THE SCR-109-A AND SCR-159-A SETS.

Equipment.

1 transmitter, type BC-86-A.
1 receiver, type BC-98-A.
1 antenna equipment type A-9-A.
1 dynamotor, type DM-13.
3 batteries, type BB-14.
4 batteries, type BA-2.
1 headset, type P-11.
3 tubes, type VT-1.
1 tube, type VT-2.
2 tubes, type VT-4.
1 microphone transmitter, type T-3.
1 key, type J-12 or J-2.
1 cord, type CD-48.
2 cords, type CD-38.
3 cords, type CD-49.
1 wave meter, type SCR-125-A.
1 wave meter type SCR-61.

GENERAL CONSTRUCTION OF THE SCR-109-A AND SCR-159 SETS.

Information.

The SCR-109-A and SCR-159 are ground radio sending and receiving vacuum tube sets providing three means of communication; undamped or continuous wave radio telegraphy, buzzer modulated radio telegraphy and radio telephony. The two sets are identically the same, differing only in the antenna equipment. Their transmitting wave-length range is from 300 to 500 meters and the receiving wave-length range is frome 300 to 1,100 meters. The SCR-109-A set will furnish reliable communication with a similar set over a distance of 60 miles by undamped wave telegraphy; over a distance of 30 miles by buzzer modulated telegraphy; and over a distance of 20 miles by telephony.

NOTE.—As the SCR-109-A set and the SCR-159 set differ only in antenna equipment only one of the sets, the SCR-109-A will be referred to in this Unit Operation.

TRANSMITTER SET BOX, TYPE BC-86-A.

Three 4-volt storage batteries, connected in series, are required to furnish the necessary power to operate the BC-86-A transmitter. In practice two groups of batteries are connected in parallel, there

being three batteries in series in each group. This grouping of batteries is necessary if the sets are to be operated any length of time, as a considerable amount of current is consumed by the vacuum tubes and dynamotor in the set. A dynamotor is provided for changing the 12-volt direct current furnished by the storage batteries to a 750–800-volt direct current. The motor takes about 27 amperes at 12 volts, while the output of the generator is approximately 0.2 of an ampere at 750 volts.

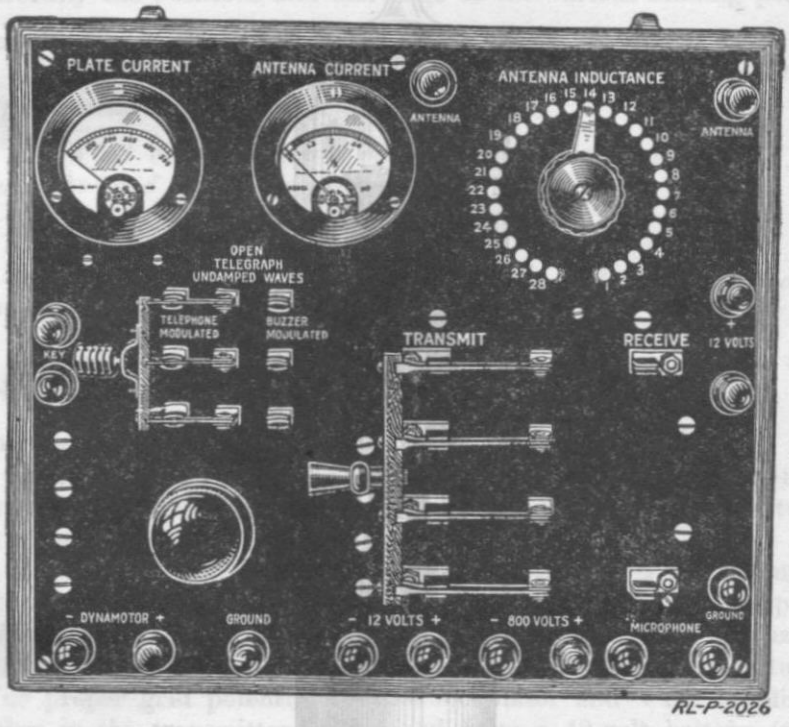

Fig. 101.—Front panel of transmitter set box, type BC–86A.

The BD–86–A set box (see Fig. 101) contains the necessary apparatus for the three methods of transmission. At the upper left-hand corner of the front panel is a milliammeter which indicates the plate current of the vacuum tubes used in the transmitter. To the right of this meter is a thermoammeter, which indicates the antenna current. In the upper right-hand corner is a 28-point dial switch controlling the number of turns of inductance included in the antenna circuit and hence controlling the transmitted wave length. Below this dial switch is a large four-pole, double-switch

marked "Transmit-Receive." When thrown to "Transmit," the upper blade connects the antenna to the transmitting apparatus; the second blade closes the 800-volt plate circuit; the third blade closes the circuit of the 12-volt supply to the dynamotor, thus causing it to start up; and the bottom blade closes the filament circuit of the transmitting tubes. When thrown to "Receive," the upper

