THE SCR–67–A RADIO TELEPHONE SET.

Equipment.

1 SCR–67–A (set box BC–13–A only).
1 power board (BD–1–A).
1 SCR–125–A wave meter.
1 SCR–61 wave meter.
3 storage batteries, 4-volt, type BB–14.
2 dry batteries, 22½-volt, type BA–2.
2 VT–1 vacuum tubes.
2 VT–2 vacuum tubes.
1 transmitter, type T–3.
1 control button and cord (CD–25).
1 extension cord (CD–23).
1 headset, type P–11.
1 antenna system, type A–9–A.

GENERAL CONSTRUCTION OF THE SCR–67–A.

Information.

The type SCR–67–A set is a two-way radio telephone set for use on the ground in communication with a similar set or with airplane

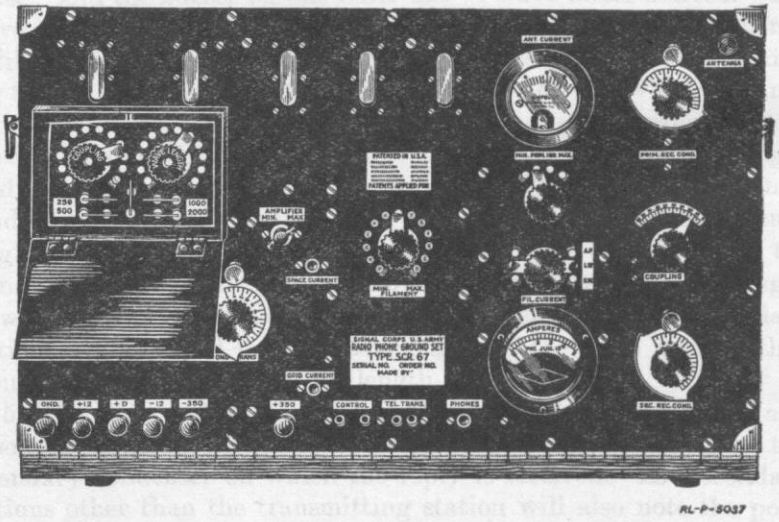

Fig. 77.—Front panel of set box BC–13–A of the SCR–67–A set.

radio telephone sets. Communication between two sets of this type may be carried on over a distance of from 5 to 7 miles. When used with a suitable antenna, the range of wave lengths of the set is from

250 to 450 meters when transmitting, and from 200 to 700 or 800 meters when receiving.

The SCR–67–A consists of two units: the BC–13–A set box and the BD–1–A power board. (See Figs. 77 and 78.) The BC–13 set box contains a vacuum tube, radio telephone transmitter, and receiver. The transmitting and receiving circuits are adjusted by the various controls on the front panel.

In order to operate the transmitter vacuum tubes properly, it is necessary to use 350 volts on the plates of the tubes. This voltage is

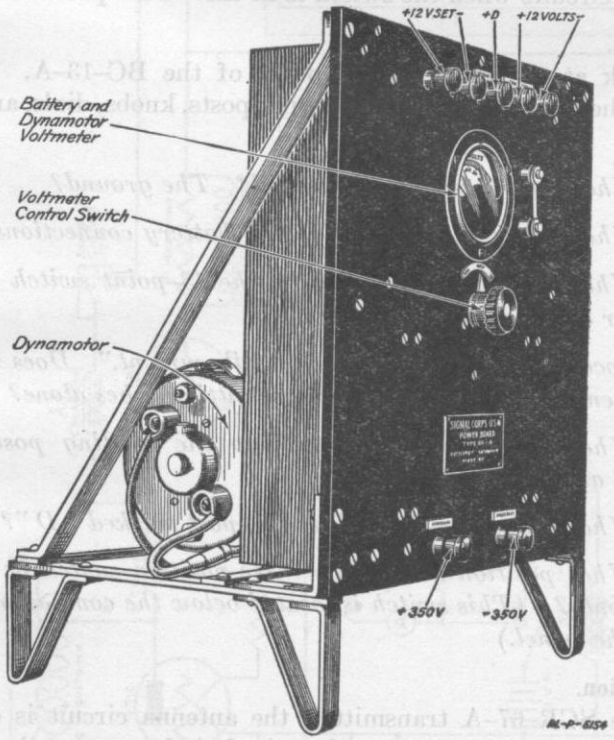

Fig. 78.—Power board type BD–1–A.

supplied by a dynamotor mounted in the rear of the BD–1–A power board unit. The 12-volt storage battery which is used to light the filaments of the transmitting and receiving tubes, also provides the current necessary to run the dynamotor.

