THE SCR–74–A TRANSMITTER.

(COUPLED CIRCUITS.)

Equipment.

1 Set box, type BC–18–A.
1 antenna equipment, type A–3–A.
2 helical inductances with clips (bare wire or a copper strip).
1 hot-wire ammeter, scale 0–0.5.
1 wave meter, type SCR–61.
1 transmitting condenser, fixed, capacity approximately 0.004 mfd. (microfarad).
1 storage battery, type BB–3; or 3 storage batteries, type BB–14.

Information.

The SCR–74–A is an *untuned* induction coil or spark coil transmitter. This means that no provisions are made in the set box itself for tuning to any particular wave length. The only way in which the wave length of this set can be changed is by altering the dimensions of the antenna provided with the set. However, the set box of the SCR–74–A may be used with some additional apparatus to form different types of transmitting circuits which may be operated on more than one wave length.

The method of tuning certain circuits in conjunction with the SCR–74–A is somewhat similar to that used in tuning the wave meter to transmit any given wave length. In the wave meter three inductance coils are used which are not variable; that is, the number of turns of wire in each coil can not be varied. The capacity of the rotary condenser, however, can be varied, and thereby cause the wave meter to be tuned to a given wave length. In tuning the SCR–74–A to a given wave length one or two variable inductances and a condenser which can not be varied are used. In construction the inductance coils used with the SCR–74–A differ from the coils used in the SCR–61 wave meter. The coils of the wave meter are wound with small wire for the reason that the current carried is very small. The large coils used with the SCR–74–A are wound with large wire or brass strips in order to carry the large currents.

Directions.

1. Examine one of the large inductance coils.

Questions.

(1) *How does the manner in which the larger coil is wound differ from the winding of the wave meter coils?*

(2) *What part of a clock or watch is wound similar to the large coil?*

(3) *Why is the coil constructed of such heavy wire or strip?*

(4) *What means are provided to make the inductance coil variable?*

Information.

Coupling.—When a radio set contains more than one circuit there must be a way provided to transfer the energy from one circuit to the other. This transfer of energy from one circuit to another is accomplished by what is known as *coupling.* Two circuits are said to be coupled when it is possible for the energy of one circuit to be transferred to the other circuit. Transfer of energy may be accomplished in any one of the following methods of coupling:

Direct coupling.—Two circuits are directly coupled when a part of one circuit is also a part of the other circuit.

Inductive coupling.—Two circuits are inductively coupled when the energy of one circuit is transferred to the other by means of a magnetic field.

Capacitive coupling.—Two circuits are capacitively coupled when the energy of one circuit is transferred to the other by means of condensers.

NOTE.—This form of coupling is limited in use and will therefore not be discussed further.

In some radio sets the coupling used between two circuits is a combination of all three of the above methods.

The degree of coupling between the two circuits is measured by the amount of energy that is transferred from one circuit to the other. When the greater part of the energy in one circuit is transferred to the other circuit the coupling is referred to as *close* or *tight* coupling. When only a small part of the energy is transferred the coupling is referred to as *loose* coupling.

The SCR–74–A set contains only one high frequency circuit; consequently no coupling is involved. In the experiments which follow, the set box, type BC–18–A, of the SCR–74–A, will be used with some additional apparatus to illustrate the subject of coupling.

Questions.

(5) *How many high frequency circuits are there in the SCR–74–A?*

(6) *Can the wave length on which the SCR–74–A transmits be changed?*

(7) *What is inductive coupling?*

(8) *What is direct coupling?*

(9) *What is capacitive coupling?*

(10) *How is inductive coupling varied?*

(11) *How is direct coupling varied?*

(12) *How many inductance coils are needed in a direct coupled set?*

(13) *In what two ways may the coils of an inductively coupled set be moved in order to change the coupling?*

(14) *When an SCR–61 wave meter is used, what kind of coupling exists between it and the circuit which is being measured?*

EXPERIMENT No. 1.

TUNING.

Information.

As previously mentioned a circuit may be tuned by changing either the capacity or the inductance. In high power spark transmitting circuits it is impractical to construct the condensers so that they may be continuously varied. It is therefore necessary to tune the transmitting circuit by changing the inductance of the circuit. In the following experiment the set box, type BC–18–A is used to set up radio currents in the circuit to which it is connected. This was done similarly in Unit Operation No. 7 when the set box was connected to the antenna system. The circuit used in this experiment can be considered as equivalent to the antenna circuit, with the exception that this circuit can be varied while the antenna circuit can not.

Directions.

2. Make the following connections as shown in Fig. 34.

a. Connect the antenna terminal on the set box, type BC–18–A, to one side of the transmitting condenser.

b. Connect the remaining side of the transmitting condenser to one of the clips which fit on the helix and place the clip on the fourth or fifth turn (counting from the center) of the helix.

c. Connect the center of the helix to the terminal marked "Ground" on the set box.

d. Connect the three storage batteries, type BB–14, in series, and connect the battery leads from the set box to the 12-volt battery thus formed.

