THE SCR–72 AMPLIFIER.

Equipment.

1 SCR–72 amplifier (set box BC–17 only).
1 SCR–61 wave meter.
1 SCR–54–A receiver (set box BC–14–A only).
1 SCR–55 detector (set box DT–3–A).
1 headset, type P–11.
1 4-volt battery, storage type BB–14.
1 plug with cord.
3 VT–1 vacuum tubes.
1 small rheostat.
5 22½-volt "B" batteries.
1 ammeter (0–5 amps. scale).
1 rule.

GENERAL CONSTRUCTION OF THE AMPLIFIER.

Information.

Radio signals are often so weak, due to the distance they are transmitted or for other reasons, that, although the detector will respond feebly, the converted currents from the detector are too weak to actuate the diaphragm of the telephone receivers. In such cases it is necessary to use some device which will increase the strength of the weak signals in the detector circuit in order that they may be heard in the telephone receivers. The device used for this purpose is known as an amplifier.

A vacuum tube when properly connected is an amplifier as well as a detector; accordingly the strength of the signals from a vacuum tube detector can be increased by the addition of one or more vacuum tubes connected as amplifiers. An amplifier consisting of one vacuum tube is known as a one-stage amplifier, while an amplifier consisting of two vacuum tubes is known as a two-stage amplifier.

When the currents in a radio circuit are vibrating slow enough to produce a sound in a pair of telephone receivers connected in the circuit, the currents are said to be vibrating at low or *audio frequency.* For this reason an amplifier, used to increase the values of the slowly vibrating currents in a detector circuit, is termed an "Audio Frequency Amplifier."

The SCR–72 amplifier is a two-stage audio frequency amplifier which will increase materially the strength of detected signals. (See Fig. 59.) A telephone jack is connected in the circuit of each stage; consequently the amount of amplification may be varied by plugging

the telephone receivers in either jack. In addition, a third jack is provided which is connected indirectly through binding posts on the panel to the DT–3–A detector by means of a cord and plug. If amplification is not desired, the phones may be connected to the detector circuit by inserting the phone plug in this jack.

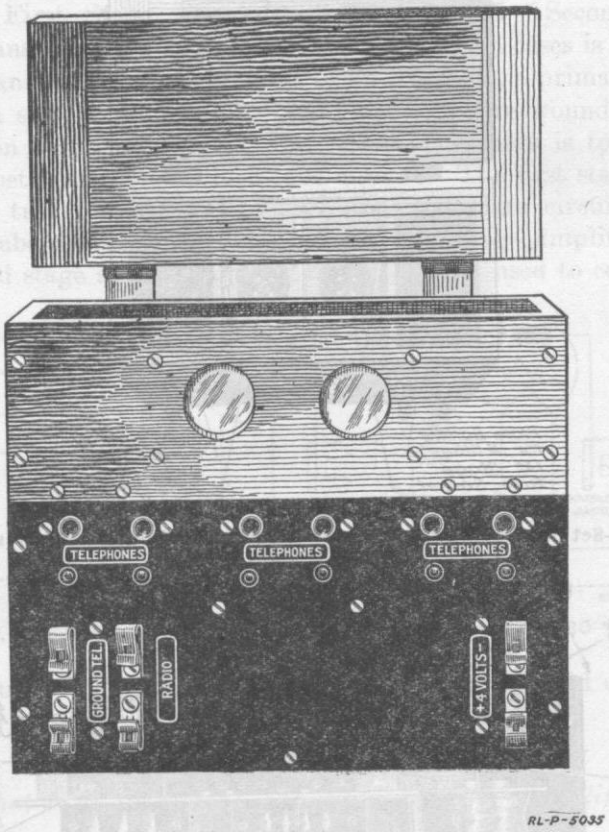

Fig. 59.—Set box, BC–17 of the SCR–72 amplifier.

The filaments of the two VT–2 vacuum tubes in the SCR–72 amplifier are lighted by a 4-volt storage battery. The amount of current supplied to each filament is limited by small fixed resistances connected in series with the filaments. The plate or "B" batteries are in a compartment inside the set box.

The SCR–72 amplifier may also be used in the circuits of ground telegraphy by connecting to the proper terminals.

Directions.

