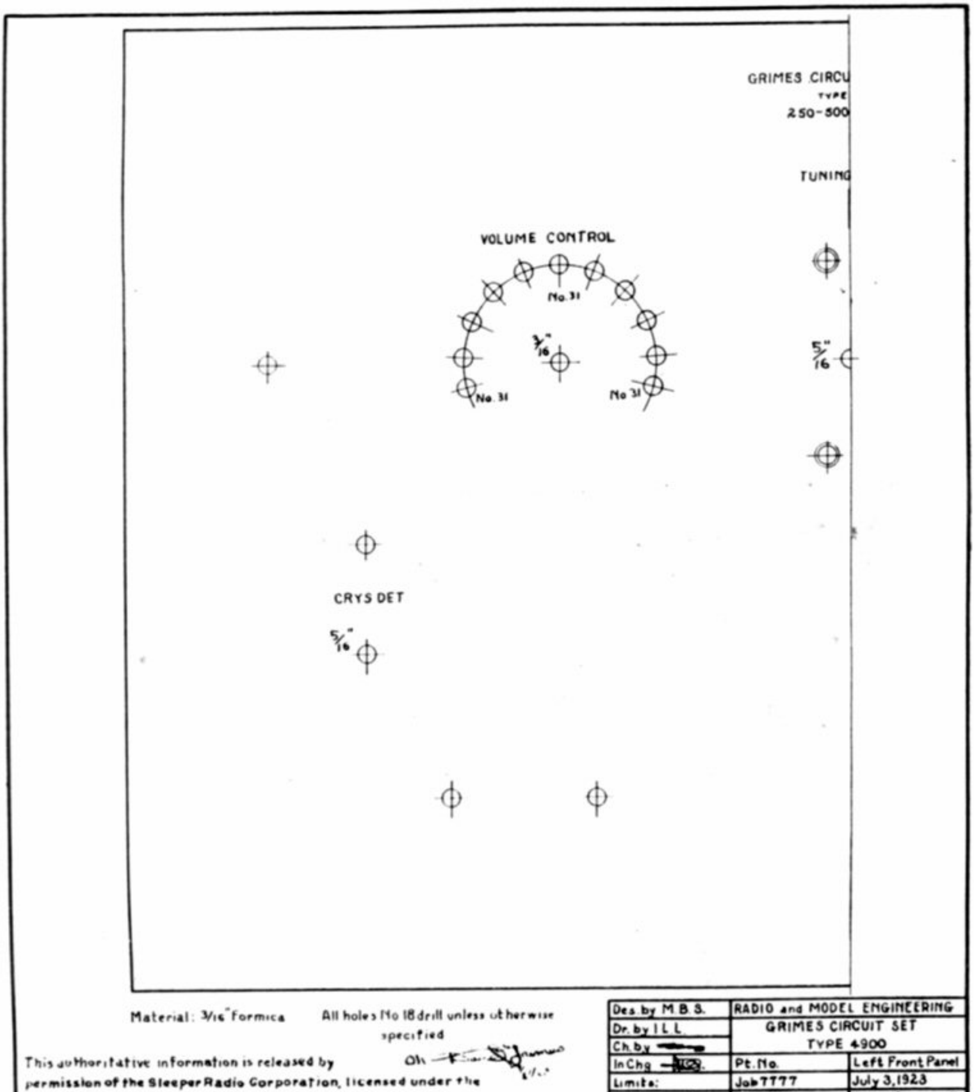

Fig. 5. A one-half scale drawing of the left-hand half of the front panel

be remembered that the schematic diagram is not intended to correspond exactly with the picture wiring diagram, but to show the principle of the circuit. Each terminal in Fig. 8 is numbered to correspond to the assembly instructions.

Be sure to have all your parts ready before you start in with the assembly work. It will then proceed smoothly, and without mistakes and faulty workmanship. Remember to put soldering lugs on each instrument, pointing in the directions indicated by the heavy lines, before mounting it.

1. Mount the two stopping points marked X and the switch points 1, 2, 3, 4, 5, 6, 7, 8 and 9 on the front panel. Tin the end of each screw so that it will be ready for soldering at the proper time.

2. Mount the socket marked A on the base panel.

3. Mount binding posts 10, 27 and 29 on the base panel. Put a soldering lug under the base

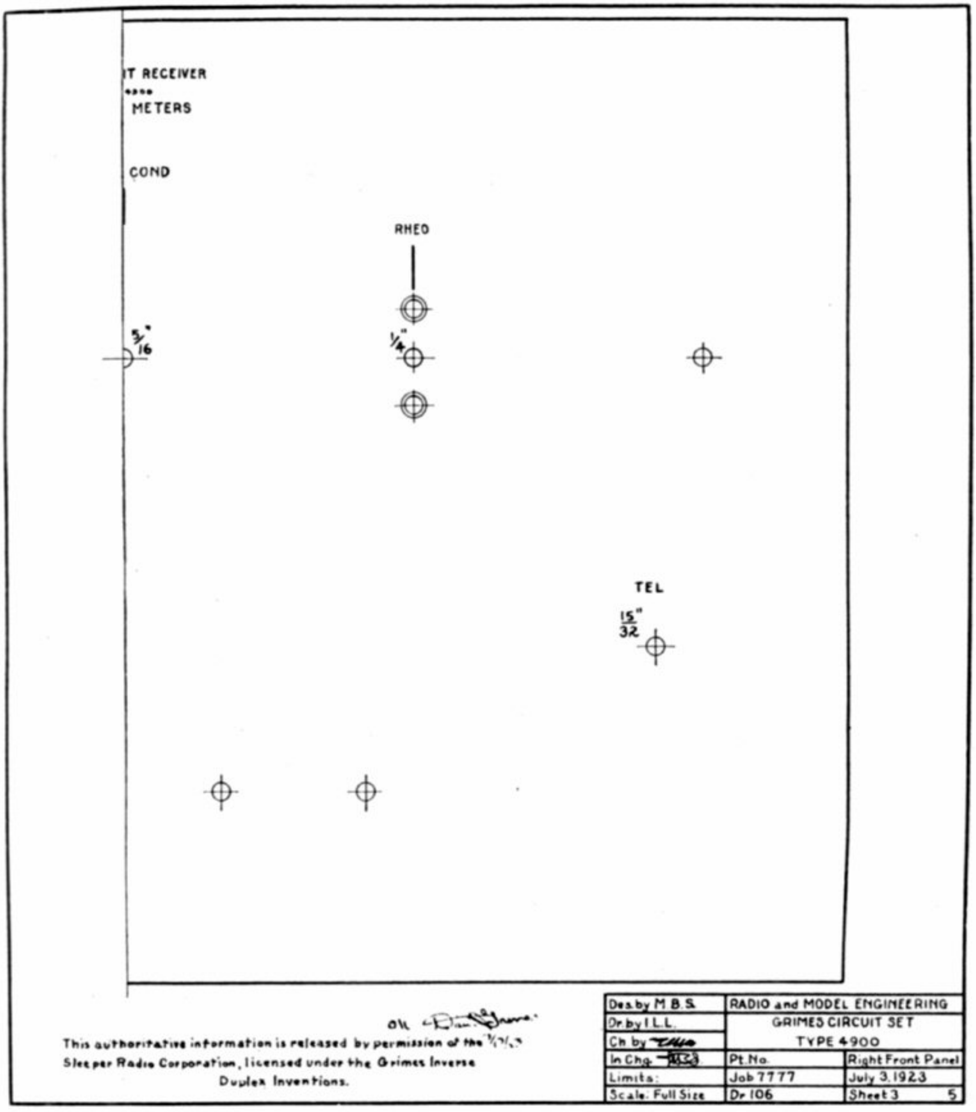

Fig. 6. The right-hand half of the front panel, one-half size. Concentric circles indicate countersinking

of binding post 10 on top of the panel. Put soldering lugs under the heads of the screws beneath the panel, for binding posts 27 and 29.

4. Connect 10 to 11. Use square tinned copper bus bar, carefully bent and fitted to run in a direct line. Take a little extra care to have your bends at exactly right angles, for the effort required is well repaid by the improved appearance of the wiring.

5. Mount transformer R-2, using ½-inch 6-32 R. H. screws and nuts. Do not tighten the screws so much that you will crack the transformer case.

6. Connect 12 to 13, and 14 to 15. Connections 13 and 14 are made to soldering lugs fastened to the 0.001 mfd. Micadon by means of ¼-inch 6-32 R.H. screws and nuts.

