ELIMINATING SO–a INTERFERENCE TO TCS RECEIVERS

Reports have been received from field engineers stating that radar interference has been experienced in the TCS receiver after making the SO to SO-a conversion.

Interference was not present with the original SO equipments, and none of a variety of bonding systems tried eliminated this dufficulty. However, field engineers found that the pickup in the TCS receiver was partially eliminated by alignment of the stationary electrode in spark gap.

A remedy was found by shielding the cabling from J-103 to terminal strip E-130 (inside the modulator unit). In all cases, this has eliminated the interference. As a precautionary measure, the cable should be shielded on all SO-a conversions.

PPI INTERFERENCE DUE TO BLOWER MOTORS

Interference on the PPI, not unlike radar interference, has been reported in a large number of installations. The interference, which was found to be due to the magnetron blower motor, is easily isolated by merely removing the blower fuse F-202/F-205 and observing whether the interference pattern disappears.

Several remdeies have been tried, none of which eliminated the trouble in every case. Very often cleaning and seating the blower motor brushes eliminates the interference. The addition of two 0.5 μfd condensers, bypassing the blower leads to ground, usually correct the trouble (these condensers will be added to production unit when sufficient condensers are available). On ships having one side of the ship's power grounded, reversing the blower motor leads frequently cures the interference. Difficult cases that do not respond to the above treatments may require a new motor.

TRUE BEARING FIELD CHANGE KITS

True bearing equipment for SO/SO-a/SO-13, SO-1, SO-2, SO-8, and SO-9 radar are special features not furnished with the radars. They are procured under separate contract and are made available in kit form as modifications to the radar.

True bearing kits have been assigned to all SO/SO-a/SO-13 type radars installed on vessels which have gyro flux gate compass systems or step-by-step gyrocompass repeater systems. They also have been assigned to SO-1, and SO-8 equipments installed on vessels which have step-by-step gyro repeaters.

There are two types of step-by-step true bearing equipments available for SO-8 radars, namely, Field Changes 60 and 62. These systems differ mainly in the manner in which compass information is carried electrically to the antenna and converted to mechanical motion at the differential system.

The manufacturer's specification numbers (RX prefix) together with the Navy Field Change Nos. are given below (paragraphs (a) to (e) for each particular installation).

a. SO Navy Field Change 25 (RX-1155). SO/SO-a/SO-13 Radar Equipment for LCC vessels with 70 volt step-by-step gyro repeater systems.

b. SO Navy Field Change 38 (RX-1002). SO/SO-a/SO-13 Radar Equipment installed on PT boats, for operation from a flux gate compass master indicator No. 12005-1-A which has a special autosyn output connection for this purpose.

NOTE: All PT Squadrons shall have No. 12005-1-A Master Indicator made available to them. (The older type Master Indicator No. 12001-1-A does not provide this output and therefore has to be replaced with the newer type No. 12005-1-A indicator before the radar true bearing system is installed and connected.) Some have already been shipped with others in the process of shipping.

c. SO Navy Field Change 41 (RX-1006). SO-1 Radar Equipment installed on all vessels having 70 volt step-by-step gyrocompass repeater systems.

d. SO Navy Field Change 60 (RX-1156). All vessels with SO-8 Radar Equipment. This is the torque unit differential step-by-step gyrocompass type, and is supplied with a Bearing Control Unit CRP-23AEK. The left hand assembly of this unit is provided with a compass repeater of the step-by-step gyro type, which can be used to replace a repeater when step-by-step gyrocompass is loaded to capacity.

e. SO Navy Field Change 62 (RX-1196). This is the 70-volt, step-by-step motor differential type and is also designed for SO-8 installations. A step Motor Control Unit CRP-23AEY is provided for synchronizing the radar indicator with the compass repeater systems after switching to true bearing.

f. SO-2 Equipment-SO Navy Field Change 25 (RX-1155) and SO Navy Modification 62 (RX-1196). Step motor differential true bearing units may be used on SO-2 equipment. However, special instructions for adapting these units will be covered in Navy Field Change 83.

g. SO-9 Equipment (step motor type)-SO Navy Field Change 62 (RX-1196) and SO Navy Field Change 25 (RX-1155). Step motor differential true bearing units may be used on SO-9 equipments. However, special instructions for adapting these units will be covered in Navy Field Change 84.

h. SO-9 Equipment (torque unit type)-SO Navy Field Change 60 (RX-1156). Torque unit differential true bearing unit may be used on SO-9 equipments. However, special instructions for adapting these units will be covered in Navy Field Change 85.

i. SO-3 and SO-4 Equipment-The true bearing unit shipped with the SO-3 equipment is to be used on ships having a flux gate compass.

