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OPERATOR'S INSTRUCTION MANUAL

FOR

RADIO SET ✓ SCR-521-B

MANUFACTURED BY

PHILCO CORPORATION

PHILADELPHIA, PA., U. S. A.

Res. & Dev. Div.

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OPERATOR'S INSTRUCTION MANUAL

FOR

RADIO SET SCR-521-B

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for

RADIO SET SCR-521-B

1. GENERAL

The following instructions are intended for use by personnel concerned with operating Radio Set SCR-521-B. It is presumed that the operator of this equipment has had adequate training in the tactical employment of this equipment. The information contained herein is for the purpose of familiarizing the operator with those non-technical characteristics of the equipment which are considered necessary in order to obtain the proper operation and longest service life of the equipment.

2. COMPONENT UNITS

The normal operation of the equipment will require adjustment of the external controls only on the following units:

- Transmitter (BC-702-B): See Fig. 1.
- Receiver (BC-701-B): See Fig. 2.
- Indicator (BC-704-B): See Fig. 3.
- Control Panel (BC-703-B): See Fig. 4.
- Inverter (PE-115-B): See Fig. 5.
- Antenna (Receiver Antenna Selector Switch): See Fig. 6.
- (Transmitter Antenna Selector Switch): See Fig. 7.

Note: Under abnormal conditions it may be necessary for the operator to make certain adjustments which involve manipulation of certain internal controls. See Section 5 "Service Adjustments" for further details.

3. INSTALLATION

a. General. In general, the location of various component units inside the aircraft varies with the different types of aircraft. However, it will be found that the units are mounted as closely together as possible for the convenience of the operator.

It is presumed that the operator will have received instructions as to the physical location of the SCR-521-B equipment in the various types of aircraft and this subject will not be covered in these instructions.

Several types of aircraft will normally be equipped with two separate antenna systems for the SCR-521-B equipment. The two transmitter antennas are connected to the Transmitter Antenna Selector Switch. Either antenna may be used by setting the switch to the corresponding indicated position.

The two Receiver Antennas are connected to the Receiver Antenna Selector Switch. Either antenna may be used by setting the switch to the corresponding indicated position.

The tactical employment of the two antenna systems will not be discussed here.

It shall be noted that some of the types of aircraft may not be equipped with two antenna systems. In these installations, no antenna switches are used and the antennas are connected directly to the Receiver and Transmitter.

The following characteristics are normally common to all types of installations for Radio Set SCR-521-B.

b. Power Supply. The equipment uses the 28-volt d-c system of the airplane to supply the necessary electrical energy. Part of the d-c power is used to operate the transmitter blower motor, antenna switch motor, start relay, and pilot light. The balance of the power required is supplied to the Inverter PE-115-B, which in turn converts the direct current to alternating current required to operate portions of the equipment. The inverter is connected to a 28-volt d-c Junction Box and to the Control Panel by means of suitable flexible cables. The Control Panel regulates the alternating current voltage. The regulated voltage from the Control Panel is supplied to the Transmitter and Receiver by means of flexible power cables. The Indicator or Indicators receive the necessary power from the Receiver.

c. Component Units, General. The component units with which the operator is concerned are those given in Section 2. However, in certain installations there are two Indicators

used instead of one. One of the Indicators is called the "Local Indicator" and is mounted near to the Transmitter, Receiver and Control Panel. The other indicator, called the "Remote Indicator", is mounted at some other location in the aircraft, usually near the navigator or pilot's seat. Both Indicators are identical in type and provide the same indications. The proper operation of the two Indicators is described under Section 4.

A detailed description of the component units will not be given herein, but a sketch of the front panel of the major units is furnished in the back of this book to enable the operator to recognize these various component units and to identify the necessary controls as referred to in these instructions.

All of the major component units are enclosed in cabinets, sometime referred to as "dust covers". The dust covers are secured by means of Dzus fasteners and are readily removable for servicing the units.

The major component units are provided with mountings, sometimes referred to as "trays". The mountings, as such, do not include such additional brackets and supports as may be required for securing them in an aircraft. The mountings are all of the same general type and are provided with rubber shock absorbers (except the Control Panel). The back of each mounting is provided with holes to receive the guide pins of the unit. The front of each mounting is provided with knurled locking-ring nuts which engage the studs on the bottom of the front panel of the unit.

The mounting bracket provided for the Indicator is somewhat different in construction from the brackets for the other mountings, in that it is adjustable. The mounting bracket can be adjusted so that the Indicator may be viewed at a convenient angle by the operator.

- d. *Interconnecting Cables.* The units are interconnected by means of flexible cables which are fitted with suitable plugs for the purpose. All socket connectors for these cables are located on the front panels of the units. Under normal conditions, the operator will not be concerned with the various interconnecting cables and plugs other than checking up periodically to make sure that none of the plugs have become loosened during flight. Under no circumstances should any of the

plugs be disconnected while the equipment is operating.

Under certain conditions, in order to isolate trouble in the equipment, it may be necessary for the operator to disconnect certain specific plugs. Refer to Section 4 for details before attempting to disconnect any part of the equipment.

It will be noted that some cables which are equipped with small coaxial plugs are furnished with color markings. The color marking of the cable (or plug) corresponds with the color marking of the socket connector into which it is to be connected. This color coding may be followed when connecting the plugs in order to obtain proper operation and to avoid damage to the equipment. Refer to the panel diagrams in this book for the color coding for the various cables.

- e. *Adjustment.* All units are completely adjusted before leaving the factory and under normal conditions should not require readjustment for relatively long periods of time. However, after the units have been mounted in the aircraft and properly interconnected, the adjustments of the various units should be checked by a specially trained radio mechanic who has had training in the test and maintenance of Radio Set SCR-521-B. Adjustments should not be attempted without the proper test equipment designed for the purpose.

Full instructions for the adjustment of the units comprising Radio Set SCR-521-B are not within the scope of these instructions. Such adjustments as may be necessary for the operator to make under abnormal conditions are described under Section 5.

