



INSTRUCTIONS

for

Test Equipment IE-36



R E S T R I C T E D

(For Official Use Only)

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Approved 10 FEBRUARY 1944



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SAFETY NOTICE

OPERATION OF THIS EQUIPMENT INVOLVES THE USE OF HIGH VOLTAGES WHICH ARE DANGEROUS TO LIFE. OPERATING PERSONNEL MUST AT ALL TIMES OBSERVE ALL SAFETY REGULATIONS. THIS PARTICULARLY APPLIES TO CHANGING TUBES OR MAKING ADJUSTMENTS INSIDE THE EQUIPMENT WITH ANY BUT THE "OFF" POSITION OF CONTROL UNIT BC-1303 IN USE.

A DANGEROUS POTENTIAL EXISTS ON BOTH THE TRANSMITTER AND RECEIVER OF RADIO SETS SCR-522-A AND SCR-542-A WHENEVER THE EQUIPMENT IS IN EITHER THE TRANSMIT OR RECEIVE CONDITION.

NEVER LEAVE THE SHIFTER SLIDES DISENGAGED AFTER TUNING HAS BEEN COMPLETED OR AFTER REPAIRS NECESSITATING REMOVAL OF TRANSMITTER OR RECEIVER FROM RACK HAVE BEEN MADE, AS THIS WILL RESULT IN FAILURE TO TURN ON THE TRANSMITTER AND RECEIVER IF ONE PARTICULAR CHANNEL PUSH-BUTTON IS PRESSED ON. CONTROL UNIT BC-1303.

NO DANGEROUS ELECTRICAL POTENTIALS APPEAR AT ANY POINT OF TEST EQUIPMENT IE-36.

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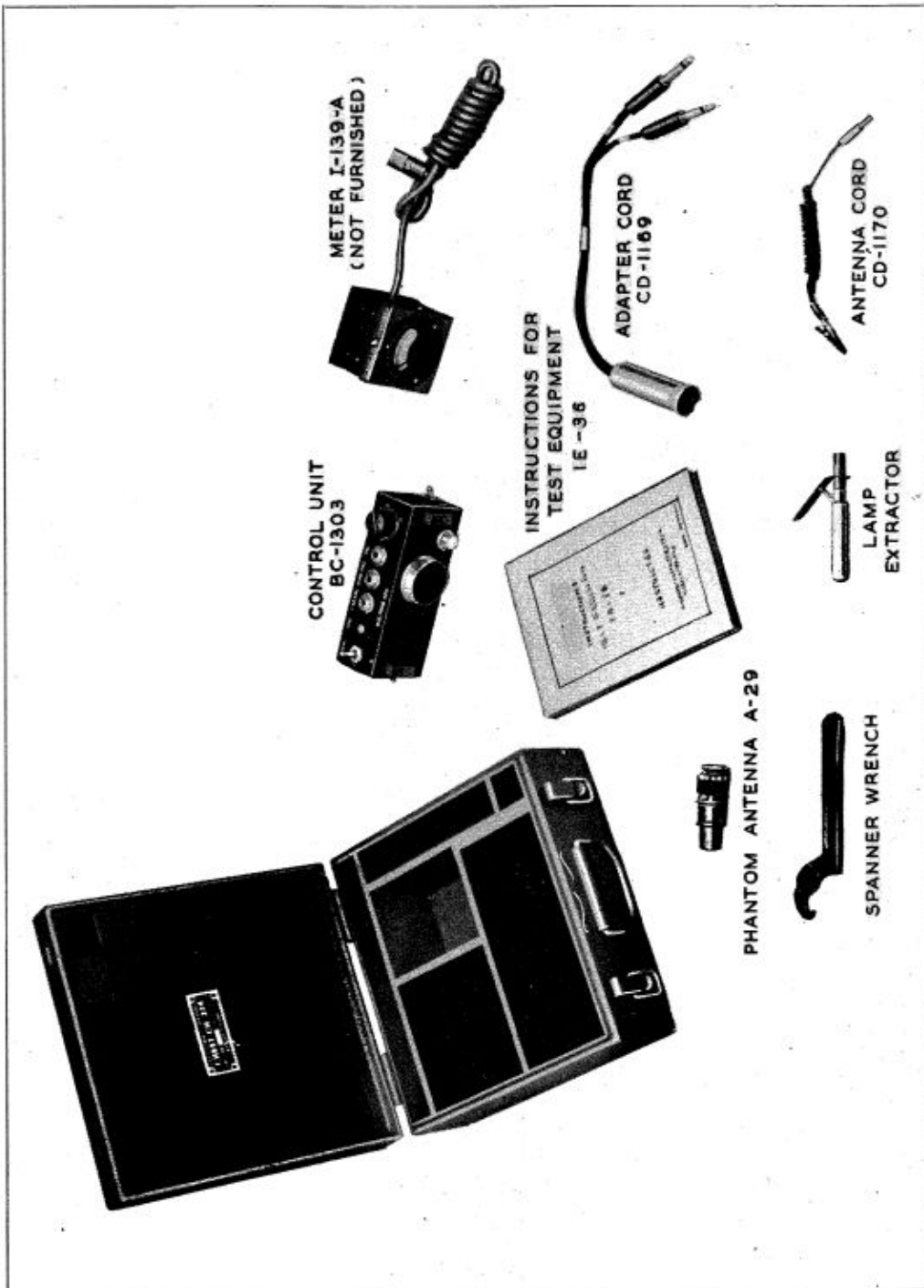


Figure 1—Test Equipment IE-36, Composite View

INSTRUCTIONS

for

Test Equipment IE-36



SECTION I GENERAL DESCRIPTION

1. PURPOSE OF HANDBOOK.

This Handbook has been prepared to describe Test Equipment IE-36 and to give instructions in the use and maintenance of this equipment.

2. PURPOSE OF EQUIPMENT.

Test Equipment IE-36 is used to make field tests of Radio Sets SCR-522-A and SCR-542-A.

Test Equipment IE-36 reproduces the operating functions of the control boxes and jack boxes of these radio sets by providing headphone and microphone connections, thereby eliminating the control boxes and jack boxes as necessary in making troubleshooting tests and permitting such tests to be made at the point-of-installation of Radio Sets SCR-522-A and SCR-542-A.

3. EQUIPMENT SUPPLIED.

Principal components supplied with Test Equipment IE-36 are as follows:

<i>Quantity</i>	<i>Name of Unit</i>	<i>Overall Dimensions</i>	<i>Weight Lbs</i>	<i>Numerical Series of Reference Numbers</i>
1	Chest CH-234	10" x 9 ⁷ / ₈ " x 4"	4.5	100-114
1	Control Unit BC-1303	3 ¹ / ₄ " deep x 7 ¹ / ₄ " long x 2 ⁷ / ₁₆ " high	1.6	
1	Phantom Antenna A-29 (Phantom)	1 ¹ / ₄ " dia. x 2 ¹¹ / ₁₆ " long	.1	
1	Cord CD-1169 (Adapter)	15 ³ / ₄ " long	.2	
1	Cord CD-1170 (Antenna)	3' 2 ³ / ₄ " long	.25	
1	Wrench, Spanner Type 471			
1	Lamp Extractor			
1	"Instructions for Test Equipment IE-36"			

4. EQUIPMENT REQUIRED BUT NOT SUPPLIED.

<i>Quantity</i>	<i>Name of Unit</i>	<i>Overall Dimensions</i>	<i>Weight Lbs</i>	<i>Numerical Series of Reference Numbers</i>
1	Test Set I-139-A	4" x 4" x 3 ¹ / ₂ "	1.1	300-400
1	Microphone T-17 (Carbon)			
1	Microphone T-44 (Magnetic)			
1	Head set			
1	Bristol No. 6 Set Screw Wrench			

The above equipment is available as part of Test Set IE-19-A and Radio Sets SCR-522-A, or may be issued separately.

