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NAVSHIPS-900,777

RESTRICTED

INSTRUCTION BOOK
for
REMOTE CONTROL-INDICATOR SYSTEMS
(UTILIZING)

REMOTE CHANNEL SELECTOR UNIT, NAVY TYPE CQC-23445

SELECTOR CONTROL UNIT, NAVY TYPE CQC-23497

POWER SUPPLY UNIT, NAVY TYPE CQC-20409

ADMIRAL CORPORATION
CHICAGO, ILLINOIS

NAVY DEPARTMENT

BUREAU OF SHIPS

RECORD OF CORRECTIONS MADE

CHANGE NO.	DATE	SIGNATURE OF OFFICER MAKING CORRECTION

ADDENDA
to
INSTRUCTION BOOK for
REMOTE CONTROL-INDICATOR SYSTEMS
(UTILIZING)

Remote Channel Selector Unit, Navy Type CQC-23445
Selector Control Unit, Navy Type CQC-23497
Power Supply Unit, Navy Type CQC-20409

<u>Section</u>	<u>Page</u>	<u>Symbol</u>	
8	8-3	C-101	Change Equipment quantity from 7 to 5. Change Tender quantity from 20 to 10. Change Stock quantity from 32 to 15.
8	8-9	L-101	Change Equipment quantity from 16 to 5. Change Tender quantity from 32 to 10. Change Stock quantity from 48 to 15.
8	8-10	R-101	Change Tender quantity from 54 to 15. Change Stock quantity from 90 to 20.
8	8-13	X-103	Change Equipment quantity from 2 to 1. Change Tender quantity from 2 to 1.

NOTE: The above changes are not contained in the first 2,000 Instruction Books.

ADMIRAL CORPORATION
U. S. A.

CHICAGO

ILLINOIS

TABLE 8-2 COMBINED PARTS and SPARE PARTS LIST by SYMBOL DESIGNATION for NAVY TYPE CQC-23497 Selector Control Unit												
PARTS							SPARE PARTS					
Symbol Desig.	Name of Part and Description	Function	AWS, JAN or Navy Type Designation	Navy Stock Number	Army Stock Number	Mfr. and Mfr's Desig.	Contractor's Dwg. and Part Number	All Symbols Designation Involved	Total No. Per Equip.	Equip. No.	Teader No.	Stock Quan.
K104	RELAY: Contact arrangement IC1A; 4' lg. x 1 1/2' wd. x 1 1/8' h overall.	Relay to apply voltage to minor switch K105	29976-A			Potter- Brumfield LTS-11-A	Part/dwg P-830-120-4	K104	1			
K104	OR RELAY: Contact arrangement IC1A; 4' lg. x 1 1/2' wd. x 1 1/8' h overall.	Relay to apply voltage to minor switch K105	29976			Potter- Brumfield LTS-11 C.P. Clare D23092	Part/dwg P-830-120-4	K104	1			
NOTE: Navy type designation 29976 & 29976-A are identical with the exception of the start and finish positions of the hold-in coil. When connected properly, their operation is identical.												
Contract N5sr-759												

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CONTRACTUAL GUARANTEE

(a) The Contractor guarantees that at the time of delivery thereof the articles provided for under this contract will be free from any defects in material or workmanship and will conform to the requirements of this contract. Except as to vacuum tubes, batteries, rubber and material normally consumed in operation, the equipment, including all spare parts, is guaranteed for a period of one (1) year from the date of its delivery to and acceptance by the Government, with the understanding that all items found to be defective as to material, workmanship or manufacture will be repaired or replaced, f.o.b. any point within the continental limits of the United States designated by the Government, without delay and at no expense to the Government; provided, that such guarantee shall not obligate the Contractor to repair or replace any such defective items unless the defect appears within the aforementioned period and the Contractor is notified thereof in writing within a reasonable time and unless the defect is not the result of normal expected shelf life deterioration. This guarantee shall then continue as to corrected or replacing articles or, if only parts of such articles are corrected or replaced, to such corrected or replacing parts, until one year after the date of redelivery.

(b) To the extent the equipment, including all parts and spare parts, as defined above, is of the Contractor's design or is of a design selected by the Contractor, it is also guaranteed, subject to the foregoing conditions, against defects in design, with the understanding that if ten per cent (10%) or more of the total quantity comprising such item furnished under the contract (but not less than two thereof) is found to be defective as to design, the entire item will be conclusively presumed to be of defective design and shall be subject to one hundred per cent (100%) correction or replacement by a suitably redesigned item.

(c) All defective items will be subject to ultimate return to the Contractor except that the exigencies of the naval service may necessitate expeditious repair of certain items in order to prevent extended interruption of communications and in such cases the return of the defective items for examination by the Contractor prior to repair or replacement shall not be mandatory. The report of a responsible authority, including details of the conditions surrounding the failure, will be acceptable as a basis for effecting expeditious adjustment under the provisions of this contractual guarantee.

(d) If the Government does not require correction or replacement of a defective or nonconforming article, the Contractor, if required by the contracting officer within a reasonable time after the notice of defect or nonconformance, shall repay such portion of the contract price as is equitable in the circumstances. Equitable in the circumstances is to be determined by mutual agreement between the Contractor and the contracting officer. Failure to agree to such adjustment shall be a dispute concerning a question of fact within the meaning of the section of this contract entitled "Disputes".

(e) Section 9 of the General Provisions, entitled "Guaranty", is hereby superseded and deleted.

INSTALLATION RECORD

Contract Number N5sr-759 Date of Contract April 13, 1945
Serial Number of equipment.....
Date of acceptance by the Navy.....
Date of delivery to contract destination.....
Date of completion of installation.....
Date placed in service.....

Blank spaces in this table shall be filled in at time of installation. Operating personnel shall also mark the "date placed in service" on the date of acceptance plate located below the model nameplate on the equipment, using suitable methods and care to avoid damaging the equipment.

REPORT OF FAILURE

Report of failure of any part of this equipment, during its service life, shall be made to the Bureau of Ships in accordance with current instructions. The report shall cover all details of the failure and give the date of installation of the equipment. For procedure in reporting failures see Chapter 67 of the "Bureau of Ships Manual," or superseding instructions.

ORDERING PARTS

All requests for requisitions for replacement material should include the following data:

1. Navy stock number or, when ordering from an Army supply depot, the Army stock number.
2. Name of part.

If the Navy stock number has not been assigned, the requisitions should specify the following:

1. Equipment model designation.
2. Name of part and complete description.
3. Manufacturer's designation.
4. Contractor's drawing and part number.
5. AWS, JAN, or Navy type designation.

SAFETY NOTICE

The attention of officers and operating personnel is directed to Chapter 67 of Bureau of Ships Manual or superseding instructions on the subject of Radio-Safety precautions to be observed.

RESUSCITATION

AN APPROVED POSTER ILLUSTRATING THE RULES FOR RESUSCITATION BY THE PRONE PRESSURE METHOD SHALL BE PROMINENTLY DISPLAYED IN EACH RADIO, RADAR OR SONAR ENCLOSURE. POSTERS MAY BE OBTAINED UPON REQUEST TO THE BUREAU OF MEDICINE AND SURGERY.

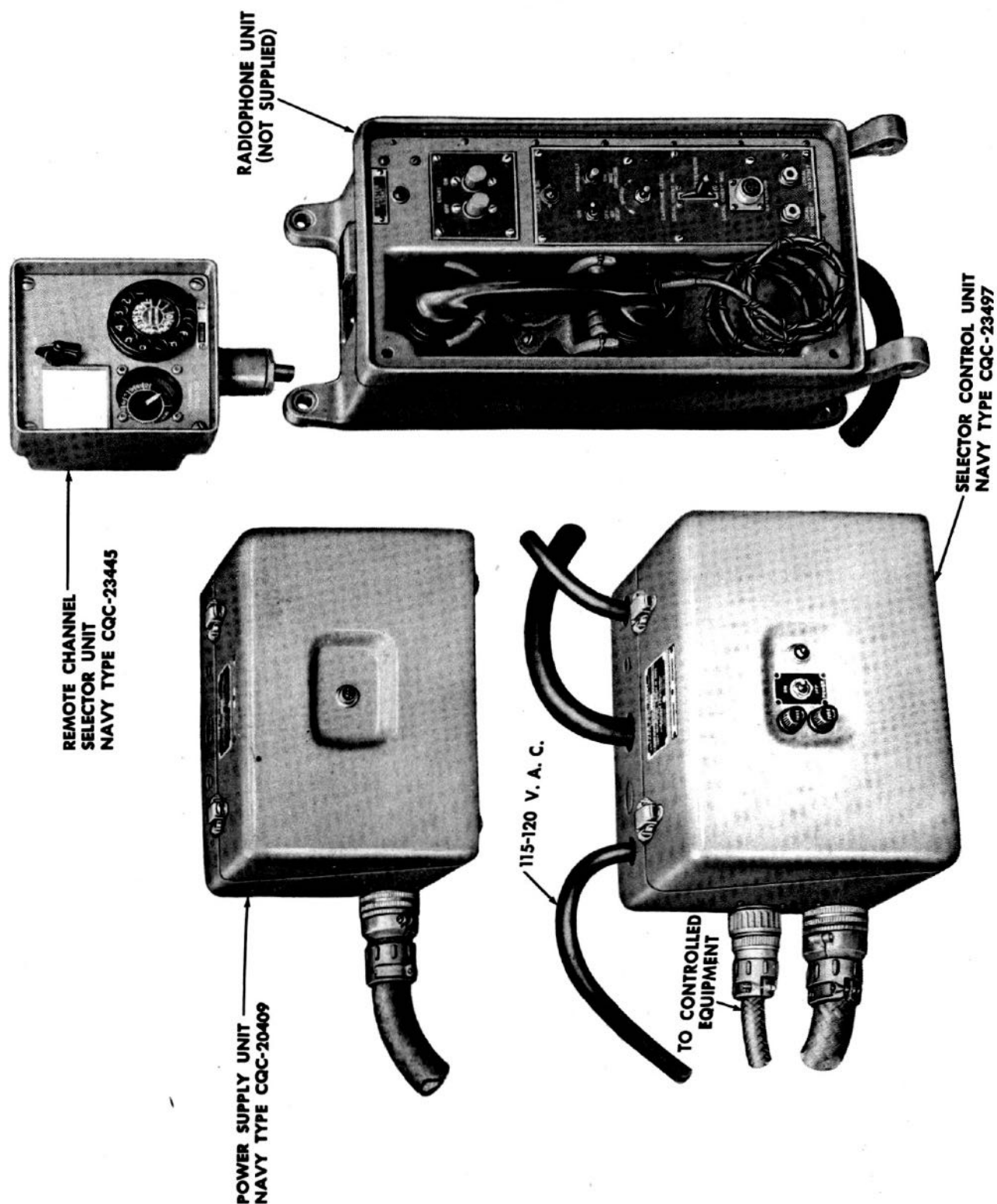


Figure 1-1—Basic Units of Remote Control Indicator System

SECTION I GENERAL DESCRIPTION

1. INTRODUCTION.

Navy Type CQC-23445, Remote Channel Selector Unit, Navy Type CQC-23497 Selector Control Unit, and Navy Type CQC-20409 Power Supply Unit covered by these instructions and shown in Figure 1-1 have been developed to operate in various combinations and in conjunction with other electronic units to provide standard but flexible remote control systems for VHF/UHF communication equipment.

2. PURPOSE AND BASIC PRINCIPLES.

a. FUNCTION.—The principal function of any of the various systems employing any or all of the units supplied under Contract N5sr-759 is to permit rapid selection of pre-set frequency channels at stations remote from the points of installation of the communication equipment. These units, when operated in conjunction with the Navy Type CQC-23496 Control-Indicator Unit, or the Navy Type 23127 or 23211-A Radiophone Unit, also provide facilities for (1) remote release, where desired, of silencing or squelch circuits in the receiving equipment, and (2) remote push-to-talk operation of composite transmitting-receiving equipment.

b. APPLICATION.—The remote-control indicator system is used generally in one of two types of installation: installations involving the control of a receiver only (Model RDZ, RDR equipments, or similar) utilizes one Navy Type CQC-23497 Selector Control Unit, and from one to four Navy Type CQC-23445 Remote Channel Selector Units, and/or Navy Type CQC-23496 Control-Indicator Units, depending upon the number of remote station units so controlled. In the second type of installation the equipment serves for control of a transmitter-receiver (Model MAR equipment, or similar). The same basic units are required and, in addition, a Navy Type CQC-20409 Power Supply Unit is utilized to supply the power required by the change-over relay in the controlled equipment, also the power to the remote stations normally supplied by shipboard transmitters.

c. OPERATION.—The functions of the several units in a typical installation are as follows:

(1) The Navy Type CQC-23445 Remote Channel Selector Unit is installed at the remote operating position and serves for selection of from one to ten transmitting-receiving channels. Channels are selected by means of a standard telephone dial, and an indication of the channel in use is provided by a synchro (Selsyn) indicator. An "ON-OFF" switch provides for turning on and turning off that particular remote channel selector unit, but does not affect the operation of the transmitter-receiver or other channel selector units



Figure 1-2—Navy Type CQC-23445 Remote Control Selector Unit

which may be connected to the controlled equipment.

(2) The Navy Type CQC-23497 Selector Control Unit is installed adjacent to the controlled equipment and contains the minor switch and relays necessary for selection of the required channels and the transmittal of the required indication signals back to the remote channel selector unit. It provides also for control of the squelch circuit.

(3) The Navy Type CQC-20409 Power Supply Unit is installed adjacent to the controlled equipment and serves as a source of power for operation of the change-over relay in the controlled equipment and for operation of the microphone at the operating station. It serves also as a junction box in that the microphone and monitor circuits are routed through this unit.

(4) The controlled equipment is not supplied and may be one of several types such as the Model RDZ or RDR receiver, the Model MAR receiver-transmitter, or equivalent.

3. MAJOR UNITS.

a. REMOTE CHANNEL SELECTOR UNIT.

(1) Navy Type CQC-23445 Remote Channel Selector Unit (Figure 1-2) is contained in a cast aluminum housing suitable for bulkhead or top of table mounting. A telephone dial, synchro indicator, and an "OFF-ON" switch are mounted on the front panel. Also mounted

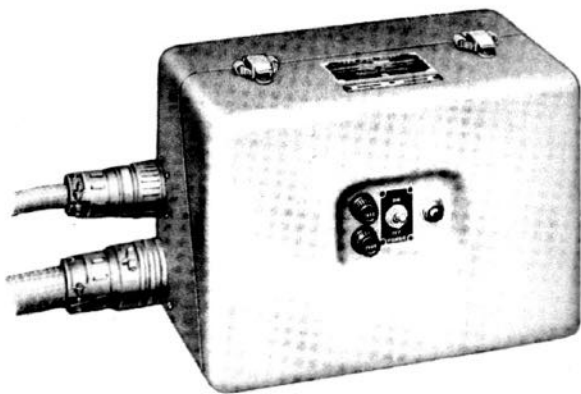


Figure 1-3—Navy Type CQC-23497 Selector Control Unit

on the front panel is a card holder containing a set of cards on which data regarding the ten channels may be marked. A short tube is supplied for the cable lead in. This tube is attached at the bottom of the case as shown when the unit is mounted on a bulkhead, and at the back of the case when the unit is mounted on a table top.

(2) This unit is designed for installation at stations remotely located from the controlled equipment. Operating in conjunction with Navy Type CQC-23497 Selector Control Unit (or in conjunction with Model TDZ or similar equipments possessing facilities incorporated in the Selector Control Unit), it permits rapid selection of 10 pre-set frequency channels and provides indication of the channel (by number) so selected.

b. SELECTOR CONTROL UNIT.

(1) Navy Type CQC-23497 Selector Control Unit (Figure 1-3) is housed in an aluminum case suitable for bulkhead, shelf, or top of table mounting. The front panel is hinged to allow access for servicing and installation. Two fuse holders, a pilot lamp, and the "POWER ON-OFF" switch are recessed into the front panel.

(2) The functions of this unit are: (1) to effect the selection of the desired (dialed) channel in the controlled equipment, (2) to cause an indication to register on the synchro indicator of the remote channel selector unit, (3) to provide at the remote control station an indication when the controlled equipment is operated locally, and (4) provides facilities to render inoperative the signal squelch circuit of the controlled receiver or transmitter-receiver, and so provide a means for the remote operator to tell whether the controlled equipment is working.

c. POWER SUPPLY UNIT.

(1) Navy Type CQC-20409 Power Supply Unit (Figure 1-4) is mounted in the same type case as the selector control unit. A pilot lamp is recessed into the front panel.

(2) This unit supplies power for the radiophone unit and/or the Navy Type CQC-23496 Control-Indicator Units, and also provides the power required for effecting the change-over from reception to transmission in the controlled equipment when the "PUSH-TO-TALK" button on the radiophone handset is depressed.

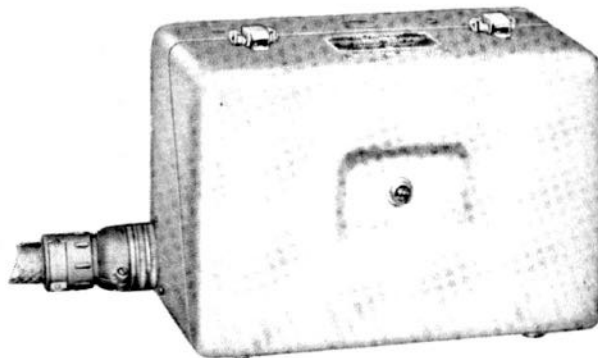


Figure 1-4—Navy Type CQC-20409 Power Supply Unit

4. EQUIPMENT SUPPLIED.

Quantity	Unit	Remarks
3,460	Navy Type CQC-23445 Remote Channel Selector Unit	See Figures 7-2 and 7-14 for proper connection of linkages. Each selector control unit furnished complete with necessary interconnecting plugs (see paragraph 1 of Section III).
7,000	Navy Type CQC-23497 Selector Control Unit (for use with receiving equipments only)	
2,000	Navy Type CQC-23497 Selector Control Unit (for use with receiving and transmitting equipments)	
2,000	Navy Type CQC-20409 Power Supply Unit	This unit is employed with selector control units used with transmitting and receiving equipments. Each power supply unit furnished complete with necessary interconnecting plug (see paragraph 1 of Sec. III).

4. EQUIPMENT SUPPLIED (Continued)

3,460 434 200 80	Spare Parts for Remote Channel Selector Units Equipment Spare Parts Additional Equipment Spare Parts Tender Spare Parts Stock Spare Parts	See Table 8-2 for list by symbol designations.
9,000 900 525 185	Spare Parts for Selector Control Unit Equipment Spare Parts Additional Equipment Spare Parts Tender Spare Parts Stock Spare Parts	See Table 8-2 for list by symbol designations.
2,000 200 150 60	Spare Parts for Power Supply Unit Equipment Spare Parts Additional Equipment Spare Parts Tender Spare Parts Stock Spare Parts	See Table 8-2 for list by symbol designations.
18,750	Instruction Books	

5. EQUIPMENT REQUIRED, BUT NOT SUPPLIED.

UNIT	REMARKS
Navy Type 23172A or 23211A or similar standard Radiophone Unit.	See Figures 3-6 and 3-7.
Navy Type CQC-23496 Control Indicator Unit, for Model TDZ and 2 Model RDZ equipments.	See Figures 3-6 and 3-7, and the instruction book covering this unit.
Selector Control Adapter for Model MAR and RDR Equipment.	This adapter required to provide operation for the Model MAR and RDR Equipment with the standard remote control system. See equipment instruction book.
Navy Type 49131 or 49620 Speaker Amplifier, or a Navy Type 49546 Speaker and a Navy Type 50210 Amplifier.	

6. REFERENCE DATA.**a. NOMENCLATURE.**

- (1) Remote Channel Selector Unit, Navy Type CQC-23445.
 (2) Selector Control Unit, Navy Type CQC-23497.
 (3) Power Supply Unit, Navy Type CQC-20409.

b. CONTRACT NUMBER AND DATE.—N5sr-759, dated 13 April, 1945.

c. CONTRACTOR.—Admiral Corporation, 3800 W. Cortland Street, Chicago 47, Illinois.

d. COGNIZANT NAVY INSPECTOR.—Inspector of Naval Materiel, Chicago 4, Illinois.

e. NUMBER OF PACKAGES PER COMPLETE CONTRACT.

NOTE

Because of the fact that the equipment units listed in this table are not supplied in any set number or ratio for a given installation, the number of units and spares indicated represents the total number supplied on the subject contract.

(1) 3,460 crates each containing one Navy Type CQC-23445 Remote Channel Selector Unit.

(2) 9,000 crates each containing one Navy Type CQC-23497 Selector Control Unit.

(3) 2,000 crates each containing one Navy Type CQC-20409 Power Supply Unit.

(4) 3,894 crates each containing one set of Equipment Spare Parts for the Remote Channel Selector Unit.

(5) 200 crates each containing one set of Tender Spare Parts for the Remote Channel Selector Unit.

(6) 80 crates each containing one set of Stock Spare Parts for the Remote Channel Selector Unit.

(7) 9,900 crates each containing one set of Equipment Spare Parts for the Selector Control Unit.

(8) 525 crates each containing one set of Tender Spare Parts for the Selector Control Unit.

(9) 185 crates each containing one set of Stock Spare Parts for the Selector Control Unit.

(10) 2,200 crates each containing one set of Equipment Spare Parts for the Power Supply Unit.

(11) 150 crates each containing one set of Tender Spare Parts for the Power Supply Unit.

(12) 60 crates each containing one set of Stock Spare Parts for the Power Supply Unit.

(13) 18,750 Instruction Books.

f. TOTAL CUBICAL CONTENTS.

(1) CRATED.

(a) Remote Channel Selector Unit 1742 cu. in.

(b) Selector Control Unit, 4425 cu. in.

(c) Power Supply Unit, 4425 cu. in.

(d) Equipment Spare Parts (Set) for item (a), 1335 cu. in.

(e) Tender Spare Parts (Set) for item (a), 1335 cu. in.

(f) Stock Spare Parts (Set) for item (a), 1335 cu. in.

(g) Equipment Spare Parts (Set) for item (b), 3300 cu. in.

(h) Tender Spare Parts (Set) for item (b), 5200 cu. in.

(i) Stock Spare Parts (Set) for item (b), 5300 cu. in.

(j) Equipment Spare Parts (Set) for item (c), 1970 cu. in.

(k) Tender Spare Parts (Set) for item (c), 3300 cu. in.

(l) Stock Spare Parts (Set) for item (c), 3400 cu. in.

(2) UNCRATED.

(a) Remote Channel Selector Unit, 285 cu. in.

(b) Selector Control Unit, 865 cu. in.

(c) Power Supply Unit, 865 cu. in.

(d) Equipment Spare Parts (Set) for item (a). Each metal box, 455 cu. in.

(e) Tender Spare Parts (Set) for item (a). Each metal box, 455 cu. in.

(f) *Stock Spare Parts (Set) for item (a). Each container, 1225 cu. in.

(g) Equipment Spare Parts (Set) for item (b). Each metal box, 1520 cu. in.

(h) Tender Spare Parts (Set) for item (b). Each metal box, 2745 cu. in.

(i) *Stock Spare Parts (Set) for item (b). Each container, 5200 cu. in.

(j) Equipment Spare Parts (Set) for item (c). Each metal box, 775 cu. in.

(k) Tender Spare Parts (Set) for item (c). Each metal box, 1520 cu. in.

(l) *Stock Spare Parts (Set) for item (c). Each container, 3300 cu. in.

g. TOTAL WEIGHT.

(1) CRATED.

(a) Remote Channel Selector Unit, 23 lbs.

(b) Selector Control Unit, 42 lbs.

(c) Power Supply Unit, 38 lbs.

(d) Equipment Spare Parts (Set) for item (a), 25 lbs.

(e) Tender Spare Parts (Set) for item (a), 25 lbs.

(f) Stock Spare Parts (Set) for item (a), 40 lbs.

(g) Equipment Spare Parts (Set) for item (b), 40 lbs.

(h) Tender Spare Parts (Set) for item (b), 50 lbs.

(i) Stock Spare Parts (Set) for item (b), 50 lbs.

(j) Equipment Spare Parts (Set) for item (c), 40 lbs.

(k) Tender Spare Parts (Set) for item (c), 50 lbs.

(l) Stock Spare Parts (Set) for item (c), 50 lbs.

(2) UNCRATED.

(a) Remote Channel Selector Unit, 6.25 lbs.

(b) Selector Control Unit, 19 lbs.

(c) Power Supply Unit, 14.25 lbs.

(d) Equipment Spare Parts (Set) for item (a). Each metal box, 12 lbs.

(e) Tender Spare Parts (Set) for item (a). Each metal box, 12 lbs.

(f) *Stock Spare Parts (Set) for item (a). Each container, 20 lbs.

(g) Equipment Spare Parts (Set) for item (b). Each metal box, 25 lbs.

(h) Tender Spare Parts (Set) for item (b). Each metal box, 30 lbs.

(i) *Stock Spare Parts (Set) for item (b). Each container, 30 lbs.

(j) Equipment Spare Parts (Set) for item (c). Each metal box, 25 lbs.

(k) Tender Spare Parts (Set) for item (c). Each metal box, 30 lbs.

(l) *Stock Spare Parts (Set) for item (c). Each container, 30 lbs.

b. POWER FACTOR OF EQUIPMENT.—90%.

i. CHARACTERISTICS OF POWER REQUIRED.

(1) VOLTAGE.—110-120 volts, 50/60 cycle, 1 phase.

(2) CURRENTS.—(All values are maximum, *i.e.*, with four radiophone units and four channel selector-indicator units connected in system.)

Condition	Selector Control Unit	Power Supply Line
Standby	.15 amp a.c.	.10 amp a.c.
Dialing	.8 amp a.c.	.10 amp a.c.
Squelch Release	.18 amp a.c.	.10 amp a.c.
Push-to-Talk	.15 amp a.c.	.15 amp a.c.
Local Control	.22 amp a.c.	.10 amp a.c.
Maximum Total	.8 amp a.c.	.15 amp a.c.

j. HEAT DISSIPATION.

Remote Channel Selector Unit: None

Selector Control Unit: 15 Watts

Power Supply Unit: 10 Watts

k. VACUUM TUBES EMPLOYED.—None.

*Spare Parts are loosely packaged in wood crate.

SECTION II

THEORY OF OPERATION

1. GENERAL THEORY.

a. In order to control any device from a distant or remote location, suitable means must be provided for the transmission of energy from the remote operating position to the controlled device. Most electronic equipment is easily controlled from a remote location, the simplest system requiring only an extension of the local switching circuits to the remote position. When the remote control plan requires control of numerous circuits, however, the simplicity of circuit design provided by extending each circuit to the remote station is often outweighed by the number of conductors required for such an installation. This becomes a major problem particularly in shipboard installations. In order to reduce the number of conductors between the remote station or stations and the controlled device, it is necessary that the remote control stations be connected into a local switching central which provides the required switching facilities. The dial telephone is a typical example of this system. The remote control systems covered by these instructions employ the basic telephone dial system for selection of channels in the controlled equipment. The remote control systems herein described provide also for control of other related functions necessary for remote controlled operation of the equipment, accomplishing this control through relays located in the switching central. In this way, control of the receiver squelch circuit, "no-channel" indication, and other functions are provided.

b. In some of the installations where this equipment is used, the switching central is provided as an integral part of the controlled equipment. In such installations only the Navy Type CQC-23445 Remote Channel Selector Unit is used. When the switching central is not incorporated as a part of the controlled equipment (Model RDR, RDZ, and MAR Equipments), this facility is provided by Navy Type CQC-23497 Selector Control Unit.

2. DETAILED THEORY.

a. CHANNEL SELECTION.

(1) REMOTE STATIONS.—Navy Type CQC-23445 Remote Channel Selector Unit, employed as the remote control box or station in the remote control systems covered by these instructions, provides a standard telephone type dial for the selection of channels in the controlled equipment. (In certain installations the same facility is provided by Navy Type CQC-23496 Control Indicator Unit.) This assembly is essentially an automatic switch which makes and breaks an electrical circuit a required number of times, depending upon the number dialed.

(a) THE DIAL.—The mechanism of the dial employed in the remote channel selector unit is shown in Figure 2-1. It consists chiefly of the following parts: finger plate, number plate, impulse cam, speed control governor, and driving mechanism. In operating the dial the finger is inserted in the appropriate hole, and the finger plate is turned in a clockwise direction until the finger strikes the stop. This winds the main (helical-type) spring with sufficient tension to return the dial to normal. The finger plate carries the helical spring and a ratchet pawl on its shaft. These are not shown in Figure 2-1. As the dial returns (counterclockwise) to normal, the pawl engages the ratchet, which rotates solidly with the main shaft. A large gear on the shaft drives a small pinion on the second shaft. On this shaft are a laminated gear that drives the governor assembly and the impulse cam that operates the impulse springs. The purpose of the impulse springs is to make and break the electrical circuit as the dial returns to normal. This breaks the direct current flowing in the control loop to the central switching box, and these current impulses operate the central switches. The contacts on the shunt spring assembly are nor-

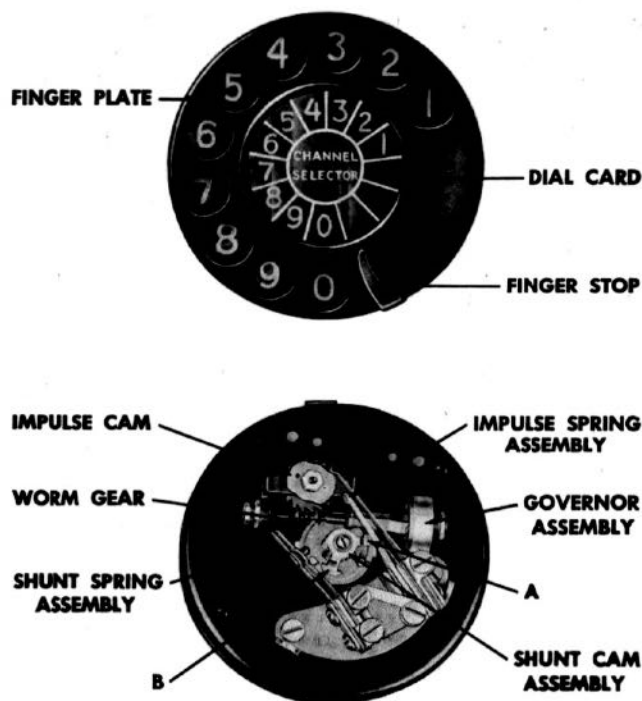


Figure 2-1—Telephone Dial

mally open. When the finger plate is moved in a clockwise direction, arm "A" on the shunt cam assembly moves permitting the shunt spring contacts to close as shown on Figure 2-1. These contacts remain closed until the finger plate returns to its normal position. Rotation of the finger plate also moves arm "B" on the shunt cam assembly and permits the impulse spring assembly to move toward the center of the dial, thus placing the tip of the impulse spring in the path of the impulse cam. Figure 2-1 shows the cam just about to open the circuit. This mechanical action on the tip of the impulse spring forces the impulse contacts apart, and causes an alternate breaking and making of the electrical circuit to the switching central as the impulse cam rotates. The impulse cam interrupts the circuit a number of times corresponding to the number dialed, effecting the operation of a stepping relay (minor switch) at the switching central. A further open circuit pulse is delivered when the shunt spring contacts are opened by the return of arm "A" to the normal position. The speed or rotation of the impulse cam is regulated by the governor assembly.