4. OPERATION

- a. *General.* The operation of this equipment imposes a heavy current drain on the d-c supply system of the aircraft. Therefore, the equipment should not be operated unless the aircraft engines are running at a sufficient speed for the d-c generators to charge the battery. If the SCR-521-B equipment is turned on when the aircraft engines are not running, or when the engines are running too slowly to provide d-c from the generators, the battery (or batteries) will be discharged in a very short time. In certain types of aircraft it may be possible to run the equipment for

5 minutes or less without the aircraft engines running, but this should not be done without the approval of the crew-chief for the particular airplane. In most cases, if it is necessary to operate the equipment without the aircraft engines running, it will be necessary to obtain the d-c power from a battery cart or auxiliary power supply.

It should be noted that the battery voltage should not be less than 24 volts for such operation, otherwise the equipment may be damaged or fail to operate properly. If a battery cart or auxiliary power supply is provided, the d-c voltage should be adjusted to 28 volts.

b. *Procedure for Placing Equipment in Operation.*

Note: For explanatory notes on Steps 1 to 12, see paragraph 4d, below.

Step 1: Check that "HV OFF" "HV ON" switch (40) is in "HV OFF" position. (See Fig. 1.)

Step 2: Throw "PWR OFF" "PWR ON" switch (31) on Panel Control to "PWR ON" position. (See Fig. 4.)

Step 3: Check pilot light (30). (See Fig. 4.) Pilot light should be lighted.

Step 4: Make sure that the transmitter blower is operating. This may be done by placing hand over the louvered cover on the right side of the transmitter panel and noting the outward draft of air. If no draft of air is felt, the "PWR OFF" "PWR ON" switch (31) should be turned off at once to avoid overheating the transmitter tubes.

Step 5: Allow at least one minute after turning on power switch (31) for the tubes to warm up before turning on the high voltage switch (40) for the plate supply of the transmitting tubes.

Step 6: Throw "HV OFF" "HV ON" switch (40) to "HV ON" position.

Step 7: Immediately after throwing switch (40) to "HV ON" position check the amount of plate current indicated on meter (41). (See Fig. 1.) If the meter reading is in excess of 6 milliamperes the high voltage switch (40) should be thrown to "HV OFF" position immediately, since the equipment is not operating properly and damage will result to

the tubes and other components if operated in this condition. The reading on meter (41) should be between 3 and 6 milliamperes for proper operation.

Step 8: Observe whether there is any sparking at socket (24), or evidence of sparking within the Transmitter. (Do not remove Transmitter covers with high voltage switch on.) If any sparking persists for more than a second or two the high voltage switch should be thrown to "HV OFF" position at once.

Step 9: If transmitter appears to be operating satisfactorily, observe Local Indicator screen. A vertical line should appear on the face of the screen. If this line does not appear, alter the setting of the "BRILL" (71) and "FOCUS" (72) controls simultaneously until a line appears. These settings will probably have to be readjusted when changing position of the "RANGE" switch (73). (See Fig. 3.) The "RANGE" switch (73) should be set at all three positions in turn and operation noted.

Step 10: See that "LOCAL" "REMOTE" switch (101) (Fig. 2) on Receiver is set to "LOCAL" position. Set "RANGE" switch (73) to "10" position. Turn "GAIN" control (70) clockwise until some images appear to the right and left of the vertical line: Readjust the "FOCUS" and "BRILL" controls to obtain clear images. While observing one of the images rotate the "TUNE" control (102) (See Fig. 2) on the Receiver to obtain maximum width (amplitude) of the image. If the image extends almost to the edge of the screen, it will be necessary to reduce the "GAIN" and then readjust the "TUNE" control.

Note: When the "TUNE" knob is rotated a complete turn, it should be possible to obtain two points approximately 180 degrees apart, which will give correct tuning.

Step 11: After Receiver "TUNE" control has been adjusted (in Step 10) throw "LOCAL" "REMOTE" switch (101) to "REMOTE" position. Set "RANGE" switch on Remote Indicator to "10" position. Adjust "FOCUS" "BRILL" and "GAIN" controls to obtain the same indications that were ob-

tained on the Local Indicator. Note that the "GAIN" setting for *both* Indicators is controlled from either the Local or Remote Indicator, depending upon the position of the "LOCAL" "REMOTE" switch (101).

Note: If only one Indicator is installed in the aircraft, Step No. 11 does not apply.

Step 12: If the aircraft is provided with two antenna systems (for the SCR-521-B equipment), the operation of the equipment with both antenna systems should be checked.

Caution: Before switching the Transmitter Antenna Switch, throw "HV OFF" "HV ON" switch (40) on transmitter to "HV OFF" position. This precaution must be observed to avoid destruction of the transmitting tubes.

Make sure that both Receiver and Transmitter Antenna Selector Switches are thrown to same corresponding position before checking operation.

(It is presumed that the operator will have received previous instruction in the proper operation and tactical use of the two antenna systems.)

c. *Procedure for Switching OFF the Equipment*

1. Throw the "HV OFF" "HV ON" switch (40) to "HV OFF" position.
2. Allow 30 seconds or more for the transmitting tubes to cool.
3. Throw "PWR OFF" "PWR ON" switch (31) to "PWR OFF" position.

d. *Explanatory Notes for Steps 1 to 12 (Par. 4-b above)*

Note on Step 1—If the high voltage switch (40) is left in the "HV ON" position when the power switch (31) is thrown to "PWR ON" position, the high voltage is applied to the transmitter tubes before they have time to heat up and failure of the tubes may result.

Note on Step 2—When power switch (31) is thrown to "PWR ON" position, the d-c supply is fed through the starting relay to the Inverter Unit, which in turn furnishes the d-c supply for operating the equipment. D-c is also supplied to the pilot light, transmitter blower, and various other components.