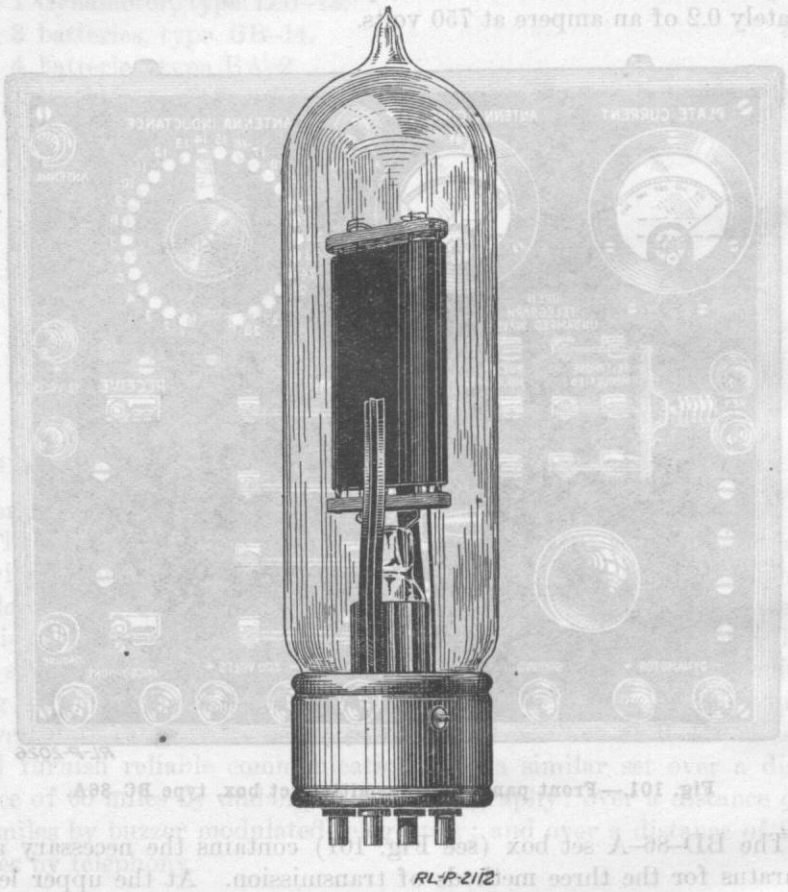

Fig. 102.—Type VT–4 vacuum tube.

blade connects the antenna to the receiving apparatus (in the BD–98–A set box), and the lower blade closes the filament circuit of the receiver vacuum tubes.

Beneath the two ammeters is a small three-pole double-throw switch which must be considered as having three positions—closed to the left, closed to the right, and open. This switch controls the three methods of transmission which are properly marked on the

switch positions. The buzzer used in buzzer modulated telegraphy is mounted just below the three-pole switch. The necessary binding posts for connections are mounted along the edges of the panel and are plainly marked.

Directions.

1. Examine the panel of the BC–86–A (see Fig. 101), and note the marking of the various switches, knobs, and controls. Also observe carefully the positions and markings of the various binding posts.

Questions.

(1) *What is the range of the meter marked "Plate Current"? Of the meter marked "Antenna Current"?*

(2) *What connections are made to the four binding posts on the right-hand side of the panel?*

(3) *Where is the key connected to the set?*

(4) *For what purpose are the two binding posts marked "+ and Dynamotor?"*

(5) *Where are the filament current connections made for the transmitting tubes?*

Information.

Three vacuum tubes are used in the BC–86–A transmitter—two type VT–4 tubes and one type BT–2 tube. The VT–4 vacuum tube is a high-power tube. (See Fig. 102.)

Its output is rated at 50 watts. One of the VT–4 tubes is used as an oscillator while the other is used as a modulator. The purpose of the VT–2 tube in this circuit is to amplify the voice or buzzer currents which are impressed upon the grid of the oscillator tube. The proper grid potential for the modulator and VT–2 amplifier tubes in the transmitter is obtained from a 40-volt battery (two type BA–2 batteries in series), which is placed in a container inside the set box.

Capacity coupling is used between the grid and plate circuits of the oscillator tube. The antenna circuit acts as part of the capacity coupling, and therefore is a factor in determining the wave length of the transmitter. The plate circuit of the oscillator tube is directly coupled to the antenna circuit through the antenna inductance. The coupling is varied by means of an 8-point switch. This switch is located at the rear of the antenna inductance inside the set box. The coupling between the oscillator, modulator, and amplifier tubes is obtained by the use of audio frequency transformers.

When the large three-position switch on the front of the panel is thrown to "Open," the proper connections are made for transmitting undamped wave signals. (See Fig. 103.) In this case the VT–4 modulator tube and the VT–2 amplifier tube are not connected in the transmitting circuit. The impulses delivered to the antenna circuit by the oscillator tube are controlled by the telegraph key. For instance, when the key is depressed the impulses are being generated by the VT–4 and radiated from the antenna in the form of continuous waves. When the key is released the generating

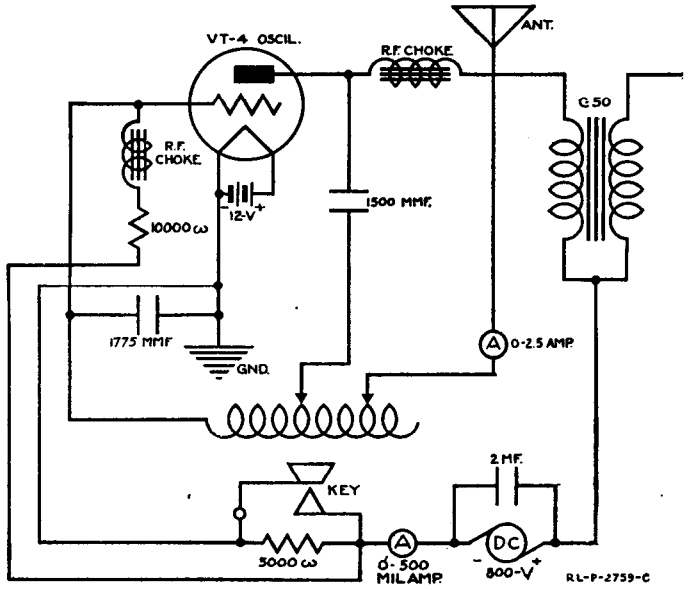

Fig. 103.—Schematic diagram of connections when the BC–86–A transmitter is being used for the transmission of undamped-wave signals.

action ceases. In this way signals are sent by the usual manipulation of the key.