Notice in the cording diagram that the two leads from the storage battery do not run directly to the set box but are directly connected to terminals on the power board. Thus a flexible extension cord may be used for all connections from the power board to the set box.

With this arrangement the apparatus can be easily set up in a short time.

A voltmeter which reads from 0–50 volts is mounted on the power board. When the switch directly underneath the meter is turned to the position marked " 12 volts " the meter will indicate the voltage of the storage battery. When the switch is turned to the position marked " 350 V " the meter will indicate the high voltage of the dynamotor. It will be necessary to multiply the latter reading by 10, as only one scale is provided on the meter. The meter is disconnected from the circuits when the switch is in the " Off " position.

Directions.

1. Look at the front of the panel of the BC–13–A. Carefully observe the marking of all the binding posts, knobs, dials, and meters.

Questions.

(1) *Where is the antenna connected? The ground?*

(2) *Where are the filament lighting battery connections made?*

(3) *What circuit is controlled by the 13–point switch located at the center of the panel? Explain.*

(4) *Locate the ammeter marked " Fil. current." Does it indicate the filament current used by the transmitting tubes alone? Explain.*

(5) *What connections are made to the binding posts marked* "+ 350 " *and* " —350 "?

(6) *What connection is made to the post marked " D "?*

(7) *What position should the three-position switch be in for reception only? (This switch is located below the compartment on the left of the panel.)*

Information.

In the SCR–67–A transmitter, the antenna circuit is coupled to the vacuum tube circuit through a single inductance coil. (See Fig. 79.) A wave-length change switch controls the number of turns in the inductance coil and thus controls the wave-length range of the transmitter. A variable condenser, marked "Antenna Cond.," connected directly between the antenna and ground terminals, provides a means for fine adjustment of the wave length.

There are two VT–2 vacuum tubes used in the transmitting circuit. The vacuum tube which is coupled to the antenna circuit is called the *oscillator tube.* The term " oscillator " implies that the tube is a generator of electrical impulses. As long as the filament of