Note on Step 3—If pilot light (30) fails to

light when power switch (31) is thrown to "PWR ON" position: (a) the pilot light may be burned out, (b) the light may be turned off by rotation of control, or (c) the d-c fuse inside fuse panel (33) (See Fig. 4) may be burned out. If it is determined that the pilot light is burned out, replacement may be made as soon as convenient, since the operation of the equipment will be unaffected. Refer to Section 5e for information concerning checking and replacement of fuses.

Note on Step 4—If transmitter blower does not operate when the pilot light is lighted in "PWR ON" position, it is an indication that (a) there is a loose connection in the plug, or, (b) broken or loose wire connection, or, (c) defective blower motor. Make sure that power plugs to sockets (18), (19), (20) and (27) (See Fig. 1 and Fig. 4) are screwed on tightly. If the plugs are not at fault, the possible defects (b) and (c) should be checked by a specially trained radio mechanic.

Note on Step 5—If the high voltage switch (40) is turned on too soon (before one minute warm-up) the transmitting tubes may be damaged.

Note on Step 6—It is considered good practice to throw the high voltage switch (40) to "HV ON" position only momentarily for the first time to observe quickly whether the plate current is normal and to make sure there is no sparking. See Steps 7 and 8.

Note on Step 7—If the plate current reading is less than 3 milliamperes, normal operation cannot be expected and the Transmitter should be checked by a specially trained radio mechanic.

Note on Step 8—If sparking occurs, the Transmitter is probably out of adjustment. Refer to Section 5 for proper tuning procedure.

Note on Step 9—If no vertical line appears on the indicator tube (with high voltage switch (40) in "HV ON" position and meter reading 3 to 6 ma.) make sure that "BRILL" control is turned full on. If a spot only is observed, check plugs to sockets (13), (17), (25), and (26) for proper fit. If color-marking of plugs do not correspond, turn off high voltage switch (40) and connect plugs

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to proper sockets. If plug connections are satisfactory and no vertical line appears with high voltage switch on, it is apparent that there is an electrical defect in the cables or the units. The equipment should not be operated in this condition to avoid further damage. Only a specially trained radio mechanic should attempt repair of the equipment.

Note on Step 10—If rotation of the "TUNE" control does not affect the width (amplitude) of the images, or causes little effect, the Receiver or the Transmitter, or both, are tuned improperly. When required, in case of necessity, and when a specially trained radio mechanic is not available, the operator may attempt such tuning adjustments on the Transmitter as are outlined in Section 5.

Note on Step 11—In case of necessity while in flight, if it is found that either the Local or Remote Indicator does not function properly, the operable unit may be placed at the desired (Local or Remote) position. All color-markings on the plugs and sockets must be observed. Plugs must not be removed unless the high voltage switch (40) and power switch (31) are turned off. Also, all plugs to the Indicator not in use should be disconnected *at the Receiver*. **CAUTION:** *When the power plug is removed from the Receiver, extreme care must be exercised to avoid placing the fingers into the open socket while the equipment is operating. Extremely high voltages are used which are dangerous to life.*

Note on Step 12—A small variation in the plate current on meter (41) may be noted when changing from one Transmitter antenna to the other. If the plate current for each antenna is not between 3 and 6 milliamperes, the transmitter adjustment or the antenna may be at fault and should be checked by a specially trained radio mechanic.

5. SERVICE ADJUSTMENTS

- a. *General.* Under normal conditions, the operator shall perform only the "Operational Adjustments", such as manipulation of external control knobs and switches. All adjustments requiring access inside the unit case, or inserting a tool inside the unit case are considered "Service Adjustments" and should be accomplished by a specially trained mechanic. However, under adverse or emergency con-

ditions, in order to effect a correction of certain defects in a non-operating (or misadjusted) equipment without harmful delay, the operator may attempt the service adjustments described herein. In any case, the operator shall not attempt any more adjustments than are actually necessary to restore normal operation.

- b. *Transmitter Unit.* If sparking occurs at the white socket (24) or inside the Transmitter, or, if the plate current is less than 3 milliamperes or more than 6 milliamperes, the following Transmitter antenna adjustment may be made:

- (1) Make sure that high voltage switch (40) is in "HV OFF" position.
- (2) Remove tuning tool (47) from the inner side of the louvered cover on the right side of the Transmitter panel.
- (3) Insert tuning tool into hole in right hand side panel of Transmitter case and engage tuning capacitor adjustment control.
- (4) Turn on high voltage switch (40) and tune slowly for maximum plate current (3 to 6 ma.).

Note: If the maximum current obtainable is 3 ma. or less, further Transmitter or antenna adjustment may be necessary and should not be attempted by the operator.

Sparking usually occurs when the antenna is not loading the Transmitter properly. A defective or damaged antenna (or transmission line) will produce this effect. Sparking at socket (24) may be due to dirt, foreign matter or moisture between the center and outside contact. This may be cleaned out with a clean, dry cloth after the high voltage switch (40) is turned off.

- (5) Turn off high voltage switch (40), replace turning tool and louvered cover.

- c. *Receiver.* Under normal conditions, the internal adjustments of the Receiver are securely locked, and there is little reason for the operator to question the setting of the various adjustments. However, if the Receiver appears to be generally insensitive, or

if the "noise" indications and "signal" indications do not reach maximum at the same setting of the "TUNE" control, then the internal tuning adjustments may not be set correctly. Resetting the internal adjustments of the Receiver should be attempted only by a specially trained radio mechanic.

- d. *Indicator.* The internal adjustments of the Indicator should not be disturbed by the operator. The adjustment of these controls requires special calibrating instruments.

Under the sliding cover plate (74) (See Fig. 3) are three controls with slotted shafts (75), (76), and (77). The setting of these controls is usually checked by a specially trained radio mechanic immediately before the equipment is to be used. However, under abnormal conditions it may be necessary for the operator to adjust these controls.

If the vertical line which appears on the screen is not in a central position, adjust the top ("HOR SHIFT") control (75) to shift the line to the right or left, and adjust the middle ("VER SHIFT") control (76) to alter the up and down position to coincide with the calibrated scale. When two Indicators are used in an installation, both will be in operation and will have to be adjusted separately. However, the "GAIN" can only be controlled from one Indicator at a time, and this is dependent upon the position of "LOCAL" "REMOTE" switch (101) (See Fig. 2).