7. Mount socket B, using the screws and nuts provided with it.

8. Connect 16 to 17, 18 to 19, and 20 to 21.

9. Mount transformer R-3.

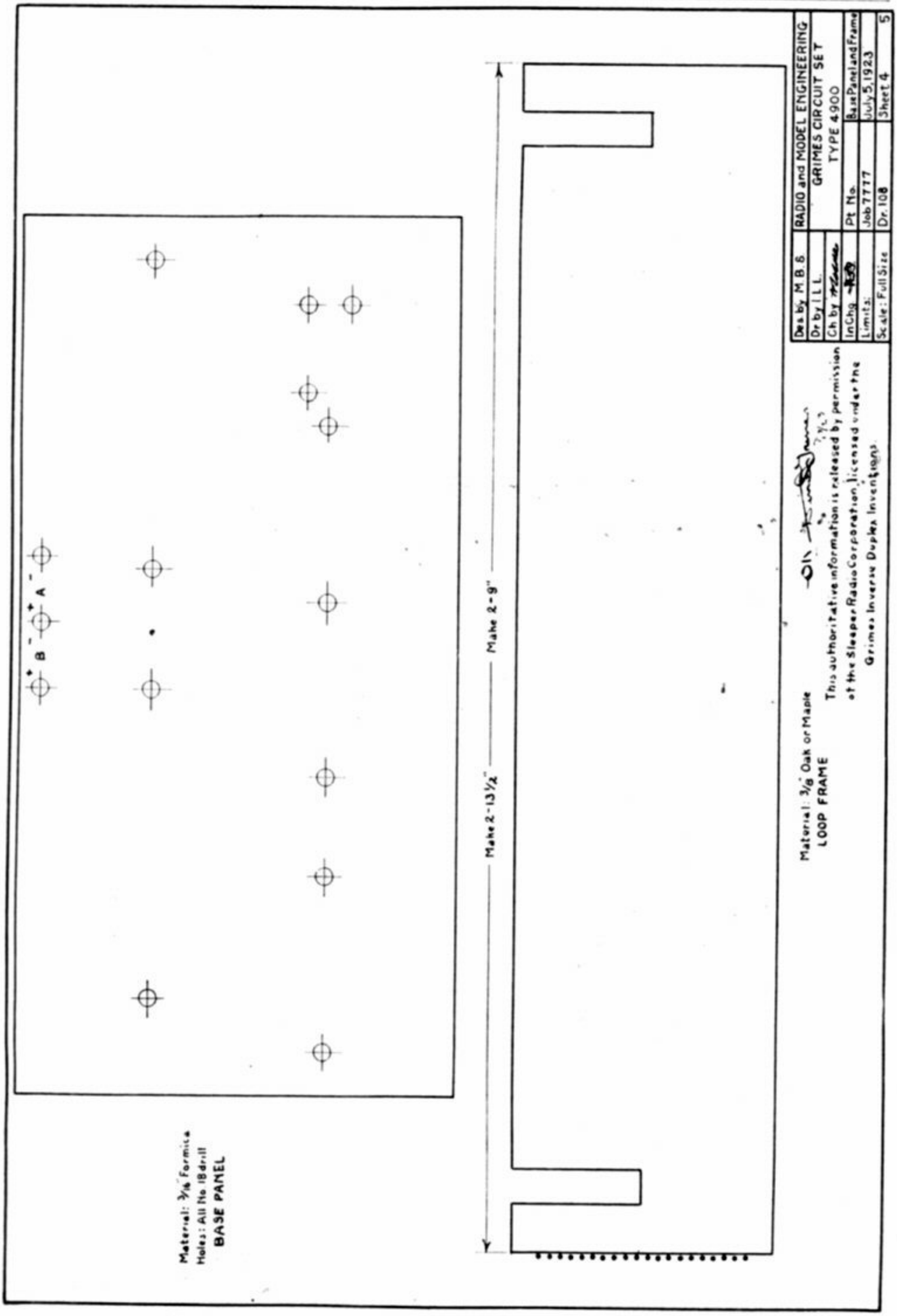

Fig. 7. One-half scale drawings of the base panel and loop frame

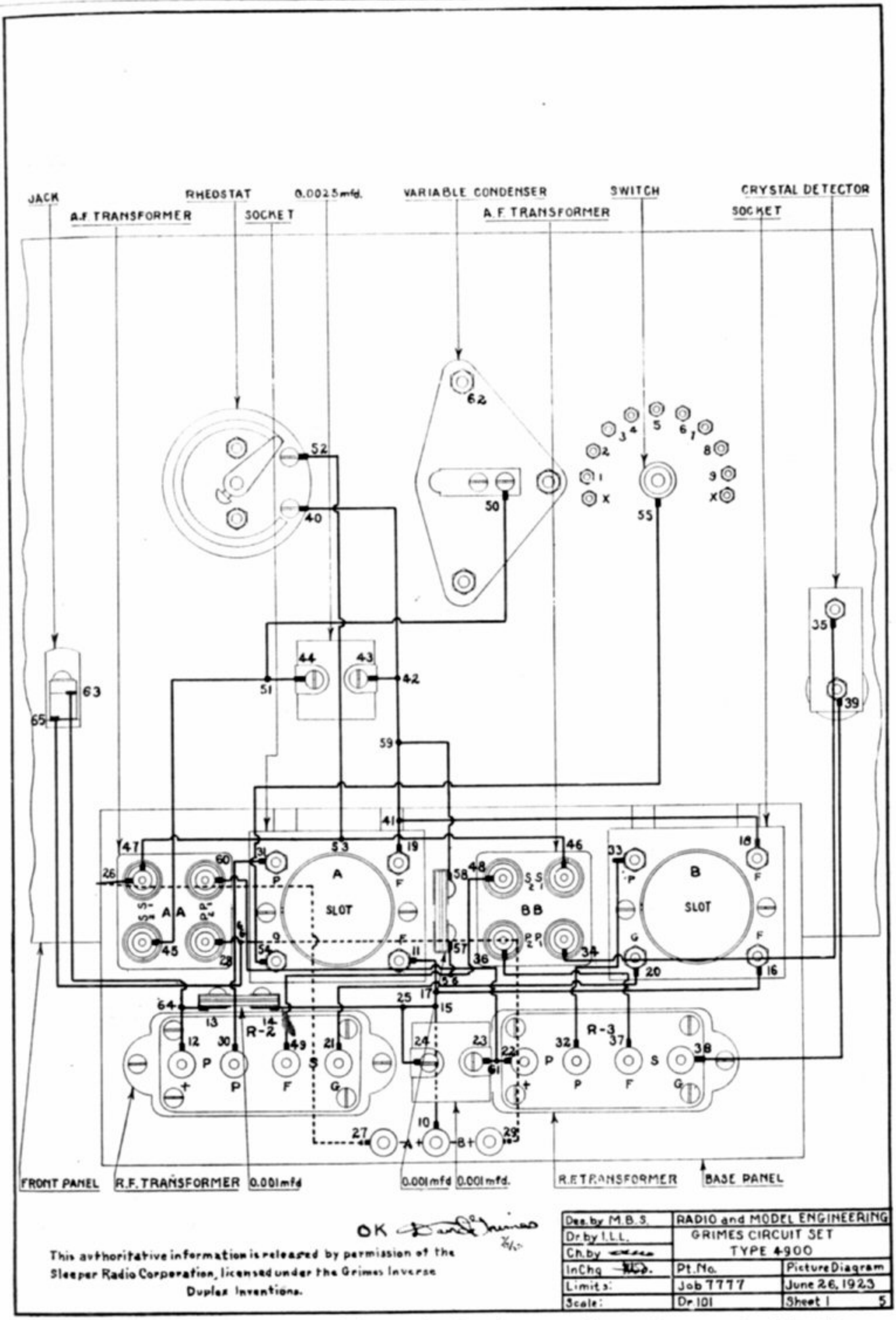

Fig. 8. Picture wiring diagram of the set, showing the connections as they are actually made

10. Connect 22 to 23, and 24 to 25. Terminals 23 and 24 are on the 0.001 mfd. Micadon held in place as previously described.

11. Mount transformer AA, using the screws provided with it.

12. Connect 26 to 27. The wire runs down from 26 underneath the base panel to the lug on binding post 27. Connect 28 to 29. The wire from 28 runs down the side of the transformer case through a hole in the base panel, and around to the lug on binding post 29. Connect 30 to 31.

13. Mount transformer BB.

14. Connect 32 to 33, and 36 to 37.

15. Mount the rheostat on the front panel, using the screws and nuts provided with it. If you replace the knob furnished by the Sleeper Radio indicating knob, simply unscrew the knob and pointer from the rheostat shaft, put the contact arm on the threaded end of the shaft, replace it on the rheostat, and secure the knob to the shaft by means of the set screw.

16. Mount the crystal detector on the front panel. This is of the Fada type, with the base removed and replaced by a small strip of ⅛-inch Formica. The detector is held in place by removing the thumb screw at the top of the supporting pillar and putting in its place a nut to hold the pillar to the panel. Soldering lugs are fitted to the screw holding the cup and to the lower threaded end of the supporting pillar. Be sure that the adjusting knob moves freely and does not bind against the side of the hole.

17. Mount the base panel on the front panel. You will see that the dimensions bring the two sockets 5/16 inch back from the rear of the front panel. Therefore, binding post bases 5/16 inch long should be fitted on the ⅝-in 6-32 R. H. screws which hold the sockets and the base panel to the front panel. This makes a

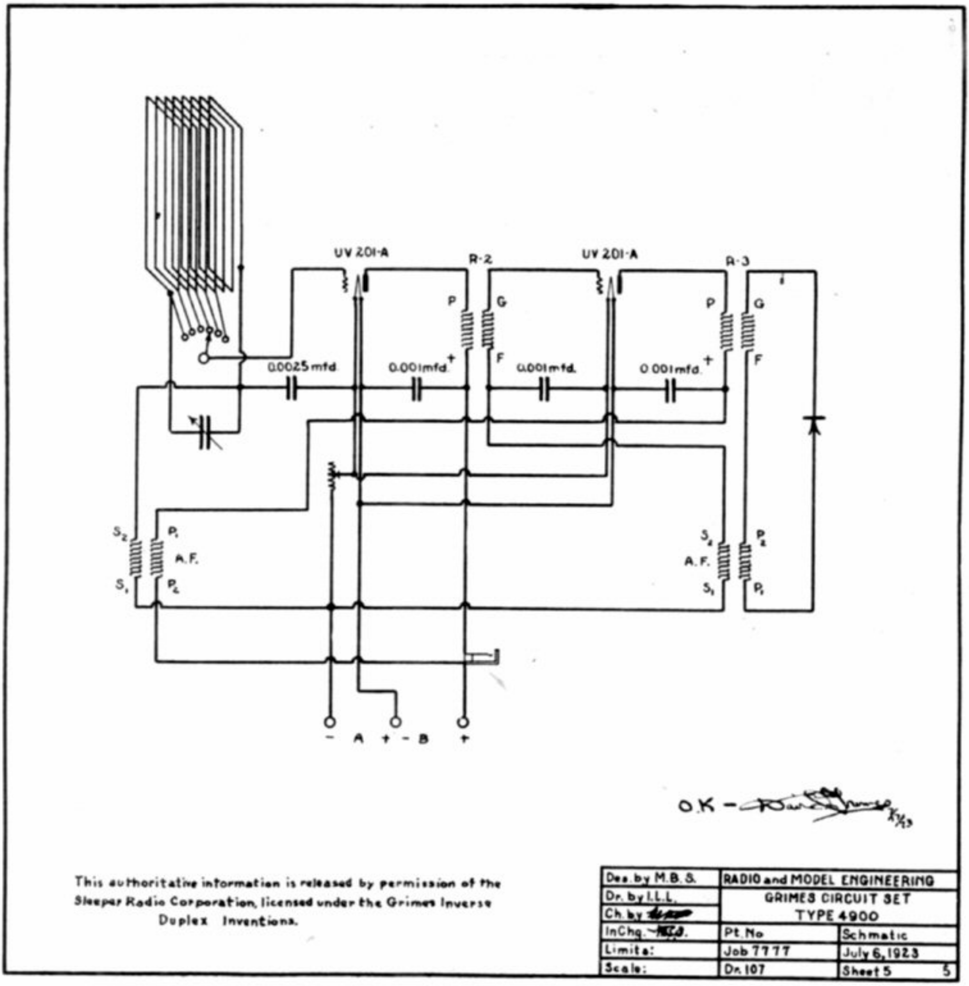

Fig. 9. Schematic diagram showing the arrangement of the Inverse Duplex Circuit

very firm mounting. If any adjusting is necessary, the four screws holding the sockets to the base panel should be loosened slightly and the rear of the base panel tapped with a rawhide hammer until it fits snugly against the front panel. Then the screws should be tightened again. Clearance is allowed in the base panel hole for this purpose.

18. Connect 34 to 35, 38 to 39, 40 to 41, 42 to 43, and 44 to 45. 43 and 44 are soldering lugs fastened to the 0.0025 mfd. Micadon. Connect 46 to 47, and 48 to 49.

19. Mount the variable condenser with the screws provided. Put a soldering lug under the upper fixed plate support rod nut, and under the right-hand screw holding the shaft contact spring. Connect 50 to 51, and 52 to 53.

20. Mount the volume control switch, making sure that perfect contact is made with the switch points and the terminal lug.

21. Connect 54 to 55, 56 to 57, and 58 to 59. 57 and 58 are soldering lugs fastened to the 0.001 mfd. Micadon. Connect 60 to 61.

22. Mount the open circuit jack on the front panel. Three rings are supplied with the Pacent jack. All three should be put at the front of the panel.

23. Connect 63 to 64, and 65 to 66. 66 is not clearly marked in Fig. 8. This connection is just at the right of the P2 terminal of transformer AA.

24. Mount the loop in place with the taps at the top above the volume control switch. One-inch, No. 6 F. H. wood screws should be used for this purpose.

25. Connect 62 to 1. Connect the end of the loop winding to 62. Connect the start of the loop to 50. Connect the first tap from the loop to switch point 9, the second 8 and so on around.

With this work completed the set will be ready for testing and operation.

Testing and Operating Before you mount the set in the cabinet it should be carefully tried out to make sure that there are no errors in the wiring. Put the tubes, preferably UV 201-A's, in the sockets and connect the filament battery to the center and right-hand posts, looking at the set from the front. The positive terminal goes to the center, and the negative to the right. The tubes should light when the rheostat is turned on. Always do this first in trying out a new set so that, if any mistakes have been made, the tubes will not be burned out by the B battery.

