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instruction book

978F-2S
Synchro Simulator

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table of contents

section 1

general description

1.1 Purpose of Book.

This instruction book presents information on the 978F-2S Synchro Simulator, shown in figure 1-1.

1.2 Purpose of Equipment.

The 978F-2S is used with the 978F-3M Mode Control Test Set to check the 614E-7( )series of Flight Director Controls, and with the 978F-1D Instrument Test Set when checking the 329B-6( )/7( )/8( )series of Flight Director Indicators, and the 331A-6( )/7( ) series of Course Indicators. In all cases, the 978F-2S is used to provide, to the units under test, signals that would normally be derived from the gyro compass in the aircraft or other components of the FD-108 Integrated Flight System.

The equipment supplied with the 978F-2S is listed in table 1-1.

1.3 Equipment Description.

The 978F-2S consists of three synchros: a synchro transmitter and a synchro control transformer connected through a gear train to a crank and a dial indicator, and a second synchro transmitter connected through another gear train to a crank and a dial indicator. Three sets of five terminals each, located on the front panel, provide points where the operation of the synchros can be monitored. During tests, a meter connected to these terminals may be used to measure the outputs of the synchros. Each set of jacks is marked H, C, X, Y, and Z, to designate the point on each synchro to which each terminal is connected.

TABLE 1-1
EQUIPMENT SUPPLIED

ITEM	PART NUMBER
978F-2S Synchro Simulator	Collins 522-3498-00
Connector (mates with J1)	Winchester XAC14P-C-1A306

The 978F-2S is constructed on a 19-inch panel, so the equipment can be mounted in a standard 19-inch relay rack. The test set can also be used on the bench as a portable unit. Handles are provided on the front panel, and a dust cover is furnished.

1.4 Equipment Specifications.

All power requirements of the 978F-2S are satisfied by connecting the equipment to associated test sets. As with the associated equipment, the 978F-2S operates in a normal factory environment.

Figure 1-1. 978F-2S Synchro Simulator

section 2

installation

2.1 Unpacking and Inspection.

Refer to the packing slip for a list of all units supplied with the order. Open crates or cartons carefully, check for damage, and search all packing material for loose hardware. Be certain that all controls on the equipment operate properly.

All claims for damage must be filed promptly with the transportation company involved. Keep all original packing material against the possibility of a claim for damage.