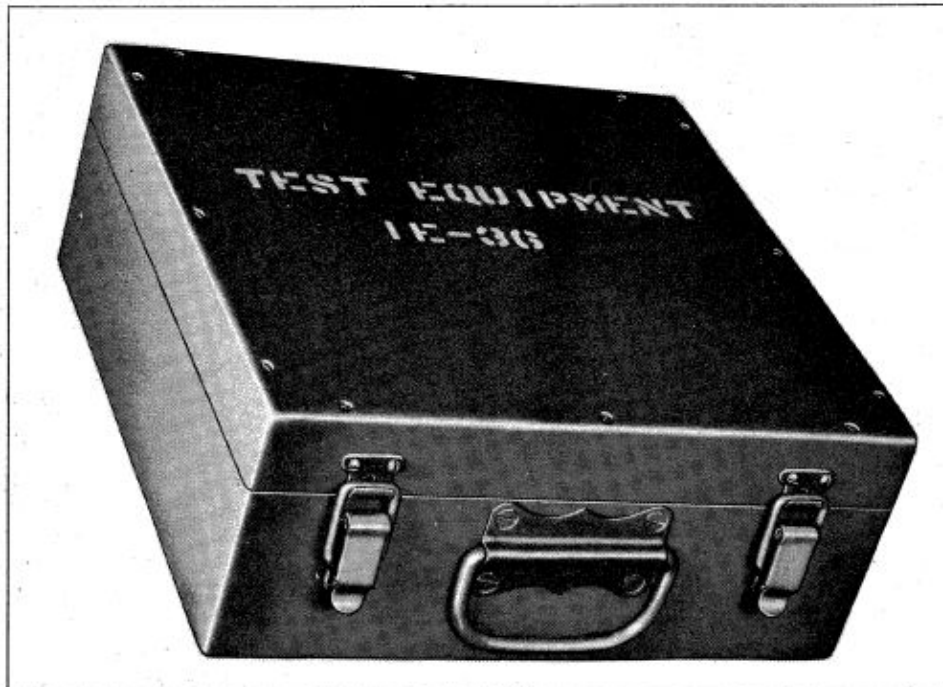


Figure 2—Chest CH-234, Open and Closed Views

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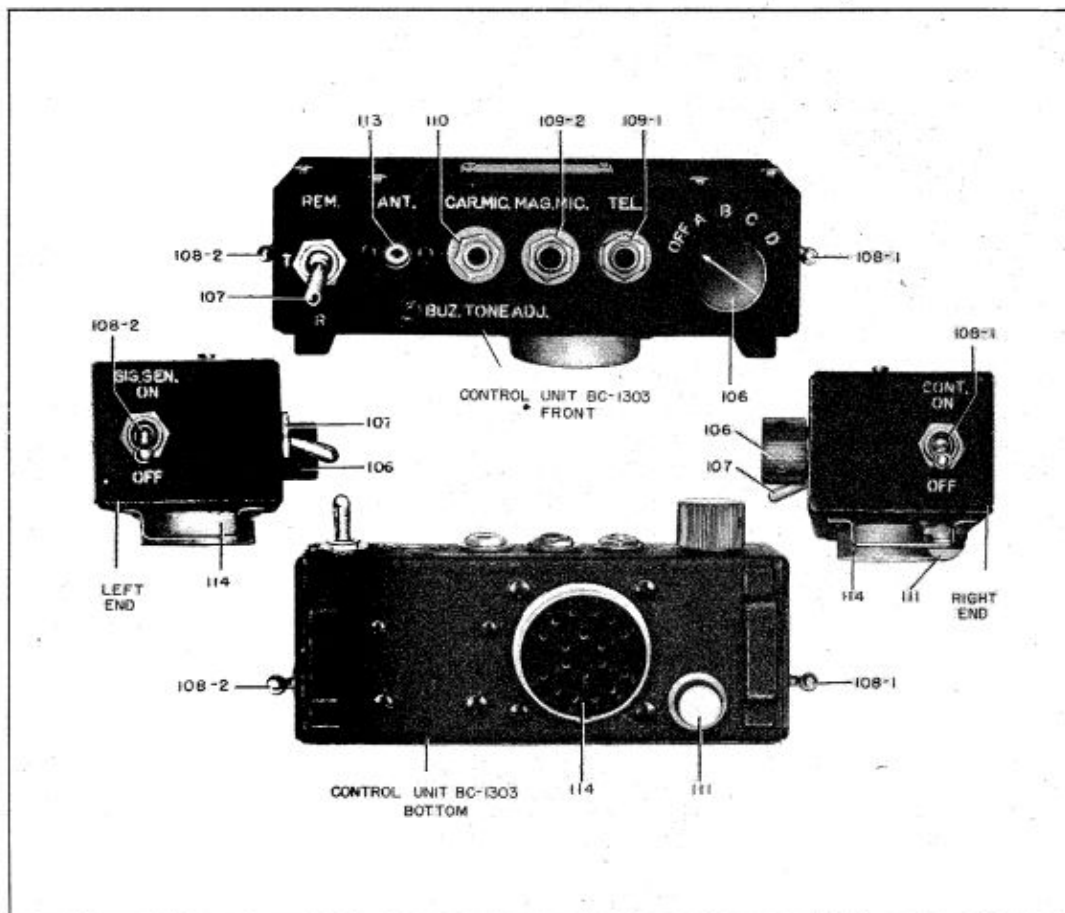


Figure 3—Control Unit BC-1303, Front, Bottom and End Views

5. DESCRIPTION OF MAJOR UNITS.

a. CHEST CH-234.—All components of Test Equipment IE-36 are contained in Chest CH-234. This chest is made of wood and is divided into suitable compartments for transportation of the components. The hinged cover of the chest is fastened by two hasp type catches, between which is the handle for carrying the chest. (See figures 1 and 2.)

b. CONTROL UNIT BC-1303.—This control unit is packed in the front compartment of Chest CH-234. It is a metal case with black wrinkle finish, with operating controls on its front, bottom and two ends. The top and rear comprise the cover which is removable. On the bottom is the 18-contact plug and a pilot light. On the front, from left to right, are a "T-R-REM" toggle switch; an "ANT" pin jack; a "CAR MIC" jack; a "MAG MIC" jack; a "TEL" jack; a combined "OFF ABCD" band selector knob switch and a hole marked "BUZ TONE ADJ" through which adjustment is made. On the right hand end is a "CONT ON-OFF" toggle switch and on the left hand end is a "SIG GEN ON-OFF" toggle switch. (See figures 1, 3, and 4.)

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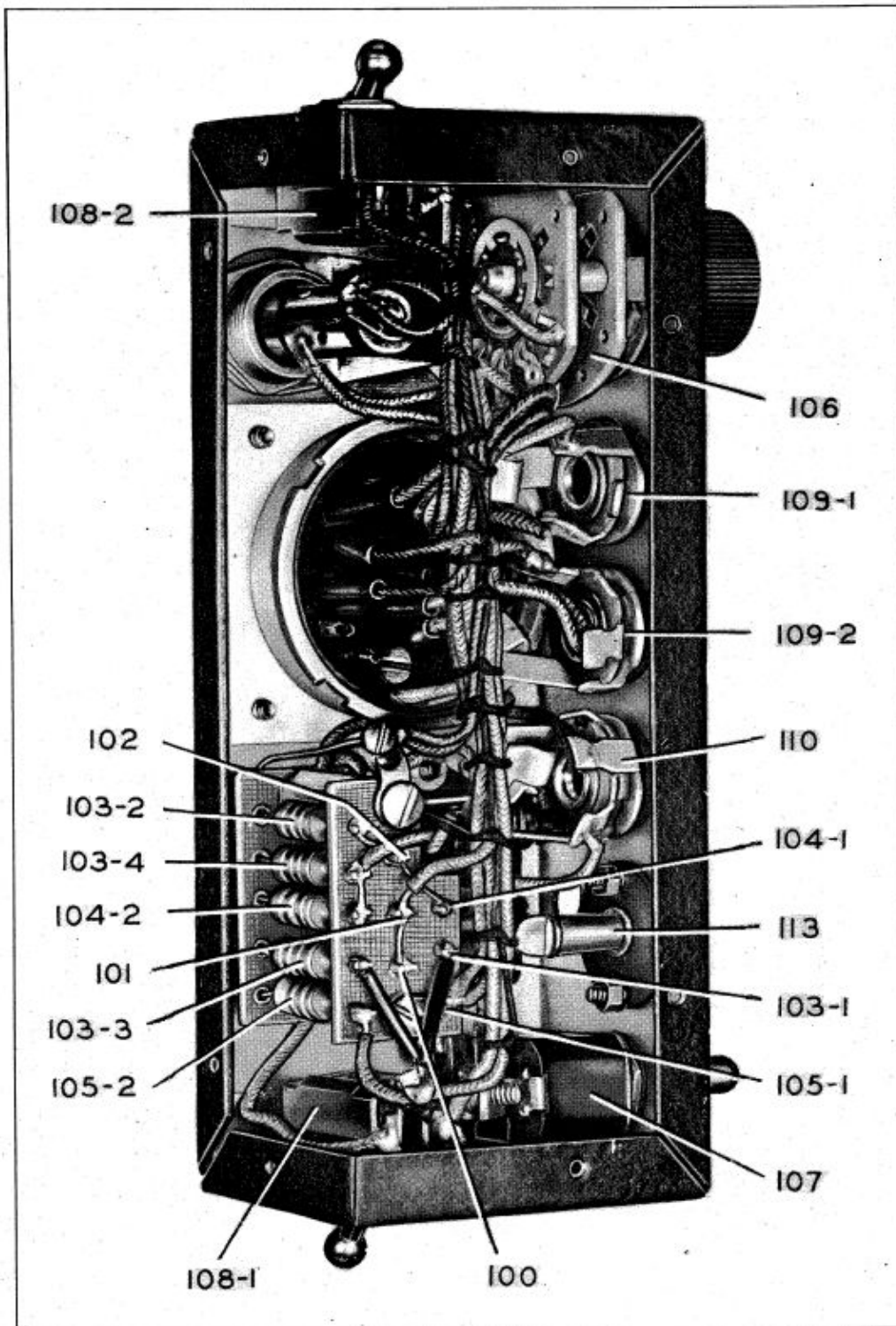