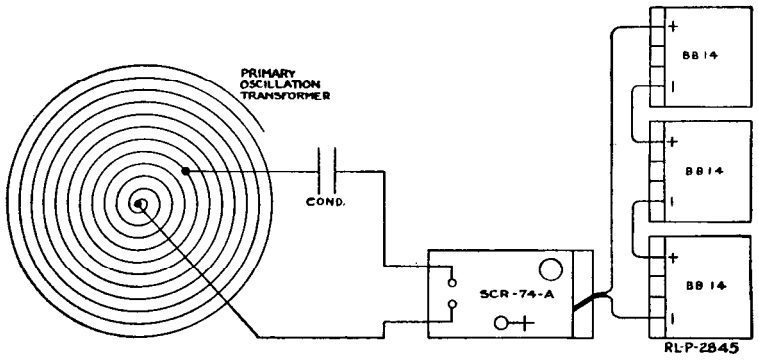

Fig. 34.—Method of connecting inductance and condenser to SCR–74–A transmitter.

3. Set the spark gap on the set box to about 1/16 of an inch, close the key, and adjust the interrupter until it is operating smoothly and the ammeter shows a current of from 5 to 7 amperes.

4. Using the SCR–61 wave meter measure the wave length on which the set is transmitting and tabulate the result in the following table:

Wave length.	Number of turns of inductance.

5. Increase the number of turns of inductance in the circuit by moving the helix clip out three or four turns and again measure the wave length and record in the above table.

6. Tune the circuit to transmit on a wave length of 200 meters by setting the wave meter to 200 meters and moving the helix clip until maximum signal strength is obtained in the wave meter. Record in the above table the number of turns required.

Questions.

(15) *As the number of turns of the inductance which are in the circuit is increased, what happens to the wave length on which the set is transmitting?*

(16) *Do the inductance and capacity in this circuit take the place of the standard antenna with respect to the set transmitting on a definite wave length?*

(17) *If a smaller condenser were used in this circuit would the wave length be greater or less?*

(18) *Does one-half of a turn of the inductance make much difference in the transmitted wave length?*

(19) *Will a small variation of the wave-meter knob tune out the signal?*

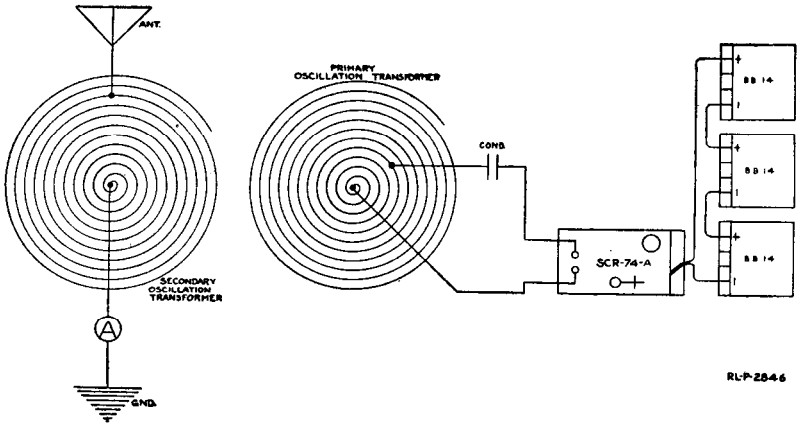

Fig. 35.—The SCR-74-A transmitter inductively coupled to the antenna circuit.

EXPERIMENT No. 2.

INDUCTIVE COUPLING.

Information.

It was probably noted in Experiment No. 1 that the signals could be heard over a considerable portion of the scale of the wave meter. A transmitter which produces signals of this character is said to be *broadly* tuned. If such signals were used in radio communication, there would be a great deal of interference between different stations transmitting at the same time. A receiving station would be unable to tune out the undesired transmitters. This difficulty may be, to a large extent, overcome by coupling the antenna or radiating circuit to the circut in which the signals are generated, instead of

having them generated directly in the radiating circuit. In the following experiment inductive coupling is used to accomplish this result.

Directions.

7. With the inductance coil, set box, and batteries connected the same as in Experiment No. 1, place the second helical inductance coil close to and with its plane parallel to the first coil. Connect the antenna lead-in wire to the clip on the second coil and place the clip on about the eighth or ninth turn from the center. Connect the center end of the coil to one side of the hot-wire ammeter and the other side of the ammeter to the ground. (See Fig. 35.)

8. Start the set and observe the ammeter in the ground lead. Vary the number of turns in the secondary or antenna inductance until the highest possible reading is obtained on the ammeter. When the ammeter reads a maximum, the antenna or secondary circuit is in tune with the primary or closed circuit. Couple the SCR–61 wave meter to the antenna circuit by wrapping a turn of the ground wire around the lid of the wave-meter box and measure the wave length on which signals are being transmitted. Note particularly over how much of the wave-meter scale the signals can be heard. Vary the amount of inductance in the primary circuit without changing the antenna circuit, and note what happens to the signal strength.