The bottom "SYN" control (77) affects the calibration of the Indicator and should not be altered except by a specially trained radio mechanic who is equipped with the proper test equipment. However, under flight conditions, if the vertical line does not appear or is very short in length (see note below), the operator may turn the "SYN" control (77) clockwise just far enough to obtain a normal vertical line. Since this adjustment has probably altered the calibration accuracy, it should be rechecked by a specially trained radio mechanic at the earliest opportunity.

Note: This adjustment should not be made until all other points which could produce this effect have been checked. See Section 4.

- e. *Control Panel.* The internal voltage regulator adjustments should not be attempted by the operator because special instruments and special technique are required.

If any of the major units fail to operate (tubes not lighting or warming up, blower not operating, pilot light not lighted, etc.), the cause may be due to a blown fuse. (See also Paragraph f below.) Behind the fuse cover (32) (See Fig. 4) is a fuse block carrying six fuses. The top three fuses are connected in circuits, the bottom three are spares. A blown fuse should be replaced by one of the spares. However, if the newly replaced fuse also blows, this indicates a short circuit or overload in one of the power cables or one of the units, and no further attempt should be made to operate the equipment until the trouble has been located and corrected.

- f. *Inverter.* The Inverter unit normally does not require adjustment throughout its service life and no adjustments should be attempted by the operator. However, if there are indications that the various major units are not being supplied with the necessary a-c power, the Inverter PE-115-B should be checked for the following:

- (1) Check that the Inverter is running when the power switch (31) is turned on. If the Inverter is not running with power switch (31) on, the trouble may be due to a blown "50 ampere fusatron". Turn off power switch (31) before installing spare fusatron. (Spare fusetrans and fuse links are secured on inner side of housing cover.)

Note: If the newly replaced fusatron blows immediately or within five minutes, an overload or short circuit is indicated and no further attempt should be made to operate the equipment.

- (2) If Inverter runs properly when the power switch (31) is turned on, but no a-c power is being supplied to the major units, the trouble may be due to a blown "10 ampere fuse". This fuse is for the a-c output. Before attempting to inspect the 10 amp. fuse, turn power switch (31) off. Unscrew the end of the 10 ampere

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fuse and inspect the fuse link. If the fuse link is blown, insert a new one (spares are contained in an envelope inside housing cover). If this fuse blows immediately or within a few minutes' operation, no further attempt should be made to operate the equipment.

- (3) Check operation of the starting relay (located inside housing). When power switch (31) is turned on, the starting relay should be heard to click. If the starting relay does not operate, a fuse

in the Control Panel may be blown (See Par. 5e).

- (4) Check plugs and wing-nut terminals and make sure that they are tight.
- (5) If all the fuses in the SCR-521-B equipment are good, and the Inverter will not operate, the trouble may be due to blown fuses in aircraft junction boxes. The operator should not attempt to replace fuses in the aircraft junction-fuse boxes without permission and instructions from the aircraft crew chief.

- 23 ANTENNA OUTPUT
- 24 NEGATIVE TRANSMITTER OUTPUT (WHITE)
- 25 26 POSITIVE TRANSMITTER OUTPUT (ORANGE)
- 27 POWER OUTPUT FROM CONTROL PANEL
- 40 HIGH VOLTAGE SUPPLY SWITCH FOR PLATES OF TRANSMITTING TUBES
- 42 FILAMENT TUNING CONDENSER ADJUSTMENT
- 43 FILAMENT TUNING CONDENSER ADJUSTMENT
- 47 BAKELITE WRENCH