1. Examine the front of the set box. (See Fig. 59.) Notice the type of terminals used for making connections. Open the lid of the box and see how the "B" batteries are put in and how the

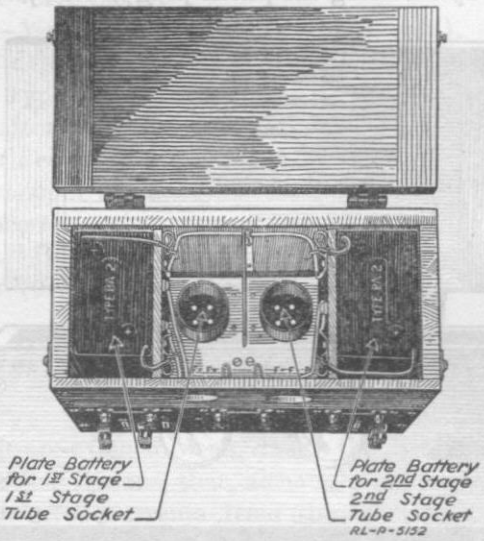

Fig. 60.—Set box BC–17 with lid open to show location of batteries and tube sockets.

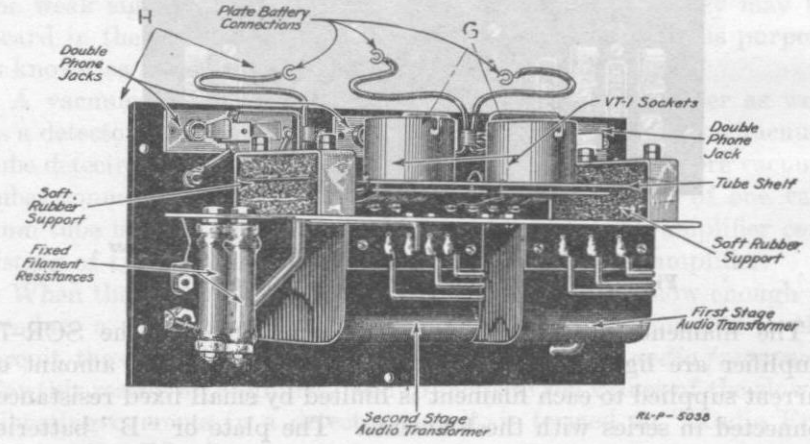

Fig. 61.—Panel of set box BC–17 removed to show interior parts.

vacuum tubes are inserted in their sockets. (See Fig. 60.) Note the three wires coming up to the "B" battery clip terminals. Remove these wires from beneath the screws and leave them loose so that the front panel may be removed. Take out the five screws

from the edges of the bakelite panel. Carefully remove the panel and attached parts from the box. (See Fig. 61.) Check the wiring diagram shown in Fig. 62 with the wiring in the set itself.

Information.

It will be noticed in Fig. 61 that there are two iron covered parts marked "First Stage Audio Transformer" and "Second Stage Audio Transformer." Inclosed in each of the iron cases is a special type of transformer which consists of an iron core, a primary winding, and a secondary winding. Both windings are wound directly on the iron core. The purpose of the transformers is to provide coupling between the amplifier tube circuits. The first stage audio frequency transformer is used to couple the plate circuit of the detector tube to the grid circuit of the first stage amplifier tube. The second stage audio frequency transformer is used to couple the

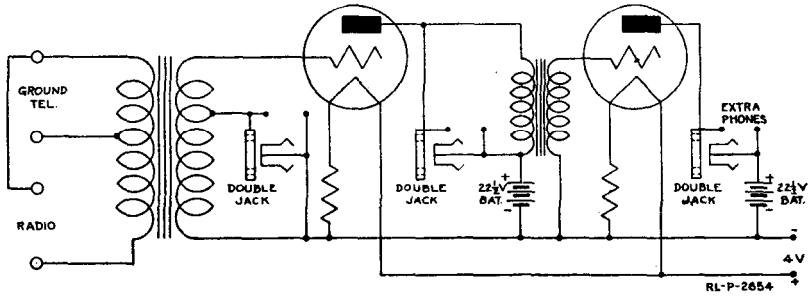

Fig. 62.—Schematic diagram of connections in set box BC–17.

plate circuit of the first stage amplifier tube to the grid circuit of the second stage amplifier tube.

Questions.