(2) THE CENTRAL STATION.

(a) GENERAL.—The central station may be considered as a receiver which accepts pulses from the dial transmitter and translates these pulses into switching operations. It consists essentially of a stepping relay (minor switch), a number of control relays, and a d-c power supply. The Model TDZ transmitting equipment has the necessary central switching circuits incorporated in its design and requires no external central switching facilities. Other communication equipment, such as the Models RDR, RDZ, and MAR Equipments, do not have such switching facilities and external central switching must be provided. Navy Type CQC-23497 Selector Control Unit is employed as the switching central in the remote control systems described herein for the latter equipments.

(b) RELAYS.—A relay is an electromagnetic device which operates in response to the flow of an electric current through its winding. The relay is used for mechanically changing (breaking or making) connections in the same or in one or more other electric circuits. The principal parts (see Figure 2-2) of relays employed in these remote control systems are the heelpiece (also called the base of frame), the armature, the coil, and the spring (contact) assembly. The magnetic circuit consists of coil core, heelpiece, and armature, all of good magnetic materials and properly annealed to provide a good magnetic path. The coil is wound from many turns of insulated copper wire, the wire size and number of turns being determined by the operating requirements of the relay and the limited winding space for any particular relay design. An ordinary relay operates in a very short time interval. In dial systems it is necessary to employ relays that are slow to operate. This can be accomplished by placing a copper sleeve or slug on the relay core. The magnetic field links with the copper slug. When

the current in the relay tends to build up or die out in order to operate the relay, the magnetic field linking the slug is changed. In this way the relays are made slow to operate. If the slug is placed on the armature end of the coil, the relay is slow to close. If the slug is placed on the heelpiece end of the coil, it is quick to close but slow to release. The amount of time delay is governed by the size and location of the copper slug.

(c) THE SWITCHING MECHANISM.—The final circuit switching to the controlled equipment is accomplished by means of a rotary switch mechanism with associated contacts and relay assembly. The rotary mechanism consists of a wiper that is rotated over a bank of contacts by means of a ratchet mechanism actuated by an electromagnet designated as the "stepper." Each time the stepper magnet is energized, the contacts of the minor switch are advanced one step. The minor switch contains a second magnet which, when energized, causes the stepping ratchet to disengage and allows the wiper contacts to return to their neutral position.

(3) CIRCUIT ANALYSIS.—A simplified schematic diagram of the circuits employed in the remote control systems is provided in Figure 2-3. Circuit designations referenced in the following description are as used in this illustration.

(a) When the finger plate of the telephone dial (S302) is rotated counter-clockwise from its normal position the impulse contacts remain closed and the off-normal contacts are caused to close. This provides a circuit to the coil of relay K101.

(b) Operation of relay K101 opens the circuit to the stepper magnet by opening contacts 1-2, and, by closing contacts 2-3, provides a circuit to the slow release relay K103.

(c) Slow release relay K103 breaks the circuit between the minor switch and the controlled equipment by opening contacts 1-2 and provides a circuit to the release magnet of the minor switch by closing contacts 3-4.

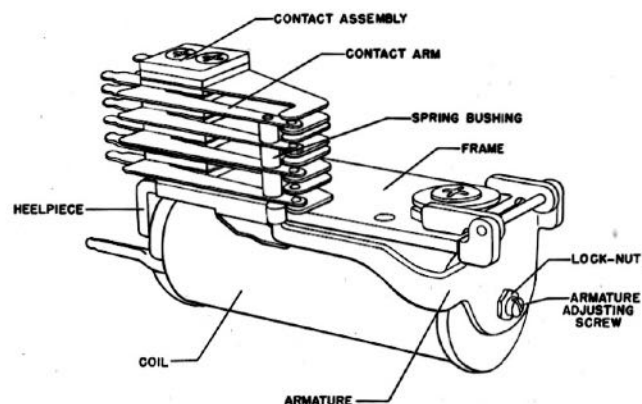


Figure 2-2—Typical Relay Assembly

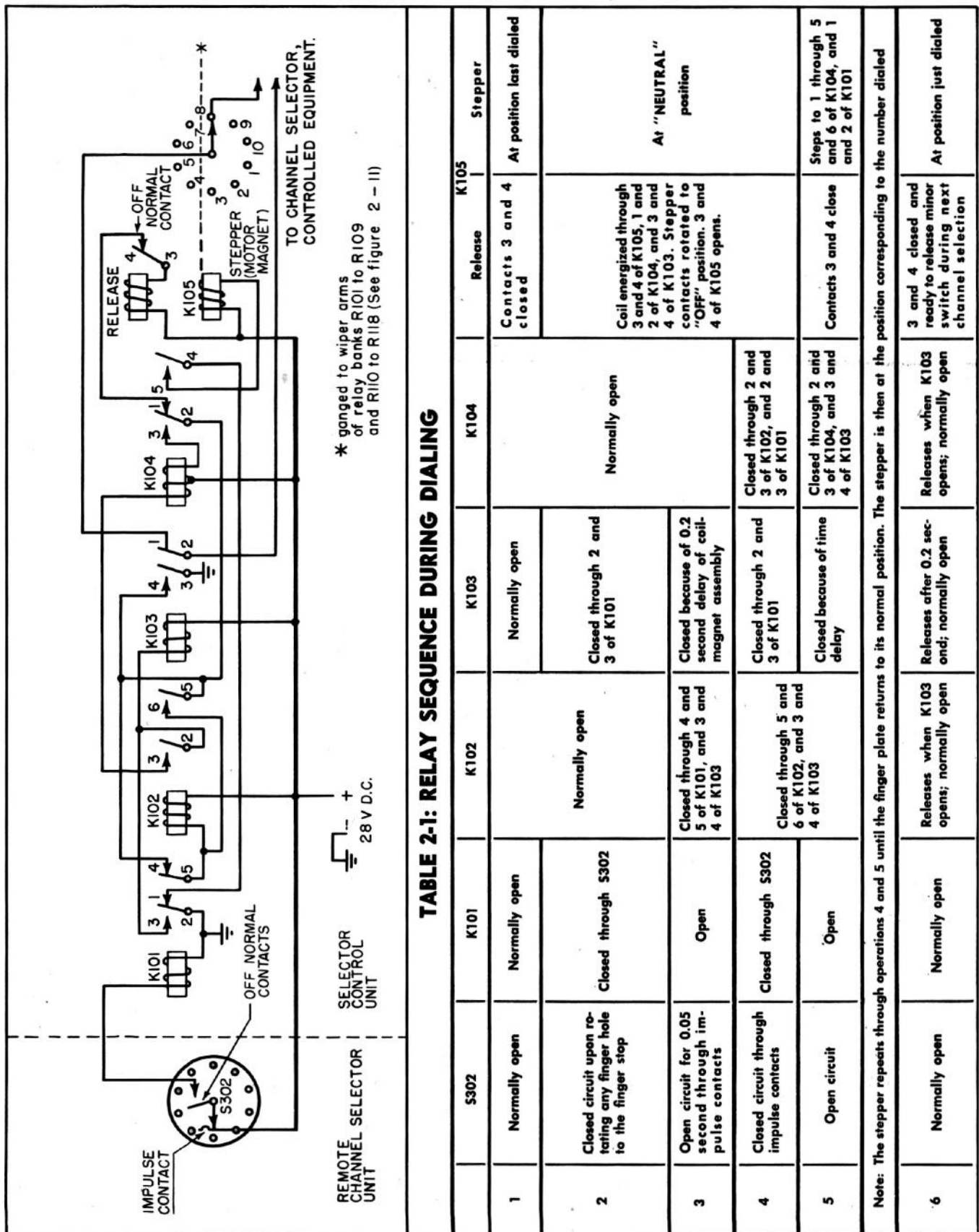


Figure 2-3—Relay Sequence During Dialing

(d) This causes the minor switch to return to its neutral position to prepare for the dialing sequence, opening the off-normal contacts 3-4 on K105 until the first impulse actuates the stepper magnet.

(e) As the finger plate is released, allowing it to return to its normal position, the impulse contacts make and break as the impulse cam rotates. The number of interruptions to the circuit is determined by the number dialed.

(f) The first "off" impulse permits relay K101 to return to its normal position, breaking the circuit to relay K103 by opening contacts 2-3, and providing a circuit to relay K102 by closing contacts 4-5. Relay K103, being slow to release, remains closed for 0.2 second.

(g) The first "on" impulse caused by the closing of the impulse contacts again energizes relay K101.

(h) Contacts 2-3 of relay K101 close again energizing relay K103 before it has had time to release.

(i) Relay K102 being "held in" by its contacts 5-6 closes the circuit to relay K104 through its second set of contacts 2-3.

(j) Relay K104 operates and "locks in" through its contacts 2-3. A circuit is also prepared to the stepper magnet of the minor switch through contacts 4-5.

(k) Each additional off impulse, causing contacts 1-2 of relay K101 to close, will advance the minor switch one step by applying a ground to the stepper coil through contacts 4-5 of relay K104.

(l) Approximately 0.2 second after the finger plate has returned to its normal position, slow release relay K103 will operate to return to its normal unenergized position, opening the circuits to relays K102 and K104, and closing the circuit between the minor switch contacts and the controlled equipment. The switch contacts of the minor switch provides the same facilities as a single pole, ten position switch.

b. CHANNEL INDICATION (Synchro Receiver).—

(1) GENERAL.—One of the fundamental requirements of any remote control installation of communication equipment is that an indication be provided at the operating station to denote the frequency to which the communication equipment is adjusted to operate. In this system this function is provided by a synchro receiver at the remote station. This synchro is actuated by an electrical vector derived from a resistive network, electrically equivalent to a synchro transmitter, located at the switching central. The voltage output of this resistive network is such that the synchro receiver at the control station assumes a definite angular position for each transmitting or receiving channel utilized. A detailed explanation of the operation of the synchro system follows:

(a) The basic principle on which a synchro operates is best demonstrated using a bar magnet, representing the rotor of the synchro, and an electromagnet, placed near by, representing the field. Such a set-up is shown symbolically in Figure 2-4. With the

electromagnet unenergized the bar magnet would assume any position with respect to the electromagnet. However, when the electromagnet is energized with a d-c voltage, the bar magnet will assume the position indicated in "A" of Figure 2-4. If the polarity of the d-c voltage (field) is negative, the position of the bar magnet will change accordingly ("B" of Figure 2-4). Variation of the voltage impressed on the magnet does not affect the position of the bar magnet in this case, but determines only how strongly the bar magnet is attracted to the electromagnet.

(b) Further control of the position of the bar magnet may be obtained through use of two electromagnets as shown in Figure 2-5. As shown in "A" of Figure 2-5 both electromagnets are energized with an equal voltage of such polarities that the electromagnets aid each other. In "B" of Figure 2-5 the electromagnets are energized with voltages which oppose. In this case the bar magnet assumes a position at variance with the perpendicular of the electromagnet, but does not assume a definite position.

(c) In Figure 2-6 the electromagnets are placed at right angles. If a d-c voltage is applied only to electromagnet 2, the bar magnet will assume the position shown in "A." If the d-c voltage is applied to electromagnet 1, the bar magnet assumes the position shown in "B."

(d) When equivalent d-c voltages are applied to both electromagnets 1 and 2, the bar magnet (rotor) comes to rest at a point half-way between the fields of the respective electromagnets as in "A" of Figure 2-7.

(e) If the polarity of the voltage employed on either of the electromagnets is changed, the bar magnet will assume the position shown in "B" of Figure 2-7.

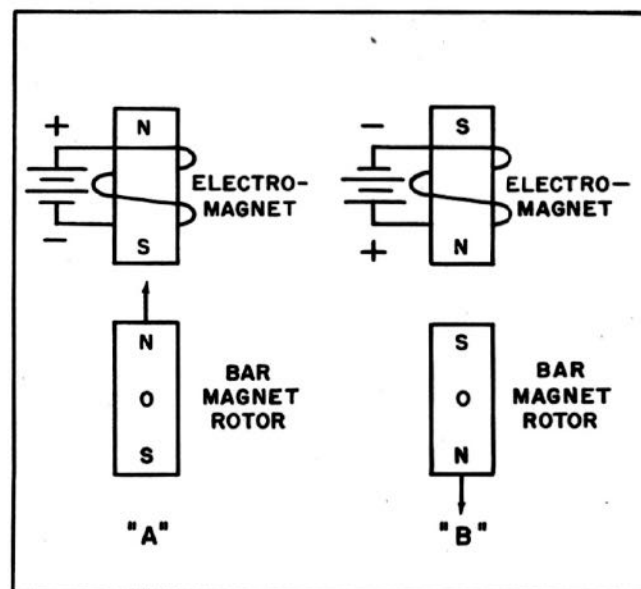


Figure 2-4—Functional Drawing of Synchro Receiver—One Coil

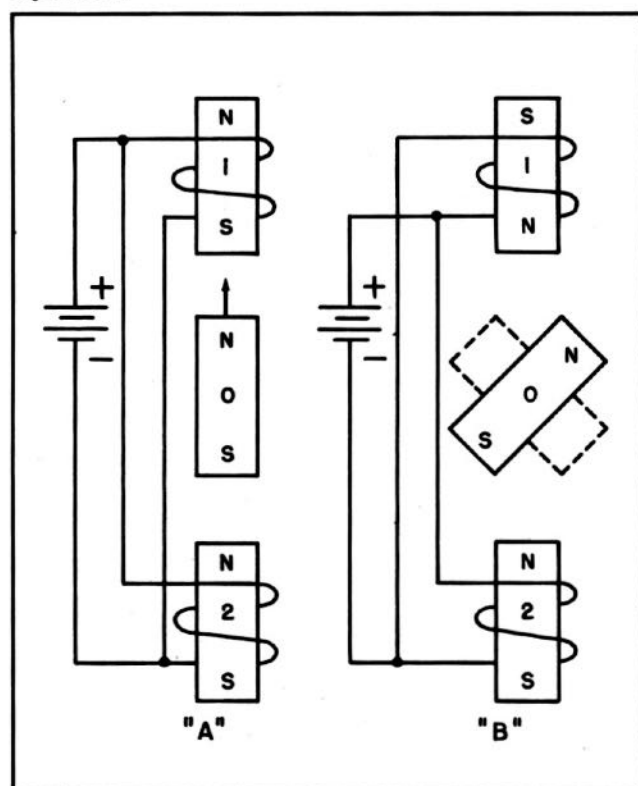


Figure 2-5—Functional Drawing of Synchro Receiver—Two Coils

(f) In this form of synchro the rotor has been caused to assume four angular positions by variations of the voltage applied to the two electromagnets (Figures 2-6 and 2-7). It should be noted that by completely reversing the polarity of a voltage source the four additional positions shown in "A," "B," "C," and "D" of Figure 2-8 may be obtained. Thus through various changes of polarity of the voltage impressed on the two electromagnets, eight definite angular positions are obtained.

(g) These eight rotor positions are obtained without the variation of the amount of voltage impressed on either electromagnet, equivalent voltage being used in each case. If rheostats are inserted, as shown in Figure 2-9, the amount of voltage impressed on either coil can also be controlled and the rotor position can be varied at will (through 360°).

(h) The foregoing applies specifically to a basic synchro mechanism. In practice a considerable improvement in accuracy is obtained using three electromagnets, or fields, spaced at 120° intervals around the rotor. Such a synchro is shown symbolically in Figure 2-10. Here, by adjusting the amplitude and polarity of the voltage appearing across the three windings, the rotor assumes a definite and accurate position for any such combination of voltages and can be adjusted to any position through 360 degrees of rotation. Six possible combinations are shown in Figure 2-10. In "I, II, and III," rotations of 0°, 60°, and 120°, respectively, are provided for. In "I" of Figure 2-10, electro-

magnets 2 and 3 are energized in parallel and electromagnet 1 is shorted. In this case the rotor assumes a position mid-way between the fields of electromagnets 1 and 2 (0 position).

(i) In "II," electromagnets 1 and 3 are energized in parallel and electromagnet 2 is shorted, resulting in rotation of the rotor to an angular displacement of 60°.

(j) In "III," electromagnets 1 and 2 are energized and electromagnet 3 is shorted, resulting in rotation of the armature to an angular position equivalent to 120°.

(k) In "IV," electromagnets 1 and 2 are connected in series across the voltage source, and the full voltage is applied also across electromagnet 3. Here the resulting field is such that the rotor positions at an angular displacement of 30°.

(l) If the slider of a potentiometer, connected across the voltage source, is connected at terminal "C", the voltage appearing across electromagnets 1 and 2 can be varied at will and the rotor can then be positioned as desired anywhere between zero and 60°. With the slider at the negative potential end of the

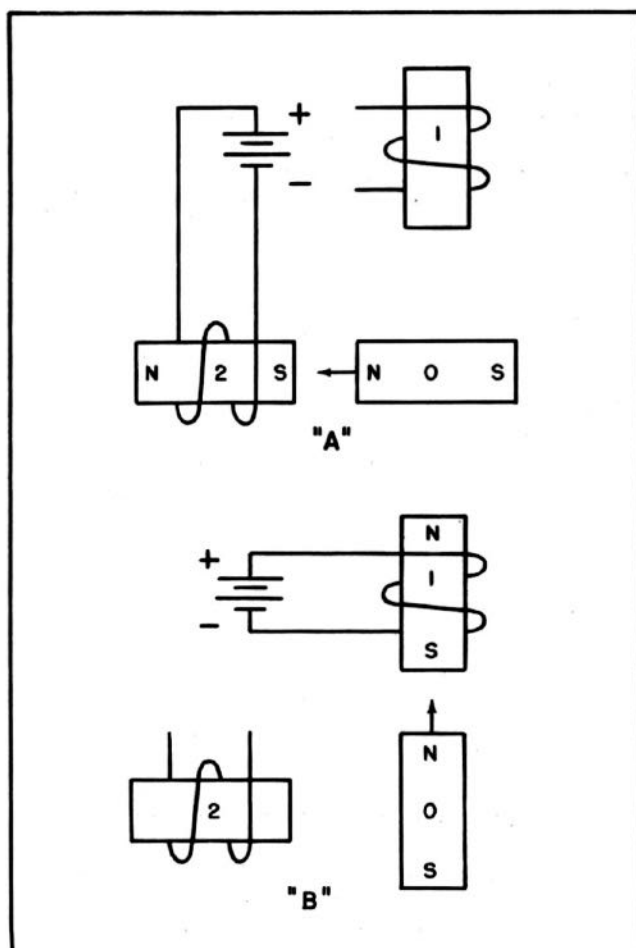


Figure 2-6—Functional Drawing of Synchro Receiver—Two Coils at Right Angles, One Energized

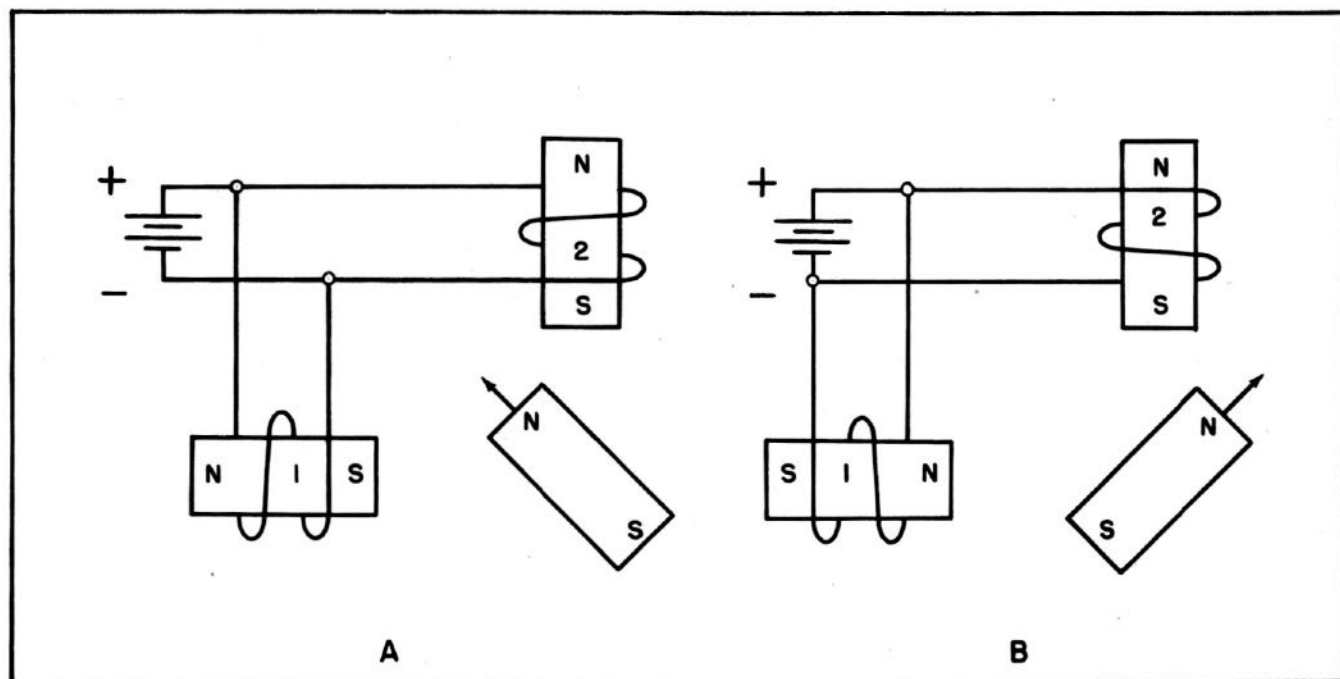


Figure 2-7—Functional Drawing of Synchro Receiver—Two Coils at Right Angles, Both Energized

potentiometer, the rotor will position at 60° since the electrical connections are essentially as shown in "II". As the slider is advanced toward the positive potential end, the force set up by electromagnets 1 and 2 serves to bring the rotor back toward the zero setting since, with the slider positioned at the extreme positive end of the potentiometer, the electrical connections, and the resulting field, are essentially those shown in "I".

(m) In "V" the setting of the potentiometer is such that the rotor is positioned at approximately 55° . As the slider is moved toward the center of the potentiometer the voltage appearing across terminals C and B, and C and A are equalized, resulting in essentially the same voltage distribution and rotor position as shown in "IV".

(n) In "VI" the slider is shown positioned near the positive end of the potentiometer and the rotor is positioned at approximately 5° . With the slider at the extreme positive end of the potentiometer the condition shown in I is obtained and the rotor positions at zero. Thus the rotor of the synchro can be caused to assume any position through 360 degrees of rotation by variation of the voltage appearing across the electromagnets. It should be noted also that the setting of the rotor is determined only by the ratio of the currents flowing through the electromagnet windings. For this reason the synchro is not affected by line voltage variations which naturally affect all of the windings simultaneously. This makes the synchro particularly well adapted for indication positions on ship-board installations or in other services where line voltage variations are apt to be encountered.

c. SYNCHRO TRANSMITTER.

(1) GENERAL.—The synchro transmitter utilized in the Navy Type CQC-23497 Selector Control Unit, and incorporated also in the design of the Navy Model TDZ equipment, consists essentially of a resistance network, components of which are selected by two of the three banks of contacts on the minor switch.

(2) CHANNEL INDICATIONS.—A simplified schematic diagram of the switching arrangement is shown in Figure 2-11. The resistors are connected in a resistive circle and function to vary, in fixed steps, the voltage applied to the synchro receiver in essentially the manner illustrated by the basic synchro diagrams shown in Figure 2-10. The minor switch moves through ten steps. The resistance values (R101 to R118) are so chosen that as the minor switch contacts move up, one step at a time, the voltages applied to the synchro receiver will position the pointer at a number corresponding to the position of the minor switch, thus indicating the channel in which the control equipment is adjusted to operate.

(3) LOCAL CONTROL INDICATION.—(See Figures 7-14 and 7-6.) When the controlled equipment is locally controlled (remote control circuit inoperative) an indication of this condition is provided by the synchro pointer. When the "LOCAL-REMOTE" switch on the controlled equipment is adjusted for local operation, contact 1 on relay K106 opens removing power from the wiper-arm circuit and rendering it inoperative. At the same time contact arms 2 and 5 of relay K106 are pulled over, making contact with points 3 and 6, respectively, supplying potential to

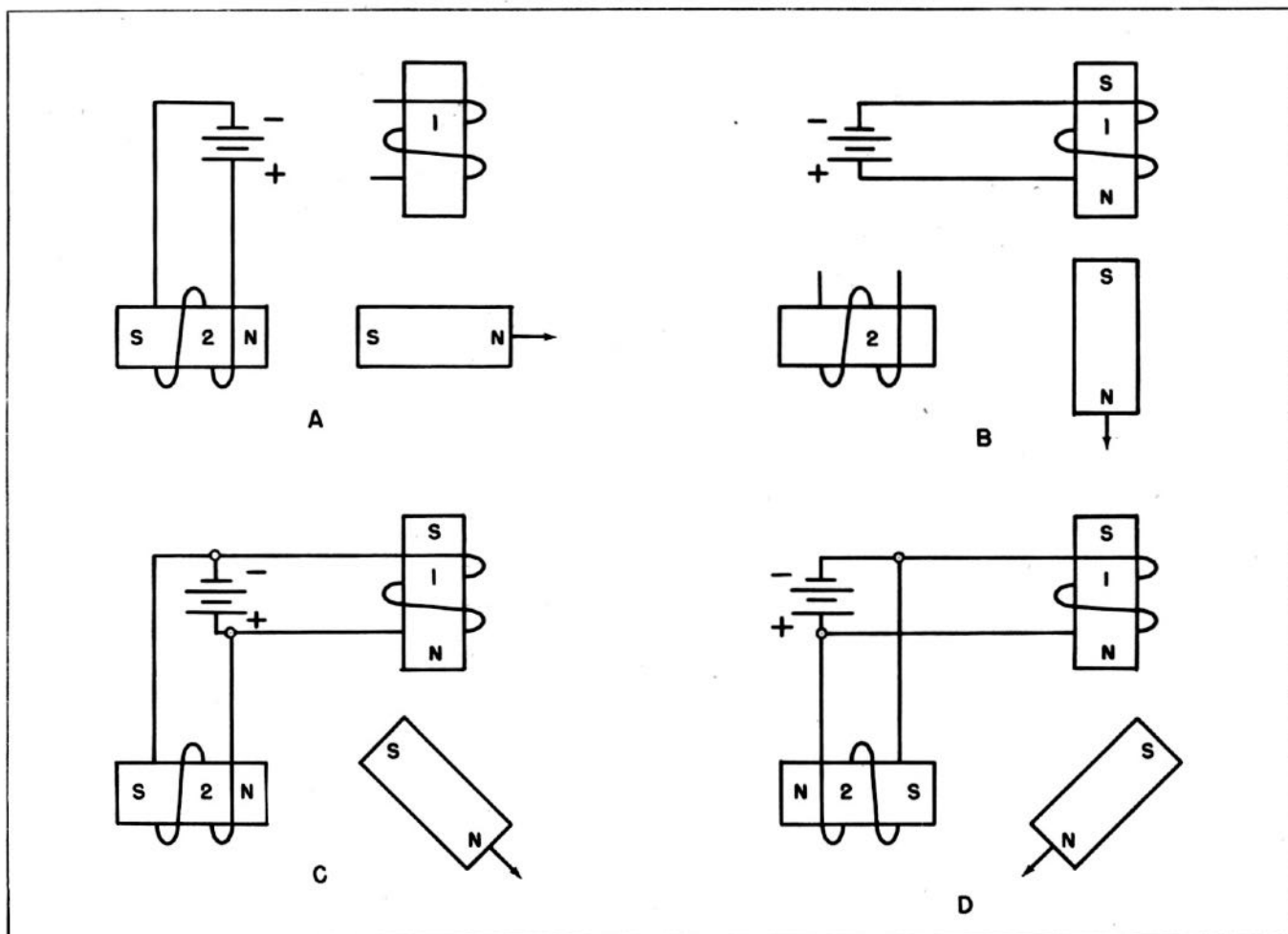


Figure 2-8—Functional Drawing of Synchro Receiver—Two Coils at Right Angles, Additional Positions

the resistance network at the same points as for a "CHANNEL 7" indication. However, the voltages are of opposite polarity and this causes the synchro receiver to rotate to a point exactly opposite the "CHANNEL 7" marker, indicating local control operation.