When the three-position switch is thrown to the "Telephone Modulated" position, all three transmitting tubes are connected in the circuit. (See Fig. No. 104.) A microphone is connected to the proper terminals, and when spoken into it conducts the voice currents to the coupling transformer which is connected to the grid circuit of the VT–2 amplifier tube. Here the voice currents are amplified and then impressed upon the grid of the modulator tube through the second coupling transformer. The modulator tube in turn amplifies the voice currents again and impresses them upon the impulses generated by the oscillator tube through the third amplifying transformer.

The result is that the continuous waves radiated from the antenna are modulated to conform to the voice currents of the microphone.

With the three-position switch thrown to the "Buzzer Modulated" position, the proper connections are made for transmitting buzzer modulated radio telegraph signals. (See Fig. 105.) The three tubes of the transmitter are again in use, the same as for radio telephony. The small buzzer is connected across a small resistance and, therefore, obtains enough current to operate steadily. The interrupted currents from the buzzer are amplified in the same manner as the voice currents from the microphone and are impressed upon the impulses generated by the oscillator tube. The oscillator tube, however, is connected the same as it is when transmitting undamped wave telegraph

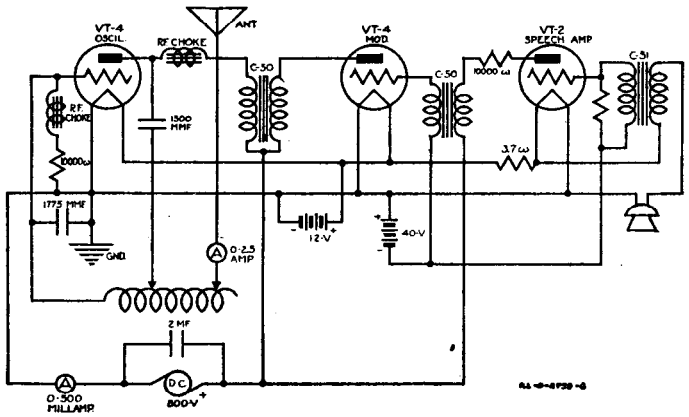

Fig. 104.—Schematic diagram of connections when the BC-86-A is being used as a radio telephone transmitter.

signals. In other words the oscillator tube generates impulses only when the key is depressed. When the key is held down the impulses generated by the oscillator tube are modulated by the buzzer currents. When the transmitter is used as a radio telephone, the oscillator tube is generating impulses continuously, and these impulses are modulated signals are transmitted the reverse of this is true, as the modulated only when the microphone is spoken into. When buzzer modulated signals are transmitted, the reverse of this is true, as the modulator is operating continuously and the oscillator generates only when the key is depressed. The buzzer modulated wave radiated by the antenna may be received by any receiving set which uses a crystal detector or a simple vacuum tube detector circuit. The note heard in the telephone receivers will be exactly the same as the original note of the buzzer in the transmitter.

Directions.

2. Remove the four screws in the corners of panel and the screws in the center of the horizontal edges of the panel. This allows the

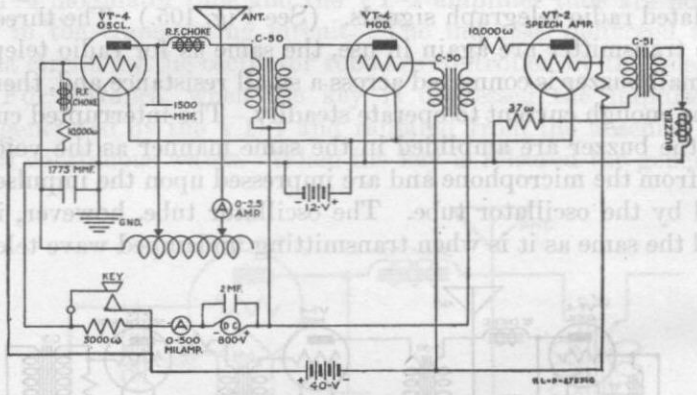

Fig. 105.—Schematic diagram of connections when the BC–86–A is being used as a transmitter of buzzer modulated signals.

panel to be removed from the wooden box frame. Using Fig. 106, locate the various parts of the apparatus on the rear of the panel.

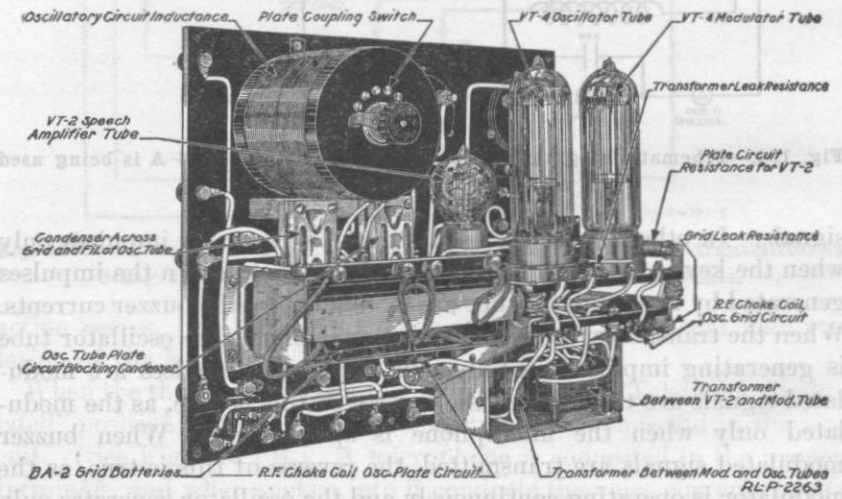

Fig. 106.—Rear view of BC–86–A transmitter panel.

Questions.