Then put on the 45 volts, negative to the center and positive to the left. Higher voltages, up to 135, can be used if loud signals are required. When you plug in the telephones there should be a strong click. If the crystal detector is not adjusted there may be a subdued howl, but this should not be loud if the wiring is right. As soon as the detector is set at a sensitive spot the howl will stop. If it persists, however, turn the volume control switch anti-clockwise. Adjust the set so that the plane of the loop is in the direction of the station from which you expect to receive. Then tune the circuit with the variable condenser until signals are heard at maximum intensity. Now increase the volume switch just below the point at which distortion occurs.

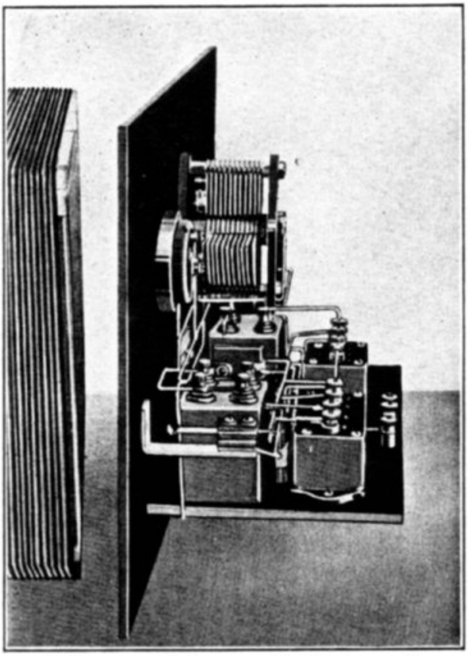

Fig. 3. The set ready for mounting the loop antenna

The volume control switch is, in a way, a range control, for it regulates the voltage applied to the first tube to the maximum before which distortion takes place.

If signals do not come in as they should, or the set howls, go over the transformers carefully to make sure that there are no open circuits or short circuits. Examine the socket contact springs to make sure that a perfect connection is obtained with the tubes. It is also necessary to check the fixed condensers. Sometimes they are damaged by overheating if you are not careful to make the soldered connections quickly.

In case you are not satisfied with the results obtained on the small loop described, a larger size can be substituted as explained in the first part of this article. In various publications the result obtained with Grimes circuit sets have been described and the distances covered show that the theoretical superiority of the Inverse Duplex is borne out in practice. The tests on this set were, of course, made in July when conditions were most unfavorable, but in comparative tests against three-tube reflex receivers the tuning was found to be much sharper and the signal volume somewhat greater. This winter should see a new series of records established by Grimes Circuit Sets.

Standard Radio Design Practice

Part II—Covering rheostats, switches, knobs and dials, plugs, jacks, screws, nuts and set screws

Filament Control Rheostats

SO varied are the designs of compression rheostats that no parts other than the mounting are at all standard. The location of the screws, however, and the size of the shaft is the same as for the wire-wound types.

Fig. 5 shows the accepted over-all diameter and height from the back of the instrument panel. The outside diameter is 2⅛ ins., and the height over the terminal screws 13/16 in. Holes for mounting with 6-32 screws are 1 in. apart, center to center, and in line with the shaft.

All shafts for rheostats are 3/16-in. in diameter, some plain on the end and some threaded 8-32 to screw into threaded bushings with the knobs. The shaft should extend a maximum of ¾-in. beyond the rheostat base.

There are two ways to fasten the contact arm to the shaft. If the shaft is threaded into the knob, the arm should be secured to a collar fastened to the shaft by means of a set screw. When the knob is secured to the shaft by a set screw, the arm should be carried directly on the shaft at the other end. This is done by making a shoulder on the rear end of the shaft and spinning or peining it over on the arm.

Knobs and Dials

Apparently there is no limit to the different designs for knobs and dials. In the diameter alone they are similar. Four sizes are now in use: 2, 3, 3¾ and 4 ins. in diameter. Some dials are still made for anti-clockwise rotation. The clockwise direction—that is, when the dial is turned clockwise to increase—is the correct way.

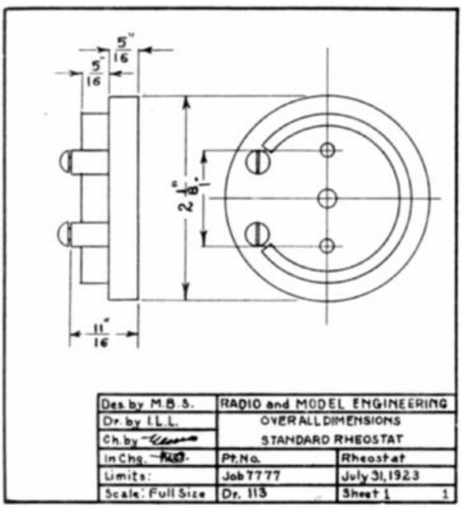

Fig. 5—One-half scale drawing showing standard rheostat features

An important feature is the location of the set screw. The center of the set screw holding the dial to the shaft should not be more than 5/16-in. from the bottom of the dial. This point is stressed because some instruments are fitted with very short shafts. Moreover, that distance brings the set screw at about the center of the part of the average shaft which is within the hole. This is shown in Fig. 6.

Dials 2 ins. in diameter are either fitted with 8-32 threaded bushings or 3/16-in. holes. The larger sizes are always made for ¼-in. shafts.

Experience has shown that a brass insert is needed to take the shaft, partly because the insert can be moulded in place more accurately than a hole in the material can be moulded or drilled, and partly because the set screw thread holds better in the brass insert than when dependence is placed entirely upon the moulded composition.

Dimensions of Phone Plugs

It is important to have the dimensions of a phone plug exactly correct. Otherwise the plug will not go in far enough to make contact or it will go so far as to short circuit. Fig. 7 gives the correct dimensions. Details of the body of the plug vary so much that no standards can be set, nor are they necessary.

Dimensions of Phone Jacks

Fig. 8 shows the dimensions of the standard phone jack frame. The arrangement of the contact depends, of course, upon the type of jack, since from one to seven springs may be used. There are a number of variations of this design, but, as a rule, changes are made at the sacrifice of mechanical or electrical efficiency.

Dipped nickel is the standard finish, except for the nut and rings which are polished nickel. Brass is the correct material for the frame and front clamping nut, and phosphor bronze or German silver for the springs. Contacts must be of silver and fairly large in contacting area. Particularly on sets giving high amplification are the contacts important, for, if the plug is removed while the vacuum tubes are lighted, a considerable spark occurs.

In designing a set, the jacks should not be depended upon to support any great weight, as is the case when they are used as brackets to hold a base panel carrying heavy transformers and other parts. While the set is in transit the weight of those parts is liable to cause the frames to bend, bringing the springs out of alignment with the holes for the plug.

Screws and Nuts

There are three standard threads used almost exclusively in radio equipment—4-36, 6-32 and 8-32. Sometimes a 10-32 is also required, but that fourth size is avoided as far as possible. The standard drills for holes to be tapped for those threads are Nos. 52, 32, 29 and 22. In metal, the slip drills are 32, 26, 18 and 9, or one size larger in Formica or Bakelite. As a matter of fact, however, a No. 18 drill is often used for both 6-32 and 8-32 screws, to reduce by one the number of drills required. As far as possible, round head screws are used because of the difficulty in regulating the depth of countersinking in insulating material. Ordinarily, flat head screws are used only when they come under knobs and dials. Polished or black nickel finish is used.

The 6-32 and 8-32 threads are standard for various kinds of threaded inserts in moulded parts.

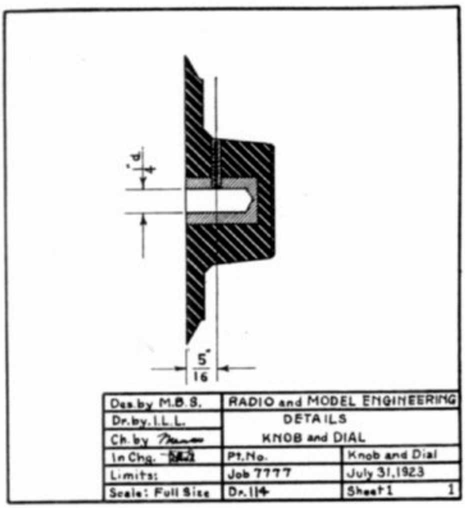

Fig. 6—The two important points of knob and dial design

Nuts vary considerably in size, and a further variation is introduced by the use of both turned and stamped nuts. Threads are, of course, the same as for the screws listed above. The only standard size is that used for switch points, $\frac{3}{32}$-in. thick and $\frac{3}{16}$-in. across the flats, with a 4-36 thread. These nuts are sometimes tinned, although the standard finish for all nuts is dipped nickel. A tendency toward the use of nuts $\frac{1}{4}$ and $\frac{5}{16}$-in. across the flats for 6-32 and 8-32 threads, and a thickness of $\frac{1}{8}$-in. is becoming noticeable.

Types of Set Screws

Until recently the cone point and round point set screws have been used. Controls held in place by these set screws, however, are liable to come loose when operated by the inexperienced who too often force the

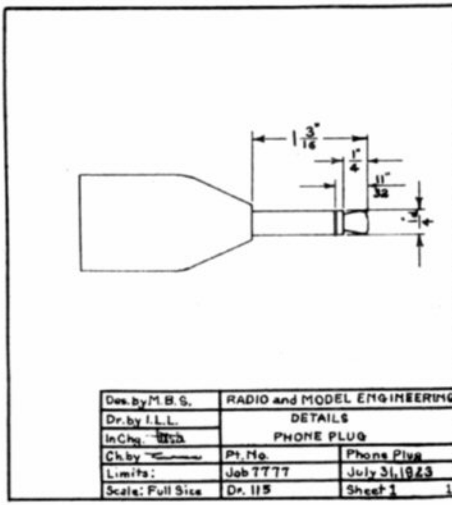

Fig. 7—One-half size drawing of the phone plug

knobs. Theoretically the cone point should dig into the brass shafts well enough to hold. In practice, the point digs in, but cuts the brass in a ring around the shaft. As a result, the hollow point has been adopted. This holds well because, when strained, the tendency is to take such a wide cut on the shaft, compared to that made by the cone point, that it stays in place.

Threads used for set screws are 6-32 and 8-32. The material should be steel. This is important, for headless screws are liable to break at the slot if the material is not good.

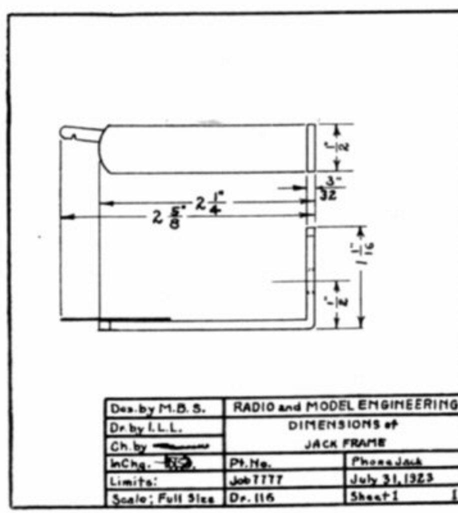

Fig. 8—Phone jack details at one-half scale

RADIO & MODEL ENGINEERING

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This issue describes work done in the R and M laboratory during the month of July.