(4) INITIAL INDICATION.—The synchro receiver serves also to indicate functions and conditions other than the selected channel. During the interval when the release magnet of the minor switch is energized, at the start of the dialing sequence, the synchro pointer is caused to position at the heavy line between the "LOCAL" and "CHANNEL 1" markings. This is accomplished by relay K108 (see Figures 7-2 and 7-14). When contacts 1 and 2 on the minor switch assembly are closed, relay K108 is energized and the synchro receiver is connected to the same position of the resistance bank as is employed for "CHANNEL 9" indication. The polarity of the voltage is reversed, however, causing the pointer to indicate a position directly opposite the "CHANNEL 9" marking (the heavy line between "1" and "LOCAL"). After relay K102 has been energized, contacts 1-2 of the minor

switch open and the off indication is held by contacts 8-9 and 11-12 of relay K102 until slow release relay K103 opens (.2 second after the dial has returned to normal). The pointer then jumps to the channel number just dialed.

d. THE REMOTE SQUELCH OR SILENCER CONTROL.—In the operation of receiving equipment employing a squelch circuit it is sometimes found that with no signal input being present, the receiver output is silenced to such an extent that the remote operator is left in doubt as to whether the controlled equipment is functioning properly. In Navy Type CQC-23497 Selector Control Unit means has been provided to enable the operator to determine that the equipment is operating properly. Depressing the "NOISE SUPPRESSOR" button on the radiophone unit actuates relay K107 in the selector control unit, disabling the squelch control circuit in the controlled equipment.

e. REMOTE PUSH-TO-TALK OPERATION.—Installations of the Model MAR, or similar transmitting and receiving equipment requiring remote control push-to-talk operation, make necessary the use of Navy

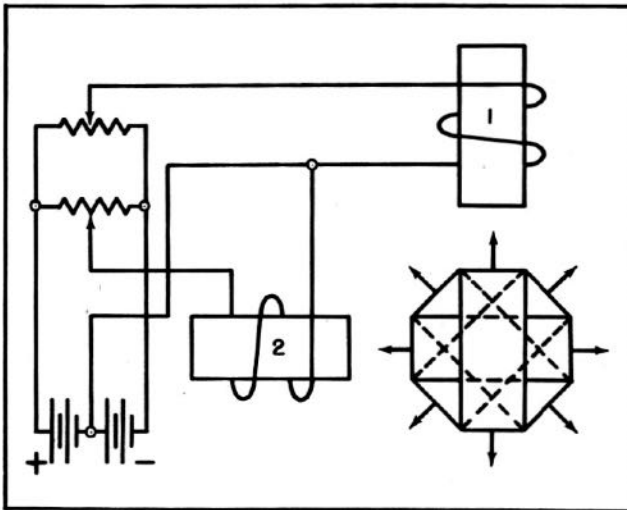


Figure 2-9—Functional Drawing of Synchro Receiver—
Two Coils at Right Angles, Voltage Varied

output of the controlled equipment (for connection from the selector control unit through contacts J and K on J201) is fed to the primary of T202 in the power supply unit through contacts 1-2, and 4-5 of relay K201, and through the d-c blocking capacitor C203. This audio voltage is then fed to the standard radiophone units and/or Navy Type CQC-23496 Control Indicator Unit for distribution to the earphones of the headsets or speakers used. The secondary of transformer T202 is center-tapped and grounded providing a balanced line output.

(2) Depressing the "PUSH-TO-TALK" switch, (TRANSMIT, Figure 2-12) on the radiophone unit hand-set causes relay K201 in the power supply unit to be energized. Contacts 2-3 and 5-6 of K201 connect the control wires of the controlled equipment to the microphone circuit of the standard radiophone or Navy Type CQC-23496 Control Indicator Unit. Thus, capacitor C203 is removed from the circuit, permitting the flow of d-c current (for explanation of the control circuits in the Model MAR equipment see Instruction Book Navships 900, 719).

f. POWER SUPPLY UNIT, NAVY TYPE CQC-20409. (See Figure 7-1.)

(1) The power supply unit consists merely of a power transformer T201, a selenium rectifier CR201, and a simple filter system. It provides a d-c voltage for operation of the transmit-receive change-over relay (located in the controlled equipment) and d-c voltage for the transmitter microphone and radiophone cir-

Type CQC-20409 Power Supply Unit in conjunction with Navy Type CQC-23497 Selector Control Unit. This power supply unit is designed to furnish the power required by the standard radiophone unit, or Navy Type CQC-23496 Control Indicator Unit, and also the power required for switching the input and output circuits of the controlled equipment.

(1) In the normal, or receiving condition, relay K201 in the power supply unit is unenergized as indicated in Figure 2-12. Under this condition the audio

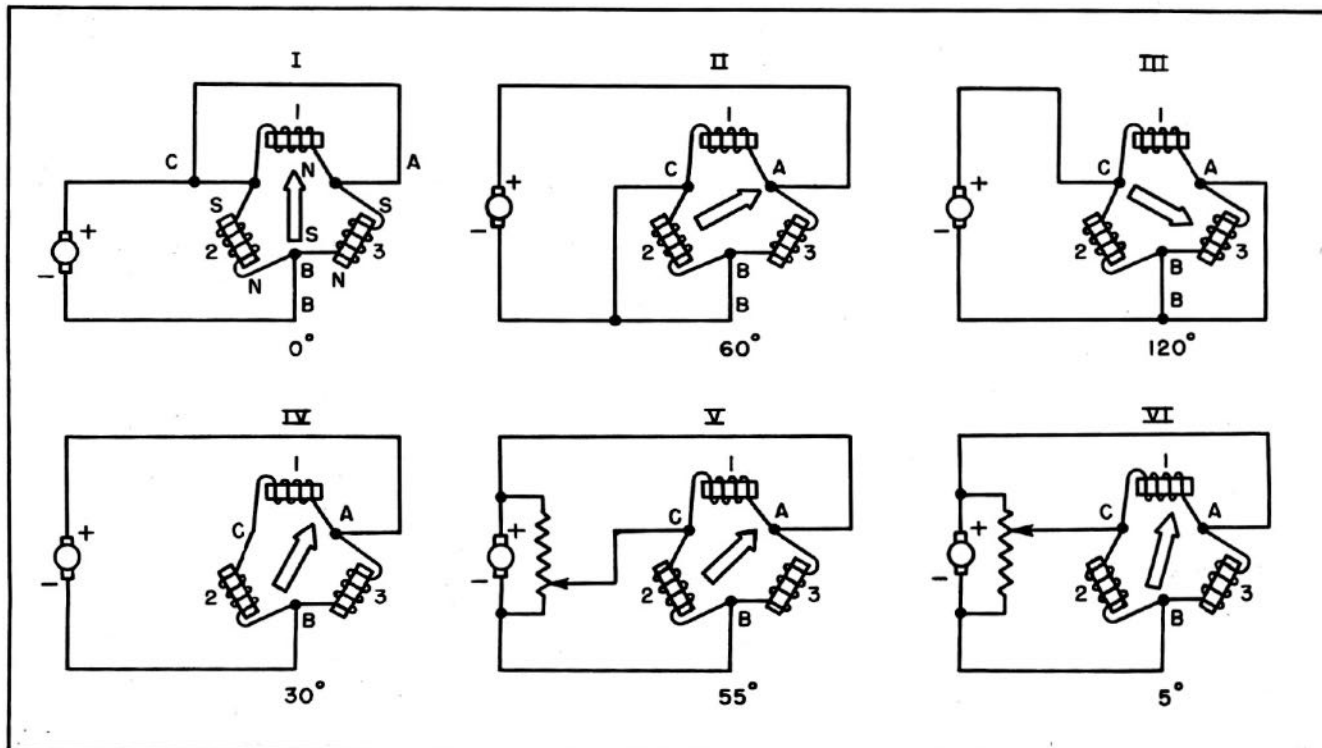


Figure 2-10—Synchro Operation—Simplified Schematic Drawing

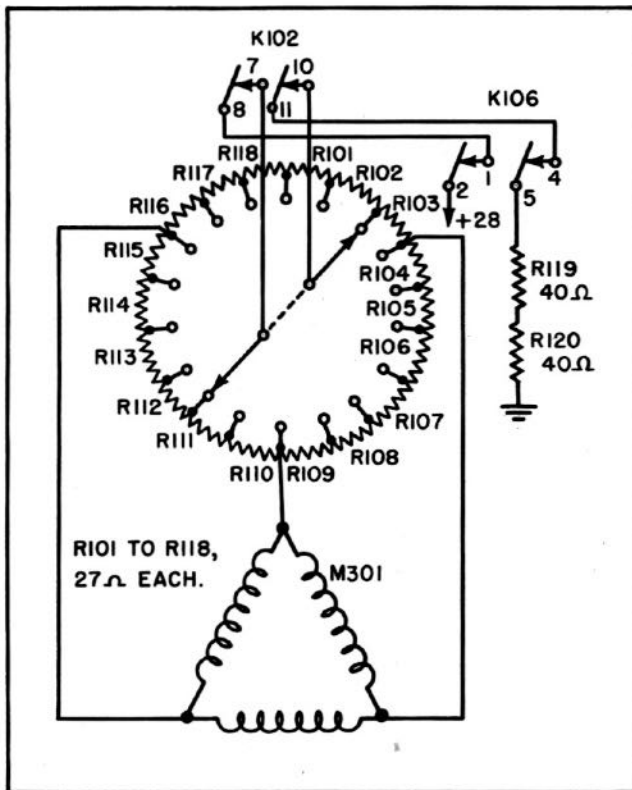


Figure 2-11—Indicator Circuit—Simplified Schematic Diagram

cuits. A single relay K201 serves for change-over of the internal circuits of the power supply unit for transmit or receive conditions.

(2) The power supply unit is used only for controlled equipment having both a transmitter and receiver. In such installations the power supply is utilized only when the "PUSH-TO-TALK" button on the radiophone hand-set is depressed. When the push-to-talk button is pressed, the relay K201 in the power supply unit closes accomplishing the following functions: Contacts 2-1 break, and 2-3 make, removing the series capacitor C203 from the control circuit and permitting a flow of d-c to operate the transmit-receive change-over relay in the controlled equipment. Contacts 4-5 break and 5-6 make permitting a flow of d-c to the microphone through the transformer T202 in the power supply unit. When the "PUSH-TO-TALK" button is pressed, power is also supplied to the "CARRIER ON" indicator on the radiophone unit.

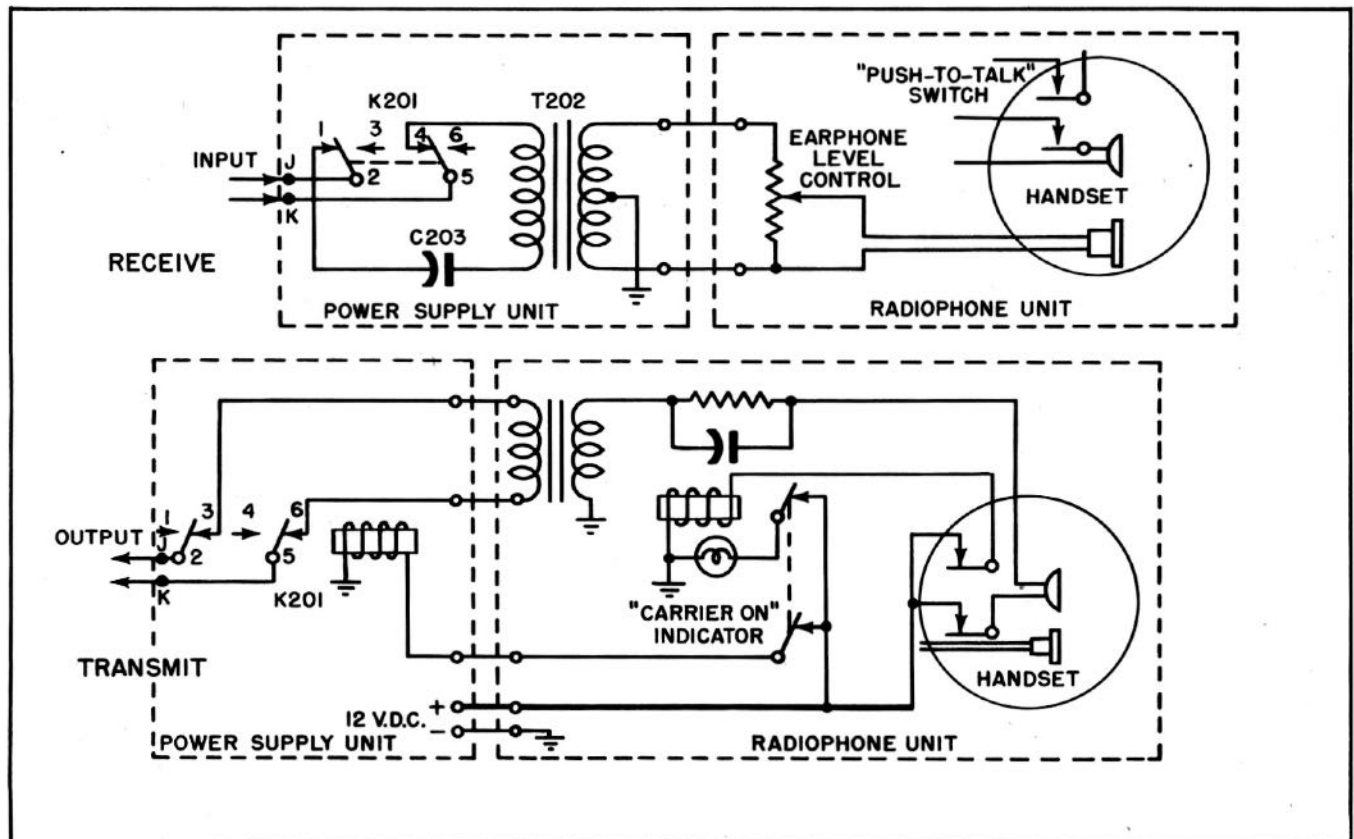


Figure 2-12—Audio Circuits—Simplified Schematic Diagram

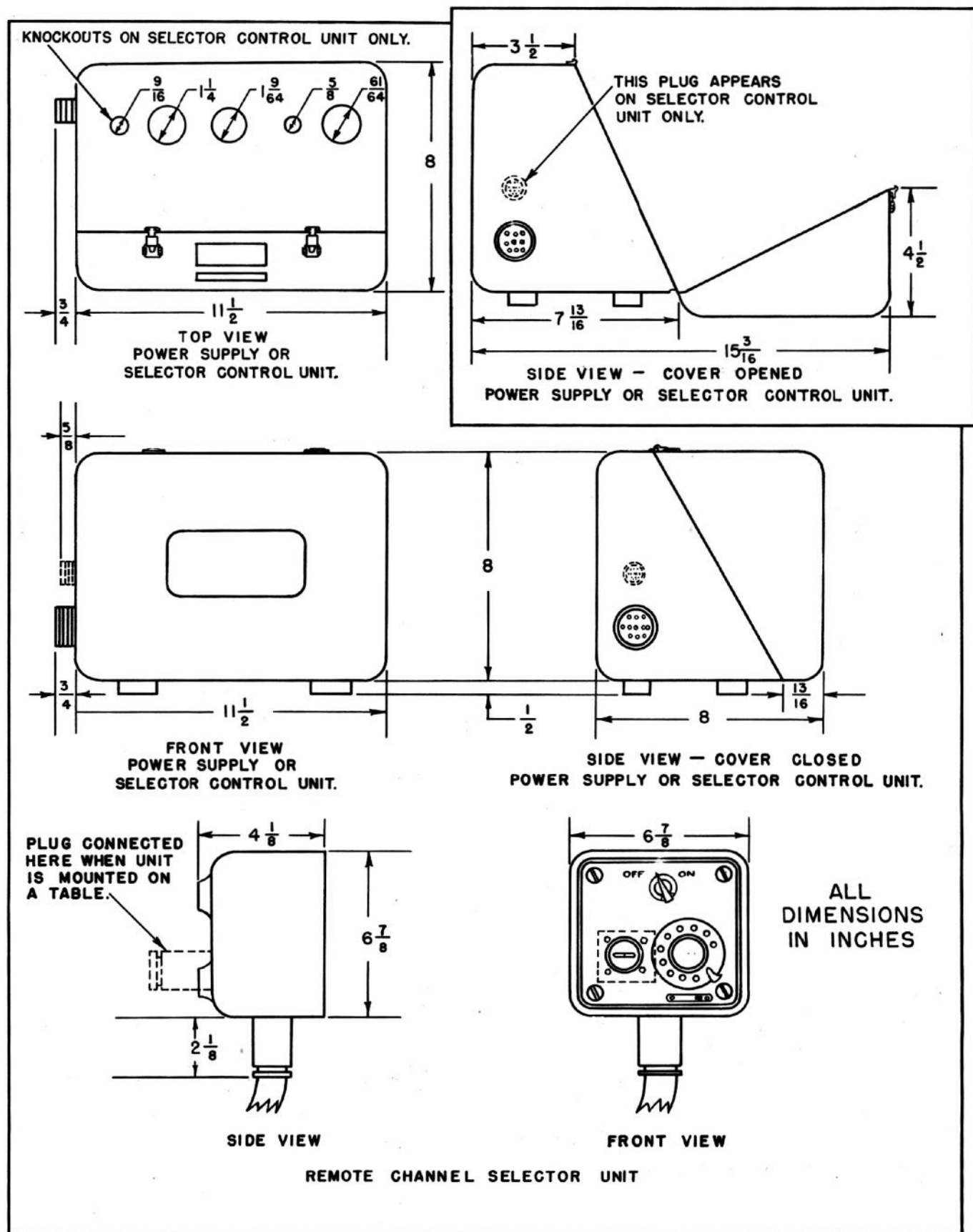


Figure 3-1—Remote Control Indicator System—Outline Dimensional Drawing

SECTION III

INSTALLATION AND ADJUSTMENT

1. UNPACKING THE UNITS.

a. Navy Type CQC-23445 Remote Channel Selector Unit, Figure 3-1, is packed in a wooden crate approximately $15\frac{1}{2} \times 13\frac{3}{8} \times 8\frac{1}{4}$ in. Carefully remove the top of the container and take out the remote channel selector unit. Inspect the unit for evidences of damage incurred in transit. Report any such damage to the officer in charge.

b. Navy Type CQC-23497 Selector Control Unit and Navy Type CQC-20409 Power Supply Unit, Figure 3-1, are packed in individual wooden crates approximately $18\frac{7}{8} \times 15 \times 15\frac{3}{8}$ in. The package containing the selector control unit contains two plugs (AN-3106-22-14S and AN-3106-28-9P), and the crate containing the power supply unit also contains one plug (AN-3106-28-9P). Carefully remove the tops of the containers and take out the units. Make certain that the proper number of plugs are packed with the units. Inspect the units and plugs for damage incurred in transit and report any such damage to the officer in charge.

2. LOCATION OF THE UNITS.

a. REMOTE CONTROL OF RECEIVING EQUIPMENTS—MODELS RDZ, RDR, OR EQUIVALENT.

(1) REMOTE CHANNEL SELECTOR UNIT.—Locate the unit directly beside or above the radiophone unit. The exact location of the two units depends upon the station from which it is desired to control the receiving equipment. The remote channel selector unit may be mounted on a table-top or directly to a bulkhead.

(2) SELECTOR CONTROL UNIT.—Locate the unit adjacent to the controlled equipment. Preferably directly above it. The front panel must be accessible for servicing and 12 inches of clearance must be provided above the unit to permit connection of the necessary cables. It may be mounted to a bulkhead, in which case a shelf must be provided, or to a table-top.

b. REMOTE CONTROL OF TRANSMITTER AND RECEIVING EQUIPMENTS—MODEL MAG OR EQUIVALENT.

(1) Locate the remote channel selector unit and selector control unit as in paragraphs 2.a.(1) and (2) of this section.

(2) Locate the power supply unit adjacent to the selector control unit in order to minimize the length of connecting cable. The front panel must be accessible for servicing. The unit may be mounted to a bulkhead, in which case a shelf must be provided, or to a table-top.

3. MOUNTING THE UNITS.

(See Figures 3-1 and 3-2.)

a. REMOTE CHANNEL SELECTOR UNIT.

(1) BULKHEAD MOUNTING.

(a) Using a template prepared as in Figure 3-2, drill four $1\frac{1}{32}$ -inch holes on $4\frac{5}{8}$ -inch centers in the bulkhead. Select the location of these holes so that at least four inches of clearance is provided beneath the unit to accommodate the lead-in-pipe and connecting cable.

(b) Remove the four screws on the face of the unit that hold the front panel to the case.

(c) Carefully remove the front panel.

(d) Bolt the unit to the bulkhead, passing four $\frac{5}{16}$ -inch bolts through the holes in the bosses on the back of the case.

(e) Attach the front plate to the case with the four screws.

(2) TABLE-TOP MOUNTING.

(a) Using a template prepared as in Figure 3-2, drill four $1\frac{1}{32}$ -inch holes on $4\frac{5}{8}$ -inch centers in the table-top.

(b) Drill a $1\frac{1}{2}$ -inch hole in the table-top on a center that is midway between the forward holes ($2\frac{5}{16}$ inches) and $\frac{3}{8}$ -inch back from their centerlines.

(c) Unscrew the lead-in-pipe from the hole in the bottom of the case.

(d) Unscrew the plug from the hole in the back of the case.

(e) Screw the lead-in-pipe into the hole in the back of the case.

(f) Screw the plug into the hole in the bottom of the case.

(g) Remove the four screws on the face of the unit that hold the front panel to the case.

(h) Carefully remove the front panel.

(i) Attach the unit to the table-top, fitting the lead-in-pipe into the $1\frac{1}{2}$ -inch hole and passing four $\frac{5}{16}$ -inch bolts through the holes in the bosses on the back of the case.

(j) Attach the front panel to the case with the four screws.

b. SELECTOR CONTROL OR POWER UNIT.

(1) BULKHEAD MOUNTING.

(a) Construct a shelf 7 x 11 inches.

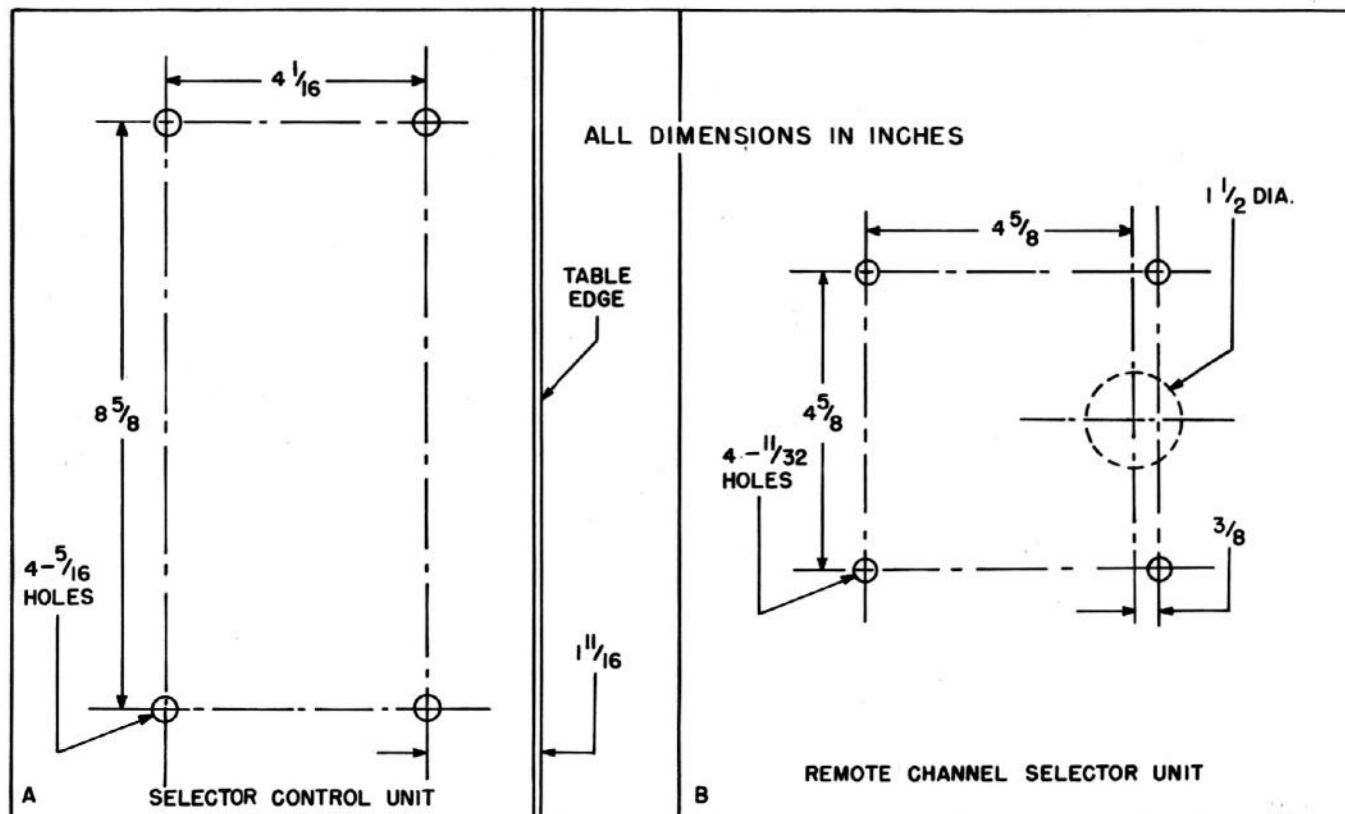


Figure 3-2—Mounting Hole Templates

(b) Using a template prepared as in Figure 3-2, drill four $\frac{5}{16}$ -inch holes in the shelf so that the centerline of the forward pair of holes is $1\frac{1}{16}$ inches from the forward edge of the shelf. This is important in order that clearance be provided to permit opening the hinged front cover of the unit.

(c) Weld the shelf to the bulkhead, allowing at least 20 inches of clearance above it and six inches of clearance to the left of it.

(d) Unsnap the two fasteners on the top of the case and open the hinged front cover of the unit.

(e) Remove the four bolts from the center holes of the shock-mounts on the bottom of the case.

(f) Attach the unit to the shelf, passing the four bolts just removed, or longer bolts if necessary, through the holes in the center of the shock-mounts and the holes in the shelf.

(g) Close and fasten the hinged front cover.

(2) TABLE-TOP MOUNTING.

(a) The table must be located in such a position that there is at least a 20-inch clearance above the surface of the table, and the unit must be so located on the table that there is at least six inches of clearance to the left of the unit.

(b) Using a template prepared as in Figure 3-2, drill four $\frac{5}{16}$ -inch holes in the table-top so that the centerline of the forward pair of holes is $1\frac{1}{16}$ inches from the forward edge of the table. This is important, for clearance must be provided to permit opening of the hinged front cover.

(c) Proceed as in subparagraphs 3.b.(1)(d) through (g) of this section.

4. INTERCONNECTING THE UNITS.

a. REMOTE CONTROL OF RECEIVING EQUIPMENTS—MODELS RDZ, RDR, OR EQUIVALENT. (See Figure 3-3.)

(1) TTHFA-10 CABLE.

(a) Measure the distance from socket J101 on the selector control unit to the proper socket on the controlled equipment, allowing the necessary slack for installation of the cable.

(b) Attach connector P101 (AN-3106-22-14S), supplied with the selector control unit, to the length of TTHFA-10 cable determined in the paragraph above. See Figure 3-4 for step-by-step instructions on the attachment of the plug to the cable.

(c) Connect plug P101 to socket J101 on the left side of the unit.

(2) MHFA-7 CABLE.

(a) Obtain the length of MHFA-7 cable necessary to connect the selector control unit to the remote channel selector unit. Allow sufficient slack for installation of the cable.

(b) Remove the four screws holding the front panel of the remote channel selector unit to the case.

(c) Carefully lift out the front panel.

(d) Insert the MHFA-7 cable into the remote channel selector unit through the lead-in-pipe.

(e) Strip back approximately four inches of insulation on cable MHFA-7.

(f) Connect the exposed wires of the cable to the terminal strip on the back of the front panel. Allow sufficient slack to permit removal of the front panel for servicing. See Figure 3-3 when making the connections.

(g) Fasten the front panel to the case with the four screws.

(h) Unsnap the two fasteners on the top of the selector control unit and open the hinged front cover.

(i) Remove the $\frac{5}{16}$ -inch knockout from the top of the case.

NOTE

In the event that cable MHFA-19 is used, combining cables MHFA-7 and TTHFA-3, use the $\frac{1}{4}$ -inch knockout.

(j) Using a standard Navy stuffing tube, bring the selector control unit end of the MHFA-7 cable into the case through the knockout.

(k) Remove approximately four inches of insulation from the end of the cable and connect the exposed wires to the terminal strip at the rear of the case as in Figure 3-3.

(3) TTHFA-3 CABLE.—Connect the radiophone unit to the selector control unit with the necessary length of TTHFA-3 cable. Bring the cable into the selector control unit through the $\frac{5}{8}$ -inch knockout in the top of the case using a stuffing tube. See Figure 3-3 when connecting the cable to the terminal boards of the two units.

(4) MCOS-2 CABLE.—Using a length of MCOS-2 cable, connect the selector control unit to a source of 115-volt, 50/60-cycle current. Bring the cable out through the $\frac{5}{16}$ -inch knockout in the top of the case using a stuffing tube. See Figure 3-3 when connecting the cable to the terminal board of the selector control unit.

