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Airplane Radio Telephone Sets

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Airplane Radio Telephone Sets

Type SCR–68

Type SCR–68–A

Type SCR–114

Type SCR–116

Airplane Radio Receiving Sets

Type SCR–59

Type SCR–59–A

Type SCR–75

Type SCR–115

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SET, AIRPLANE RADIO TELEPHONE, TYPE SCR-68-A

THE TYPE SCR-68 and SCR-68-A sets are airplane radio telephone transmitting and receiving sets designed primarily for interplane communication work between airplanes in squadron formation, these sets being used by the commanders of squadrons. The other planes of the squadron are usually equipped with the type SCR-59 receiving set. The set may also be used for two-way communication with ground stations equipped with the type SCR-67 or SCR-67-A sets. The type SCR-68 and SCR-68-A sets have an approximate wave length range of 215 to 450 meters. A detailed study will be made here of the type SCR-68-A set, which is the more recent model, and the differences with the type SCR-68 will be pointed out in a later section.

The set comprises a special constant voltage generator, which furnishes the power for transmitting and for heating the receiving vacuum tube filaments; a filter box; a radio set box; an interphone set box for permitting telephone communication between the pilot and the observer; two head sets and telephone transmitters; and the required connecting cords.

The Transmitting Circuit

A complete circuit diagram of the set is given in Fig. 1. The set box is equipped with a multi-pole double throw "Transmit-Receive" switch, which connects either the transmitting or receiving circuit. For the purpose of facilitating explanation, these circuits are treated separately.

A schematic diagram of the circuits in use when the switch is in the "Transmit" position is given in Fig. 2. This circuit comprises a type VT-2 three-electrode vacuum tube connected up as an oscillator to generate undamped high frequency oscillations in the antenna circuit. The plate circuit of this tube is energized by a 275-volt direct current generator, the terminal voltage of which is kept constant by means of special devices described in a later paragraph. In series with this plate circuit is a jack J_2, which permits the insertion of an ammeter for reading the plate current, an iron core choke

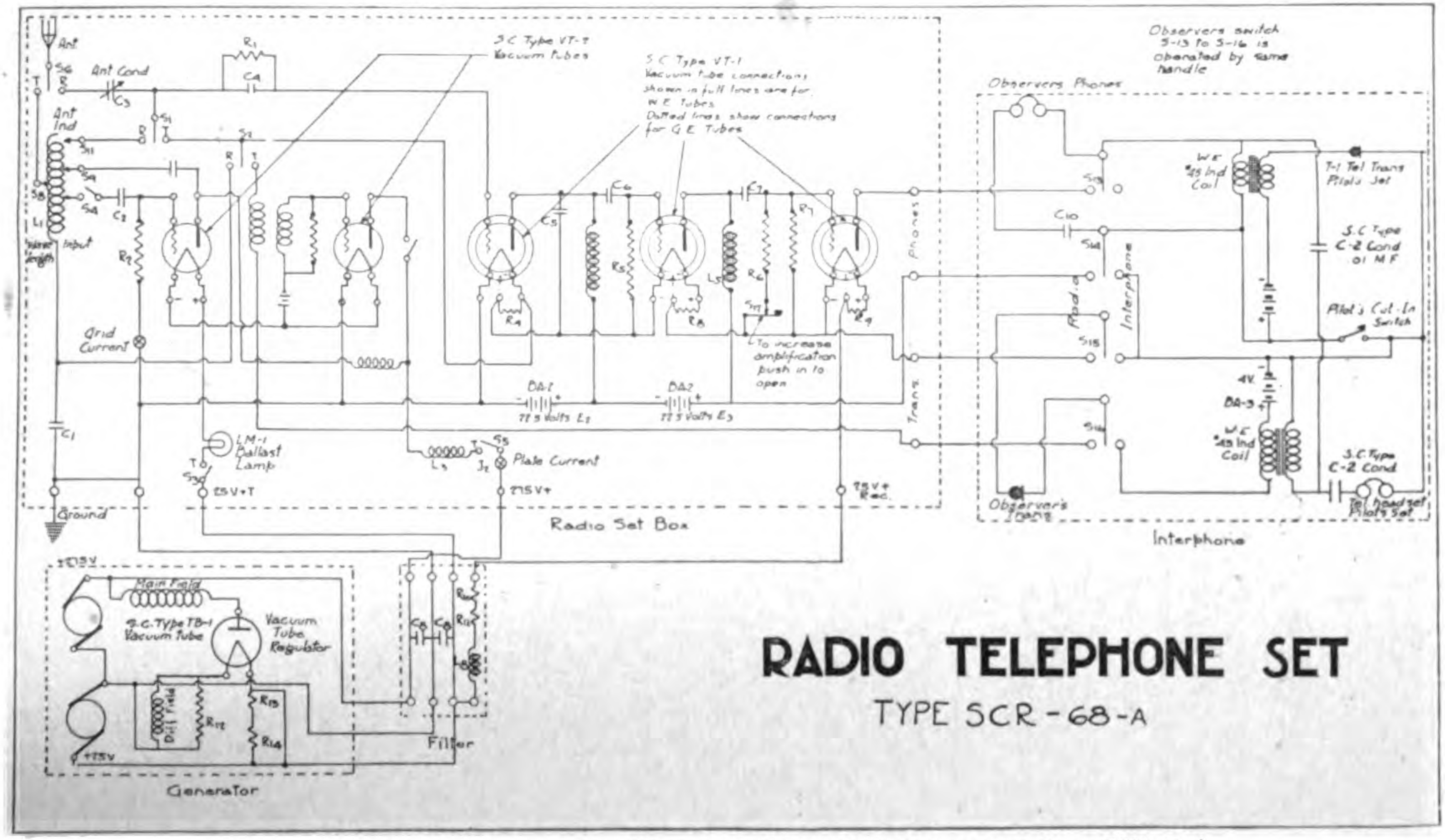


FIG. 1.—Complete Schematic Circuit Diagram of the Radio Telephone Set Type SCR-68-A.

coil L_3 which tends to keep the current from the generator constant, and a radio frequency choke coil to prevent the high frequency alternating current generated by the tube from flowing outside the radio circuits.

The filament of the oscillator tube is in series with that of a modulator tube, the function of which will be explained later, and is heated by the current from a 25-volt direct current generator,

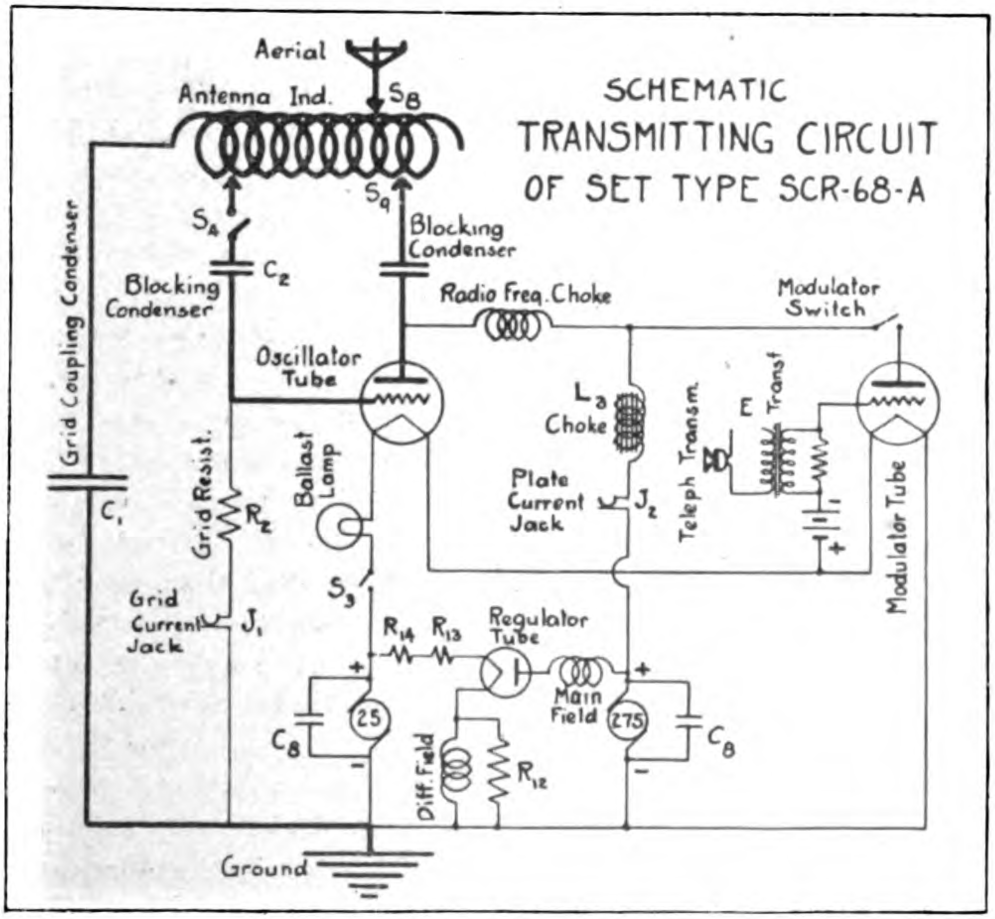


FIG. 2.—Schematic Diagram of the Transmitting Circuit of Set Type SCR.-68-A.

mounted on the same shaft and having the same fields as the 275-volt generator.

The grid circuit of the oscillator tube comprises a high resistance R_2 and a jack J_1 which permits the insertion of a milliammeter for reading the grid current. The function of the grid resistance is to obtain a negative potential on the grid when the tube is oscillated.

The grid and plate circuits are coupled electrostatically by means of a fixed condenser C_1 connected between the grid and the filament, and the condenser formed by the antenna and counterpoise in the plate circuit. An antenna inductance, which forms the inductance of the oscillatory circuit, is connected directly between the plate and the grid. A blocking condenser is inserted in each of the plate and grid radio circuits in order to prevent any possible short circuiting of the direct current circuits. The wave length, grid and plate couplings may be changed by connecting the aerial, grid and plate wires to different points of the antenna inductance.