The true bearing unit shipped with the SO-4 equipment is used on ships having a 70-volt, step-by-step gyro repeater system.

NOTE: Contact No. NXSR-39226 is marked on the true bearing box, included with the SO-3 and SO-4 equipment, and should not be separated from the equipment because of a difference in contract markings between the true bearing unit and the radar equipment boxes.

MAINTENANCE BLOWER MOTORS

Several cases of incorrect type blower motors have been reported in SO series equipment maintenance parts.

Radar personnel are requested to check their maintenance parts box and make certain that they have the correct maintenance blower motor (24-volt d.c. or 115-volt d.c.) depending upon the type SO installed aboard.

Upon inspection, if incorrect type blower motor is found in maintenance parts ship should exchange the incorrect one for a correct type.

Technician's Checkoff List (SO, SO-a, SO-1, SO-2, SO-8, SO-9, SO-13)

The maintenance procedures outlined in this checkoff list were collected from data submitted by vessels, navy yards and manufacturers' radar field service engineers. This checkoff list is to be used by the ship's radar technician or other radar personnel equally qualified. The checkoff list should be made effective immediately upon receipt of this information. A copy of this checkoff list (preferably typewritten) should be made for future use.

NOTE: After completion of each item check (√) in appropriate blank space.

	Year___											
	Month_											
	Week__	1	2	3	4	1	2	3	4	1	2	3	4
ANTENNA ASSEMBLY													
1. Tighten cover bolts and mounting bolts.													
2. Inspect turret cover for cracks, leaks or damage (all equipments except SO–1).													
3. Check interior and exterior for corrosion. Clean and recoat using grease, paint, etc.		X	X	X		X	X	X		X	X	X
		X	X	X		X	X	X		X	X	X
4. Clean and tighten cable fittings and terminals.		X	X	X		X	X	X		X	X	X
5. Clean drain hole in base of antenna.		X	X	X		X	X	X		X	X	X
6. Check antenna alignment and operation of cam and microswitch. Ref: Instruction book (maintenance).		X	X	X		X	X	X		X	X	X
		X	X	X		X	X	X		X	X	X
7. Operate antenna with cover removed and observe visually and audibly.		X	X	X		X	X	X		X	X	X
8. Tighten all hardware.		X	X	X		X	X	X		X	X	X
9. Annual lubrication and overhaul—see instruction book and lubrication chart.		ANNUALLY											
TRIPOD AND WAVEGUIDE													
1. Check alignment, tighten mounting bolts.													
2. Grease any mounting bolts showing corrosion.													
3. Check deck mounts for watertightness and mechanical damage.													
4. Inspect tripod for paint damage, chipping or delamination (SO/SOa/SO–13).		X	X	X	X	X	X	X		X	X	X
5. Clean out waveguide and elbow, reassemble carefully. See instruction book.		X	X	X	X	X	X	X		X	X	X
TRANSMITTER RECEIVER													
1. Tighten mounting hardware. Lubricate any bolts showing corrosion.													

Technician's Checkoff List (SO, SO–a, SO–1, SO–2, SO–8, SO–9, SO–13)—Con.