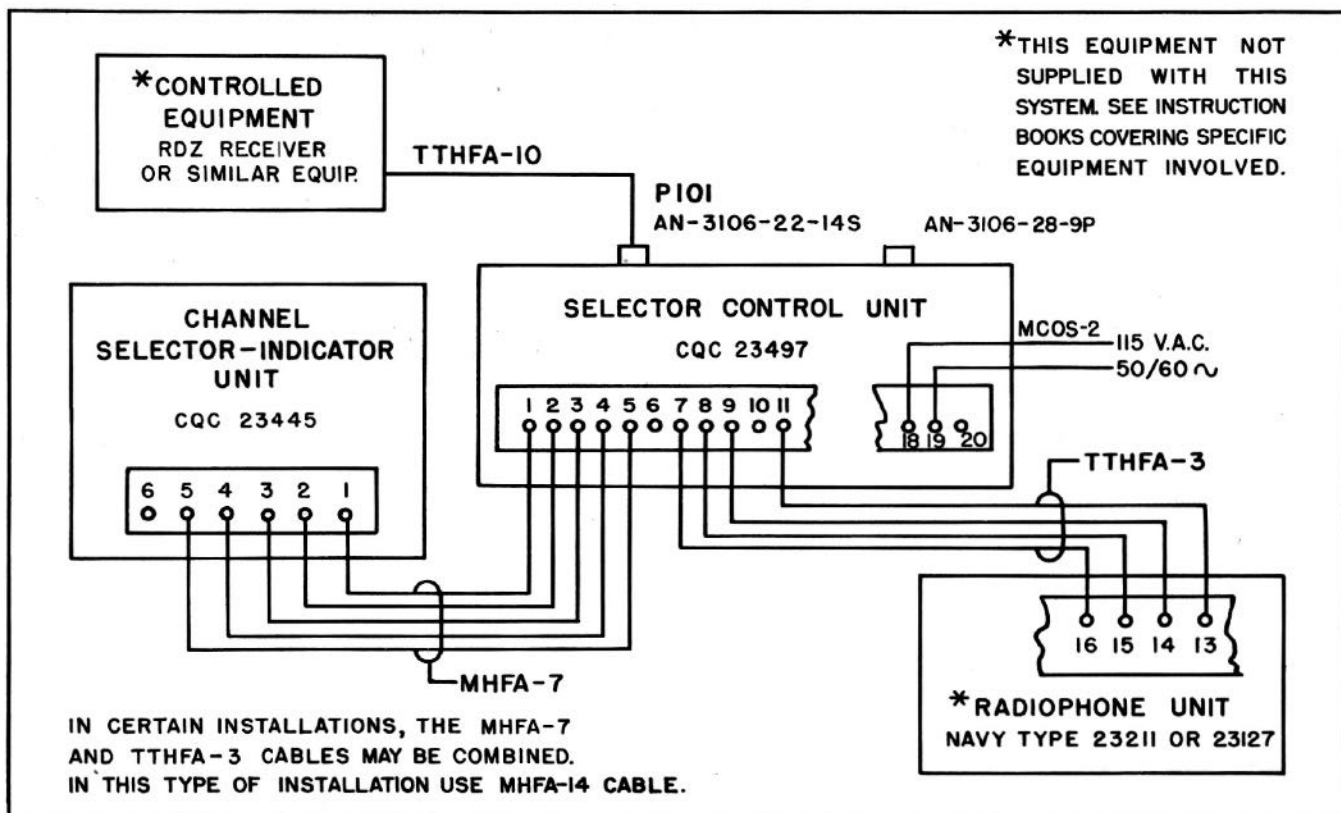
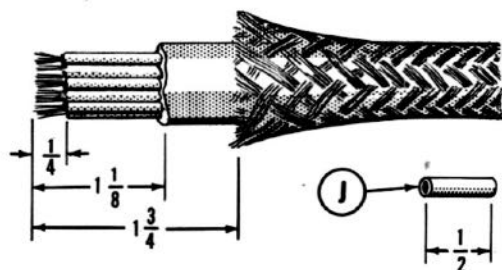
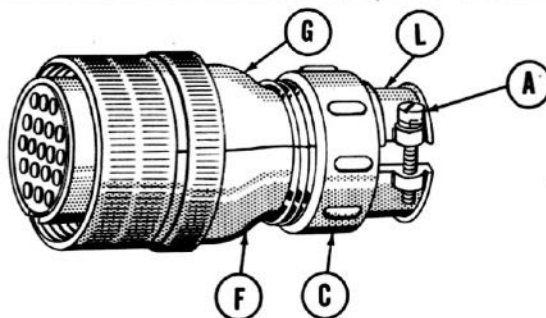


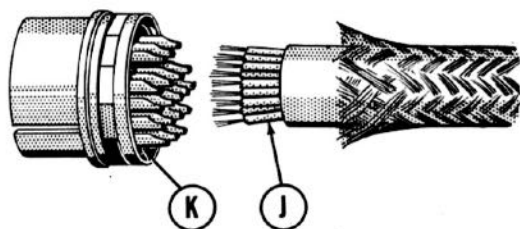
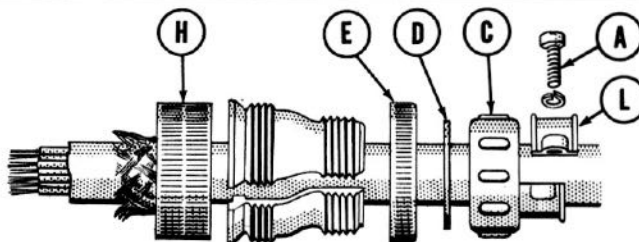
Figure 3-3—Remote Control Indicator System for Receiving Equipment—
Interconnection Diagram

1. Disassemble the plug as follows: Unscrew the cable clamp "C," and remove screws "A" and "B" to take off the cable clamp cap "L." Remove the rubber washer "D." Unscrew the split shell clamping ring "E," and remove the halves of the split shell, "F" and "G." Remove the coupling ring "H."



2. Strip the metal braid back $1\frac{1}{4}$ inches. Remove $1\frac{1}{8}$ inches of the rubber sheath and insulating filler. Strip the color-coded rubber insulation off the wires for $\frac{1}{4}$ inch and tin the end of each wire. Slide a $\frac{1}{2}$ inch length of sleeving "J" back on each wire.

3. Slide the following items over the prepared end of the cable in the order named: cable clamp "C," rubber washer "D," split shell clamping ring "E," and coupling ring "H." Each part must face in the correct direction for final assembly of the plug.



4. Solder the end of each wire into its proper terminal on the insert "K." Move the sleeves "J" forward to cover each soldered connection.

5. Slide the coupling ring "H" forward on the plug. Assemble the split shell ("F" and "G") in place, and secure the halves by screwing on the split shell clamping ring "E." Slide the rubber washer "D" into position against the end of the split shell. Screw the cable clamp "C" onto the rear end of the split shell. Hold the cable firmly during this operation to prevent unnecessary strain on the soldered wire connections. Reassemble the cable clamp cap "L" by means of the screws "A" and "B."

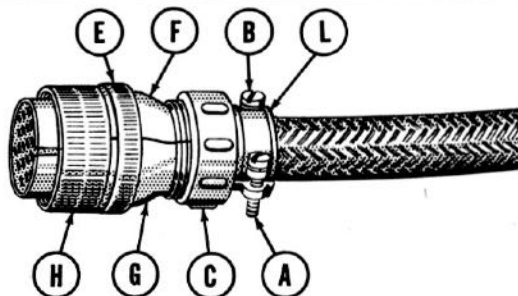


Figure 3-4—Cable Assembly Diagram

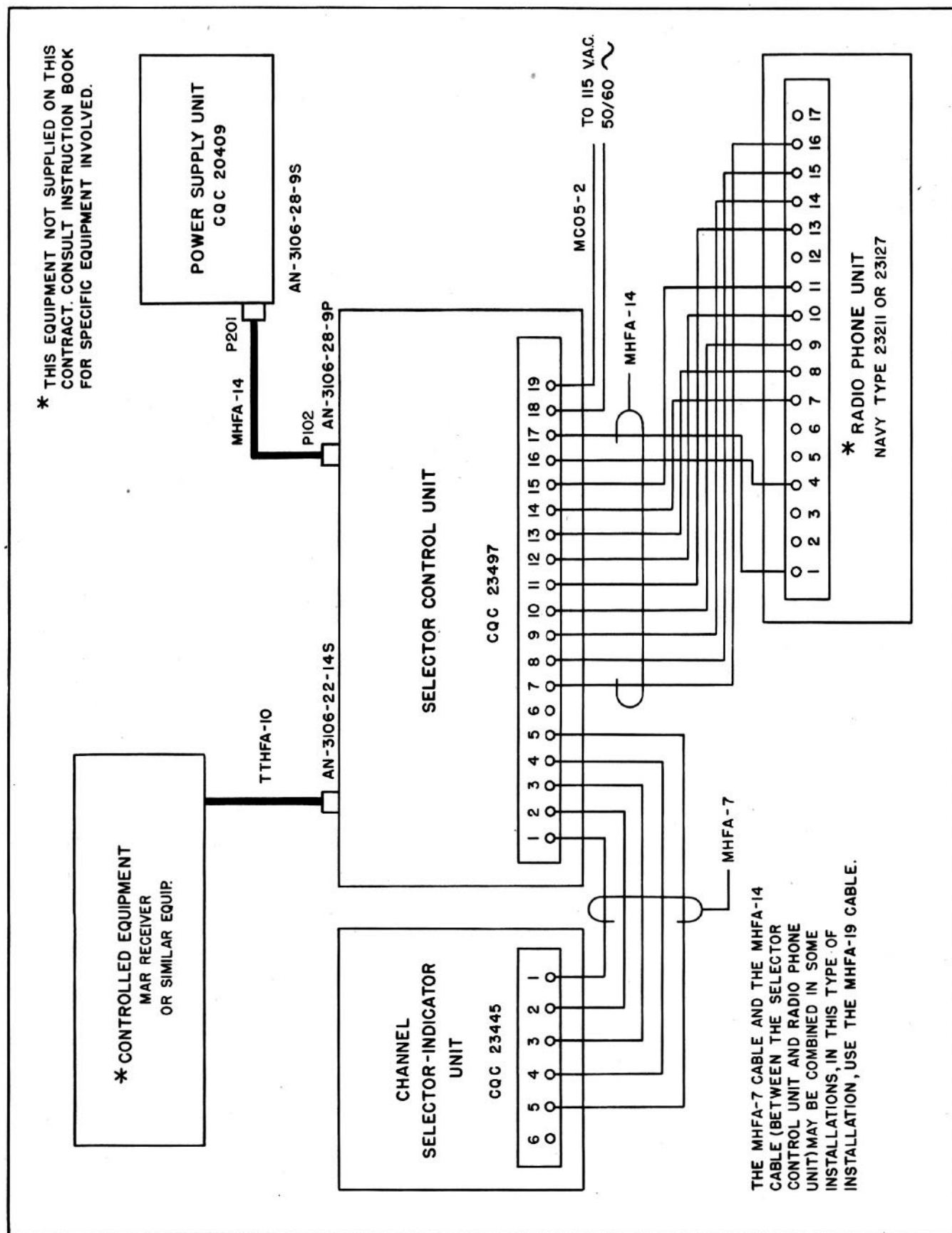


Figure 3-5—Remote Control Indicator System for Receiving and Transmitting Equipment—Interconnection Diagram

(5) SOCKET J102.—Insert the dummy plug P102 (AN-3106-28-9P), provided with the selector control unit, into socket J102. This plug has jumpers soldered into it connecting pins J-A and K-L. This plug MUST be in place.

b. REMOTE CONTROL OF TRANSMITTING AND RECEIVING EQUIPMENTS—MODEL MAR OR EQUIVALENT. (See Figure 3-5.)

(1) TTHFA-10 CABLE.—Follow the procedure established in subparagraph 4.a.(1) of this section.

(2) MHFA-7 CABLE.—Follow the procedure established in subparagraph 4.a.(2) of this section.

(3) MHFA-14 CABLE TO RADIOPHONE.—Obtain the length of MHFA-14 cable necessary to connect the radiophone unit to the selector control unit, allowing sufficient slack for installation of the cable. Bring the cable into the selector control unit through the 1 $\frac{3}{4}$ -inch knockout on the top of the case. See Figure 3-5 when connecting the cable to the terminal boards of the two units.

(4) MCOS-2 CABLE.—Follow the procedure established in subparagraph 4.a.(4) of this section.

(5) MHFA-14 CABLE TO POWER SUPPLY UNIT.

(a) Obtain the length of MHFA-14 cable necessary to connect the socket (J201) on the power supply unit to the socket (J102) on the selector control unit.

(b) Disassemble plug P102 (AN-3106-28-9P) as in step 1 of Figure 3-4 and remove the wire jumpers connecting pins J-A and K-L.

(c) Attach connector P102 (AN-3106-28-9P), supplied with the selector control unit, to one end of the cable and connector P201 (AN-3106-28-9S), supplied with the power supply unit, to the other end. See Figure 3-4 for step-by-step instructions on the attachment of these connectors to the cable.

(d) Connect the two units as shown in Figure 3-5.

c. REMOTE CONTROL OF VARIED EQUIPMENT SYSTEMS.—The subject equipment is suited for remote control of systems involving the use of a number of transmitter and/or transmitter-receiver units, controlled from several remote stations. Typical installations of this nature are shown in block diagrams "A" to "E" in Figure 3-6.

5. ADJUSTING AND TESTING THE UNITS.

a. RECEIVING EQUIPMENTS—MODELS RDZ, RDR, OR EQUIVALENTS.

(1) Fill out the log card on the front panel of the remote channel selector unit with information relating the dial numbers to the channels on which the controlled equipment operates.

(2) Check the small plate beneath the dial of the remote channel selector unit to make certain that the side marked "RECEIVER" is showing. Fill in the blank with the designation of the receiving equipment to which the unit is attached.

(3) Unsnap the fasteners on the top of the selector control unit and open the hinged front cover.

(4) Check that the links on link board E105 connect to terminals 3-1 and 4-6.

(5) Close and fasten the hinged front cover.

(6) Place the "LOCAL-REMOTE" switch on the controlled receiving equipment on "REMOTE."

(7) Place the "POWER ON-OFF" switch on the selector control unit in the "ON" position.

(8) Turn the "OFF-ON" switch on the remote channel selector unit to the "ON" position.

(9) Dial "1" on the "CHANNEL SELECTOR" of the remote channel selector unit. Check that the "CHANNEL INDICATOR" registers "1" and the controlled equipment is operating on channel "1."

(10) Repeat for each channel from 2 to 10.

(11) Set the "LOCAL-REMOTE" switch on the controlled equipment to "LOCAL" and check that the "CHANNEL INDICATOR" on the remote channel selector unit registers "LOCAL."

b. RECEIVING AND TRANSMITTING EQUIPMENTS—MODEL MAR OR EQUIVALENT.

(1) Fill out the log card on the front panel of the remote channel selector unit with information relating the dial numbers to the channels on which the controlled equipment operates.

(2) Check the small plate beneath the dial of the remote channel selector unit to make certain that the side marked "TRANSMITTER" is showing. Fill in the blank with the designation of the equipment to which the unit is attached.

(3) Unsnap the fasteners on the top of the selector control unit and open the hinged front cover.

(4) Check that the links on link board E105 connect to terminals 3-5 and 4-6.

(5) Close and fasten the hinged front cover.

(6) Perform the steps outlined in subparagraph 5.a.(6) through (10) of this section.

(7) With the radiophone unit in proper working condition press the "PUSH-TO-TALK" button on the handset. Illumination of the "CARRIER ON" lamp indicates that the power supply unit is operating satisfactorily.

(8) Set the "LOCAL-REMOTE" switch on the controlled equipment to "LOCAL" and check that the "CHANNEL INDICATOR" on the remote channel selector unit registers "LOCAL."

(9) Turn the "POWER ON-OFF" switch on the selector unit to the "OFF" position.

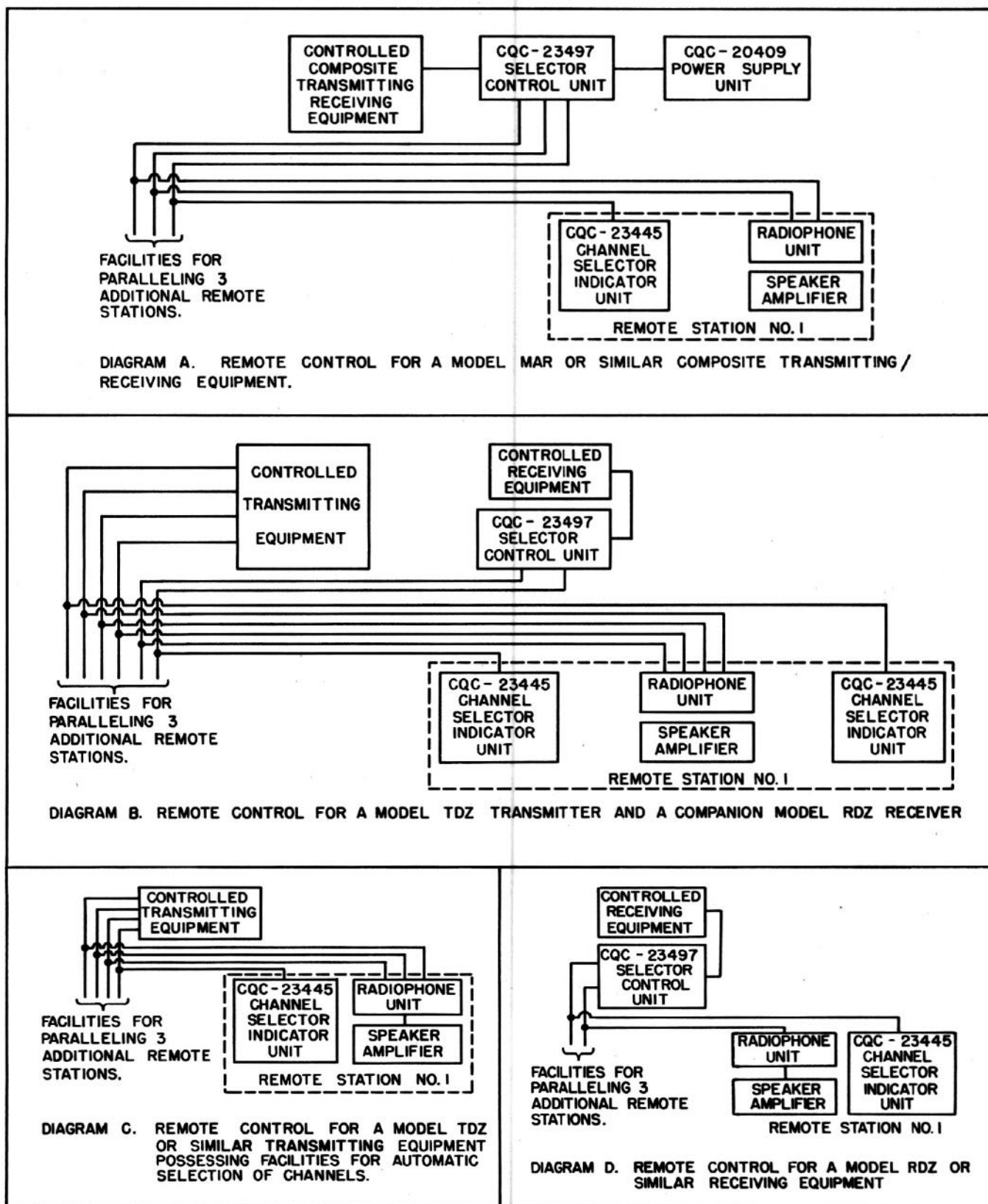


Figure 3-6—Block Diagrams of Additional Systems

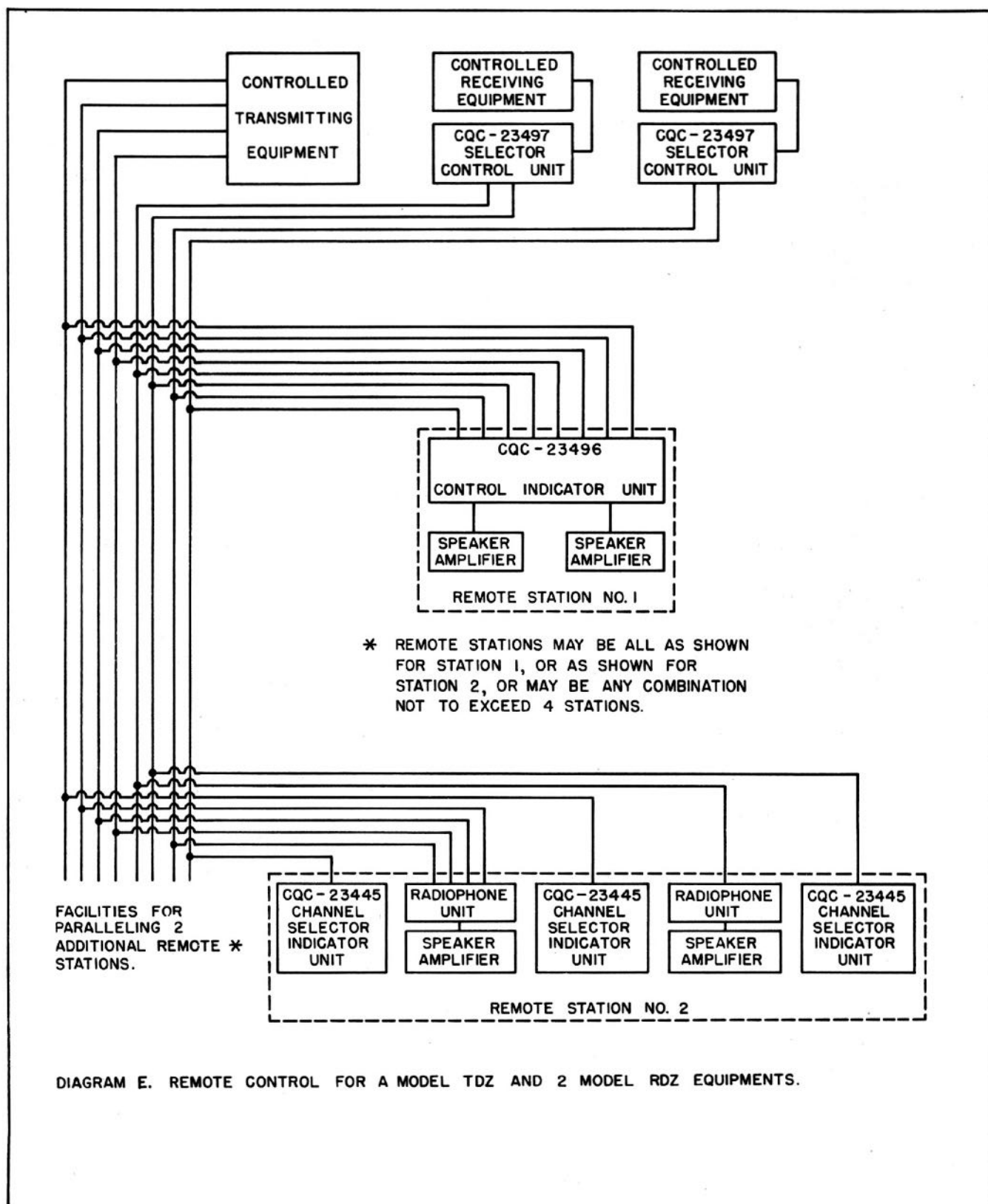


Figure 3-7—Block Diagram of Additional System

SECTION IV OPERATION

1. TO TURN THE EQUIPMENT ON.

a. Place the "POWER ON-OFF" switch on the selector control unit in the "ON" position.

b. Turn the "OFF-ON" switch on the remote channel selector unit to the "ON" position.

c. If the "CHANNEL INDICATOR" reads "LOCAL," place the "LOCAL-REMOTE" switch on the controlled equipment in the "REMOTE" position.

d. Dial the desired channel. The "CHANNEL-INDICATOR" should then point to the dialed channel.

e. If a transmitting-receiving equipment is being controlled, depress the "PUSH-TO-TALK" button on the handset. The "CARRIER-ON" light on the radiophone unit should flash on. The transmitter may then be modulated from the hand-set microphone.

f. Release the "PUSH-TO-TALK" button when

transmission has been completed. Received signals on the channel in use are then audible.

2. WHAT TO CHECK.

a. If the pointer should be found to point to the heavy line between channel "1" and "LOCAL," the indicator has been cleared by accidental movement of the dial. To obtain the proper channel, redial the desired channel.

b. If the "CARRIER-ON" indicator on the radiophone unit is illuminated, the transmitter is in use and the equipment should not be disturbed.

c. If a signal input or noise level is not audible on the headphone or speaker, press the "NOISE SUPPRESSOR" button on the radiophone unit. Receiver noise should then be audible.

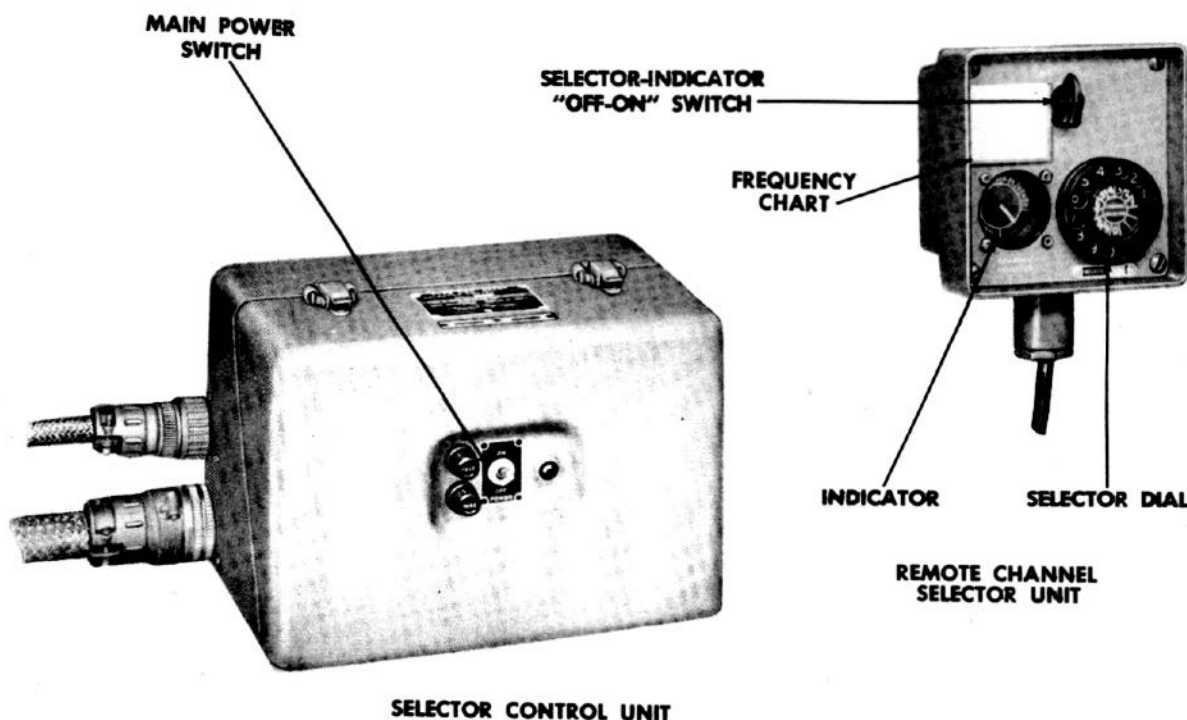


Figure 4-1—Remote Control Indicator System—Operating Controls

3. TO TURN THE EQUIPMENT OFF.

a. Turn the "OFF-ON" switch on the remote channel selector unit to the "OFF" position.

b. Turn the "POWER ON-OFF" switch on the selector control unit to the "OFF" position.

NOTE

Turning off the remote channel selector unit and selector control unit serves only to disable the control equipment at the station so turned off. It does not prevent operation of the controlled equipment from another remote control station.

SECTION V

OPERATOR'S MAINTENANCE

1. OPERATOR'S INSPECTION CHART.

UNDERWAY—EACH WATCH

NOTE

These units are always used with other major equipments. In any case where trouble exists and control equipment apparently is operating satisfactorily as evidenced by proper operation of relays in dialing, etc., check the associated equipments.

<i>What To Check</i>	<i>How To Check</i>
<i>a. Pilot Lights.</i>	1. Place the "ON-OFF" switch on the selector control unit in the "ON" position and check to see that the pilot light on the selector control unit and power supply unit is illuminated. 2. If the transmitting equipment is connected and dial and channel indicators are functioning properly, press the "PUSH-TO-TALK" switch on the hand-set. The "CARRIER ON" indicator on the radiophone unit should light. <i>If the "CARRIER ON" pilot light on the radiophone unit is illuminated, do not touch the "PRESS-TO-TALK." Instead, check first to determine that the transmitter is not already in use.</i>
<i>b. Receiver Signal.</i>	1. With equipment operating on a selected channel, listen for signal input or noise on headset or speaker. If nothing is audible, press the "NOISE SUPPRESSOR" button on the radiophone unit.
<i>c. "CHANNEL INDICATOR"</i>	1. With equipment operating, dial each channel. Check indicator to see that it reads properly. If the indicator points to the heavy line between channel "1" and "LOCAL," the dial has been bumped after selection of the channel. Redial the desired channel.

2. FUSES.

a. FUSE FAILURE.—A fuse failure is usually indicated when the equipment cannot be controlled from the remote position, the pilot lights on the front panel of the selector control unit and power supply unit are out, and the "CARRIER-ON" light on the radiophone unit a quarter-turn counter-clockwise and pull the caps ton on the hand-set is pressed.

(1) Rotate the black knurled fuse caps of the two active fuses on the front panel of the selector control unit a quarter-turn counter-clockwise and pull the caps straight out from the front panel.

(2) Inspect the fuses in the caps. A blown fuse is usually characterized by a visible break in the metal ribbon within the glass body of the fuse and a cloudy deposit on the inside of the glass.

WARNING

Never replace a fuse with one of higher rating unless continued operation of the equipment is more important than probable damage. If a fuse burns out immediately upon replacement, DO NOT REPLACE IT A SECOND TIME until the cause of trouble has been corrected. Turn the equipment over to qualified maintenance personnel.

b. REPLACEMENT OF FUSE.—(See Figure 5-1.) If either or both of the fuses inspected should prove defective:

(1) Unsnap the fasteners on the top of the case of the selector control unit and open the hinged front cover.

(2) Remove one or both of the spare 1-ampere, 115-volt fuses from their clips, located on the chassis.

(3) Remove the defective fuse from the clip in the black knurled fuse cap and insert one of the spare 1-ampere, 115-volt fuses.

(4) Close the front cover of the selector control unit and snap shut the fasteners.

(5) Insert the fuse cap into its receptacle on the front cover of the unit and, pushing in on the cap, rotate it a quarter-turn clockwise.

3. PILOT LIGHTS.

a. If the equipment is operative but a pilot light is not illuminated, remove the jewel by grasping it firmly and rotating it counter-clockwise until the threads have disengaged.

b. Push in on the 12-volt, .10-ampere bulb, which will give slightly in its spring socket, and rotate it a quarter-turn counter-clockwise. A readily felt outward pressure on the bulb indicates that the two pins on the base of the bulb have disengaged and the bulb may be withdrawn from the socket.

c. Insert a new 12-volt, .10-ampere, clear, miniature bayonet base bulb into the socket so that the pins on the side of the base engage the slots in the socket. Pushing in on the bulb, rotate it a quarter-turn in a clockwise direction.

d. Replace the jewel by screwing it on in a clockwise direction.

4. CONNECTORS.

a. If the equipment is not operative and the pilot lights are not illuminated, but the fuses prove to be good, check the cable from the power supply unit to the selector control unit and the 50/60 cycle, 115-volt a-c end of the MCOS-2 cable which enters the selector control unit through the $\frac{3}{16}$ knockout in the top of the case. Reseat the connectors if they appear to be loose in their sockets.

b. If the remote units are operating satisfactorily, as indicated by proper operation of relays, but the controlled equipment does not respond, check the cable from the selector control unit to the controlled equipment.