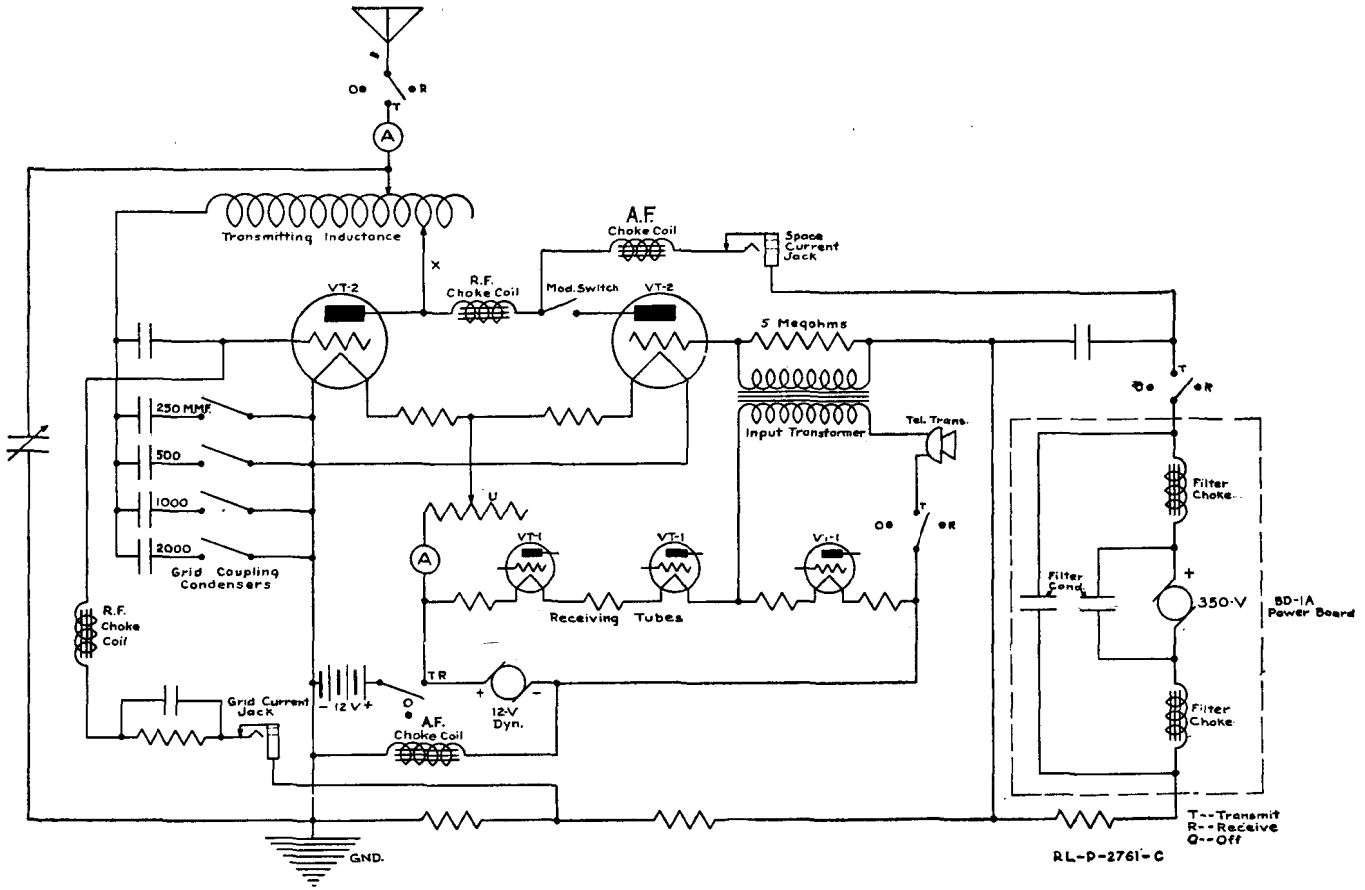

Fig. 79.—Schematic diagram of transmitter connections in the SCR–67–A set.

the oscillator tube remains lighted and the proper plate voltage is applied with proper coupling between grid and plate circuit, a continuous stream of electrical impulses will be generated and conveyed to the antenna, from which they will be radiated in the form of continuous waves. It will be noticed that there are four condensers in the grid circuit of the oscillator tube which are controlled by four single-pole switches. They are used to obtain the proper coupling between the grid and plate circuits, so that the tube will generate the electrical impulses.

The second vacuum tube in the transmitter is known as the *modulator tube.* The grid circuit of this tube is connected with a telephone transmitter through an induction coil or *modulation transformer* as it is called. When the telephone transmitter is spoken into, the voice vibrations are converted or changed into electrical voice currents. The modulator tube amplifies these currents and then combines them with the impulses generated by the oscillator tube. This is done in such a way that the combined currents are radiated from the antenna in the form of waves, the continuous waves formed serving as a carrier for the voice current waves. This process of impressing the voice currents upon the continuous or carrier wave is called *modulation.*

It will be noticed in the schematic diagram that the microphone or telephone transmitter is connected across the filament terminals and resistances of the detector tube in the receiving circuit. This was done to obtain the current required to operate the telephone transmitter. It is necessary, therefore, to have the filaments of the receiver tubes lighted or the telephone transmitter can not be made to operate. Notice also that there is a switch called the modulator switch in the plate circuit of the modulator tube. The operation of the modulator tube may be stopped by opening this switch. Wave length readings of the transmitter are taken with this switch open. It is also an aid in locating trouble if the transmitter is not working properly.

Directions.

2. Observe the transmitting controls on the panel of the BC–13–A set box. Pull the knob in the upper left-hand corner and open the door to the wave length adjusting compartment.

Questions.

(8) *How many points has the "Wave-length" switch? The "Coupling" switch?*

(9) *What is the purpose of the four small horizontal knife switches in the compartment?*

(10) *What connections are made in the transmitting circuit when the small vertical knife switch is closed?*

(11) *Locate the "Con.-Trans." condenser. What is its purpose?*

(12) *What is the use of the meter marked "Ant. Ammeter"? Why is the red line drawn on its scale?*

Information.