A second three-electrode vacuum tube (the modulator) is connected with its plate circuit in parallel with that of the oscillator tube, that is, between the negative terminal of the 275-volt generator armature and a point between the iron core choke coil and the radio frequency choke. The grid of this modulator tube is connected to the filament through a 20-volt dry battery, type BA-2, and the secondary of an "input" transformer. This gives the grid of the modulator tube a constant negative potential. The primary of the input transformer is connected in series with a telephone transmitter type T-3 described below, and a source of continuous potential which is the voltage drop across the filament of one receiving tube and two resistances of the receiving tube filament circuit.

With the circuits as described above and shown in Fig. 2, it may be seen that the constant current of the 275-volt generator divides between the plate circuits of the oscillator and modulator tubes. The amplitude of the alternating current generated by the oscillator tube in the antenna circuit, and therefore of the waves radiated by the latter, is directly proportional to the amount of direct current flowing in the plate circuit of that tube. On the other hand, the potential of the grid of the modulator tube controls the amount of current which may flow through the modulator tube. And since, due to the iron core choke coil L_3, the sum of the plate currents in the two tubes is constant, any variation in the amount of current allowed to flow through the modulator tube is accompanied by a corresponding variation (in opposite direction) of the current supplied to the plate circuit of the oscillator tube, and therefore, in the amplitude of the oscillations generated by the latter tube.

The principle underlying the transmission of speech by means of this set is therefore the following. When no speech is impressed on the telephone transmitter, the potential of the modulator tube grid remains constant, and there is no variation in the plate currents of the two tubes. The oscillations in the antenna circuit are then of constant amplitude, as shown in Fig. 3. When one talks into the telephone transmitter, a pulsating current is made to flow in the primary of the input transformer, resulting from the action of the transmitter, which impresses on the grid of the modulator tube an alternating or varying potential following the modulations of the voice. These variations of potential produce corresponding variations in the current allowed to flow in the plate circuit of the modulator tube, and therefore in the plate current of the oscillator tube, and finally, in the amplitude of the oscillations in the antenna circuit. The result is that the waves radiated by the set, instead of being of constant amplitude, have an envelope reproducing the pulsations of current in the telephone transmitter circuit. In

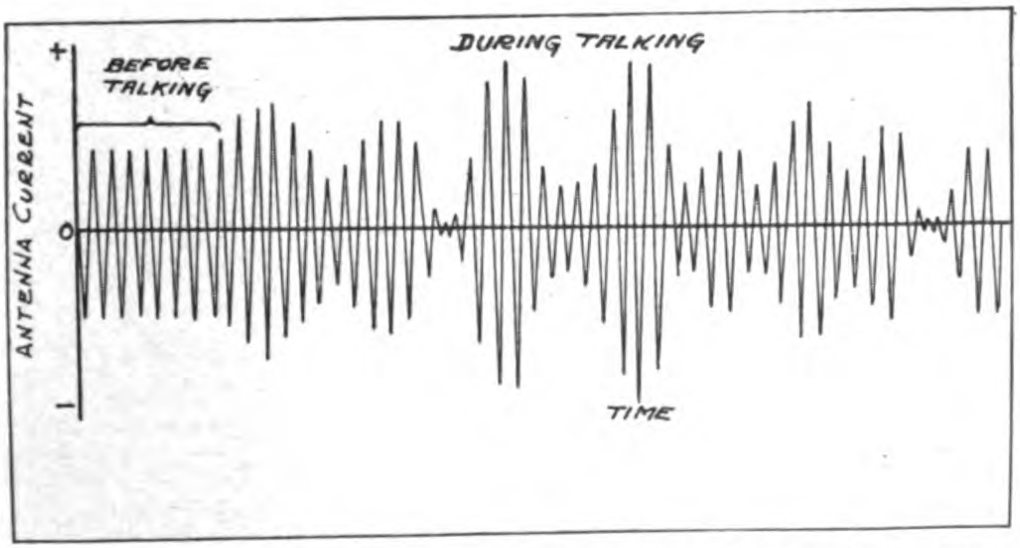
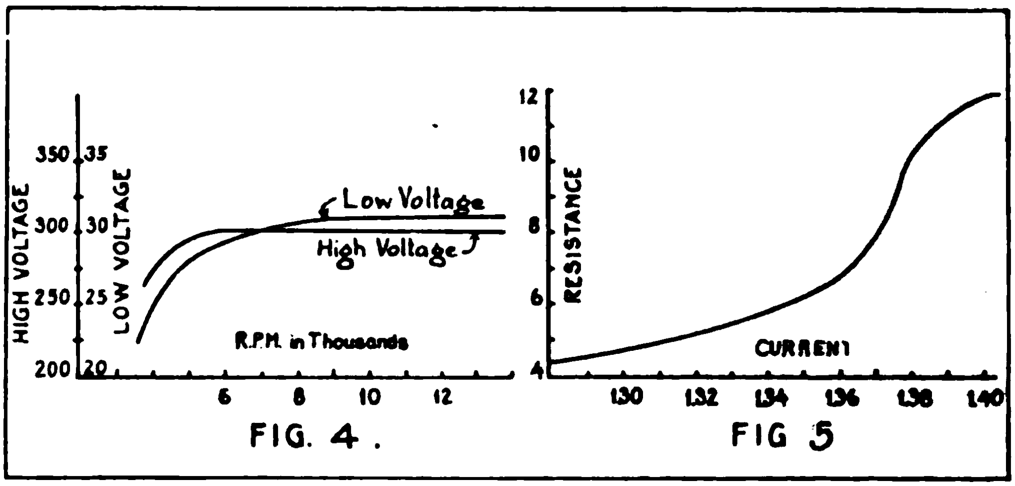


FIG. 3.—Effect of Voice Modulation upon the Amplitude of the Waves in the Antenna Circuit.

other words, the waves are modulated to the speech. For a more thorough explanation of modulation and voice transmission by radio, see Radio Pamphlets Nos. 1 and 40.

Some essential requirements must be fulfilled for giving a satisfactory operation of the set, and with the conditions encountered in airplane work these requirements necessitate the use of special regulating devices. The generator furnishing the power to the plate and filament circuits is a fan driven generator mounted on the strut of the landing gear of the airplane. It is enclosed in a streamline case, and driven by a special regulating airfan, the purpose of which is to keep the speed of the generator constant for varying airplane and wind speeds. This airfan, type FA-7, is made of metal and its two blades may be rotated around their longitudinal axis so that the pitch of the airfan will automatically change when the speed of the airfan through the air changes. The twist of the airfan blades is counterbalanced by a set of springs and weights inside the airfan hub. The operation of this airfan maintains a constant generator speed of about 4000 r. p. m. for airplane speeds of from 50 to 200 m. p. h.

An additional means of keeping the generator voltage constant is provided in the peculiar method of exciting the generator. It is self-excited and has a main and differential field winding, the fluxes of which are opposed. The main field winding is connected in series with a special two-electrode type TB-1 vacuum tube, the filament circuit of which comprises the differential winding. This is shown in Fig. 2. The operation of this device is then as follows.



Figs. 4 and 5.

If the generator speed should tend to increase, the generated voltage would increase, which consequently would increase the current in the main field winding and in the regulator tube filament in series with it. It would also increase the plate voltage on the tubes, and therefore the plate current. The latter current, flowing through the differential field winding, would increase the flux in the latter and counteract that of the main field. and thus prevent any further rise of the generator voltage. In case the generator should be driven at a speed below normal, the effect would be exactly opposite, and the generator voltage would be thus kept constant despite the small variations in speed which are not entirely corrected by the regulating airfan. The combined effect of the several regulating devices is shown in Fig. 4.

In order to reduce the pulsations in the output current of the two armatures of the generator resulting from commutation, a condenser C_8 is shunted across each. These condensers are located in the filter box, and serve as a by-pass for the commutation pulses. Without this precaution, these pulsations, especially those on the 275-volt armature, would produce a steady hum in the telephone receivers, due to a modulation of the wave resulting from them.

An additional precaution in maintaining constant the current in the filament circuit is taken by the use of a "ballast lamp." This lamp, which is located in the radio set box, is connected in series with the filament circuit. It has an iron filament and is filled with hydrogen. The resistance of this lamp is a function of

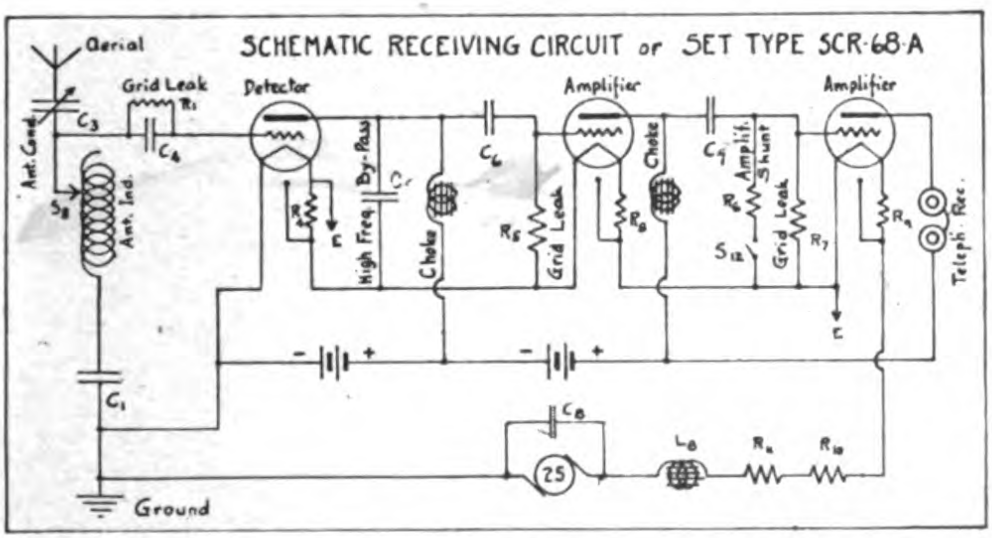


Fig. 6.—Schematic Diagram of the Receiving Circuit of Set Type SCR-68-A.

the current flowing through it, as shown by the characteristic curve of Fig. 5. The operation of this lamp may be understood when it is noted that an increase of filament current would increase the ballast lamp filament resistance, which would therefore tend to prevent the current from increasing (and vice versa), thus aiding to keep the current constant.

