

NAVSHIPS 91500

RESTRICTED

INSTRUCTION BOOK

*for*

**RADIO FREQUENCY  
SWITCHING GROUP**

**AN/FRA-3**

*(Remotely Controlled)*

TRANSCONTINENTAL ELECTRONIC CORP.  
274 MADISON AVE., NEW YORK, N. Y.

BUREAU OF SHIPS

NAVY DEPARTMENT

Contract NObsr-49003

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**LIST OF EFFECTIVE PAGES**

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17 July 1951

From: Chief, Bureau of Ships  
To: All Activities Concerned with the  
Installation, Operation and Main-  
tenance of the Subject Equipment  
Subj: Instruction Book for Radio Frequency  
Switching Group, AN/FRA-3 NAVSHIPS  
91500

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2. When superseded by a later edition, this publication shall be destroyed.
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H. N. WALLIN  
Chief of Bureau



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# GUARANTEE

The equipment including all parts and spare parts, except vacuum tubes, batteries, rubber and material normally consumed in operation, is guaranteed for a period of one year from the date of delivery of the equipment to and acceptance by the Government with the understanding that all such 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 will not obligate the Contractor to make repair or replacement of any such defective items unless the defect is not the result of normal expected shelf life deterioration.

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 condition, against defects in design with the understanding that if ten percent (10%) or more of any such said item, but not less than two of any such item, of the total quantity comprising such item furnished under the contract, are found to be defective as to design, such item will be conclusively presumed to be of defective design and subject to one hundred percent (100%) correction or replacement by a suitably redesigned item.

All such defective items will be subject to ultimate return to the Contractor. In view of the fact that normal activities of the Naval Service may result in the use of equipment in such remote portions of the world or under such conditions as to preclude the return of the defective items for repair or replacement without jeopardizing the integrity of Naval communications, the exigencies of the Service, therefore, may necessitate expeditious repair of such items in order to prevent extended interruption of communications. In such cases the return of the defective items for examination by the Contractor prior to repair or replacement will not be mandatory. The report of a responsible authority, including details of the conditions surrounding the failure, will be acceptable as a basis for affecting expeditious adjustment under the provisions of this contractual guarantee.

The above one year period will not include any portion of time the equipment fails to perform satisfactorily due to any such defects, and any item repaired or replaced by the Contractor will be guaranteed anew under this provision.

# INSTALLATION RECORD

Contract Number NObsr-49003	Date of Contract, 19 July 1949
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 on this page shall be filled in at time of installation.

## REPORT OF FAILURE

Report of failure of any part of this equipment, during its entire service life, shall be made to the Bureau of Ships in accordance with current regulations using form NAVSHIPS NBS 383 (revised) except for Marine Corps equipment, in which case the "Signal Equipment Failure Report" form shall be used and distributed in accordance with instructions pertaining thereto. 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 or requisitions for replacement material should include the following data:

1. Federal stock number or, when ordering from a Marine Corps or Signal Corps supply depot, the Signal Corps stock number.
2. Name and short description of part.

If the appropriate stock number is not available the following shall be specified:

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

## DESTRUCTION OF ABANDONED MATERIAL IN THE COMBAT ZONE

In case it should become necessary to prevent the capture of this equipment, and when ordered to do so, DESTROY IT SO THAT NO PART OF IT CAN BE SALVAGED, RECOGNIZED, OR USED BY THE ENEMY. BURN ALL PAPERS AND BOOKS.

*Means:*

1. Explosives, when provided.
2. Hammers, axes, sledges, machetes, or whatever heavy object is readily available.
3. Burning by means of incendiaries such as gasoline, oil, paper or wood.
4. Grenades and shots from available firearms.
5. Burying all debris, where possible and when time permits.
6. Throwing overboard or disposing of in streams or other bodies of water.

*Procedure:*

1. Obliterate all identifying marks. Destroy nameplates and circuit labels.
2. Demolish all panels, castings, switch and instruction boards.
3. Destroy all controls, switches, relays, connections and meters.
4. Rip out all wiring and cut interconnections of electrical equipment. Smash gas, oil, and water cooling systems in gas engine generators, etc.
5. Smash every electrical or mechanical part, whether rotating, moving or fixed.
6. Break up all operating instruments such as keys, phones, microphones, etc.
7. Destroy all classes of carrying cases, straps, containers, etc.
8. Bury or scatter all debris.

**DESTROY EVERYTHING!**



## SAFETY NOTICE

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

This equipment employs voltages which are dangerous and may be fatal if contacted by operating personnel. Extreme caution should be exercised when working with the equipment.

While every practicable safety precaution has been incorporated in this equipment, the following rules must be strictly observed:

### KEEP AWAY FROM LIVE CIRCUITS:

Operating personnel must at all times observe all safety regulations. Do not change tubes or make adjustments inside equipment with high voltage supply on. Under certain conditions dangerous potentials may exist in circuits with power controls in the off position due to charges retained by capacitors. To avoid casualties always

remove power and discharge and ground circuits prior to touching them.

### DON'T SERVICE OR ADJUST ALONE:

Under no circumstances should any person reach within or enter the enclosure for the purpose of servicing or adjusting the equipment without the immediate presence or assistance of another person capable of rendering aid.

### DON'T TAMPER WITH INTERLOCKS:

Do not depend upon door switches or interlocks for protection but always shut down motor generators or other power equipment. Under no circumstances should any access gate, door, or safety interlock switch be removed, short-circuited, or tampered with in any way, by other than authorized maintenance personnel, nor should reliance be placed upon the interlock switches for removing voltages from the equipment.

## 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.

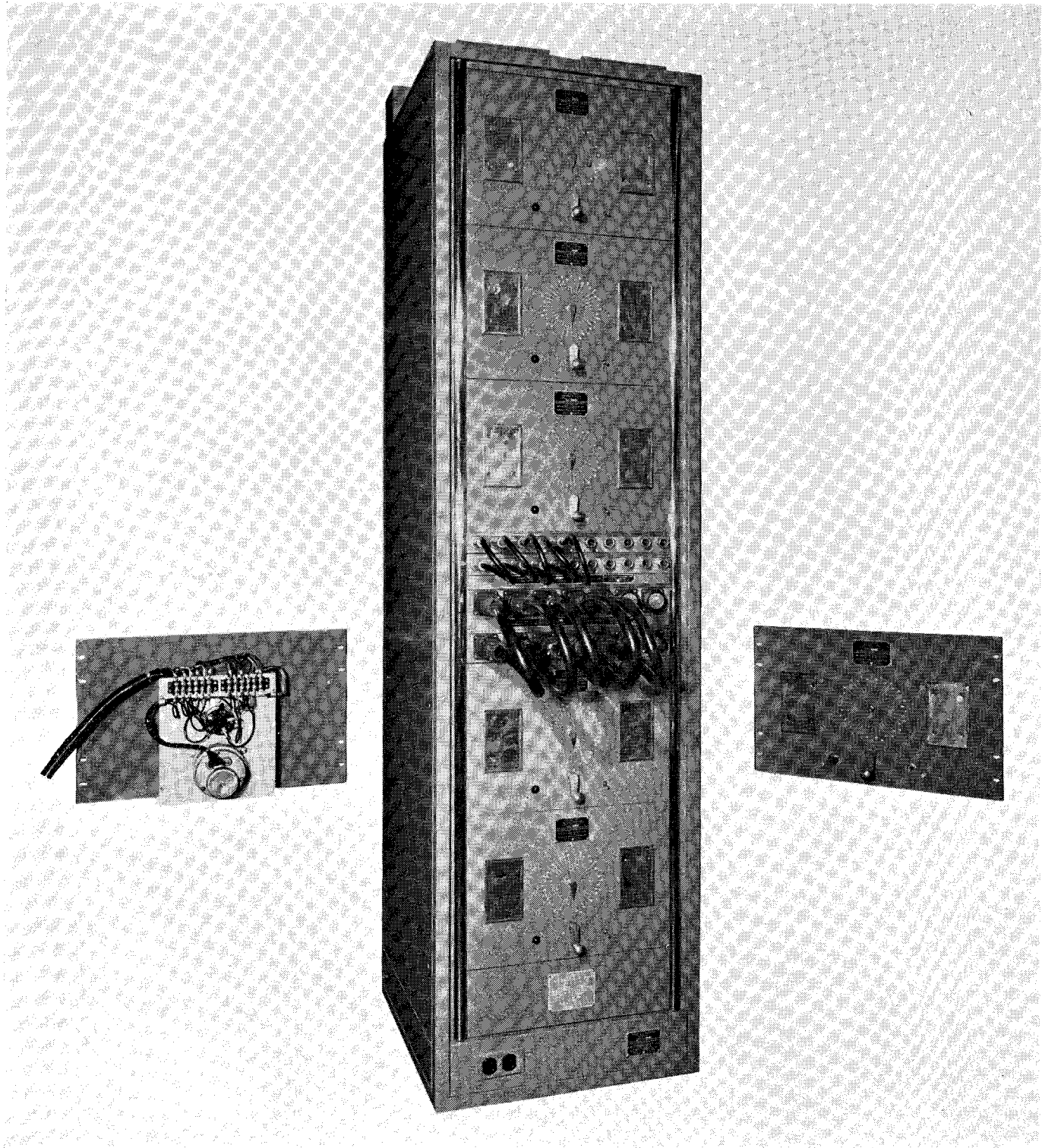


Figure 1-1. Radio Frequency Switching Group AN/FRA-3, Relationship of Units

## SECTION 1 GENERAL DESCRIPTION

### 1. PURPOSE AND BASIC PRINCIPLES.

The RF Switching Group Equipment allows the operator of a radio receiver to rapidly select any of forty antennae from his operating position at the receiver. Since the equipment consists of five complete systems, each of five receiver operators at five different locations may each select any one antenna from a remotely located group of forty. Furthermore, by means of a patching arrangement at the switching location any of the five remote control panels may be patched to control any one of the five forty point antenna selector switches.

The receiver operator by turning a hand crank on a control panel mounted at his position turns a synchro generator which is electrically connected to a synchro motor at the antenna switch location. The synchro motor drives a gear train which in turn rotates a co-axial antenna switch. Ordinarily a synchro is not called upon to deliver any appreciable torque and is not usually capable of so doing. In this case the gear train has a forty to one mechanical advantage giving sufficient torque to turn the rather large switch one fortieth of a turn for each complete turn of the synchro. Since the switch has forty equally spaced positions, one complete turn of the crank at the receiver operator's location moves the antenna selector switch one position. A small synchro generator geared through a one to one ratio to the switch shaft is electrically connected to a small synchro motor back at the remote control panel. A pointer is mounted on the shaft of this motor to indicate to the receiver operator the position of the antenna switch.

In the complete equipment there are five identical systems as described above. The five control panels are located convenient to the receiver with which each is used. The five antenna selectors are located all together in a relay rack cabinet as near as is practical to the antenna groups. Also mounted in the relay rack panel are two RF patch panels for patching any antenna switch to any receiver and to synchro control patch panels for patching the control of any antenna switch to any control panel.

### 2. DESCRIPTION OF UNITS.

(a) CONTROL PANEL—The control panel consists of a 19" x 12 $\frac{7}{8}$ " panel for standard relay rack mounting behind which are mounted a 5F Synchro Generator and a 1F Synchro Motor. There is a hand crank on the shaft

of the larger (5G) synchro which protrudes through the lower center of the panel. A pointer, mounted on the shaft of the smaller (1F) synchro, moves over a 360 degree 40 division scale etched in the center of the panel. Two card holders with transparent acetate face strips are mounted one on each side of the panel. These are used to hold cards made out to correlate the etched scale with the remote switch positions and corresponding antennae. A neon pilot lamp at the lower left side of the panel indicates when lighted that the panel is patched to an antenna selector and that the synchro power is turned on. A double throw toggle switch at the lower right of the panel turns the synchro power on and off. The synchro power may also be controlled from the antenna selector.

(b) ANTENNA SELECTOR—The antenna selector consists of a front panel behind which are mounted a 5F synchro motor, a 1G synchro generator, a gear train and the antenna selector switch. All five of the antenna selectors which go to make up a complete equipment are mounted in the same relay rack cabinet. The front panel is identical with that of the control panel described under (a) of this section, and the controls thereon perform the same functions in the same manner. This panel is mounted on the cabinet separately from the other equipment in order that it may be removed to gain access to the gear train, synchros and antenna switch behind it.

The 5F synchro follows the motion of the 5G, crank driven, synchro to which it is patched and drives the antenna switch at one fortieth of the speed of the No. 5 synchros. The 1G synchro is geared directly to the switch shaft and transmits the movement of the switch back to the 1F synchro and pointer on the control panel.

The antenna switch may also be driven through the gear train by means of the hand crank in the lower center of the front panel. Normally this crank is unclutched from the gear train; and, in order to operate it, it must be pushed a fraction of an inch toward the panel against a clutch spring. If the antenna switch has stopped between positions it may be necessary to rotate the crank slightly in order to engage the clutch. Normally the switch detent mechanism will hold the switch in one of its contact positions while the weight of the crank handle will hold it in position to engage the clutch.

(c) RF PATCH PANELS J-239/G—These patch panels were designed for general electronic use and are not specifically adopted for this application. Each panel

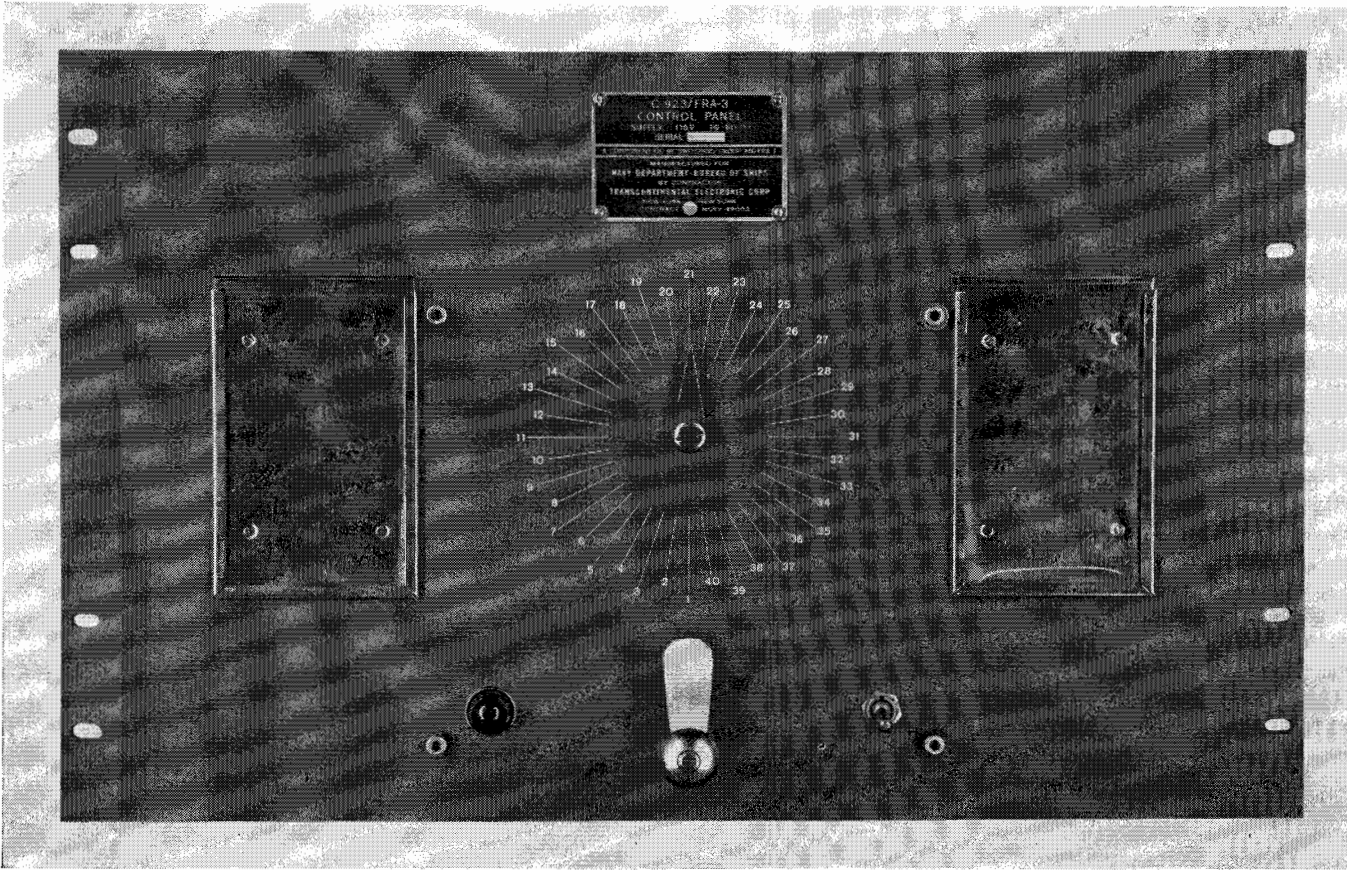


Figure 1-2. Control Panel, C-923/FRA-3

contains eleven Navy type CIA-491388 Jack Switches five of which are partially used in this equipment. A function diagram of the Jack Switch is shown in fig. 1-5. As can be seen from this diagram connector B is normally connected to connector C both at the back of the panel. When a patch cord is inserted into Jack A at the front of the panel, the connection between B and C is broken and A is connected to B which is the upper connection at the back of the panel. As applied in the equipment only A and B are used; thus, when there is no patch cord in place, the antenna or receiver connected to B is in reality open circuited. Two of these Patch Panels are mounted in the relay rack cabinets with the antenna selectors. Five of the upper terminals (B) of the upper panel are connected to the enter taps of the five antenna switches. Five of the upper terminals (B) of the lower panel are connected to the receivers. Thus by patching between corresponding jacks (A), by means of a type 49122-B RF Patch Cord an antenna switch is connected to a receiver.