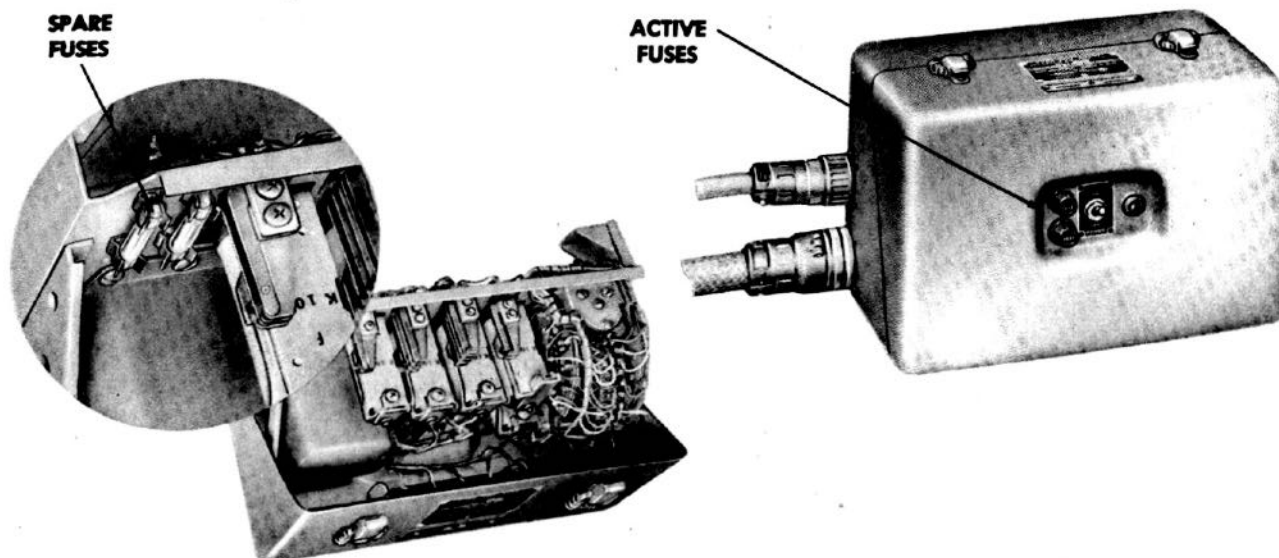


Figure 5-1—Fuse Location

SECTION VI

PREVENTIVE MAINTENANCE

NOTE

The attention of maintenance personnel is invited to the requirements of Chapter 67 of the "Bureau of Ships Manual" of the latest issue.

1. RELAYS.

(See Figures 7-2, 7-3, 7-5, 7-12, and 7-13.)

a. INSPECTION.—Inspect all relays weekly (K101 through K107 in the selector control unit and K201 in the power supply unit). None of the relays need be removed from their units for this inspection. Use a flashlight and mirror to inspect those relays that are less accessible (K107 and K104). In addition, inspect the contacts on the dial mechanism in the remote channel selector unit. Inspect for:

(1) CONNECTIONS TO RELAYS.—Inspect all wiring for sound joints and well soldered connections. Re-solder suspected connections.

(2) RELAY MOUNTING.—Inspect attaching screws for evidences of looseness. Insure that relay assemblies are firmly attached to the chassis.

(3) MECHANICAL ACTION.—Manually depress the armatures which should move freely, without binding or dragging. Observe that the moving and stationary contacts come together in a positive manner and that they are directly in line with each other.

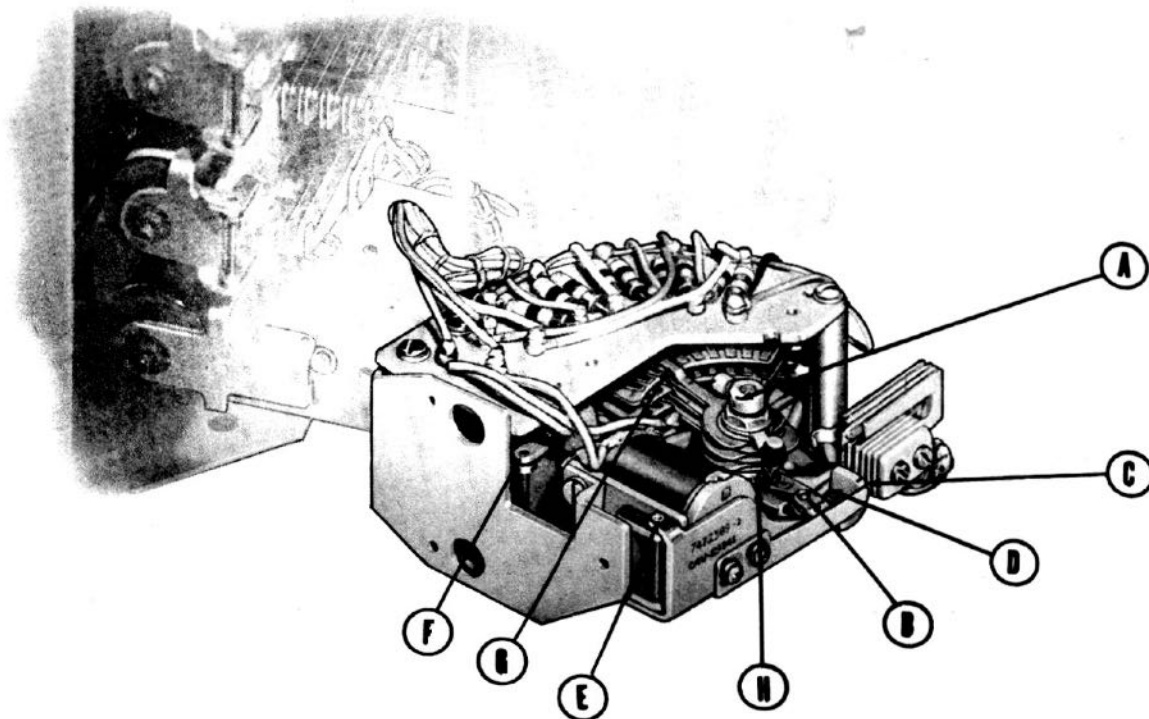


Figure 6-1—Lubrication Points for Minor Switch

If the operation of a relay is faulty refer to paragraph 4, Section VII.

(4) **CONTACT SURFACES.**—Inspect the surfaces of the contacts for films of dirt and evidences of cones and craters. Films may form from the oxidizing action of the air or, more commonly, from grease. A greasy film will carbonize, due to the flow of current, and leave rings of carbon on the contacts which may build up to such an extent that the contacts are prevented from closing. Cones and craters are caused by the flow of current in one direction through the contacts. This uni-directional flow results in the removal of metal from one contact (crater) and the deposit of it on the other (cone). If evidence of film is detected, refer to subparagraph *b.* of this paragraph. If cones and craters are detected, refer to paragraph 4, Section VII.

b. **CLEANING.**—Clean all relays monthly or more frequently if inspection indicates the need. None of the relays need be removed from their units for this cleaning. Use a flashlight and mirror to aid in the cleaning of those relays that are less accessible (K107 and K104). In addition, clean the contacts on the dial mechanism in the remote selector unit.

(1) Dip a strip of clean wrapping paper in fresh carbon tetrachloride. Permit the excess liquid to drain from the paper.

(2) Insert the paper between the contacts and, holding them closed, withdraw the paper. Repeat the operation if the amount of film warrants it.

(3) Insert a strip of clean wrapping paper be-

tween the contacts and, holding them closed, withdraw the paper. Repeat this operation until the contacts are polished clean and dry.

2. LUBRICATION OF MINOR SWITCH.

(See Figure 6-1.)

WARNING

DO NOT LUBRICATE THE TELEPHONE DIAL MECHANISM.

a. PREPARATION FOR LUBRICATION.

(1) Unsnap the fasteners on the top of the selector control unit case and open the hinged front cover.

(2) Locate the link board in the upper right hand corner of the bottom of the chassis contained in the front cover. (See Figure 7-2.)

(3) Remove the two 6-32 screws which hold the link board to the bottom of the chassis.

(4) Gently pull the link board away from the chassis exposing two screws. These screws, together with the screw located beneath resistor R119 (see Figure 7-2) attach the minor switch to the top right hand corner of the chassis. Remove the three screws.

(5) Tilt up the minor switch, being careful not to place too much tension on the connecting wiring.

(6) When lubrication has been completed, attach the minor switch and link board to the chassis following subparagraphs *a.* through *d.* of this paragraph in inverse order.

b. LUBRICATION PROCEDURE.

SEMI-ANNUALLY	Point	Part	Location	Lubricant	Instructions
	A	Wiper Assembly Bearing	Beneath slot in top of wiper shaft	Sperm Oil (Clock Weight)	Distribute one "dip"* of lubricant among points A, B, C, and D, in the order named.
	B	Pawl Bearing	"Stepper" Armature		
	C	"Stepper" Armature Spring Bearing Surface	Forepart of frame		
	D	Pawl Guide Arm Bearing Surface	Forepart of frame		
	E	"Stepper" Armature Bearing Pin	Left of "Stepper" coil mounting plate		Distribute one "dip"* between points E and F in the order named.
	F	"Release" Armature Bearing Pin	Left of "Release" coil mounting plate		

b. LUBRICATION PROCEDURE (Continued)

SEMI-ANNUALLY	Point	Part	Location	Lubri- cant	Instructions
	G	Wiper Tips	End of Wiper Arms	Sperm Oil (Clock Weight)	(1) Manually move wiper tips to third or fourth contact. (2) Distribute one "dip"* among three decks of switch—touching each deck top and bottom on the bare section to the left of the first contact. (3) Depress "release" armature allowing tips to snap back to the extreme left position. (4) Move tips gently back and forth over oiled spots. (5) Move tips to extreme right hand contact. (6) Remove excess oil from decks with clean fiber or dry brush.
	H	Ratchet Teeth	Bottom of wiper arm shaft		Distribute one "dip"* among teeth.

*DIP A SMALL ARTIST'S BRUSH IN THE INDICATED LUBRICANT TO A DEPTH OF $\frac{3}{8}$ INCH, SCRAPE THE BRUSH ON THE SIDES OF THE CONTAINER UNTIL THERE IS NOT SUFFICIENT OIL ON THE BRISTLES TO FORM A DROP AT THE TIP THE OIL REMAINING ON THE BRISTLES CONSTITUTES A "DIP."

SECTION VII

CORRECTIVE MAINTENANCE

1. REPLACEMENT OF FUSES AND LAMPS.—Paragraphs 2 and 3 of Section V give detailed procedures for the replacement of fuses and lamps.

2. SYSTEM TROUBLE SHOOTING.

a. GENERAL.—The primary indication of faulty equipment is inability to dial the desired channel from the remote station or false indication of the channel dialed. The most commonly experienced troubles are blown fuses, burned out pilot light bulbs, inadequate source of 110-volt power, loose plugs, and defective connections to terminal boards or plug and socket pins. Look for these troubles first.

b. LOCALIZATION OF TROUBLE.

(1) INABILITY TO DIAL THE DESIRED CHANNEL OR FALSE CHANNEL INDICATION.—This will most generally be caused by the selector control unit. Secondly, it may be caused by the dial mechanism of the remote selector unit, the two contacts which the dial mechanism activates, or, more seldom, by the channel indicator itself. The remote channel selector unit may usually be eliminated as a source of trouble by removing the front panel and observing the connections to the terminal board and the action of the impulse cam and two contacts while dialing.

(2) PILOT LIGHT ON SELECTOR CONTROL UNIT.—Failure of the pilot light on the selector control unit to illuminate when the "POWER ON-OFF" switch is turned on will most probably be caused by a burned out bulb or blown fuse, F101 or F102, in the selector control unit. Secondly, it may be caused by failure of the 110-volt power supply or defective connections to it or terminals 18 and 19 of the selector control unit.

(3) PILOT LIGHT ON POWER SUPPLY UNIT.—The pilot light on the power supply unit should light when the selector control unit is turned on. If it does not and the pilot light on the selector control unit is illuminated, the trouble is in the power supply unit or the cable between it and the selector control unit. If the selector control unit pilot light is likewise out see subparagraph (2) preceding.

(4) TRANSMITTER CANNOT BE CONTROLLED.—Inability to control the transmitter and obtain the channel dialed will most commonly be caused by the power supply unit (relay K201). However, do not overlook the possibility of trouble in the controlled equipment or associated equipment.

(5) RECEIVER CANNOT BE HEARD.—Inability to hear the receiver may be caused by the selector control unit or the power supply unit (if one is used). Always depress the "NOISE SUPPRESSOR" button on the radiophone unit when this trouble is reported and check for a noise level under this condition. Do not overlook the possibility that the controlled equipment or associated equipment may be defective.

3. UNIT TROUBLE SHOOTING.

a. GENERAL.—First check the connections to the unit and the wiring to the sockets and terminal boards within the unit. Check the fuses and lamps within the unit and inspect visually for evidences of burned out resistors or capacitors or badly pitted contacts on the relays (see paragraph 4 of this section). The following voltage and resistance charts will be helpful in a general analysis of troubles within the units.

WARNING

Make sure all power is off when using an ohmmeter.

(1) SELECTOR CONTROL UNIT.—(See Figure 7-14.) The voltage values to ground were taken with a 1000 ohm-per-volt, d-c meter. The resistance values to ground were taken with interconnection cables removed. Values should not vary more than 10%.

VOLTAGE AND RESISTANCE TABLE

<i>Point</i>	<i>To</i>	<i>Voltage</i>	<i>Resistance</i>
Output (red lead) CR101	Ground	28	
Wipe tips, minor switch, B bank (facing unit it is left hand bank)	Ground	28	
See Figure 7-10 and check voltage indicated for terminals 1, 2, and 3 at channel setting of minor switch.	Ground		
R101 (minor switch at "OFF" position and remote selector control unit at "OFF" position).	R109		243
R110	R118		243
Wipe tips, minor switch, A bank (facing unit it is right hand bank).	Ground		80

(2) POWER SUPPLY UNIT.—(See Figure 7-1.) Voltage readings taken with 1000 ohms-per-volt d-c meter. Resistance reading taken with cable disconnected.

Point to Ground	Voltage	Resistance
Output terminal CR201	14.5	40
Socket I201	14	45

b. TROUBLE IN POWER CIRCUIT.

(1) SELECTOR CONTROL UNIT.

- (a) Check power source with an a-c voltmeter.
- (b) Check MCOS-2 cable connections.
- (c) Check a-c voltage across terminals 1 and 2 of transformer T101 (see Figure 7-2) with an a-c voltmeter. 110 volts a-c should be indicated. If not:
 1. Check fuses F101 and F102.
 2. With fuses out and "POWER ON-OFF" switch in "ON" position, check for continuity across input and output terminals of switch with resistance meter.
 3. Check for continuity across terminals 1 and 2 of transformer T101. 10 ohms should be indicated.

(d) Test across terminals 3 and 5 of transformer T101 with an a-c voltmeter; 34 volts a-c should be indicated. Test across terminals 3 and 4; 12 volts a-c should be indicated. If not:

1. Test for continuity (with power off) from 3 to 5 and 3 to 4.
2. Test for continuity from 4 and 5 to rectifier CR101 (see Figure 7-3).

(e) Check output of CR101 (red lead) to ground with d-c voltmeter. 28 volts d-c should be indicated.

(f) Refer to voltage chart subparagraph 3.a.(1) of this section and check the d-c voltages at the points indicated.

(2) POWER SUPPLY UNIT.

- (a) Check fuses F101 and F102 and switch S101 in the selector control unit.
- (b) Check connections to pins "F" and "E" of socket J102 in the selector control unit.
- (c) Check with an a-c voltmeter for 110 volts across terminals 1 and 2 of transformer T201 and 17 volts across terminals 3 and 4 in the power supply unit (see Figure 7-4).

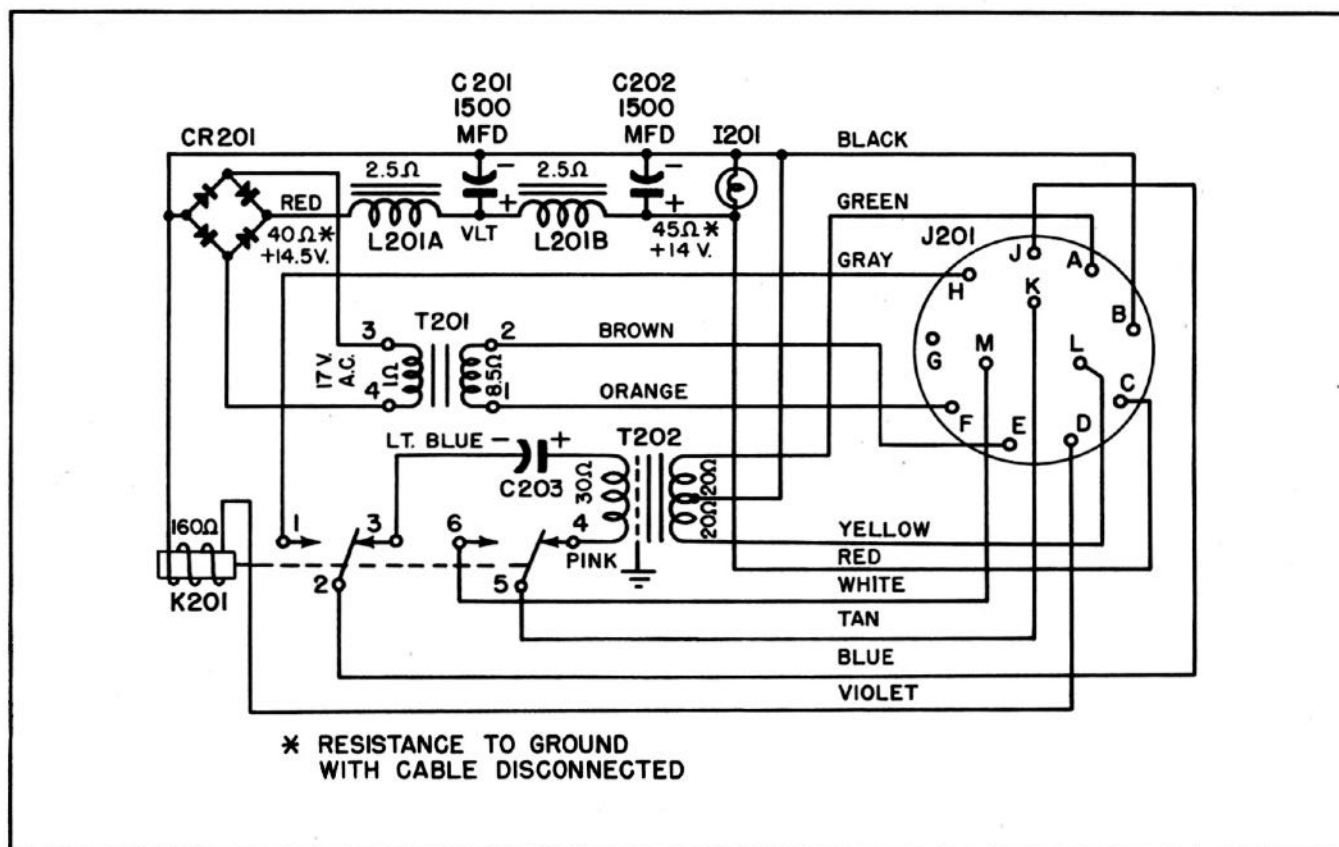


Figure 7-1—Navy Type CQC-20409 Power Supply Unit—Schematic Diagram

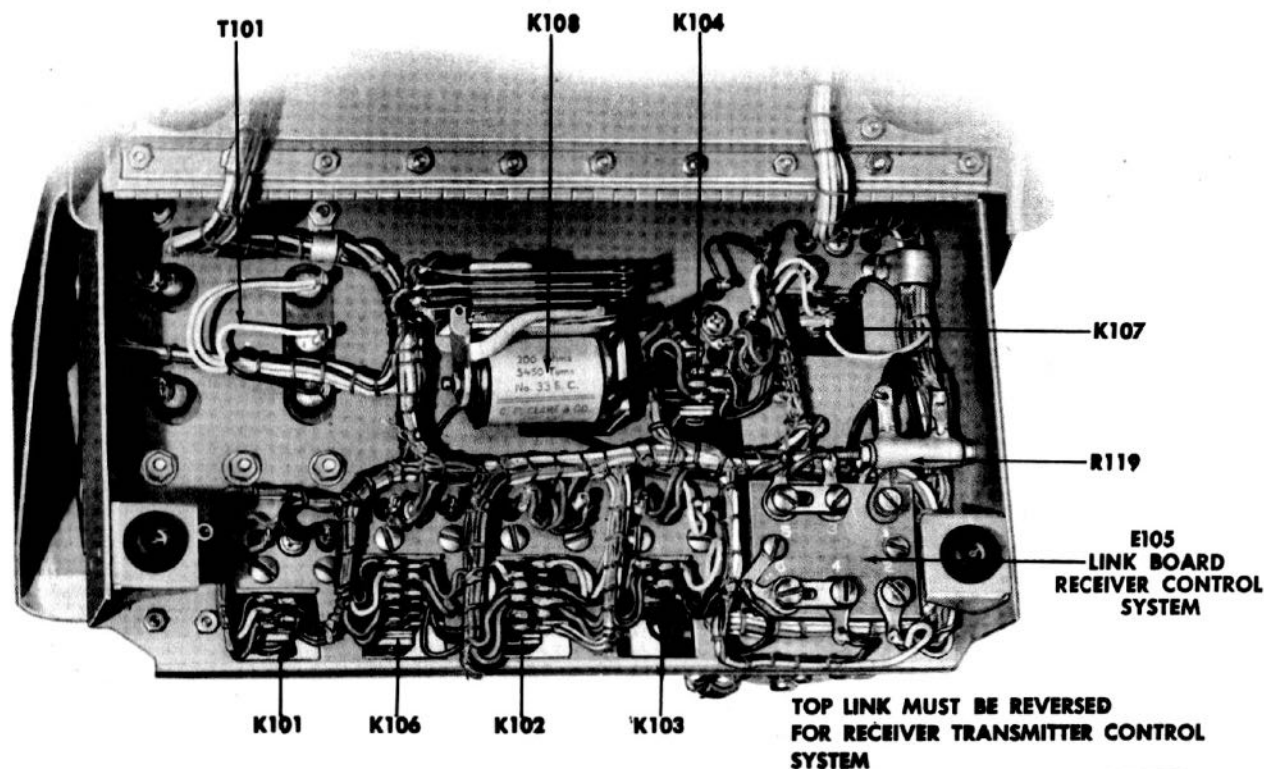


Figure 7-2—Navy Type CQC-23497 Selector Control Unit—Bottom View of Chassis

1. If 110 volts is not indicated across terminals 1 and 2, remove MHFA-14 cable and check for continuity across terminals 1 and 2 (8.5 ohms), continuity from 1 and 2 to "E" and "F" of socket J201, and continuity in the MHFA-14 cable between pins "E" and "F" at each end.

2. If 17 volts a-c is not indicated across terminals 3 and 4 of transformer T201, check for continuity across terminals 3 and 4 (1 ohm) and continuity from 3 and 4 to CR201, with power off or MHFA-14 cable disconnected.

(d) Test for 14.5 volts d-c with a direct current meter at the output (red lead) side of rectifier CR201.

(e) Test for 14 volts d-c at the socket of lamp I201 (see Figure 7-5) and pin "C" of socket J201.

c. TROUBLE IN REMOTE-LOCAL CIRCUIT.—If the "REMOTE-LOCAL" switch on the controlled equipment is set for "REMOTE" but the "CHANNEL INDICATOR" of the remote channel selector unit indicates "LOCAL" or if the opposite condition exists:

(1) Check connections to the switch within the controlled equipment.

(2) Check the pin "L" connections at each end of the TTHFA-10 cable between the selector control unit and the controlled equipment.

(3) With power on, inspect relay K106 in the selector control unit. It should be energized when the controlled equipment is set for "LOCAL" and de-energized when it is set for "REMOTE."

(4) If it is not, see schematic diagram, Figure 7-14, and check for continuity from pin "L" of socket J101, through the coil of relay K106 (160 ohms) to the output (red lead) of rectifier CR101.

(5) Inspect the contacts of relay K106, see paragraph 1, Section VI, and the wiring to them.

(6) See the simplified schematic, Figure 7-6, and check for continuity from the contacts of the relay to the indicated points. Test for the d-c voltage indicated.

(7) Test for continuity through the MHFA-7 cable from terminals 1, 2, and 3 on the selector control unit to 1, 2, and 3 on the remote channel selector unit (see Figures 7-7 and 7-8).

(8) With the power off, test for 80 ohms across terminals 1 and 3 of the remote channel selector unit, terminals 2 and 3, and terminals 1 and 2.

NOTE: CAPACITORS C101 TO C116,
C117 TO C132, AND INDUCTANCES
L101 TO L116 FORM FILTER NET-
WORKS INDICATED AS Z101 TO Z116
ON SCHEMATIC DIAGRAM.

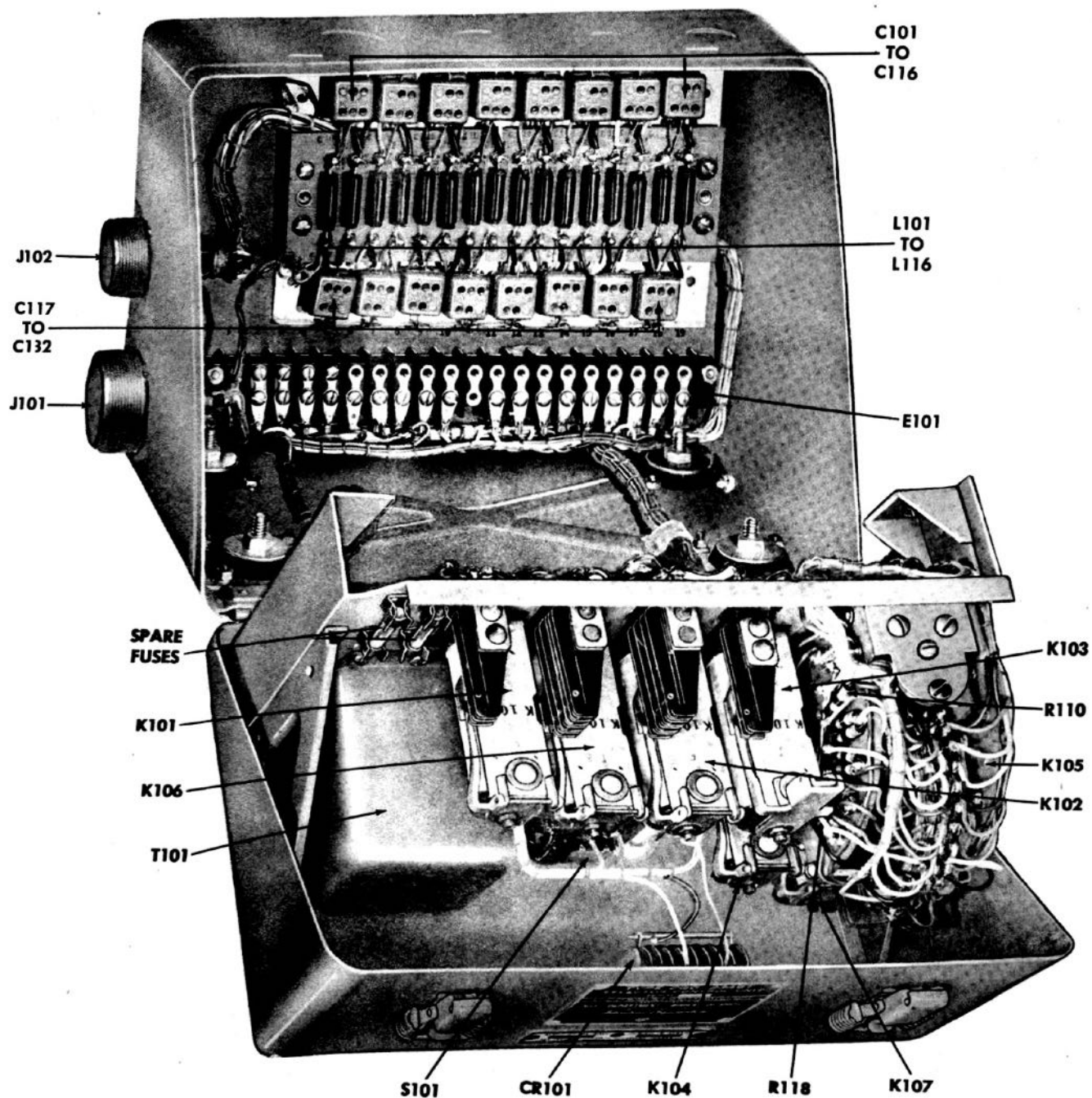


Figure 7-3—Navy Type CQC-23497 Selector Control Unit—Interior View

d. TROUBLE IN DIALING CIRCUIT.

(1) Check the operation of the relays in the dial-

ing circuits of the selector control unit by means of the following trouble chart:

DIAL ACTION	NORMAL OPERATION	CONDITION OF CHECK FOR ABNORMAL OPERATION	SYMPTOMS OF ABNORMAL OPERATION	POSSIBLE CAUSES OF TROUBLE
DIAL ROTATED TO FINGER STOP GIVING FIRST ON IMPULSE	K101 CLOSES		K101 DOES NOT CLOSE	1. Cable connections between remote channel selector unit and selector control unit. 2. Rectifier CR101 output voltage (28 volts d-c between red and black lead). 3. Coil of K101 open. 4. K106 energized ("LOCAL").
	K103 CLOSES		K103 DOES NOT CLOSE	1. Contacts 2-3 of K101. 2. Coil of K103 open.
	MINOR SWITCH RELEASES		MINOR SWITCH DOES NOT RELEASE	1. Contacts 3-4 of K105. 2. Release coil open. 3. Release mechanism jammed.
	K108 CLOSES AND CHANNEL INDICATOR POINTS TO LINE BETWEEN 1 AND LOCAL		INDICATOR DOES NOT POINT TO LINE BETWEEN 1 AND LOCAL	1. Relay K108. 2. Contacts 1-2 of relay K105. 3. Cable between remote channel selector unit and selector control unit. 4. Contacts 1-2 and 4-5 of K106. 5. Wrong resistance values on two outside decks of minor switch. 6. Winding of channel indicator open.
DIAL RELEASED GIVING FIRST OFF IMPULSE	K101 OPENS AND K102 CLOSES	STOP DIAL AND CHECK ACTION OF RELAYS, HOLDING DOWN TIME DELAY RELAY K103	K102 DOES NOT CLOSE	1. Dial mechanism. 2. Contacts 4-5 on K101. 3. Contacts 3-4 on K103. 4. Coil of K102 open.
			K102 CLOSES BUT CHATTERS	1. Contacts 5-6 on K102.
SECOND ON IMPULSE	K101 K104 CLOSE	STOP DIAL AND CHECK ACTION OF RELAYS, HOLDING DOWN TIME DELAY RELAY K103	K104 DOES NOT CLOSE	1. Contacts 2-3 on K101. 2. Contacts 2-3 on K102. 3. Coil of K104 open.
			K104 CLOSES BUT CHATTERS	1. Contacts 2-3 on K104. 2. Coil of K104 open.
DIAL RETURNED TO NORMAL POSITION GIVING SECOND OFF IMPULSE	K101 OPENS AND MINOR SWITCH STEPS TO NUMBER 1 POSITION	CHANNEL SELECTOR DIAL AT NORMAL POSITION; HOLD DOWN TIME DELAY RELAY K103	MINOR SWITCH FAILS TO STEP	1. Contacts 4-5 on K104. 2. 8-ohm stepper coil open. 3. Stepping mechanism jammed.
			INDICATOR MOVES FROM POSITION BETWEEN 1 & LOCAL	1. Contacts 8-9 on K102.
.02 SECONDS LATER K103 RELEASES	INDICATOR MOVES TO 1 POSITION		INDICATOR DOES NOT MOVE TO 1	1. Contacts 7-8 and 10-11 of K102.