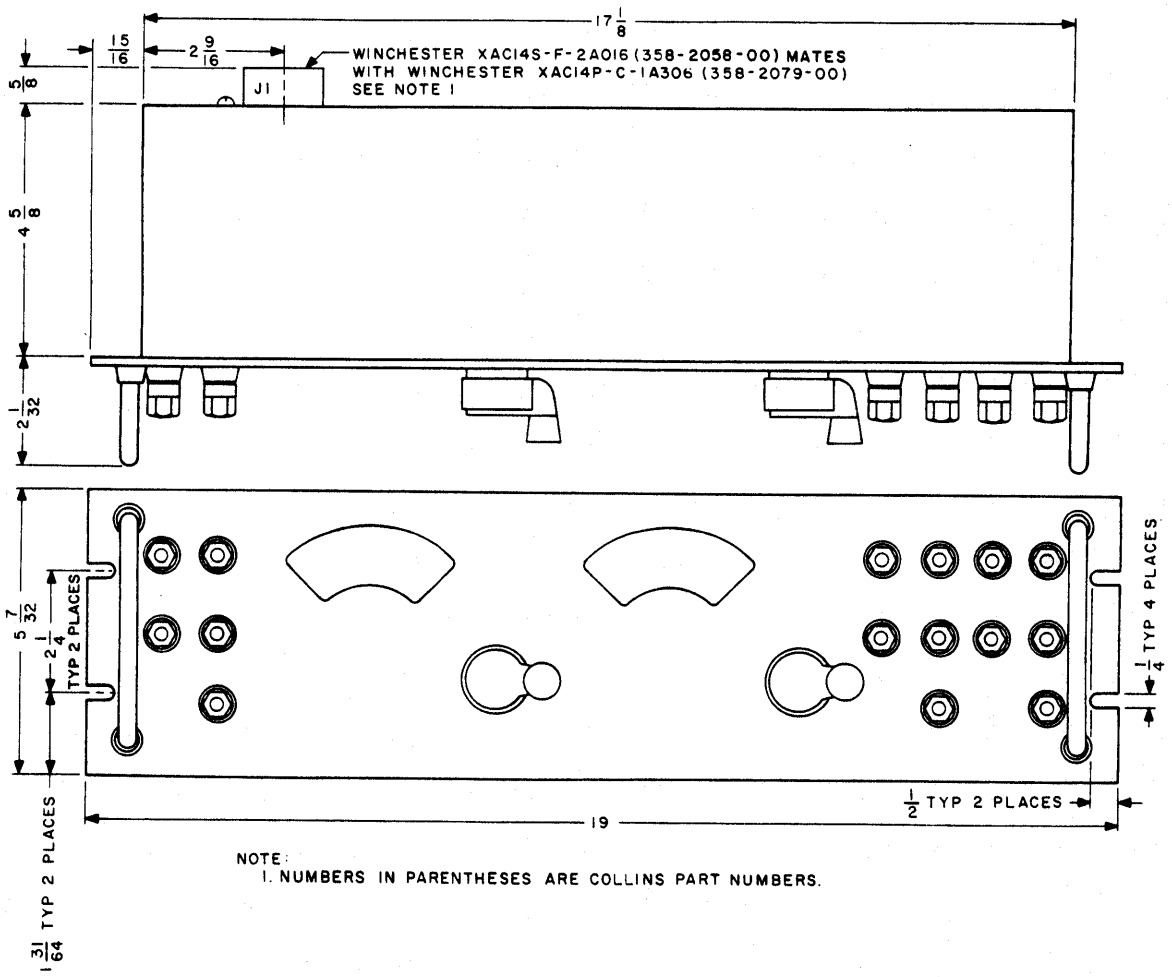

Figure 2-1. 978F-2S Synchro Simulator, Outline and Mounting Dimensions

section 3

operation

3.1 General.

This section describes the functions of the components on the front panel of the 978F-2S. Since the 978F-2S is used in conjunction with other test equipment, operational procedures for the 978F-2S are presented in the applicable equipment overhaul manuals.

3.2 Description of Controls.

The components on the front panel of the 978F-2S are shown in figure 3-1 and described below.

3.2.1 CRANKS AND DIALS.

The cranks set the synchros in the 978F-2S to any angular position, as indicated on the dials.

3.2.2 TRANSMITTER H, C, X, Y, AND Z TERMINALS.

Synchro transmitter voltages may be measured at these terminals with a suitable meter.

3.2.3 CONTROL TRANSFORMER H', C', X, Y, AND Z TERMINALS.

Synchro control transformer voltages may be measured at these terminals with a suitable meter.