(1) *What is an amplifier? An audio-frequency amplifier?*

(2) *What is the purpose of the SCR–72 amplifier?*

(3) *Is it possible to vary the amount of amplification in the SCR–72 amplifier? Explain.*

(4) *How many telephone head sets can be connected to each stage of amplification?*

(5) *Can several head sets be connected to more than one stage at a time?*

(6) *What is the purpose of each of the small resistances located at the left of the amplifying transformers in Fig. 61?*

(7) *How many volts are used in the plate circuit of this amplifier?*

(8) *For what type vacuum tube is this amplifier constructed?*

(9) *How many stages of amplification are provided?*

(10) *Does the amplifier contain any device for varying the filament current?*

(11) *How is the filament current kept low enough so as not to damage the vacuum tubes?*

(12) *How are the tube sockets mounted? Why are they mounted in this manner?*

(13) *What type of coupling is used in the amplifier circuits?*

(14) *What is the name of the device which provides this coupling?*

(15) *Why are two of these devices necessary in the SCR–72 amplifier?*

EXPERIMENT No. 1.

AMPLIFICATION WITH 22½ VOLTS IN PLATE CIRCUIT

Directions.

2. Replace the panel of the set box, being sure to get the leads to the "B" batteries back properly. If these leads are reversed the amplifier will not operate.

3. Make the same set-up of apparatus as in Unit Operation No. 11, with the following exceptions: (Also see Fig. 63.)

a. Connect leads from the telephone jack of the DT–3–A detector to the terminals marked "Radio" on the SCR–72 amplifier.

b. Connect a 4-volt storage battery direct to the DT–3–A detector. Also connect the positive terminal of the same battery direct to the positive terminal of the "4 Volts" terminal on the SCR–72 panel. Connect the negative terminal on the SCR–72 panel to one of the rheostat terminals and the remaining rheostat terminal to the positive terminal of the ammeter. Connect the negative terminal of the ammeter to the negative terminal of the 4-volt battery.

c. See that the plate or "B" batteries are connected in the set box with due regard to polarity.

4. Start the wave meter transmitting on 250 meters. Plug a head set in the first jack at the left on the SCR–72 amplifier. Adjust the rheostat so that no current flows through the amplifier tube filaments.

5. Tune the SCR–54–A receiver until the signal from the wave meter is heard with maximum intensity in the head set. Loosen the

coupling between the wave meter and the SCR–54–A receiver until the wave meter signal is just faintly heard in the head set. With the rule provided, measure the distance between the wave meter and the SCR–54–A receiver. Prepare a table similar to Table No. 1 shown at the end of this Unit Operation. Record the measurement just made in the proper place in the prepared table.

6. Adjust the small rheostat so that the ammeter reads about 2.2 amperes. Disconnect the head set from the detector jack and plug it in the first stage jack (the middle jack on the SCR–72). Again loosen the coupling between the wave meter and the SCR–54– set until the signal from the wave meter is just faintly heard in the head

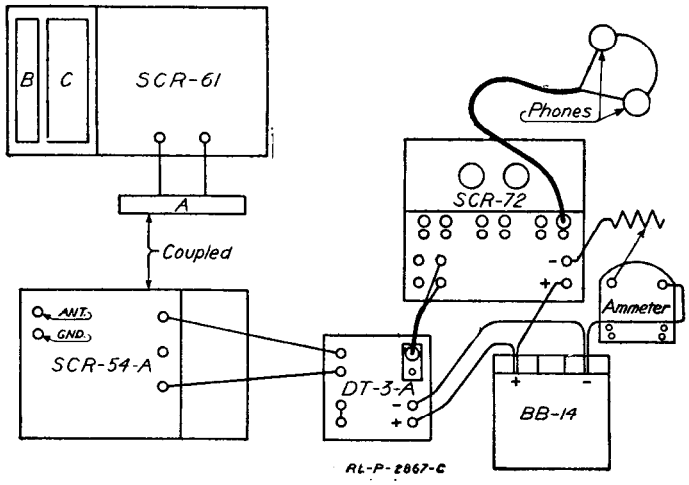

Fig. 63.—Cording diagram of connections when operating the SCR–54–A, the DT–3–A, and the SCR–72 sets together.

set. Measure the distance between the wave meter and the SCR–54–A set with the rule. Record this measurement in the table prepared.

7. Disconnect the head set from the first stage jack and plug it in the second stage jack (the jack at the right). Loosen the coupling between the wave meter and the SCR–54–A set until the signal from the wave meter is just faintly heard in the head set. Measure the distance between the wave meter and the SCR–54–A set and record this measurement in the table prepared.