The Receiving Circuit

The type SCR-68-A set has a receiving circuit which is connected for operation when the switch on the radio set box is closed in the "Receive" position. It may be used for the purpose of receiving a conversation sent out by another set using the transmitting circuit described above or a similar one. A schematic diagram of this receiving circuit is given in Fig. 6. It may be seen that the circuit comprises a type VT–1 three-electrode vacuum tube used as a detector, and two similar tubes used as audio frequency amplifiers, the coupling between successive tubes being by means of iron core choke coils. The antenna circuit comprises a variable air condenser C_3 used for tuning, an antenna inductance, a large blocking condenser C_1, and the antenna-counterpoise condenser. The antenna inductance and blocking condenser are connected between the grid and filament of the detector tube, there being also a grid condenser and leak resistance in series with the grid. The plate circuit of the detector tube is energized by a type BA–2 dry battery, in series with

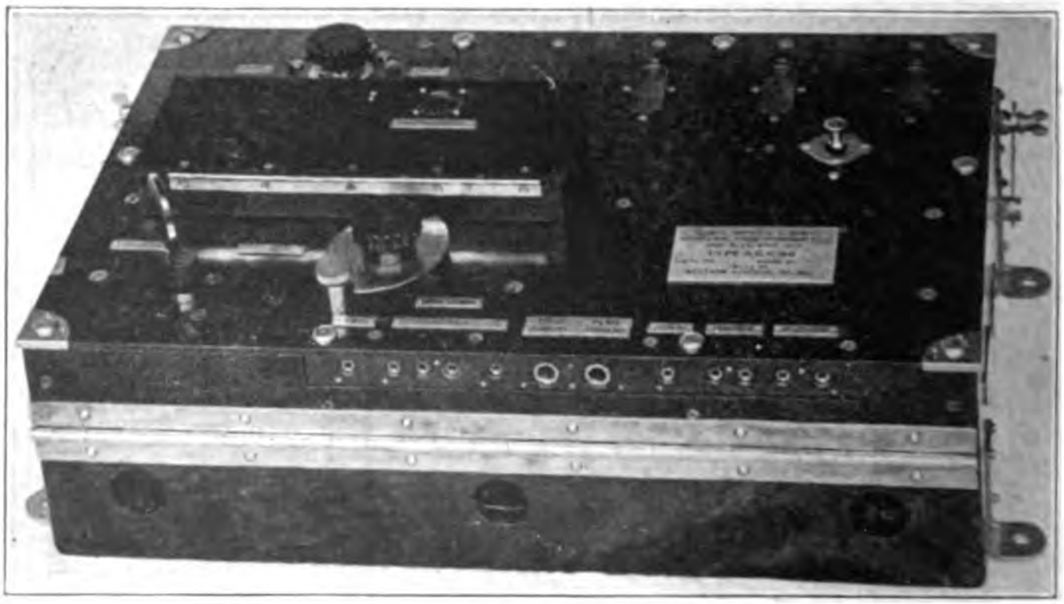


FIG. 7.—Operating Panel of Set Box Type BC–11 Used in Set Type SCR–68, Showing Jacks Along the Bottom Edge.

which is an iron core choke coil. Shunting the battery and choke is a condenser C_5, which by-passes the high frequency oscillations, while the audio frequency pulsations which are the envelope of the incoming waves produce pulsations in the plate current of the detector tube. In flowing through the choke coil, these pulsations induce a high counter-emf. across the latter, which is impressed upon the grid of the first amplifier tube through the condenser C_6.

The potential variations of the grid of the first amplifier tube are thus similar to those of the grid of the detector tube, but are of greater amplitude. The resulting variations in the plate current of the first amplifier tube are therefore amplifications of those of the plate current of the detector tube. The amplifier tube operates at a plate voltage of about 40 volts, obtained by means of two type BA-2 dry batteries in series. Connected between the grid and filament of the first amplifier tube is a high resistance R_5 through which the charges on the grid may leak off to the filament, thus preventing the accumulation of a charge on the grid as it is being transferred from the detector tube to the amplifier tube.

The first amplifier tube is coupled to the second amplifier tube in the same way the detector tube is coupled to the first amplifier. The plate circuit of the second amplifier tube, however, instead

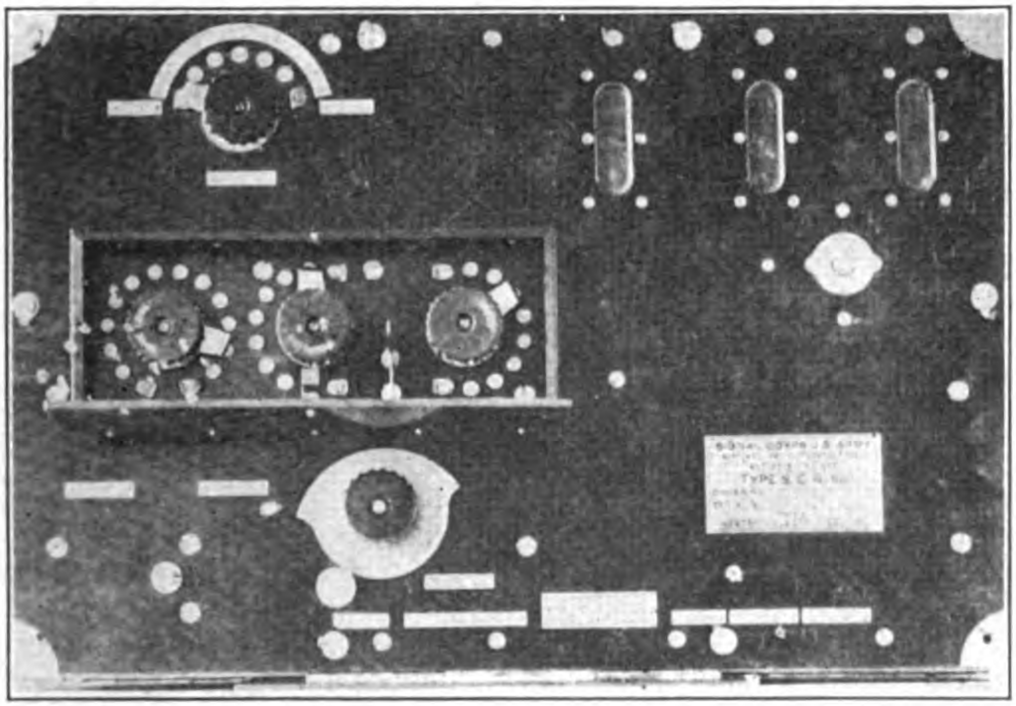


FIG. 8.—Operating Panel of Set Box Type BC-11 Used in Set Type SCR-68, Showing the "Wave Length," "Coupling" and "Input" Switches in the Small Covered Panel.

of comprising a choke coil, comprises the telephone head sets of the observer and pilot, which are connected to it through the circuits of the interphone set box in a manner described in a later paragraph. A resistance R_6 is shunted between the grid and filament of the last amplifier tube and may be connected by means of a push button switch when it is desired to reduce the amount of amplification.

The filaments of the three receiving vacuum tubes are connected in series and are energized by the 25-volt armature of the generator. In series with each filament is a small resistance of about one ohm, which, for certain types of tubes, is short circuited automatically, as indicated in Fig. 1. The filament circuit also comprises an iron core choke coil L_8 located in the filter box and the function of which is to assist in maintaining the filament current constant.

Set, Airplane Interphone, Type SCR-57-A

The telephone head set and transmitter of the radio operator may be connected directly to the radio set box of the type SCR–68–A

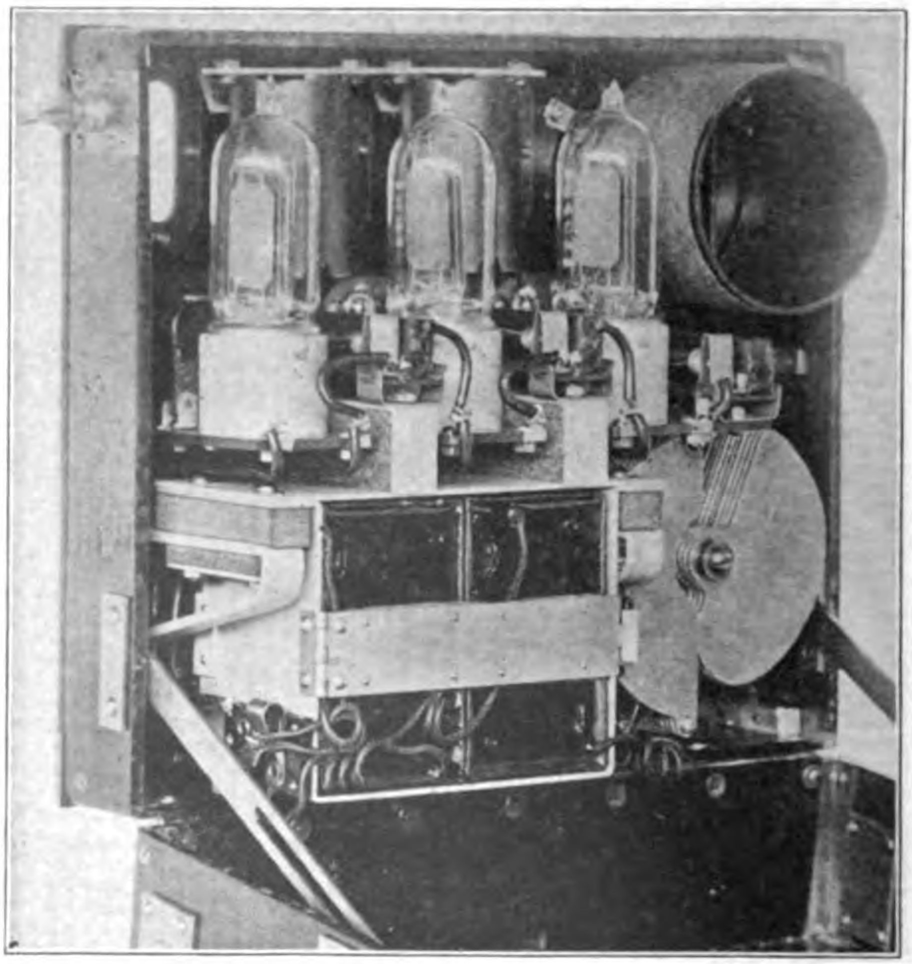


FIG. 9.—Mounting of Apparatus in Set Box Type BC–11 Used in Set Type SCR–68.

set. However, it is of advantage that both the observer and the pilot should be able to receive signals and to converse with each other. This is done by means of the interphone set type SCR–57–A, which differs from the type SCR–57 in some points as explained at the end of this paragraph. A circuit diagram of the set is shown in Fig. 1 and two photographs in Fig. 10.