Figure 4—Control Unit BC-1303, Cover Removed

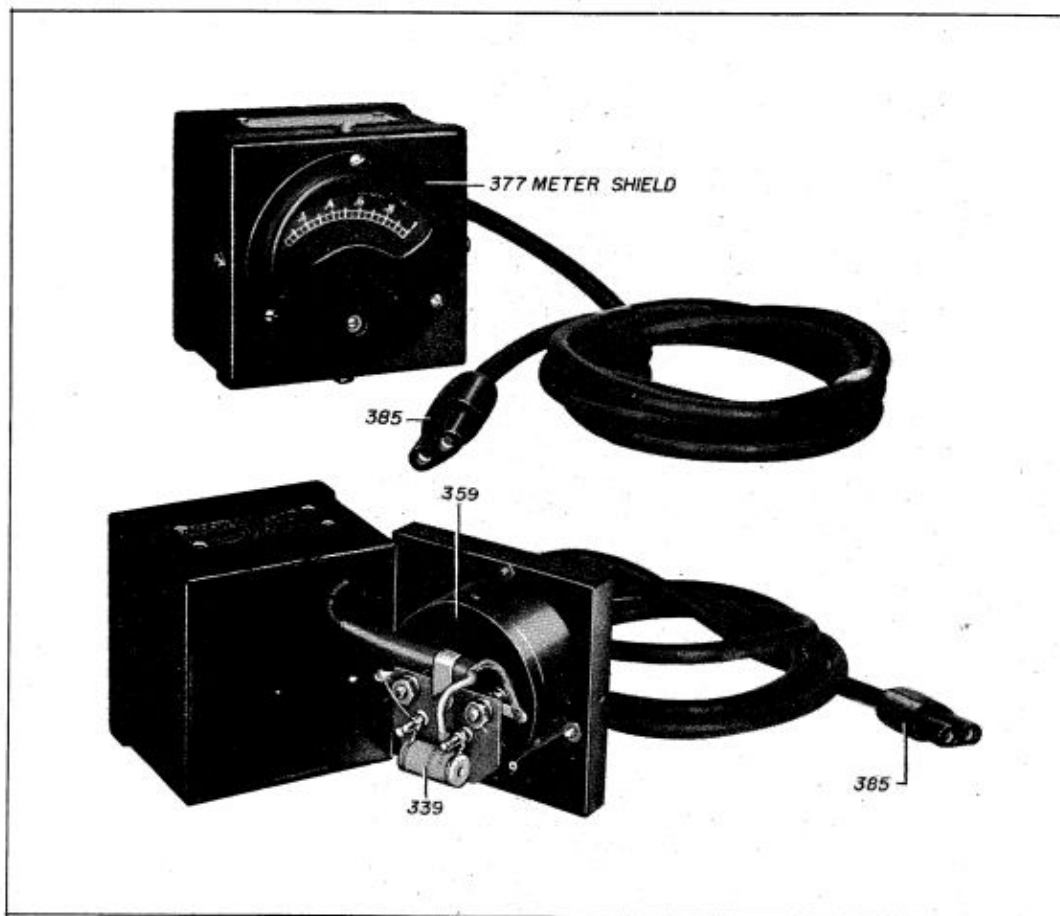


Figure 5—Test Set I-139-A, Closed and Open Views

c. TEST SET I-139-A.—This test set is the 0-1 ma d-c meter as used in Test Equipment IE-19-A and may be separately issued for addition to Test Equipment IE-36. It is to be carried in the compartment of Chest CH-234 immediately in back of Control Unit BC-1303. (See figures 1 and 5.)

d. PHANTOM ANTENNA A-29.—This phantom antenna is packed in the small square compartment in the right-front of Chest CH-234. On one end is a brass plug to fit into Socket SO-153 of Rack FT-244-A. (See figure 10.) Mounted above the base are the 12 resistors comprising the phantom antenna, arranged in a circular mounting. At the top is a pilot lamp, the base of which is within the resistor mounting. (See figure 6.)

NOTE

To fit into recess of Chest CH-234, the pilot lamp should be in the downward position.

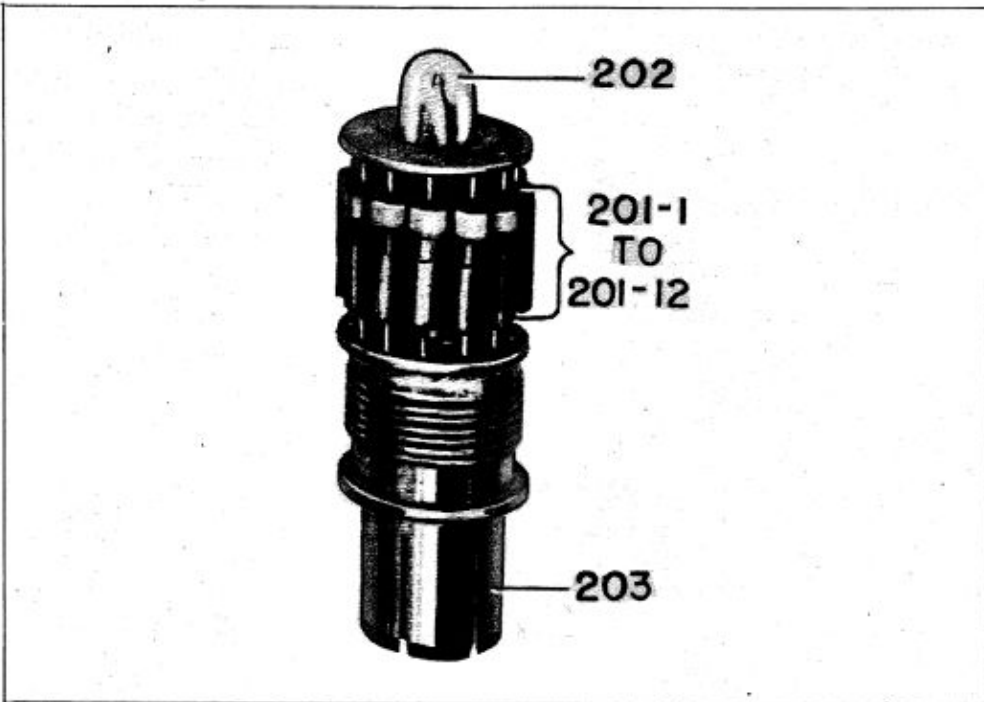


Figure 6—Phantom Antenna A-29

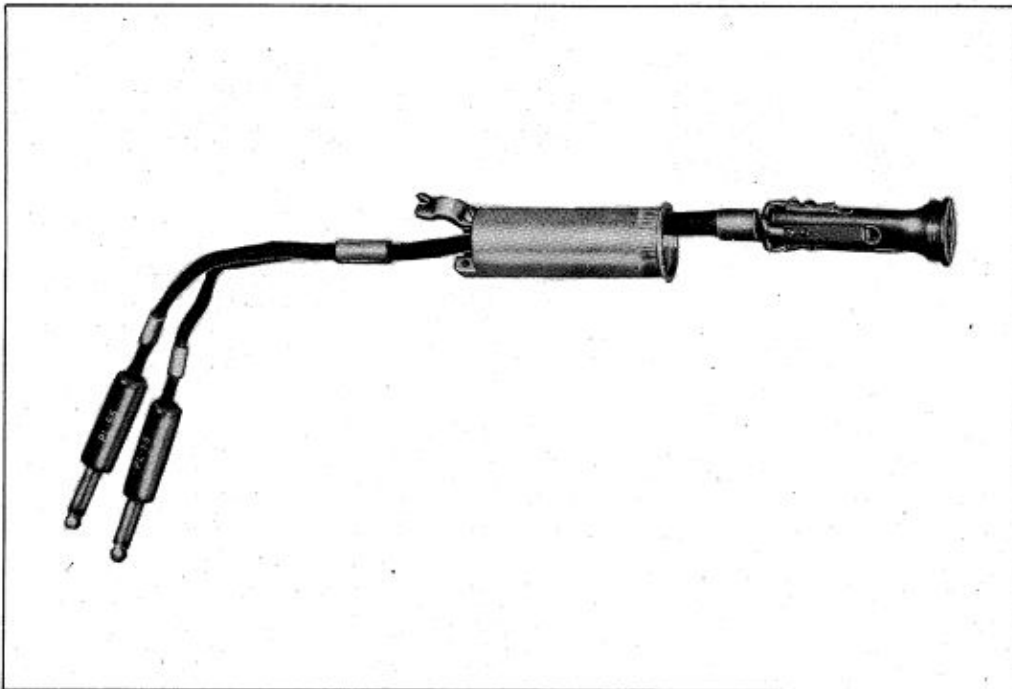


Figure 7—Cord CD-1169

e. CORD CD-1169.—This adapter cord is made up of four wires connecting a Jack JK-49 and 2 Plugs PL-55, with one end of the four wires connected to the jack and the other ends divided, 2 each to a Plug PL-55. Each pair is marked with phenolic marker, one being marked "TEL" and the other marked "MIC." (See figure 7.)

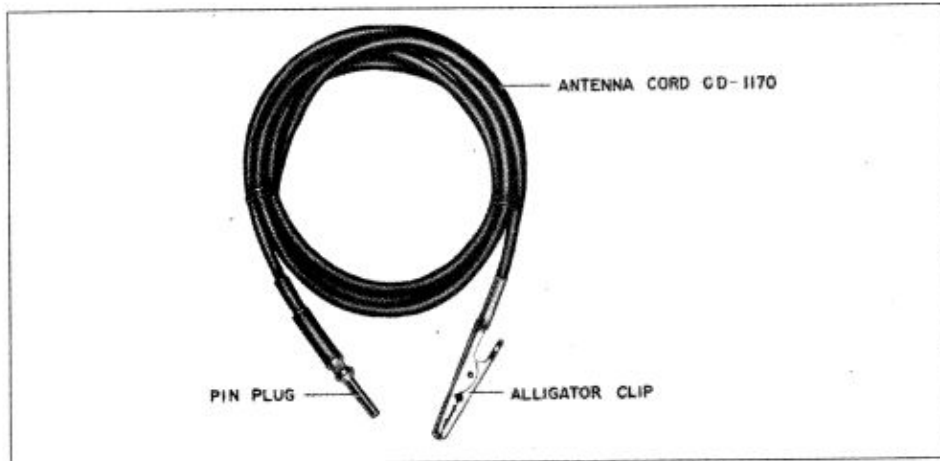


Figure 8—Cord CD-1170

f. CORD CD-1170.—This cord is 3 feet, $2\frac{3}{4}$ inches long and approximately $\frac{1}{8}$ inch in diameter. On one end is an alligator clip and on the opposite end a pin probe for plugging into the "ANT" pin jack on the front panel of Control Unit BC-1303. This cord, with the adapter cord, is packed in the compartment beside and to the right of Test Set I-139-A in Chest CH-234. (See figure 8.)

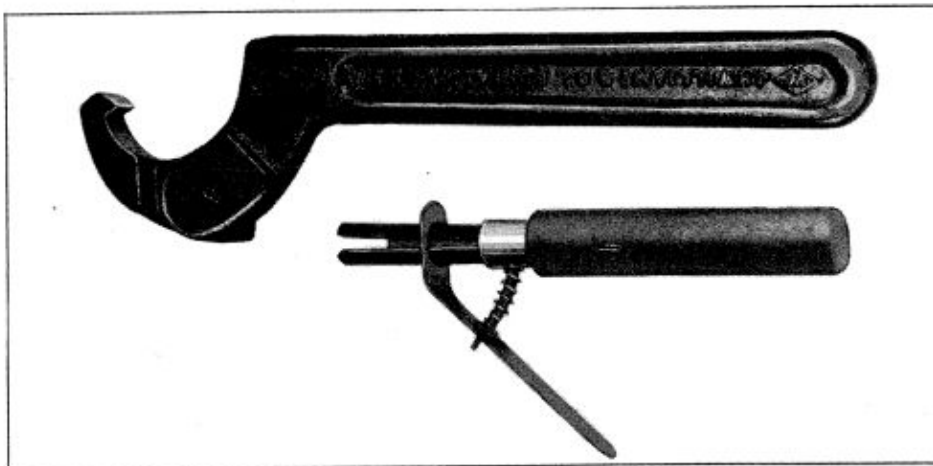


Figure 9—Spanner Wrench and Lamp Extractor

g. SPANNER WRENCH AND LAMP EXTRACTOR.—The spanner wrench is a Type 471, Adjustable. It is continuously adjustable to adequately fit the various plugs found in Radio Sets SCR-522-A and SCR-542-A. The lamp extractor is the same as is used in Test Equipment IE-12-A and is for removal of lamps in Radio Control Box BC-602-A or BC-602-B.