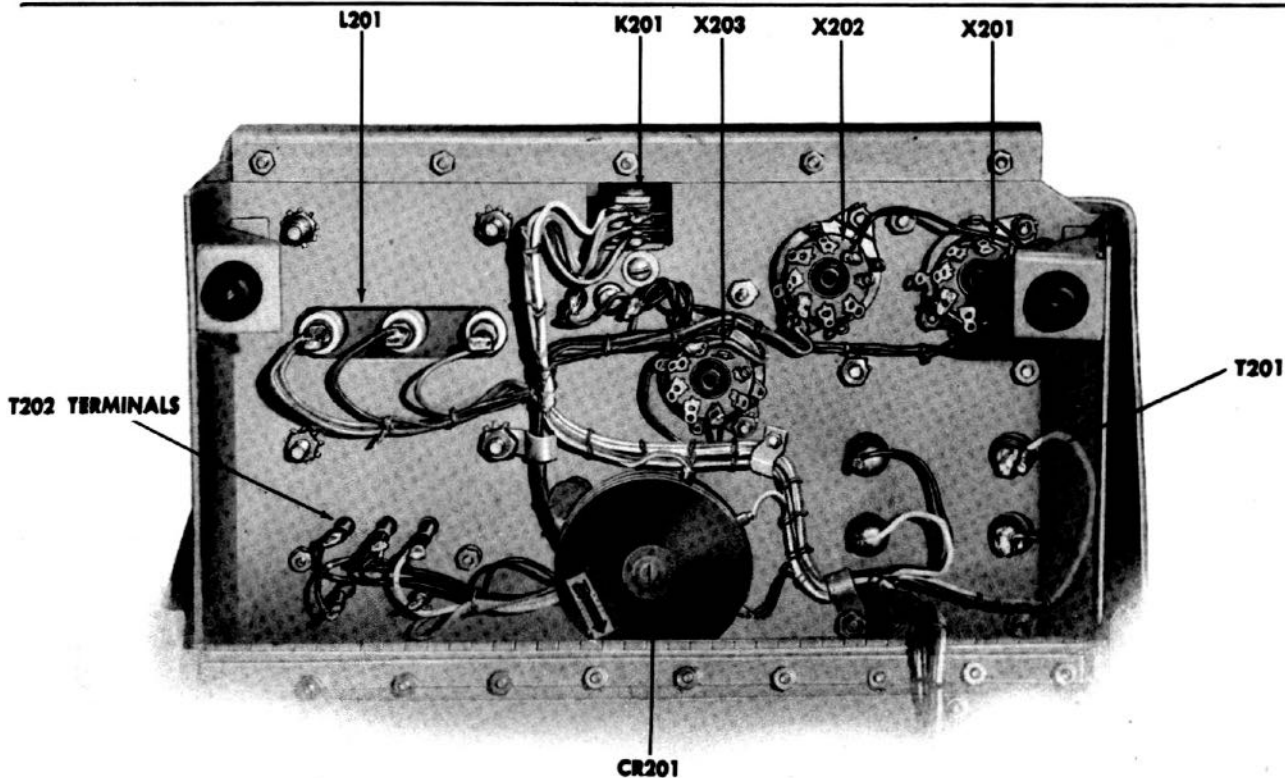


Figure 7-4—Navy Type CQC-20409 Power Supply Unit—Bottom View of Chassis

(2) If relays K101, K102, and K103 operate normally but relay K104 does not energize, check the circuits indicated in the simplified schematic, Figure 7-9.

(3) If all relays operate normally but the stepper does not advance, check the contacts as in subparagraph (2) preceding and check for continuity across the stepper coil. Inspect the armature of the stepper coil and the ratchet mechanism for evidence of jamming or mechanical breakage.

(4) If the sequence of relay operation is normal, but the indicator points to a channel other than the one selected, refer to the simplified schematic, Figure 7-10, and check the normal voltages for the channel dialed on the terminal board of the selector control unit.

(a) If the voltages are incorrect, resistor R119 or R120 or a resistor in the R101 to R118 series is probably defective. Check them.

(b) Test for continuity from terminals 1, 2, and 3 to the resistors of the minor switch.

(5) If the voltages are normal test for continuity in the MHFA-7 cable from terminals 1, 2, and 3 on the selector control unit to terminals 1, 2, and 3 of the remote channel selector unit.

(6) Test for 80 ohms across terminals 1 and 3, 2 and 3, and 1 and 2 of the remote channel selector unit.

e. TROUBLE IN INITIAL INDICATION CIRCUIT.—If the pointer of the "CHANNEL INDICATOR" does not point to the heavy line between channel "1" and "LOCAL" during the time when the dial is being rotated toward the right at the start of dialing, or if the pointer remains at this position after dialing:

(1) Check the dialing relays as in subparagraph d.(1) preceding.

(a) If the indicator leaves the "OFF" position before the dialing action is completed and wavers around the channel positions, the trouble is in contacts 8-9 and 11-12 of relay K102. Inspect them.

(b) If the indicator remains at "OFF" after the dial has returned to its normal position, the trouble is in contacts 7-8 and 10-11 of relay K102. Inspect them.

(2) If the relay action is normal see the simplified schematic, Figure 7-11, and test for the voltages indicated with the minor switch in the off position. Energize K105 by moving the dial on the remote channel selector unit a trifle to the right (less than the position obtained by dialing channel 1).

(a) If the voltages are not normal, resistor R119 or R120 or a resistor in the R101 to R118 series is probably defective. Check them.

(b) Check for continuity (power off) from the points indicated in the schematic to terminals 1, 2, and 3.

(3) If the voltages are normal, check the MHFA-7 cable for continuity from terminals 1, 2, and 3 of the selector control unit to terminals 1, 2, and 3 of the remote channel selector unit.

(4) Test for 80 ohms resistance across terminals 1 and 3, 1 and 2, and 2 and 3 of the remote channel selector unit.

f. TROUBLE IN NOISE SUPPRESSOR CIRCUIT.

—If it is impossible to control the noise suppressor circuit of the controlled equipment:

(1) Check the wiring of the MHFA-14 or TTH-FA-3 cable from terminals 15 and 16 on the radio-phone unit to terminals 7 and 8 on the selector control unit.

(2) With the power on, short terminals 7 and 8 and see that relay K107 energizes.

(3) Check for continuity from pin 8 to the 28-volt side of relay K107. 250 ohms should be indicated.

(4) Check the contacts of relay K107 as in paragraph 4 of this section.

(5) If Model RDZ or similar equipment is connected, check for continuity from "R" of socket J101 to ground with the relay de-energized. Check for continuity from "V" of socket J101 to contact 3 of relay K107.

(6) If Model MAR or similar equipment is connected, check for continuity from the output terminal of CR101 to "R" of socket J101. Check for continuity

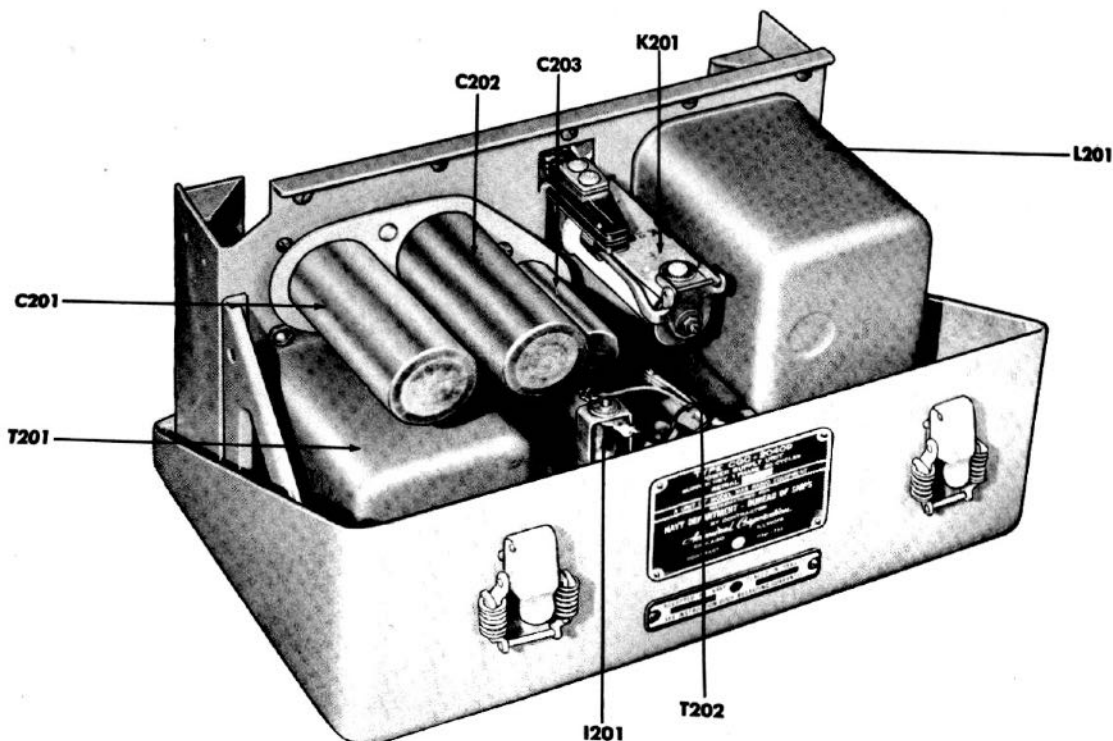


Figure 7-5—Navy Type CQC-20409 Power Supply Unit—Top View of Chassis

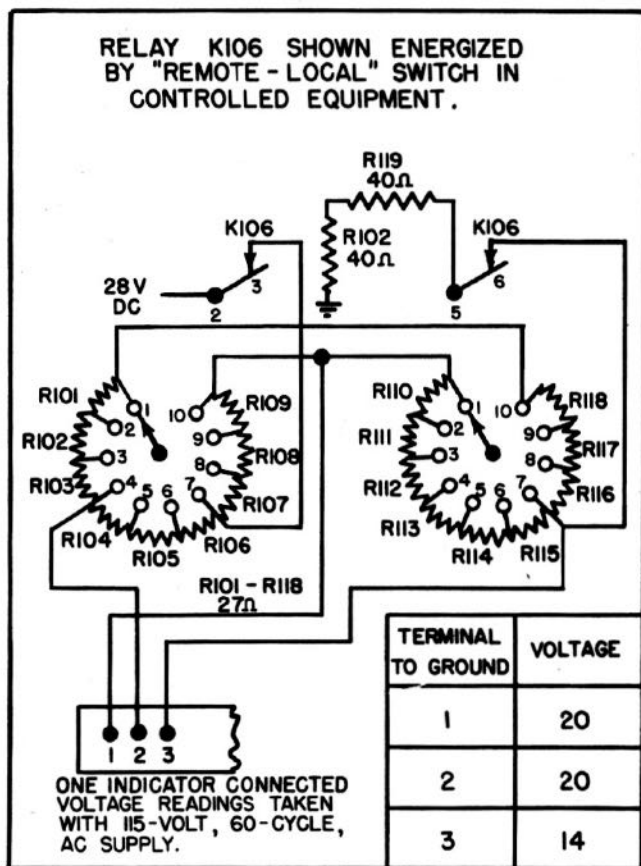


Figure 7-6—Local Indication—Simplified Schematic Diagram

from contact 2 of relay K107 to ground and from contact 3 to "V" of socket J101.

(7) Check the wires of the TTHFA-10 cable that connect pins "V" and "R" to the controlled equipment.

g. TROUBLE IN THE RECEIVER CIRCUIT.—If the controlled equipment, channel selection circuits of the selector control unit, and noise suppressor circuits are operating normally but the receiver cannot be heard from the remote position:

(1) Check the wires of the TTHFA-10 cable that connect pins "J," "K" and "G" on socket J101 of the selector control unit to the controlled equipment.

(2) If RDZ or similar equipment is connected, check that dummy plug P102 is firmly seated in socket J102 of the selector control unit, and that the jumpers connecting "J-A" and "K-L" within the plug are sound. Check for continuity from "J" and "K" of socket J101 to terminals 9 and 11 of the main terminal board of the selector control unit. Check cable connections of 9 and 11 to radiophone unit.

(3) If Model MAR or similar equipment is connected, check for continuity from "J" and "K" of socket J101 to "J" and "K" of socket J102 in the selector control unit. Check that plug P102 is firmly seated. Check for continuity from "L" and "A" of socket J102 to terminals 9 and 11 of the main terminal board of the selector control unit. Check cable connections of 9 and 11 to radiophone unit.

(a) Check for continuity of the wires in the MHFA-14 cable that connect "J," "A," "K," and "L" of socket J102 on the selector control unit to the power supply unit.

(b) Check for continuity across the primary and across the secondary of transformer T202 in the power supply unit. Check that the center tap of the secondary is grounded.

(c) Check contacts 1 and 2, and 4 and 5 of relay K201 in the power supply unit.

(d) Check capacitor C203 in the power supply unit that it is not shorted to ground or open.

b. TROUBLE IN TRANSMITTING CIRCUIT.—If the controlled equipment and channel selection of the selector control unit are operating normally but the transmitter cannot be controlled from the remote position:

(1) If the "CARRIER ON" pilot light on the radiophone unit does not light but the power supply unit pilot light is illuminated, check the interconnection cable from the selector control unit to the power supply unit (pins "B," "C," and "D"). Check from pins "B," "C," and "D" of the selector control unit to terminals 14, 13, and 15 on the terminal board. Check from 13, 14, and 15 on the terminal board of the selector control unit to terminals 7, 8, and 11 of the radiophone unit.

(2) Inspect contacts 3 and 2, and 5 and 6 of relay K201 in the power supply unit which should be energized when the "PUSH-TO-TALK" switch on the hand-set is depressed.

(3) Check for continuity from 3 and 6 of relay K201 to "H" and "M" of socket J201, to "H" and "M" of socket J102 on the selector control unit, to terminals 12 and 10 on the terminal board, to terminals 10 and 9 on the radiophone unit.

(4) Repeat the tests in subparagraph 3.g.(1), 3.g.(2), and 3.g.(3) of this section.

i. TROUBLE IN DIALING CONTROL EQUIPMENT.—If trouble is encountered in dialing the controlled equipment and the minor switch appears to be operating properly, check continuity from pin "G" of socket J101 to the following pins of socket J101: (See Figure 7-14.)

- (1) Channel 1 position of minor switch—"U"
- (2) Channel 2 position of minor switch—"T"
- (3) Channel 3 position of minor switch—"E"
- (4) Channel 4 position of minor switch—"S"
- (5) Channel 5 position of minor switch—"C"
- (6) Channel 6 position of minor switch—"H"
- (7) Channel 7 position of minor switch—"P"
- (8) Channel 8 position of minor switch—"A"
- (9) Channel 9 position of minor switch—"B"
- (10) Channel 10 position of minor switch—"N"

4. REPAIR OF RELAYS.

(See Figure 2-2, 7-12, 7-13.)

a. CORRODED, BURNED, OR PITTED CONTACTS.

(1) If it is necessary to dismount the relay in order to remove the burned surface, pit, or cone, make certain to tag all wires connected to the relay before removing the mounting screws that attach the relay to the chassis.

(2) Polish the surface with a crocus cloth stick (a thin board on which crocus cloth has been mounted) if the position of the relay permits it, otherwise use a piece of unmounted crocus cloth. Draw it back and forth gently over the surface of the contact.

(3) Apply a final polish with a piece of dry, clean canvas to remove any traces of pumice that might be left, and to give a dull polish to the surface of the relay.

b. ADMUSTMENT OF RELAYS.

NOTE

These relays have all been factory adjusted. Replace them if spares are available. Attempt adjustment only in emergencies.

(1) ARMATURE.

NOTE

NEVER ATTEMPT ARMATURE ADJUSTMENT OF TIME DELAY RELAY K103.

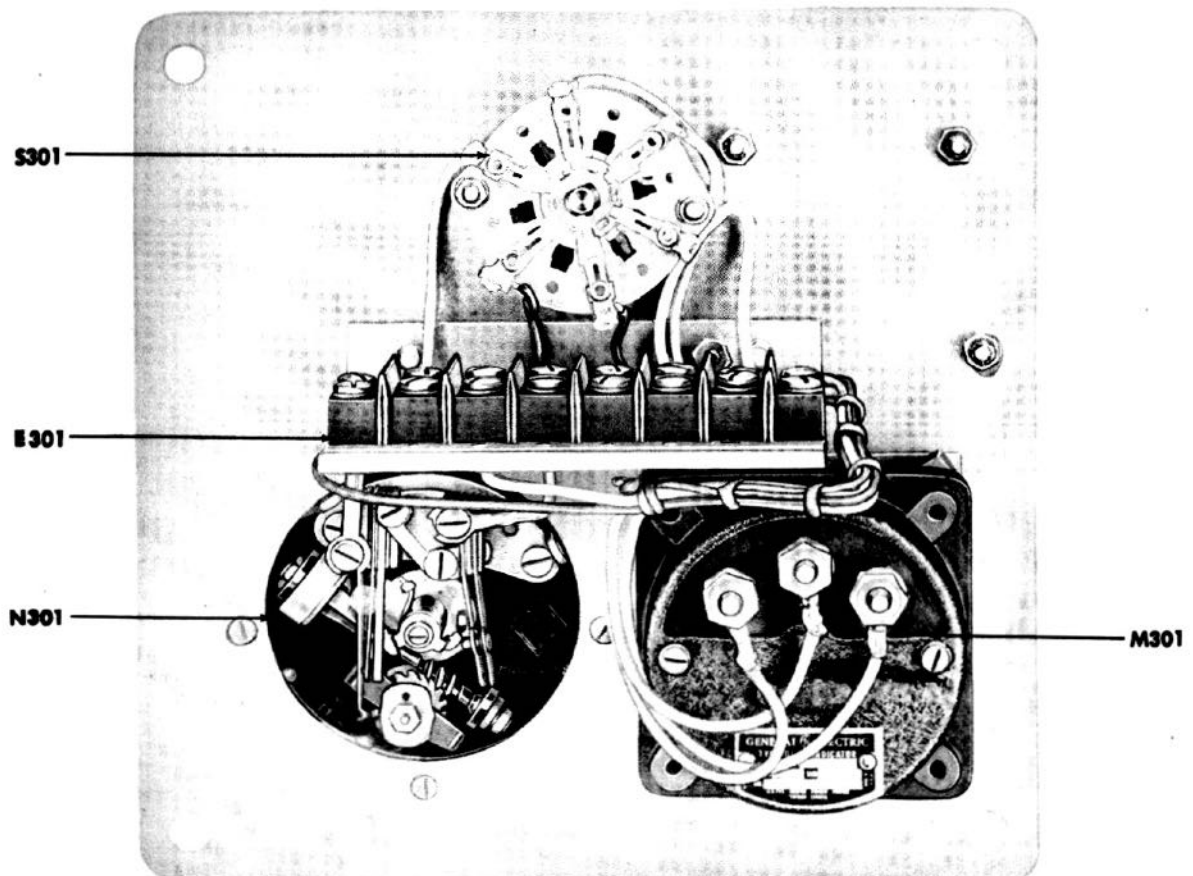


Figure 7-7—Navy Type CQC-23445 Remote Channel Selector Unit—Interior View

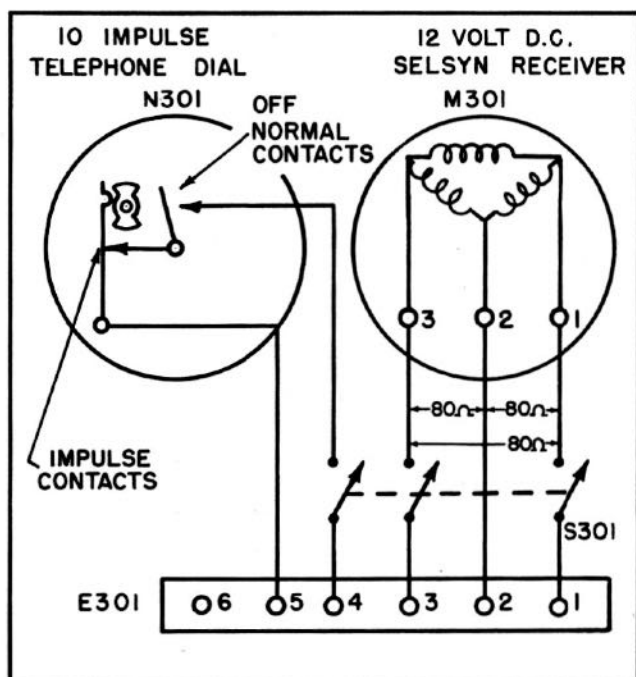


Figure 7-8—Navy Type CQC-23445 Remote Channel Selector Unit—Schematic Diagram

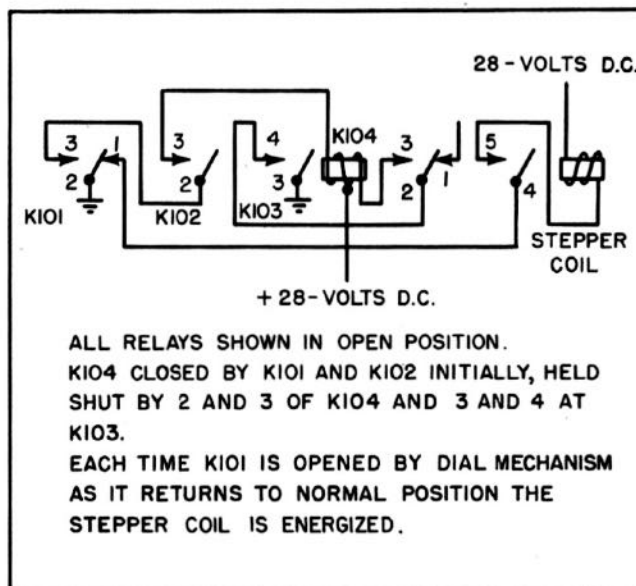


Figure 7-9—Stepper Circuits—Simplified Schematic Diagram

(a) If it is necessary to dismount the relay in order to get at the contact arms, make certain to tag all wires connected to the relay before removing the mounting screws that attach the relay to the chassis.

(b) Loosen the locknut on the screw which passes through the armature and turn the screw counter-clockwise. (See Figure 2-2.)

(c) Insert a piece of notebook paper between the core of the coil and the armature.

(d) Hold the armature against the core and tighten the screw until it visibly compresses the surface of the paper. Do not tighten it sufficiently to puncture a hole in the paper.

(e) Tighten the locknut on the screw being careful that the setting of the screw is not disturbed. Test it after tightening the locknut by closing the armature on a new spot on the paper and comparing the mark left.

(f) Insert three thicknesses of notebook paper between the armature and the core.

(g) Close the armature on the paper. The breaking contacts should just close.

(h) If the contacts do not close properly, the tension of the contact springs must be adjusted until they do.

(2) CONTACT SPRINGS.—If the contacts do not make although the armature closes properly:

(a) Grasp the contact springs (see Figure 2-2) near their mountings with a pair of long-nose pliers.

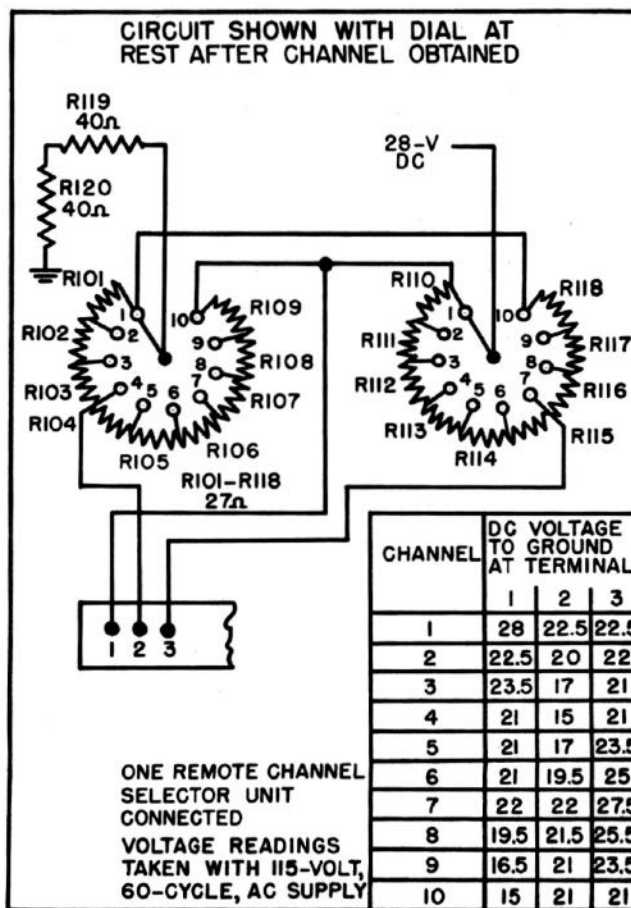


Figure 7-10—Channel Indication—Simplified Schematic Diagram

(b) Gently twist the pliers in the direction that tension is required.

(c) Move the pliers a quarter of an inch along the surface of the contact spring away from the mounting.

(d) Again twist the pliers slightly in the direction that tension is required.

(e) Repeat this process until the bakelite spring bushings are reached.

(f) Test the closing of the contacts again by depressing the armature against three sheets of notebook paper inserted between the armature and the core.

(g) If the contacts still do not close properly, repeat the steps of subparagraphs (a) through (e) of this paragraph. If too much tension has been created, reverse the process. Start at the bakelite bushing and work back toward the mounting, twisting the pliers in the opposite direction.

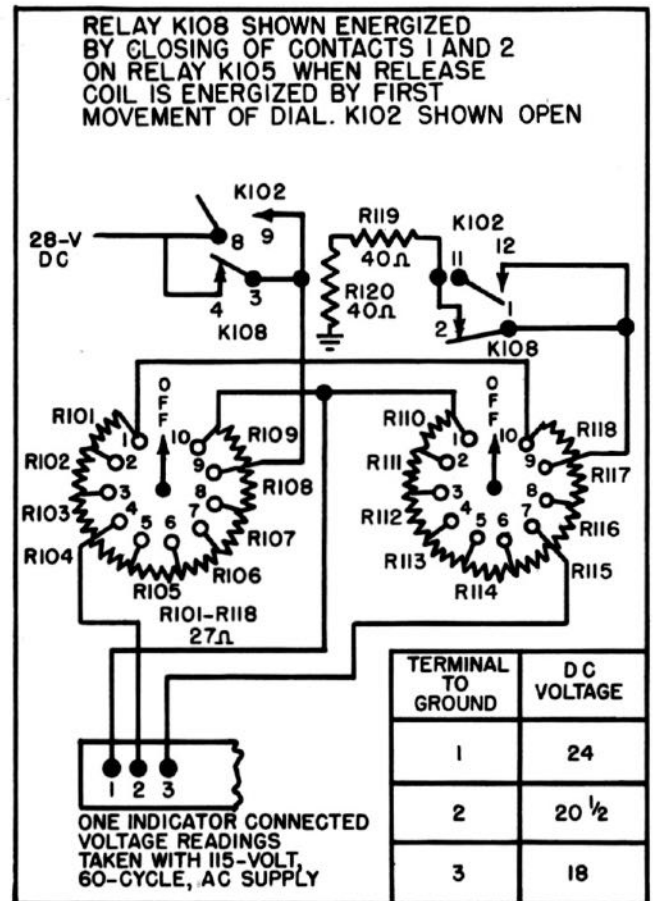
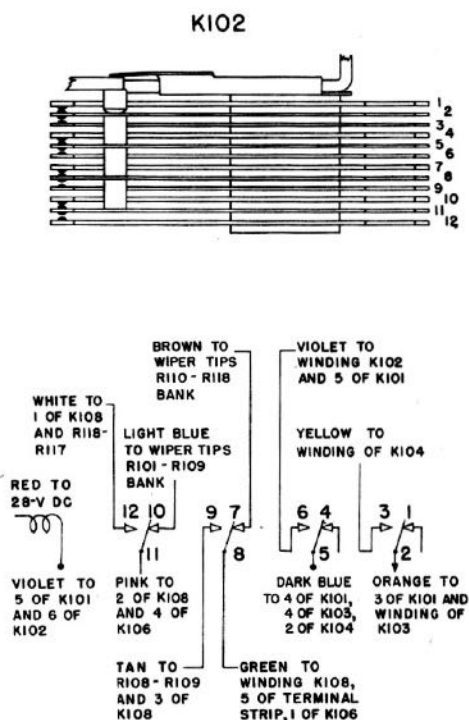


Figure 7-11—Initial Indication—Simplified Schematic



COIL RESISTANCE = $125\Omega \pm 10\%$
6700 TURNS *30 E.C.
DUTY CYCLE 2 SEC. ON AND 58 SEC. OFF.