(d) ELECTRICAL CONNECTOR ASSEMBLIES J-435/G AND J-436/G — These two assemblies are mounted in the relay rack cabinet with the Antenna Selectors. They are used as patch panels to patch the synchro control cables from the control panels to the Antenna Selectors. The two assemblies are the same except that the upper one (J-435/FRA-3) which is connected to the Antenna Selectors has female contact pins in the connectors while the lower one (J-436/FRA-3) has male pins. The (J-435/FRA-3) Assembly is supplied with the interconnecting cable already attached for connection to the Antenna Selectors. Designation Strip Holders on the panels are to be filled out to correlate the connectors with the corresponding Antenna Selectors and Control Panels.

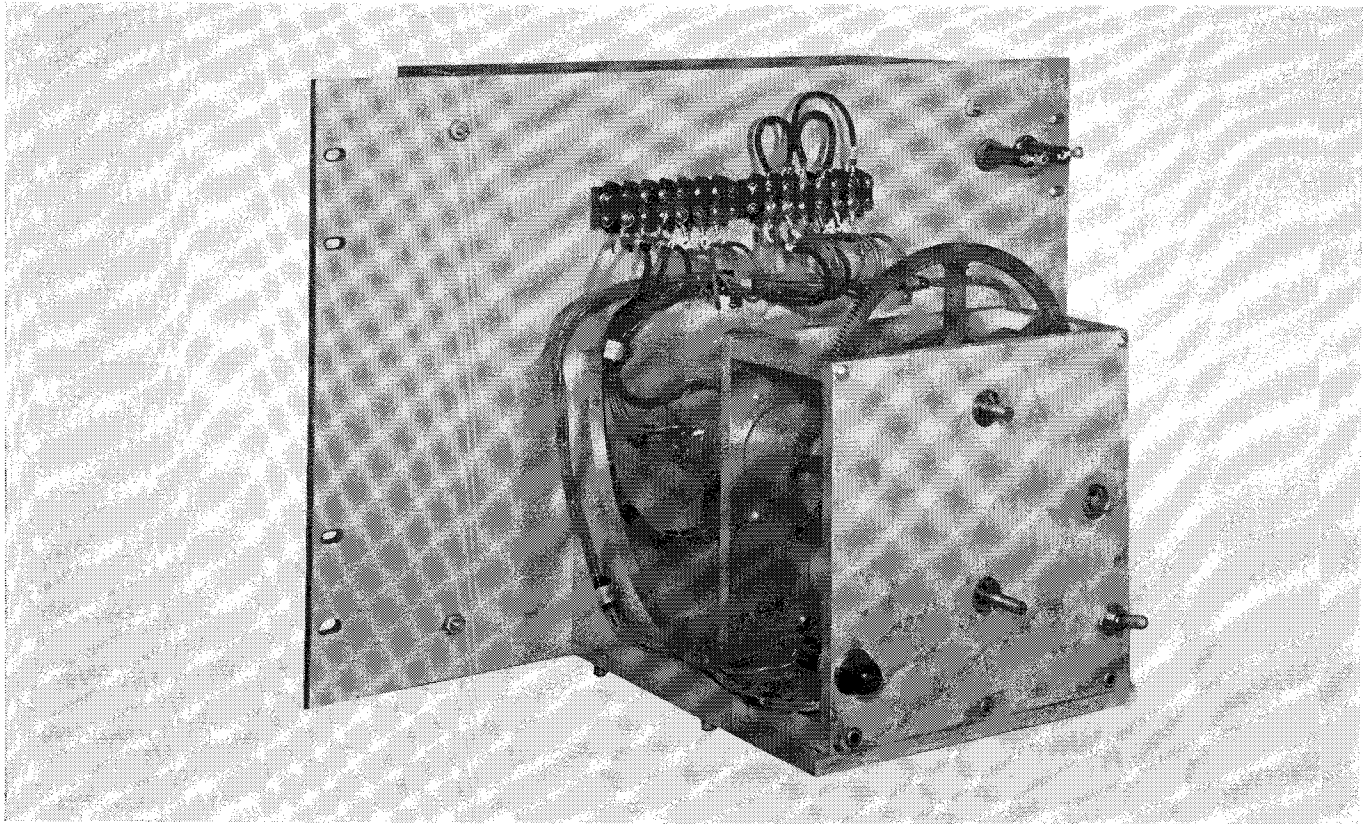


Figure 1-3. Antenna Selector, SA-256/FRA-3

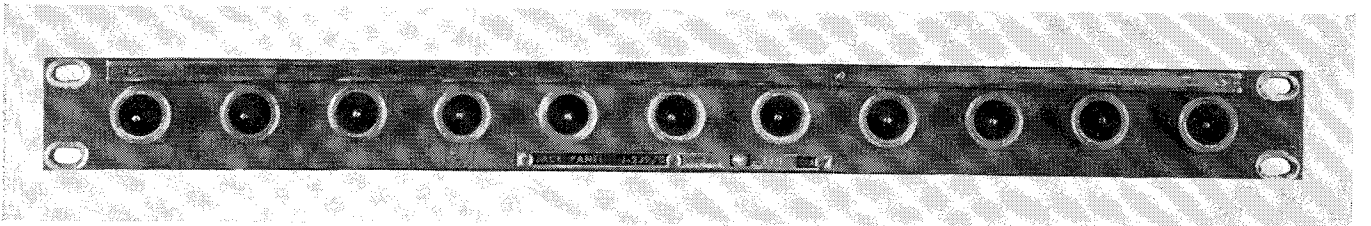


Figure 1-4. Radio Frequency Patch Panel J-239/G-3

3. REFERENCE DATA.

(a) NOMENCLATURE — The official nomenclature for the complete equipment described in the instruction book is:

RADIO FREQUENCY SWITCHING GROUP  
AN/FRA-3

(b) CONTRACT NUMBER AND DATE — The Navy Contract Number is NObsr-49003 dated 19 July 1949.

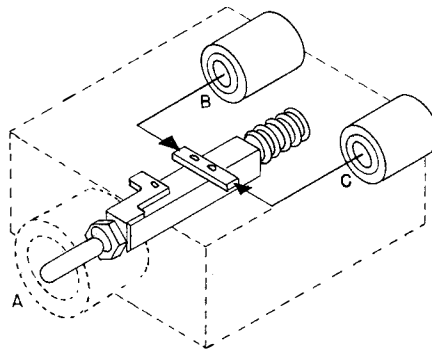
Change Order No. 1 dated 18 Nov. 1949  
Amendment 2 dated 7 June 1950

(c) CONTRACTOR — TRANSCONTINENTAL ELECTRONIC CORP., 274 Madison Ave., New York, New York.

(d) COGNIZANT NAVAL INSPECTOR — Inspector of Naval Material, New York, New York.

(e) POWER SUPPLY—The equipment is connected to the AC Mains at the location of the Antenna Selector Cabinet only. Required: 115 volts, 60 cycles, single phase, 150 watts.

RF JACK SWITCH NAVY TYPE CIA-491388 AS INCLUDED IN JACK SWITCH PANEL J-239/G



NORMAL CONNECTION B TO C  
PATCHCORD CONNECTION A TO B

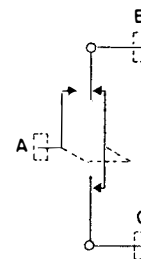


Figure 1-5. Function Diagram of Navy Type CIA-491388 Jack Switch

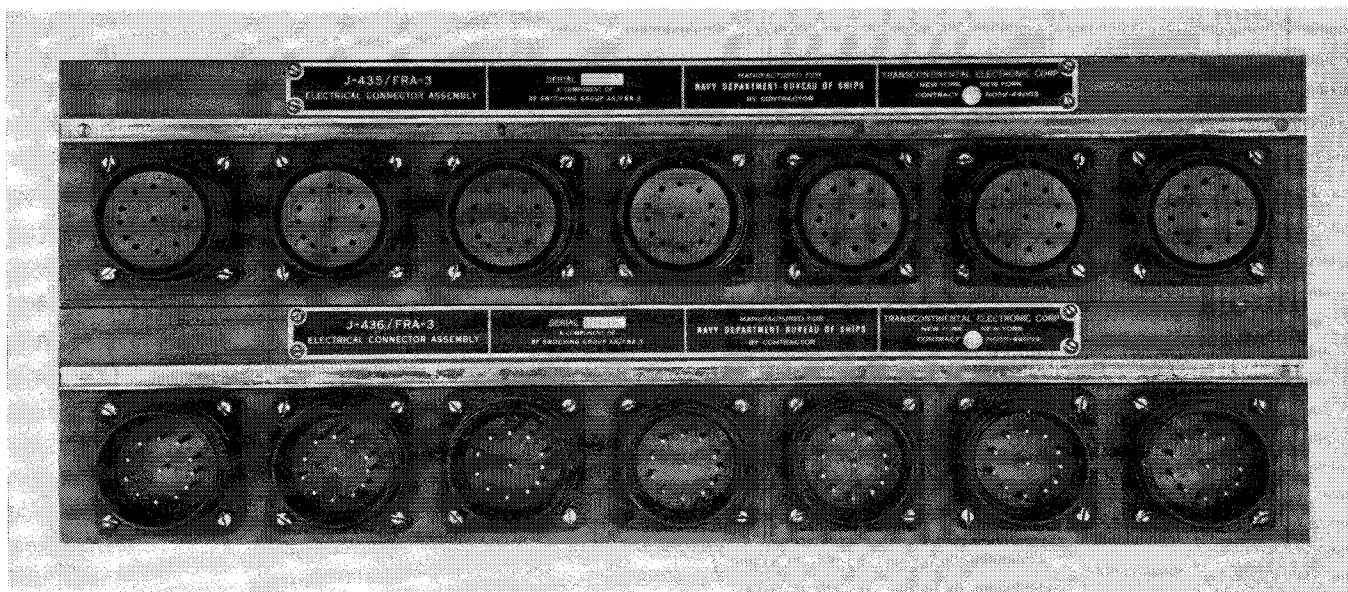


Figure 1-6. Electrical Connector Assemblies, J-435/G and J-346/G

**TABLE 1-1. EQUIPMENT SUPPLIED**

QUANTITY PER EQUIPMENT	NAME OF UNIT	NAVY TYPE DESIGNATION	OVER-ALL DIMENSIONS			VOLUME	WEIGHT
			HEIGHT	WIDTH	DEPTH		
5	Antenna Selector	SA-256/FRA-3	12-7/32	19	15	2.0	47.5
5	Control Panel	C-923/FRA-3	12-7/32	19	8-1/4	1.1	16
1	Electrical Connector Assembly	J-435/FRA-3	3-15/32	19	2-1/4	.086	2-1/4
1	Electrical Connector Assembly	J-436/FRA-3	3-15/32	19	2-1/4	.086	1-7/8
1	Blank Panel		5-7/32	19	3/16	.086	4-5/8
5	Synchro Control Patch Cords						
2	Sets Installation Drawings						
1	Box Equipment Spares						
2	Instruction Books						
			TOTALS				

UNLESS OTHERWISE STATED, DIMENSIONS ARE INCHES, VOLUME CUBIC FEET, WEIGHT POUNDS.

**TABLE 1-2. EQUIPMENT AND PUBLICATIONS REQUIRED BUT NOT SUPPLIED**

QUANTITY PER EQUIPMENT	NAME OF UNIT	NAVY TYPE DESIGNATION	REQUIRED USE
1	Relay Rack Cabinet	CY-597/G	Housing for: Antenna Selectors, RF Jack Panels, and Electrical Connector Assemblies
2	Radio Frequency Patch Panel	J-239/G	Patch Antenna Selectors to Receivers
5	Radio Frequency Patch Cords	49122-B	Patch between RF Patch Panels
	Co-Axial Cable	RG-12/U	Interconnect between Antenna Selectors and Receivers
	Multiconductor Cable	MHFA-14	Interconnect between Antenna Selectors and Control Panels

**TABLE 1-3. SHIPPING DATA**

SHIPPING BOX NO.	CONTENTS		OVER-ALL DIMENSIONS			VOLUME	WEIGHT
	NAME	DESIGNATION	HEIGHT	WIDTH	DEPTH		
1	5 Antenna Selectors	SA-256/FRA-3	14	21	82	14	300
2	5 Control Panels	C-923/FRA-3	14	21	52	9	125
	1 Electrical Connector Assembly	J-435/FRA-3					
	1 Electrical Connector Assembly						
	1 Blank Panel						
3	1 Box Equipment Spares						
	5 Synchro Control Patch Cords						
	2 Instruction Books						
	2 Sets Installation Drawings						

UNLESS OTHERWISE STATED, DIMENSIONS ARE INCHES, VOLUME CUBIC FEET, WEIGHT POUNDS.

UP TO 40 RG-12/U  
CABLES FROM EACH  
ANTENNA SELECTOR TO  
ANTENNA MULTICOUPLERS

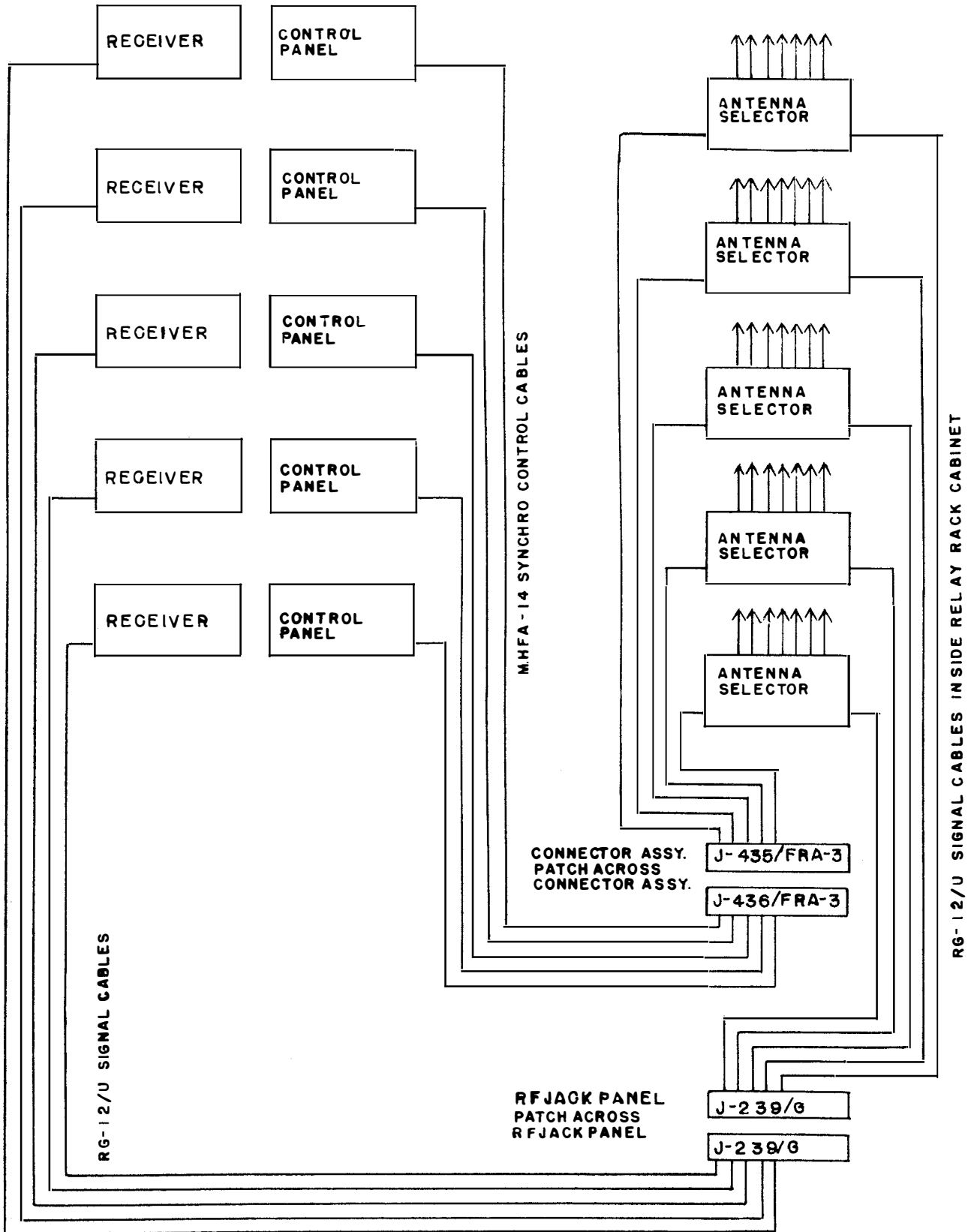


Figure 2-1. Block Cabling Diagram of Complete Equipment.