SECTION II

INSTALLATION AND ADJUSTMENT

1. INSTALLATION.

Set up Test Equipment IE-36 as follows:

a. Plug Control Unit BC-1303 into Rack FT-244-A of Radio Set SCR-522-A or SCR-542-A by inserting the 18-contact plug on the bottom of the control unit into socket 417 of the rack. (See figure 10.) Push it firmly down.

b. Plug Phantom Antenna A-29 into socket (416) of Rack FT-244-A.

c. Plug Cord CD-1170, when used, into Control Unit BC-1303 by inserting the pin probe of the cord into the "ANT" pin jack of the control unit. Clip the alligator clip end of the cord to the center pin of Socket SO-153 when the phantom antenna is not in use.

d. Cord CD-1169 is for interconnection of headphones and magnetic microphone with Control Unit BC-1303. Jack JK-49 on this cord is for connection with a magnetic microphone and telephone plug. Plugs PL-55 are for plugging into "MAG MIC" and "TEL" jacks of the control unit.

e. If a carbon microphone is used, connect it directly to the "CAR MIC" jack on the control unit.

f. Test Set I-139-A is kept in Chest CH-234. To make tests insert its leads into meter socket 288 of Radio Receiver BC-624-A or meter socket 171 of Radio Transmitter BC-625-A. (See figure 10.)

2. ADJUSTMENT.

a. There are no adjustments required for pre-use of Test Equipment IE-36.

b. The following precautions should be observed before use of Test Equipment IE-36.

(1) Make sure that the toggle switches on both ends of Control Unit BC-1303, that is, the "SIG GEN ON-OFF" switch and the "CONT ON-OFF" switch are in the "OFF" position at all times when these switches are not in use.

(2) Exercise care in handling Phantom Antenna A-29 as its resistor assembly and pilot lamp will easily break if dropped.

SECTION III

OPERATION

1. OVERALL FUNCTIONS.

Test Equipment IE-36 provides point-of-installation trouble shooting tests of Radio Sets SCR-522-A and SCR-542-A. The usual jack boxes and control boxes are eliminated, connection for headphones and microphone to the various circuits in the radio transmitter and radio receiver being made by Control Unit BC-1303 of Test Equipment IE-36.

2. CAPABILITIES AND LIMITATIONS.

a. CAPABILITIES.—Test Equipment IE-36 provides a means for making the following tests:

(1) A test of the starting and stopping mechanisms of Radio Transmitter BC-625-A (see paragraph 3., *a.*) and Radio Receiver BC-624-A (see paragraph 3., *c.*).

(2) A test of the functioning of the channel selection circuits in the transmitter and receiver. (See paragraph 3., *a.*, (5).)

(3) A test of the Receiver-Transmit-Remote switching functions. (See paragraph 3., *a.*, (10).)

(4) A test of contactor operation in the transmitter. (See paragraph 3., *a.*, (9).)

(5) A test of relative signal to microphone and resultant input modulation in the transmitter. (See paragraph 3., *a.*, (8).)

(6) A test of relative sensitivity of Radio Receiver BC-624-A. Test Equipment IE-36 may also be used for channel tuning in Radio Receiver BC-624-A and Radio Transmitter BC-625-A, however use of test equipment IE-19-A is preferable for this purpose.

b. LIMITATIONS.

(1) Test Equipment IE-36 will not give an indication of field strength produced by the transmitter.

(2) It will give only relative power output as indicated by the brightness of the lamp of Phantom Antenna A-29.

(3) It will give only a relative index of modulation not the actual percentage. Again the phantom antenna lamp shows the modulation as the lamp varies in brilliance.

3. TESTING RADIO SETS SCR-522-A AND SCR-542-A.**a. TESTING TRANSMITTER BC-625-A.**

(1) The following components of Test Equipment IE-36 are required for transmitter testing: Control Unit BC-1303, Phantom Antenna A-29, and Cord CD-1169. A microphone of either carbon or dynamic type and Test Set I-139-A are also necessary.

(2) Remove the transmitter and receiver covers by loosening the Dzus fasteners pinning them to the center cover. Raise the covers slightly and slide them away from the tuning controls.

(3) Remove cable connection from socket 417 of the rack and insert the 18-contact plug 114 on the bottom of Control Unit BC-1303 into this socket.

CAUTION

Be sure the "SIG GEN" toggle switch and the "CONT" toggle switch on each end of the control unit are off, and also see that the band selector switch "OFF ABCD" on the front panel of the control unit is in the "OFF" position.

(4) Plug Phantom Antenna A-29 into Socket SO-153 (416) of the rack, for test purposes. For transmitter channel tuning use the airplane antenna of Radio Set SCR-522-A or SCR-542-A.

(5) Turn the band selector switch "OFF ABCD" to "A." The dynamotor unit will start, and the frequency-shifter mechanism of the transmitter will operate, shifting the equipment to channel A. Try channels B, C, and D, and observe action of the shifter mechanism.

(6) After allowing about one minute for the tubes to warm up, throw the "T-R-REM" switch on the control unit to the "T" position. Note the pilot lamp on Phantom Antenna A-29. This will light on all channels, if the channels are tuned. If on one or more channels the lamp is dim or does not light, tuning is required. (See paragraph 3., *b.*)

(7) Insert microphone plug in "CAR" or "MAG MIC" jack, depending upon the type of microphone being used. If combination, helmet head set and throat microphone is used, this connection is made through the Cord CD-1169. Jack JK-49 receives the plug from the head set and microphone, and Plug PL-55 (attached to cord marked "MIC") is inserted in the "MAG MIC" jack.

NOTE

Using Cord CD-1169 or a direct connection to Control Unit BC-1303, any combination of microphones and telephone found in the plane may be tested.

(8) Whistle a sustained note into the microphone and note action of the pilot lamp on Phantom Antenna A-29. If the carrier wave is being modulated there will be an increase in the brilliance of the lamp.

(9) To test contactor operation, throw the "CONT" toggle switch located on the right hand end of Control Unit BC-1303, to the "ON" position. The frequency shifter mechanism will shift the equipment to channel D, and the pilot lamp on the dummy antenna will light and show that transmission is occurring.

NOTE

Under these conditions a tone will be heard in the earphones. When the "CONT" switch is returned to the "OFF" position the equipment will shift back to the position at which it was operating before the switch was turned on and the tone in the head set will disappear.

(10) Test contactor operation with "T-R-REM" switch in each position, using different channels each time. In every case when "CONT" switch is turned off, the mechanism will return to its original position. To be certain that tone modulated (MCW) transmission is taking place, first observe the pilot lamp on the Phantom Antenna A-29 with band selector switch on "D" position, "T-R-REM" switch on "T" position, and "CONT" switch at "OFF." Now throw "CONT" switch to "ON." An increase in brilliance of pilot lamp in phantom antenna shows that the carrier wave is being modulated, and that the contactor signal will be transmitted.

(11) To stop the transmitter turn "OFF ABCD" switch to "OFF" position.

b. TRANSMITTER CHANNEL TUNING.

(1) Test Equipment IE-36, Test Set I-139-A, and microphone, either carbon (Microphone T-17) or magnetic (Microphone T-44), are needed for transmitter tuning.

(2) When being tuned, Radio Transmitter BC-625-A must be inside Case CS-80-A with Radio Receiver BC-624-A connected.

NOTE

If the transmitter is tuned while removed from the case, the additional capacitances introduced by replacing the transmitter in the case will tend to upset the tuning adjustments.

(3) If the receiver and transmitter covers are closed, loosen the Dzus fasteners pinning them to the center cover. Raise the covers slightly and slide them away from the tuning controls as shown in figure 10.

(4) The crystal chosen for any transmitter channel should have a rated fundamental frequency one-eighteenth of the desired final output frequency (fundamental frequencies appear on the crystal holders).

(5) Remove Phantom Antenna A-29 and plug in airplane antenna at antenna coupling 416. Install crystals in sockets.

(6) Connect Control Unit BC-1303 into Rack FT-244-A by inserting the 18-contact plug on the bottom of the control unit into socket 417 of the rack. Connect Test Set I-139-A to test socket 171 of transmitter.

(7) To tune Channel A:

(a) Turn Control Unit "OFF ABCD" switch to "D."

(b) Press channel release pushbutton (426). (See figure 10.)

(c) Loosen transmitter tuning control lock nuts 1, 2, 3, 4, until they exert a light pressure on the cam.

(d) Turn "OFF ABCD" switch on control unit to "A."

(e) Loosen tuning control lock nuts completely.

(f) Turn transmitter "METER SWITCH" 165 to position "3" and check Test Set I-139-A for current reading of from .4 to .75 milliamperes.

(g) Throw "T-R-REM" switch on control unit to "T" position.

(h) Avoid tuning to an undesired harmonic by making certain that all four tuning controls, 1, 2, 3, and 4, when adjusted, indicate approximately the desired output frequency on the calibration plate. Check crystals (172).

(i) Turn transmitter "METER SWITCH" 165 to position "1." Adjust transmitter tuning control 1 for a maximum reading on Test Set I-139-A by tuning black plate under lock nut either to the left or right.