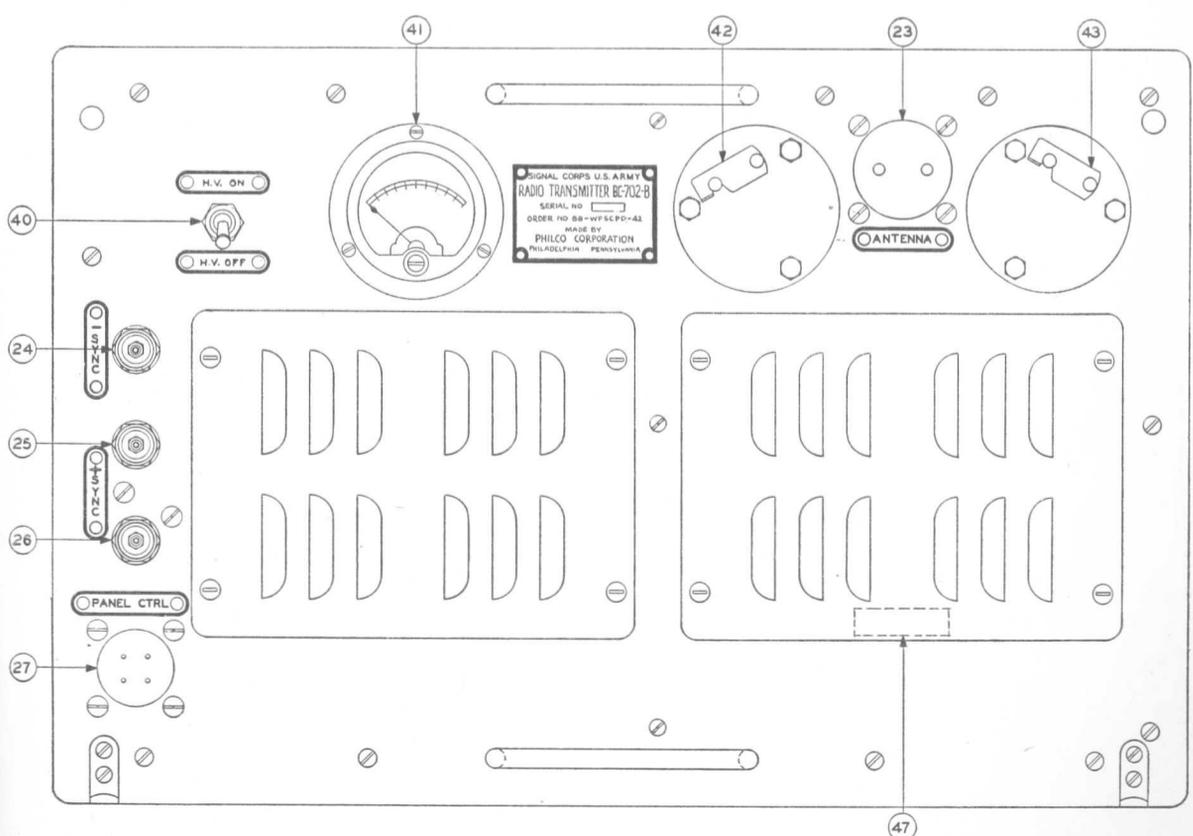


FIGURE 1—TRANSMITTER BC-702-B, FRONT VIEW

- 1 RECEIVER OUTPUT TO REMOTE INDICATOR (BLACK)
- 2 STARBOARD RECEIVER ANTENNA INPUT (GREEN)
- 3 PORT RECEIVER ANTENNA INPUT (RED)
- 4 RECEIVER OUTPUT TO REMOTE INDICATOR (BLUE)
- 5 POWER OUTPUT TO LOCAL INDICATOR
- 6 RECEIVER OUTPUT TO LOCAL INDICATOR (BLACK)
- 7 POWER OUTPUT TO REMOTE INDICATOR
- 8 POWER INPUT FROM CONTROL PANEL
- 9 RECEIVER OUTPUT TO LOCAL INDICATOR (BLUE)
- 101 LOCAL-REMOTE GAIN CONTROL SWITCH
- 102 RECEIVER TUNING CONTROL

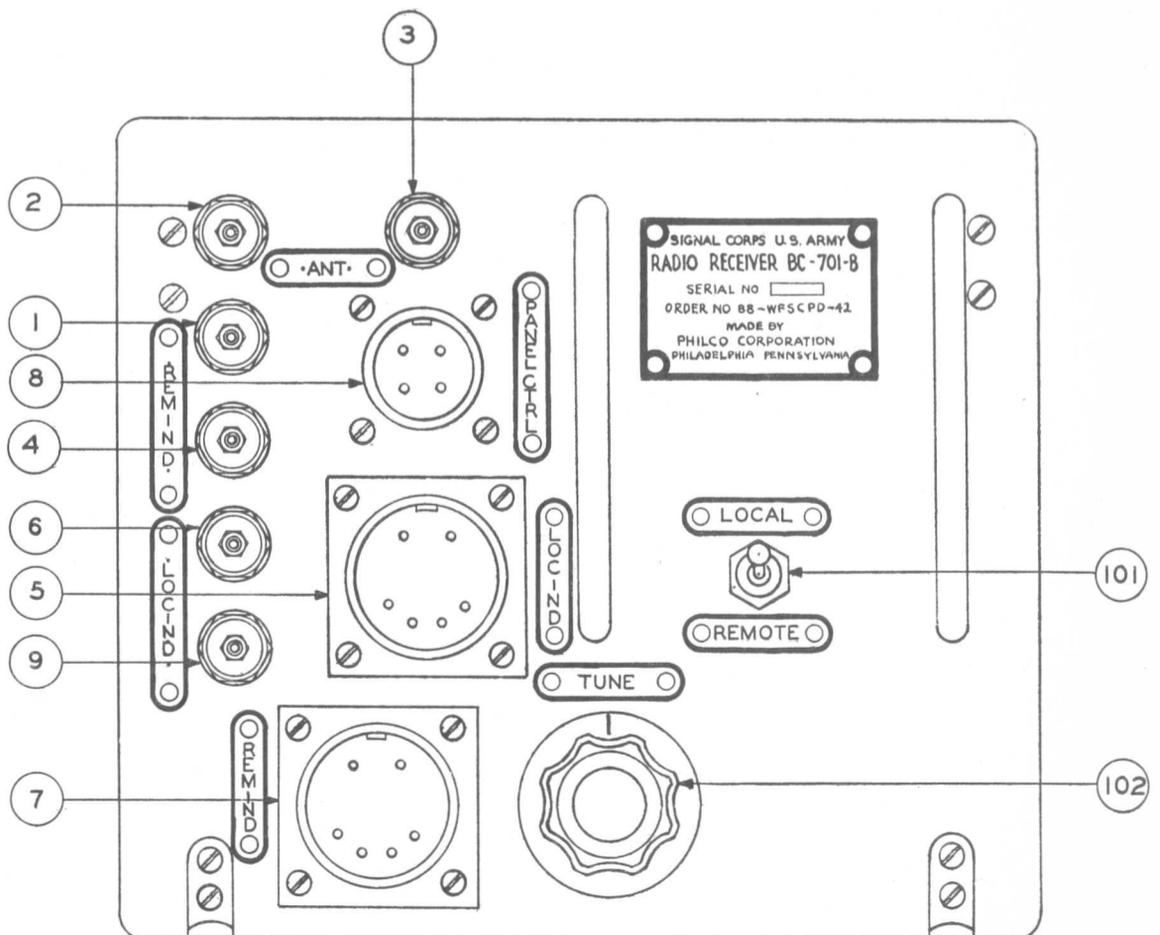


FIGURE 2—RECEIVER BC-701-B, FRONT VIEW

- 10 14 POWER INPUT FROM RECEIVER
- 11 15 INDICATION INPUT FROM RECEIVER (BLACK)
- 12 16 INDICATION INPUT FROM RECEIVER (BLUE)
- 13 17 TRIGGER INPUT FROM TRANSMITTER (ORANGE)
- 70 RECEIVER GAIN CONTROL
- 71 BRILLIANCE CONTROL FOR INDICATOR
- 72 FOCUS CONTROL FOR INDICATOR
- 73 RANGE SWITCH
- 74 SLIDING COVER
- 75 HORIZONTAL SHIFT CONTROL
- 76 VERTICAL SHIFT CONTROL
- 77 SYNCHRONIZATION CONTROL—DO NOT ALTER