With the four-pole double throw switch closed to the right in the "Interphone" position, the pilot and observer are entirely disconnected from the radio set, and are connected to each other by an ordinary telephone circuit. They may talk back and forth without any additional operation. A special feature of the set is the "side tone" circuit, which comprises a condenser the purpose of which is to shunt some of the telephone current from the transmitter circuit back into the telephone receiver circuit of the person talking. This circuit is used in order to enable the operator to hear his own voice and know how loud he is talking and whether the circuit is in working condition. Without this provision, he would not hear himself talk on account of the sound proof helmet he wears.

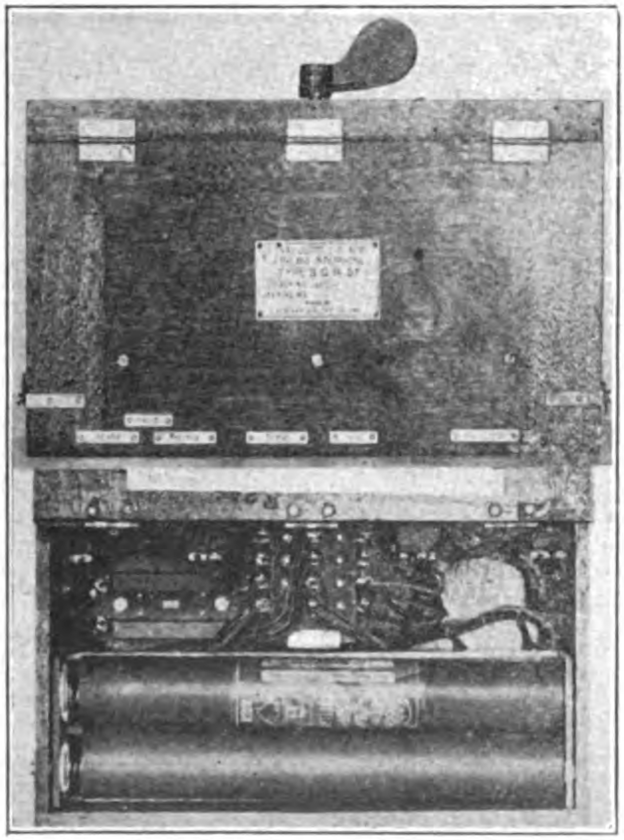


FIG. 10.—Set Box Type BC-10 Used in the Interphone Set Type SCR-57, Lower View Showing the Mounting of Batteries and Radio-Interphone Switch Within the Box.

With the switch closed to the left in the "Radio" position, the observer's telephone receivers are directly connected to the radio receiving circuit, and his telephone transmitter is directly connected to the transmitter terminals at the radio set box. The observer's telephone transmitter is however disconnected from the interphone circuit so that the observer cannot talk to the pilot. The pilot's circuits are disconnected, but by closing the "cut-in switch," he can receive radio signals and talk to the observer.

The operation of the set is then as follows. When the observer and pilot want to talk back and forth to each other, the observer closes the interphone-radio switch to "Interphone." When the observer desires to receive or send radio signals, this switch is closed to "Radio." If, now, the pilot desires to talk to the observer, he must first close his cut-in switch, and if he does not hear any incoming radio conversation, he may speak to the observer without interrupting him in the reception of a message. If he hears an incoming radio conversation, he should wait for the end of the message. If the observer desires to answer the pilot, he must close the interphone radio switch to "Interphone." This, however, disconnects him from the radio set so he should not leave the switch in this position longer than necessary or he may miss some incoming radio signals.

Other Parts of The Set

Fan Driven Generator.—The characteristics of the fan driven generator supplying the current for heating the filaments of the transmitting and receiving vacuum tubes and for supplying power

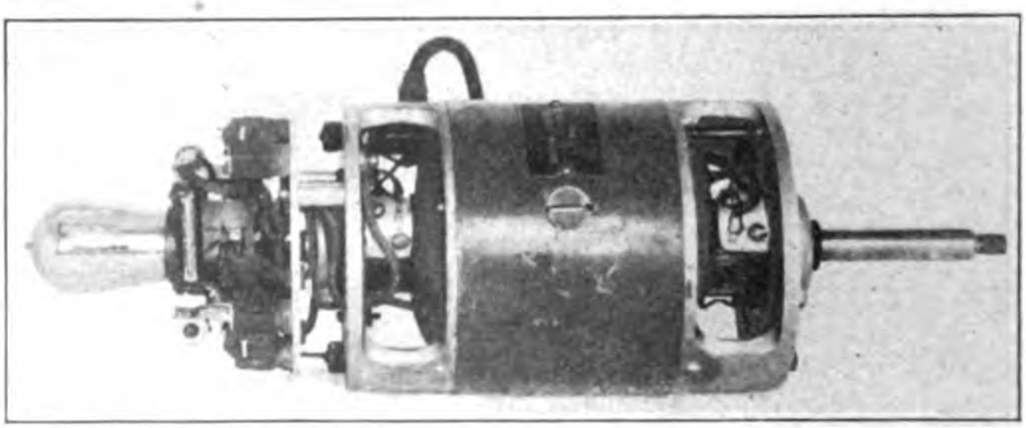


FIG. 11.—Generator Type GN-1 with the Housing and Airfan Removed.

to the plate circuits of the transmitting vacuum tubes were partly described in the discussion of the transmitting circuit. The generator is a self-excited unit having one main field, one differential field, and two armatures wound on the same core. It is enclosed in a streamline case, including also the regulator tube, the function of which was explained in a previous paragraph. See Fig. 11. Due to the regulating action of the airfan type FA-7 and of the regulator tube, the generator will work satisfactory between speeds of 4000 to 14000 r. p. m. The regulation will be entirely satisfactory provided the brushes are correctly adjusted. This adjustment is made in the following manner:

The high voltage brushes which are at the front end of the generator are locked exactly on the no-load electrical neutral point, and the low voltage brushes which are at the rear end of the generator are moved enough forward of the no-load electrical neutral point to obtain the flat voltage characteristic curve shown in Fig. 4.

As may be seen from the circuit diagram of Fig. 1, three resistances labeled R_{12}, R_{13}, and R_{14}, are mounted inside the generator casing. They are respectively of 100, 1.5 and 1.5 ohms resistance. They are mounted around the regulator tube socket in a triangle. The 100-ohm resistance is connected across the main field winding and helps to prevent hunting. The other two resistance units are not connected in any circuit when the generator leaves the factory. They are to be used for voltage adjustment as explained in the following paragraph.

It was explained above that the voltage regulation is dependent on the current through the filament of the regulator tube. This current is determined by the voltage generated by the low voltage armature and by the resistance o the filament circuit, which includes the main field winding. If this resistance decreases for any reason, the voltage required for supplying sufficient filament current to produce regulation will be less and it will be attained at a lower generator speed. Therefore, both high and low voltages will have values below those required by the set. This occurs at high altitudes and during cold weather, the field windings being kept cooler, and having therefore less resistance. To compensate for this effect, one or both of the 1.5-ohm units may be connected in series with the main field winding to obtain the correct resistance. Connecting one of the units increases the low voltage by about two volts and the high voltage by about twenty volts·

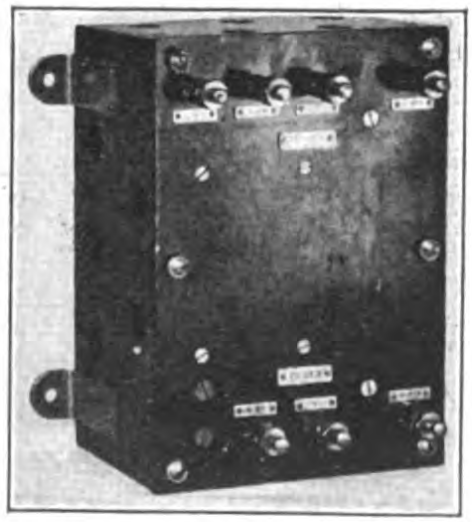


FIG. 12.—Filter Type FL-1 Used in Set Type SCR-68.

While the generator may be safely used on airplanes producing a wind speed of from 50 to 200 miles per hour if equipped with a type FA-7 regulating airfan, it should not be used outside the limits of from 60 to 160 miles per hour when using the airfan type FA-3.

Filter Box.—The filter box contains two condensers, labelled C_8, Fig. 1, one choke coil L_8, and two resistances R_{10} and R_{11}. It is a wooden box with a bakelite panel and binding posts, weighing 6 lb. and measuring $8\frac{3}{8}$ in. x $3\frac{7}{16}$ in. x 6 in., Fig. 12. The function of these units has been previously discussed.

Radio Set Box.—The radio set box contains the circuits shown in Fig. 1, and is illustrated by the photographs given herewith. It weighs about 17 lb. and measures 16½ in. x 4¾ in. x 11 in.

Installation of the Set.