(j) Throw transmitter "METER SWITCH" 165 to position "2" and adjust tuning control 2 for maximum meter reading.

(k) Throw transmitter "METER SWITCH" 165 to position "3" and adjust tuning control 3 for maximum meter reading.

(l) Leave transmitter "METER SWITCH" 165 on position "3" and adjust tuning control 4 for a "MINIMUM" meter reading.

NOTE

Having tuned the airplane antenna to the transmitter, by means of the transmitter tuning control 4 (see figure 10) and using "METER SWITCH" 165 position "3," do NOT retune to the Phantom Antenna A-29 because the capacitance and reactance differ.

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(*m*) If the meter readings in steps (*j*) and (*k*) are more than .75, slide the antenna coupling control (see figure 10) to the right to decouple and reduce the reading. Retune controls 1, 2, 3, and 4 again.

(8) ADJUSTMENT OF REMAINING CHANNELS.—To tune channel B, turn "OFF ABCD" switch on Control Unit BC-1303 to "B" and follow the same tuning procedure outlined for channel A in paragraphs 3., *b.*, (7). However, do not change the antenna coupling adjustment unless the meter reading is more than .75. Tune channels C and D in like manner.

(9) Press channel release control button (426) and tighten lock nuts on tuning adjustments 1, 2, 3, and 4.

(10) METER CHECK.

(*a*) With the tuning control lock nuts tightened and the transmitter "METER SWITCH" 165 in position "5," the meter reading for all channels should normally be full-scale 0-1 or more. Any reading greater than half-scale (.5 or more) is satisfactory. If this condition is not achieved for any channel, readjust the third tuning control 3 for a maximum meter reading ("METER SWITCH" 165 position "5"), retuning that particular channel in accordance with the procedure in paragraph 3., *b.*, (7).

(*b*) Now, with the tuning control lock nuts tightened, there is a positioning detent which makes it possible to turn the tuning controls slightly, in either direction, against spring pressure. In some cases a large amount of torque is necessary to rotate the controls. Tuning controls 1, 2, and 3 can be checked by rotating them in both directions against the positioning detent, and by noting that maximum meter reading occurs in the resting position of the control. If the meter reading is not a maximum in the resting position, retune that particular control in accordance with paragraph 3., *b.*, (11) below.

(*c*) FINAL MODULATION CHECK (do not retune during this check).

1. Install Phantom Antenna A-29 in antenna coupling 416.
2. Plug in microphone. See paragraph 3., *a.*, (7).
3. Whistle a sustained note into the microphone and note action of pilot lamp on Phantom Antenna A-29. If carrier wave is being modulated properly, there will be an increase in brilliance in the lamp 202.
4. Replace airplane antenna AN-104 in antenna coupling 416.

NOTE

Never shut off Radio Set SCR-522-A or SCR-542-A with the shifter slides disengaged, as this will result in failure to turn on the transmitter and receiver if one particular channel pushbutton is pressed on radio control box BC-602-A.

(11) PROCEDURE FOR TUNING ONE CHANNEL ONLY.—If it is known that one channel is out of adjustment, it may be tuned without disturbing other channels. Refer to paragraph 3., *b.*, (7). The following is a brief summary of procedure.

(*a*) Turn "OFF ABCD" switch to the channel preceding the desired channel in the sequence "A," "B," "C," "D," etc.

(*b*) Press the channel-release pushbutton 426 (on the rack).

(*c*) Loosen all transmitter tuning-control lock nuts.

(*d*) Turn the "OFF ABCD" switch to the desired channel.

(*e*) Tune the desired channel (see paragraph 3., *b.*, (7)).

(*f*) Press the channel-release pushbutton 426.

(*g*) Tighten all transmitter tuning-control lock nuts 1, 2, 3, 4.

(*h*) Press the channel-release pushbutton 426.

(*i*) If necessary, adjust the antenna-coupling control 411-2. (See figure 10 and note 3., *b.*, (7).) Check the meter reading on the lowest frequency channel. If this reading is approximately 0.63 no adjustment of the antenna coupling is necessary. If it is less than 0.60 or more than 0.75, readjust the coupling on this channel in accordance with the instructions in paragraph 3., *b.*, (7).

(12) ADJUSTMENT OF TRANSMITTER "GAIN" CONTROL.—With any channel switched on, all channels tuned, and the airplane engines running, adjust the "GAIN" control 125 for normal voice level under conditions of normal operation. A setting of one-half turn clockwise from the extreme counterclockwise position is usually satisfactory.

NOTE

In all cases, point of proper adjustment of gain control 125 is that which gives maximum of volume without excessive distortion in a second receiver. This adjustment, once made, is good for all channels. In late models of the transmitter this gain control has been locked with glyptal at the point of proper operation with magnetic microphones.

(13) SIGNIFICANCE OF METER READINGS.

(*a*) In general, a meter reading on Test Set I-139-A greater than 0.75 with the transmitter "METER SWITCH" 165 in position "1," "2," or "3," indicates a defect in the equipment or improper adjustment.

<i>Position</i>	<i>Normal</i>	<i>Trouble</i>
1	.4	Greater than .75
2	.5	Greater than .75
3 (Average for channels A, B, C, D)	.63	Greater than .75
5	Full scale	Less than .5
6	Off	

Significance of Meter Readings

(b) In some sets r-f diode current is measured with the "METER SWITCH" 165 in position "4." This switch position is seldom used. The reading obtained is purely relative, without quantitative significance, and is equivalent to a neon-bulb indication of r-f voltage across the final amplifier tank inductor.

(c) The Test Set I-139-A reading obtained with the "METER SWITCH" 165 in position "5" is another variable quantity. Transmitting-tube data sheets describe grid "drive" or grid current as "approximate, subject to wide variations depending on the impedance of the load circuit." It is desirable that this current be as large as possible (even off-scale) but this is not possible with some of the tubes being used. The real test of satisfactory adjustment is whether or not "upward modulation" of the carrier results. "Upward modulation" is indicated by an increase in brilliance of the Phantom Antenna A-29.

(d) It is reasonable to assume that half-scale or higher meter readings, with the "METER SWITCH" 165 in position "5," are satisfactory although there are exceptions to this rule.

(e) It should be noted that there is an "idle" or standing plate current resulting in a meter reading of approximately 0.4 when the "METER SWITCH" 165 is in position "3" and Radio Set SCR-522-A or SCR-542-A is in the *receive* condition. This is normal and correct and indicates the existence of a load on the modulator at all times. If this current is abnormally high, an open or short circuit is indicated in the dynamotor unit.

(f) With the "METER SWITCH" 165 in position "4," it should be noted that there is a small emission current in the r-f diode in the "standby" condition.

(g) Position "6" of "METER SWITCH" 165 is an "OFF" or open switch position. (Position "4" will also be an open switch position on sets in which the r-f indicator diode has been omitted.)

CAUTION

Radio Receiver BC-624-A must be in Case CS-80. Be certain all switches on Control Unit BC-1303 are in the "OFF" position.

c. TESTING RADIO RECEIVER BC-624-A.

(1) The following components of Test Equipment IE-36 are required for receiver testing: Control Unit BC-1303, Cord CD-1169 and Cord CD-1170. A head set is also necessary.

(2) Control Unit BC-1303 should be connected to Rack FT-244-A as described in paragraph 3., *a.*, (3). Plug Cord CD-1170 into the control unit by inserting the pin probe of the cord into the "ANT" pin jack, and clip the alligator clip end of the cord to the center pin of socket (416) of the rack. Insert the plug from the head set in Jack JK-49 of the Cord CD-1169, and insert Plug PL-55 (attached to cord marked "TEL") in "TEL" Jack of the Control Unit BC-1303.

(3) Turn band selector switch "OFF ABCD" on the control unit to "A." The dynamotor will start and the frequency-shifter mechanism will shift the equipment to channel A. If the mechanism does not shift, turn band selector switch to another channel and then switch back to "A." Now, try channels B, C, and D, and observe action of the mechanism.

(4) After allowing about one minute for the tubes to warm up, throw the "T-R-REM" switch on the control unit to the "R" position.

(5) Turn the "SIG GEN" switch, located on the left hand end of the control unit, to "ON." Assuming that the receiver channels have been tuned, the signal will be heard in the phones.

NOTE

The buzzer tone can be adjusted by use of a screw driver through the hole in the front of Control Unit BC-1303 marked "BUZ TONE ADJ." The screw, visible through this hole, is turned in either direction until the desired tone is obtained.

(6) Turn band selector switch to "B," "C," and "D," noting the signal in the phones. If the signal is weak or absent on one or more channels, tuning is required. (See paragraph 3., *d.*) If the signal is too loud, tests should be made with the alligator clip on the Cord CD-1170 removed from the center pin of socket (416) of the rack and the antenna cord left hanging from the control unit.

(7) Only relative output of the receiver can be judged by the intensity of the signal. However, by using the same Control Unit BC-1303 a comparison can be made between a set known to be in good working order and the set under test.

(8) To stop the receiver turn band selector switch on the control unit to the "OFF" position.

d. RECEIVER CHANNEL TUNING.

- (1) Test Equipment IE-36 and a head set are required for receiver tuning.
- (2) Loosen the Dzus fasteners pinning the receiver cover to the center cover, lift the receiver cover slightly and slide it away from the control panel.
- (3) A receiver crystal is identified by the fundamental frequency in kilocycles which appears on the crystal holder. In order to select the correct receiver crystal for a particular receiver channel it is necessary to find the correct fundamental frequency (kc) of the crystal to be used. The fundamental frequency (*f*) is determined from the expression:

$$f = \frac{fr - 12}{H} \times 1000$$

where *fr* is the frequency in megacycles to which the receiver is tuned and *H* is the receiver crystal harmonic used (see following table). The receiver crystal harmonic (*H*) used depends only upon the frequency (*fr*) to be tuned in, and is given in the following table:

<i>Frequency (fr)</i>	<i>Receiver Crystal Harmonic (H)</i>
100-108 mc	11
108-116 mc	12
116-124 mc	13
124-132 mc	14
132-140 mc	15
140-148 mc	16
148-156 mc	17
156 mc	18

(4) TUNING ADJUSTMENT FOR CHANNEL A.