## SECTION 2 THEORY OF OPERATION

### 1. GENERAL DESCRIPTION OF CIRCUITS AND CIRCUIT ANALYSIS.

Fig. 2-1 shows a cabling block diagram of the complete equipment. It can be seen from this diagram that the equipment consists of five separate systems. Each system consists of a signal circuit and a synchro control circuit. The signal circuit is very simple. It conducts the radio frequency signal through RG-12/U co-axial cable from the selected antenna multicoupler to the antenna selector switch and from there to the antenna connection of the receiver. The signal circuit is diagrammed in fig. 2-2 and needs no further analysis.

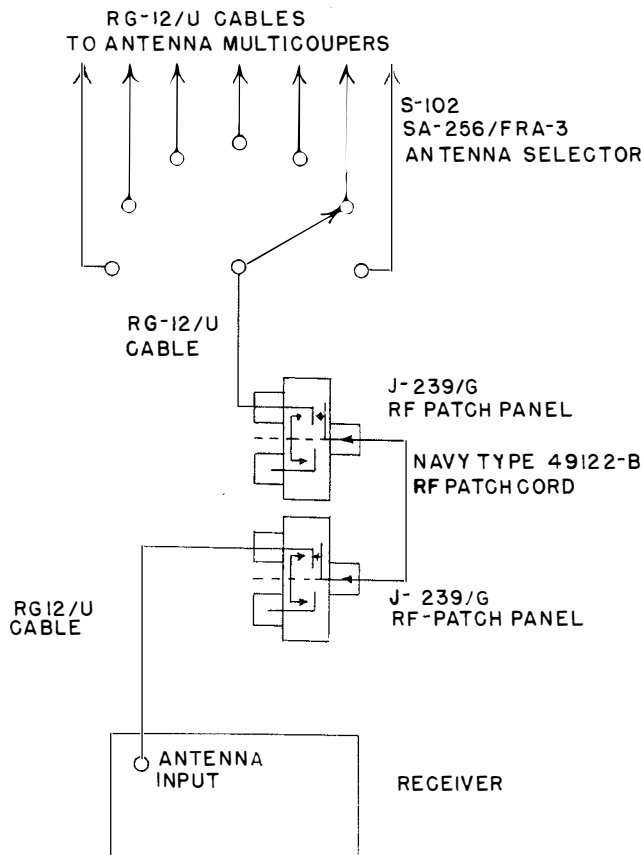


Figure 2-2. Signal Circuit Diagram

One of the five identical synchro circuits is shown complete on the schematic diagram included in the Maintenance Section of this book. The circuit connects the

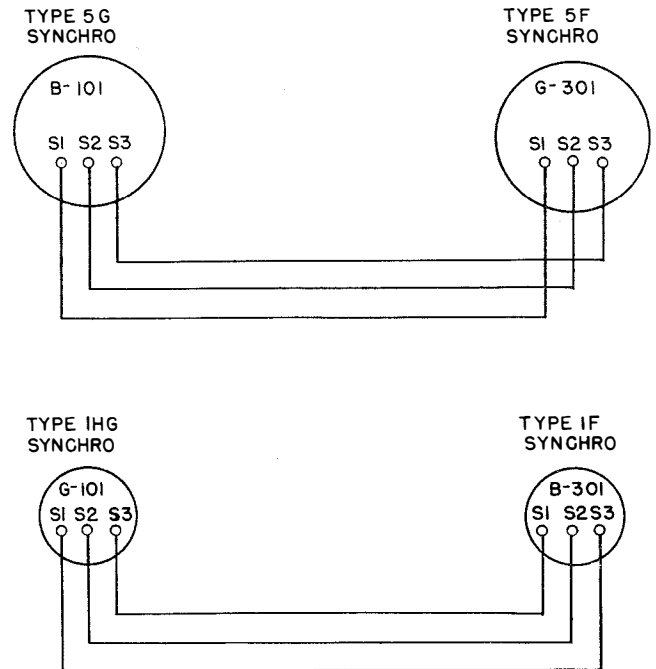


Figure 2-3. Inter-connection of Synchro Stator Terminals

stator windings of the two No. 5 synchros together; and the stator windings of the No. 1G synchro generator to those of the No. 1F synchro motor. It also supplies 115 volt 60 cycle excitation to all four of the synchro rotor windings in parallel with the two neon pilot lamps. Because the stator terminals S1, S2 and S3 of the No. 5F synchro motor are connected respectively to S1, S2 and S3 of the No. 5G synchro generator these two synchros rotate in the same direction. The gear reduction from the No. 5F synchro motor to the antenna switch is carried out in two steps. The first step gives a speed reduction of 1/5, the second a reduction of 1/8, thus accomplishing a total speed reduction of 1/40. Of course, this speed reduction gives a mechanical advantage of 40 making it possible for the synchro to drive the switch. Because the speed reduction is carried out in an even number of steps (2) the switch rotates in the same direction as the synchros. The No. 1G synchro generator is geared to the switch shaft in one step (no speed reduction or mechanical advantage). Because an odd number of steps (1) is used, the No. 1G synchro generator rotates in the opposite direction to the switch. To make the pointer

(on the shaft of the No. 1F synchro motor) at the control panel rotate in the same direction as the pointer on the switch shaft it is necessary to have the No. 1 synchros rotate in opposite directions. This is done by connecting S1, S2 and S3 on the generator to S3, S2 and S1 respectively on the motor. The two stator winding interconnections are shown in fig. 2-3.

The 115 volt 60 cycle circuit which excites the four synchro rotor windings and the two pilot lamps may be more easily understood by reference to fig. 2-4. Circuit tracing on this diagram reveals that, with the two switches in the positions shown and a patch cord in place, synchro excitation is supplied to both the antenna selector and the control panel. The unit may be excited from either switch, and must be turned off again at the point where it was turned on. Note that when either end

of the patch cord is removed, in order to patch control to a different selector, excitation to the other panel is disconnected. Also note that it is poor practice to excite any synchro generator or motor without exciting the corresponding motor or generator. Excitation of one synchro by itself would be harmful to the synchro. It should be further noted and remembered that operation of the switches or removal of the patch cord in order to extinguish the pilot lamps does not necessarily make the circuits safe to touch as one side of the line may still be connected. To make the circuits safe either the plug should be removed from the AC bus or both fuses extracted, or the primary power switch, located on the Switch Panel SA-134/G in the bottom of the Cabinet, should be turned off.

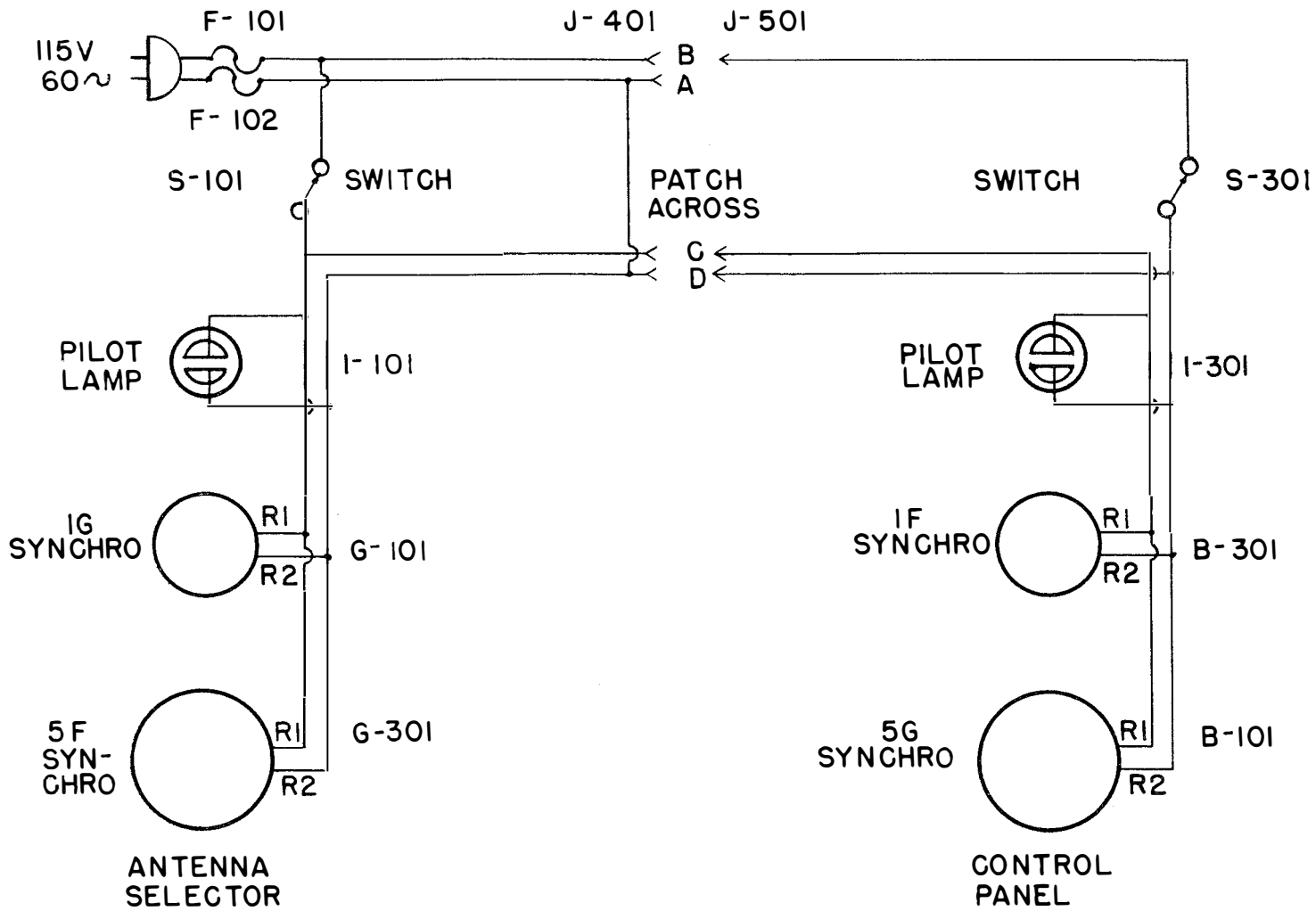


Figure 2-4. Synchro Excitation Schematic

## SECTION 3 INSTALLATION

### 1. UNPACKING.

Material supplied by the contractor is packed in three nailed wooden boxes as detailed in Table 1-3 of Section 1 of this book. In box 1 the front panels of the Antenna Selectors are packed separately in cardboard. Each Antenna Selector (exclusive of the front panel) is contained in an individual sealed cardboard container whose seals should not be broken until the unit is to be set in place. No special precautions beyond reasonable care are necessary in unpacking any of the three boxes. In box 2 the five Control Panels are each packed in an individual sealed cardboard container. The two Electrical Connector Assemblies are packed together in a sealed cardboard container. These seals should not be broken until the units are to be set in place. The Blank Panel in box 2 is wrapped in cardboard but not sealed. In box 3 the metal Spare Parts Box is sealed in a cardboard container. This seal may be broken in order to gain access to Instruction books, Installation Drawings, etc.

### 2. MOUNTING OF RELAY RACK CABINET COMPONENTS.

Before any of the components which are mounted in the relay rack cabinet are unpacked the cabinet itself should be bolted in place and the conduit carrying AC power connected. The cabinet (except in the case of the pre-production model) is government furnished directly to the installation activity. In choosing the location for the cabinet, care should be taken to leave sufficient room behind it for the various cables which enter and leave. The built-in cable ducts on the top are insufficient for the purpose as there are one hundred forty RG-12/U cables and five MHFA-14 cables entering the cabinet. A cabling diagram is shown in fig. 2-1 of Section 2 of this book. Consideration should also be given to the direction of these cable runs when locating the cabinet and it should be kept in mind that access to the rear of the cabinet must be available after the cables are installed.

To prepare the cabinet to receive the Antenna Selectors the internal vertical mounting angles must be moved and bolted in place. Use the 11th and 12th tapped holes from the front on the horizontal members to bolt the vertical angles. Have the flat of the angle facing the rear (door side) of the cabinet. A photograph of the empty cabinet indicating the various parts referred to is given in fig. 3-1. A photograph of the cabinet indicating the relative position of the cabinet mounted components is given in fig. 1-1.

The first component mounted should be the lowest Antenna Selector. It is installed through the rear door of the cabinet with the crank and pointer facing the front, the pointer above the crank. It is bolted by means of the screws provided (attached to the panel) through the holes in the panel to the internal vertical angles of the cabinet. The screws through the lowest holes of the panel should go into the 12th holes up from the bottom of the internal vertical angles. The blank panel, carrying the orange name plate of the equipment is to be installed in the lowest position on the front of the cabinet. It should be tried in place at this time to make sure that the lowest Antenna Selector is mounted in the correct position. The front panels of the Antenna Selectors are not installed until after the internal synchro control cables have been connected.

The remaining Antenna Selectors are now bolted in place. The second one goes directly above the lowest. The third is high enough to clear the patch panels. The screws through the lowest holes of the panel go into the 52nd holes up from the bottom of the vertical mounting angles. The fourth and fifth Antenna Selectors completely fill the remaining space to the top of the cabinet. Fig. 3-2 shows how the Antenna Selectors should look at this point.

The next component installed should be the J-435/FRA-3 connector assembly. This is the one with the cables already soldered to the backs of the first five connectors. As it is moved into place the cables should be led along the left side of the cabinet in front of the already installed rear panels of the Antenna Selectors to the Antenna Selector terminal strips. The longest cable on the extreme left of the assembly goes to the top Antenna Selector. The remaining four cables progressing from left to right go to the remaining Antenna Selectors progressing from top to bottom. This connector assembly is screwed to the front of the cabinet matching the lowest holes on the assembly panel to the 39th holes up from the bottom on the cabinet's front mounting angles. After it is screwed in place the far ends of the synchro control cables should be connected to the Antenna Selector terminal strips matching the numbered lead ends to the numbers stamped on the panel. When this is completed the cables should be dressed and clamped in place by means of the clamps provided. The photograph of fig. 3-2 was taken when the work had progressed to this point.