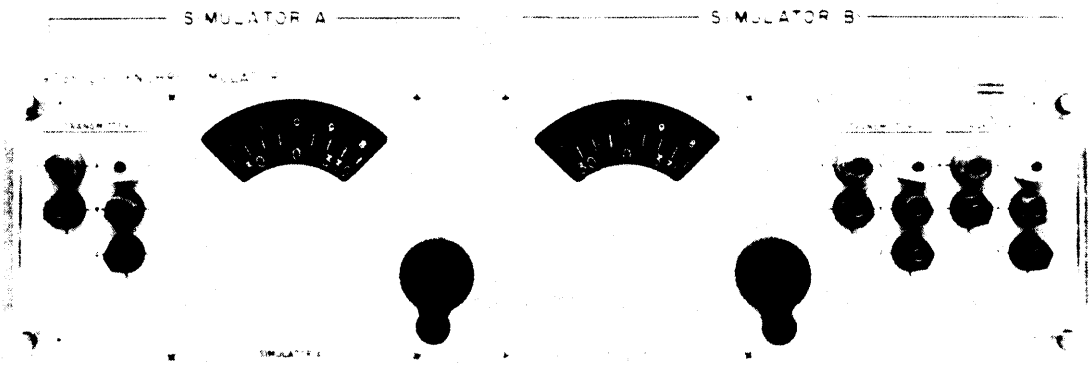

Figure 3-1. 978F-2S Synchro Simulator, Operating Controls

section 4

principles of operation

4.1 General.

The 978F-2S is used in two types of testing procedures. In one, when used with the 978F-3M Mode Control Test Set, it provides test signals when checking the 614E-7( ) series of Flight Director Controls. In the other, the 978F-2S is used with the 978F-1D Instrument Test Set when testing the 329B-6( )/7( )/8( ) series of flight director indicators and the 331A-6( )/7( ) series of course indicators. Refer to figure 7-1, a 978F-2S schematic diagram.

4.2 Operation.

The 978F-2S consists of three synchros. Setting the synchro transmitters to various angular positions, as specified in the test procedures, produces 3-wire signals to the components under test. Setting the synchro transformer to various angular positions, as specified in the test procedures, produces 2-wire signals to the components under test. These signals simulate information normally developed in other portions of the FD-108 Integrated Flight System. Excitation voltages for these synchros are provided by the test set to which the 978F-2S is connected.

section 5

maintenance

5.1 General.

The procedures in this section should be performed on new equipment or after either of the synchro transmitters or the synchro control transformer has been removed or replaced. The alignment, zeroing, and testing procedures for both synchro transmitters are identical.

5.2 Periodic Maintenance.

Lubricate the 978F-2S using six months as a guide for lubrication intervals. The actual intervals will be influenced by the environmental conditions. Clean components thoroughly before applying new lubricant, and use only that amount of lubricant necessary for smooth operation. Do not overlubricate. Lubricate all shafts and gears with aircraft and instrument grease, Beacon 325 (or equivalent in accordance with the latest version of military specification MIL-G-3278).

5.3 Test Equipment Required.

The test equipment required to perform the tests presented in this section is listed in table 5-1.

TABLE 5-1
TEST EQUIPMENT REQUIRED

ITEM	DESCRIPTION
Vom	Triplett Model 630
Ac vtvm	Ballantine Model 300
Synchro bridge	Rubicon Model 1901
Null meter	Phazon Model 100A

5.4 Bench Test.

5.4.1 CONTINUITY TEST.

A continuity test should be performed to ensure that all components are connected properly.

Table 5-2 lists the readings that should be obtained when an ohmmeter is connected between the points specified.

b. Set the calibrated synchro transmitter to 0.0 degree. A null should be indicated when the SIMULATOR B dial on the 978F-2S is set to 0.0 ±0.15 degree.

c. Set the calibrated synchro transmitter to 30 degrees. A null should be indicated when the 978F-2S SIMULATOR B dial is set to 30 ±0.3 degrees.

d. Repeat step c at 30-degree increments from 60 degrees through 330 degrees. The tolerance should be 0.3 degree in each case.

5.5 Adjustment.

5.5.1 SYNCHRO TRANSMITTER ALIGNMENT.

a. Set the dial on the 978F-2S to 0.0 degree. Connect a shorting wire between the TRANSMITTER C and Z terminals. Connect the ac vtvm to TRANSMITTER H and X terminals. Connect 26 volts at 400 cycles to the TRANSMITTER H and C terminals.

b. Loosen the clamps holding the synchro transmitter, and rotate the case for a maximum reading on the vtvm.

c. Remove the shorting wire between TRANSMITTER C and Z terminals. Connect the vtvm between the TRANSMITTER X and Y terminals. Carefully rotate the case of the synchro transmitter to the nearest exact null, as measured on the vtvm. Tighten the clamps holding the synchro transmitter case carefully, to ensure that the null position is not disturbed.