EDITORIAL

IT is a great privilege that we can show, in this month's issue of "R.andM.," complete details of two types of Grimes Circuit sets and disclose details of Mr. Grimes' inventions which, for obvious reasons, have not been made public previously. There are, of course, additional features of the Grimes Circuit which cannot be shown, although they will be published later on when proper patent protection has been obtained.

The development work done by Mr. Grimes is most interesting, particularly in view of the fact that it has been in process since 1917, a period of six years. The majority of this work was carried on in a private laboratory, carefully guarded, at Mr. Grimes' home.

As is so often the case, some of the electrical problems recently solved have been worked out in a way that makes one wonder how anyone could fail to see the answers immediately, but the years that Mr. Grimes has spent on them explain his unqualified agreement with Edison's assertion that inventing is two per cent inspiration and ninety-eight per cent perspiration.

The outstanding features of the Grimes Circuit are: The full efficiency of the radio frequency amplifiers can be utilized without overloading the tubes, since the load on each tube is equally distributed. On the plain reflex set a potentiometer must be used to cut down the radio amplifier efficiency so that the tubes will not be overloaded. This circuit has no tendency to oscillate, nor is there any regenerative action from tuned circuits. Thus the circuit is so stable that the tone at loud speaker volume is as clear as that obtained with a plain crystal detector set and phone. The tuning is far sharper than on any other type of loop receiver. Since the full effect of straight radio frequency amplification can be used, without cutting it down by a potentiometer, the range is correspondingly increased. Only one tuning control is required, with a vernier adjustment, and the scale can be calibrated for various transmitting stations. As in all loop sets the loop is most useful as an interference and static reducer.

For those who do not understand the effect of a potentiometer, a brief explanation is in order. The potentiometer is used to put a small positive charge on the grid of the first tube. This causes a slight current to flow across the grid and filament, thus reducing the tendency of the set to oscillate or regenerate. In practice the potentiometer is adjusted so that regeneration takes place, but not oscillation. When the grid-filament current flows, a grid-filament resistance is of course created. The effect is the same as putting a 50,000-ohm resistance across the tuning condenser. When you build a Grimes Circuit set, try connecting a 50,000-ohm resistance across the variable condenser, and you will find that it makes the tuning very broad and cuts down the signals greatly. That is what happens on any potentiometer-adjusted radio frequency set.

Consequently, while a potentiometer is essential in some types of radio frequency sets, it is best to select a circuit which does not require one. The foregoing, so far as it concerns signal strength, does not hold true on regenerative receivers, for there a potentiometer can be used to increase the signal strength.

All of which goes to show that the experimenter who feels sorry for himself because Armstrong, when he brought out regeneration, did all there was to do, so far as improving radio-receiving circuits is concerned, now has Prof. Hazeltine's Neutrodyne and the Grimes Circuit set for inspiration.

In justice to Major Armstrong, however, it should be said that there is still no single tube set superior to the regenerative type. It is also true that a regenerative set with a detector and one-step audio frequency amplifier gives greater volume than any other two-tube set, unless a crystal detector is used. With three tubes or more, however, the regenerative circuit is easily out-distanced in range and particularly in tone quality by these later developments.

Next month starts a new department in RADIO AND MODEL ENGINEERING, a department which was planned for the magazine when it was first published, but for which there has not been room until now—namely, a section devoted to model work. The material will be prepared with the co-operation and assistance of Mr. H. E. Boucher, who is as outstanding a figure in model work in America as is Marconi in radio. It will help greatly in planning these articles if the readers who are interested in model work will let me know in what branch they are most interested.

M. B. SLEEPER,
Editor.

A Long Range Loop Receiving Set

This Four-tube Grimes Inverse Duplex Receiver is designed to give a long receiving range and signals of great volume when operated on a loop antenna

General Description of the Set

THE Grimes Inverse Duplex Circuit, when built into a receiving set designed for long range actually does the things that were expected of the super-regenerative equipment which was brought out a year ago. Like the super-regenerative receiver, however, the receiving set described here does require a certain amount of experimental work to make it operate just right and a degree of skill in the construction and wiring of the outfit.

This set is not one which should be built by a novice for it requires the intelligent handling which comes from considerable experience with radio equipment. Moreover, so enormous is the amplification that each detail of the work must be handled with the utmost care to guard against leakage and the breaking down of insulation. That this is true you can demonstrate to your own satisfaction by putting your fingers across the terminals of the telephone receivers. A very considerable shock can be obtained in that way. There is no danger, however, connected with the use of telephones altho you will find that under ordinary circumstances the signal strength is so great that a loud speaker must be used. In this 4-tube set the first two tubes give both radio and audio frequency amplification, the third tube acts as a detector, and the fourth as a straight power amplifier. This is equivalent, therefore, to a 6-tube set.

The design of this outfit is interesting inasmuch as it introduces an entirely new arrangement of the controls, a system which, it is predicted, will be widely used for apparatus designed to be operated by people who are now interested in the radio part of a radio set but only in the music and speech which comes from it.

You will notice that the front panel carries only one control, which gives the wavelength adjustment, a telephone plug, and filament switch. When the equipment is set up, the detector and amplifier filaments are adjusted to the correct brilliancy by means of the two rheostats inside the cabinet. In use the set is put in operation by throwing the filament switch up and signals tuned in by means of the left hand control. There is nothing on the panel to indicate that the set is a scientific instrument. It is like a desk lamp on which the switch is turned and the shade adjusted. As long as the batteries maintain their rated voltage, only the tuning knob and the switch are used.

Another feature of the interior arrangement is that the terminal panel which carries the binding posts, conveniently located, in addi-

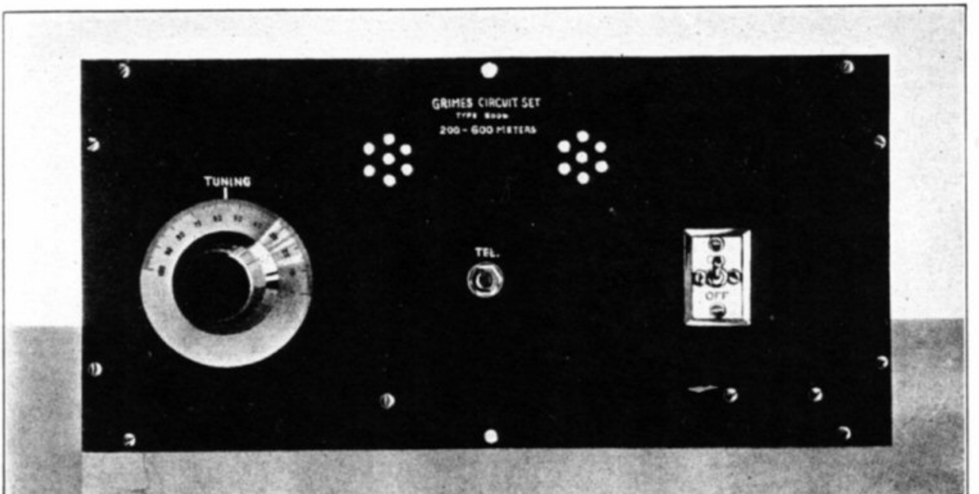


Fig. 1. The front view of this set has little to suggest a radio receiver, so simple is the arrangement of controls

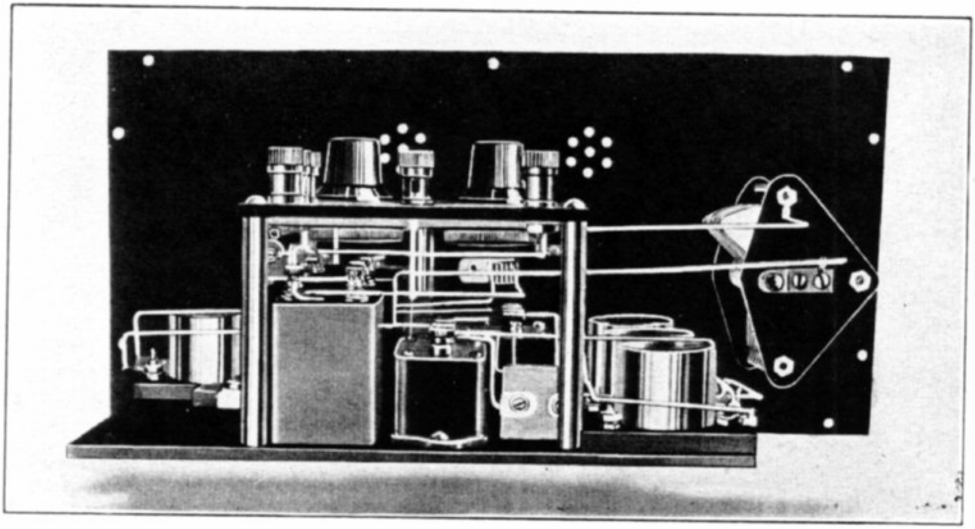


Fig. 4. In the rear view you can see the arrangement of the base and the terminal panel, supported on three pillars

tion to the rheostats, hides practically all of the set except the vacuum tubes. Looking into the set, then, when the cover is lifted, you only see a few simple parts and practically no wiring or anything that looks complicated.

Anyone of a number of arrangements can be used for the loop antenna but you will probably find it most convenient to buy one of the assembled types which are now available. The loop can be set up on the table near the set, back far enough so that it will not be in your way when you revolve it. Another method is to mount the loop on the top or at the rear of the cabinet.

Inverse Duplex Circuit

The great amount of publicity which has been given recently to the Inverse Duplex Circuit has been largely concerned with the theory of operation rather than with practical working details. A brief outline of the Inverse Duplex system is given in previous pages.

Essentially the Inverse Duplex Circuit provides radio and audio frequency amplification for the incoming signals without recourse to regeneration for further increase in signal strength. In fact it has been generally demonstrated that a radio frequency amplifier of more than one step is not satisfactory on a regenerative receiver. Moreover, if regeneration and radio frequency are employed the number of controls is considerably increased.

A particular feature of this set is that it has only one control for tuning and a calibration can be made so that, if the dial is in a position where a given station was heard previously, it will be heard at the same adjustment later on if that station is transmitting. This is particularly helpful to those who are interested only in the reception of broadcast stations and not in the experimental phase of radio. The significance of the name Inverse Duplex is just this: The same tubes are used for both radio and audio frequency amplification, a duplex use of the tubes. The sequency in which incoming signals are applied to the tubes for radio and audio frequency is opposite or inverse, for the front tube in the left hand row is the first radio but the second audio frequency amplifier and the center tube in that row is the last radio but the first audio frequency amplifier.

Construction Work Required

The design of this outfit may appear, from the photographs, to be rather complicated but it can be resolved into the same essential features of which all radio sets are comprised. All the panels are of standard sizes, readily available. The only work to be done on them is the drilling and engraving. At the rear is a base panel which carries the transformers and sockets and supports, on nickel plated brass pillars, the connection panel which carries the binding posts and rheostats.

If you do not buy your loop antenna you will have to make that up but very little work is involved other than cutting out the cross arms and mounting them. In either case a switch, described later on, is needed, secured to one of the loop supports.

Standardized Parts Employed

The panels for this set are cut from Formica. Substitutes are not recommended for, in this set, both mechanical strength and high insulating qualities are essential. Acme transformers, types R1 and R2, are used for the radio frequency amplification as this combination gives a reasonably flat curve over the wave-lengths now in use.

The jack is of the standard Pacent type, for which a Pacent type 40 or 50 plug is recommended.