The plan of installation of the type SCR–68 or SCR–68–A sets as given here is only of a very general character, since definite and

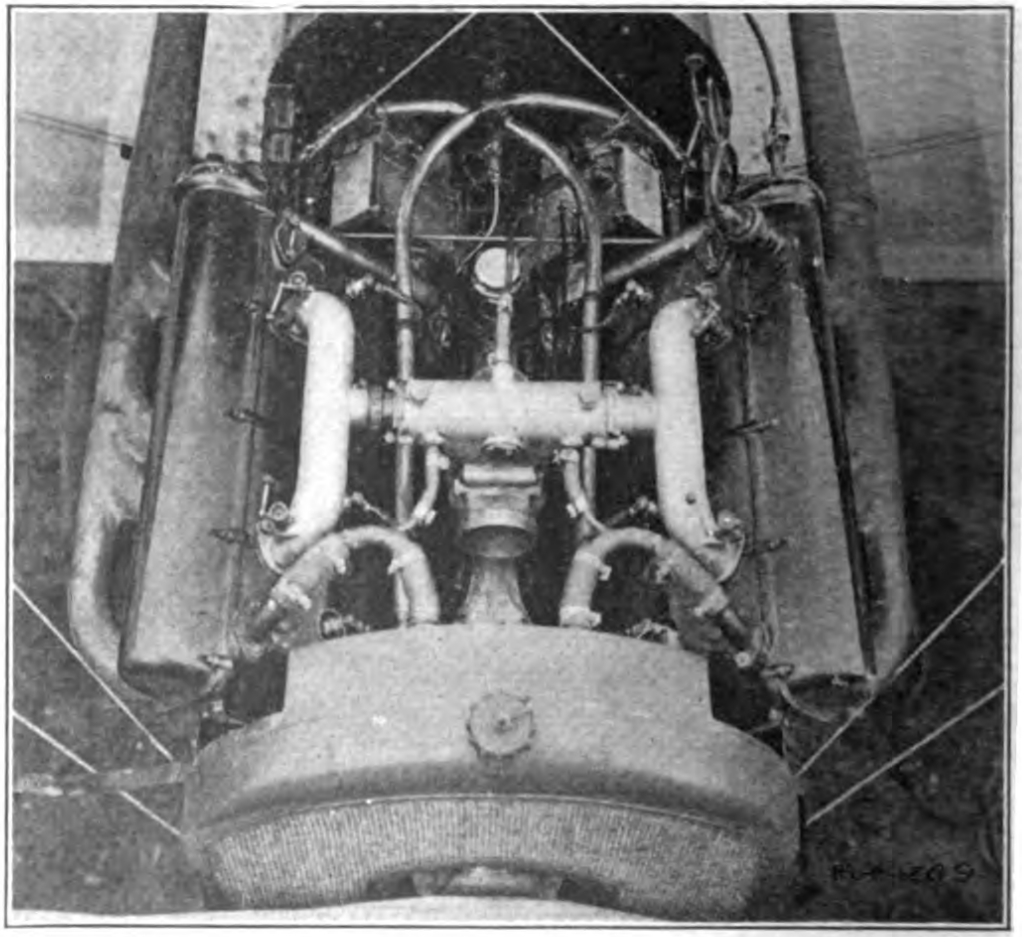


FIG. 13.—Engine Ignition Circuits Encased in Copper Tubing and Magnetos Also Encased as a Shield Against Interference with the Radio Set.

special instructions will have to be given for each kind of airplane on which the set is to be used. Before attempting to install any radio apparatus on an airplane, a thorough knowledge of the contents of Radio Pamphlet No. 30 should be had.

As a special precaution against interference, no wires should be near and parallel to those of the switch operated by the pilot in controlling the ignition system, for the magneto is a source of particular annoyance to the radio set. As a further remedy against magneto interference, it is well to shield the entire magneto system. This may be done by means of metallic covers for all the high-tension wires and the magnetos. The best practice is that of using solid metallic tubing for enclosing the high tension ignition wires and

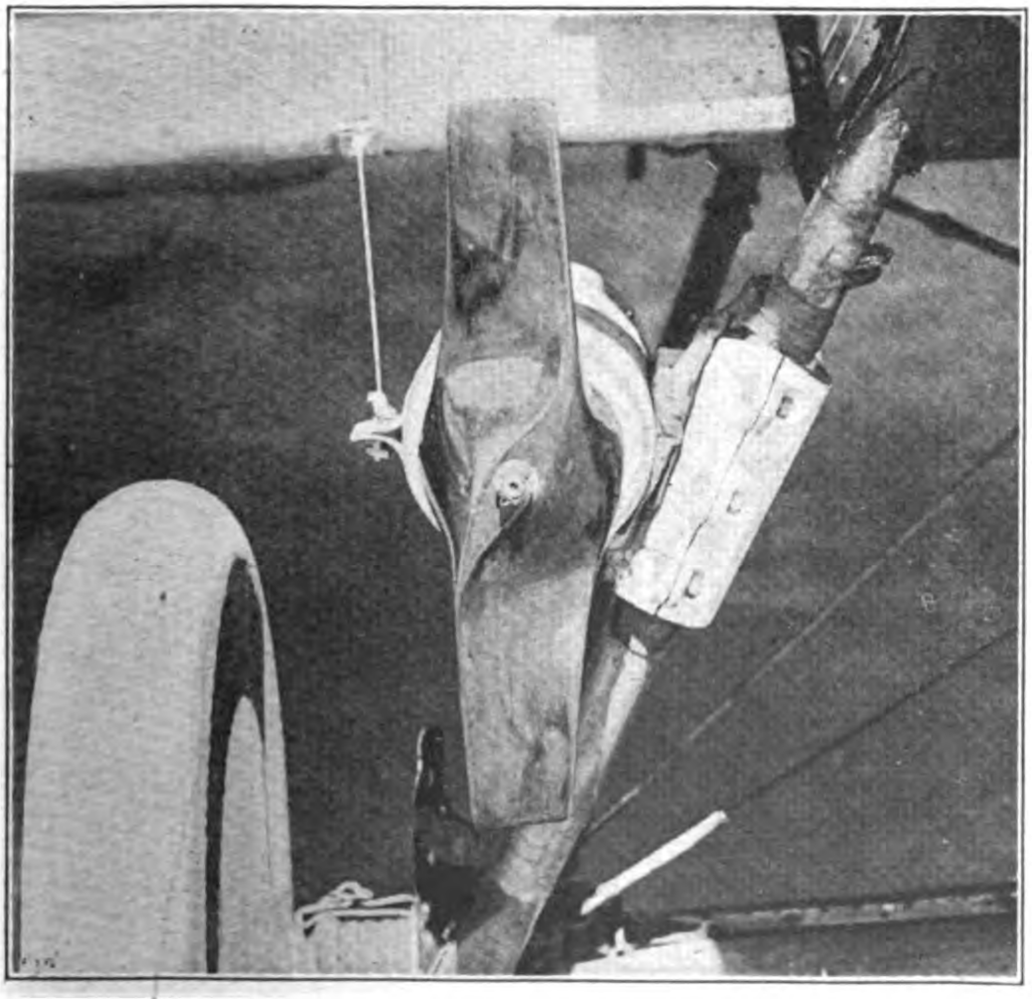


FIG. 14.—Method of Mounting the Generator of Set Type SCR-68 on the Landing Gear Strut.

then connecting the tubing and the magneto covers to the frame of the airplane motor. An installation of this kind is shown in Fig. 13.

The generator should be mounted in the slip stream, a good location being slightly above the middle of the right hand vertical strut of the landing gear, Fig. 14. When this position is not available, due to a lighting or heating generator occupying this strut, as is the case with the De Hāviland airplane, the left hand strut must be

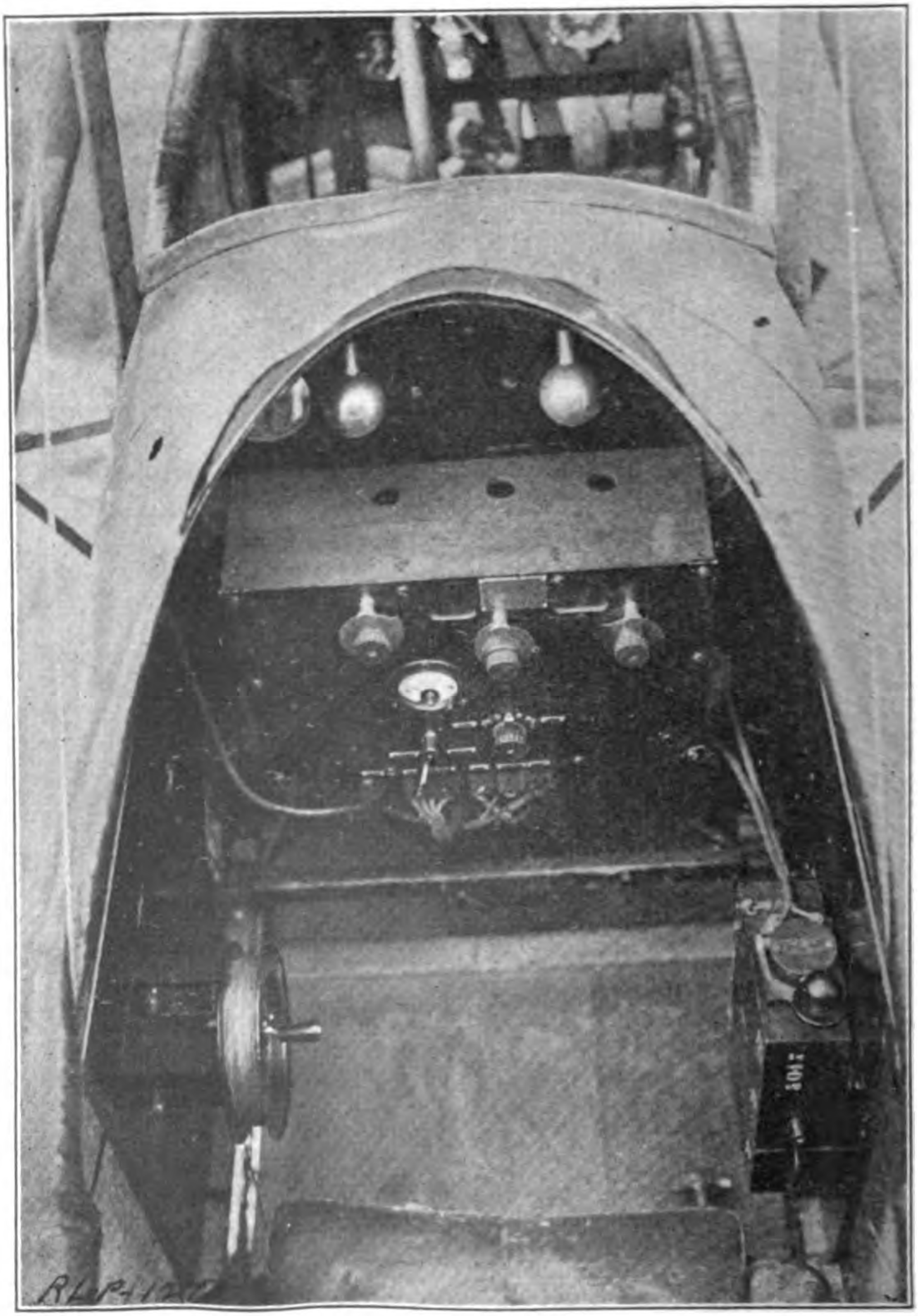


FIG. 15.—General View of the Mounting of Set Type SCR-80 in the Observer's Cockpit. The Mounting of this Set is Practically Identical with that of the Set Type SCR-68-A.

used. The generator base is bolted to a mounting made of iron, aluminum or wood (Mountings Type FT-7 or FT-8) which is clamped to the strut.