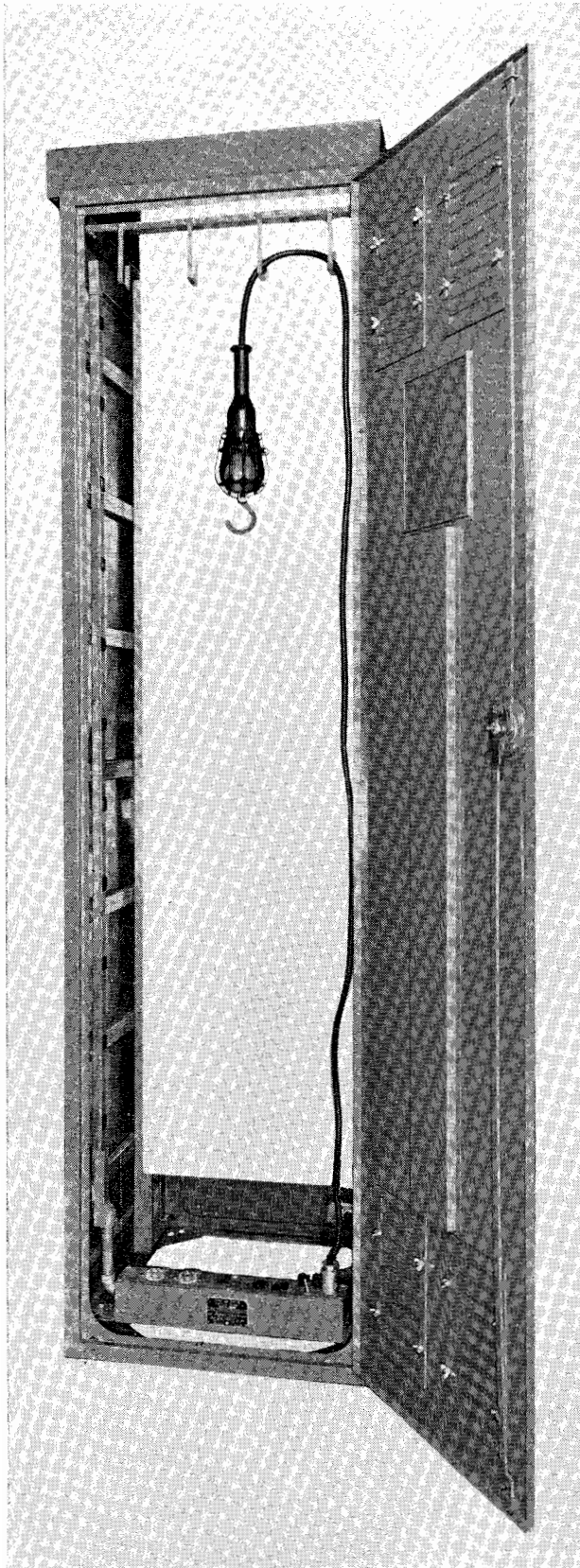


Figure 3-1. Relay Rack Cabinet before Components are Mounted

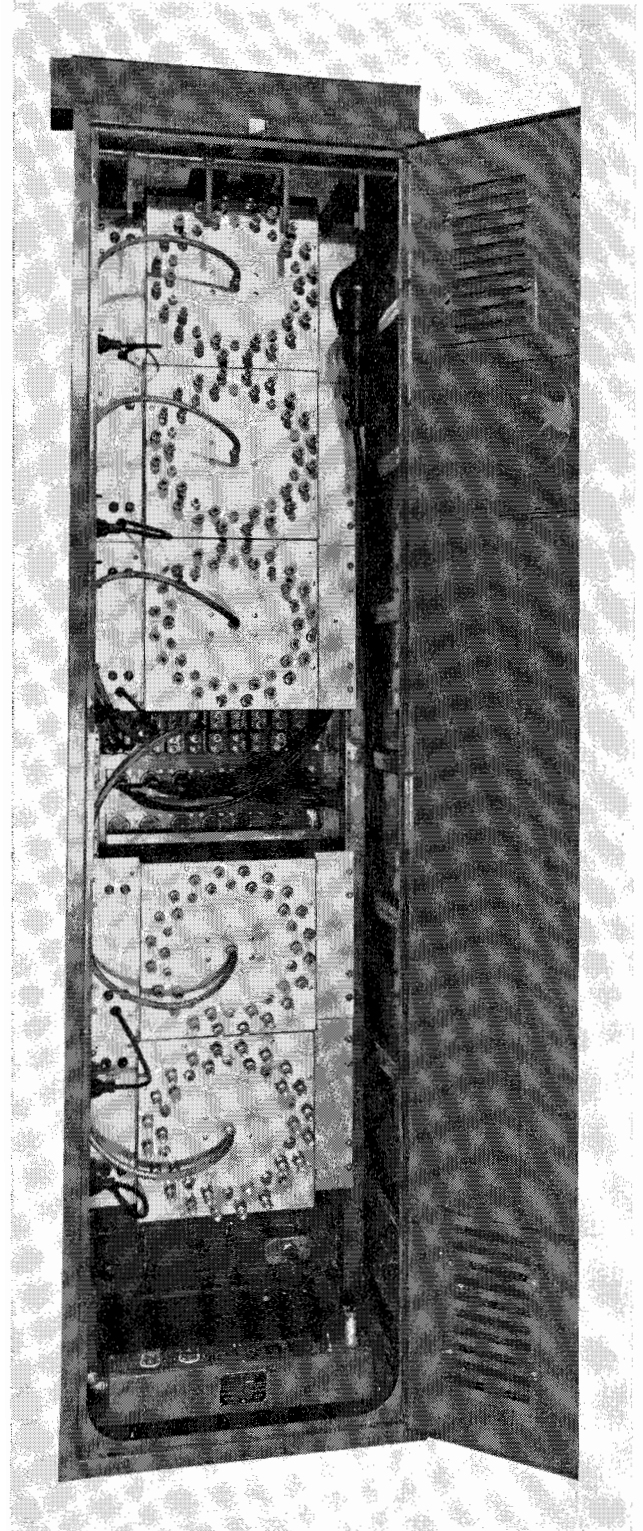


Figure 3-2. Relay Rack Cabinet with Antenna Selectors Mounted and Internal Synchro Control Cables in Place

The final step in installing the relay rack cabinet components is to remove the cranks and pointers from the Antenna Selectors and to mount all the front panels including the J-239/G RF Patch Panels, the J-436/FRA-3 Patch Panel and the Blank Panel with the orange equipment name plate. The positions of the panels may be checked in fig. 1-1. When replacing the cranks care should be taken to have the crank handle in its lowest position when the clutch is engaged and the Antenna Switch detent mechanism is holding the switch in a contact position. This point may be determined by listening to the switch and by the feel at the crank. The pointers should not be replaced in their final position until the checks described in paragraph 7 of this section are being performed.

**3. MOUNTING OF REMOTE CONTROL PANELS.**

One each of these panels mounts on a standard 19" relay rack as convenient as possible to the receiver with which it is used. It requires 12<sup>7</sup>/<sub>8</sub>" of rack space. One MHFA-14 cable terminates at the rear of the panel. Space is required for sufficient slack in this cable to allow dismounting the panel, with the cable connected, far enough to allow zeroing of the synchro in the unlikely event that this should become necessary.

**4. INTERCONNECTING OF RADIO FREQUENCY CIRCUITS.**

All radio frequency connections in this equipment are made with RG-12/U armored co-axial cable and ultra high frequency Navy type 49195 plugs. The separate connections to be made are as follows:

- (a) Connect Antenna Multicouplers to the individual switch poles around the circumference at the back of each co-axial switch.
- (b) Connect center pole at the back of each co-axial switch to top receptical at the back of upper J-239/G RF Jack Panel. Top switch is connected to left hand jack and so on progressively.
- (c) Connect top recepticals at the back of lower J-239/G RF Jack Panel to receivers.

Fig. 3-3 shows the steps in the assembly of type 49195 plug to RG-12/U cable. 490 such assembly operations are required to make the connections specified above. Referring to fig. 3-3 the required steps are as follows:

- 1. Push back cable armor and cut at least an inch off end of cable square and clean.
- 2. Redress armor tightly back over cut cable end form it to a diameter smaller than the cable end. Slide connector shell and coupling nut onto cable over the armor.
- 3. Push back cable armor again and cut outer vinylite jacket 1-1/4" from end of cable exposing copper braid sheath. Do not nick copper braid sheath!

4. Bare 3/4" of center conductor by cutting copper braid sheath and inner insulation (dielectric) square and clean. Do not nick center conductor!

5. Fan copper braid sheath and cut it back 1/8".

6. Smooth and tin copper braid sheath. Do not use excessive heat! Wipe solder smooth and clean.

7. Screw plug body over outer vinylite jacket until 1/16" of inner conductor is exposed. Be careful not to push back copper braid sheath. Solder plug body to copper braid sheath through holes in plug body. Solder inner conductor to contact sleeve. Cut off part of inner conductor which projects past contact sleeve.

8. Dress armor back over plug body and trim it back to just overlap the back of the plug body.

9. Slide coupling nut and shell forward as shown. Tighten screw in shell.

**5. INTERCONNECTION OF SYNCHRO CONTROL CABLES.**

The terminal strips on the backs of the Receiver Operator's Control Panels are connected to connectors in the J-436/FRA-3 Connector Assembly through an appropriate length of MHFA-14 cable. Only ten of the cable's fourteen conductors are used. The connections are shown schematically in the system schematic and in table 3-1 below. The color coding of the cable is immaterial but should be consistent for each system of the equipment. Color used should be filled in in table 3-1 as the work progresses.

**TABLE 3-1**

NUMBER AT TERMINAL STRIP	LETTER AT CONNECTOR	CONDUCTOR COLOR USED
1	K	
2	J	
3	H	
4	G	
5	F	
6	E	
7	D	
9	C	
11	B	
12	A	

Connections between Control Panel Terminal Strip and J-436/FRA-3 Connector Assembly.

**6. CONNECTION OF PRIMARY POWER.**

The 115 volt, 60 cycle, single phase power line is led to the relay rack cabinet through conduit laid either on

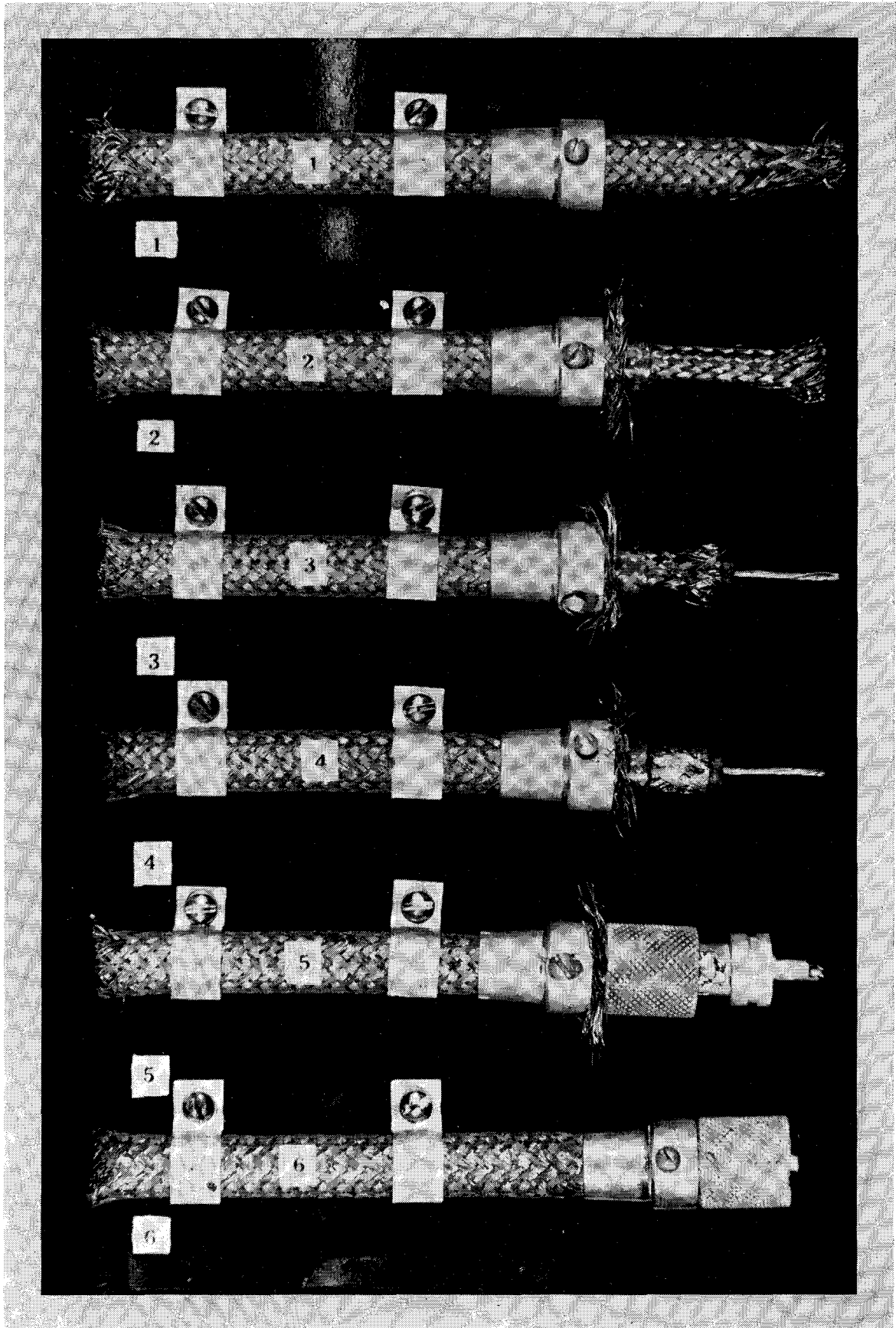


Figure 3-3. Steps in the Assembly of Type 49195 Plug to RG-12/U Cables

**Paragraph 7**

or through the deck and enters the cabinet from below. The conduit enters the SA-134/G Switch Panel (built into the relay rack cabinet) through the knock-outs provided, and the power is connected to the distribution system of the cabinet within this Switch Panel. The individual Antenna Selectors are then connected by plugging them into the bus provided up one side of the cabinet. See fig. 3-4 for the internal wiring of the SA-134/G Switch Panel.

**7. INITIAL ADJUSTMENTS AND TESTS.**

After all connections have been completed as described in paragraphs 2, 4, 5, and 6 above, certain initial adjustments may be made. These are not difficult as the most confusing adjustment, zeroing the synchros, has already been completed by the contractor. Under no circumstances should any of the synchros be rotated in their mountings unless it is found necessary after the instructions below have been followed to completion. The purpose of the following steps is to set up all five systems so that any Antenna Selector may be patched to any Control Panel and the Control Panel Pointer will always indicate the position of the Antenna Switch.

(a) Make sure the primary power is connected and turned on by checking the main switch and all fuses in the SA-134/G Switch Panel (see fig. 3-4) mounted in the bottom rear of the CY-597/G cabinet and by turning on the trouble light by means of the toggle switch in this Switch Panel.

(b) Patch between the connectors in use on the J-435/FRA-3 and J-436/FRA-3 Connector Assemblies by means of the five patch cords supplied packed with the Spare Parts box.

(c) Turn on the synchro control power by operating

the toggle switches on the front panels of the five Antenna Selectors. Make sure the lamps are lighted on both the Antenna Selectors and the Control Panels. Make sure, also, that the power may be turned on and off from either the Antenna Selectors or the Control Panels.

(d) With the power turned on, turn the hand cranks on all the Operator's Control Panels until the pointer comes to position 40. By means of an ohmmeter, bell and battery or similar continuity checker, make sure that there is continuity through the five Antenna Switches. There should be less than one ohm DC resistance from the center conductor of the middle pole of an Antenna Switch to the center conductor of pole 40 on the same switch.

(e) When the front panels of the Antenna Selectors were installed in accordance with paragraph 2 of this section, the Antenna Selector Pointers were removed. They should now be replaced and tightened on their shafts. With all the power on and all the Control Panel Pointers set to 40 as described in (d) directly above, replace all the Antenna Selector Pointers so that they also point to 40. Make sure now that the Antenna Selector Pointers follow the Control Panel Pointers when the Control Panel Cranks are turned. By testing with the continuity checker make sure that the Antenna Switch is correctly following its pointer.

(f) Patch all five of the Control Panels to each one of the Antenna Selectors in turn to make sure that any Control Panel will correctly operate any Antenna Selector.

When the steps (a) through (f) above have been completed, the equipment is ready for use. If difficulty is encountered in completing any of the steps, refer to the Maintenance Section following for its possible cause and cure.