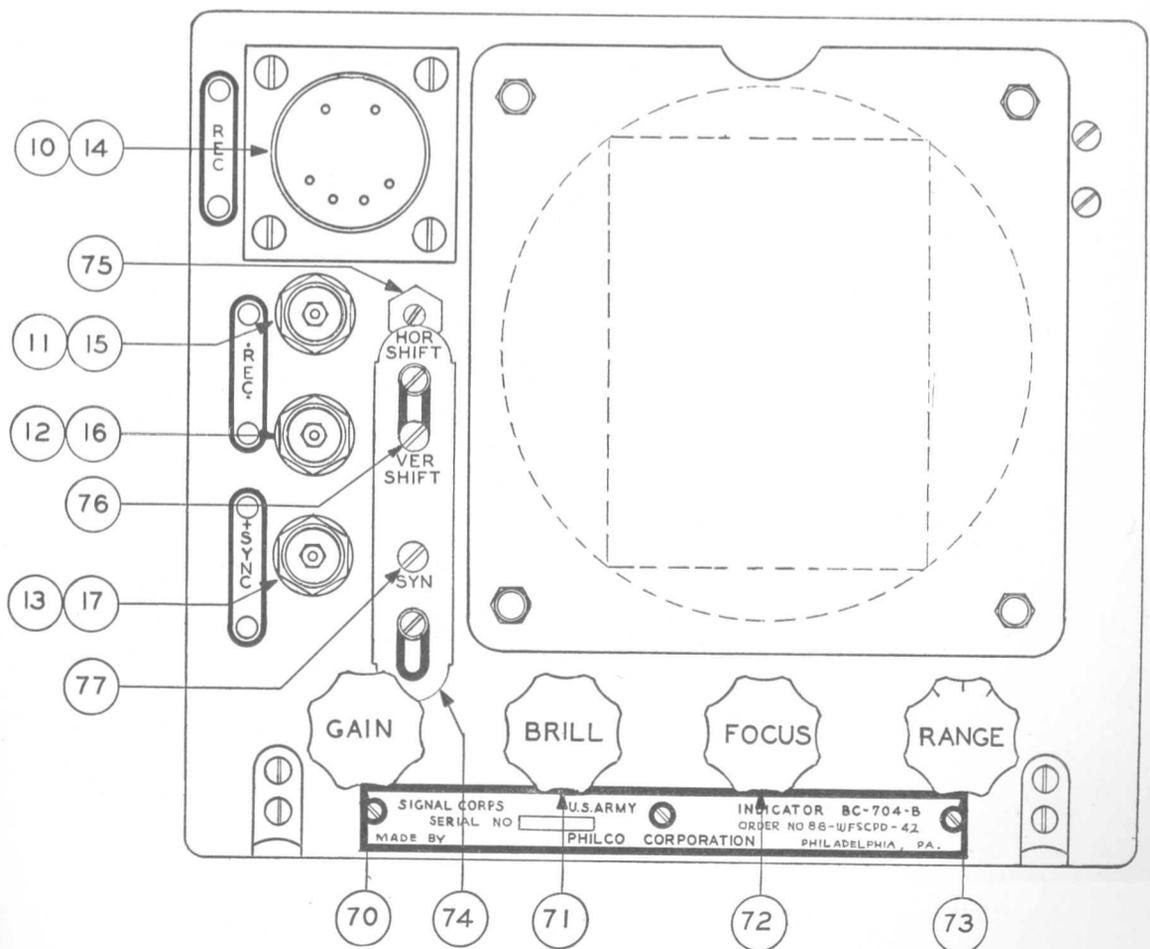


FIGURE 3—INDICATOR BC-704-B, FRONT VIEW

- 18 19 POWER OUTPUT FOR TRANSMITTER AND RECEIVER
- 20 INVERTER STARTING RELAY POWER
- 21 BATTERY INPUT
- 22 INVERTER INPUT
- 30 PILOT LIGHT
- 31 POWER SWITCH
- 32 FUSE BLOCK COVER
- 33 FUSE BLOCK—TOP THREE FUSES OPERATING
- 114 A-C INPUT VOLTAGE CONTROL
- 115 VOLTMETER PIN-JACKS