5.5.2 SYNCHRO CONTROL TRANSFORMER ALIGNMENT.

a. Set the SIMULATOR B dial on the 978F-2S to 270.0 degrees. Connect shorting wires between the CONTROL TRANSFORMER C' and Z terminals, and between the X and Y terminals. Connect the ac vtvm between the CONTROL TRANSFORMER H' and X terminals.

b. Loosen the clamps holding the synchro control transformer and rotate the case for a maximum reading on the vtvm.

c. Remove the shorting wire between the CONTROL TRANSFORMER C' and Z terminals. Connect the vtvm between the CONTROL TRANSFORMER H' and C' terminals.

d. Set the SIMULATOR B dial on the 978F-2S to 0.0 degree. Carefully rotate the case of the synchro control transformer to the nearest exact null. Tighten the clamps holding the synchro control transformer case carefully, to ensure that the null position is not disturbed.

5.6 Disassembly and Assembly.

During disassembly and assembly procedures, refer to figure 6-1.

5.6.1 DISASSEMBLY.

5.6.1.1 DISASSEMBLY OF SYNCHRO SIMULATOR. Loosen setscrews (H1), knob (MP2, MP36), and remove knob from front panel. Place the 978F-2S face down. Use the handles (MP1, MP35) to support the equipment. Remove screws (H24) and nuts (H25) to loosen connector (J1). Remove screws (H22), and lift off rear panel (MP65).

Mark all leads connected to terminal studs (H15). Disconnect leads from the terminal studs mounted on the rear gear plate (MP28, MP59) of the gear train assembly being disassembled.

Remove screws (H18), lockwashers (H17), flat washers (H16), and lift off rear gear plate (MP28, MP59) assembly. Refer to paragraph 5.8.1.2 for disassembly of rear gear plate assembly.

Loosen screw (H8), nut (H7), and clamp (MP24, MP57) from the end of shaft (MP5, MP38). Lift off gear (MP23, MP56).

Loosen screw (H8) and nut (H7) from clamp (MP15, MP48). Loosen screw (H8) and nut (H7) from clamp (MP9, MP42). Slip spur gearshaft (MP22, MP55) from front gear plate (MP10, MP43), out of middle gear plate (MP17, MP50), and off end of shaft (MP5, MP38).

Remove sleeve nuts (MP18, MP51), and slide middle gear plate (MP17, MP50) assembly from front plate gear assembly. Refer to paragraph 5.6.1.3 for further disassembly of middle gear plate assembly.

Remove sleeve nuts (MP11, MP44) and threaded studs (H13), and lift off the front gear plate (MP10, MP43) assembly. Refer to paragraph 5.6.1.4 for further disassembly of the front gear plate assembly.

Further disassembly of the 978F-2S Synchro Simulator should not be necessary.

5.6.1.2 DISASSEMBLY OF REAR GEAR PLATE ASSEMBLY.

To disassemble the rear gear plate assembly, loosen screw (H8), nut (H7), and clamp (MP21, MP26, MP54) from the shaft of synchro (B1, B2, B3). Slide gear (MP20-MP20A, MP27-MP27A, MP53-MP53A) from synchro shaft.

To remove synchro, loosen screw (H21), and twist synchro clamps (H19) until synchro is free. Slide synchro free from rear gear plate (MP28, MP59).

For overhaul of the synchro (B1, B2, B3) refer to the appropriate section of Electromechanical Components Overhaul Manual (Collins part number 523-0757895).