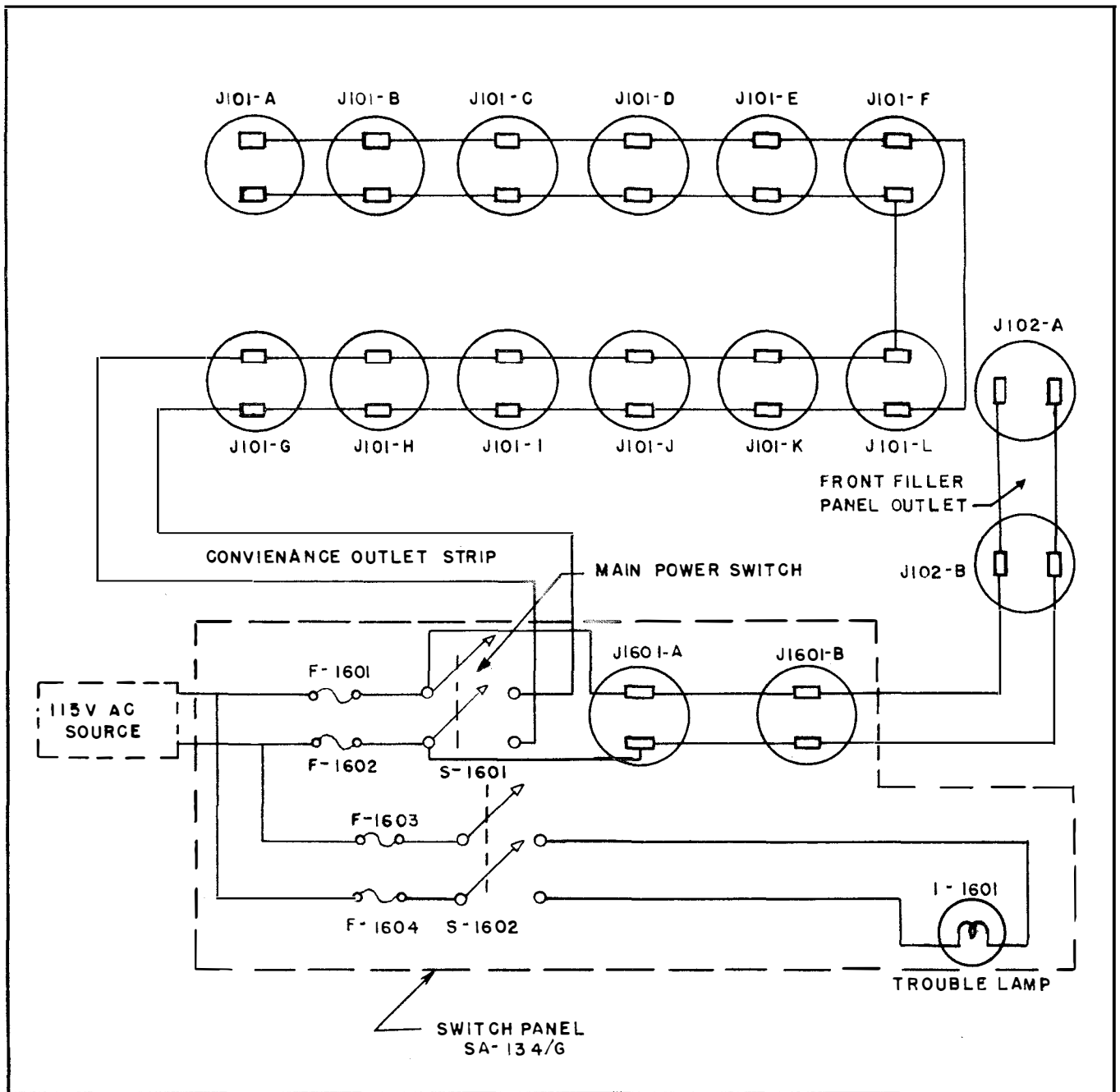


Figure 3-4. Primary Power Distribution in Relay Rack Cabinet

## SECTION 4 OPERATION

### 1. OPERATION

The RF Switching Group Equipment covered in this instruction book is used with and is supplementary to the RF and AF Signal Distribution Unit. The capabilities of the RF Switching Group Equipment are covered in the General Description, Section 1 of this book. For general operating procedure reference should be made to the instruction book for RF and AF Signal Distribution Unit, NAVSHIPS 91047; and to the orders of the officer in charge of the station where the equipment is used.

In particular, however, it should be noted that in this equipment "Normal Through" Operation is obtained only when RF patch cords are in place connecting the

two J-239/G Jack Panels. This is contrary to the procedure described in NAVSHIPS 91047 where in general "Normal Through" Operation is obtained with all Patch cords secured. It should be further noted that, whenever RF patching is changed to connect a given Antenna Selector to a different Receiver, the synchro control patching must be changed at the same time in order to transfer Antenna Selector control to the proper Control Panel. As was the case with the RF patching, "Normal Through" Operation of the synchro control circuits is obtained only when Synchro Control Patch Cords are in place between the J-235/FRA-3 and J-236/FRA-3 Electrical Connector Assemblies.

## SECTION 5 OPERATOR'S MAINTENANCE

### 1. ROUTINE.

It is the operator's responsibility to keep the RF Switching Group Equipment shipshape. The exterior should be dusted off daily and any damaged paint touched up with grey paint Navy Specification #52E4. Use a dry cloth or foxtail, but do not use a damp cloth unless all circuits are secured. **DON'T MAKE YOURSELF A GROUNDING LUG!** If the equipment is secured for sufficiently long periods clean out the interior of the cabinet with a vacuum device or foxtail. Brush out particularly the rear of jack panels and the ventilation screens in the top and door. Inspect for loose spaces, damaged insulation, or disconnected grounding leads. But if the power cannot be secured keep completely outside of the cabinet. The dust may be blown out with compressed air if due care is exercised that contact with conductors is avoided.

The cabinet is equipped with adjustable louvres on

the top and rear door which regulate the circulation of air. The air screens over the louvres must be kept free from dust which would restrict circulation of air.

### 2. EMERGENCY MAINTENANCE.

#### NOTICE TO OPERATORS

Operators shall not perform any of the following procedures without proper authorization.

The operator must replace fuses when the occasion arises. The only fuses in the equipment are the two in the back of each Antenna Selector and in the primary power distribution panel. (See fig. 5-1 for the location of all these). If a primary fuse blows, turn off all components connected to the convenience strip and outlets and install a new fuse. Turn on the components one by one. If the fuse blows again, it will be easy to tell which component is causing the overload.

### 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 AFTER REPLACEMENT, DO NOT REPLACE IT A SECOND TIME UNTIL THE CAUSE HAS BEEN CORRECTED.

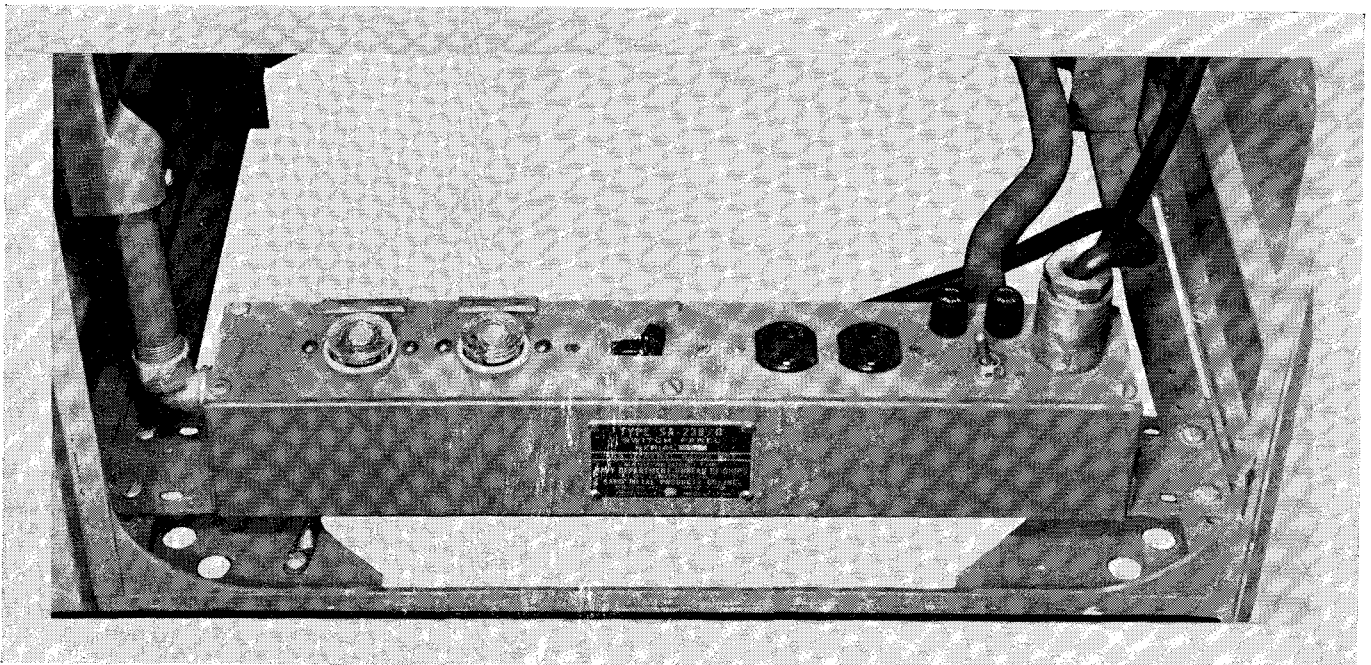


Figure 5-1. Location of Fuses

**TABLE 5-1. FUSE LOCATIONS**

SYMBOL	LOCATION	PROTECTS	AMPS	VOLTS	NUMBER
F-101 F-102	Rear Panel of each Antenna Selector SA-256/FRA-3	Synchro Excitation Circuit	3 3	250 250	28032-3 28032-3
F-1601 F-1602	Switch Panel SA-134/G	All conven- ience Outlets	15 15	125 125	28102-15 28102-15
F-1603 F-1604	Switch Panel SA-134/G	Trouble Lamp	1 1	250 250	28032-1 28032-1

## SECTION 6 PREVENTIVE MAINTENANCE

### 1. GENERAL.

Preventive maintenance is a systematic series of operations performed at regular intervals on equipment to eliminate unnecessary interruptions in service, and to keep the equipment operating at top efficiency. The function of preventive maintenance is to locate and repair minor malfunctions, thereby eliminating extensive repairs which might interrupt operation at some vital time. The entire system of radio communication demands that each receiver be operating efficiently when needed. Since the Radio Frequency Switching Group is a part of the communication system, the importance of preventive maintenance cannot be over-emphasized.

#### NOTE

THE ATTENTION OF MAINTENANCE PERSONNEL IS INVITED TO THE REQUIREMENTS OF CHAPTER 67 OF "THE BUREAU OF SHIPS MANUAL", OF THE LATEST ISSUE.

### 2. ROUTINE MAINTENANCE CHECKS.

(a) INSPECTION. Inspection is the most important operation in the preventive maintenance program. Inspection consists in carefully observing all parts of the equipment noticing color, placement, state of cleanliness, etc. Access to the working parts of the Antenna Selectors is obtained by removing the front panels. Be sure that pointers and cranks are replaced properly in accordance with paragraphs 2 and 7 (e) of Section 3. Inspect for the following conditions:

#### WARNING

BE SURE THE PRIMARY POWER SWITCH IS TURNED OFF TO PREVENT INJURY OR DEATH BEFORE CONDUCTING THE FOLLOWING MAINTENANCE PROCEDURES.

1. OVERHEATING — Indicated by discoloration, blistering or bulging of parts, leaking of insulating compounds and oxidation of metal contact surfaces. Replace all parts found defective.

2. PLACEMENT—Observe that all leads and cables are in their proper position, laced and secured properly. Replace and secure as necessary.

3. CLEANLINESS—Carefully clean all recesses in the cabinet, especially between connecting terminals or terminal boards. Parts, connections and joints should be free of dust corrosion and other foreign matter. In tropical and high humidity location look for fungus growth and mildew. Re-tropicalize wherever growth is found as described in paragraph 3 of this section.

4. TIGHTNESS—Test all connections and mountings for looseness. Tighten all loose terminals and re-dress or resolder all defective lugs and connectors.

#### CAUTION

Screws, bolts, nuts, and cable connectors should not be tightened carelessly. Fittings tightened beyond the pressure for which they were designed may be damaged or broken.

5. INSULATION TESTS—Make regular periodic insulation tests of all circuits and record the results for future reference.

6. GROUND TESTS — Make regular periodic ground tests of all circuits and record the results for future reference. Inspect ground connections for tightness.

7. VENTILATOR SCREENS—Keep clean and free of dust.

8. SYNCHRO CONTROL PATCH CORDS — These cords are subject to loose connections and shorts if not properly maintained. They should be inspected and tested monthly as follows:

Open both ends to obtain access to backs of contacts where leads are soldered. Inspect carefully and resolder where necessary. Make ground and insulation tests.

### 3. RE-TROPICALIZATION.

The equipment has been tropicalized with material meeting the requirements of JAN-C-173 which was applied in accordance with the requirements of JAN-T-152. The purpose of this process is:

(a) To render the surfaces moisture resistant.

(b) To envelope terminals and connections with a low moisture absorbing film, thereby minimizing surface electrical leakage and arc-overs.

- (c) To retard the absorption of moisture.
- (d) To aid in retarding corrosion.
- (e) To prevent the growth of fungi.

When it is found necessary a new coating should be applied. Use any coating material which conforms to specification JAN-C-173. An example of this is Tuf-On #74 S. The varnish should be applied with a soft brush to the following places:

**WARNING**

THE ANTI-FUNGUS AGENT IS POISONOUS. DO NOT INHALE FUMES AND AVOID CONTACT WITH THE SKIN UNTIL THE MATERIAL IS DRY.

Apply Varnish to:

- (a) Terminal strips in both the SA-256/FRA-3 Antenna Selectors and the C-923/FRA-3 Control Panels.
- (b) The back of the No. 1 synchros in both the above Units.
- (c) The soldered connection and plastic material at the rear of all the multi-contact connectors in the synchro control patch cords and the J-435/FRA-3 and J-436/FRA-3 Electrical Connector Assemblies.
- (d) All toggle switches and their soldered connections.

(e) The outside of and connections to fuse holders and pilot lamp assemblies, i.e., the plastic parts of these assemblies.

Carefully Avoid Applying Varnish to: (Mask if necessary)

- (a) Contact portion of connectors, fuses, jacks, plugs, sockets, switches . . .
- (b) Mechanical parts such as . . . gears, glass (Pilot lamps) . . .

(c) Painted, lacquered or varnished exterior surfaces.

The following parts need not be coated but no harm will result if coating from adjacent parts overlaps onto them:

Cable, wire, braids, and jackets whose outside surface is of rubber or vinylite type composition . . . painted, lacquered, or varnished interior surfaces . . . parts made of, or plated with nickel or cadmium.

All surfaces of parts to be coated shall be sufficiently clean so that they are free from dirt, oil, grease or other foreign matter which could interfere with the adherence or proper functioning of the material. All readily visible deposits of rosin shall be cleaned off by scraping, chipping, etc. Soldered joints with no readily visible deposits of rosin need not be cleaned. The use of solvents such as alcohol or acetone is not advisable as they tend to spread a thin coat of rosin over a large area.

The coating materials shall be applied only on dry surfaces. In no case shall coatings be applied on wet or damp materials with moisture on their surfaces.

## SECTION 7 CORRECTIVE MAINTENANCE

### 1. GENERAL.

Corrective maintenance includes location, isolation and repair of failures of the equipment which affect its operating characteristics. This section contains information to aid personnel in locating and correcting trouble. Proper maintenance will do much to prevent and minimize failures of the equipment. Most important in the detection and localizing of trouble is a good ohmmeter and the knowledge of how to use it. The Navy Model ZM-1/U Ohmmeter and the Navy Model OBQ-4 Volt-Ohm-Milliammeter supplied with the RF and AF signal Distribution Unit (of which this equipment is a supplement) are recommended, because they are equipped with adapters useful in patching into RF circuits; but any good meter may be used. The instruction books, NAVSHIPS 900,948 and NAVSHIPS 900,988 for these instruments should be completely familiar to personnel assigned to servicing this equipment.

A trouble light for use when working in the cabinet, and convenience outlets for soldering irons, electric drills, etc. are included in the cabinet. Reference to fig. 3-4 will show that outlets in the front filler panel (J102-A and J-102-B), outlets in the SA-134/G Switch Panel (J1601-A and J1601-B) and the trouble lamp are not affected by operation of the main power Switch.