	Year											
	Month											
	Week	1	2	3	4	1	2	3	4	1	2	3	4
TRANSMITTER RECEIVER—continued													
2. Tighten cover screws (wing bolts) and entrance plugs in side of case.													
3. Inspect cables for sharp bends or damage. Check terminal tubes.													
4. Check air gap (¼") between case plexiglass and lower waveguide flange. Wipe out gap with soft cloth. Carefully replace rubber boot. Check boot drain hole.													
5. Check dehydrators and replace as needed. Color is blue when good and pink when bad.			X X	X X	X X		X X	X X	X X		X X	X X	X X
6. Clean and tighten interlock contacts.			X	X	X		X	X	X		X	X	X
7. Check operating log for hours service on TR box tube (721–A). Replace after 300 hours.			X X	X X	X X		X X	X X	X X		X X	X X	X X
8. Check service on blower motor brushes and blower motor. Replace brushes after 300 hours and motor after 600 hours.			X X	X X	X X		X X	X X	X X		X X	X X	X X
9. Check crystal mixer current (0.4 to 0.6 ma). Ref: Instruction book.			X	X	X		X	X	X		X	X	X
10. Check magnetron current. Ref: Instruction book.			X	X	X		X	X	X		X	X	X
11. Check magnetron anode tip for arcing—loose tip—burned anode.													
12. Tune mixer line and adjust local oscillator coupling. Tune TR box. Ref: Instruction book.			X X	X X	X X		X X	X X	X X		X X	X X	X X
13. Observe TR box to be sure tube is firing properly as indicated by blue glow.			X	X	X		X	X	X		X	X	X
14. Throw OFF-ON switch at indicator several times while observer watches wave guide shutter to be sure operation is smooth and regular.			X X	X X	X X		X X	X X	X X		X X	X X	X X
15. Tighten all mounting hardware and terminals.			X	X	X		X	X	X		X	X	X
16. Open terminal boxes and inspect for moisture and proper lead dress.			X	X	X		X	X	X		X	X	X
17. Lubricate captive wiring screws with cup grease and captive nut insert bushings with a medium grade oil.			X X	X X	X X		X X	X X	X X		X X	X X	X X
18. Make GENERAL checks 1 through 6.			X	X	X		X	X	X		X	X	X
PLAN POSITION INDICATOR													
1. Tighten panel screws and inspect shock mounts.													
2. Check operation of all controls.													

Technician's Checkoff List (SO, SO-a, SO-1, SO-2, SO-8, SO-9, SO-13)—Con.

	Year___											
	Month_											
	Week__	1	2	3	4	1	2	3	4	1	2	3	4
PLAN POSITION INDICATOR—continued													
3. Check accuracy of markers and bearings by comparison with targets at known distances and bearings.													
4. Check and replace dehydrators when needed.			X	X	X		X	X	X		X	X	X
5. Operate unit out of case (using test cable) and observe action of PPI subassembly.			X	X	X		X	X	X		X	X	X
6. Check operation of cam and microswitch. Ref: Instruction book.			X	X	X		X	X	X		X	X	X
7. Tighten Allen set screws on synchro coupler.			X	X	X		X	X	X		X	X	X
8. Tighten mounting hardware and inspect wiring.			X	X	X		X	X	X		X	X	X
9. Check setting of multivibrator bias pot.—R-429. Ref: Instruction book.			X	X	X		X	X	X		X	X	X
10. Inspect J-401, P-401, J-402 and P-402 for corrosion.			X	X	X	X	X	X	X	X	X	X	X
11. Open terminal box and check for moisture and lead dress.			X	X	X		X	X	X		X	X	X
12. Check terminal tubes.													
13. Tighten pressure cap on terminal box.			X	X	X		X	X	X		X	X	X
14. Make GENERAL checks 1 through 6.			X	X	X		X	X	X		X	X	X
15. Lubricate the small PPI drive gear shaft bearings and both bearings of the deflection coil. See lubrication chart.	ANNUALLY												
RESONANCE CHAMBER (ECHO BOX)													
1. Tighten mounting screws.			X	X	X		X	X	X		X	X	X
2. Check operation of neon bulb and ringing time on PPI. Ref: Instruction book.			X	X	X		X	X	X		X	X	X
3. Make GENERAL check number 5.			X	X	X		X	X	X		X	X	X
ACCESSORY CONTROL UNIT													
1. Tighten panel screws.													
2. Check operation of all controls.													
3. Observe unit while operating out of case. (Use test cable.) Throw range switch on indicator to operate relays in ACU.			X X	X X	X X		X X	X X	X X		X X	X X	X X
4. Check and replace dehydrators when needed.			X	X	X		X	X	X		X	X	X

Technician's Checkoff List (SO, SO–a, SO–1, SO–2, SO–8, SO–9, SO–13)—Con.