5.6.1.3 DISASSEMBLY OF MIDDLE GEAR PLATE ASSEMBLY.

Loosen setscrews (H14) in flywheel (MP19, MP52). Remove flywheel from shaft (MP6, MP39). Remove shaft (MP6, MP39) from middle gear plate (MP17, MP50).

section 6

parts list

ITEM	DESCRIPTION	COLLINS PART NUMBER
B1	SYNCHRO, TRANSMITTER: size 11 w/ single phase rotor and wye-connected 3-phase stator; 26 vac, 400 cps input; 0.280 amp; 0.94 w; 5700 mm/deg torque gradient; 0.454 transformation ratio; John Oster Manufacturing Co.	229-3039-00
OR		
B1	SYNCHRO, TRANSMITTER: size 11 w/ single phase rotor and wye-connected 3-phase stator; 26 vac, 400 cps input; 0.280 amp; 0.94 w; 5700 mm/deg torque gradient; 0.454 transformation ratio; Clifton Precision Products Co, part no. TGH-11-F-4	229-3040-00
OR		
B1	SYNCHRO, TRANSMITTER: size 11 w/ single phase rotor and wye-connected 3-phase stator; 26 vac, 400 cps input; 0.280 amp; 0.94 w; 5700 mm/deg torque gradient; 0.454 transformation ratio; Kearfott Division, General Precision Inc. part no. 7RS911-1E	229-3041-00
B2	Same as B1	229-3039-00
B2	Same as B1	229-3040-00
B2	Same as B1	229-3041-00
B3	SYNCHRO, CONTROL TRANSFORMER: size 11 w single phase rotor and wye-connected 3-phase stator; 11.8 v rms input voltage, 400 cps input frequency; 2.203 transformation ratio; Kearfott Division, General Precision, Inc. part no. 7RS901-3E	229-5017-00
H1	Part of MP2 and MP36	
H2	SCREW, MACHINE: stainless steel, passivate finish; 8-32 NC-2A thd, 7/15 in. lg; MS type MS35200-41	342-0079-00
H3	SCREW, MACHINE: Phillips recessed flathead; 10-32 thd, 1/2 in. lg; cres	342-0224-00
H4	SCREW, MACHINE: Phillips recessed panhead; stainless steel, passivate finish; 2-56 UNC-2A thd; 1/4 in. lg; MS type MS35216-3	343-0124-00
H5	WASHER, LOCK: stainless steel, passivated finish; split helical ring type; 0.088 in. id, 0.175 in. od, 0.020 in. thk; MS type MS35338-77	310-0275-00
H6	WASHER, FLAT: cres, 0.092 in. id, 0.219 in. od, 0.018 in. thk	310-6320-00
H7	NUT, PLAIN, SQUARE: steel; cadmium plated; 4-40 NC-2B thd, 3/16 in. w across flats, 0.062 in. thk o/a	334-0485-00
H8	SCREW, CAP, SOCKET, HEAD: cadmium pl steel; socket head; 4-40NC-2 thd, 1/2 in. lg.	324-0300-00
H9	RING, RETAINING: beryllium copper, plain finish; type E 0.094 in. id, 0.230 in. od, 0.015 in. thk	340-0250-00
H10	SPRING, HELICAL, COMPRESSION: 0.010 steel music wire, plain finish, right-hand coil w/approx. 9 turns, 0.070 in. id by 0.090 in. od by 0.250 in. working	340-0127-00
H11	SHIM: brass; 0.250 in. id, 0.500 in. od, 0.0050 in. thk	545-3899-002
AND/ OR		
H11	SHIM: brass; 0.250 in. id, 0.500 in. od, 0.100 in. thk	545-3900-002
AND OR		
H11	WASHER, FLAT: brass; 0.250 in. id, 0.500 in. od, 0.032 in. thk	545-3901-002
H12	WASHER, SPRING TENSION: phosphor bronze; 17/64 in. id, 1/2 in. od, 0.010 in. thk, 0.062 in. h o/a	310-4714-00