### 2. WIRING.

In the RF Switching Group one of the more probable sources of trouble is the internal wiring. The most common troubles in the wiring are as follows:

(a) **GROUNDING OR PARTIALLY GROUNDING CIRCUITS**—A circuit which is grounded is one in which one or both sides make contact with the ground, i.e., the electrical ground. One side grounded (the outside conductor) is normal in the RF circuits of this equipment but not in the synchro circuits. A ground on one side of a circuit does not necessarily make the circuit inoperative, but should another ground develop on the other side of the line, the circuit will fail. It is, therefore, essential that grounds be cleared as soon as possible after they are detected.

Grounds are readily detected by the use of an ohmmeter. The ohmmeter is more suitable than a bell or lamp testing apparatus, as it will detect partial grounds; whereas the other devices will show, at best, a dead

ground, i.e., zero resistance to ground. To detect a ground in this equipment make sure that the main power switch is "off", and put one ohmmeter test lead in contact with the cabinet frame which is ground. Remove all patch cords from the four jack panels in the front of the equipment and test each connector contact in the Jack Panels individually noting the deflection of the ohmmeter pointer indicating the relative leakage to ground. In testing the RF circuits either test through a patch cord or make sure that the center conductor contact of the RF jack panel is depressed in order to close the jack switch. All conductors of the synchro circuits should show at least 5 megohms to ground, while the RF circuits should show at least 50 megohms to ground if the receivers and similar apparatus (multi-couplers, etc.) are disconnected. While testing the RF circuits rotate the Antenna Switch associated with the circuit under test by means of the hand crank on the Antenna Selector. Do not be satisfied that the circuits are ungrounded until the patch cords have also been tested. Some time can be gained by testing through the patch cords when testing the other circuits both ways from the cabinet.

(b) **GROUNDING IN THE SYNCHRO WIRING**—A ground in the synchro wiring may develop as a result of insulation breakdown between the conductors in the cable and the armor which is grounded. Another much more likely possibility is grounding of a conductor to the cabinet frame or a connector body as a result of some mechanical derangement. Do not neglect the remote Control Panel when isolating such a fault. Redress and tape or replace as necessary to cure the fault.

(c) **GROUNDING IN THE RF SECTION**—Grounds in the RF Section of this equipment are unlikely. However, it is common practice to terminate RF cables in their characteristic impedance within the connected equipment. Since for RG-12/U cable this impedance is low (70-80 ohms) one must make sure that all apparatus is disconnected from the cable before testing the circuit for grounds. In the event that a true ground should develop it will probably be caused by failure of the dielectric in the cable or failure of the insert in a co-axial fitting. Cables or fittings showing a resistance of less than 50 megohms to ground should be replaced as necessary to cure the fault.

(d) **SHORTED OR CROSSED CIRCUITS**—A short circuit condition is created when two sides of a circuit

at a potential difference come directly into electrical contact. In the RF Section of the equipment a short circuit will be the same as a ground. In the Synchro circuits a short circuit will probably blow one or more fuses. To detect a short circuit apply an ohmmeter between the two insulated conductors. A low resistance reading indicates a short circuit. In most cases shorted cables must be replaced with new cables rather than repaired. If a fuse has blown it must be replaced before operation can be resumed.

(e) OPEN CIRCUITS—An open circuit exists when continuity through a conductor is broken. Most open circuits are caused by the conductor actually breaking or coming loose from a terminal. They are detected by applying an ohmmeter to opposite ends of the same conductor. When located an open circuit must be repaired or replaced.

(f) IMPROPERLY GROUNDED SHIELD IN RF SECTION—If the shields in the RF section are not properly grounded the effects may not be immediately noticed in the operation of the equipment. This defect, however, can cause "crosstalk" and voltages may be set up in the shields which can increase the attenuation characteristics of the line and cause high noise level. Another effect is to detune the input stage of a connected receiver. Check frequently and reground as necessary.

**3. ANTENNA SELECTOR SWITCH TROUBLE SHOOTING.**

The Antenna Selector Switches are the most complicated components of the RF Switching Group and consequently are the most susceptible to trouble. They should be tested monthly for mechanical action, continuity, and grounds. The following table, 7-1, give possible trouble symptoms and the probable location of the trouble. Corrective action for each is given in paragraph 4.

**4. ANTENNA SELECTOR SWITCH, CORRECTIVE ACTION.**

(a) If only one contact position is defective, it may usually be repaired without removing the switch from the cabinet. The most likely cause is insufficient contact between the stationary contact and the spring loaded contact of the rotor.

Loosen the locking nut (see fig. 7-1) and tighten the connector, Navy type-49191, until it is hand tight. **DO NOT USE A WRENCH OR THE INSULATING WASHER WILL BE DAMAGED.** Tighten the locking nut with a wrench and check the continuity. If this does not correct the trouble, remove the connector from the equipment. The contact and insulating washer should come out with it. Inspect for corrosion and damage. Clean with chamois and replace parts as necessary. Insure that there is good contact between the button-head

**TABLE 7-1 ANTENNA SELECTOR SWITCH TROUBLE SHOOTING**

TROUBLE		PROBABLE LOCATION
a.	One position faulty	Indicates that one of the stationary contacts is faulty.
b.	All positions faulty	Center (common) contact is usually defective.
c.	Every second position faulty	Usually indicates that the contact on one end of the rotor arm is defective.
d.	One whole segment inoperative, i.e. every other position for several positions.	If several adjacent contact positions are faulty, suspect that the axis of the rotor is not perpendicular to the plane of the contact plate.
e.	Operation intermittent on all positions	This indicates that the detent mechanism is not holding the rotor in the contact position. Rotate the switch to see that the detent action is positive and that the rotation is not jerky or sticky. See if continuity is more positive with switch slightly out of detention.
f.	High noise level in a particular circuit	This usually indicates that the ground contacts are faulty.

contact and the contact sleeve of the Type-49191 connector. If either of the insulating washers are cracked or deformed, replace it. Screw connector securely into the rear of the contact plate and re-check. This should correct the trouble.

(b) If all contact positions are inoperative, suspect the center contacts. Loosen the locking nut on the center connector in until it is hand tight. Tighten the locking nut. If this does not correct the discontinuity, remove the connector and inspect the contact. Clean with chamois or replace as necessary. Insert a pair of long-nose pliers through the hole left by the removal of the center contact and carefully pull out the contact of the rotor. Clean or replace as necessary. If the rotor contact spring has become weak, remove it in the same manner and replace. Replace the rotor contact and press it in with the index finger to see that the spring is loading it sufficiently to insure positive contact. Reassemble and test again. If this does not correct the trouble, the whole switch must be removed and disassembled for repairs.

All other troubles require that the switch be removed from the equipment. Proceed as follows:

1. Tag all cables and disconnect them.
2. Loosen the set screws in the rigid brass coupling just in front of the switch mounting panel.
3. Remove the eight screws on the rear connector



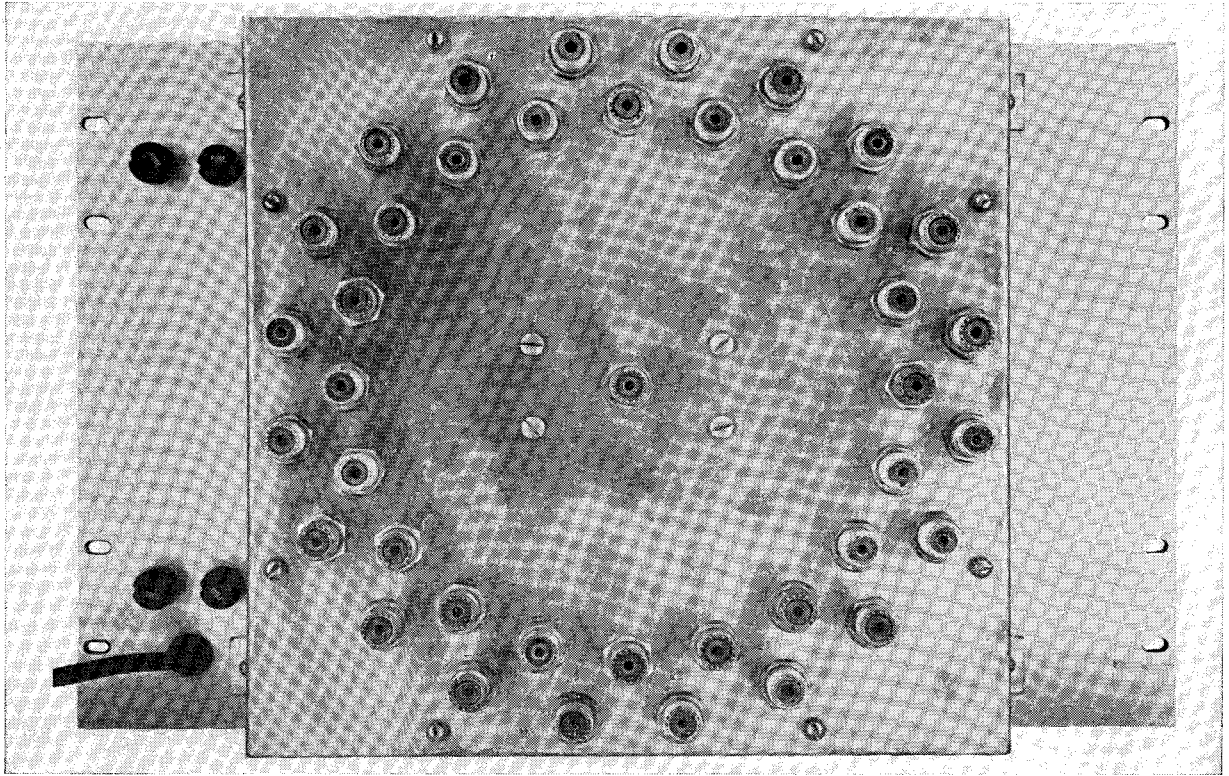


Figure 7-1. Rear View of Antenna Selector Switch

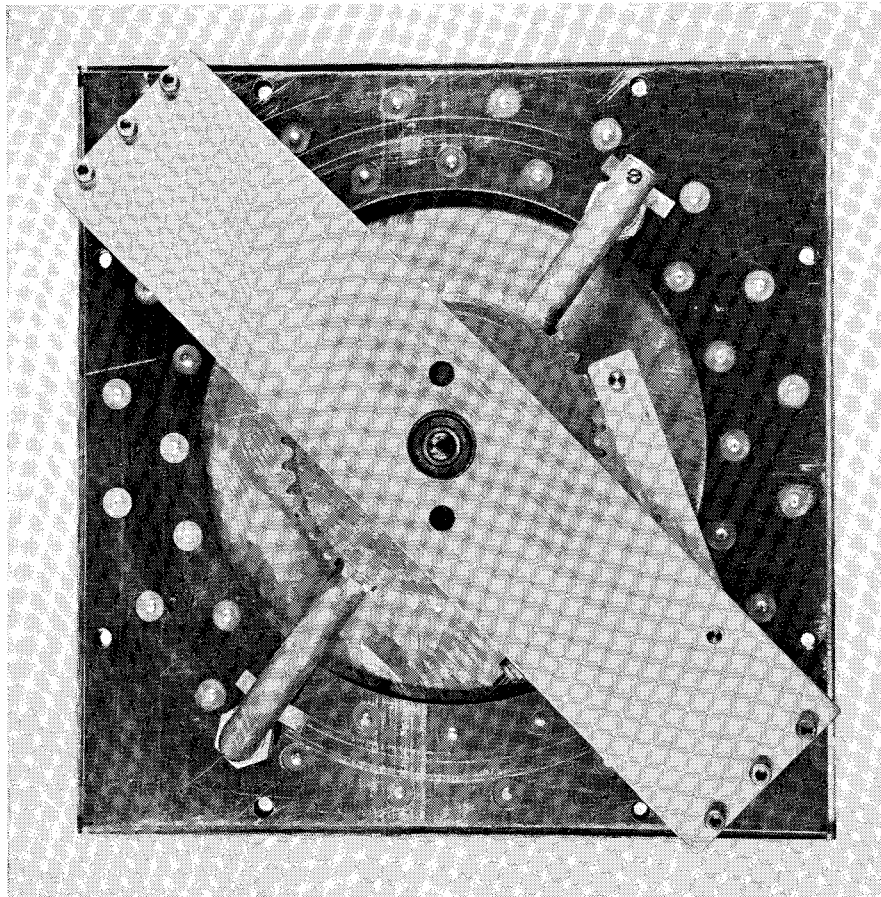


Figure 7-2. Antenna Selector Switch Removed from Cover Box

plate which hold the switch in the switch cover box and pull out the whole switch. Do not remove the switch cover box from the panel.

(c) If every second switch position is faulty, one of the end rotor contacts is defective. Rotate the switch slowly noting whether both rotor contacts are making with the stationary contacts. There should be at least 0.010" interference between the stationary and rotor contacts to sure positive contact. Check with a feeler gauge to see that the rotor contacts have a clearance of at least 0.020" from the contact plate when they are between the stationary contacts or they will ground the circuits. Adjust by loosening the locking nut on the rotor arm (see fig. 7-2) and rotate the cap nut to give the proper clearance. Inspect the insulator for damage or dirt which might cause an RF ground. Insure that the grounding contact is applying a positive pressure against the contact plate.

(d) If the switch will not establish proper contact with the detent in its normal position but will show continuity if the rotor is held at some other position, the detent mechanism is not stopping the rotor at the correct contact position. If the action is positive and pressure must be applied to hold the rotor arm in any other position, loosen the two screws which secure the sprocket in place and move the contact arm in relation to the sprocket until proper contact is made. Tighten the screws to lock the arm in relation to the sprocket. If the rotor may be made to stop in any position other than the point of positive detent action, check to see that the shaft is not binding. If the bearing is sticky, replace it with a bearing from spare parts. If the shaft is free but the detent action is not positive adjust the detent spring to apply greater pressure. Insure that the detent roller turns freely and that the sprocket teeth are free of corrosion. If necessary apply one drop of Navy Type 2075 oil to the detent arm pivot and the axle of the detent roller.

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ONE OF SEVEN FEMALE RECEPTACLES  
IN FRONT PANEL

ONE OF SEVEN MALE RECEPTACLES  
IN FRONT PANEL

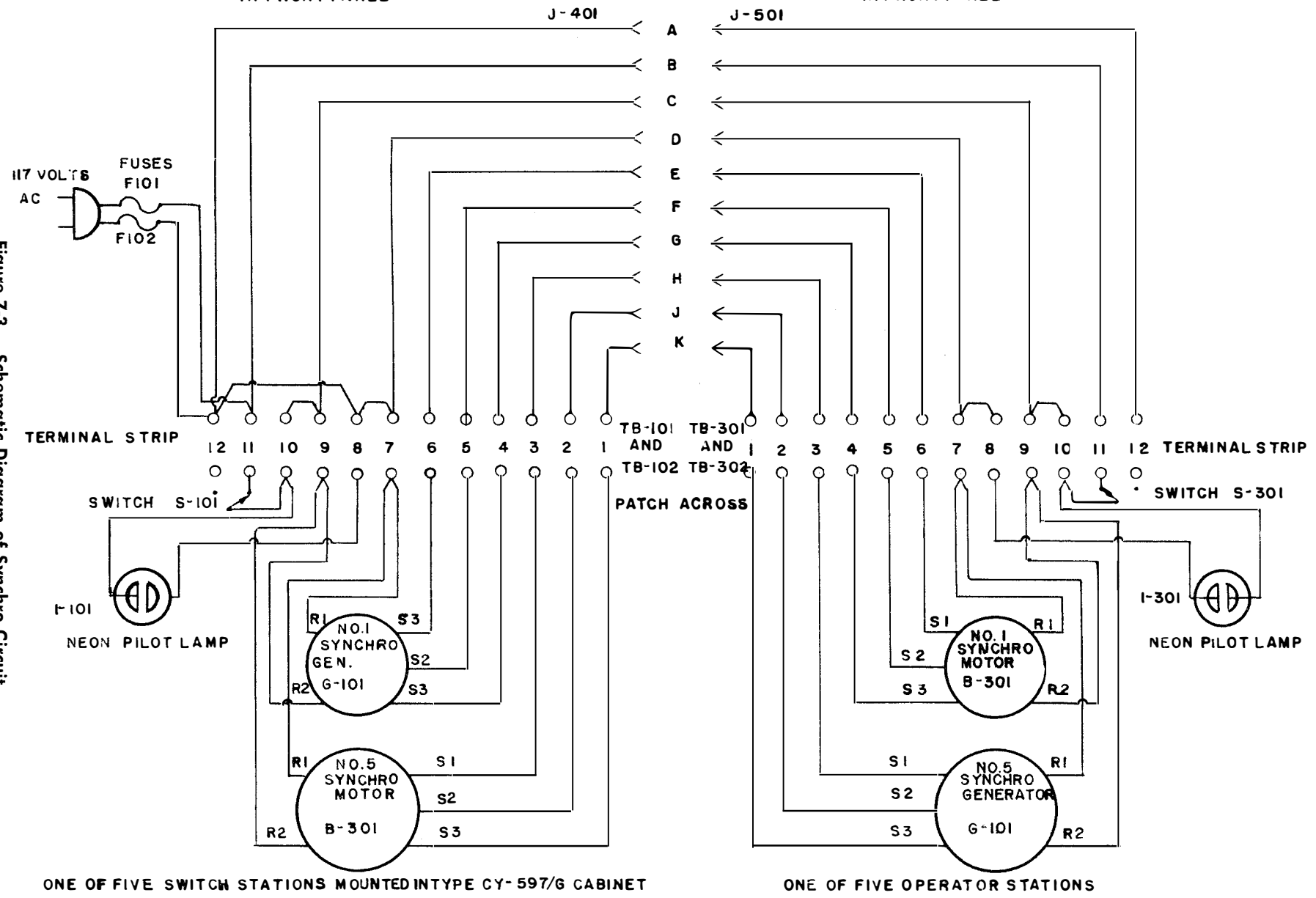


Figure 7-3. Schematic Diagram of Synchro Circuit.