8. Slowly decrease the filament current flowing through the amplifier tubes by adjusting the rheostat until a point is reached where the wave meter signal disappears. Note the reading of the ammeter as well as the brightness of the filaments.

Questions.

(16) *Was the distance between the wave meter and the SCR–54–A set greater in Direction 6 than in Direction 5?*

(17) *Does this distance increase as the number of amplifier tubes is increased?*

(18) *What does the increase in this distance indicate regarding the action of the SCR–72?*

(19) *What reading did the ammeter show when the filament current was reduced according to Direction 8?*

(20) *When receiving a weak signal, what effect is produced in the SCR–72 amplifier if the filament current is slightly lowered?*

EXPERIMENT No. 2.

EFFECT OF CHANGING VACUUM TUBES.

Directions.

9. Interchange the vacuum tubes in the detector and amplifier units by placing the detector tube in the first stage socket, the first stage tube in the second stage socket, and the second stage tube in the detector socket. Repeat Directions 4, 5, 6, and 7 and record observations in the table prepared.

Questions.

(21) *Are the measurements recorded in this experiment different from those recorded on Experiment No. 1?*

(22) *If there is a difference, what does this indicate?*

(23) *Judging from the results obtained, what is a good plan to follow when using radio equipment provided with several vacuum tubes?*

EXPERIMENT No. 3.

AMPLIFICATION WITH 45 VOLTS IN PLATE CIRCUITS.

Directions.

10. Repeat Experiment No. 1, using 45 volts in the plate circuit of each amplifier tube. The additional voltage may be obtained as follows: Remove the two 22½-volt batteries from the container in the SCR-72 amplifier. Connect these two batteries in series, and with short pieces of wire connect their two remaining wire terminals to the clip terminal used for the first stage plate connections. Connect the two spare 22½-volt batteries in series and connect the two

remaining leads to the clip terminals used for the second stage plate connections. Care should be taken that the connections are correct in polarity. Prepare a table similar to Table No. 2, shown at the end of this Unit Operation, and record all observations made in this Experiment.

Questions.

(24) *Do the results recorded in the table for this experiment show that there is an increase in amplification when the additional plate voltage is used?*

(25) *Is the increase in amplification sufficient to warrant using the 45-volt plate battery, if the signals are weak when using the 22½-volt battery?*

EXPERIMENT No. 4.

EFFECT OF WRONG CONNECTIONS ON AMPLIFIER.

Directions.

11. Increase the coupling between the wave meter and the SCR-54-A receiver until the signal from the wave meter is heard with fair volume in the head set. Reverse the filament connections to the amplifier and note any change in the signal strength in the head set.

12. Again reverse the filament connections to the amplifier, so that they are correct in polarity. Reverse the plate battery connections and note any effect on the signal strength.

13. Again reverse the plate battery connections, so that they are correct in polarity. Remove the second stage amplifier tube from its socket and note whether or not the wave meter signal can be heard. Replace this tube in its socket and remove the first stage tube from its socket. Note whether or not the signal can be heard. Replace the first stage tube in its socket.

14. Insert the head set plug in the first stage jack. Remove the first stage tube from its socket and note any effect on the signal strength. Replace this tube and remove the second stage tube from its socket. Note whether or not the signal can be heard.

Questions.

(26) *What is the effect of reversing the filament connections to the amplifier?*

(27) *What is the effect of reversing the amplifier plate battery leads?*

(28) *Will the amplifier operate with the head set plugged in the second stage jack if either tube is removed?*

(29) *If the head set is plugged in the first stage jack, will the amplifier operate when the second stage tube is removed?*

(30) *If when using the SCR-72 amplifier the second stage tube suddenly burns out and a new tube is not available, what should the operator do?*

TABLE No. 1.

Observations (ammeter reading 2.2 amperes).		Brightness of filaments.	Distance between wave meter and SCR-54-A receiver.
Detector	Experiment No. 1		
	Experiment No. 2		
First stage	Experiment No. 1		
	Experiment No. 2		
Second stage	Experiment No. 1		
	Experiment No. 2		

TABLE No. 2.

Observations (ammeter reading 2.2 amperes).		Brightness of filaments.	Distance between wave meter and SCR-54-A receiver.
Detector	Experiment No. 3		
First stage	Experiment No. 3		
Second stage	Experiment No. 3		