- (a) Install the proper crystal in the receiver socket 289 for receiver channel A.
- (b) Set up Test Equipment IE-36 as described in paragraph 3., *c.*, (2).
- (c) Turn band selector switch on Control Unit BC-1303 to "D." This is the channel preceding the channel to be tuned (channel A). (See paragraph 3., *b.*, (7).).
- (d) Press the channel-release pushbutton 426 located on Rack FT-244-A. (See figure 10.)
- (e) Loosen the two receiver tuning-control lock nuts 5 and 6 by turning them counterclockwise. Tighten the two lock nuts just enough to exert a slight

pressure on the cam pile-up, otherwise vibration may change the position of the cam, introducing considerable set-up error.

(f) Turn the control unit band selector switch to "A" and completely loosen the receiver tuning control nuts 5 and 6. After allowing about one minute for the receiver vacuum tubes to warm up, throw the control unit "T-R-REM" switch to the "R" position.

CAUTION

Avoid tuning to an undesired harmonic by making certain that the receiver r-f and oscillator tuning controls, 5 and 6, are turned to the desired frequency on the calibration plate. See figure 10. With any given crystal in use, it is possible to tune the receiver perfectly at any of several equally spaced frequencies in the 100-156 mc range, and buzzer noise will be received well at any of the frequencies. Therefore, it is essential that the tuning dials 5 and 6 indicate within plus or minus three mc of the desired operating frequency. A greater error than this may mean that the receiver is tuned using the wrong crystal harmonic, which means that the receiver may be operating some 8 mc removed from the operating frequency.

(g) Turn on the "SIG GEN" switch located on the left end of the control unit, and rotate the "AUDIO" 236 and "RELAY" 237 controls (see figure 10) to their maximum clockwise rotation positions.

(b) Starting from the extreme clockwise position, slowly turn the channel A oscillator plate-coil tuning screw adjustment A, figure 10, counterclockwise so that about three to five threads of the screw protrude from the coil-mounting insert. The higher the crystal frequency the further the plate-coil screw must be backed out of the coil-mounting insert, thus obtaining the necessary inductance to permit the oscillator to start.

1. When the oscillator starts, a signal should be heard in the phones. If there is no audible signal, simultaneously adjust the receiver r-f (6) and oscillator tuning (5) controls slightly, and if necessary, turn the channel A oscillator plate-coil tuning screw A still further counterclockwise until the signal is heard. (See figure 10.) When the signal is heard, rotate the oscillator plate-coil tuning screw A clockwise until the signal suddenly ceases, then rotate the screw counterclockwise to a position at least three-quarters of a turn past the point at which the oscillator starts. The additional three-quarters of a turn is required for a stable adjustment of the crystal oscillator. If the output is decreased appreciably by this extra rotation, continue turning the screw counterclockwise until the output audible signal is increased as much as possible. (Final adjustment should be made on a

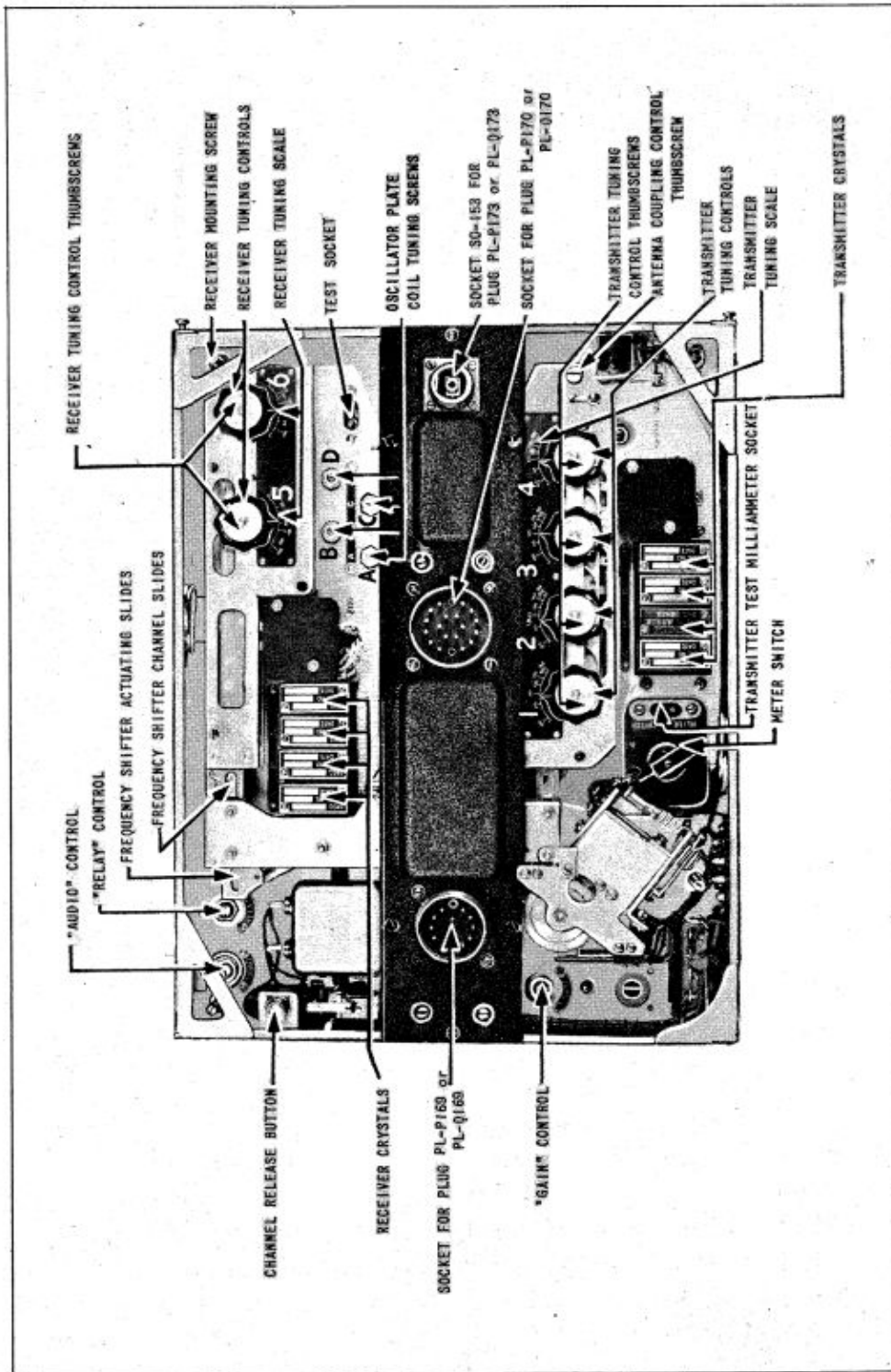


Figure 10—Transmitter and Receiver Assembly, Covers Open, Top View

weaker signal by removing the alligator clip on Cord CD-1170 from the center pin of socket (416) of the rack.

NOTE

In Radio Receivers BC-624-A modified for suppression of impulse noise, the signal heard in the headphones will be considerably less in volume than before modification.

2. For modified receivers, most accurate tuning is obtained if controls 5 and 6 (figure 10) are peaked using only circuit noise or hiss and with the "SIG GEN" switch in the "OFF" position. This "fine" adjustment is to be made after "rough" tuning with the "SIG GEN" switch in the "ON" position.

(5) TUNING OF REMAINING CHANNELS.

(a) To adjust the remaining channels, turn band selector switch on Control Unit BC-1303 to "B" and completely loosen all receiver tuning-control lock nuts.

CAUTION

Before turning band selector knob 106 to "B," hold the tuning controls with the fingers and tighten the lock nuts 5 and 6 just enough to exert a slight pressure on the cam pile-up. While doing this, make certain that the audio output level remains constant. This is accomplished by readjusting tuning controls 5 and 6, figure 10. Follow the same tuning procedure outlined for channel A in the paragraphs under 3., *d.*, (4).

(b) The tuning instructions for channel A will hold good for channel B, if the letter B is substituted for A wherever the crystal, the channel, and the oscillator plate-coil tuning screw are mentioned. This likewise applies when tuning channels C and D. Tune channels C and D in like manner; after which press the channel-release pushbutton 426 and tighten the two receiver tuning-control lock nuts 5 and 6 by turning them tightly clockwise with the fingers. If using a tool, do not tighten lock nuts excessively. Re-check all channels for satisfactory receiver output, with slight movement of the controls 5 and 6 against the detent. Maximum signal should be obtained in the rest position.

(c) This completes the tuning of the receiver. However, if at any time it is necessary to tune one receiver channel only, the following procedure applies:

(6) PROCEDURE FOR TUNING ONE CHANNEL ONLY.—If one channel is out of adjustment, it may be tuned without disturbing the other channels.

(a) Turn band selector switch to the channel preceding the channel to be tuned, in the sequence A, B, C, D. In other words, if retuning channel B, turn switch to "A," if retuning A, turn switch to "D," etc.

- (b) Press the receiver channel-release pushbutton 426.
- (c) Loosen the receiver tuning-control lock nuts 5 and 6.
- (d) Turn the band selector switch to the desired channel.
- (e) Tune the desired channel as described in paragraph 3., *d.*, (4), ignoring reference to channel A and substituting the applicable letter.
- (f) Press the channel-release pushbutton 426.
- (g) Tighten the receiver tuning-control lock nuts 5 and 6.
- (b) Press the channel-release pushbutton 426 to re-select the channel just tuned.

NOTE

Never shut off Radio Set SCR-522-A or SCR-542-A with the shifter slides disengaged, as this will result in failure to turn on the transmitter and receiver if one particular channel pushbutton is pressed on Radio Control Box BC-602-A or band selector switch.