ONE OF FIVE SWITCH STATIONS MOUNTED IN TYPE CY-597/G CABINET

ONE OF FIVE OPERATOR STATIONS

**TABLE 8-3. LIST OF MAJOR UNITS**

SYMBOL GROUP	QUANTITY PER EQUIPMENT	NAME OF MAJOR UNIT	AN TYPE DESIGNATION
Government Furnished	1	Radio Frequency Switching Group	AN/FRA-3
101-299	5	Relay Rack Cabinet	CY-597/G
301-399	5	Antenna Selector	SA-256/FRA-3
Government Furnished	2	Control Panel	C-923/FRA-3
401-499	1	Radio Frequency Patch Panel	J-239/G
401-499	1	Electrical Connector Assembly	J-435/FRA-3
501-599	1	Electrical Connector Assembly	J-436/FRA-3
Government Furnished	5	Radio Frequency Patch Cords (18 inch)	49122-B
401-599	5	Synchro Control Patch Cords	_____

TABLE 8-4. TABLE OF REPLACEABLE PARTS

REFERENCE DESIGNATION	STOCK NO.— STANDARD NAVY	NAME AND DESCRIPTION	LOCATING FUNCTIONS	ALL SYMBOL DESIG. INVOLVED	NUMBER PER EQUIPMENT	EQUIP. SPARES
101-299	F16-C-89293-3466	Army-Navy Antenna Selector; SA-256/FRA-3; Consists of: 1 Switch Panel, SA-292/FRA-3, 1 Gear Train, 1 Synchro Generator, type 5G, 1 Synchro Generator, type 1G, 1 Rotary Antenna Switch, SA; Requires 115V, 60 cycles, single phase, 15 watts; Unit requires 14 <sup>5</sup> / <sub>8</sub> " behind a 19" relay rack panel which is 19" by 12-7/32"; Transcontinental Electronic Corp. dwg. #49003-20.	Connects a remote radio receiver to any of 40 antennae.		5	
301-399	F16-P-17851-1703	CONTROL PANEL: Army-Navy control panel, C-923/FRA-3; consists of 1 modified switch panel, SA-137/G; 1 type 5G synchro, 1 type 1F synchro; unit requires 6 <sup>1</sup> / <sub>4</sub> " behind standard 19" by 12-7/32" rack panel; Transcontinental Electronic Corp. dwg. #49003-130.	Remote station from which Antenna Selector may be controlled.		5	
401-499	*N17-C-74575-4203	CONNECTOR ASSEMBLY, female contact: Army-Navy Connector Assembly, J-435/FRA-3; seven type AN 3102-28-18S receptacles mounted on size B rack panel; panel 19" lg, 3-15/32" h; Transcontinental Electronic Corp. dwg. #49003-140.	Synchro control patch panel.		1	
501-599	N17-C-74575-4213	CONNECTOR ASSEMBLY, male contact: Army-Navy Electrical Connector Assembly, J-436/FRA-3; seven type AN 3102-28-18P male contact receptacles mounted on a standard size B rack panel; 19" lg, 3-13/32" h; Transcontinental Electronic Corp. dwg. #49003-150.	Synchro power patch panel.		1	
A-101	*F17-P-17693-5973	PANEL BOARD, control: Army-Navy Switch Panel, SA-292/FRA-3; aluminum, gray enamel finish; 19" wd, 12-7/32" h, 3/16" thk; mtg. holes for size G rack panel provided; radial lines numbered 1 through 40 etched around center hole drilled to accommodate pointer shaft, holes also drilled for crank shaft, pilot light and toggle switch; Transcontinental Electronic Corp. dwg. #49003-120-1.	Front panel for Antenna Selector.	A-101	5	
A-301	*N17-P-17698-5975	PANEL BOARD, control: Army-Navy Switch Panel, SA-292/FRA-3; aluminum gray enamel finish; 19" wd, 12-7/32" h, 3/16" thk; standard mtg. holes for size G relay rack panel; radial lines numbered 1 through 40 etched around center hole; drilled to accommodate pointer shaft, crank shaft, pilot light, toggle switch and screws holding back mounted equipment; Transcontinental Electronic Corp. dwg. #49003-120-1.	Rack panel for C-923/FRA-3 Control Panel.	A-301	5	

\*"Not furnished as maintenance part. If failure occurs do not request replacement unless item cannot be repaired or fabricated."

TABLE 8-4. TABLE OF REPLACEABLE PARTS

REFERENCE DESIGNATION	STOCK NO.— STANDARD NAVY	NAME AND DESCRIPTION	LOCATING FUNCTIONS	ALL SYMBOL DESIG. INVOLVED	NUMBER PER EQUIPMENT	EQUIP. SPARES
A-401	*N17-M-79973-5694	MOUNTING, panel: aluminum, gray enamel finish; 19" lg, 3-15/32" h, 3/16" thk; standard mtg. holes for size B relay rack panel; seven 1 7/8" diam. holes to accommodate AN-3102-28-18 connectors, also tapped holes (#6-32) for mtg. seven connectors; Transcontinental Electronic Corp. dwg. #49003-120.	Mounting Panel.	A-401, A-501		
A-501	N17-M-79973-5694	MOUNTING, panel: same as A-401.	Mounting Panel.			
A-601	*N17-P-17693-5694	PANEL: Navy standard 19" relay rack panel size C; aluminum, gray enamel finish, std. mtg. holes; four holes provided to mount Equipment Nameplate; Navy dwg. #23F225.	Blank Panel.	A-601	5	
B-101	N16-G-3995-3150	Type 5G Synchro Generator, government furnished.	Control for Antenna Selector.			
B-301	N17-M-61545-1710	MOTOR, self-synchronous: Navy type 1F synchro motor MK VIII Mod 2A; 115 volts, 60 cycles, single phase; 3.9" lg, 2.25 diam overall; closed frame; tapered shaft, 13/32" lg from housing, #5-40 thread on end 5/32" lg, one #5-40 hex nut included; flange mounted, single flange 2.25" diam, 1/4" thk; five screw type terminals #6-32, 3/16" lg; Navy dwg. #265343.	Motor driving pointer assembly H-301.	B-301	5	
E-101, E-102	N17-F-74266-9201	HOLDER, fuse: Extractor post type for one 3AG fuse; moulded black bakelite; 250 volts, 10 amps max; 2 1/8" lg, 3/4" diam; overall; 1/2" diam mtg. hole required; 2 solder lug terminals; Littelfuse, Inc. Part #1075.	Holder for F-101 and F-102.	E-101 through E-104	20	
E-103, E-104	N17-F-74266-9201	HOLDER, fuse: same as E-101.	Holders for spare fused F-103, F-104.			
E-105	*N17-C-81968-9268	CONTACT, switch: 16 wiping contact fingers 0.008" thk, 1/8" lg, 1/16" wd; beryllium copper silver plated; cylindrical shape overall; 0.722" diam, 3/8" lg overall; 0.6425" ID; no mtg. means provided; Navy dwg. #RE24F174 Symbol #13.	Ground wiping contact for common terminal of S-102.	E-105	5	1
E-106 through E-145	*N17-C-82032-8552	CONTACT, switch: tap switch point type; single "fasaloy" #106 tipped contact (brass backed), oval shaped contact, 0.187" diam, 0.021" thk; cylindrical overall 0.218" diam, 0.500" lg; no mtg. means provided; Fansteel Metallurgical Corp. Composit Contact Rivet, Part #QFC-45605-E; Navy dwg. #RE24F274 Symbol #15.	Center conductor contacts for antenna terminals of S-102.	E-106 through E-149	220	20

\*"Not furnished as maintenance part. If failure occurs do not request replacement unless item cannot be repaired or fabricated."

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E-146	N17-C-82032-8552	CONTACT, switch: same as E-106.	Center conductor stationary contact for common terminal of S-102.			
E-147	N17-C-82032-8552	CONTACT, switch: same as E-106.	Center conductor rotor contact for common terminal of S-102.			
E-148, E-149	N17-C-82032-8552	CONTACT, switch: same as E-106.	Center conductor rotor contacts for antenna terminals of S-102.			
E-150 through E-189	*N17-I-77190-3282	INSULATOR, washer: GE plastic #1422; 0.063" thk, 0.436" OD, 0.161" ID; Navy dwg. #RE24F174 Symbol #16.	Insulates contacts E-106 through E-145.			
E-190 through E-229	*N17-I-49516-6990	INSULATOR, washer: GE plastic #1422; 0.060" thk, 0.500" OD, 0.191" ID; undercut for shoulder 0.031" deep, 0.4625" diam; Navy dwg. #RE24F174 Symbol #19.	Insulates contacts E-106 through E-145.	E-190 through E-229	200	40
E-230	*	ROTOR, switch: consists of rigid section of coaxial line with bearing housing and common contact assemblies at center and moving contact assemblies at each end; 11" lg, 2" h, 2 1/2" deep approx. overall; mounted by means of two #6-32 machine screws provided tapped into bearing housing; Transcontinental Electronic Corp. dwg. #49003-500. (Listed for reference only.)	Subassembly of S-102.	E-230	5	
E-230A	*N17-H-750001-253	HOUSING, switch rotor: silver plated brass and bronze; cylindrical center casting with projecting cylindrical arms; 13.185" lg, 2.075" h, 2-13/32" wd overall; Transcontinental Electronic Corp. dwg. #49003-500. "P/O E-230".	Houses and supports the various removable parts of the Antenna switch rotor, E-230.	E-230A	5	
E-231, E-232	*N17-I-48996-7517	INSULATOR, bushing: cylindrical shape; made of GE plastic #1422, 0.236" lg, 0.562" OD overall, 0.191" ID; Navy dwg. #RE24F174 Symbol #33.	Insulates contacts at ends of E-230.	E-231, E-232	10	2
E-233, E-234	*N17-C-81984-6741	CONTACT, switch: 2 contacts beryllium copper silver plated, curved wiping arm shape, wiper 0.010" thk, 5/16" wd, 1/8" lg, single 0.136" diam mtg. hole provided; Navy dwg. #RE24F174 Symbol #34.	Ground wiping contacts at ends of E-230.	E-233, E-234	10	2

\*"Not furnished as maintenance part. If failure occurs do not request replacement unless item cannot be repaired or fabricated."

PARTS LIST

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Section 8  
E-146-E-234

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TABLE 8-4. TABLE OF REPLACEABLE PARTS

REFERENCE DESIGNATION	STOCK NO.— STANDARD NAVY	NAME AND DESCRIPTION	LOCATING FUNCTIONS	ALL SYMBOL DESIG. INVOLVED	NUMBER PER EQUIPMENT	EQUIP. SPARES
E-235, E-236	*N17-C-82053-6711	CONTACT, switch: single sleeve, beryllium copper silver plated; 9/16" lg, overall, 0.176" diam; threaded externally solid end #4-40, 1/4" lg; Navy dwg. #RE24F174 Symbol #35.	Cradles E-148 and E-149.	E-235, E-236	10	2
E-237	*N17-C-82056-1564	CONTACT, switch: single sleeve, beryllium copper silver plated, 41/64" lg, 0.176" OD, 0.159" ID; 1-11/64" lg overall, 0.176" diam; threaded externally solid end #4-40, 1/4" lg; Navy dwg. #RE24F174 Symbol #36.	Cradles E-147.	E-237	5	1
E-238	*N17-B-801497-362	BUSHING: brass silver plated; 0.282" lg, 0.178" OD, 0.1332ID; Navy dwg. #RE24F174 Symbol #38.	Spacer for insulators in contact assembly at center of E-230.	E-238 through E-240	15	
E-239- E-240	N17-B-801497-362	BUSHING: same as E-238.	Spacers for insulators in contact assemblies at ends of E-230.			
E-241 through E-244	*N17-I-77200-1753	INSULATOR, washer: GE plastic #1422; 0.124" thk, 0.570" OD, 0.177" ID, Navy dwg. #RE24F174 Symbol #39.	Center conductor insulator, spacer for section of coax line in switch rotor, E-230.	E-241 through E-244	20	2
E-245 through E-247	*N17-I-77189-8299	INSULATOR, washer: GE plastic #1422; 0.124" thk, 0.570" OD, 0.158" ID; Navy dwg. #RE24F174 Symbol #40.	Same as E-241.	E-245 through E-247	15	
E-248	*N16-T-25301-1278	ROD: brass silver plated; 10.182" lg, 0.178" diam overall; no mtg. means provided; Transcontinental Electronic Corp. dwg. #49003-18.	Coaxial center conductor in E-230.	E-248	5	
E-249, E-250	*N17-C-781583-546	BAND: brass silver plated; cylindrical shape overall; 0.875" ID, 5/16" h, material 0.030" thk; no mtg. means provided; ears 5/16" lg with one 0.136" hole provided each end of band to accommodate ground wiping contact and clamp; Navy dwg. #RE24F174 Symbol #44.	Bands ground wiping contacts, E-233, E-234 to cap nuts, H-104, H-105.	E-249, E-250	10	
F-101, F-102	N17-F-16302-120	FUSE, cartridge: Navy type #238032-3; 3 amps, opens in 1 hr at 135% load, 2 mins. at 200%, continuous at 110% 250 volts; one time; glass body; ferrule terminals; non-indicating; 1/4" lg, 1/4" diam; Littelfuse, Inc. Part #1043-310031.	Protects an individual Antenna Selector power circuit.	F-101 through F-104	20	

\*"Not furnished as maintenance part. If failure occurs do not request replacement unless item cannot be repaired or fabricated."