(6) *Locate the antenna inductance. How is it varied?*

(7) *Does this variation affect the wave length of the transmitter?*

(8) *How is the coupling between the antenna current and the oscillator circuit varied? What kind of coupling is used?*

(9) *Locate the oscillator, modulator, and VT–2 tube sockets. What difference is there in the sockets?*

(10) *Where is the container for the grid battery located?*

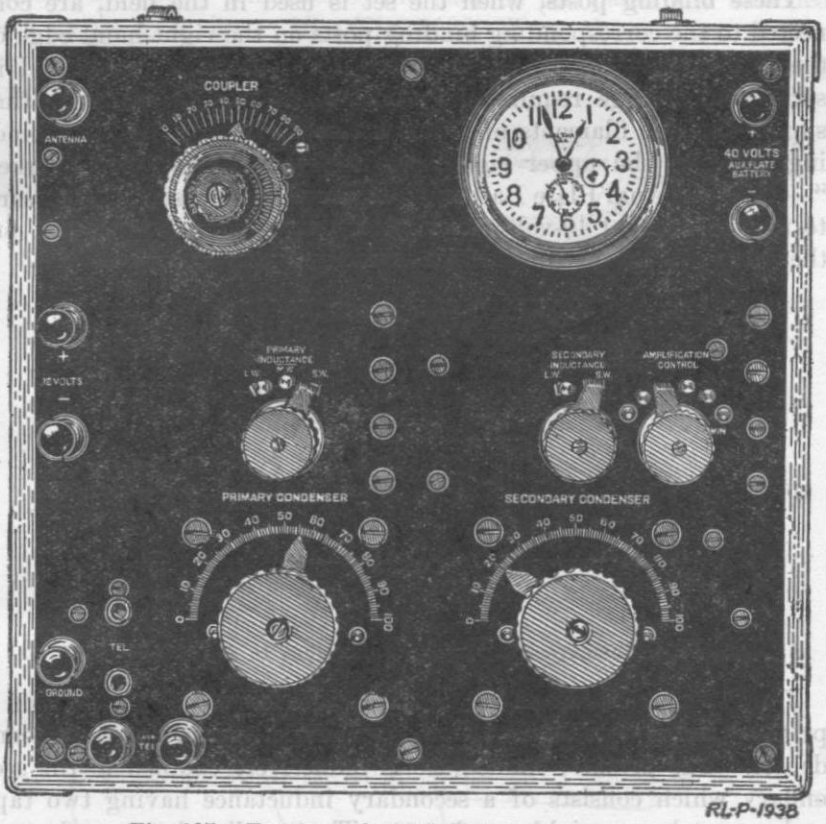

Fig. 107.—Front panel of BC–98–A receiver set box.

(11) *Locate the transformer used for coupling the oscillator and modulator tubes.*

(12) *What is the use of the buzzer in this set?*

(13) *Does the buzzer operate continuously when buzzer modulated telegraph signals are being transmitted?*

Information.

The receiving apparatus of the SCR–109–A is contained in the BC–98–A set box. (See Fig. 107.) It is similar in size to the trans-

mitter set box. The necessary controls for operating the receiver are mounted on the front panel. The receiver is equipped with a vacuum tube detector and two stages of audio frequency amplification. Along the left-hand edge of the panel are four binding posts marked "Antenna," "+ 12 Volts," "— Volts," and "Ground," respectively.

These binding posts, when the set is used in the field, are connected to the corresponding binding posts on the right-hand edge of the transmitter panel. As the three VT–1 tubes are connected in series, the voltage required for the filaments is the same as that supplied to the filaments of the transmitting tubes. The two binding posts on the upper right edge of the receiver panel marked "+40 Volts Aux. Plate Battery" are provided in case it is necessary to use an external 40-volt plate battery instead of the one that fits the compartment provided in the inside of the set box.

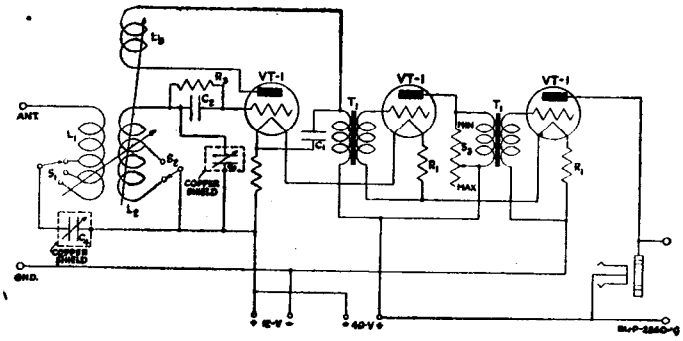

Fig. 108.—Schematic diagram of connections in set box BC–98–A.

The antenna circuit of the receiver (see Fig. 108) consists of a primary inductance having three taps and a primary variable condenser. The primary inductance is inductively coupled to the secondary which consists of a secondary inductance having two taps and a secondary variable condenser. The coupling between the primary and secondary inductances is varied by turning the larger of the two knobs mounted together on the upper left-hand corner of the panel.

The plate circuit of the detector tube (see Fig. 108) contains a tickler coil which is coupled to the secondary inductance coil. This coupling is varied by means of the knob marked "Tickler" which is mounted, together with the secondary coupler knob, on the upper left-hand corner of the panel.

The adjustment of the tickler is especially important in the BC–98–A receiver. The tickler in this set provides a means for ad-

justing the receiving circuit so that C. W. signals as well as damped wave signals may be received. The proper adjustment of the tickler also makes possible an increase in signal strength and greater selectivity when receiving damped wave signals.

Directions.

3. Release the two latches at the top of the BC–98–A set box and remove the back. This leaves the back of the panel and attached part exposed to view. (See Fig. 109.) Turn the various controls and the parts on the rear of the panel that move. Check wiring diagram as far as possible.