ITEM	DESCRIPTION	COLLINS PART NUMBER
H13	STUD, CONTINUOUS THREAD: stainless steel, plain finish; 8-32NC-2 thd, 3/4 in. lg; mfr 13499 P/N 312-0106-00	312-0097-00
H14	SETSCREW: fluted, multiple-spline socket, cup point, 4-40NC-2A thd, 1/8 in. lg; MS type MS51053-112	328-0371-00
H15	TERMINAL, STUD: brass, terminal arc resistant plastic insulation; 3000 vac breakdown; 0.250 in. w across flats by 5/8 in. lg o/a; Armel Electro, Inc. part no. RTMT 12-2M	306-0980-00
H16	WASHER, FLAT: cres, 0.172 in. id, 0.375 in. 0.036 in. thk	310-0047-00
H17	WASHER, LOCK: split helical ring; cres; passivated finish; 0.168 in. id by 0.296 in. od, 0.040 in. thk; MS type MS35338-80	310-0072-00
H18	SCREW, MACHINE: steel; cross-recess drive pan head, 8-32 NC-2A thd, 7/16 in. lg	343-0188-00
H19	CLAMP, SYNCHRO: cres, passivate finish; 0.179 in. by 0.259 in. by 0.308 in. o/a; 0.120 in. id.	545-3924-002
H20	WASHER, LOCK: stainless steel, passivated finish; split helical ring type; 0.115 in. id, 0.212 in. od, 0.025 in. thk; MS type MS35338-78	310-0279-00
H21	SCREW, MACHINE: cres, cross-recess drive fillister head; 4-40 NC-2A thd, 3/8 in. lg.	347-0008-00
H22	SCREW, MACHINE: cres; Phillips flathead; 4-40NC-2A thd; 5/16 in. lg; MS type MS35200-13	342-0045-00
H23	SCREW, MACHINE: stainless steel; flat countersunk head; 4-40NC-2A thd, 1/4 in. lg	330-2290-00
H24	SCREW, MACHINE: Cross-recessed panhead; stainless steel, passivate finish; 4-40OUNC-2A thd; 5/16 in. lg; MS type MS35216-13	343-0134-00
H25	NUT, SELF-LOCKING, HEXAGON: aluminum, anodized; 4-40 NC-2 thd, 0.250 in. hex, 0.143 in. h; ESNA 68NM-40	333-0347-00
H26	SCREW, MACHINE: steel; cross-recess drive 2-56 NC-2A thd; 0.375 in. lg; MS type MS35200-5	342-0135-00
H27	Same as H20	310-0279-00
H28	Same as H24	343-0134-00
H29	SCREW, MACHINE: stainless steel; Phillips recessed flat head; 4-40OUNC-2A thd, 7/16 in. lg	342-0047-00
J1	CONTACT, ELECTRICAL: socket type, 7.5 amp; 0.121 in. dia by 0.764 in. lg o/a dim (P/O J1)	372-8038-00
J2	POST, BINDING: insulated, captive type; 1000 vdc working; 30 amp; red insulation; 0.555 in. dia by 2.046 in. lg o/a	372-1062-00
J3	POST, BINDING: insulated 1000 vdc, 30 amp current rating; black nylon insulation; The Superior Electric Co. part no. DFN 30 BC	372-1061-00
J4	POST, BINDING: insulated, captive type w/ banana plug jack; 1000 vdc, 30 amp; yellow insulation color; The Superior Electric Co. part no. DFN 30 YC	372-1067-00
J5	POST, BINDING: insulated; 1000 vdc, 30 amp current rating; green nylon insulation; The Superior Electric Co. DFN 30 GNC	372-1065-00
J6	Same as J3	372-1061-00
J7	Same as J2	372-1062-00
J8	Same as J3	372-1061-00
J9	Same as J4	372-1067-00
J10	Same as J5	372-1065-00
J11	Same as J3	372-1061-00
J12	Same as J2	372-1062-00