(7) RECEIVER "AUDIO" CONTROL ADJUSTMENT.—The exact setting of the "AUDIO" volume control 236 depends on the headphones being used and the volume desired by the pilot. However, for Radio Receiver BC-624-A the volume control should never be advanced beyond $\frac{3}{4}$ of its maximum rotation. At full volume excessive distortion occurs with strong signals such as are encountered in formation flying. For Radio Receiver BC-624-AM the volume control may be operated in the extreme clockwise position. If Jack Box BC-629-B is used, set the receiver "AUDIO" control at $\frac{3}{4}$ of its maximum setting and adjust the volume by means of the jack box "AUDIO" control. If the pilot desires more volume and the audio output is connected to terminal No. 6 of transformer 296, transfer the output connection to terminal No. 7. Reference number 296 appears near the transformer in the receiver.

(8) RECEIVER "RELAY" CONTROL ADJUSTMENT.—This is the last adjustment to be made on the receiver and it should be done with the airplane antenna connected, the equipment operating on any tuned channel and no signal being received. First rotate the "RELAY" control 237 to the extreme clockwise position and then turn it slowly counterclockwise until the noise ceases and continue the counterclockwise rotation for a very small fraction of a turn. This adjustment can normally be made without having the engines running. However, if the adjustment has been checked and the pilot still complains of excessive noise in the phones at all times, adjust the "RELAY" control 237 while the engines are running but omit the above-mentioned small fraction of a turn.

e. REMOTE (PRESS-TO-TALK) OPERATION.—By using the "T-R-REM"

switch on Control Unit BC-1303 in the "REM" position, the press-to-talk switching and circuit operation in Radio Set SCR-522-A or SCR-542-A may be tested.

(1) With Control Unit BC-1303 plugged into socket 417 of the rack and Phantom Antenna A-29 in Socket SO-153 (416), throw the "T-R-REM" switch to "REM."

(2) In this position, "REM," the receiver will be operating. Test with headphones and buzzer to make certain that it is.

(3) In the "REM" position pressure on the "push-to-talk" button in the cockpit should actuate the transmitter as observed by a lighted lamp in Phantom Antenna A-29.

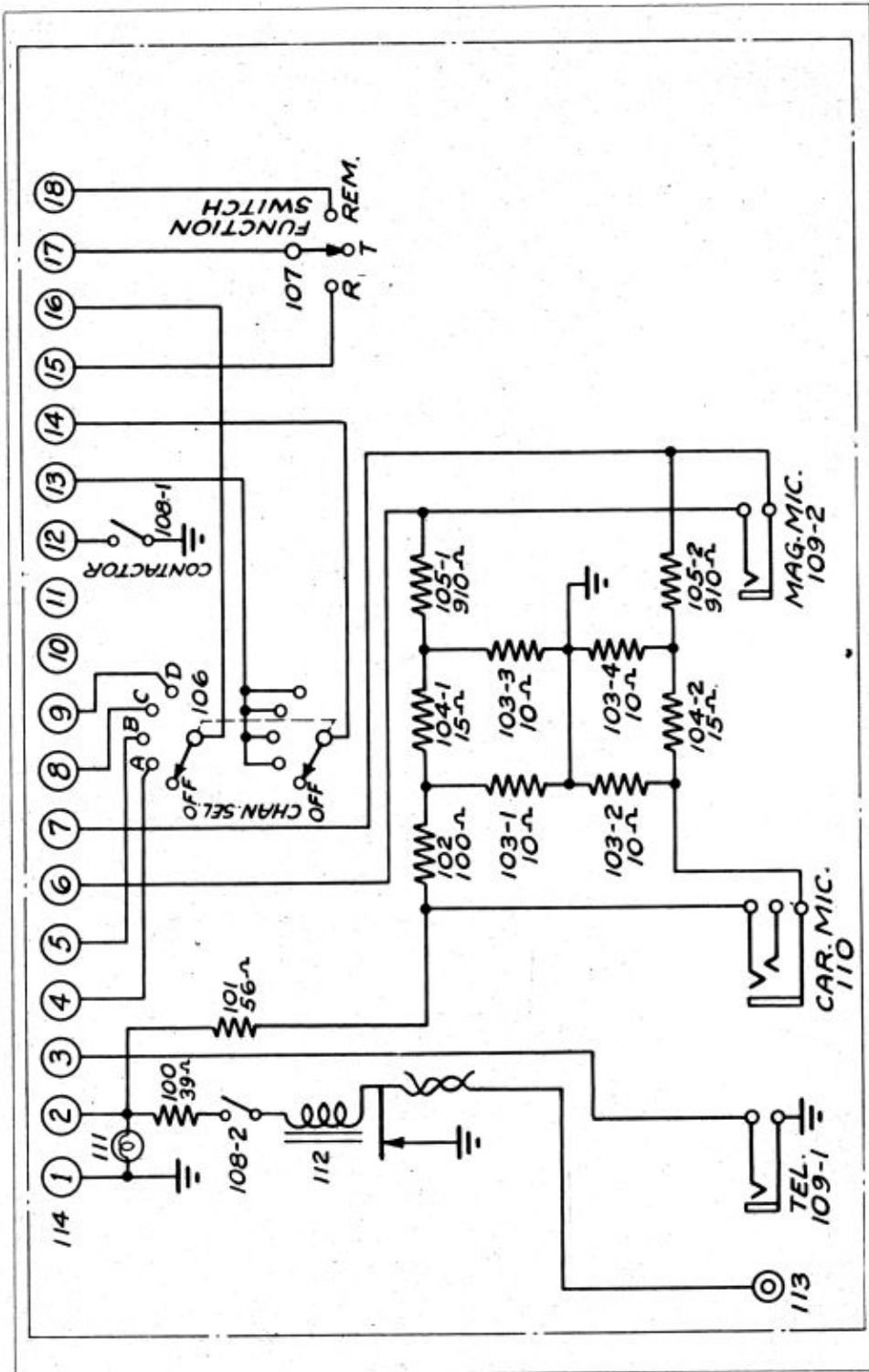


Figure 11—Control Unit BC-1303, Schematic Diagram

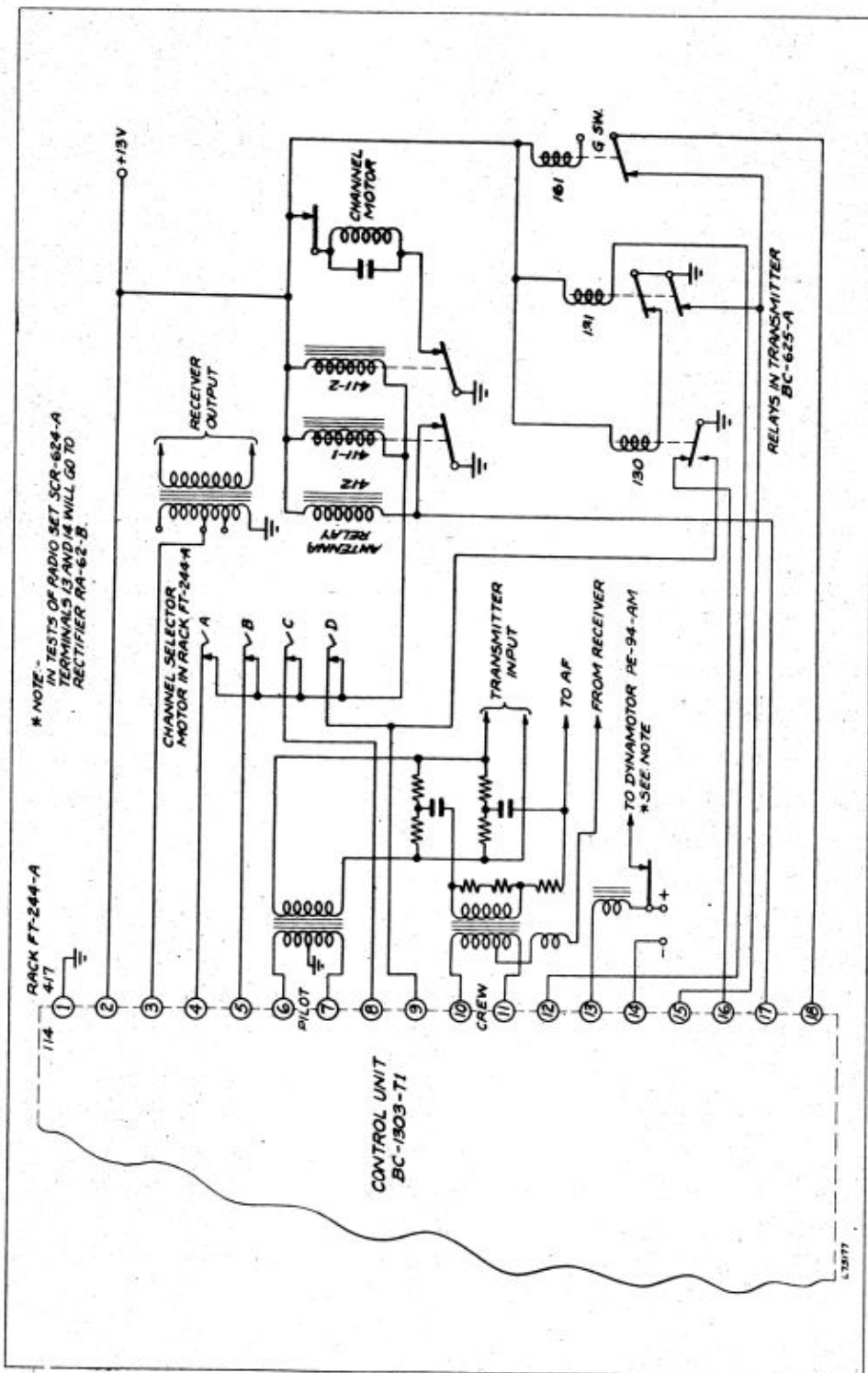


Figure 12—Interconnecting Circuits, Control Unit BC-1303 With Radio Set SCR-522-A

SECTION IV

MECHANICAL AND ELECTRICAL CHARACTERISTICS

1. MECHANICAL.

The main component of Test Equipment IE-36 is the Control Unit BC-1303. This unit is housed in a metal case with black wrinkle finish. It is $3\frac{1}{4}$ " deep x $7\frac{1}{4}$ " long x $2\frac{7}{16}$ " high. The cover is an angle cover, comprising the top and back, and is fastened to the case by eight screws, four on the top and four on the back. The cover will lift off easily upon removal of the screws. Two legs, one on each end of the bottom of the case, support the unit when attached to Rack FT-244-A, the legs being metal strips of the same finish as the case. The components of Control Unit BC-1303 are all mounted directly to the case, with necessary insulation provided for those components which are not grounded. All jacks are insulated from the case. All resistors in the control unit are mounted in one assembly. This assembly is removable by removing the two screws in the top of the assembly mounting. The knob of switch 106 is removable by loosening the setscrew with a Bristol wrench.