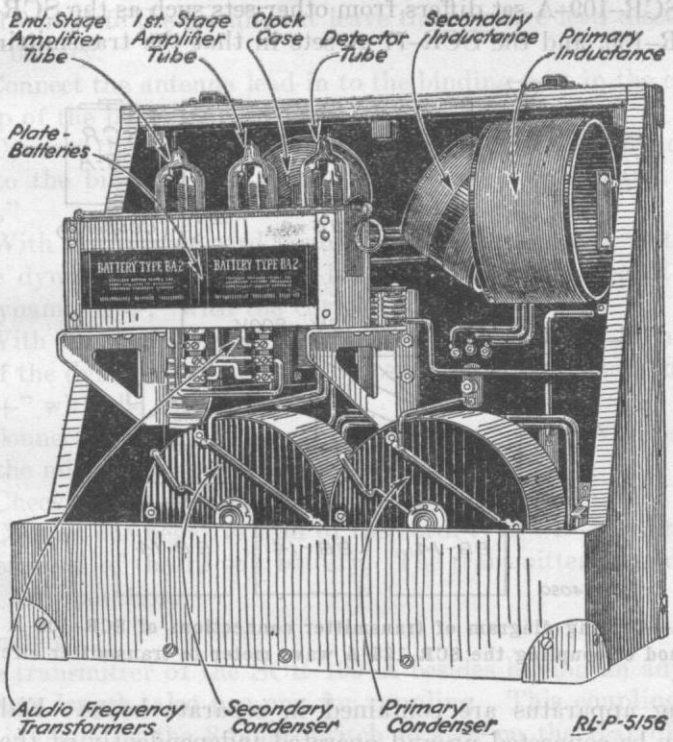

Fig. 109.—Rear of BC–98–A receiver panel.

Questions.

(14) Note how the primary, secondary, and tickler inductance coils are mounted. Which is the secondary? Which the tickler?

(15) What is the purpose of the switch marked "Amplification Control"?

(16) How is the wave length of the primary circuit varied? Of the secondary circuit?

(17) Locate the "B" battery container. How many terminals are provided on it?

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

(19) What connections are made to the binding posts marked "Aerial" and "Ground"?

EXPERIMENT NO. 1.

TO CONNECT UP AND TUNE THE SCR–109–A.

Information.

The SCR–109–A set differs from other sets such as the SCR–79–A, the SCR–130, and the SCR–77–A sets in that the transmitting and

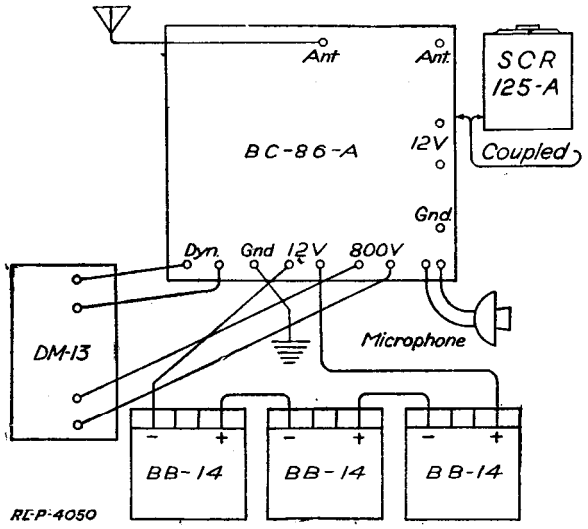

Fig. 110.—Cording diagram of transmitter connections of SCR–109–A set and method of coupling the SCR–125–A wave meter to transmitter circuit.

receiving apparatus are contained in separate boxes. Either set box may be connected up and operated independently of the other. Also the receiver set box may be connected up in conjunction with the transmitter set box so that the receiver may be placed in operation when desired by manipulating the proper switches on the transmitter panel. The transmitter and receiver are tuned separately.

Directions.

4. To connect up the transmitter. (See Fig. No. 110.)

a. Place the BC–86–A set box on the surface on which it is to be operated. Remove the cover of the set box.

b. Insert two VT–4 tubes in the two large sockets on the tube shelf and insert a VT–2 tube in the small socket.

c. Place two BA–2 batteries in the compartment back of the tube shelf and connect the leads from the batteries to the four binding posts provided in the correct order indicated. Make sure that the connections are correct in polarity.

d. Open the "Trans.-Rec." switch.

e. Connect three 4-volt storage batteries in series and using the cord, type CD–48, connect the 12-volt battery thus formed to the two binding posts on the lower edge of the panel marked "— 12 volts +." Do not complete the circuit, but leave the negative lead disconnected at the battery.

f. Connect the antenna lead-in to the binding post in the center of the top of the panel marked "Ant."

g. Connect the wire from the counterpoise or other ground system used to the binding post on the lower edge of the panel marked "Gnd."

h. With the proper cord connect the motor (or low voltage side of the dynamotor) to the two binding posts on the panel marked "— Dynamotor +," with the correct polarity.

i. With the proper cord connect the generator (or high voltage side of the dynamotor) to the two posts on the panel marked "— 800 volts +" with the correct polarity.

j. Connect the key to the proper binding posts on the panel and plug the microphone in the jack provided.

k. Check all connections to see that they are correct.

l. Connect the negative lead of the cord, type CD–48, to the negative terminal of the 12-volt battery. The transmitter should now be ready for operation.

Information.

The transmitter of the SCR–109–A besides having an adjustment for wave length, also has one for coupling. This coupling adjustment is made by the 8-point switch located on the rear of the antenna inductance. Its position has some influence on the transmitting wave length, so that, it is necessary to note its position if it is desired to return to any given wave length.

The wave length on which the BC–86–A set box transmits is dependent on the type of antenna used and it is, therefore, impossible to calibrate it for use with any antenna. It is necessary to make a table of settings corresponding to the wave lengths on which the set will be required to transmit for each antenna system used. The settings for each of these wave lengths should be obtained in the manner explained below.