The receiving circuit of the SCR–67–A is of the inductively coupled type. (See Fig. 80.) The primary circuit comprises the antenna, a variable condenser, an inductance coil variable in four steps, and the ground. The secondary circuit consists of an inductance coil (inductively coupled to the primary), variable in two steps, and a variable condenser. A three-position switch is provided so that for short waves one-half of the secondary coil is used, while for the longer waves the entire coil is used.

When the switch is in the "AP" (aperiodic or untuned) position, the secondary circuit is entirely disconnected and the primary circuit is directly connected to the detector. This position of the switch is used when searching for signals of unknown wave length.

A vacuum tube detector is used in the receiver. In addition, two stages of audio frequency amplification are provided. The 40-volt "B" battery (made up of two type BA–2 batteries in series), necessary to operate the receiver tubes, is contained in a holder inside the set box. In the amplifier circuit, choke coils are made use of instead of amplifying transformers. While the choke coils have only one winding and are connected differently in the circuit, the effect produced is similar to that when using transformers.

An "amplifier" switch is provided in the circuit between the two amplifier tubes. When this switch is closed, a high grid lead resistance is shunted by a comparatively low resistance, thereby decreasing amplification of the second stage.

Directions.

3. Observe the receiver controls on the panel of the BC–13–A set box.

Questions.

(13) *Locate the primary and secondary condenser dials. How many degrees are marked on each?*