	Year___											
	Month_											
	Week__	1	2	3	4	1	2	3	4	1	2	3	4
ACCESSORY CONTROL UNIT—continued													
5. Tighten mounting hardware and terminals.			X	X	X		X	X	X		X	X	X
6. Inspect interior of terminal box for moisture and lead dress.			X	X	X		X	X	X		X	X	X
7. Inspect and clean J–701 and P–701.			X	X	X		X	X	X		X	X	X
8. Make GENERAL checks 1 through 6.			X	X	X		X	X	X		X	X	X
RECTIFIER POWER UNIT													
1. Blow out dust and wipe off terminal blocks.													
2. Inspect tubes with unit running to see that rectifier filaments and regulator tubes are lighting properly.													
3. Measure d-c voltage between terminals 31 and 33 (230 to 260 volts).													
4. Clean and tighten interlock contacts.			X	X	X		X	X	X		X	X	X
5. Tighten cable clamps and check lead dress.			X	X	X		X	X	X		X	X	X
6. Make GENERAL checks 1 through 6.			X	X	X		X	X	X		X	X	X
MOTOR ALTERNATOR MODULATOR													
1. Blow out dust and wipe off insulators.													
2. Observe rectifier (705–A) to see that filament is lighted properly and tube is not gassy (blue glow between elements).													
3. Inspect gap electrodes for damage.													
4. Drain water trap on gap exhaust manifold or blow out both the intake and the exhaust flame trap with dry compressed air.													
5. Tighten coaxial cable ground clamps.													
6. Inspect gap high voltage bushing.													
7. Measure a-c current in primary of T–101 or T–105.			X	X	X		X	X	X		X	X	X
8. Tighten case cover bolts.													
9. Inspect Thyrite assembly (Z–103) for damage			X	X	X		X	X	X		X	X	X
10. Check exciter-field grounding brush and replace if badly worn.			X	X	X		X	X	X		X	X	X
11. Inspect gap grounding brush and replace if badly worn.			X	X	X		X	X	X		X	X	X

Technician's Checkoff List (SO, SO–a, SO–1, SO–2, SO–8, SO–9, SO–13)—Con.

	Year											
	Month											
	Week	1	2	3	4	1	2	3	4	1	2	3	4
MOTOR ALTERNATOR MODULATOR—continued													
12. Check operation of voltage regulator. Ref: Instruction book.			X	X	X		X	X	X		X	X	X
13. Check electrode spacing and timing of gap. Ref: Instruction book.			X	X	X		X	X	X		X	X	X
14. Clean and tighten interlock contacts.			X	X	X		X	X	X		X	X	X
15. Tighten mounting hardware and terminals.			X	X	X		X	X	X		X	X	X
16. Make GENERAL checks 1 through 6.			X	X	X		X	X	X		X	X	X
17. Lubricate motor alternator bearings and rotating electrode assembly bearings. See instruction book and lubrication chart.		ANNUALLY											
EFF CONTROL UNIT													
1. Tighten mounting hardware.													
2. Check operation of controls.													
3. Check voltmeter reading against test meter.													
VOLTAGE REGULATOR													
1. Check operation of voltage regulator by measuring a-c output of alternator with and withoug gap firing. See instruction book.			X X	X X	X X		X X	X X	X X		X X	X X	X X
2. Tighten mounting and terminal bolts.			X	X	X		X	X	X		X	X	X
GENERAL CHECKS													
1. Clean fuse and resistor ferrules and clips.			X	X	X		X	X	X		X	X	X
2. Seat tubes firmly in sockets after cleaning pins and sockets.			X	X	X		X	X	X		X	X	X
3. Burnish relay contacts and check operation. Clean and tighten all grounding bonds.			X X	X X	X X		X X	X X	X X		X X	X X	X X
4. Clean and repaint armored cables where corroding.			X	X	X		X	X	X		X	X	X
5. Check cable connectors. Check all cables and terminations for tightness, and cables for proper dressing.			X	X	X		X	X	X		X	X	X
6. Check Radar Log of Modifications and Changes.													
7. Personnel checking equipment should initial and date.	Initial												
	Date												