Directions.

5. To tune the transmitter to a given wave length.

a. Set the antenna inductance switch approximately at the wave length desired. (Suppose that the wave length desired is 400 meters. Four hundred meters is halfway along the wave-length range of the set. Therefore, as a trial setting, place the antenna inductance switch halfway around "Max.")

b. Throw the small double-pole switch on the panel to the "C. W." position and the "Trans.-Rec." switch to the "Trans." position. The dynamotor should now start running and the filament of the oscillator tube should light with a dull red glow.

c. Close the key and vary the coupling switch (on the back of the of the antenna inductance) until the plate milliameter on the panel reads about 125 milliamperes.

d. Light the lamp of the SCR–125–A wave meter and adjust it to a dull red glow.

e. Couple the SCR–125–A wave meter to the antenna inductance and vary the wave meter dial until the lamp glows brightly. If this occurs at a wave length greater than that desired, reduce the antenna inductance. If it occurs at a wave length less than the wave length desired, increase the antenna inductance.

f. After adjusting the antenna inductance, measure the wave length again and continue this process until the inductance tap is found which gives the wave length nearest that desired.

g. If the plate milliammeter does not indicate a reading of about 125 milliamperes, readjust the coupling until this value is obtained. If the coupling switch is adjusted in order to get the correct plate current, the antenna inductance switch may require readjustment in order to maintain the correct wave length.

h. After the above adjustments have been made the transmitter should be sending continuous waves on the desired wave length. If it is desired to send buzzer or telephone modulated waves, the small double-pole switch on the panel is thrown to the proper position for the type of modulation desired and the wave length again checked and adjusted if necessary.

Questions.

(20) *Why is the "Trans.-Rec." switch left open until all connections have been made?*

(21) *Would the set transmit any kind of signal without the key being connected?*

(22) *What is the range of the antenna current ammeter?*

(23) *Why can not the transmitter be permanently calibrated?*

(24) *What is the wave length range of the SCR-125-A wave meter?*

(25) *What is the purpose of the coupling switch?*

(26) *What plate current does the oscillator tube normally draw?*

(27) *Does the plate milliammeter read only the plate current of the oscillator tube?*

(28) *How much difference in wave length does one tap of the antenna inductance make?*

(29) *When the coupling switch is varied, does it vary the transmitting wave length?*

(30) *When transmitting continuous waves, do the filaments of all three tubes light?*

(31) *What value of antenna current did you obtain in tuning the transmitter?*

Information.

The receiver of the SCR-109-A is contained in a separate box known as set box, type BC-98-A. It may be used either separately or with its transmitter. When connected up with the transmitter it forms a complete unit for transmission and reception. The transmitter is provided with the necessary binding post for connecting the receiver. In the following directions it is assumed that the transmitter has already been connected up and that it is desired to complete the set by connecting up the receiver.

Directions.

6. To connect up the receiver. (See Fig. 111.)

a. Place the set box, type BC-98-A on the right side of the transmitter and with their panels in line. Open up the cover to the receiver.

b. Place two BA-2 batteries in the compartment back of the panel and connect the leads of the batteries to the binding posts provided in the correct order and with the proper polarity. Insert three VT-2 tubes in the three sockets and close the cover of the receiver.

c. On the left edge of the panel of the receiver are four binding posts marked "Antenna," "+ 12 volts", "— 12 volts," and "Ground." On the right edge of the transmitter panel are four binding posts corresponding to the first four. After making sure that the "Trans.-Rec." switch is open, connect the corresponding binding posts to-

gether, that is, the "Antenna" post on the receiver to the "Antenna" post on the transmitter and so on.

d. Insert the plugs of one or two head sets, type P-11, in the jacks provided on the receiver panel and adjust one of the head sets to fit the head comfortably. (If the head sets available have no plugs, they may be connected to the two binding posts on the receiver panel marked "Aux. Tel.") The receiver is now completely connected and ready for operation.

e. If it is desired to connect up the receiver only, and not the transmitter, the four binding posts on the left edge of the receiver panel are

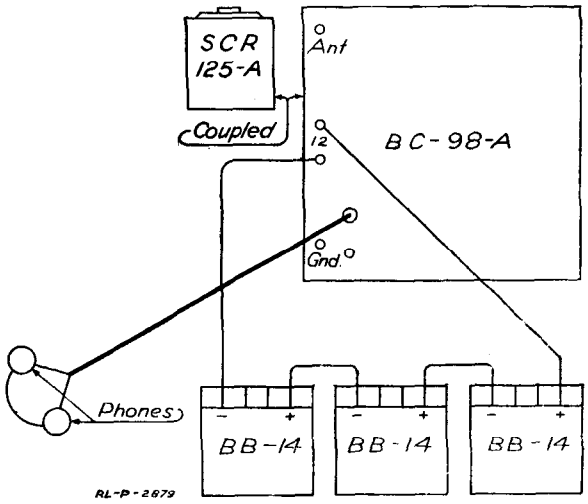

Fig. 111.—Cording diagram of receiver connections of SCR–109–A set and method of coupling the SCR–125–A wave meter to the receiver circuit.

connected directly to the "Antenna", "Ground," and "+ and − 12-volt" leads from the storage battery and *not* to the corresponding posts on the transmitter panel.

Questions.

(32) *Why do the antenna, ground, and filament battery connections for the receiver go through the transmitter when both units are connected up?*

(33) *For what reason are the two binding posts on the receiver panel marked "+ and − 40 volts Aux. plate battery"?*

(34) *When the receiver alone is used, how can you turn off the filament current?*

(35) *What kind of connectors did you use between the corresponding binding posts on the receiver and transmitter panels?*

(36) *What is the advantage of having the transmitter in a separate box?*

(37) *What is the disadvantage of having the receiver in a separate box?*

Directions.