(14) *How many switch points has the primary inductance switch?*

(15) *How many positions has the short and long wave switch?*

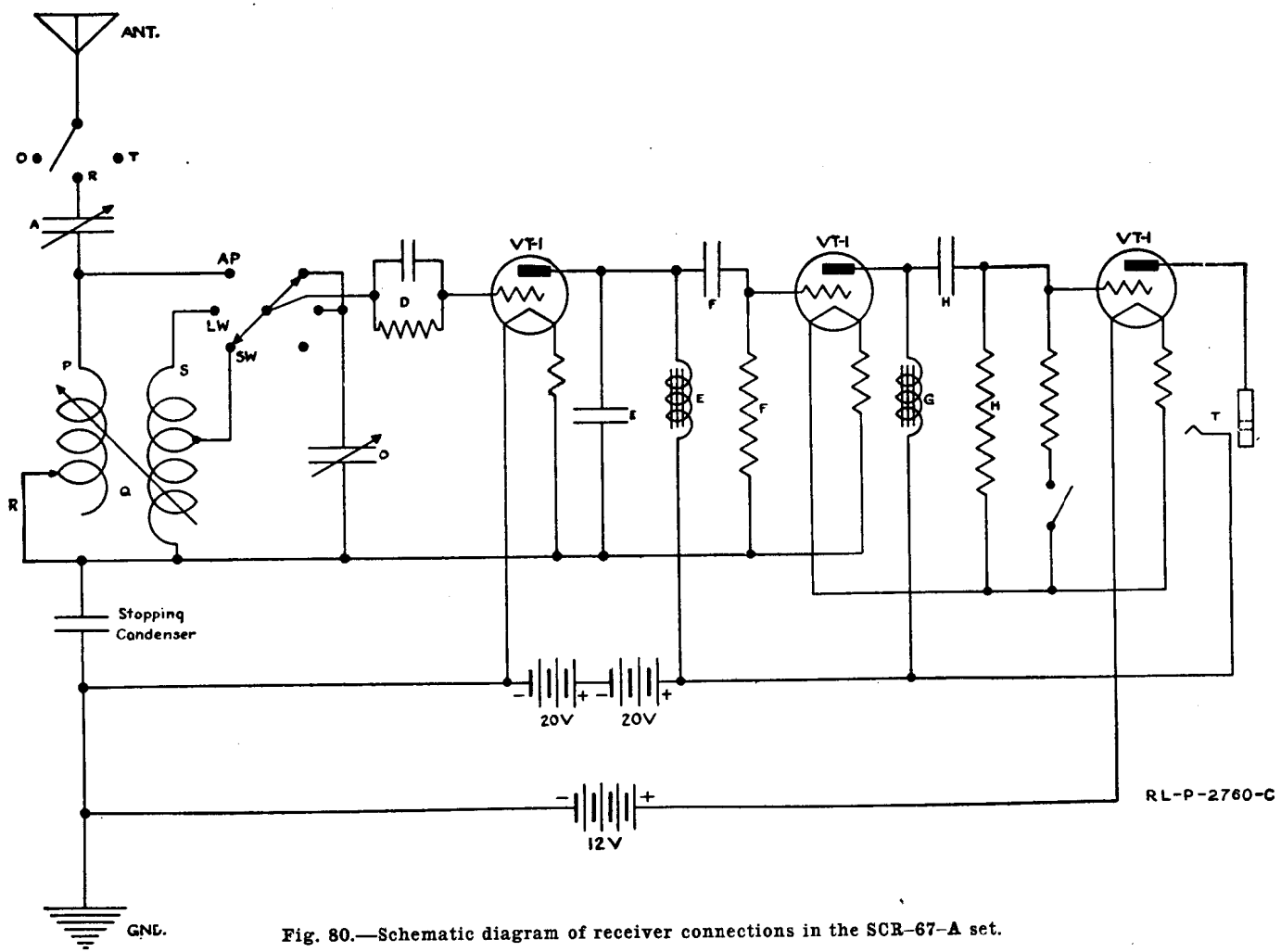

Fig. 80.—Schematic diagram of receiver connections in the SCR-67-A set.

(16) *What happens in the circuit when the switch is in the "AP" position?*

(17) *Locate the coupling control. Why is it provided?*

(18) *How many positions has the amplifier switch?*

(19) *How many pairs of phones can be plugged into this set?*

Information.

To carry on two-way communication between two sets of the SCR–67–A type, it is necessary to provide some means by which a change from transmit to receive can be made rapidly. This is accomplished by the use of the control push button, which is plugged

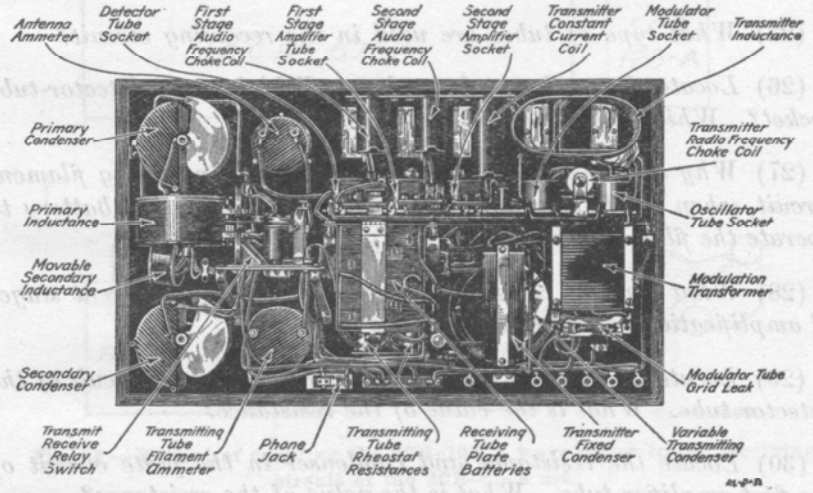

Fig. 81.—Interior of set box BC–13–A, showing parts mounted on back of panel.

into the jacks marked "Control." When the button is pressed, a relay switch is operated inside the set box which connects the "+ 350 V" to the plates of the transmitter tubes, connects the telephone transmitter in the circuit, and makes connection between the transmitting circuit and the antenna.

When the control button is released, the relay switch arm returns to its original position. This automatically connects the antenna to the receiving circuit.

Directions.

4. Unfasten the hooks on the side of the set box and pull the panel forward. (See Fig. 81.) Inspect the parts in the rear of the panel carefully. Move the control knobs on front of the panel and note what moves in the rear.

Questions.

(20) *Locate the relay switch. What connections are made to the contacts on the movable arm?*

(21) *Which is the primary receiving coil? How many taps on it?*

(22) *Which is the secondary receiving coil? How many taps on it?*

(23) *Locate the primary and secondary variable receiving condensers. What is the purpose of each condenser?*

(24) *Locate the receiving grid condenser and grid leak. How are they connected in the circuit?*

(25) *What type of tubes are used in the receiving circuit?*

(26) *Locate the receiver-tube sockets. Which is the detector-tube socket? Which are the amplifier sockets?*

(27) *Why is a 12-volt battery connected in the receiving filament circuit, when a VT–1 vacuum tube requires only a 4-volt battery to operate the filament?*