LUBRICATION CHART (SO–1)

Proper maintenance requires periodic lubrication of the various components. This chart is intended to reference the units involved, time serviced, and to give the Navy type number if available. Reference must also be made to the instruction book for location of lubrication points and the quantity of lubricant required.

Equipment			Service					Lubrication data						
Unit involved	Name of component	Circuit symbol	Hours	Daily	Weekly	Monthly	Annual	Oil	Grease	Instruction book type	Commercial type	Navy type	Nearest Navy equivalent	Comments
Motor alternator assembly.	Bearings (grease cups)	G–101A					Q		X	Andok—Grade C			14L3—Grade 3	
Spark gap assembly	Rotating electrode assembly						Q		X	Colonial Beacon Andok C			14L3—Grade 3	
PPI assembly	{Deflection coil / Pinion gear} Bearings						Q	X		Univis P–48			{N. S. 9110, N. S. 2110, O. S. 1362.	
Antenna assembly	Motor grease cups						Q		X	Colonial Beacon Andok C			14L3—Grade 3	
	Shaft bearings of differential						Q	X		Univis P–48			O. S. 1362, N. S. 9110	
	Gear reduction box						X		X	M–285			O. S. 1350	
	Antenna spindle ball bearings						X		X	Colonial Beacon Andok C			14L3—Grade 3	
	Drive spur gears						X		X	Colonial Beacon M–285			O. S. 1350	

LUBRICATION CHART (SO–a, SO–13)

Motor alternator and spark gap.	Bearings—rotating electrode assembly bearing.	B–101					Q		X	Colonial Beacon Andok C			14L3—Grade 3	
Antenna	Spindle ball bearing	B–502E					X		X	Colonial Beacon Andok C			14L3—Grade 3	
	Slewing motor and reduction box.	B–502A					X		X	Beaconlube M–285			O. S. 1350	
PPI assembly	{Deflection coil / Pinion gear} Bearings						X	X		Univis P–48			{N. S. 2210, N. S. 9110, O. S. 1362.	

LUBRICATION CHART (SO–2, SO–8, SO–9)

Motor alternator assembly.	Bearings Zerk fittings	G–101					Q		X	Colonial Beacon Andok C			14L3—Grade 3	
Spark gap	Rotating electrode assembly						Q		X	Colonial Beacon Andok C			14L3—Grade 3	
Antenna assembly	Antenna spindle ball bearing						X		X	Colonial Beacon Andok C or equivalent.			14L3—Grade 3	
	Drive spur gears						X			Tocar No. 1 or M–285			O. S. 1350	
	Slewing motor	B–502					X		X	M–285			O. S. 1350	
PPI assembly	{Deflection coil / Pinion gear} Bearings						Q		X	Univis P–48			{N. S. 9110, N. S. 2110, O. S. 1362.	

Q=Quarterly.

LUBRICATION CHART (SO–3)

Proper maintenance requires periodic lubrication of the various components. This chart is intended to reference the units involved, time serviced, and to give the Navy type number if available. Reference must also be made to the instruction book for location of lubrication points and the quantity of lubricant required.

Equipment			Service					Lubrication data						
Unit involved	Name of component	Circuit symbol	Hours	Daily	Weekly	Monthly	Annual	Oil	Grease	Instruction book type	Commercial type	Navy type	Nearest Navy equivalent	Comments
Motor alternator and spark gap.	Bearings—rotating electrode assembly bearing.	B–101					Q		X	Colonial Beacon Andok C			14L3—Grade 3	
Antenna	Upper and lower spindle shaft					X			X	Beaconlube M–285 or equivalent			O. S. 1350	
	Rotary waveguide joint					X			X	Beaconlube M–285 or equivalent			O. S. 1350	
	Drive gears					X			X	Beaconlube M–285 or equivalent			O. S. 1350	
	Transfer and mechanical differential gears.					X			X	Beaconlube M–285 or equivalent			O. S. 1350	
	Ball bearing assemblies					X		X		Univis P–48			N. S. 9110, O. S. 1350	
	Gear reduction box					X			X	Beaconlube M–285 or equivalent			O. S. 1350	
PPI assembly	Deflection coil bearings						Q	X		Univis P–48			N. S. 2110, N. S. 9110, O. S. 1362.	
	Pinion gear bearings													