The airfan driving the generator may be the wooden fan type FA-3 or the regulating fan type FA-7. The fan type FA-3 is held in place by a nut screwed on the end of the generator shaft which presses against the aluminum hub of the fan, forcing it against a collar on the shaft and thus preventing the fan from rotating independently of the shaft. To replace fan type FA-3 by a type FA-7, remove the fan and generator front casing; then put on the casing supplied with the airfan type FA-7, using the screws taken out of the old casing. The nut which held the wooden fan is not to be used, as the type FA-7 fan is itself screwed on the shaft and then clamped in place.

A variable speed fan should be twisted about its longitudinal axis before each flight, to determine that the governor is functioning properly. The fan must be tightly fastened on the shaft or it may vibrate loose. A light oil should frequently be used to lubricate the bearings and gears of the fan and generator shaft. To properly oil the type FA-7 airfan, remove it from the shaft and oil the cone bearing and ball bearing of each blade as well as the gears at the bottom of the shaft bore.

The filter box is usually screwed to the fusilage floor, under the forward seat, or placed in the cockpit under the dash. In the De Haviland it is necessary to mount the filter box on the left side of the cockpit.

The radio set box should be mounted where its operating panel will be in easy reach of the operator so that he may readily use the various switches mounted thereon. It should be supported so that vibration will be reduced to a minimum, and whenever possible, so that the panel may be readily swung open from bottom hinges without interference.

When possible the interphone set box should be located near the radio set box and placed so that the switch is within easy reach of the operator, and with the jacks in a position which will allow the plugs to be readily inserted. The box may be mounted on the side of the cockpit without unbalancing the airplane.

The pilot's interphone extension cord, type CD-6, should be run along the longitudinal member supporting the seat, and the pilot should have the interphone jack within easy reach so that the transmitter and receiver plugs may be inserted conveniently. The pilot's cut-in switch should be installed in a readily accessible position. The cord type CD-62 is provided with the SCR-68-A set to care for the necessity in certain installations to mount the interphone box and the transmitter and receiver jacks in different locations and some distance apart.

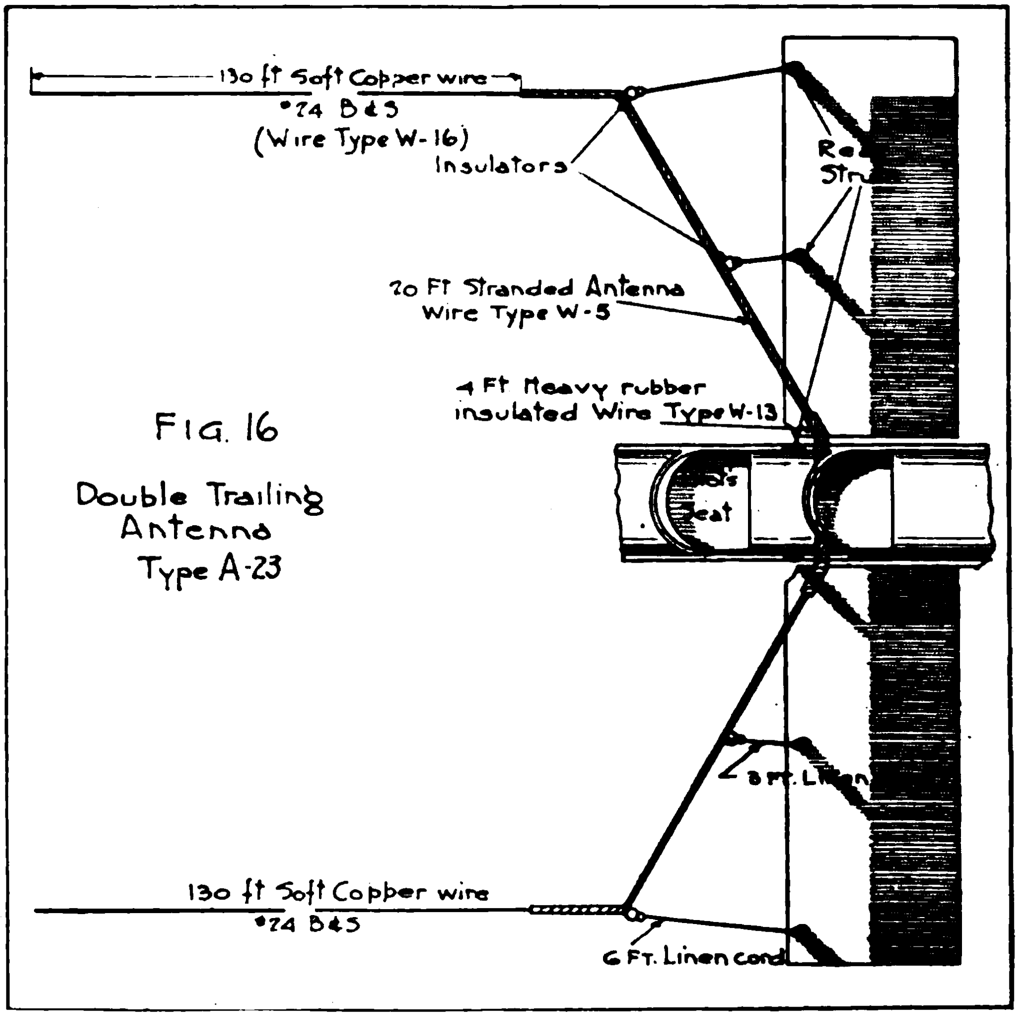


FIG. 16.

If a trailing antenna is to be used, the antenna reel should be mounted on the left hand inside of the fusilage on a wooden mounting fastened between the upper longeron and the seat support. The fairlead should be installed in the floor so that the wire will be guided directly in line with the reel.

The single trailing antenna type A-21 which is used for straightaway flying comprises a 4-ft. length of cord made fast to the reel at one end and tied at the other end to a 290-ft. length of antenna wire, which at its free end is spliced to a 10-ft. length of hemp center phosphor bronze wire having a lead fish weight on the end.

For airplanes flying in squadron formation, it is necessary to use a double trailing antenna so that there will be less restriction of the movements of the machine. This antenna is illustrated in Fig. 16. The counterpoise, as in the case of a single wire trailing antenna, consists of the metal parts and wires of the airplane itself.

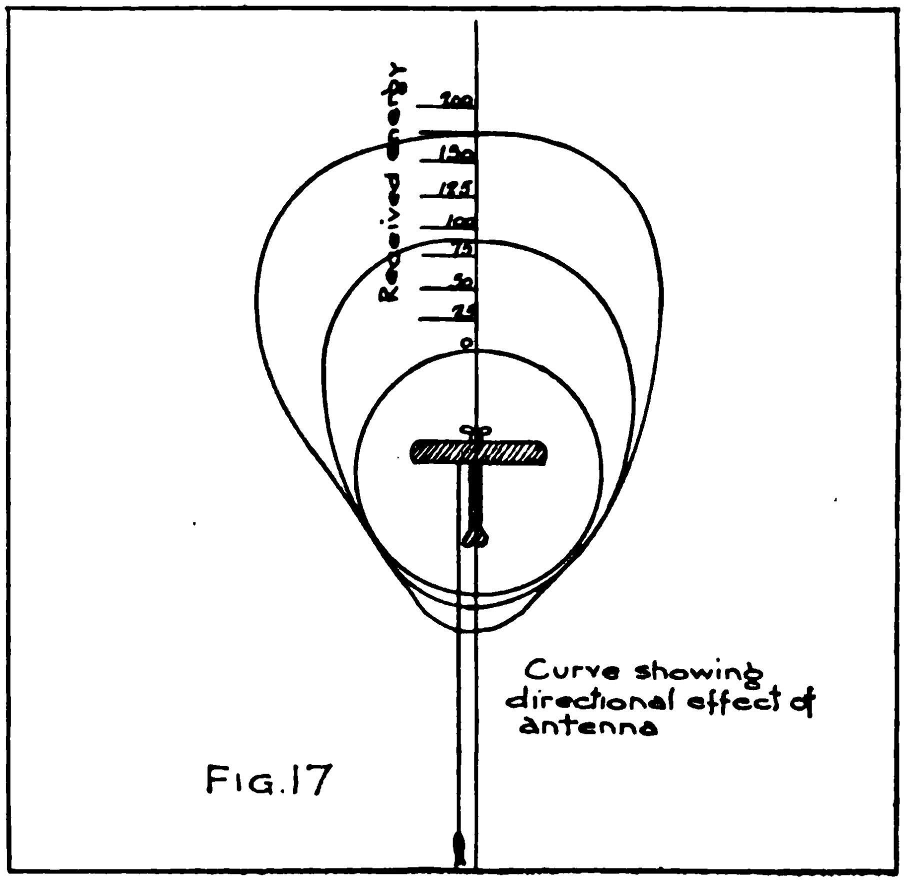


FIG. 17.

Both of these antennae have a general directive effect about as shown on Fig. 17. Transmission and reception is best when the airplane is flying toward the station with which communication is being carried on.

All the stay wires of the airplane should be carefully bonded and electrically connected to the motor and other important metal parts of the airplane to form the counterpoise. This is a very important part of the installation work, and the thoroughness with which it is done not only improves the operation of the set but insures against dangerous sparks between metal parts resulting from the high voltage.

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The various units of the type SCR-68 set having been installed as explained above, they should be interconnected by means of the extension cords furnished with the set and in the manner shown in the cording diagram of Fig. 18.