(28) *What kind of coupling is used between the different stages of amplification? Locate these choke coils.*

(29) *Locate the resistance and condenser in the plate circuit of the detector tube. What is the value of the resistance?*

(30) *Locate the resistance and condenser in the plate circuit of the first amplifier tube. What is the value of the resistance?*

(31) *Locate the transmitter inductance coil.*

(32) *Which socket is the oscillator-tube socket? The modulator-tube socket?*

(33) *Locate the oscillator-tube grid condenser. Why are there a number of small condensers provided? How are they connected with respect to each other?*

(34) *Locate the modulation transformer and the resistance connected across its secondary winding. What is the value of this resistance?*

EXPERIMENT No. 1.

RECEIVING WAVE LENGTH RANGE.

Directions.

5. Insert three VT–1 vacuum tubes in the receiving sockets. Insert and connect properly two BA–2 batteries. Close up the front panel of the set and fasten the hooks at the sides. Connect a 12-volt storage battery to the +12 and −12 binding posts. (See Fig. 82.) Throw the three-position switch to "Receive only."

6. Start the buzzer on the SCR–125–A wave meter vibrating as evenly as possible. Couple the SCR–125–A to the secondary receiv-

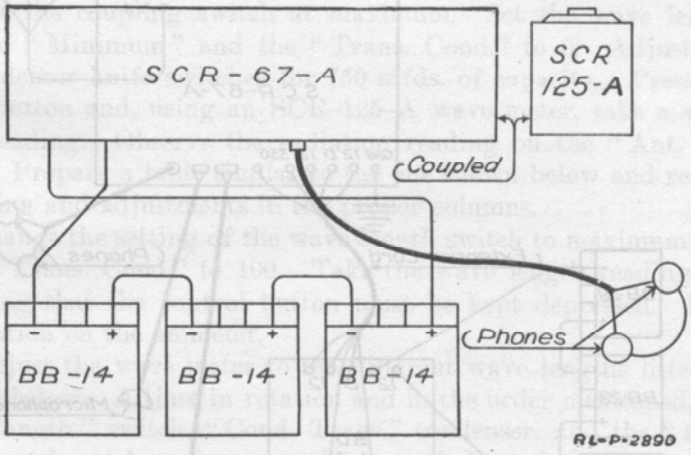

Fig. 82.—Method of coupling the SCR–125–A wave meter to the receiving circuit of the SCR–67–A set.

ing coil of the SCR–67–A. Set the secondary switch on "SW" and the secondary receiving condenser at 0. Plug in a pair of phones in the SCR–67–A and take a wave length reading.

a. Change the setting of the secondary variable condenser to "100" and take a wave length reading.

b. Change the setting of the secondary inductance switch to "LW" and the secondary variable condenser to 0. Take a wave length reading.

c. Change the setting of the secondary condenser to "100" and take a wave length reading.

d. Change the setting of the secondary inductance switch to "AP" and vary the secondary variable condenser, noting the point at which it is in tune.

Questions.

(35) *From the above four wave length readings, what would you say was the receiving wave length range of the SCR–67–A?*

(36) *Does varying the secondary variable condenser change the received wave length of this set when the switch is on "AP"? Explain.*

(37) *Why is the "AP" circuit used in this set?*

Directions.

7. Disconnect the 12-volt storage battery from the set box BC–13–A.

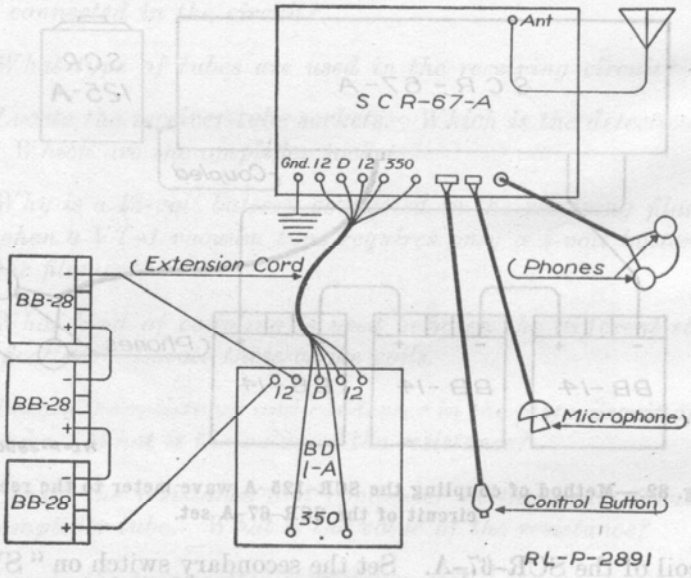

Fig. 83.—Method of coupling the SCR–125–A wave meter to the transmitting circuit of the SCR–67–A set.