Both rheostats are of the Fada 153-A type. Their resistance, of 8 ohms, is correct for both the UV200 detector and UV201-A amplifier tubes for which the set was designed. The Fada knob and pointer was changed for the Sleeper Radio indicating knob to match the knob on the dial altho that, of course, is not necessary.

Dubilier condensers are used throughout because of the high voltage which is applied to them. Moreover, it is important to have capacities exactly correct for otherwise the circuits will be upset and tend to howl.

Sleeper Radio audio frequency transformers are used as they fit in very nicely with the mechanical design. The same make of socket is employed because the design lends itself to the arrangement employed for fastening the base panel to the front panel.

Eby binding posts will be used in all equipment described in the future for, altho more expensive than other types, they have tops which cannot come off, the clamping arrangement is such that a number of wires can be held securely and with no tendency to cut them off, and the base is knurled so that the binding post does not turn around and come loose on the screw which holds it in place.

The Connecticut toggle switch is of a design which is rapidly gaining popularity in this country altho it has been used for years abroad. It is very convenient to control the switch by merely pushing the handle up or down. Another important point is the very low cost of this switch.

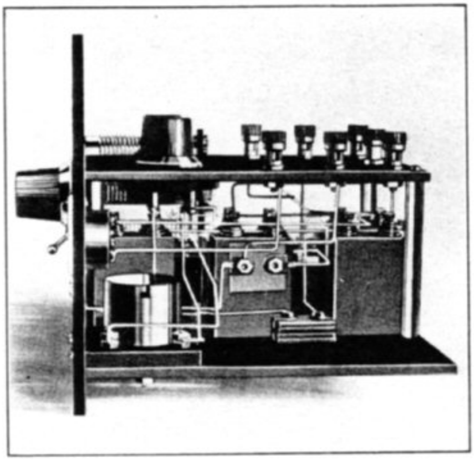


Fig. 5. Here the three audio transformers and the 0.005 mnd. condenser can be seen

Laying Out the Panels

Dimensions for the front, base, and terminal panels are given in Figs. 6 and 7 at one-half scale. Dimensions for the location of the holes have not been shown because they complicate the appearance of the drawing and are more often confusing than helpful. However, it is an easy matter to measure the distances on the drawing and, doubling them, transfer them to the panels. The best way to do this is to measure with dividers. Then put the dividers on a scale and see just what the dimension is. Multiply by two and lay it outon

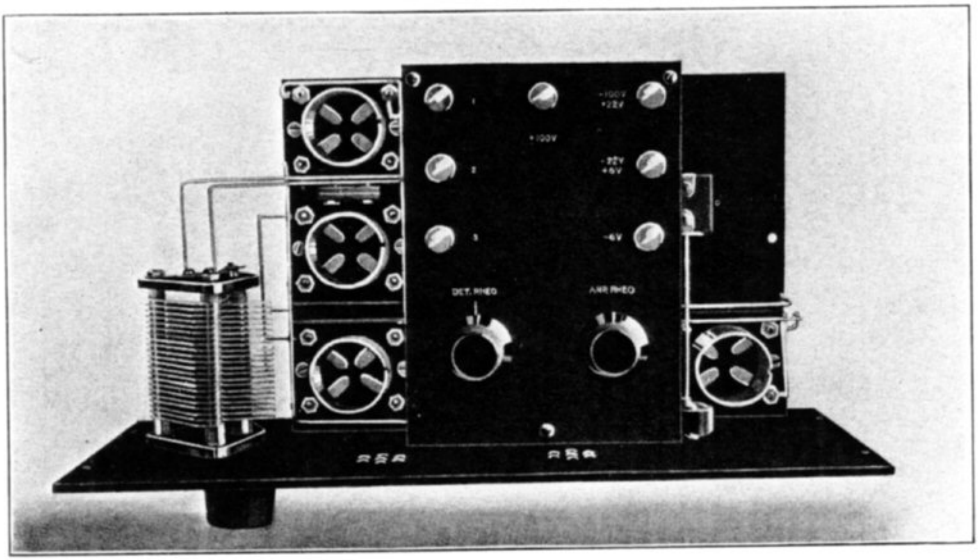


Fig. 2. Looking down on the set very little of the instruments are visible, for they are hidden by the terminal panel

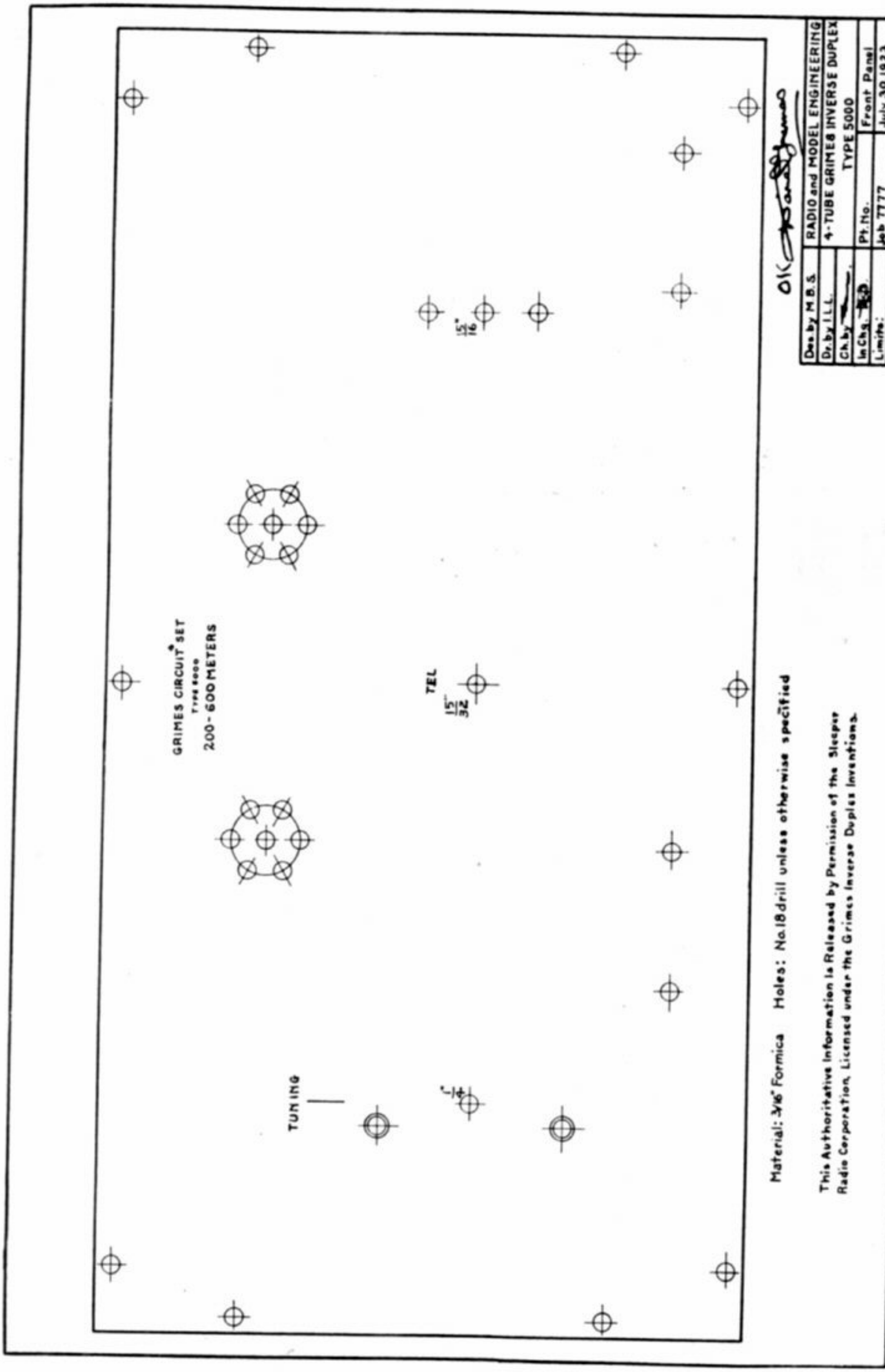


Fig. 6. One-half scale drawing of the front panel. Remember that concentric circles call for countersinking

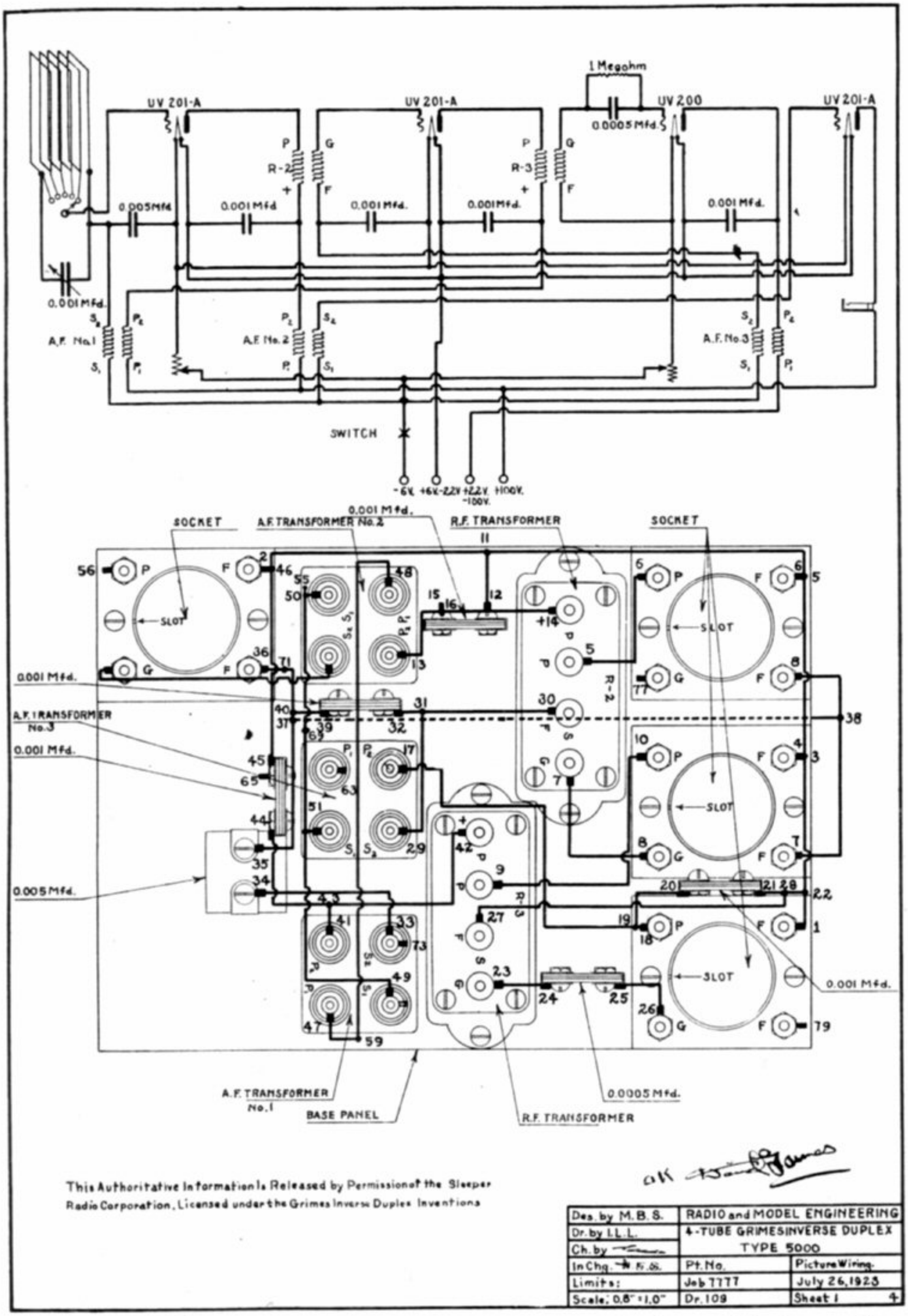


Fig. 8. Above is the schematic diagram, and below the picture wiring diagram of the base panel. No wires to the front or terminal panels are shown