7. To connect up the complete set.

a. Connect up the transmitter as previously given.

b. When the transmitter has been completely connected up, connect up the receiver as given above and the complete set will be ready for operation.

Information.

In tuning the receiver, several different cases will occur. They are as follows:

a. Tuning in a C.W. signal of known wave length.

b. Tuning in a damped wave signal of known wave length.

c. Tuning in a C.W. signal of unknown wave length.

d. Tuning in a damped wave signal of unknown wave length.

Directions.

8. To tune the receiver to a C.W. signal of known wave length.

a. Throw the "Trans.-Rec." switch to the "Rec." position (if the transmitter is connected up).

b. Set the secondary coupling on the 20° mark.

c. Set the secondary "LW-SW" switch and the secondary condenser to the desired wave length as given by the calibration of the set.

d. Beginning at "0" on the scale, increase the tickler coupling until a distinct double click is heard in the head set, and then set the coupling adjustment two scale divisions beyond the point where the click is heard.

e. Vary the primary inductance switch and the primary condenser at the same time until a distinct double click is heard. Without moving the secondary condenser, set the primary condenser about 5° to either side of the point where this click was heard.

f. The receiver should now be in tune on the desired wave length, but due to inaccuracies which may occur, the tuning may not be exact enough to pick up the signal desired. If the signal is not heard, the secondary condenser control should be slowly rotated, covering

an arc of 10°, about 5° either side of the setting given by the calibration of the set.

g. A small further adjustment of the primary condenser, the secondary coupling, and the tickler coupling should now be made in order to increase the loudness of the signal.

9. To tune the receiver to a damped wave signal of known wave length:

a. Same as *a* above.

b. Same as *b* above.

c. Same as *c* above.

d. Same as *d* above.

e. Same as *e* above.

f. Decrease the tickler coupling to a point just below where the double click is heard.

g. Same as *f* above.

h. Same as *g* above.

10. To tune the receiver to a C.W. signal of unknown wave length:

a. Same as *a* under Direction 8.

b. Same as *b* under direction 8.

c. Set the primary inductance switch on "SW."

d. Set the secondary inductance switch on "SW."

e. Set the secondary condenser on about 5° and increase the tickler coupling until a click is heard.

f. Vary the primary inductance switch and the primary condenser until the double click indicating resonance is heard.

NOTE.—For every adjustment of the secondary circuit there should be a corresponding adjustment of the primary circuit at which the two are in tune. In searching for a signal of unknown wave length, both condensers should be varied at the same time, attempting always to keep the primary condenser close to that point where its circuit is in tune with the secondary.

g. Starting with the secondary condenser at about 5° and the primary condenser at the point where it is in tune, slowly turn both condensers as outlined in the note above, over their entire scale. It may be necessary to increase the primary inductance as the secondary condenser reaches the higher part of its scale in order that the primary circuit may remain in tune with the secondary.

h. If the desired signal is not heard as under Direction *g* above, set the secondary inductance switch on "LW" and repeat Direction *g*, being sure that at all times the primary circuit is in tune.

i. When the desired signal is found, adjust very carefully the primary and secondary condensers, and the secondary and tickler couplings for a loud clear signal of good readable pitch.

11. To tune the receiver to a damped wave signal of unknown wave length:

a. Follow exactly the procedure outlined under Direction 10 above until the desired signal is found. When found the natural tone of the damped wave will be very badly distorted.

b. Decrease the tickler coupling until the natural tone of the damped wave appears and if necessary readjust the primary and secondary condensers and the secondary coupling.

NOTE.—Damped waves may be received with the tickler coupling adjusted so that the receiver is oscillating, if the change in tone is not objectionable. In receiving telephone signals the tickler coupling must be reduced until the distortion of signals is eliminated.

Questions.

(38) *Why is a different method of tuning followed when looking for a signal of unknown wave length than when looking for one of known wave length?*

(39) *If your receiver were not calibrated how would you tune in a signal of known wave length?*

(40) *Which condenser has the greatest effect on the tuning?*

(41) *When you tune in a telephone signal with the tickler coupling to near maximum, what happens?*

(42) *Is the adjustment of the secondary condenser as critical when tuning in a telephone signal as when tuning in a C. W. signal?*

EXPERIMENT No. 2.

OPERATION OF TRANSMITTER.

Directions.

12. Place the BC–86–A transmitter in operation as given in Experiment No. 1. (See Fig. No. 110.)

a. Pull open the small 3-pole switch. Throw the large switch to the "Transmit" position. The dynamotor should start and the oscillator tube should light up. Turn the "Antenna Inductance" switch to stud No. 1 (Min.). Close the key of the transmitter and adjust the 8-point coupling switch until the "Plate Current" ammeter shows a reading of 125 milliamperes or as near this value as can be obtained. With this adjustment the "Antenna Current" meter should show a reading of over one ampere.

b. Throw the small switch to the "Buzzer Modulated" position and note any changes in the reading of the two meters on the panel when the telegraph key is alternately opened and closed

c. Throw the small switch to the "Telephone Modulated" position and note any further changes in the reading of the two ammeters. Speak and whistle into the microphone and note variation of the plate current reading, if any.

Questions.

(43) *Is there any difference between the readings of the two meters when using the modulated methods of transmission and when using the continuous wave method?*

(44) *Do the readings of the meters change when the key is opened and closed while using "Buzzer Modulation"?*

(45) *Does any change take place in the reading of the "Plate Current" ammeter when using telephone modulation?*

(46) *Which method of transmission would cover the greatest distance?*

EXPERIMENT No. 3.