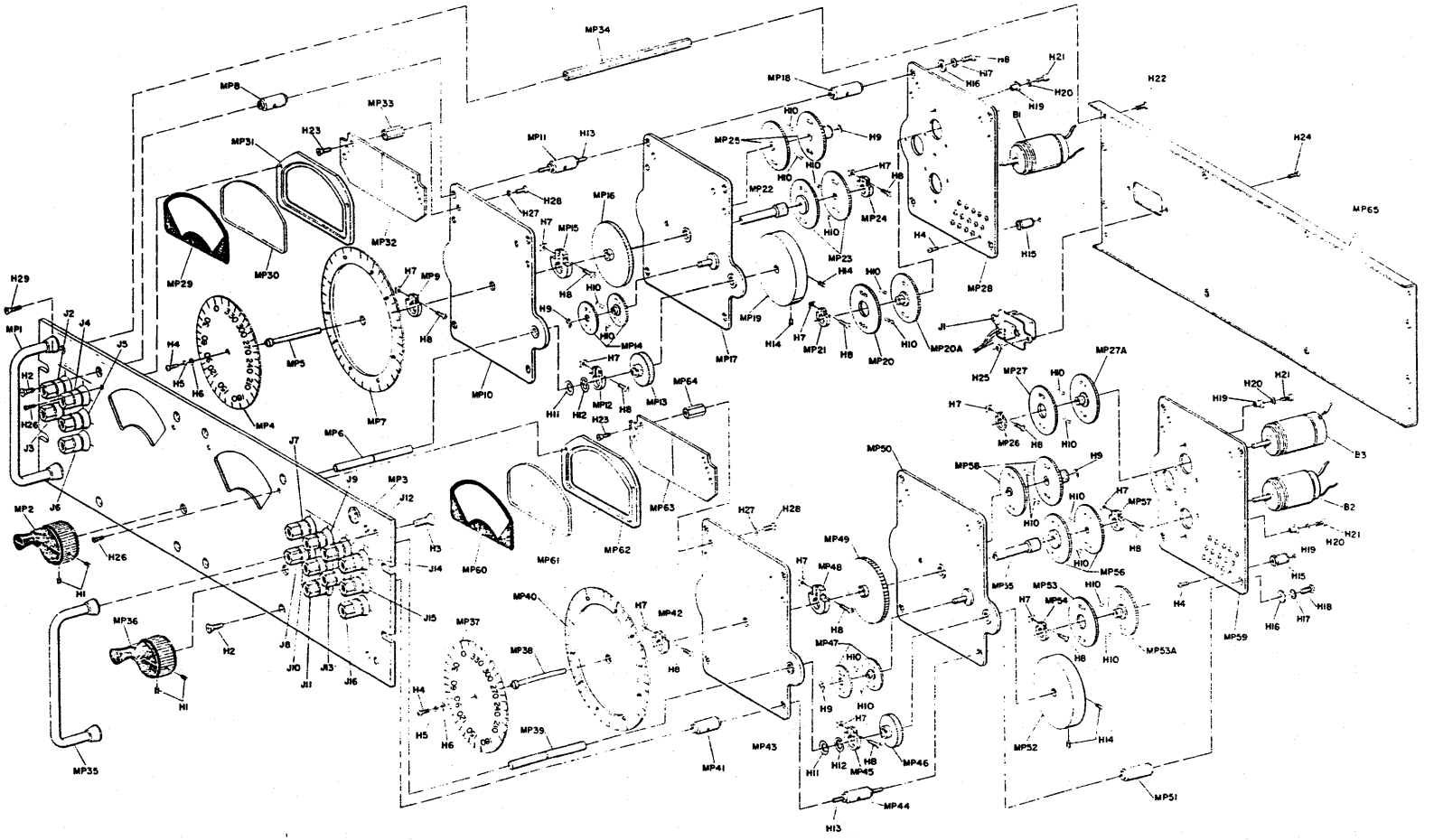

Figure 6-1. 978F-2S Synchro Simulator, Exploded View