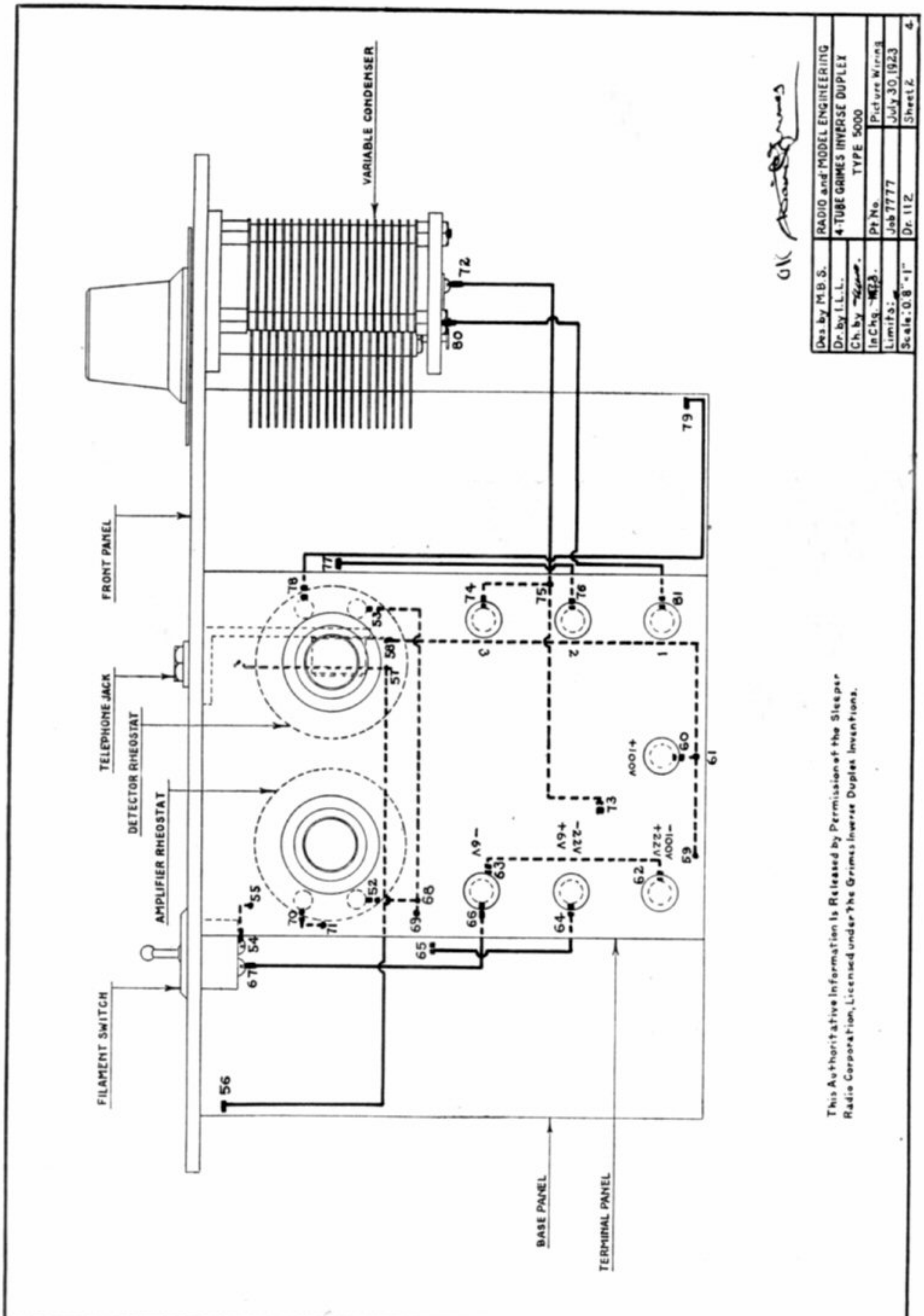


Fig. 9. The balance of the wiring, not shown in Fig. 8. Note that each of these drawings bears the O.K. and signature of Mr. David Grimes

the panel with a combination square and scriber. Make certain that the corners of the panels are at exactly right angles for any deviation will cause errors in the work of laying out the holes. If a panel is not true, select one long edge which is straight and work entirely from that, measuring the distances to one side or the other from a center line drawn across the panel.

Be sure to locate each hole with a center punch mark before you start the drilling. A sufficient allowance has been made in the hole sizes to take care of any reasonably errors which may be made.

It is best to leave the surfaces of the panels polished for the tendency to surface leakage is increased by graining them. An additional polish can be given the panels by rubbing them down with linseed oil and rottenstone.

The three sizes required for the panels are 7 by 14, 7 by 10, and 7 by 5 ins., all 3/16-in thick.

Construction of the Loop

The design of the loop for this set is very simple so that you can make it yourself or adapt one of the types now on the market for this set by adding a switch to it.

The loop, if of the cage type, should be 2½ ft. on a side, wound with 15 turns of annunciator wire or Tautflex loop cable, spaced ¼-in. apart. There should be a 9-point switch mounted on the loop connected to taps taken off at the 1st, 2nd, 3rd, 4th, 5th, 7th, 9th, 12th, and 15th turns.

Another way to make the loop is in the flat pancake style. The frame should be arranged so that the outside turns is 2½ ft. on a side and subsequent turns spaced ½-in. in from one another. The taps should be arranged in the same way. The first or inside terminal should have a lead to run to binding post 3, a lead from the switch to binding post 2 and a lead from the end or outside of the loop to binding post 1.

It is possible, of course, to use a smaller loop but the larger size is recommended because of its greater efficiency. These leads should be run as directly as possible to the set and aught not to be more than 12 ins. in length.

Assembly and Wiring

In Fig. 8 is a schematic wiring diagram of the set to show the general plan of the connections. It gives the same circuit as the picture wiring diagram altho in details it may vary slightly. The picture wiring diagram is divided into two parts, Fig. 8 and Fig. 9. Fig. 8 shows the wiring of the parts mounted on the base panel while Fig. 9 gives the additional connections between the base panel and the front and terminal panel.

When the panels have been properly drilled and engraved and all the parts collected ready for assembly, go through the steps of the work as they are shown in the following instructions. Do not go ahead independently of these instructions for you will surely make a great deal of extra work if you do.

1. Mount the four sockets on the base panel using the screws and nuts provided. Be sure to see that the terminals are arranged as shown in Fig. 8. Have the soldering lugs pointing in the directions shown by the heavy lines before you mount the sockets.

2. Connect 1 to 2. Use square tinned copper bus bar for connections, bending it carefully at right angles. If possible, use an electric soldering iron, preferably the American Beauty type for it maintains an even heat and is hot enough to make fairly heavy joints flow freely and yet not so hot as to burn the tip of the iron. Keep the iron well tinned at all times and apply sufficient heat to the joint so that the solder melts smoothly. Do not leave large irregular lumps on the joints. Use Nokorode soldering paste but be very sparing with it so that it does not spatter over the insulated parts and cause surface leakage. In the same way connect 3 to 4, 5 to 6, and 7 to 8.

3. Mount radio frequency transformer R2 on the base panel using ½-in. 6-32 R.H. screws and nuts. Put the soldering lugs on the terminals and tighten them before mounting the transformer.

5. Mount transformer R3.

6. Connect 9 to 10.

7. Mount audio frequency transformer No. 2 using the screws provided. Have the lugs pointing in the directions indicated.

8. Connect 11 to 12, 13 to 14, and 15 to 16. Terminals 12 and 16 are made by putting soldering lugs, held by ¼-in. 6-32 R.H. screws on the 0.001 mfd. Micadon. 15 is the other end of connection 15 to 16, soldered to the wire 13 to 14.

9. Mount audio frequency transformer No. 3. Be sure that the terminals are in the position indicated in the picture wiring diagram.

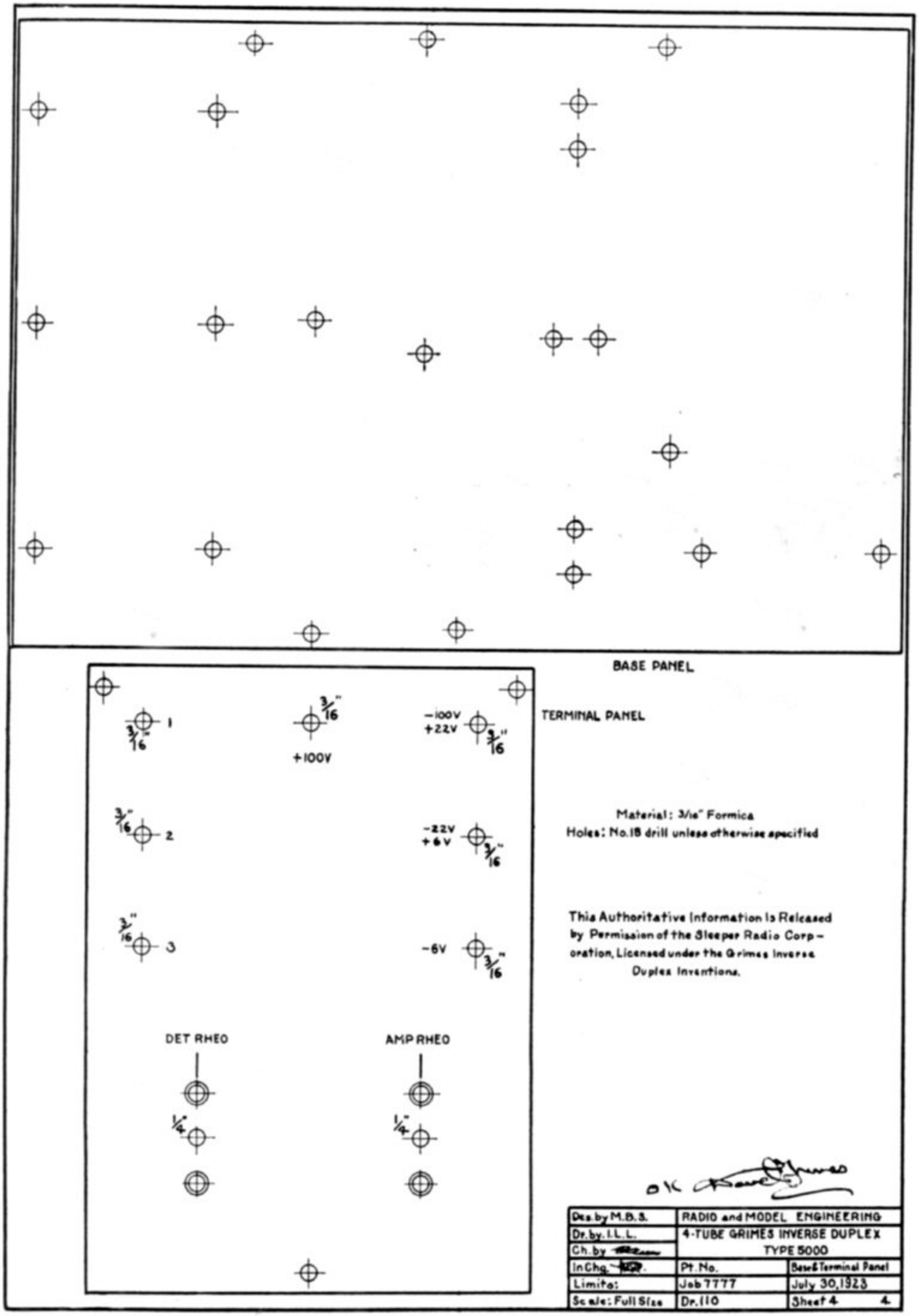
10. Connect 17 to 18, 19 to 20, 21 to 22, 23 to 24, 25 to 26, 27 to 28, 29 to 30, and 31 to 32. Terminals 20, 21, 24, 25 and 32 are lugs secured to the Micadons as previously described. Connect G, on the left-hand socket, to S2 on transformer No. 2. These terminals are not numbered.