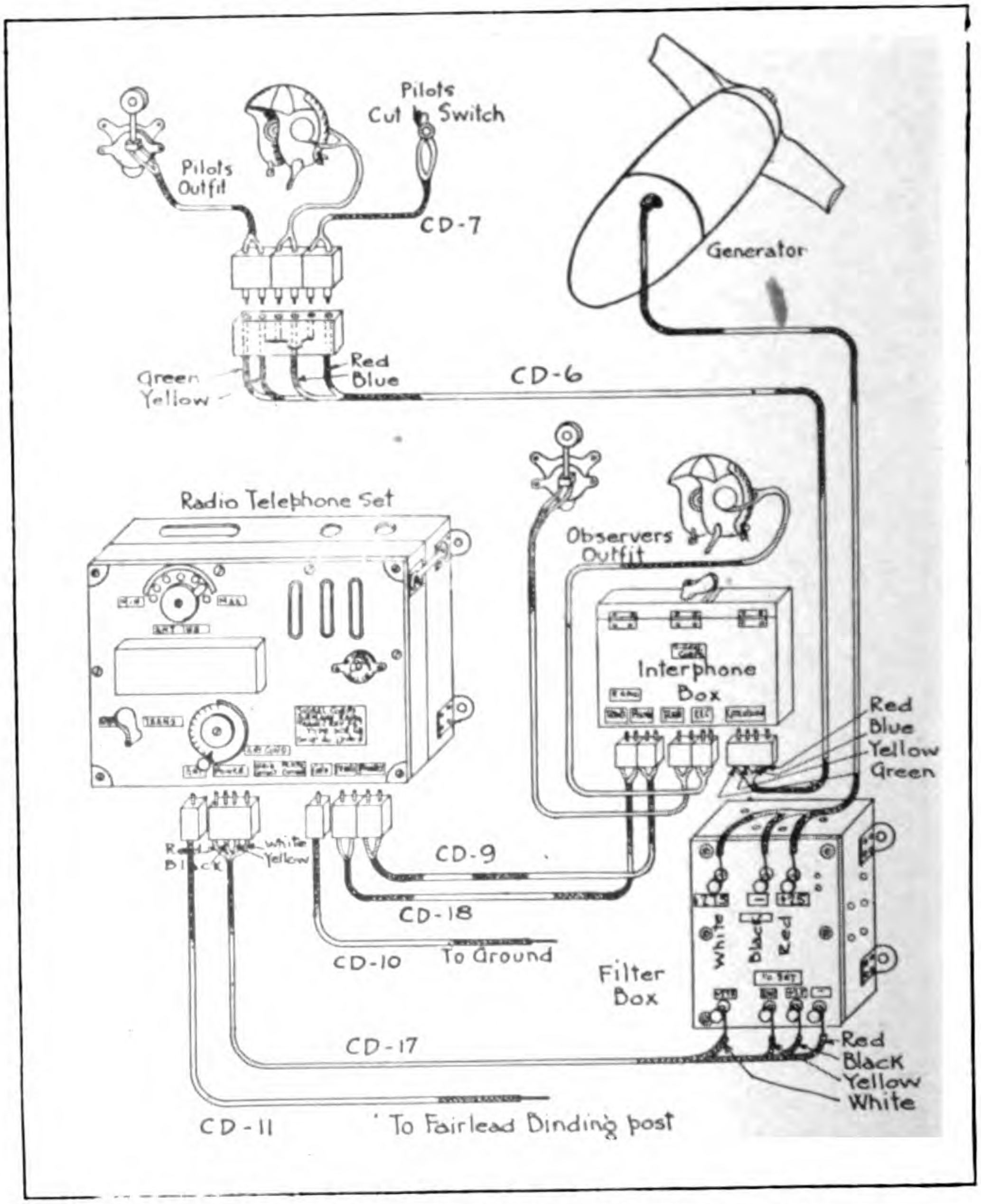


FIG. 18.—Cording Diagram of Sets Type SCR-68 and SCR-68-A.

Calibration of Set Type SCR-68-A

The set having been properly installed and connected as explained in previous paragraphs, it is necessary to tune it for transmitting and receiving at a given wave length. While the operation of tuning may be done in the air during flight, it is better practice to calibrate the set on the ground and record the settings of the various switches for a number of different wave lengths within the range of the set. It is then possible, by referring to this record chart, to rapidly tune the set to any desired wave length. This calibration must be repeated every time the set is installed in a different airplane, or whenever a new antenna is used having different characteristics. The method of calibrating the set on the ground is as follows:

The calibration of the set on the ground is made with a phantom antenna adjusted to have the same effective resistance and capacitance as the actual antenna to be used with the set. The first thing to do is then to determine the constants of the actual antenna to be used. These may be readily measured, but this process is not described here. The antennae generally used are the type A-21 or type A-23. The former is a 300-ft. single wire trailing antenna, while the latter is a double trailing antenna, as shown in Fig. 16. The constants of these two antennae are given in the curves of Fig. 19 for different wave lengths. The natural wave length of the single wire trailing antenna is given in Fig. 20 for various lengths of wire.

A phantom antenna well suited for this purpose of calibration is the type A-50. The following meters will also be required:

1 Voltmeter Type I-5, range 0-50 volts.
1 Voltmeter Type I-6, range 0-500 volts.
1 Ammeter Type I-7, range 0-150 mililamp.
1 Ammeter Type I-9, hot wire, 0-0.5 amp.
1 Wavemeter Type SCR-60-C

The method of calibrating the set is then given in the following paragraph, the various operations being performed in the order given.

Calibrating the Transmitting Circuit.—

1. Remove the airfan from the generator and couple the generator shaft to a motor which will drive it at any desired speed between 4000 and 6000 r. p. m. Also remove the streamline casing of the generator.

2. With the "Transmit-Receive" switch of the radio set box on "Receive" to protect the operator from high voltage on the antenna and in the transmitting circuit, drive the generator at several speeds between 4000 and 6000 r. p. m. and measure the voltage at the

brushes. This should be between 275 and 300 volts on the high voltage side, and from 25 to 29 volts on the low side. If the voltage is much above 310 volts on the high side, inspect the connections and brushes. If these are in good condition, change the regulator tube and repeat the test.

3. Disconnect the real antenna by removing from the radio set box the "Antenna" and "Ground" plugs.

4. Substitute for the real antenna, the phantom antenna type A-50, after the latter has been properly set to have the same constants as the real antenna, as given in the curves of Fig. 19. The settings should be those corresponding to the average wave length of the set, that is, about 400 meters. In order to be connected to the "Ground" and "Antenna" jacks of the radio set box, the wires coming from the phantom antenna terminals should be equipped with plugs type PL-12.

5. Insert the telephone transmitter and receiver plugs in the proper jacks of the interphone set box.

6. Throw the "Interphone-Radio" switch of the interphone set box to the position "Radio."

7. Throw the "Transmit-Receive" switch of the radio set box to "Transmit."

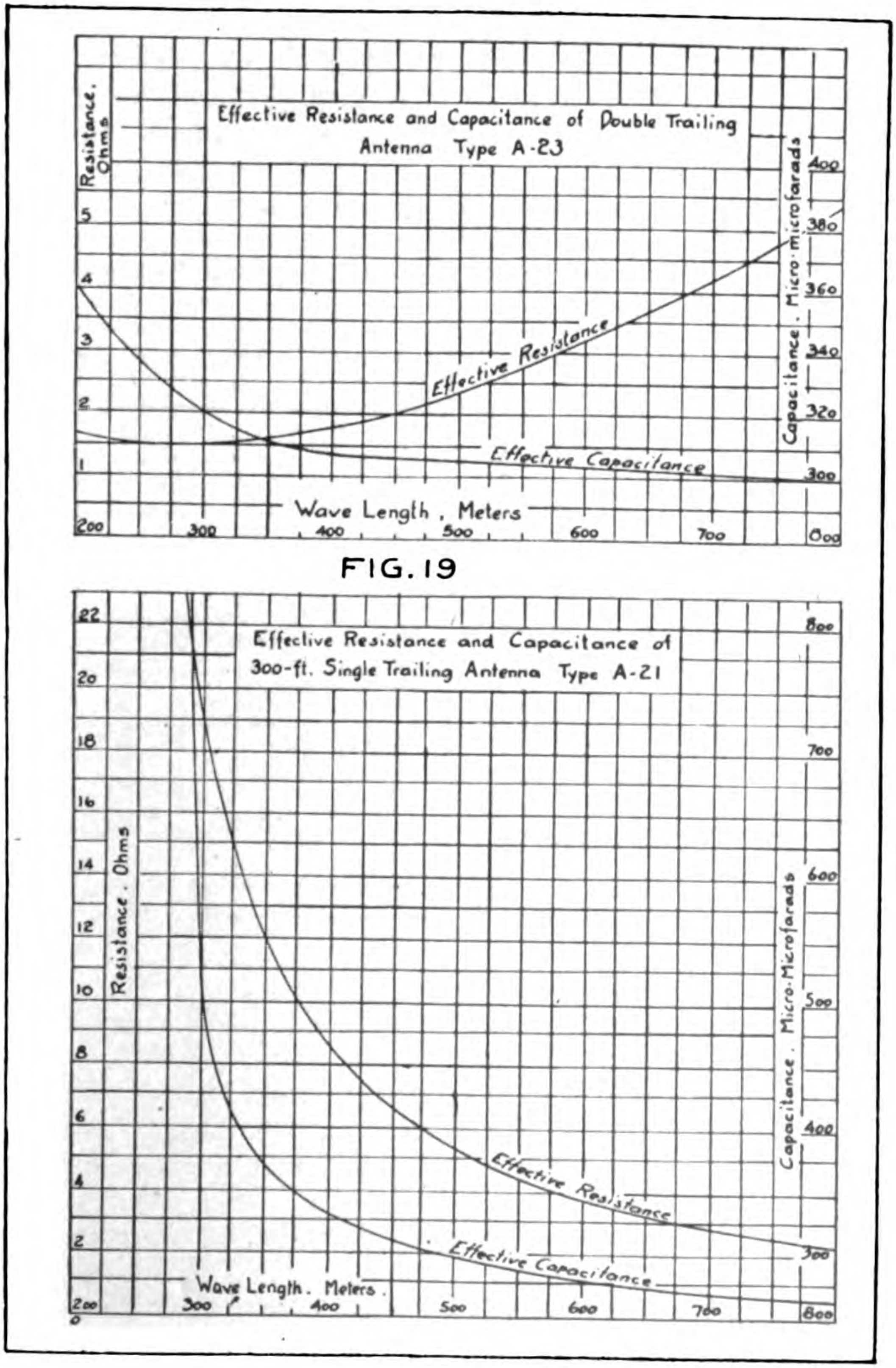
8. Turn the "Input" and "Coupling" dial switches in the small covered panel of the radio set box all the way to the left and right, respectively, which corresponds to their maximum settings. The settings of the "Wave Length" switch are made for adjusting the wave length, the longer waves being obtained when the switch is turned to the right. In order to calibrate the set over the entire range, the various steps given below should be repeated for each position of the wave length switch.