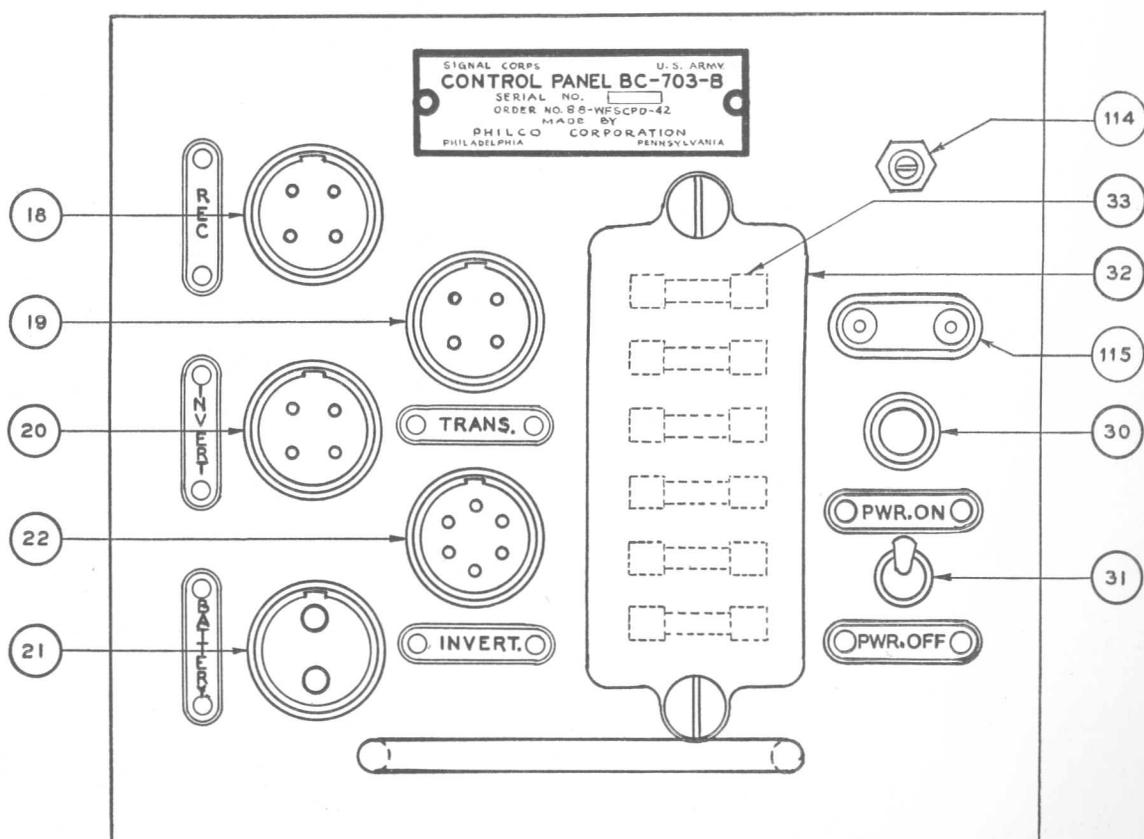


FIGURE 4—CONTROL PANEL BC-703-B, FRONT VIEW

- 109 RELAY INPUT
- 110 REMOVE HOUSING TO REPLACE FUSES
- 111 INVERTER OUTPUT
- 112 MOUNTING FT-107

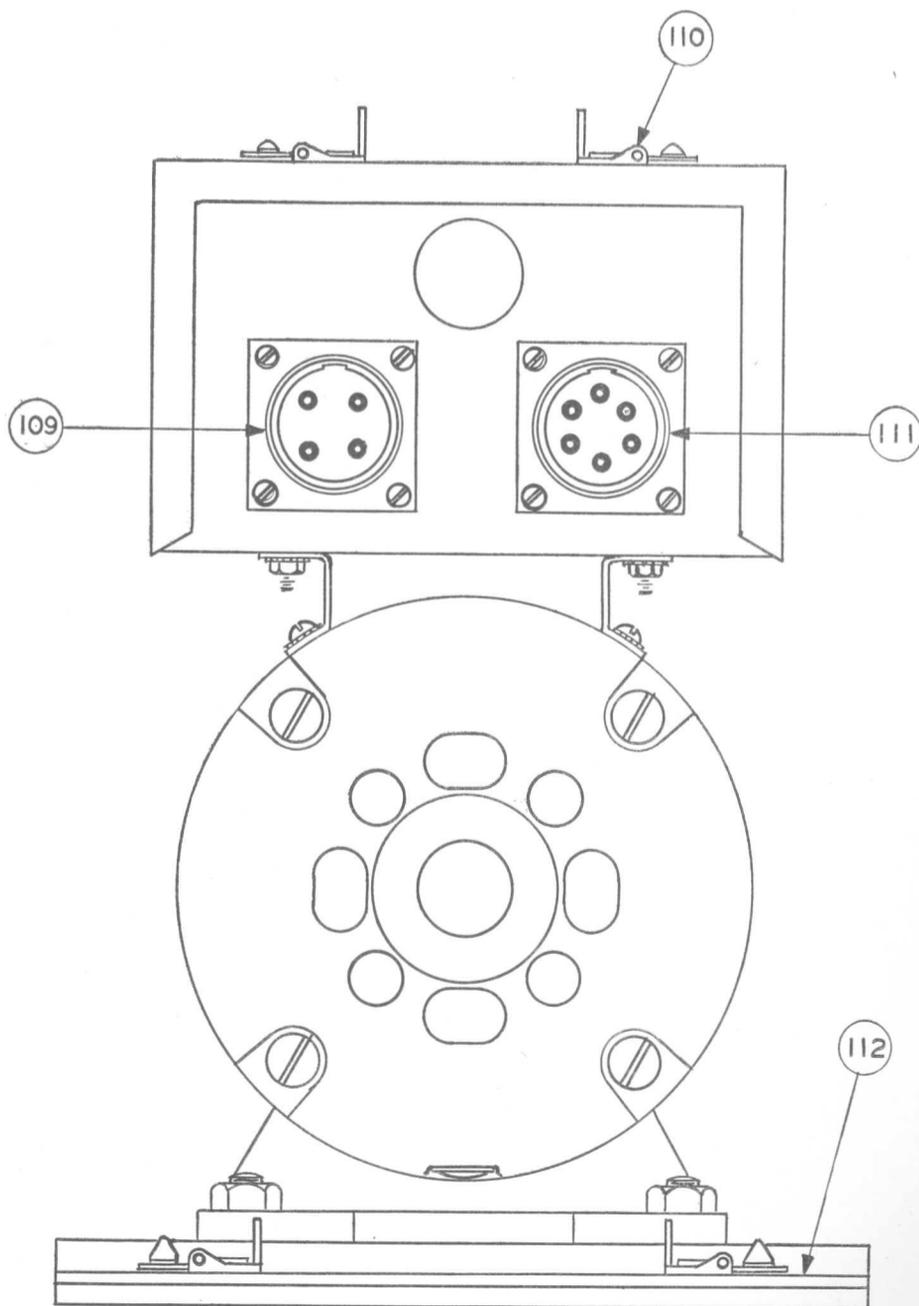