2. ELECTRICAL.

a. CONTROL UNIT BC-1303.—All electrical contacts between microphones, telephones, Phantom Antenna A-29, Radio Transmitter BC-625-A, and Radio Receiver BC-624-A are made through Control Unit BC-1303.

(1) The circuits of Control Box BC-1303 are connected to Rack FT-244-A through plug 114 on the control unit and socket 417 in the rack. (See figures 11 and 12.) Contact is made as follows:

<i>Contact in Plug 114</i>	<i>Goes To</i>	<i>In Unit</i>
1	Ground	Radio Receiver BC-624-A
2	+13v	Radio Receiver BC-624-A
3	Output	Radio Receiver BC-624-A
4	Band Selector Switch Channel A	Rack FT-244-A
5	Band Selector Switch Channel B	Rack FT-244-A
6	Pilot Microphone Input	Radio Transmitter BC-625-A
7	Pilot Microphone Input	Radio Transmitter BC-625-A
8	Band Selector Switch Channel C	Rack FT-244-A
9	Band Selector Switch	Rack FT-244-A

<i>Contact in Plug 114</i>	<i>Goes To</i>	<i>In Unit</i>
	Channel D	
10	Microphone, Crew	Radio Receiver BC-624-A
11	Crew Microphone	Radio Receiver BC-624-A
12	Contact 131	Radio Transmitter BC-625-A
13	Dynamotor +28	Dynamotor Unit
14	Dynamotor -28	Dynamotor Unit
15	Contact 131	Radio Transmitter BC-625-A
16	Channel Selector Common	Radio Transmitter BC-625-A
17	Antenna Changeover Relay	Rack FT-244-A
18	Press to Trans Switch	Radio Transmitter BC-625-A

(2) In Control Unit BC-1303 the contacts of plug 114 are connected as follows:

<i>Terminal No.</i>	<i>Goes to</i>
1	Ground
2	"ANT" Pin jack 113 through resistor 100, buzzer 112 and switch 108-2 and to "CAR MIC" jack 110 through resistor 101
3	"TEL" jack 109-1
4	Contact A-Band selector switch 106
5	Contact B-Band selector switch 106
6	"MAG MIC" jack 109-2 and to the "CAR MIC" jack 110 through resistors 105-1, 104-1, and 102
7	"MAG MIC" jack 109-2, and to the "CAR MIC" jack 110 through resistors 105-2 and 104-2
8	Contact C-Band selector switch 106
9	Contact D-Band selector switch 106
10	Open
11	Open
12	Contact 108-1
13	"OFF" position, Band selector switch 106
14	"OFF" position, Band selector switch 106
15	Contact "R," "R-T-REM" switch 107
16	Common of band selector switch 106
17	Contact "T," "R-T-REM" switch 107
18	Contact "REM, R-T-REM" switch 107

(3) Pilot lamp 111 is connected across the leads from terminals 1 and 2 of plug 114.

(4) Resistors 105-1, 105-2, 104-1, 104-2, 103-1, 103-2, 103-3, and 103-4 comprise the microphone attenuator network.

(5) The buzzer is provided with a dropping resistor 100, so that a suitable voltage will be applied to the buzzer.

(6) The Microphone T-17 input is balanced to ground so that direct current flow through the input transformer in Radio Transmitter BC-625-A is eliminated. The circuit is arranged to supply 60 milliamperes of current through the microphones. A balanced type "H" attenuator provides a loss of approximately 44 db. At one volt output of the carbon microphone, it supplies 15 millivolts to the input transformer of Radio Transmitter BC-625-A.

(7) The attenuator output impedance is high so that Microphone T-44 may be used simultaneously with the Microphone T-17. Only approximately one-half the output of the carbon microphone is available at the transmitter with the magnetic microphone plugged in.

b. TEST SET I-139-A.—This is a 0-1 milliampere direct-current meter, in which a 49-ohm resistor is connected in series with the meter, making a total series resistance of 75 ohms. It is separately issued for use with Test Equipment IE-36 or Test Set IE-19-A.

c. PHANTOM ANTENNA A-29.—This phantom antenna consists of 12 resistors, each 820 ohms, connected in parallel. A pilot lamp 202 is connected in parallel with the resistors.

SECTION V

MAINTENANCE

1. CONTROL UNIT BC-1303.

The circuits of Control Unit BC-1303 are so simple that burned out or shorted resistors or defective switches can readily be located by simple continuity tests with Test Equipment I-56-A or its equivalent. The values of the resistors appear on the circuit diagram, figure 11.

2. PHANTOM ANTENNA A-29.

The resistance of Phantom Antenna A-29 is approximately 50 ohms at frequencies 100 to 156 mc. An ohmmeter will not accurately show this resistance value because of the lamp changing its resistance value with temperature. With the lamp removed the resistance value of the antenna will be approximately 67 ohms. Whenever this resistance is not shown by an ohmmeter, any one of the 12 resistors can be defective.

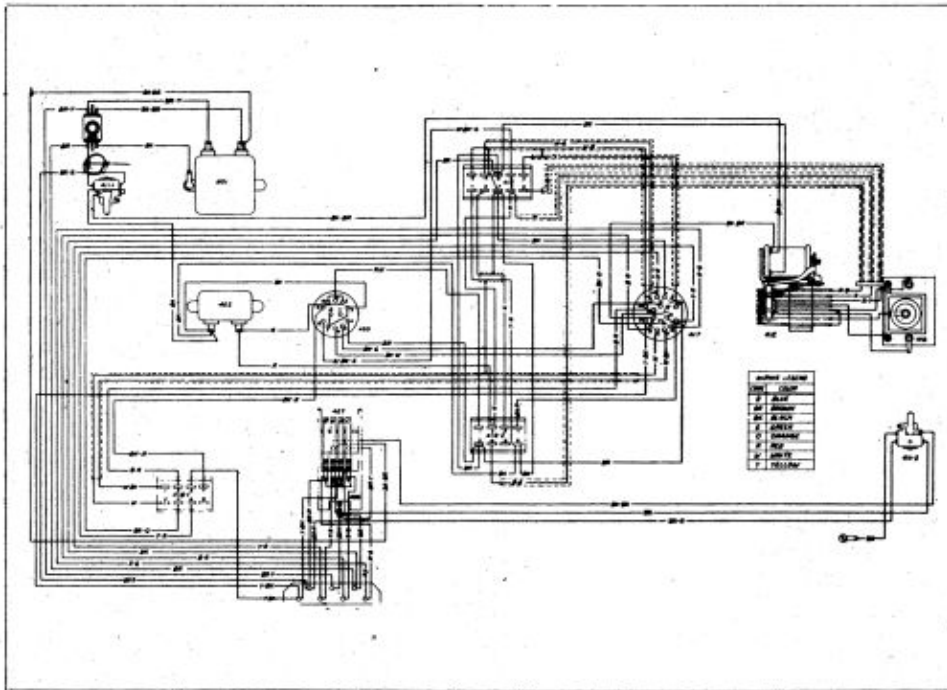


Figure 13—Rack FT-244-A Wiring Diagram

SECTION VI
TABLE OF PARTS

Model: Test Equipment IE-36
Major Assembly: Control Unit BC-1303

<i>Reference Symbol</i>	<i>Name of Part and Description</i>	<i>Function</i>
100	Resistor, 39 Ohm 5% 1W	Buz. Drop.
101	Resistor, 56 Ohm 5% 1W	Mic. Dropping
102	Resistor, 100 Ohm 5% 1W	Mic. Equalizer
103-1	Resistor, 10 Ohm 5% 1/2W	Attenuation Shunt
103-2	Resistor, 10 Ohm 5% 1/2W	Attenuation Shunt
103-3	Same as 103-1	Attenuation Shunt
103-4	Same as 103-1	Attenuation Shunt
104-1	Resistor, 15 Ohm 5% 1/2W	Atten. Ser.
104-2	Same as 104-1	Atten. Ser.
105-1	Resistor, 910 Ohm 5% 1/2W	Atten. Ser. Out Put.
105-2	Same as 105-1	Atten. Ser. Out Put.
106	Switch, 2P5T	ON-OFF and Band Selection
107	Switch, SPDT	T-REM-R Switch
108-1	Switch, toggle, SPST	CONTactor
108-2	Switch, same as 108-1	SIG. GEN. Switch
109-1	Jack, 2P	TEL. Jack
109-2	Same as 109-1	MAG. MIC. Jack
110	Jack, 3P	CAR. MIC. Jack
111	Lamp, Bayonet base, Mazda type 44	Pilot Lamp
112	Relay, 12V	Buzzer
113	Jack, 1P	ANT. pin jack
114	Plug, 18 terminal	Connection for contact to SCR-522-A

<i>Reference Symbol</i>	<i>Name of Part and Description</i>	<i>Function</i>
201-1	Resistor, 8200, 10% 1/2W	Antenna Loading
201-2	Same as 201-1	
201-3	Same as 201-1	
201-4	Same as 201-1	
201-5	Same as 201-1	
201-6	Same as 201-1	
201-7	Same as 201-1	
201-8	Same as 201-1	
201-9	Same as 201-1	
201-10	Same as 201-1	
201-11	Same as 201-1	
201-12	Same as 201-1	
202	Lamp	
203	Shell Plug	