RUSTING OF PROTECTIVE ARMOR ON RADAR EXTERNAL CABLING

The Engineering Test Laboratory investigated the cause of rusting and failure of the protective armor on SO radar external cabling. The findings and corrective suggestions are given below:

The solution of this trouble appears to be largely a question of proper installation and maintenance: The following were noted:

Chafe: Considerable mechanical shafe was noted on the boats of a new squadron just in for commissioning, especially where the cables passed over the edge of the deckhouse and near the tripod feet. A serving with heavy cod line or other suitable hard twine would transfer the chafe from the cable to the readily replaceable twine.

Painting: It was noted that the cables were poorly painted, especially where they run up the tripod. The aluminum paint with which the cables are coated is not considered to be a satisfactory corrosion inhibitor when used without further protection. It is suggested that at the time of installation of the equipment, after running the cable, but before clamping it to the tripod, that it be thoroughly painted all over with two coats of whatever paint is applied as a protective cover to the remainder of the boat.

Rusting of Armor at Terminal Tubes: The greater part of rust found occurred where the armor passed into the stuffing tubes. The armor is made of steel wire, painted with aluminum paint. It was found that the stuffing tubes were made of aluminum and the gland nuts were made of brass, unplated. Furthermore, the "duct seal" was applied in such a manner that a cup was formed allowing the retention of water; both fresh from rain, and salt from spray, etc., around the gland nut and cable, thus promoting electrolytic action. Under these conditions, the steel in the armor will be first to corrode.

The following remedies will greatly extend the life of the armor:

a. Substitution of aluminum gland nuts for the brass now used.

b. Thorough painting of the armor well down into the gland nut prior to the application of "duct seal."

c. Proper finishing off of the "duct seal." Frequent inspection to prevent formation of the water cup as a result of cable movement is desirable. Figure 1 shows what was found together with a suggested finishing method.

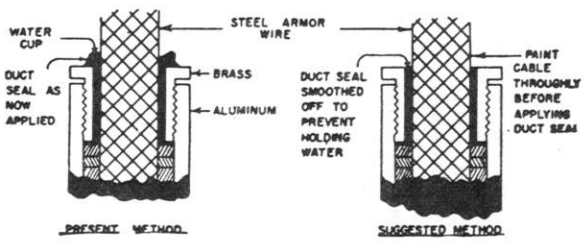


FIGURE 1.—Left, present method; right, suggested method.

PROTECTIVE PAINTING OF EXPOSED MECHANICAL COMPONENTS

It is desired to eliminate corrosion and increase the protective coating of the metal surfaces of the exposed mechanical components. These may be the mountings, unit housings, antenna base and/or waveguide.

Wherever corrosion is visible, the area about this broken painted surface is to be scraped clean of all the old paint, then sanded thoroughly, exposing the bare metal surface. With the metal surface clean and dry, apply a coat of zinc chromate metal primer and allow to dry thoroughly. The next step is to apply a coat of "Raytheon Grey" or Navy approved exterior paint. Two coats are recommended allowing sufficient time for the first coat to dry.

NOTE: Do not sandpaper gold plated surfaces. When possible, lightly rub plated surfaces with crocus cloth and paint.

It is recommended that the antenna drive motor shaft projection be painted or grease coated as reports have been received that, though the shaft is of stainless steel, corrosion has occurred. In this case sandpaper the entire surface, clean with rag and gasoline and apply one coat evenly of "Raytheon Grey" paint, allow to dry and apply second coat.