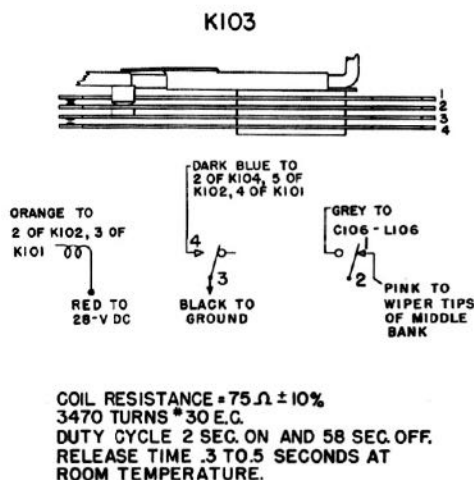
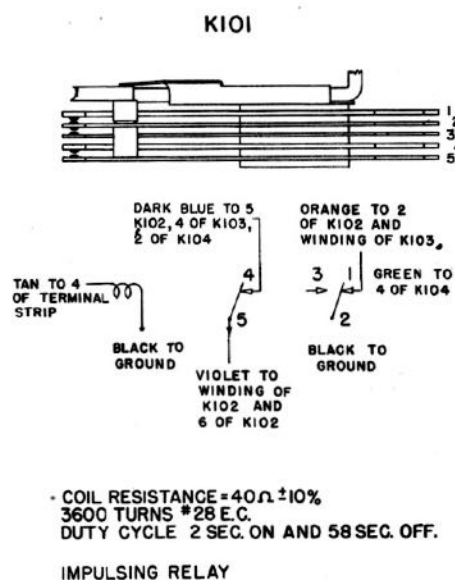


Figure 7-12—Relays K101, K102, and K103—Detailed Drawings

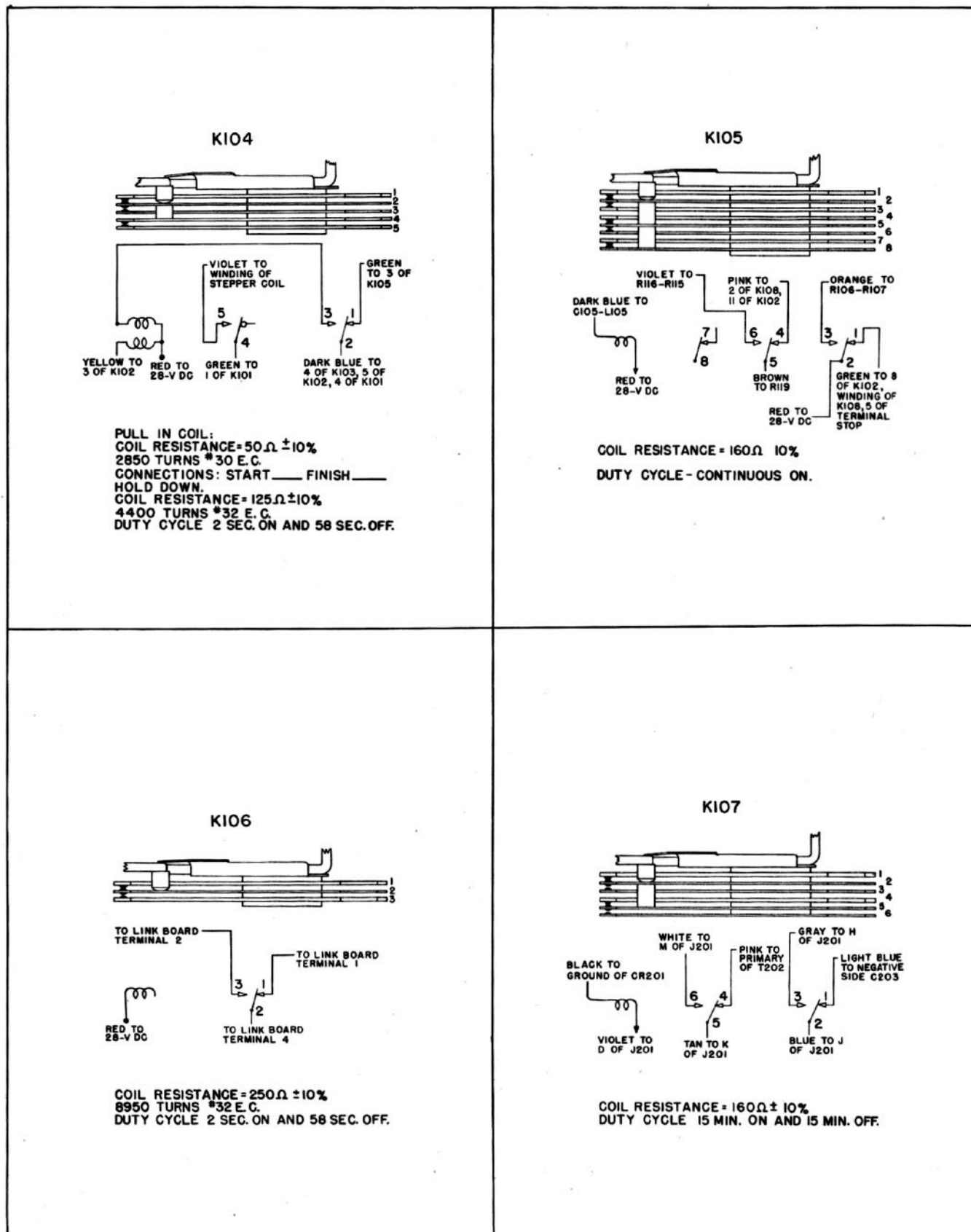
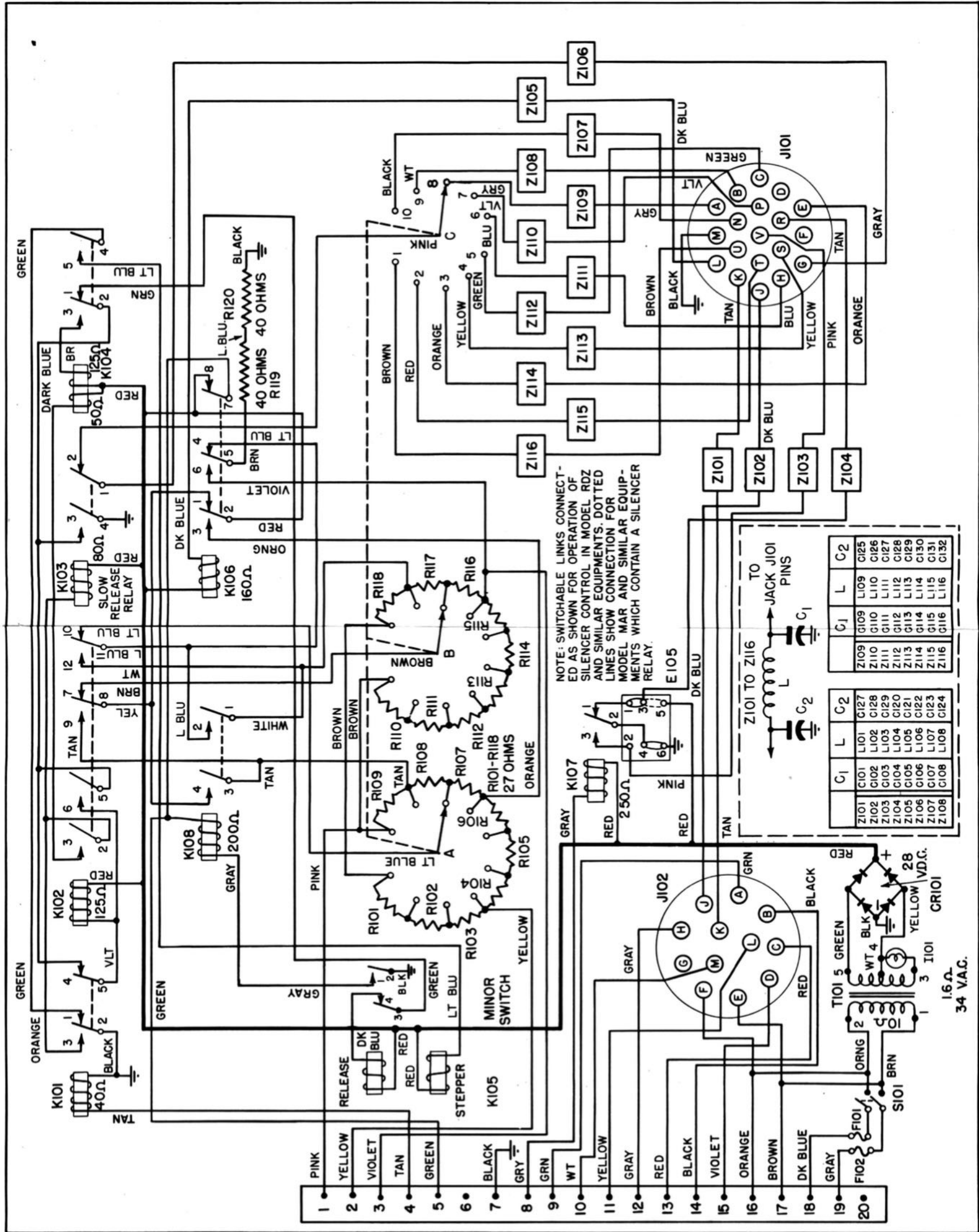
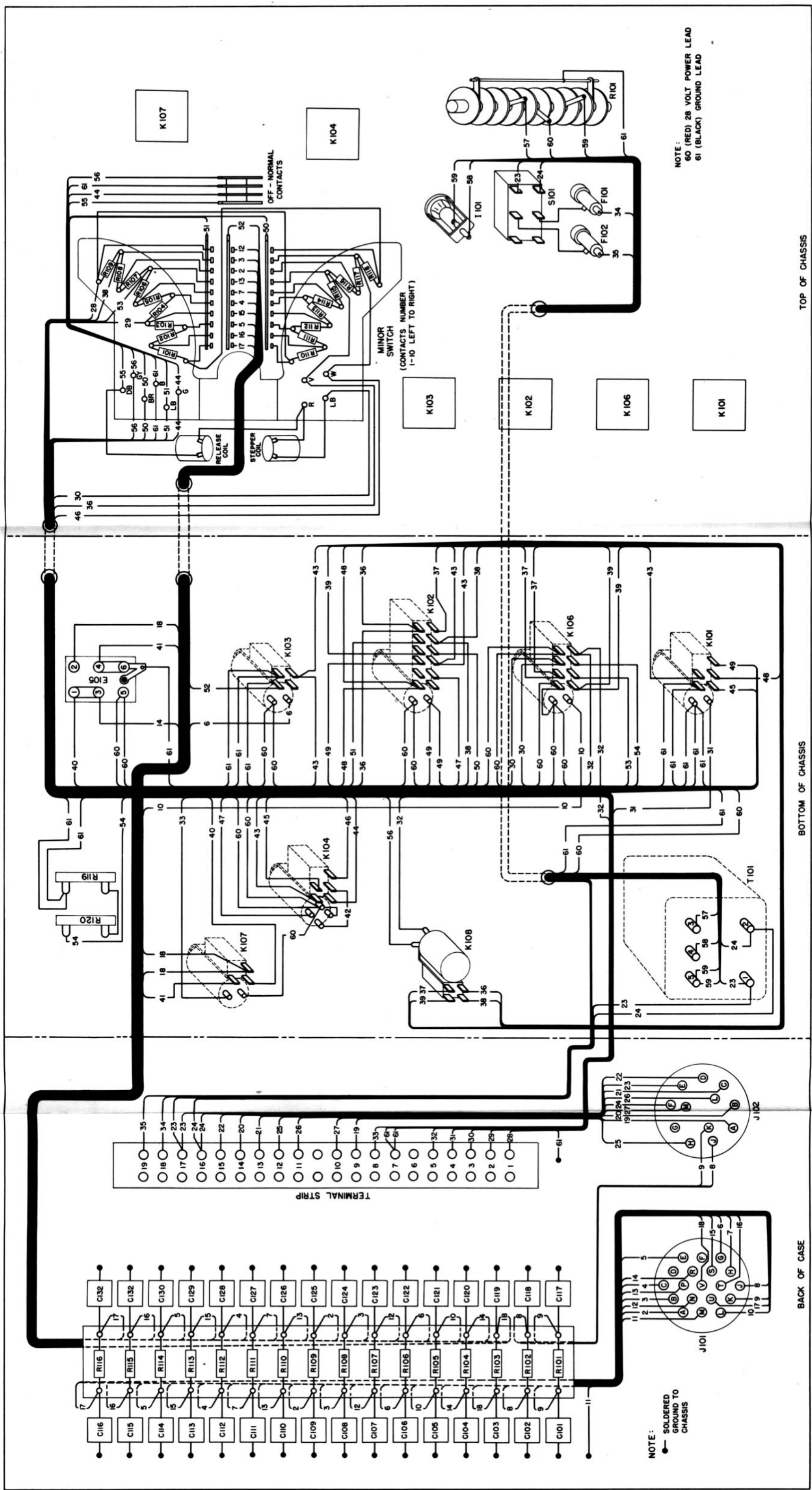


Figure 7-13—Relays K104, K106, K107, and K201—Detailed Drawings

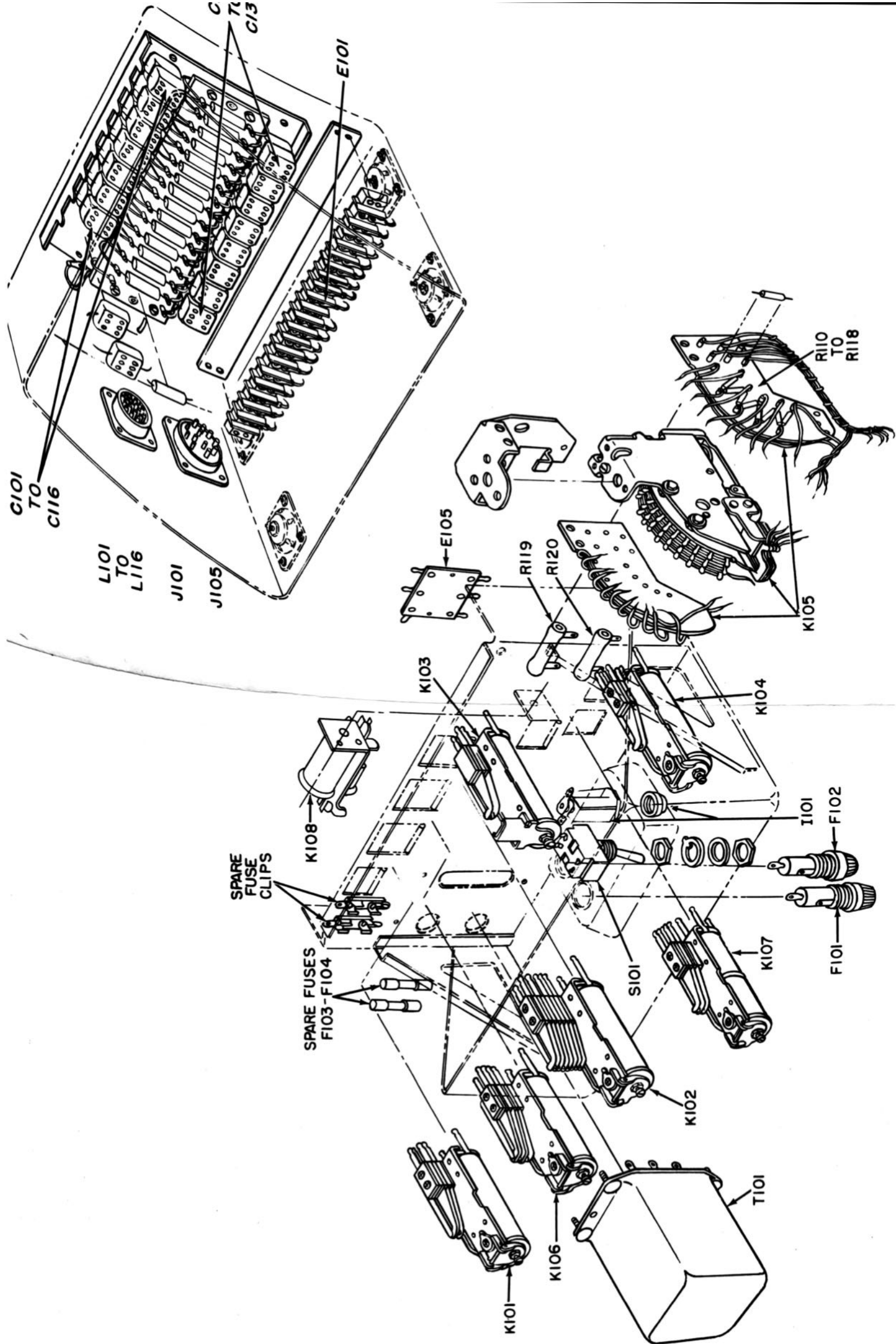




TOP OF CHASSIS

BOTTOM OF CHASSIS

BACK OF CASE



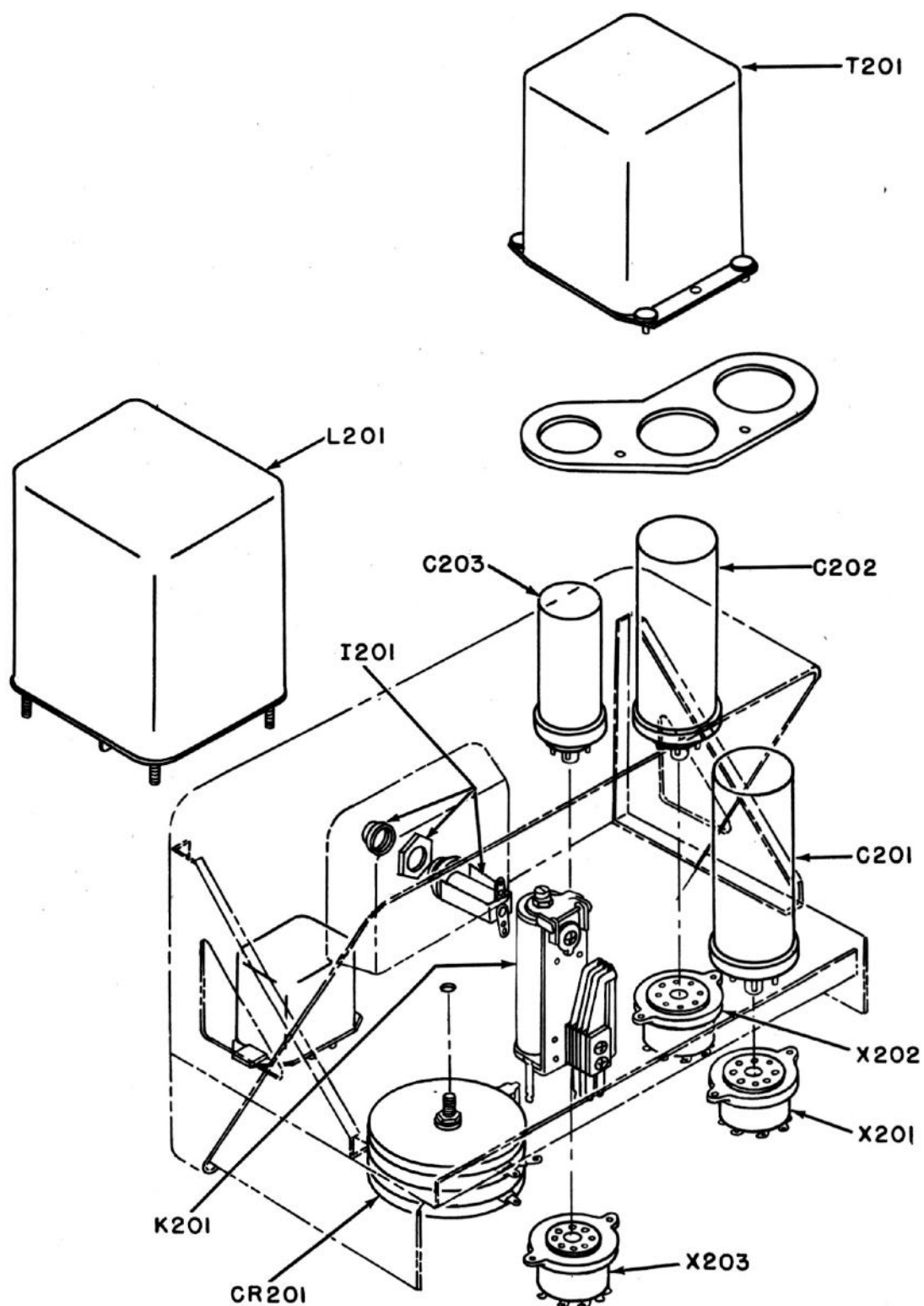
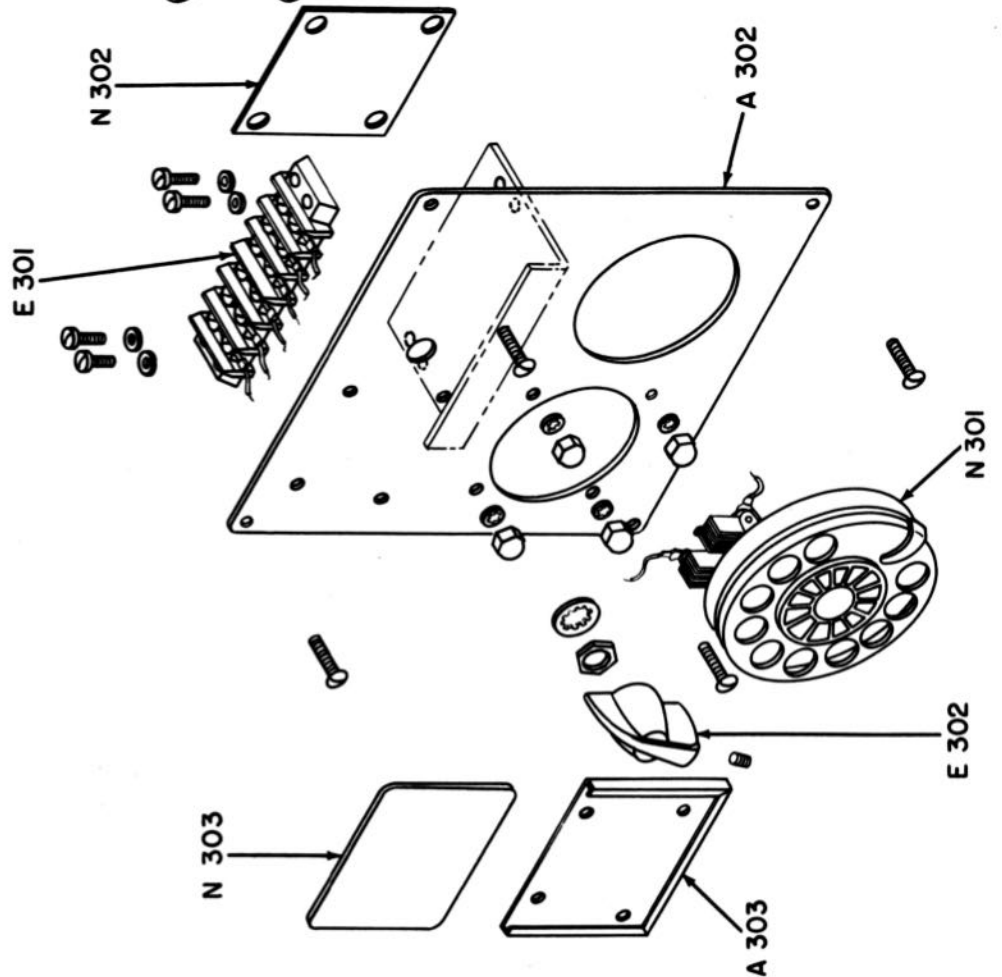
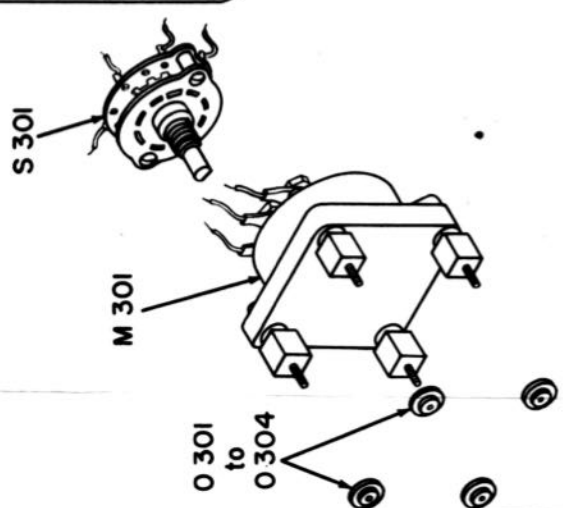
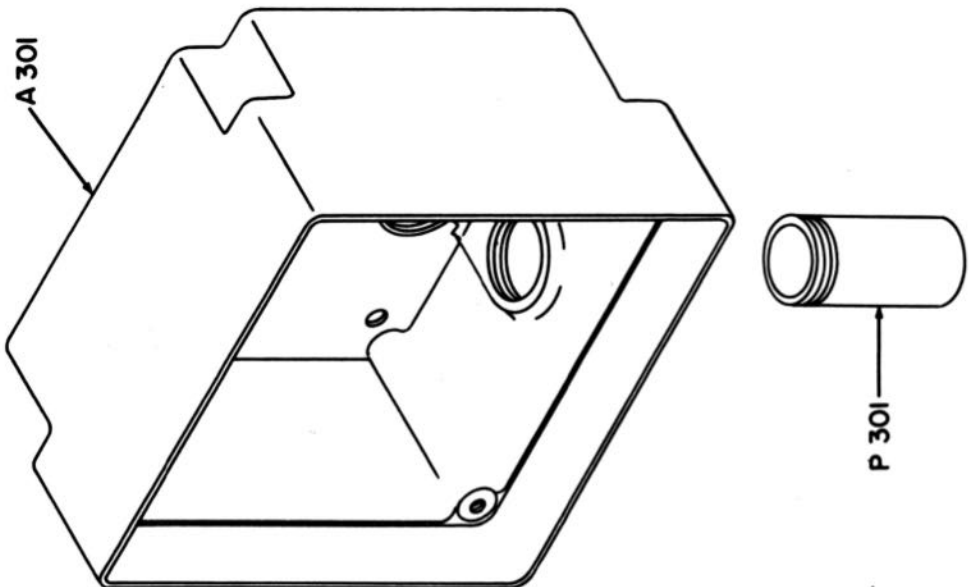


Figure 7-17—Exploded View of Power Supply Unit



**SECTION VIII
PARTS AND
SPARE PARTS**

TABLE 8-1
LIST OF MAJOR UNITS

Quantity	Name of Major Unit	Navy Type Designation	Symbol Group
1	Selector Control Unit	CQC-23497	101-199
1	Power Supply Unit	CQC-20409	201-299
1	Remote Channel Selector Unit	CQC-23445	301-399

Contract N5sr-759

TABLE 8-2
COMBINED PARTS and SPARE PARTS LIST by SYMBOL DESIGNATION
for NAVY TYPE CQC-23497 Selector Control Unit

Symbol Desig.	Name of Part and Description	Function	AWS, JAN or Navy Type Designation	Navy Stock Number	Army Stock Number	Mfr. and Mfr's Desig.	Contractor's Dwg. and Part Number	All Symbols Designation Involved	Total No. Per Equip.	SPARE PARTS			
										Equip.	Tender	Stock	Quan.
										Box No.	Box No.	Box No.	Box No.
										Quan.	Quan.	Quan.	Quan.
A101	HOUSING: Case-Chassis-Cover assembly: Aluminum; gray paint; chassis welded to case; hinged cover held by two catch clips; 11½" lg x 9" wd x 8" h	To mount parts and house entire selector control unit				1 Part/dwg G-2300	Part/dwg G-2300	A101	1				
A102	COVER: Aluminum .064 th; gray paint; 8¼" lg x 5¼" wd x 1" h	To cover RF filter unit				13 Part # P204-226	Part/dwg P204-226	A102	1				
A103	PLATE, Filter Base: Brass .032 th; hot tin dipped; 8¼" lg x 4¼" wd x 1½" h	To mount filter unit and act as ground plate				13 Part # P204-225	Part/dwg P204-225	A103	1				
A104	BRACKET, Minor Switch: CRS .075 th; gray paint; 3½" lg x 2½" wd x 2" h	To mount minor switch K105 to chassis				13 Part # P202-441	Part/dwg P202-441	A104	1				
A105	CATCH, Corbin: Steel, gray paint; double springs; .051 music wire; 50 lb catch tension	Use with clip A107 to close housing A101				15 Part of #15821	Part/dwg P207-183-2	A105, A106, A204, A205	4				4
A106	CATCH: Same as A105	Use with clip A108 to close housing A101											
A107	CLIP: Catch; for Corbin catch; steel; gray paint; ½" lg x ¾" wd x ¾" h overall	Use with catch A105 to close housing A101				15 Part of #15821	Part/dwg P207-183-1	A107, A108, A202, A203	4				4
A108	CLIP: Same as A107	Use with catch A106 to close housing A101											
C101	CAPACITOR, Mica: 10,000 mmfd ±20%; 300 vdcw; ⅜" lg x ⅜" wd x 1½" th	RF filter capacitor	CM35B103M			16 Type VXM	Part/dwg P303-129-3	C101 thru C132	32	7	20		32

Contract N5sr-759

TABLE 8-2
COMBINED PARTS and SPARE PARTS LIST by SYMBOL DESIGNATION
for NAVY TYPE CQC-23497 Selector Control Unit

TABLE 8-2													
COMBINED PARTS and SPARE PARTS LIST by SYMBOL DESIGNATION for NAVY TYPE CQC-23497 Selector Control Unit													
PARTS													
Symbol Desig.	Name of Part and Designation	Function	AWS, JAN or Navy Type Designation	Navy Stock Number	Army Stock Number	Mfr. and Mfr's Desig.	Contractor's Dwg. and Part No.	All Symbols Designation Involved	Total No. Per Equip.	SPARE PARTS			
										Equip.	Tender	Box No.	Quan.
										Box No.	Quan.	Box No.	Quan.
										Box No.	Quan.	Box No.	Quan.
										Box No.	Quan.	Box No.	Quan.
										Box No.	Quan.	Box No.	Quan.
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TABLE 8-2
COMBINED PARTS and SPARE PARTS LIST by SYMBOL DESIGNATION
for NAVY TYPE CQC-23497 Selector Control Unit

PARTS										SPARE PARTS			
Symbol Desig.	Name of Part and Description	Function	AWS, JAN or Navy Type Designation	Navy Stock Number	Army Stock Number	Mfr. and Mfr's Desig.	Contractor's Dwg. and Part Number	All Symbols Designation Involved	Total No. Per Equip.	Equip. No.	Tender No.	Stock No.	Quan.
E101	BOARD, Terminal: 19 brass nickel-plated dual 6-32 screw terminals; molded bakelite, black; 9 1/2" lg x 1 1/2" w x .525 h overall	Terminal board				20-141 Special	Part/dwg P610-256-20	E101	1				
E102	BOARD, Terminal: Bakelite 3/4" th; type LTS-E-1-(PBP) with 10 stud terminals; 4 1/16" lg x 2 3/4" w x 2 3/4" th overall	To mount resistors R101 to R109; affixed to minor switch K105				17 Part Admiral P610-257	Part/dwg P610-257	E102	1				
E103	BOARD, Terminal: Bakelite 3/4" th; type LTS-E-1-(PBP); with 10 stud terminals; 4 1/16" lg x 2 3/4" w x 2 3/4" th overall	To mount resistors R110 to R118; affixed to minor switch K105				17 Part Admiral P610-258	Part/dwg P610-258	E103	1				
E105	BOARD, Terminal: 3/4" bakelite; type LTS-E-1-(PBP); 6 terminals with 2 links	To switch power to outside silencer relay circuit				1 Part/dwg G-2330	Part/dwg G-2330	E105	1				
E106	BOARD, Terminal: 3/4" bakelite; type LTS-E-1-(PBP); with 32 studs, 3/16" diam x 3/8" lg; 8" lg x 2 3/8" wd x 2 3/4" h overall	To mount RF filter network C101 thru C132, L101 thru L116				1 Part/dwg G-2315	Part/dwg G-2315	E106	1				
E107	CLAMP, Cable: Aluminum, die-cast; sandblast; for 7/8" OD cable; 1 3/16-18 threads; 1 3/8" diam x 1 1/16" lg overall	Supplied to affix external cable to selector control unit	AN-3057-12			18 Part # AN-3057-12	Part/dwg P715-187-5	E107	1	1	1		2
E108	CLAMP, Cable: Aluminum, die-cast; sandblast; for 1 1/8" armored cable; 1 1/16-18 threads; 1 3/8" diam x 1 1/16" lg overall	Supplied to affix external cable to selector control unit	AN-3057-16 Special			18 Part # AN-3057-16 Special	Part/dwg P715-187-6	E108, E202	2	2	2		4
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TABLE 8-2
COMBINED PARTS and SPARE PARTS LIST by SYMBOL DESIGNATION
for NAVY TYPE CQC-23497 Selector Control Unit