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F-103, F-104	N17-F-16302-120	Same as F-101.	Spare fuses.				
G-101	N17-M-61445-1122	MOTOR, self-synchronous: Navy type 1HG Synchro Generator MK-14 Mod 4; 115 volts, 60 cycles, single phase; 3.9" lg, 2.25" diam overall; closed frame; tapered shaft, 13/32" lg from housing, #5-40 thread on end of shaft 5/32" lg, one #5-40 hex nut included; flange mounted single flange 2.25" diam, 1/4" thk; five screw type terminals #6-32, 3/16" lg, Bendix Aviation Co. part #2324-1A; Navy (Bureau of Ordnance) dwg. #90502.	Order generator for switch position indicator on remote Control Panel.	G-101	5		
G-301	N16-M-4095-3450	Navy type 5F synchro motor.	Motor for Antenna Selector.	G-301	5		
H-101	*N16-P-500001-164	POINTER, indicator: brass nickel plated; 1 5/8" lg overall mounted on 1/4" shaft by means of two #6-32 Allen head set screws tapped radially into hub; Transcontinental Electronic Corp. dwg. #49003-138.	Shows position of S-102.	H-101	5		
H-102, H-103	N17-N-88780-2701	NUT, hexagon: brass silver plated; #3/4-20; 1/8" thk, 7/8" across flats; Navy dwg. #RE24F174 Symbol #31.	Jam nuts for H-104, H-105.	H-102, H-103	10	2	
H-104, H-105	*N17-C-202179-641	NUT, cap: brass silver plated; #3/4-20; height overall 0.450", diam 0.875"; knurled circumference; Navy dwg. #RE24F174 Symbol #32.	Adjust interference of E-148 and E-149.	H-104, H-105	10	2	
H-106, H-107	*N17-C-780651-947	CLAMP: brass; silver plated; one bolt employed; 11/16" h, 5/16" wd, 5/8" deep; max thickness 9/64"; Navy dwg. #RE24F174 Symbol #42.	Tightens contact band E-249.	H-106, H-107	10		
H-108	*N16-S-150225-130	FITTING, transmission line: plug; brass silver plated; cylindrical; 7/16" lg, 0.570 diam; head one end 1/16" thk, 0.625" diam, tapped hole in side for #6-32 machine screw; Navy dwg. #RE24F174 Symbol #45.	Counter Weight short end of switch rotor, E-230.	H-108	5	2	
H-109	*N43-S-19123-7585	SCREW, spade: brass, cad. plated; #6-32; 3/4" lg; spade 1/4" square, 3/16" thk; 1/16" diam hole; Navy dwg. #RE24F174 Symbol #63.	Adjust tension of detent spring, O-112.	H-109	5		
H-301	*N17-P-500001-106	POINTER, indicator: consists of pointer, pointer screw, shaft nut and shaft adaptor; all parts brass nickel plated; 1.70" lg, 1/2" wd, 3/4" deep overall; single axial tapered mtg. hole to accommodate tapered shaft of #1 synchro; Transcontinental Electronic Corp. dwg. #49003-505.	Shows position of Antenna Switch S-102 at Control Panel.	H-301	5		

\*"Not furnished as maintenance part. If failure occurs do not request replacement unless item cannot be repaired or fabricated."

PARTS LIST

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TABLE 8-4. TABLE OF REPLACEABLE PARTS

REFERENCE DESIGNATION	STOCK NO.— STANDARD NAVY	NAME AND DESCRIPTION	LOCATING FUNCTIONS	ALL SYMBOL DESIG. INVOLVED	NUMBER PER EQUIPMENT	EQUIP. SPARES
I-101	N17-L-76854-4026	LIGHT, indicator: 1/2" diam, red fluted plastic lens; for miniature bayonet, T-3 1/4 bulb; 105-125 volts, 1/25 watt; enclosed shell; chrome plated steel; 2 1/8" lg, 1" diam overall; 11/16" diam mtg. hole required, 1/4" max panel thk; horizontal mtg., lamp replaceable from front; lens externally threaded #9/16-27 by 3/16" lg; 2 solder lug terminals located together at back of base; supplied with hex nut and lockwasher from mtg.; Dialco Part #53408-991.	Indicates "Power On" and "Patch in place" between Antenna Selector and Control Panel.	I-101, I-301	10	
I-301	N17-L-76854-4026	LIGHT, indicator: same as I-101.	Same as I-101.			
J-101 through J-140	N17-C-67727-5787	CONNECTOR, female contact: Navy type 49191; double ended female; one round female contact each end; straight; 1 1/8" lg, 5/8" diam; non-constant impedance; cylindrical brass body, silver plated; machined polystyrene insert; external #5/8-24 thread entire length; Navy dwg. #RE49F169.	Terminals for antenna connections to S-102.	J-101 through J-141	205	
J-141	N17-C-67727-5787	CONNECTOR, female contact: same as J-101.	Terminal for common connection to S-102.			
J-401 through J-407	N17-C-72271-1575	CONNECTOR, female contact: type AN-3102-28-18S; 12 round female contacts polarized.	Synchro power patching jack.	J-401 through J-407	7	
J-501 through J-507	N17-C-72635-1596	CONNECTOR, male contact: type AN-3102-28-18P; 12 round male contacts polarized.	Synchro power patching jack.	J-501 through J-507	7	
N-101, N-102	N16-H-61951-1005	HOLDER, card: brass nickel plated; 5-5/64" lg, 3-5/64" wd, 7/64" thk overall; 4 mtg. holes 0.096" diam csk for #2-56 flat head screw on 2" by 3" by 2" mtg/c; holds card size 5" x 3", provided with 0.020" thk pyrolin face strip; Navy dwg. #RE24F174 Symbol #2.	Designates switch positions of S-102.	N-101, N-102, N-301, N-302	20	
N-301, N-302	N16-H-61951-1005	HOLDER, card: same as N-101.	Same as N-101.			
N-401	*N16-H-61951-1006	HOLDER, card: brass nickel plated, 17" lg, 5/16" h, 1/8" thk overall, pressed from 0.030" material, holds card size 17" by 3/16" provided with 0.020" pyrolin face strip; 4 mtg. holes 0.096" diam csk for #2 flat head screw spaced on 5 3/4"-5"-5 3/4" mtg/c; Transcontinental Electronic Corp. dwg. #49003-503.	Connector designation strip.	N-401, N-501	7	

\*"Not furnished as maintenance part. If failure occurs do not request replacement unless item cannot be repaired or fabricated."

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ORIGINAL	N-501	N16-H-61951-1006	HOLDER, card: same as N-401.	Same as N-401.			
	O-101	*N16-C-920001-140	CRANK ASSEMBLY, hand: brass nickel plated; 2" lg, 1-21 32" deep, overall; mounts on 1/4" shaft by means of two #6-32 Allen head set screws tapped radially into hub; Transcontinental Electronic Corp. dwg. #49003-135.				
	O-102	*N17-C-98432-4633	COUPLING, rigid: sleeve type; 1/4" shaft each end; 2 set screw mtg. each end; 47/8" lg, 1/2" diam overall; brass; includes four #10-32 screws; Transcontinental Electronic Corp. dwg. #49003-100.	Couples S-102 to speed reduction unit U-101.	O-102	5	
	O-103	*N17-S-46660-8048	SPRING: helical compression type; 0.019" diam beryllium copper wire, silver plated; 5/16" lg, 0.145" diam overall; 6 turns; 3/4 turn flattened both ends; Navy dwg. #RE24F174 Symbol #37.	Supplies contact pressure to E-147.	O-103 through O-105	15	
	O-104, O-105	N17-S-46660-8048	SPRING: Same as O-103.	Supplies contact pressure to E-148 and E-149.			
	O-106	*N17-S-450321-101	SLEEVE, centering: brass silver plated; 1.145" lg, 0.875" diam overall no mtg. means provided, internal thread one end #5/8-24 by 1/4" deep to accommodate Navy type 49191 coaxial adapter; Navy dwg. #RE24F174 Symbol #12.	Centers contact assemblies at common terminal of S-102.	O-106	5	
	O-107	N17-S-46718-8294	RING, retainer: brass silver plated; 15/16" OD, 0.875" ID; no mtg. means provided; Navy dwg. #RE24F174 Symbol #14.	Retains contact F-105.	O-107	5	
	O-108	N17-B-111-01002-2000	BEARING, ball: single row radial; double shield; light duty; 0.3937" bore, 1.1811" OD, 0.3548" wd; 7 balls; packed with grease similar to Navy type O.S.-1350; standard fit; ABEC-3 tol.; New Departure #77500; Navy dwg. #RE24F174 Symbol #64.	Bearing for detent assembly, O-111.	O-108	5	
	O-109, O-110	*	BUSHING: brass; 0.630" ID, 1/2" lg, #3/4-20 external thread entire length; Navy dwg. #RE24F174 Symbol #26. (Listed for reference only.)	Reducing fitting for cap nuts H-104 and H-105.	O-109, O-110	10	
	O-111	*N16-L-30001-144	LEVER ASSEMBLY: consists of detent lever, detent roller, roller sleeve bearing, lever sleeve bearing, lever screw and roller screw; 45/8" lg, 15/16" wd, 5/16" thk; mounted by means of lever screw 1/4-20 provided; Transcontinental Electronic Corp. dwg. #49003-501.	Carries detent roller.	O-111	5	

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TABLE 8-4. TABLE OF REPLACEABLE PARTS

REFERENCE DESIGNATION	STOCK NO.— STANDARD NAVY	NAME AND DESCRIPTION	LOCATING FUNCTIONS	ALL SYMBOL DESIG. INVOLVED	NUMBER PER EQUIPMENT	EQUIP. SPARES
O-112	*N17-S-46718-8294	SPRING: helical extension type; #18 AWG stainless steel spring temper wire; 5/16" OD, 1/2" lg (free length); 14 turns; ends bent to hooks 5/16" OD at right angles to length, 1-13/16" free length over hooks; Navy dwg. #RE24F174 Symbol #56.	Applies detent pressure.	O-112	5	
O-113	*N16-W-220001-106	SUB-ASSEMBLY: consists of steel sprocket (Boston Gear Works KSA-40 modified), stainless steel shaft and ball bearing; sprockets cad plated; sprocket 4.98" OD, 3/16" thk; shaft 2-3/16" lg, 0.2495" diam at connecting end; mounted in ball bearing 0.3937" bore, 1.1811" OD, 0.3543" wd; switch rotor assembly is mounted to this assembly; Transcontinental Electronic Corp. dwg. #49003-502.	Star wheel for detent.	O-113	5	
O-114	G-77B-991-15074-0000	BEARING, ball: single row, radial; double shield, light duty 0.250" bore, 0.6875" OD, 0.250" wd; six balls; packed with std slush grease; std fit; ABEC-3 tol; Nice Ball Bearing Co. dwg. #1602; Boston Gear Works part #1602 DS.	Crank shaft bearing in U-101.	O-114 through O-119	30	
O-115	G-77B-991-15074-0000	BEARING, ball: same as O-114.	Front bearing for transfer shaft in U101.			
O-116	G-77B-991-15074-0000	BEARING, ball: same as O-114.	Rear bearing for transfer shaft in U-101.			
O-117	G-77B-991-15074-0000	BEARING, ball: same as O-114.	Front bearing for pointer shaft in U-101.			
O-118	G-77B-991-15074-0000	BEARING, ball: same as O-114.	Rear bearing for pointer shaft in U-101.			
O-119	G-77B-991-15074-0000	BEARING, ball: same as O-114.	Positioning bearing for shaft of S-102.			
O-120	N17-B-111-02002-2000	BEARING, ball: single row, radial; double shield; light duty; 0.7874" bore, 1.8504" OD, 0.5512" wd; 8 balls; packed with grease similar to Navy type OS-1350; std. fit; ABEC-3 tol; New Departure part #77504; Navy dwg. #RE24F174 Symbol #23.	Bearing for rotor of S-102.	O-120	5	

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O-301	N16-C-920001-140	CRANK, hand: same as O-101.	Same as O-101.		
P-101 through P-120	N17-C-71414-2800	CONNECTOR, male contact: Navy type 049195; one round male contact; straight type; 1-17/32" lg, 11/16" diam; non constant impedance; cylindrical brass body, silver plated; polystyrene insert; cable opening 7/16" diam; cable mounted; Navy dwg. #RE49F-167.	Connect RG-12/U cables to antenna posts of S-102.	P-101 through P-121	105
P-121	N17-C-71414-2800	CONNECTOR, male contact: same as P-101.	Connect cable to common post of S-102.		
P-401 through P-405	N17-C-76619-1588	CONNECTOR, male contact: type AN-3106-28-18P; 12 round male contacts polarized.	One end of synchro power patching cord.	P-401 through P-405	5
P-501 through P-505	N17-C-70359-1575	CONNECTOR, female contact: type AN-3106-28-18S; 12 round female contacts.	One end of synchro power patching cord.	P-501 through P-505	5
S-101	N17-S-74139-7130	SWITCH, toggle: OPDT; JAN #ST26N.	Power switch for Antenna Selector.	S-101, S-301	10
S-102	*F17-2-60681-1091	Army-Navy SA-293/FRA-3; single pole 40 position; silver plated fasaloy contacts; cadmium plated steel case; 14-9/16" by 14-9/16" by 5"; Navy type 49191 coax adapters for terminals; Navy dwg. #RE24F174.	Antenna Switch.	S-102	5
S-301	N17-S-74139-7130	SWITCH, toggle: same as S-101.	Same as S-101.		
TB-101, TB-102	N17-B-77739-5063	BOARD, terminal: General purpose; 6 brass nickel plated screw terminals; 7/16" between centers, with barriers; molded phenolic; 33/8" lg, 11/8" wd, 1/2" thk overall; 4 mtg. holes .144" diam on 3-1/16" by 27/64" centers; Howard B. Jones, Barrier Terminal Strip, Code 6-141.	Synchro power ter- minals at Anten- na Selector.	TB-101, TB-102, TB-301, TB-302	20
TB-301, TB-302	N17-B-77739-5063	BOARD, terminal: same as TB-101.	Synchro power ter- minal at Control Panel.		
U-101	*N16-S-15001-1007	REDUCTION UNIT, speed: consists of one 5F synchro, one 1G synchro, one 1" spur gear, one 5" spur gear, one 3/4" spur gear, one 6" spur gear, two 21/2" spur gears; case anodized aluminum, gears and shafts brass; 9" wd, 9" high, 8" deep overall; 2 mtg. holes 17/64" diam to accommo- date #1/4-20 screws, on 4" mgt/c in bottom plate; Transcontinental Electronic Corp. dwg. #49003-90-3.	Supplies mechanical advantage of 40 between synchro and Antenna Switch in Anten- na Selector.	U-101	5

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Section 8

TABLE 8-4. TABLE OF REPLACEABLE PARTS

REFERENCE DESIGNATION	STOCK NO.— STANDARD NAVY	NAME AND DESCRIPTION	LOCATING FUNCTIONS	ALL SYMBOL DESIG. INVOLVED	NUMBER PER EQUIPMENT	EQUIP. SPARES
U-101-A	N16-G-434557-101	GEAR: spur type; brass; straight teeth; 192 teeth; 32 DP, 6" PD; 6.06" OD, 3/8" bore, 3/16" thick; spoke style; hub projects 5/16" has 7/8" D; pinned by #50 taper pin 5/8" lg; Boston Gear Works #G189 modified.	Drives Gear, O-122 and Antenna Switch.	O-121	5	
U-101-B	N16-G-432490-592	GEAR: spur type; brass; straight teeth; 80 teeth; 32 DP, 2 1/2" PD; 2.56" OD, 3/8" bore, 3/16" thick; web style; hub projects 5/16" has 5/8" OD; pinned by #50 taper pin 3/8" lg; Boston Gear Works #G184 modified.	Drives Gear, O-122.		5	
U-101-C	N16-G-432490-607	GEAR: spur type; brass; straight teeth; 80 teeth; 32 DP, 2 1/2" PD; 2.56" OD, 5/8" bore, 3/16" thk; web style; no hub; force fit on 3/8" D shaft; Boston Gear Works #G184 modified.	Drives #1 Synchro Generator, G-101.	O-123	5	
U-101-D	N16-G-431370-443	GEAR: spur type; brass; straight teeth; 24 teeth; 32 DP, 3/4" PD; .812" OD, 5/16" bore, 3/16" thk; straight face; hub projects 5/16" has 9/16" OD; pinned by #50 taper pin 5/8" lg; Boston Gear Works #G171 modified.	Drives Gear, O-121.	O-124	5	
U-101-E	N16-G-434048-565	GEAR: spur type; brass; straight teeth; 160 teeth; 32 DP, 5" PD; 5.06" OD, 5/16" bore, 3/16" thk; spoke style; hub projects 5/16" has 3/4" D; pinned by #50 taper pin 5/8" lg; Boston Gear Works #G188 modified.	Drives Gear, O-124.	O-125	5	
U-101-F	N16-G-431530-496	GEAR: spur type; brass; straight teeth; 32 teeth; 32 DP, 1" PD; 1.06" OD, 1/2" bore, 3/16" thk; straight face no hub; force fit on 1/2" shaft; Boston Gear Works #G175 modified.	Drives Gear, O-125	O-126	5	
U-101-G	*	CLUTCH: engages handle of antenna switch to shaft of 5F motor; consists of spring Part #196A; slotted connector Part #196B and shaft extension Part #196C; Transcontinental Electronic Corp. dwg. #49003-135A (P/O U-101).		U-101-G	5	
W-401 through W-405	*N17-C-48464-1631	CABLE ASSEMBLY, power: type MHFF-14 cable 2 ft long excluding terminations; AN-3106-28-18P one end, AN-3106-28-18S other end; Transcontinental Electronic Corp. dwg. #49003-504.	Synchro control patch cord	W-401 through W-405	5	

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