11. Mount audio frequency transformer No. 1. Be sure to put two lugs on terminal S2.

12. Connect 33 to 34, 35 to 36, and 37 to 38. Note that this last connection runs under the panel and comes up through a hole to connection 37, where it connects on the wire running from 35 to 36. Connect 39 to 40, 41 to 42, 43 to 44, 45 to 46, 47 to 48, and 49 to 50. Connect this wire also to terminal 51 by which it passes. Terminals 34, 35, 44, 45, and 39 are soldering lugs mounted on the Dubilier condensers. Extra long screws must be provided for holding the terminals at 34 and 35 as the 0.005 mfd. condenser is made up of two condensers of 0.0025 mfd. Remember that there are two terminals, 45 and 65 on the same screw.

13. Mount the filament control switch on the front panel, using ½-in. 6-32 F.H. screws and nuts.

14. Mount the Pacent jack. Three rings are provided with this jack, all of which should be put at the front of the panel.



ig. 7. One-half scale drawing of the base and terminal panels. Engraving for the binding posts is also indicated

15. Mount the variable condenser on the front panel, using the screws provided.

16. Mount the rheostats on the connection panel with the terminals in the positions indicated in Fig. 9.

17. Mount the seven binding posts on the terminal panel. When you tighten the nuts on the binding posts, insert a file in the slot and hold the binding post in place in that way so that the slot will not be turned at an angle. Fasten the terminal panel support pillars in place, using ½-in. 8-32 R.H. screws. These pillars are ⅜-in in diameter and 3⅜ ins. high, threaded at each end.

18. Connect 52 to 53.

19. Fasten the front panel to the base panel by means of ⅜-in. 6-32 R.H. screws threaded into the inserts in the two front sockets. The sockets should fit against the panel and the front edge of the base panel should also be tightly against the rear of the front panel. If the fit is not exact, loosen up the screws holding the sockets to the base panel and tap the base panel slightly with a rawhide hammer until the fit is perfect.

20. Connect 54 to 55, 56 to 57, 58 to 59, and 72 to 73. These wires are shown in Fig. 9. Terminals 55, 56, 59, and 73 will be found on Fig. 8.

21. Mount the terminal panel on the terminal panel support pillars, using ½-in. 8-32 R.H. screws. Connect 60 to 61, 62 to 63, 64 to 65, 66 to 67, 68 to 69, 70 to 71, 74 to 75, 76 to 77, 78 to 79, and 80 to 81. Terminals No. 63, 65, 69, 71, 77 and 79 appear in Fig. 8. Terminal 63 is P1 of audio frequency transformer No. 3, 65 is the extra terminal on the 0.001 mfd. Micadon at the left of transformer No. 3, 69 is a connection on the wire running from 49 to 50, 71 is a connection on the wire running from 35 to 36, 77 is the grid terminal of the front right-hand socket, and 79 is the filament terminal of the rear right-hand socket.

22. Put on the condenser knob and dial, adjusting it so that the 100-division mark on the dial coincides with the line of the panel when the plates are totally interleaved.

This completes the somewhat complicated job of wiring the four-tube Grimes Receiver. Even tho you have carried out this work with the greatest of care, check it over very carefully and compare it with the schematic wiring diagram as well, but do not let yourself become confused if the schematic agrees only in effect and not in exact detail with the picture wiriug diagrams.

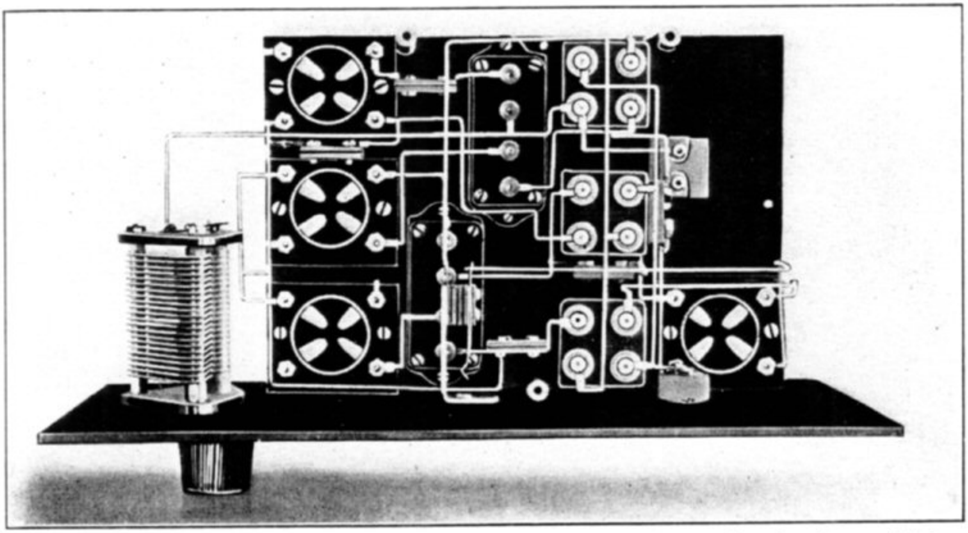


Fig. 3. Compare this illustration of the set with the terminal panel removed to the picture wiring diagram, when you are assembling the parts

Testing and Operating

With the set ready for operating, put UV201-A tubes in the first two sockets at the left and the single socket at the right and a UV200 tube in the rear left hand socket. The Cunningham equivalents of these tubes, of course, be used interchangably with the Radio Corporation types. Connect the A and B batteries to the binding posts on the terminal board according to the markings in Fig. 9 and connect on the loop antenna as previously directed. While 100 volts is specified for the amplifying tubes perhaps the most practical scheme is to use three of the large size Eveready B batteries connected in series. Then the negative terminal of the first battery must go to the minus 22-volt terminal, the first 22½-volt tap to the plus 22-volt terminal and the last positive binding post on the third battery to the plus 100-volt terminal on the set. Be sure to try out your tubes, to make sure that the filaments light, before connecting the B battery. Take care in handling the positive B battery lead that you do not get a shock for, altho it will not be strong enough to hurt, it is at least unpleasant. In all probability, there will be a loud squeal in the telephones when you first plug them in because the amplification in this set is so great that, when the tubes are not adjusted to the correct brilliancy, some of the circuits become unbalanced. Means have been developed for preventing this howling but, at the present time, altho they are in use in the commercial types of Inverse Duplex sets, permission has not been yet obtained to disclose the method for overcoming this difficulty. As soon as you have the filaments properly adjusted the howling will cease. Then there will be no more trouble in that respect for the rheostat adjustments need not be changed as the tubes can be turned off by means of the switch on the front of the panel. Set the volume control switch on the loop at about the third point, and, turning the loop around slowly, move the variable condenser back and forth until the station is heard. Then advance the volume control switch until the signals are at maximum intensity without distortion. Remember, when you are demonstrating a powerful set of this sort to friends, particularly when they are not familiar with radio equipment, that a most adverse impression is created when you make the volume so great that the signals are distorted. While you may be interested in noise rather than in quality yourself, that is not true of people who are not interested in radio for experimenting's sake.

Since the work of assembling this outfit is not easy and as it is necessary to remove a number of terminals to make changes under the terminal panel once the set has been fully assembled, use the utmost care to get the connections right the first time. When we built this set and had it ready for testing, it refused to respond at all. Investigation showed later that one of the connections to the rear radio frequency transformer had been left off altogether. It is fun to build the set but it is most unpleasant to tear it apart and put it together again.

You will find it necessary, probably, to run the amplifier tubes at rather low brilliancy. This does not mean any loss of volume, however. The detector tube is apt to be rather critical but you will very quickly find the proper adjustments for the rheostats. The only alteration that may be necessary is in the capacity of the 0.005 mfd. condenser. This has some control on the quality of the signals and also effects the liability of the set to howl. You may want to decrease the capacity of this condenser somewhat but it will probably be of no advantage to increase it.

In the matter of comparison with other sets, it should be more efficient than any other type of loop receiving set. This comparison is made advisedly for the reason that there are some sections, altho fortunately very few, where loop sets do not give good results. On the other hand, conditions are often found where a particular building or nearby structures greatly assist an outfit operating on a loop. Tests made against other types of loop receivers which did transcontinental work last winter, indicate that, under reasonably favorable conditions, the range of this outfit is almost unlimited.

As an outfit to experiment with it offers endless possibilities. Mr. Grimes has been working on this circuit since 1917 and is still making further improvements so that, once you tackle the Inverse Duplex, you will find a wide range of experimental work opening up ahead of you.

Bound Volumes

For the last three months we have been trying to get together complete files of Radio and Model Engineering. We've succeeded in assembling thirty-eight sets from April, 1922 to May, 1923. Because these volumes are so limited in number we have had them bound in full leather, embossed in gold in a style used for private libraries and book collections.

Each volume is numbered and will be inscribed to the purchaser and autographed by M. B. Sleeper, as a presentation copy. As an aid in your radio work, and a record of radio apparatus design you will find this book very much worth having. There are 256 pages, with nearly 200 illustrations.

Orders for the bound volumes will be filled as received. Remittances which come in after the thirty-eight copies have been sold will be sent back by return mail. The price is five dollars.

Send your order to Radio and Model Engineering, A-88 Park Place, New York City.

Notice to Readers

There seems to be some confusion concerning the companies to which orders of various sorts should be sent. For your own protection in getting what you want without loss of time made necessary by forwarding orders to the right companies read these instructions.

Orders for books, magazines, and blue prints should not be sent to the Sleeper Radio Corporation but to M. B. Sleeper, Inc., as the two companies are separate and distinct concerns.

Orders for instruments and parts should be sent to DURRANT, and not to M. B. Sleeper, Inc., since the latter company does not sell radio equipment of any kind.