DETERMINING THE WAVE LENGTH RANGE OF THE TRANSMITTER.

Information.

The transmitter of the SCR–109–A, like that of the SCR–79–A, is dependent on its antenna system for the wave length on which it transmits. It is accordingly impossible to calibrate permanently the transmitter, and it is therefore necessary to calibrate it each time the antenna is erected and the set put in operation. This calibration will hold only so long as no change is made in the antenna or ground systems. In actual operation in the field it will not be necessary to calibrate the set for all possible wave lengths but only for those upon which it may be necessary to communicate. It is to be noted with this set that it is impossible to set the transmitting wave length exactly on any given wave length within its range unless the given wave length happens to fall on one of the taps of the antenna inductance.

Directions.

13. Throw "Transmit-Receive" switch to "Transmit" and open the small three-pole switch. Adjust the coupling switch so that the plate current meter shows a reading of about 125 milliamperes. Turn the "Antenna Inductance" switch to the No. 1 stud.

14. With the telegraph key closed take a reading of the wave length using the SCR–125–A wave meter.

15. Take wave length readings for the remaining adjustments of the "Antenna Inductance" switch and record in the table below.

Also record the readings of the two meters and the plate coupling tap used for each wave length setting. Remember that the plate coupling may have to be readjusted when changing the wave length adjustment in order to keep the reading of the "plate current" meter around 125 milliamperes.

16. Throw the small three-pole switch to the "Buzzer Modulated" position. Using the SCR–61 wave meter, check a few of the wave length readings taken in the above experiment. Also check the wave length readings with the small switch thrown to the "Telephone Modulated Position."

Wave length.	Primary inductance tap.	Plate coupling tap.	Plate current.	Antenna current.
	1			
	2			
	3			
	4			
	5			
	6			
	7			
	8			
	9			
	10			
	11			
	12			
	13			
	14			
	15			
	16			
	17			
	18			
	19			
	20			
	21			
	22			
	23			
	24			
	25			
	26			
	27			
	28			

Questions.

(47) *From Experiment No. 3, what is the wave length range of the set?*

(48) *Was there any difference in the wave length readings for the same setting of the antenna inductance when the continuous wave system was used, and when the buzzer and telephone modulated systems were used?*

(49) *If an SCR–125–A wave meter were not on hand, would it be possible to adjust the transmitter to a certain wave length for all three systems by using an SCR–61 wave meter? Explain.*

EXPERIMENT No. 4.

CALIBRATION OF THE RECEIVER.

Information.

Where possible the receiver of any radio set should be permanently calibrated over its entire wave length range. With the receiver of the SCR–109–A this is possible only for the secondary circuit and for fixed adjustments of the secondary and tickler couplings.

Directions.

17. Connect up the receiver ready for operation as given in Experiment No. 1.

a. Set the secondary coupling on 20°.

b. Set the secondary inductance switch on "SW."

c. With an SCR–125–A wave meter measure the wave length of the secondary circuit for each 10° of the secondary condenser. For each setting of the secondary condenser set the tickler coupling 5° beyond the point where a double click is heard.

d. Record the settings obtained in table similar to the one shown below.

Secondary inductance switch on "SW."

Secondary condenser.	Wave length.
0	
10	
20	
30	
40	
50	
60	
70	
80	
90	
100	

e. Set the secondary inductance switch on "LW."

f. Repeat *c.* above.

g. Record the settings obtained in a table similar to the one shown below.

Secondary inductance switch on "LW."

Secondary condenser.	Wave length.
0	
10	
20	
30	
40	
50	
60	
70	
80	
90	
100	

Questions.

(50) *From the above experiment what is the wave length range of the receiver of the SCR–109A?*

(51) *At what wave length was the change made from "SW" to "LW" on the secondary inductance?*

(52) *Did the tickler coupling vary with the wave length?*

EXPERIMENT No. 5.

RECEIVING.

Directions.

18. Set up and connect for operation the transmitter of an SCR–109–A, using the standard antenna. Three or four hundred yards away set up and connect for operation the receiver of an SCR–109–A, using either the standard antenna supplied with the set or a 150-foot "V" type antenna.

19. The operator of the transmitter will send buzzer modulated signals on a given wave length. Tune the receiver to the transmitted signals.

Questions.

(53) *After tuning the primary and secondary circuits, did the signal strength increase with increase of the tickler coupling?*

(54) *With the tickler coupling below the point where a click is obtained, do the received signals sound exactly like the buzzer on the transmitter?*

(55) *As the tickler coupling was changed, did the secondary condenser need any readjustment?*

(56) *Was the sound of the signal greatly changed as the tickler coupling was increased beyond the point where the click was obtained?*

Directions.

20. The operator of the transmitter will send continuous wave signals. Tune the receiver to these signals.

Questions.

(57) *Where was the tickler coupling when the continuous wave signals were first heard?*

(58) *Can these signals be heard with the tickler coupling below the point where the click is obtained?*

(59) *When these signals are properly tuned in, what is the effect of slight changes in the tickler coupling?*

(60) *If the tickler control is adjusted anywhere between the point where the click is heard and its maximum position, can the signals still be heard?*

Directions.

21. The operator of the transmitter will change over to telephone modulated signals. Tune the receiver to these signals.

Questions.

(61) *What is the best position of the tickler for the reception of these signals?*

(62) *Can you recognize the voice of the transmitting operator?*

(63) *Can you understand all of his words?*

(64) *With the tickler coupling beyond the point where the click is heard, what do you hear?*

(65) *Tune the set as though you were looking for a continuous wave signal. What do you hear?*

(66) *With the tuning as in Question (65) decrease the tickler coupling below the point where the click is obtained. What do you hear?*

(67) *Based on your answers to Questions (65) and (66), what would be a good method of tuning the set when trying to pick up a weak telephone signal?*