FIGURE 5—INVERTER PE-115-B, END VIEW

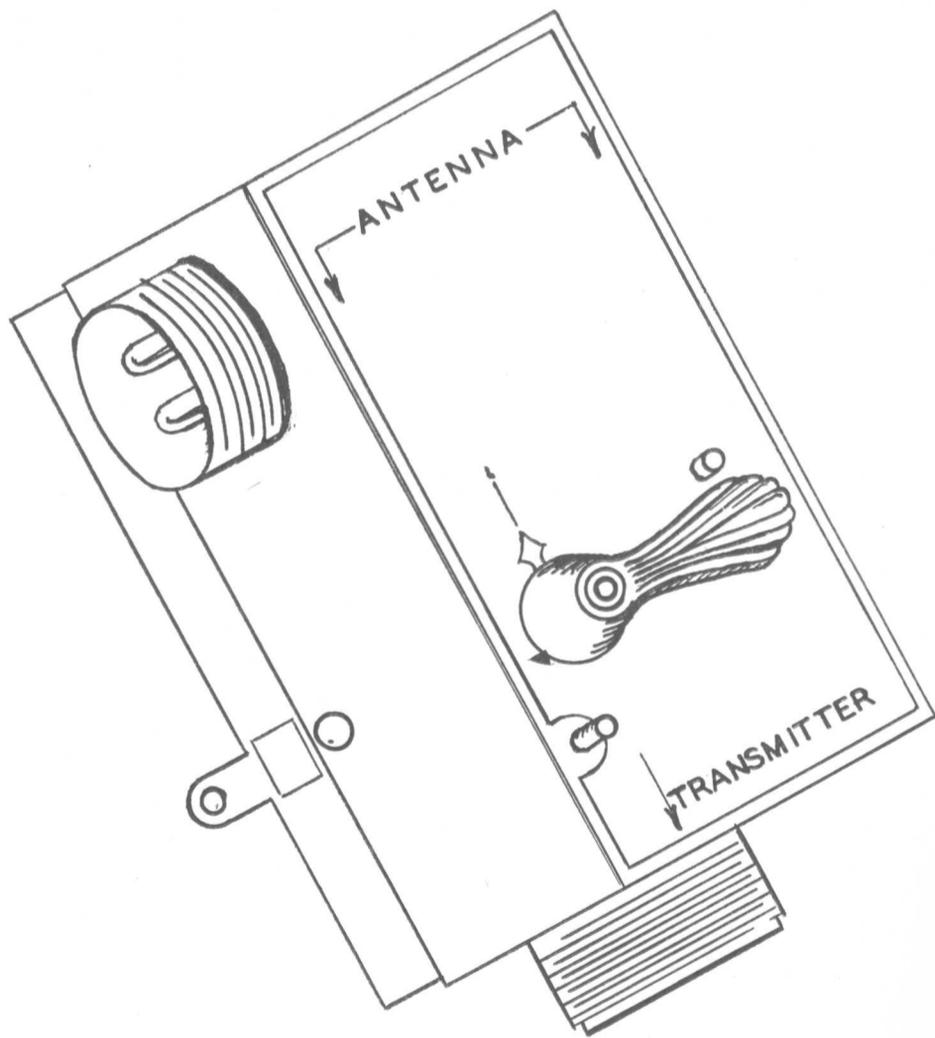


FIGURE 6—TRANSMITTING ANTENNA SELECTOR SWITCH

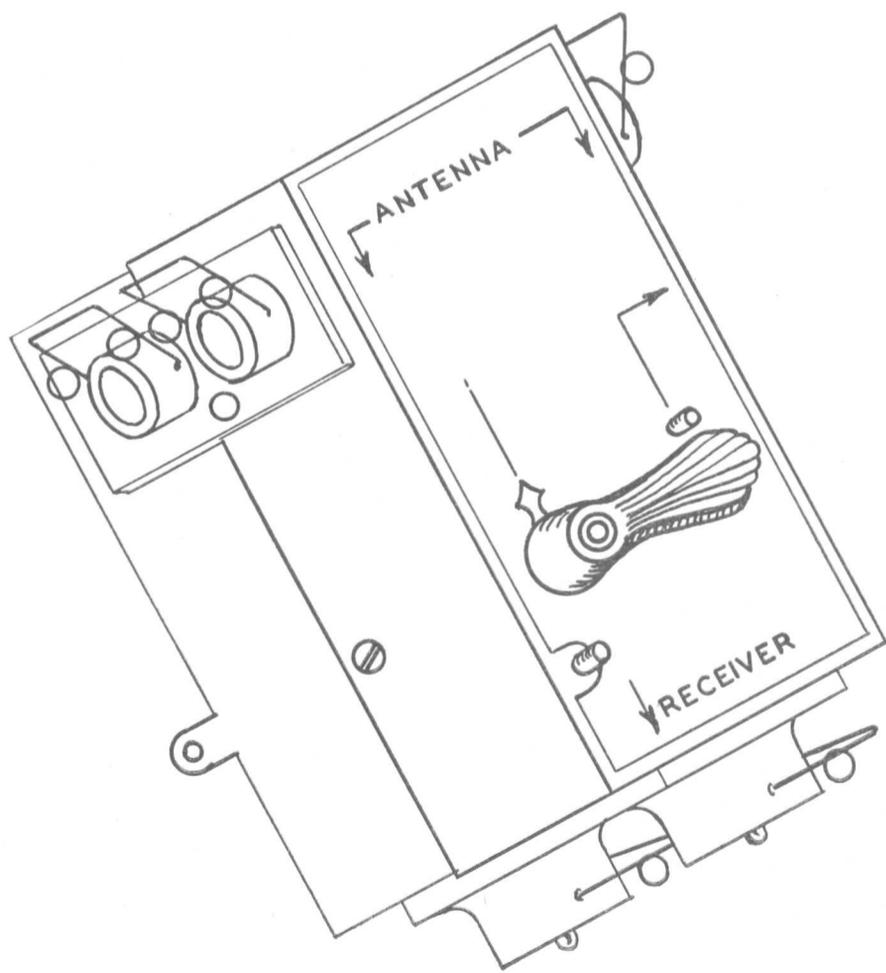


FIGURE 7—RECEIVING ANTENNA SELECTOR SWITCH