EXPERIMENT NO. 2.

TRANSMITTER CALIBRATION.

Directions.

8. Connect the 12-volt storage battery to the proper binding posts on the BD–1–A power board. (See Fig. 83.) Using the connection cord CD–23, connect the proper terminals on the BD–1–A power board to the corresponding terminals on the set box, BC–13–A. Plug in the telephone transmitter and the control button in the proper jacks. Open up the front of the set and insert two VT–2 tubes in the transmitting sockets. Close the front and fasten the hooks.

Connect the antenna and ground leaks to the proper binding posts on the set box. Throw the three-position switch to "Power on."

9. Throw the switch on the power board to the 12 volts position and check the storage battery voltage. This should be at least 12 volts and may be 14 volts without damage to the set. After checking the voltage, throw the switch to "Off." Turn the filament current switch on the set box panel all the way to the left, to the position "Minimum." Open the modulator switch in the compartment.

10. Turn the three-position switch on the set box panel to "Trans.-Rec." This should light the filaments of all the vacuum tubes and start the dynamotor. Adjust the filament current so that the filament current ammeter reads 2.6 to 2.7.

11. Set the coupling switch at maximum. Set the wave length switch to "Minimum" and the "Trans. Cond." to 0. Adjust the grid condenser knife switches for 750 mfds. of capacity. Press the control button and, using an SCR–125–A wave meter, take a wave length reading. Observe the radiation reading on the "Ant. ammeter." Prepare a table similar to the one shown below and record the reading and adjustments in the proper columns.

12. Change the setting of the wave-length switch to maximum and set the "Trans. Cond." to 100. Take the wave length reading, remembering that the control button must be kept depressed. Note the radiation on the ammeter.

13. Adjust the wave meter to the different wave lengths listed in the table below. Adjust in rotation and in the order mentioned, the "Wave length" switch, "Cond. Trans." condenser, and the "Coupling" switch until maximum readings are indicated by the antenna ammeter. Record in the table the settings and readings for each wave length under the proper heading.

14. It will be necessary to readjust several times the "Coupling" switch, grid coupling knife switches, and antenna transmitting condenser to secure adjustments which will give a maximum reading on the antenna ammeter at the desired wave length. The radiation should be from 0.3 to 0.6 amp.

TABLE.

Wave length.	Antenna switch point.	Coupling switch. point.	Antenna transmitting.	Grid coupling condenser.	Antenna ammeter reading.
250					
300					
350					
400					
450					

78063°—24——11

Questions.

(38) *From the above operation, what is the transmitting wave length range of the SCR-67-A?*

(39) *On what wave length tap, condenser settings, and grid capacity was the highest radiation obtained? What was this radiation?*

EXPERIMENT No. 3.

MODULATION.

Directions.

15. Adjust the transmitter to the wave length which gave the greatest radiation in Experiment No. 2. Close the modulator switch in the wave length adjustment compartment. Press the control button. With lips close to the telephone transmitter, whistle into it and note the movement if any of the radiation ammeter needle. Speak into the transmitter in an even tone of voice, not too high or loud, and note the action of the ammeter needle. Adjust the set to other wave lengths and note in each case the modulation indicated by the ammeter. Whistle and talk into the transmitter, listening carefully in the phones for clear and sustained speech modulation.

Questions.

(40) *Does the needle of the ammeter rise or fall as the transmitter is whistled into?*

(41) *Compare the movement of the needle when speaking into the transmitter with the movement made when whistling.*

(42) *Does the needle fluctuate more or less violently as the sound of the voice becomes clear and even in the phones?*

(43) *Is the set modulating well or poorly when the needle fluctuates a great deal and the sound in the phones is clear and even?*

CAUTION.—*Do not touch the modulator and grid condenser switches with bare hands when the power is on. A severe shock will result unless the operator is careful in this respect.*