9. With the planes of the two inductance coils still parallel, move the antenna circuit coil until they are about 3 inches apart and again adjust the number of turns in the antenna coil until the ammeter reads a maximum. Measure the wave length and again note over how much of the wave-meter scale the signals can be heard. Note how the signal strength compares with that obtained when the two coils were close together.

10. Adjust the set to transmit on a wave length of 250 meters with the greatest possible current as indicated by the ammeter in the ground lead. Have the coupling fairly loose.

Questions.

(20) *Could the signals be heard over as much of the wave meter scale in this experiment as in Experiment No. 1?*

(21) *Were the signals heard in the wave meter in this experiment as loud as those obtained in Experiment No. 1?*

(22) *When Directions 7, above, were followed, were the signals heard over as much of the wave meter scale as when Directions 6 were followed?*

(23) *Bearing in mind the answer to the preceding question, state whether close or loose coupling should be used in order to reduce interference.*

(24) *Would the signals sent out in Experiment No. 2 cause more or less interference than those sent out in Experiment No. 1?*

EXPERIMENT No. 3.

DIRECT COUPLING.

Information.

It will be noted that the direct-coupled set requires only one inductance coil. For this reason this method of coupling insures lightness and portability of the set. However, there are certain dis-

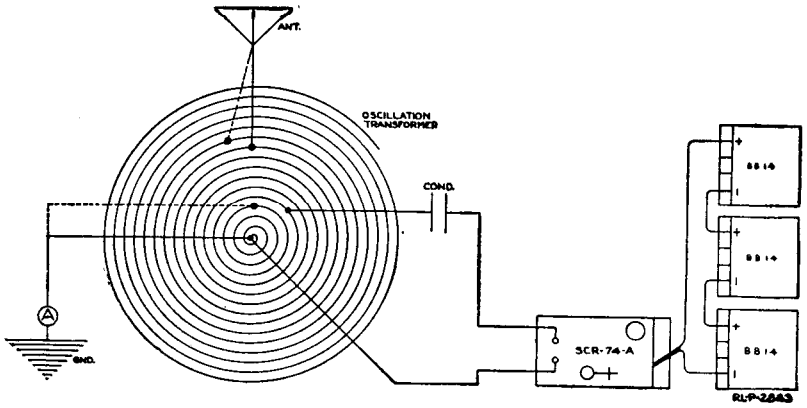

Fig. 36.—The SCR–74–A transmitter directly coupled to the antenna circuit.

advantages in direct coupling, which in most cases more than offset the above advantages. In the following experiment an attempt will be made to show some of the results obtained with direct coupling.

Directions.

11. With the inductance coil, set box, and batteries connected, the same as in Experiment No. 1, make the following additional connections:

a. Connect the ground lead to one side of the hot-wire ammeter.

b. Connect the remaining side of the hot-wire ammeter to the center end of the inductance coil.

c. Connect the antenna lead to a helix clip and place the clip on the eighth or ninth turn from the center of the coil. The completed connections are shown in Fig. 36. In this figure the dotted lines show how the antenna circuit leads are shifted in order to obtain loose coupling. When the connections used are the same as those

shown by the solid lines, all of the turns of the inductance of the closed circuits are also included in the antenna circuit, while with the dotted line connections only a part of the closed circuit inductance is common to the antenna circuit.

12. With the connections given by the solid lines in Fig. 36, adjust the antenna lead clip until the hot-wire ammeter shows a maximum reading. Using the SCR–61 wave meter, measure the wave length on which the set is transmitting, and carefully note over how much of the wave meter scale the signals can be heard.

13. Place a heliz clip on the lead from the hot-wire ammeter to the center of the coil, and connect the lead to the third or fourth turn from the center instead of to the center. Vary the position of the antenna lead clip until the ammeter gives a maximum reading. Using the wave meter, again measure the wave length and note over how much of the scale the signal can be heard.

14. Disconnect the antenna and ground clips and vary the clip on the lead from the antenna side of the spark gap until the wave meter when coupled to the inductance coil shows a wave length of 250 meters. Connect the ground lead clip to the third or fourth turn from the center and vary the position at which the antenna clip is connected until the ammeter shows a maximum reading. The set is now transmitting on 250 meters with loose coupling. Couple the wave meter to the ground lead of the set and measure the wave length, noting over how much of the wave meter scale the signal can be heard.

Questions.

(25) *When measuring the wave length of a direct coupled transmitter, over approximately what number of degrees on the wave meter scale can the signals be heard when the coupling is loose? When the coupling is close?*

(26) *Which signal was heard over a greater portion of the wave meter scale when direct, loose coupling was used or when inductive, loose coupling was used?*

(27) *Was more antenna current obtained with direct coupling or with inductive coupling?*

(28) *What type of coupling should be used in order to produce the minimum of interference?*

(29) *Is it as easy to change the degree of coupling with direct coupling as it is with inductive coupling?*

(30) *How is a direct-coupled set tuned to transmit on a given wave length?*