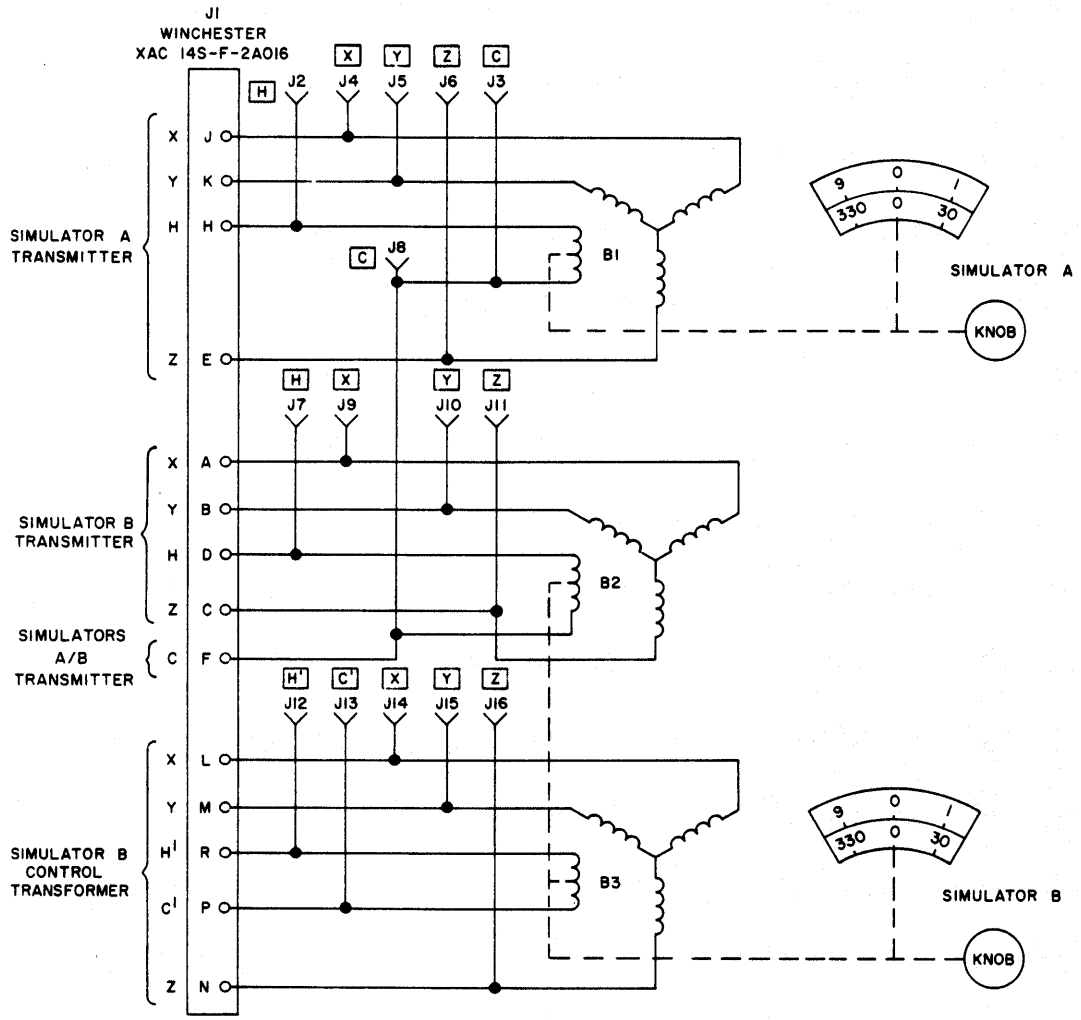

Figure 7-1. 978F-2S Synchro Simulator, Schematic Diagram