PARTS										SPARE PARTS			
Symbol Desig.	Name of Part and Description	Function	AWS, JAN or Navy Type Designation	Navy Stock Number	Army Stock Number	Mfr. and Mfr's Desig.	Contractor's Dwg. and Part Number	All Symbols Designation Involved	Total No. Per Equip.	Equip. Box No.	Tender Box No.	Stock Box No.	Quan.
I101	LAMP, Pilot: 12v, .10 amp; clear; bulb T-3/4"; min bayonet base	Indicates selector control unit power transformer is operating properly				6 Part # GE-1813	Part/dwg P460-105-3	I101, I201	2				4
J101	RECEPTACLE: Male die-cast, aluminum housing; sandblast finish; straight; 1 3/8-18 thread; 19 parallel round contacts; 1 1/2" lg x 1 5/8" wd x 1 1/8" d overall	To connect to controlled equipment cable	AN-3102-22-14P			18 Part # AN-3102-22-14P	Part/dwg P715-171-11	J101	1				1
J102	RECEPTACLE: Female; die-cast, aluminum housing; sandblast finish; straight; 1 3/4-18 thread; 12 parallel round contacts; 2" lg x 2" wd x 1 1/8" d overall	To connect to power supply unit cable	AN-3102-28-9S			18 Part # AN-3102-28-9S	Part/dwg P715-171-12	J102	1				1
K101	RELAY: Contact arrangement 1C1B; 4' lg x 1 1/2" wd x 1 1/8" h overall	Pulsing relay	29973			23 Part # A-23092	Part/dwg P830-120-1	K101	1				1
K102	RELAY: Contact arrangement 4C; 4' lg x 1 1/2" wd x 2 1/8" h overall	Interlocking relay	29974			23 Part # B23092	Part/dwg P830-120-2	K102	1				1
K103	RELAY: Contact arrangement 1B1A; 4' lg x 1 1/2" wd x 1 1/8" h overall	Holding, slow release relay	29975			23 Part # C23092	Part/dwg P830-120-3	K103	1				1
K104	RELAY: Contact arrangement 1C1A; 4' lg x 1 1/2" wd x 1 1/8" h overall	Relay to apply voltage to minor switch K105	29976			23 Part # D23092	Part/dwg P830-120-4	K104	1				1
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K105	SWITCH, Minor: 10 position 3 pole; with stepper coil and release coil; 12 vdc; off normal; 4" lg x 4 $\frac{5}{8}$ " h x 1 $\frac{5}{8}$ " wd	Stepper switch to control automatic tuning mechanism on receiver	29982				7 Part # ZH-87180-1	Part/dwg P710-161	K105	1	1	2	3
K106	RELAY: Contact arrangement 1B2C; 4" lg x 1 $\frac{1}{4}$ " wd x 1 $\frac{1}{8}$ " h overall	Local-remote relay	29977				23 Part # E23092	Part/dwg P830-120-5	K106	1	1	2	3
K107	RELAY: Contact arrangement 1C; 4" lg x 1 $\frac{1}{4}$ " wd x 1 $\frac{1}{2}$ " h overall	Silencer circuit relay	29978				23 Part # F23092	Part/dwg P830-120-6	K107	1	1	2	3
K108	RELAY: Contact arrangement 2A; 2 $\frac{1}{2}$ " lg x 1 $\frac{1}{8}$ " wd x 1 $\frac{3}{4}$ " h overall	To apply voltage to selsyn	291011				23 Part # A24129	Part/dwg P830-122	K108	1	1	2	3
L101	COIL, R.F. Choke: Integral type; single winding; single layer wound; unshielded; 48 plus 0, minus 2 turns; #26 E.C. wire 3 $\frac{3}{8}$ " lg x .312 diam overall	RF filter inductance	471378				24 Part # P505-116	Part/dwg P510-116	L101 thru L116	16	16	32	48
L102	COIL: Same as L101	RF filter inductance	471378										
L103	COIL: Same as L101	RF filter inductance	471378										
L104	COIL: Same as L101	RF filter inductance	471378										
L105	COIL: Same as L101	RF filter inductance	471378										
L106	COIL: Same as L101	RF filter inductance	471378										
L107	COIL: Same as L101	RF filter inductance	471378										
L108	COIL: Same as L101	RF filter inductance	471378										
L109	COIL: Same as L101	RF filter inductance	471378										
L110	COIL: Same as L101	RF filter inductance	471378										
L111	COIL: Same as L101	RF filter inductance	471378										
L112	COIL: Same as L101	RF filter inductance	471378										
L113	COIL: Same as L101	RF filter inductance	471378										

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TABLE 8-2
COMBINED PARTS and SPARE PARTS LIST by SYMBOL DESIGNATION
for NAVY TYPE CQC-23497 Selector Control Unit

PARTS										SPARE PARTS			
Symbol Desig.	Name of Part and Designation	Function	AWS, JAN or Navy Type Designation	Navy Stock Number	Army Stock Number	Mfr. and Mfr's Design.	Contractor's Dwg. and Part No.	All Symbols Designation Involved	Total No. Per Equip.	Equip. Tender Stock			
										Box No.	Quan.	Box No.	Quan.
L114 •	COIL: Same as L101	RF filter in- ductance	471378						8		2		8
L115	COIL: Same as L101	RF filter in- ductance	471378										
L116	COIL: Same as L101	RF filter in- ductance	471378										
O101	SHOCKMOUNT: Rubber and stainless steel; normal load 10 lb; bushing and 2 washers; clear 1/4-20 bolt; 1 3/4" lg x 1 3/4" wd x 1 1/4" h	Affixed to A101 to cushion se- lector control unit				25 Code LW-5210	Part/dwg P616-143	O101, O102, O103, O104, O201, O202, O203, O204	8		2		8
O102	SHOCKMOUNT: Same as O101	Affixed to A101 to cushion se- lector control unit											
O103	SHOCKMOUNT: Same as O101	Affixed to A101 to cushion se- lector control unit											
O104	SHOCKMOUNT: Same as O101	Affixed to A101 to cushion se- lector control unit											
P101	PLUG, Cable: Female; straight; aluminum diecast housing; sandblast finish; 1 3/8-18 thread; 19 round parallel contacts; 2 1/8" lg x 1 9/16" diam overall	To provide means to con- nect external cable to recep- tacle J101	AN-3106-22-14S			18 Part # AN-3106- 22-14S	Part/dwg P715-200-1	P101	1		1		2
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P102	PLUG, Cable: Male; straight aluminum diecast housing; sandblast finish; 1 1/4"-18 thread; 12 male round parallel contacts; 2 1/4" lg x 1 3/8" diam overall	To provide means to connect external cable to receptacle J102	AN-3106-28-9P	18 Part # AN-3106-28-9P	Part/dwg P715-200-2	P102	1	1	1	2
R101	RESISTOR: Composition; 27 ohms $\pm 5\%$ 1/2" w; insulated; 3 3/8" lg x 1/4" diam	Voltage divider in dc selsyn circular bridge circuit	RC21BF270J	27 Part # EB-2705	Part/dwg P426-102-121	R101 thru R118	18	9	54	90
R102	RESISTOR: Same as R101	Voltage divider in dc selsyn circular bridge circuit	RC21BF270J							
R103	RESISTOR: Same as R101	Voltage divider in dc selsyn circular bridge circuit	RC21BF270J							
R104	RESISTOR: Same as R101	Voltage divider in dc selsyn circular bridge circuit	RC21BF270J							
R105	RESISTOR: Same as R101	Voltage divider in dc selsyn circular bridge circuit	RC21BF270J							
R106	RESISTOR: Same as R101	Voltage divider in dc selsyn circular bridge circuit	RC21BF270J							
R107	RESISTOR: Same as R101	Voltage divider in dc selsyn circular bridge circuit	RC21BF270J							
R108	RESISTOR: Same as R101	Voltage divider in dc selsyn circular bridge circuit	RC21BF270J							
R109	RESISTOR: Same as R101	Voltage divider in dc selsyn circular bridge circuit	RC21BF270J							
R110	RESISTOR: Same as R101	Voltage divider in dc selsyn circular bridge circuit	RC21BF270J							

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TABLE 8-2
COMBINED PARTS and SPARE PARTS LIST by SYMBOL DESIGNATION
for NAVY TYPE CQC-23497 Selector Control Unit

PARTS										SPARE PARTS			
Symbol Desig.	Name of Part and Designation	Function	AWS, JAN or Navy Type Designation	Navy Stock Number	Army Stock Number	Mfr. and Mfr's Desig.	Contractor's Dwg. and Part No.	All Symbols Designation Involved	Total No. Per Equip.	Equip. Box No.	Tender Box No.	Stock Box No.	Quan.
R111	RESISTOR: Same as R101	Voltage divider in dc selsyn cir- cular bridge circuit	RC21BF270J										
R112	RESISTOR: Same as R101	Voltage divider in dc selsyn cir- cular bridge circuit	RC21BF270J										
R113	RESISTOR: Same as R101	Voltage divider in dc selsyn cir- cular bridge circuit	RC21BF270J										
R114	RESISTOR: Same as R101	Voltage divider in dc selsyn cir- cular bridge circuit	RC21BF270J										
R115	RESISTOR: Same as R101	Voltage divider in dc selsyn cir- cular bridge circuit	RC21BF270J										
R116	RESISTOR: Same as R101	Voltage divider in dc selsyn cir- cular bridge circuit	RC21BF270J										
R117	RESISTOR: Same as R101	Voltage divider in dc selsyn cir- cular bridge circuit	RC21BF270J										
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TABLE 8-2
COMBINED PARTS and SPARE PARTS LIST by SYMBOL DESIGNATION
FOR NAVY TYPE CQC-20409 POWER SUPPLY UNIT

PARTS										SPARE PARTS			
Symbol Desig.	Name of Part and Designation	Function	AWS, JAN or Navy Type Designation	Navy Stock Number	Army Stock Number	Mfr. and Mfr's Desig.	Contractor's Dwg. and Part No.	All Symbols Designation Involved	Total No. Per Equip.	Equip. Box No.	Tender Box No.	Stock Box No.	Quan.
A205	CATCH: Same as A105	Use with clip A203 to close housing A201											
A206	PLATE, Clamping: Aluminum; gray paint; two 1 $\frac{1}{2}$ " diam and one 1 $\frac{3}{8}$ " diam holes; 5 $\frac{1}{8}$ " lg x 2 $\frac{1}{2}$ " wd x .091" th overall	To hold in place, capacitors C201, C202, C203				13 Part/dwg P202-436	Part/dwg P202-436	A206	1				
A207	NOT USED												
A208	BRACKET: "L" shape; aluminum, painted navy gray; 9 $\frac{1}{2}$ " x 1 $\frac{1}{2}$ " x $\frac{1}{2}$ "; .064 th	To prevent chassis from bending				13 Part # P202-439	Part/dwg P202-439	A208	1				
C201	CAPACITOR: Dry electrolytic; 1500 mfd; 25 vdcw; case insulated from capacitor; sealed; 1 $\frac{1}{8}$ " diam x 4 $\frac{3}{8}$ " h including octal plug in base	To filter rectified d-c voltage	CE51A152F			33 Spec D-12423	Part/dwg P301-122-2	C201, C202	2	2	6		6
C202	CAPACITOR: Same as C201	To filter rectified d-c voltage	CE51A101F										
C203	CAPACITOR: Dry electrolytic; 100 mfd, 25 vdcw; metal case; insulated from capacitor; sealed; 1 $\frac{1}{8}$ " diam x 3 $\frac{3}{8}$ " h including octal plug-in base	To block flow of d-c voltage in audio line	CE51A101F			33 Spec D-12422	Part/dwg P301-122-1	C203	1	1	3		3
CR201	RECTIFIER: Selenium; input 17 v ac, 60 cycles; output 13.5 v dc, 0.5 amp; cylindrical; 2" lg x 2 $\frac{3}{8}$ " wd x 2 $\frac{1}{8}$ " h overall	To rectify a-c to d-c	20501			34 Type 9D2031	Part/dwg P440-103	CR201	1	1	1		2
E201	NOT USED												
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TABLE 8-2
COMBINED PARTS and SPARE PARTS LIST by SYMBOL DESIGNATION
FOR NAVY TYPE CQC - 20409 POWER SUPPLY UNIT

PARTS										SPARE PARTS			
Symbol Desig.	Name of Part and Description	Function	AWS, JAN or Navy Type Designation	Navy Stock Number	Army Stock Number	Mfr. and Mfr's Desig.	Contractor's Dwg. and Part Number	All Symbols Designation Involved	Total No. Per Equip	Box No. Equip.	Box No. Tender	Box No. Stock	Quan.
O203	SHOCKMOUNT: Same as O101	Affixed to A201 to cushion unit							1	1			2
O204	SHOCKMOUNT: Same as O101	Affixed to A201 to cushion unit							1	1			3
P201	PLUG, Cable: Female; straight; aluminum diecast housing; sandblast; thread 1 $\frac{1}{16}$ -18; 12 parallel, round contacts; 2 $\frac{1}{4}$ " lg x 1 $\frac{1}{2}$ " diam overall	To provide means to con- nect external cable to recep- tacle J201	AN-3106-28-9S			18 Cat # AN-3106- 28-9S	Part/dwg P715-200-3	P201	1	1			2
T201	TRANSFORMER: Power; pri- mary 110-120 v, 50/60 cycles; secondary 27 v, .886 amp at 115 v, 60 cycles input; steel case; hermetically sealed; 4 mtg studs 8-32 x $\frac{5}{16}$ " on 2" x 3 $\frac{1}{8}$ " centers; solder terminals; 3 $\frac{1}{2}$ " lg x 2 $\frac{13}{16}$ " wd x 4 $\frac{1}{4}$ " h	To supply volt- age to rectifier	302989			29 Type 9P95	Part/dwg P800-114	T201	1	1			3
T202	TRANSFORMER: Audio; pri- mary 300 ohm; secondary 300 ohms CT; steel case, hermeti- cally sealed; 2 clinch 6-32 mtg nut on 2" centers; solder termi- nals; 2 $\frac{3}{8}$ " lg x 1 $\frac{5}{16}$ " wd x 2 $\frac{1}{2}$ " h	To couple bal- anced line with unbalanced line	302991			29 Type 9A51	Part/dwg P810-114	T202	1	1			3
X201	SOCKET: Std octal; molded mica filled bakelite; 1 $\frac{1}{8}$ " diam; 1 $\frac{1}{8}$ " lg x 1 $\frac{1}{4}$ " wd x 1 $\frac{1}{16}$ " h over- all	To hold capaci- tor C201	491389			20 9663	Part/dwg P700-128	X201, X202, X203	3	2			3
X202	SOCKET: Same as X201	To hold capaci- tor C202	491389										
X203	SOCKET: Same as X201	To hold capaci- tor C203	491389										
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X204	SOCKET: Same as X103	To mount pilot light I201; shows red when on	COMBINED PARTS and SPARE PARTS LIST by SYMBOL DESIGNATION for NAVY TYPE CQC-23445 REMOTE CHANNEL SELECTOR UNIT									
A301	HOUSING, Remote Channel Selector Indicator: Cast aluminum alloy; gray paint; $6\frac{1}{8}$ " lg x $6\frac{1}{8}$ " h x $4\frac{1}{8}$ " d overall	To house complete unit	14 Dwg D-11292-P	Part/dwg P285-135	A301	1						
A302	PANEL, Remote Channel Selector Indicator: Aluminum, satin dip; gray paint; white filled engraving; bracket riveted on; $6\frac{1}{2}$ " lg x $6\frac{1}{2}$ " wd x $2\frac{1}{2}$ " d overall	To mount M301, S301, E301, and N301 on A301	8 Spec 82067	Part/dwg G-2232	A302	1						
A303	HOLDER, Card: Brass; dark gray paint; $2\frac{1}{16}$ " lg x $2\frac{1}{4}$ " wd x $\frac{1}{16}$ " d overall	To hold group of 10 channel use chart, N304	13 Part P999-215	Part/dwg P999-215	A303	1						
E301	BOARD, Terminal: Six brass nickel-plated dual 6-32 screw terminals; molded bakelite; black; $3\frac{3}{8}$ " lg x $1\frac{1}{2}$ " wd x .525 h overall	To connect Remote Channel Selector Unit wire to cable	2 6-141 Spec	Part/dwg P610-256-3	E301	1						
E302	KNOB, Pointer: Black bakelite; for $\frac{1}{4}$ " diam shaft, for single 8-32 set screw; pointer line white lacquer; $1\frac{1}{2}$ " lg x $\frac{1}{8}$ " diam x $\frac{7}{8}$ " h; brass insert	To control ON-OFF switch, S301	4 Type S-246-3L	Part/dwg P950-144	E302	1						
H301	NUT, Cap: Brass; black oxidize; 6-32; $\frac{9}{16}$ " th; $\frac{5}{16}$ " wd across flats	To mount selector M301, on shockmount O301 to panel A302	12 Part 275	Part/dwg P908-132-1-31	H301, H302, H303, H304	4						
H302	NUT: Same as H301	To mount selector M301 on shockmount O302 to panel A302										
H303	NUT: Same as H301	To mount selector M301 on shockmount O303 to panel A302										
H304	NUT: Same as H301	To mount selector M301 on shockmount O304 to panel A302										

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TABLE 8-2
COMBINED PARTS and SPARE PARTS LIST by SYMBOL DESIGNATION
for NAVY TYPE CQC—23445 REMOTE CHANNEL SELECTOR UNIT

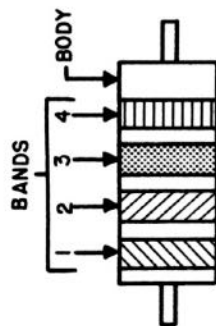
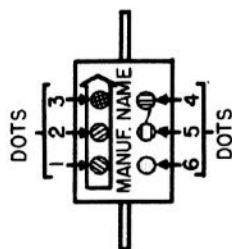
Symbol Desig.	Name of Part and Designation	Function	AWS, JAN or Navy Type Designation	Navy Stock Number	Army Stock Number	Mfr. and Mfr's Desig.	Contractor's Dwg. and Part No.	All Symbols Designation Involved	Total No. Per Equip.	SPARE PARTS			
										Equip.	Tender	Stock	Quan.
										Box No.	Box No.	Box No.	Box No.
										Quan.	Quan.	Quan.	Quan.
H305	PLUG, Pipe: 1"; brass zinc plate and cronak; $\frac{1}{8}$ " wd x $\frac{1}{8}$ " d x 1" lg slot, in place of square head; $1\frac{1}{2}$ " diam x $\frac{5}{8}$ " h	To plug extra cable hole in housing A301				9 Part P999-219	Part/dwg P999-219	H305	1				
M301	INDICATOR, Selsyn: 3 wire, 12 v operating current; non-resettable dial; scale plate black; markings and pointer end, self-activated luminescent; connection studs #8-36 x $\frac{1}{2}$ " lg with hex nuts and solder lugs; 4 mtg holes in corners on a $1\frac{1}{2}$ " radius; $2\frac{3}{8}$ " lg x $2\frac{3}{8}$ " wd x $1\frac{1}{2}$ " d overall	Channel indicator to function with controlled equipment	22445-A			6 Type 8DJ11PFT	Part/dwg P956-113	M301	1				1
N301	NOT USED												
N302	WINDOW, Plexiglass: Clear $\frac{1}{8}$ " th x $2\frac{3}{8}$ " wd x $2\frac{3}{8}$ " lg; 4 holes $\frac{9}{16}$ " diam in corners on $1\frac{1}{2}$ " radius	On front panel A302 to protect selsyn indicator M301				11 Part Admiral P999-218	Part/dwg P999-218	N302	1				
N303	WINDOW, Cellulose Acetate: Clear; $\frac{1}{8}$ " th x $2\frac{3}{8}$ " lg x $2\frac{3}{8}$ " wd; corners rounded	To insert into card holder A303 and protect charts N304				11 Part Admiral P999-217	Part/dwg P999-217	N303	1				
N304	CHART, Channel-Use: 90# white sulphite index Bristol board, printed in black ink; three columns, crosslined; $2\frac{3}{8}$ " lg x $2\frac{3}{8}$ " wd overall	To record channel freq and for what purpose used; group of ten, slip into card holder A303				1 Part/dwg P953-261	Part/dwg P-953-261	N304	10	25	25		50

Contract N5sr-759

O301	SHOCKMOUNT: Neoprene #40 durometer; $\frac{3}{8}$ " sq x $\frac{1}{2}$ " lg rubber block; 6-32 x $\frac{1}{2}$ " stud at each end; $1\frac{1}{4}$ " lg x $\frac{3}{8}$ " wd x $\frac{3}{8}$ " h overall	To cushion sel-syn M301 in mtg to panel A302				5 Type B321	Part/dwg P999-214	O301, O302, O303, O304	4	1	4	4
O302	SHOCKMOUNT: Same as O301	To cushion sel-syn M301 in mtg to panel A302										
O303	SHOCKMOUNT: Same as O301	To cushion sel-syn M301 in mtg to panel A302										
O304	SHOCKMOUNT: Same as O301	To cushion sel-syn M301 in mtg to panel A302										
P301	CONNECTOR, Terminal Tube: Aluminum; gray paint; type XX1, tube size G; pipe thread 1"; ID, $\frac{1}{4}$ "; with gland nut and gland ring	To fasten cable to housing A301				10 Type XX1 Size G	Part/dwg P715-199-1	P301	1	1	1	1
S301	SWITCH, Rotary: 3 pole, 2 position, single section; laminated body $1\frac{7}{8}$ " diam x $1\frac{1}{16}$ " lg; shaft $\frac{1}{4}$ " diam x $\frac{1}{2}$ " lg with flat; bushing $\frac{3}{8}$ " diam x $\frac{3}{8}$ " lg; solder lug terminals	On-off switch				3 Spec Type H1 29997	Part/dwg P710-162	S301	1	1	1	1
S302	DIAL, Telephone: Dialing mechanism; black, white letters; 1-10 impulse dial with SPST off normal switch, normally open; luminous dial markings; $3\frac{1}{2}$ " diam x $1\frac{1}{2}$ " d overall	To select channels on controlled equipment	24794			7 ZH- 87246-3	Part/dwg P999-213	N301	1	1	1	1
Contract N5sr-759												

TABLE 8-3
CROSS REFERENCE PARTS LIST

By JAN or AWS Designation		By NAVY TYPE NUMBERS		By ARMY-NAVY TYPE NUMBERS	
JAN or AWS DESIGNATION	KEY SYMBOL	NAVY TYPE NUMBER	KEY SYMBOL	ARMY-NAVY TYPE NUMBER	KEY SYMBOL
CE51A101F	C203	22445-A	M301	AN-3057-12	E107
CE51A152F	C201, C202	24794 (Switch Section)	N301	AN-3057-16 Special	E108, E202
CM35B103M	C101 to C132 incl.	28062-1	F101, F102, F103, F104	AN-3102-22-14P	J101
RC21BF270J	R101 to R118 incl.	29973	K101	AN-3102-28-9P	J201
RW31E400	R119	29974	K102	AN-3102-29-9S	J102
		29975	K103	AN-3106-22-14S	P101
		29976	K104	AN-3106-28-9P	P102
		29977	K106	AN-3106-28-9S	P201
		29978	K107		
		29979	K201		
		29982	K105		
		302989	T201		
		302990	T101		
		302991	T202		
		302992	L201		
		471378	L101 to L116 incl.		
CONTRACT N5sr- 759					

TABLE 8-4
APPLICABLE COLOR CODESAMERICAN WAR STANDARD COLOR CODE CHART
FOR RESISTORSAMERICAN WAR STANDARD 6-DOT COLOR CODE CHART
FOR CAPACITORS (MOLDED MICA)

COLOR	1ST DOT 1ST DIGIT	2ND DOT 2ND DIGIT	3RD DOT 3RD DIGIT	4TH DOT DECIMAL MULTIPLIER	5TH DOT TOLER- ANCE	6TH DOT CHARAC- TERISTICS
BLACK	0	0	0	1	$\pm 20\%$ (M)	* A
BROWN	1	1	1	10		B
RED	2	2	2	100	$\pm 2\%$ (G)	C
ORANGE	3	3	3	1,000		D
YELLOW	4	4	4	10,000		E
GREEN	5	5	5	100,000		F
BLUE	6	6	6	1,000,000		G
VIOLET	7	7	7	10,000,000		
GRAY	8	8	8	100,000,000		
WHITE	9	9	9	1,000,000,000		
GOLD	...	...	...	0.1	$\pm 5\%$ (J)	
SILVER	...	...	...	0.01	$\pm 10\%$ (K)	

* A—Ordinary Mica By-pass

B—Same as A—Low Loss Case

C—By-pass or Silver Mica Capacitor (± 200 Parts/Million/C)D—Silver Mica Capacitor (± 100 Parts/Million/C)E—Silver Mica Capacitor (0 to ± 100 Parts/Million/C)F—Silver Mica Capacitor (0 to ± 50 Parts/Million/C)G—Silver Mica Capacitor (0 to ± 50 Parts/Million/C)

COLOR	1ST BAND 1ST DIGIT	2ND BAND 2ND DIGIT	3RD BAND DECIMAL MULTIPLIER	4TH BAND TOLERANCE
BLACK	0	0	1	
BROWN	1	1	10	
RED	2	2	100	
ORANGE	3	3	1,000	
YELLOW	4	4	10,000	
GREEN	5	5	100,000	
BLUE	6	6	1,000,000	
VIOLET	7	7	10,000,000	
GRAY	8	8	100,000,000	
WHITE	9	9	1,000,000,000	
GOLD	...	...	0.1	$\pm 5\%$ (J)
SILVER	...	...	0.01	$\pm 10\%$ (K)
NO COLOR	...	...	...	$\pm 20\%$ (M)

TABLE 8-5
LIST OF MANUFACTURERS

Abbreviation of Manufacturer's Name as Reference in the Preceding Lists	Manufacturer's Prefix Letters Where Assigned by Bureau of Ships	Name of Manufacturer	Correspondence Address of Manufacturer
1	COC	Admiral Corporation	Chicago 47, Ill.
2	CJC	Howard B. Jones Co.	Chicago, Ill.
3	COC	Oak Mfg. Co.	Chicago 10, Ill.
4	CAUR	Kurz-Kasch Inc.	Dayton 1, Ohio
5	CBAK	United States Rubber Co.	New York 20, N. Y.
6	CG	General Electric Company	Schenectady, N. Y.
7	CAU	Automatic Electric Company	Chicago 7, Ill.
8	—	Croname, Inc.	Chicago 13, Ill.
9	—	Nicoud Mfg. Company	Chicago, Ill.
10	—	Penn. Electric Service Co.	Philadelphia, Pa.
11	—	Parisian Novelty Co.	Chicago 9, Ill.
12	—	Federal Screw Prod. Co.	Chicago 10, Ill.
13	—	Crescent Tool and Die Co.	Chicago 41, Ill.
14	—	Doehler-Jarvis Co.	Pottstown, Penn.
15	—	Corbin Cabinet & Lock Co.	New Britain, Conn.
16	CMR	Micamold Radio Corp.	Brooklyn, N. Y.
17	—	Lamacoid Fabricators, Inc.	Chicago 51, Ill.
18	CPH	American Phenolic Corp.	Chicago 50, Ill.
19	CLF	Littelfuse, Inc.	Chicago 40, Ill.
20	CMG	Cinch Mfg. Co.	Chicago 12, Ill.
21	—	McLean Mfg. Co.	Chicago 47, Ill.
22	—	Atlantic India Rubber Works	Chicago 7, Ill.
23	CRY	C. P. Clare & Co.	Chicago, Ill.
24	CAWO	Midwest Electric Prod. Inc.	Indianapolis 8, Ind.
25	CAYU	L. M. Barry Co.	Cambridge, Mass.
26	CAO	Ward-Leonard	Mt. Vernon, N. Y.
27	CBZ	Allen-Bradley Co.	Milwaukee 4, Wis.
28	CAE	Cutler-Hammer, Inc.	Milwaukee 1, Wis.
29	CADF	Standard Transformer Corp.	Chicago 22, Ill.
30	CFA	Bussman Mfg. Co.	St. Louis 7, Mo.
31	CAYS	Drake Mfg. Co.	Chicago 22, Ill.
32	CMA	P. R. Mallory Co.	Chicago 22, Ill.
33	CD	Cornell-Dubilier Elec. Corp.	Indianapolis 6, Ind.
34	CFT	Federal Telephone & Radio Corp.	So. Plainfield, N. J.
			Newark, N. J.
			200 Mt. Pleasant Ave.
			3029 Washington St.
			1713 W. Hubbard St.
			Jefferson & University Sts.
			1500 N. Halsted St.
			1333 West St. Paul Ave.
			118 W. Greenfield Ave.
			31 South Street
			189 Sidney St.
			1710 N. Lueft Ave.
			4719 Sunnyside Ave.
			1453 W. Van Buren St.
			3920 W. McLean Ave.
			2335 W. Van Buren
			4757 N. Ravenswood Ave.
			1830 S. 54th St.
			3600 W. Potomac Ave.
			1087 Flushing Ave.
			Brooklyn, N. Y.
			New Britain, Conn.
			Pottstown, Penn.
			Chicago 41, Ill.
			Chicago 10, Ill.
			Chicago 9, Ill.
			Philadelphia, Pa.
			Chicago 13, Ill.
			Chicago, Ill.
			Chicago 7, Ill.
			Schenectady, N. Y.
			New York 20, N. Y.
			Dayton 1, Ohio
			Chicago 10, Ill.
			Chicago 47, Ill.
			Chicago 7, Ill.
			Chicago, Ill.
			Indianapolis 8, Ind.
			Cambridge, Mass.
			Mt. Vernon, N. Y.
			Milwaukee 4, Wis.
			Milwaukee 1, Wis.
			Chicago 22, Ill.
			St. Louis 7, Mo.
			Chicago 22, Ill.
			Indianapolis 6, Ind.
			So. Plainfield, N. J.
			Newark, N. J.
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