Standardized Parts List

The materials used to make up the sets described in this issue were supplied by the following companies. You can buy these parts from your local dealer or order them by mail from DURRANT, A-36 E. 49th Street, New York City. 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 4900 GRIMES SET

Type	Name	Price
	F. A. D. Andrea, 1581-S Jerome Ave., New York City	
153-A	1—8-ohm rheostat	$1.00
101	1—Galena crystal detector	2.00
	Dubilier Condenser & Radio Corp., A-48 W. 4th St., New York City	
601	3—0.001 mfd. Micadon condensers	1.05
601	1—0.0025 mfd. Micadon condenser	.35
	Pacent Electric Co., A-22 Park Place, New York City	
61	1—Open circuit jack	.60
	Acme Apparatus Co., Cambridge, Mass.	
R-2	1—Radio frequency transformer	5.00
R-3	1—Radio frequency transformer	5.00
	Sleeper Radio Corp., 88-F Park Place, New York City	
A-2	1—100-division knob and dial	1.00
A-1-X	2—Audion sockets	1.60
A-16	1—21-plate condenser	3.50
A-88	1—Rheostat indicating knob, 3/16-in. hole	.30
A-14	2—Audio frequency transformers	10.00
	DURRANT, A-36 East 49th St., New York City	
61	1—Pkg. 10 ¼-in. 6-32 R. H. nickeled screws	.11
58	3—Pkg. 25 small soldering lugs	.60
47	6—2-ft. lengths square tinned copper bus bar	.30
63	1—Pkg. 10 ½-in. 6-32 R. H. nickeled screws	.12
49	2—Pkg. 10 6-32 nickeled nuts	.16
36	1—Formica panel, 10 x 15 x 3/16-in.	4.00
27	1—Formica panel, 5 x 10 x 3/16-in.	1.31

PARTS FOR THE TYPE 5000 GRIMES SET

Type	Name	Price
	F. A. D. Andrea, 1581-S Jerome Ave., New York City	
153-A	2—8-ohm rheostats	$2.00
	Dubilier Condenser & Radio Corp., A-48 W. 4th St., New York City	
601	5—0.001 mfd. Micadon condensers	1.75
601	2—0.0025 mfd. Micadon condensers	.70
	Pacent Electric Co., A-22 Park Place, New York City	
61	1—Open circuit jack	.60
	H. H. Eby Mfg. Co., 605-X Arch St., Philadelphia, Pa	
55	7—Sergeant binding posts	1.40
	Acme Apparatus Co., Cambridge, Mass.	
R-2	1—Radio frequency transformer	5.00
R-3	1—Radio frequency transformer	5.00
	Connecticut Tel. & Tel. Co., Meriden, Conn.	
75-3-Y	1—Battery switch	.40
	Sleeper Radio Corp., 88-F Park Place, New York City	
A-2	1—100-division knob and dial	1.00
A-1-X	4—Audion sockets	3.20
A-17	1—41-plate condenser	4.00
A-88	2—Rheostat indicating knobs, 3/16-in hole	.60
A-14	3—Audio frequency transformers	15.00
	DURRANT, A-36 East 49th St., New York City	
154-	1—Formica panel, 7 x 14 x 3/16-in.	2.46
153	1—Formica panel, 7 x 10 x 3/16-in.	1.81
158	1—Formica panel, 7 x 5 x 3/16-in.	1.00
61	1—Pkg. 10 ¼-in. 6-32 nickeled screws	.11
143	1—Pkg. 10 1-in. 6-32 R. H. nickeled screws	.18
58	4—Pkg. 25 small soldering lugs	.80
47	10—2-ft. lengths square tinned copper bus bar	.50
72	1—Pkg. 10 ½-in. 8-32 R. H. nickeled screws	.14
151	3—Terminal panel supports	.90
63	1—Pkg. 10 ½-in. 6-32 R. H. nickeled screws	.12
49	2—Pkg. 10 6-32 nickeled nuts	.16
62	1—Pkg. 10 ½-in. 6-32 F. H. nickeled screws	.12
59	1—Pkg. 25 large lugs, 3/16-in. hole	.25
A1	1—Pkg. 10 ⅜-in. 6-32 R. H. nickeled screws	.12

AUXILIARY EQUIPMENT

Type	Name	Price
	Stanley & Patterson, West and Hubert Sts., New York City	
843	Deveau Gold Seal Phones, 2,200 ohms,	$8.00
844	Deveau Gold Seal Phones, 3,200 ohms,	10.50
	Pacent Electric Company, A-22 Park Pl., New York City	
40	Telephone plug	.50
53	Duojack, for two phones	1.50
	National Carbon Co., Long Island City, N. Y.	
767	45-volt variable B battery	5.00
6860	6-volt, 90-ampere-hour storage battery	18.00

BLUE PRINTS

Type	Name	Price
	M. B. Sleeper, Inc., A-88 Park Place, New York City	
4900	Grimes Inverse Duplex Receiver, set of 5 full size blue prints	$1.25
5000	Grimes Inverse Duplex Receiver, set of 4 full size blue prints	1.00

The following numbers of Radio and Model Engineering can still be supplied. The months and feature articles are listed below. Take this opportunity to complete your files. Price 11c. each.

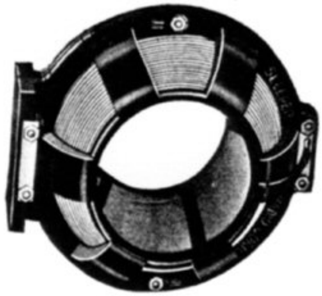
- June. 1921, Design of loose couplers.
- Oct. 1921, Radio frequency amplifier.
- Dec. 1921, Rectifier for short wave transmitter.
- May. 1922, Regenerative set with detector and 2-step.
- Aug. 1922, 2-step amplifier—Laboratory oscillator.
- Oct. 1922, Loop receiver—Wavelength inductance, capacity tables.
- Nov. 1922, 2-tube telegraph or telephone transmitter—Inductance tables.
- Jan. 1923, Non-regenerating receiving set with detector and 2-step amplifier—Super range receiver.
- Mar. 1923, 150 to 700-meter regenerative set—Sleeper circuit set.
- Vol. 3, No. 3. One-tube reflex using crystal detector—One-step tuned radio frequency amplifier for regenerative sets.
- Vol. 3, No. 4. Simplified Reinartz set, only two tuning controls—Use of the fixed coupler—Receiver with two-step radio frequency amplifier and detector.
- Vol. 3, No. 5. Special receiving set designed for the WT501 tube—Standard radio design practice, Part 1—The Duotrol set. Design of radio filters.

The SLEEPER Twins

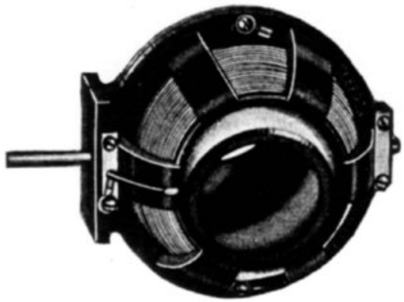
Most popular members of the Sleeper family of parts
Found wherever the best parts are assembled

The Sleeper Fixed Coupler

No switches, no taps to be soldered or break off, no coupling adjustment, yet it can be substituted for any vario-coupler in any circuit where the vario-coupler is used. Sharp tuning and louder signals on 150 to 1,000 meters. The Sleeper Fixed coupler is also the finest tuned radio frequency amplifier that you can buy.



Type A-209 Sleeper Fixed Coupler, $4.00



Type A-101 Sleeper Variometer, $6.50

The Sleeper Variometer

Endorsed by impartial engineers and testing laboratories as the most efficient molded variometer, without any exception, made in America. The sort of instrument that makes you feel glad you bought it after you get home. Maximum distributed capacity 0.000036 mfd., inductance 0.05 to 1.2mh.

The same cleverness of design and skill in manufacture will be found in the SLEEPER MONOTROL, the greatest single advance in radio reception during the past ten years. Send for the new pamphlet describing the SLEEPER MONOTROL, the one control loop receiver, first to be licensed for the Grimes inverse Duplex Circuit.

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Radio
CONSTRUCTION PARTS

SLEEPER RADIO CORPORATION

88-F PARK PLACE NEW YORK CITY

Blue Print Sets Giving Full Size Panel Patterns and Picture Wiring Diagrams—R and M Blue Print Dep't

Two-Tube Inverse Duplex

The Type 4900 Grimes set described in this issue of R and M. Panels can be laid out directly from the patterns. Full details, for station or portable use.

Set of 5 Prints $1.25

Duotrol 150-1,000 Meters

Two-control broadcast receiver using two variometers and fixed coupler. The standard regenerative circuit in a simplified design, very easy to operate. Type 4800.

Set of 5 Prints $1.25

Four Tube Inverse Duplex

Most efficient of all loop receivers is this Grimes set, both as to distance and sharpness of tuning. Only one tuning control. Type 5000.

Set of 4 Prints $1.00

Reinartz Original Set

One of the favorite sets among radio Experimenters. Hundreds of letters have been received describing exceptional work accomplished with it. Type 3300.

Set of 4 Prints $1.00

Two-Step Audio Amplifier

Designed for use with the X-1900, 3300, 4500, 4600, 4800, and 4900 sets. A clean cut instrument, fitted with phone jacks. Type 3100.

Set of 3 Prints $.75

One-Step Radio Amplifier

A tuned radio frequency amplifier adapted to non-regenerative sets but specially designed for regenerative types. Easy to build, easy to add to your set. Type 4300.

Set of 3 Prints $.75

Radio Frequency Receiver

Several interesting features are found in the short wave receiver, equipped with two steps of radio amplification and detector. An audio amplifier can be added. Type 4600.

Set of 4 Prints $1.00

Reinartz Simplified Set

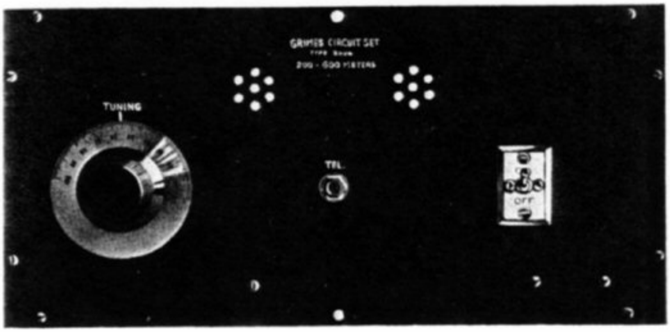
Three switches, ordinarily required on a Reinartz set, are eliminated, leaving only two tuning condensers for control. A splendid one-tube regenerative set. Type 4500.

Set of 2 Prints $.50

Super Range Receiver

Internationally known is the X-1900 set, a three-circuit tuner with variable condenser and variometer control. A fixed coupler can be substituted for the variocoupler.

Set of 3 Prints $.75



Parts for the Grimes Circuit Set

EXPERIMENTERS WHO HAVE DIFFICULTY IN GETTING LOCALLY SUPPLIES REQUIRED TO BUILD INSTRUMENTS DESCRIBED IN R AND M WILL APPRECIATE THE GET-IT-TO-ME-QUICKLY SERVICE PROVIDED BY DURRANT

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The trade mark "DEVEAU" has stood for the highest quality in telephone apparatus for thirty years,—a guarantee that every known advantage in design and manufacturing has been taken into careful consideration.

Magnets are extra-heavy one-piece units; cups are of aluminum to keep down the weight but unlike other Head Sets, every exposed metal part of the set is finished in genuine 24-karat gold,—under a protective lacquer so that the finish will last for years; the terminals of each unit are concealed,—no contact possible with users' hands.

"DEVEAU GOLD SEAL" HEAD SETS are like a piece of fine jewelry in appearance, but with all the radio niceties that the most advanced radio enthusiast can desire. DEVEAU Units exactly match each other in tone,—each has maximum sensitivity and perfection of tone quality.

The patented design of headgear is far ahead of any Head Set on the market,—affording as it does, instant fitting to ears and head without "re-harnessing" and without binding or pressure,—the latter an admitted nuisance with all other makes of Head Sets.

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