9. Connect the milliammeter to the "Plate Current" jack of the radio set box.

10. Open the modulator switch. This is the small knife switch between the "Input" and "Coupling" dial switches.

11. Throw the "Transmit-Receive" switch on the radio set box to the "Transmit" position.

12. Observing the oscillator plate current on the milliammeter, adjust the coupling switch so that the reading will be as near as possible to 40 milliamp. This current should be maintained between 30 and 50 milliamp. It should be noted that increasing the coupling (turning the coupling switch to the right) decreases the plate current.



Effective Resistance and Capacitance of Double Trailing Antenna Type A-23
Resistance, Ohms
Capacitance, Micro-microfarads
Effective Resistance
Effective Capacitance
Wave Length, Meters
200
300
400
500
600
700
800
1
2
3
4
5
300
320
340
360
380
400
FIG. 19
Effective Resistance and Capacitance of 300-ft. Single Trailing Antenna Type A-21
Resistance, Ohms
Capacitance, Micro-Microfarads
Effective Resistance
Effective Capacitance
Wave Length, Meters
0
200
300
400
500
600
700
800
2
4
6
8
10
12
14
16
18
20
22
300
400
500
600
700
800

FIG. 19.

13. Set the "Transmit-Receive" switch to "Receive."

14. Close the modulator switch.

15. Set the "Transmit-Receive" switch to "Receive." The plate current should be between 60 and 80 milliamp., generally about 70. If greater than 80 milliamp., the modulator tube is defective and should be replaced.

16. Connect the milliammeter to the grid current jack. Adjust the "Input" switch so that the grid current, as read on the milliammeter, will be between 2 and 6 milliamp., and so that the radiation is a maximum as indicated by the hot wire ammeter on the phantom antenna.

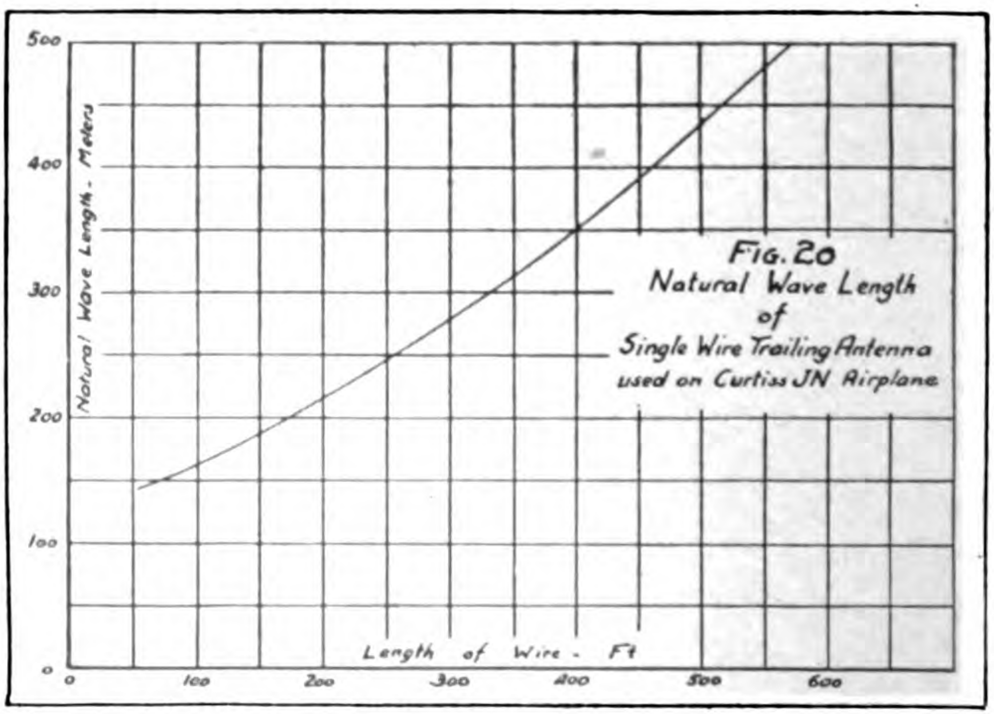


FIG. 20.

17. Measure the emitted wave length by means of the wavemeter, placing the latter near the upper left hand corner of the radio set box.

18. Record the wave length, and the settings of the input, coupling and wave length switches.

19. Repeat the procedure for all positions of the wave length switch.

Calibrating the Receiving Circuit.—

1. Follow steps 1, 2, 3, 4, 5 and 6 above.

2. Set the "Antenna Condenser" (the handle to the right of the transmit-receive switch) approximately to its middle position.

3. Place the wavemeter at some distance from the radio set box, and set its buzzer into action.

4. For each position of the "Antenna Inductance" switch, adjust the wavemeter until the maximum signals are received in the telephone receivers connected to the radio set through the interphone set box.

5. Record the wave length giving maximum signals for each setting of the antenna receiving inductance. This calibration is only approximate, as will be seen from the method of operating the set in the air.

Operating the Set

Preflight Inspection and Tests.—Before each flight, the set should be thoroughly inspected and tested to insure proper operation during the flight. This should be done in the following manner:

1. Test the generator as explained in paragraphs 1 and 2, page 27.
2. Replace the airfan on the generator shaft, tightening it securely.
3. Ascertain that the following conditions are met:

    No loose or broken connection.
    No worn insulation.
    Plugs inserted in their proper jacks.
    Good condition of the airfan.
    Secure mounting of airfan, generator, radio set box, interphone set box, filter box.
    Required number of vacuum tubes in the set box.
    Vacuum tubes free from imperfections.
    Batteries connected with the proper polarity.
    Proper insulation of antenna, and proper length of antenna wire as gauged by the eye.
    Fish weight attached to antenna, if A-21 is used.
    Receive-Transmit switch on "Receive."

4. Set the various switches in accordance with the calibration chart obtained as explained above, so that the set will be tuned to transmit and receive at the desired wave length.

5. Test the interphone box by talking to the pilot through the telephone transmitter with the switch on "Interphone." Then replace the interphone switch to the "Radio" position.

6. The set being then ready and the switches on "Radio" and "Receive," the operator should hear a certain amount of magneto noise in the receivers, while the pilot is testing out the airplane engine. Also, when the engine is brought to full speed, the generator

will be driven by the wind of the propeller, and the receiving tube filaments of the radio set box should glow a dull red.

Operating the Set in the Air.—No additional adjustments are required for transmitting if the set has been properly tuned on the ground. If a type A-21 antenna is used, it should be unreeled when the airplane has reached an altitude of about 500 meters. When receiving, some slight readjustments may be made by means of the "Antenna Condenser" handle. Until the first signals are heard, the amplification push button switch on the radio set box should be pushed in. If then the incoming signals are too strong, it should be pulled out. If the receiving circuit has not been calibrated on the ground, tuning may be done by varying the antenna condenser for each position of the antenna inductance switch, with the amplification push button pushed in until the signals are heard loudest. The operation then consists merely in throwing the switch on the interphone set box to "Radio," and the switch on the radio set box to "Transmit" or "Receive," as desired. When not transmitting or talking to the pilot, the observer should always have these switches on "Radio" and "Receive," in order to be sure of not missing any radio signals which may happen to come in.

Receiving and transmitting with the type SCR-68-A set presents no special difficulties when simple rules are remembered. A list of these, emphasizing the principal points of operation, is given below:

(1) Do not forget to inspect the set before each flight.

(2) Do not forget to plug in the telephone transmitter and telephone receiver plugs.

(3) Do not forget to throw the "Receive-Transmit" switch on "Transmit" and the "Interphone-Radio" switch on "Radio" while talking.

(4) Do not talk rapidly.

(5) Do not have the telephone transmitter away from the mouth while transmitting.

(6) Do not "cup" the hands over the telephone transmitter.

(7) Do not shout into the telephone transmitter.

(8) Do not forget to leave the "Receive-Transmit" on "Receive" when not using the set.

(9) Do not become impatient if you do not hear incoming signals immediately.

(10) Do not expect satisfactory operation over more than five miles range.

(11) Do not forget to put the "Interphone-Radio" switch on "Radio" after talking over the interphone.

(12) Do not touch any uninsulated parts of the set while the switch is on "Transmit."

(13) Do not tinker with the set.

(14) Do not forget to note any cause as to failure of the set to operate.

(15) Do not fail to study the instructions thoroughly.

Troubles and Remedies

In the following outline of troubles encountered with type SCR-68-A sets, no endeavor is made to arrange them in the order of their importance, the reason being that it is easily ascertained to just what extent such troubles may affect the operation and what can be done in case of emergency.

Generator.—

Mounting.—Trouble may be experienced with the generator mounting if it is not firmly fastened to the strut, thus allowing considerable vibration which may cause the generator base to become loosened from the mounting and possibly to break the base.

Leads.—If the lead from the generator to the filter box has been run along the innerside of the strut, the insulation may become oil-soaked and deteriorate to such an extent as to cause a short circuit. To avoid this the lead should always be fastened on the outerside of the strut—the side farthest from the engine.

Brushes and Their Mountings.—It is very important to inspect the condition of the brushes and their mountings. In the type GN-2 generator there are two kinds of brushes used, one a composition of carbon and copper for the low voltage side and the other, a high resistance carbon for the high voltage side. These should obviously not be interchanged. In the type GN-1 generator only one type of brush is used, thus obviating any trouble due to interchange of brushes. Sometimes the brush holders of the type GN-2 generator become quite hot and then unsoldered, in which event it is necessary to re-solder them. Furthermore, the pig-tails on the brushes may also become loose and thus necessitate the renewal of the brushes. Trouble from these sources has been eliminated in the design and