Since there has been evidence of corrosion and possibility of leakage of salt spray inside the antenna housing itself, it is recommended that the internal metal areas that cannot be painted be covered with grease or vaseline after first cleaning the surface of any oxidation or corrosion found there.

The waveguide should be painted after installation, using a metal primer and a Navy approved exterior paint. Care should be exercised to prevent paint from running into the upper waveguide flange. The rubber boot, at the base of the waveguide, should never be painted. All metal hardware on the tripod should be painted after installation, to prevent corrosion.

Adjusting screws such as the leveling screws on the transmitter-receiver package should not be painted; however, they should be covered with a generous coat of grease. This also applies to the captive screws securing the various unit covers.

Instructions have already been distributed for the repair and maintenance of antenna tripods. Kits supplied to squadron bases contain all necessary tools, paints and accessories required for antenna tripod repair.

The instructions are as follows: Whenever braces or legs show signs of cracking, open crack with wedge and fill with Weld-wood glue. The section is then to be clamped with "C" clamp and allowed to dry. When area is thoroughly dry, scrape and sand down excess glue remaining on surface. Apply thin coat of Weld-wood glue to this surface already sanded. When dry, sand lightly and apply a second coat of Weld-wood glue. To this area apply one coat of aluminum paint over the Weld-wood glue. Allow to dry and apply two coats of camouflage enamel over aluminum paint, sanding when dry between the two coats.

Regular use of the antenna and tripod tarpaulin during extended periods of idleness will materially reduce the chances of delamination of the tripod and corrosion of the antenna.

PAINTING ANTENNA ASSEMBLY TRIPOD:

Reports have been received from SO equipped ships stating the antenna tripod assembly is splitting and cracking in spots.

In order to reduce failures of existing tripods it is recommended that they be given a protective coat of paint. Use a dull finish lead-based oil paint and paint the complete tripod assembly including cross arms, all joints, shelf, cable clamps, bolts, etc.

NOTE: If the tripod has been painted for camouflage match the present color scheme carefully. Badly cracked or splitting tripods that paint will not correct, should be called to the Radio Material Officer's attention at the next base or navy yard availability.

If extra care is taken to keep a good coat of lead based oil paint applied to the tripod, it will be able to withstand the weather effects better and keep this trouble down to a minimum.

REPAIRS ON SO SERIES TRANSMITTER-RECEIVER WAVEGUIDE SHUTTER

In cases where the solenoid shutter fails to operate, make the following checks:

Operate shutter by hand to see whether or not it is working freely. If it is operating without friction or binding, check for open circuit in the solenoid coil after removing one lead. If coil is open, replace assembly from spares. If not, check F-204 and wiring.

If there is binding present:

a. See that there is sufficient space between wage guide and plexiglass for free movement when the cover is in place. See that the thicker case gasket and phenolite spacer referred to in SO Bulletin No. 8, are installed. Install spacer if missing.

b. Inspect the rubber skin on shutter to see that it is not peeling and causing binding between shutter and waveguide flange.

c. Frequent cases have occurred where varnish has melted inside the solenoid coil due to continuous operation. This condition results in erratic movement of the plunger. It will then be necessary to remove the plunger and ream out the cylinder.

(1) Remove four screws from U-shaped bracket stop.

(2) Remove the bolt connecting the plunger link to the shutter crank and lift out the plunger.

(3) Clean cylinder by reaming with a long dull knife blade. It may be necessary to swing the plunger stop on the rear of solenoid by loosening the screw beneath the cable clamp and removing the other screw. If the cylinder is sticky, dust with talcum. If cylinder wall is deformed due to warpage, replace the assembly.

(4) Assemble solenoid by reversing procedure outlined above. The U-shaped bracket stop should be adjusted so that shutter covers opening in waveguide squarely, and the rear stop adjusted so the guide is fully open during operation.

d. Check the spring tension. If insufficient, shift the spring end into next slot. If binding is due to frozen bearings, they may be dismantled and cleaned with fine sandpaper. When reassembling, a very light coat of petroleum jelly may be used for lubrication.

SO-3 I-F and AFC Tube Voltages

The following is a table of SO-3 i-f and AFC tube voltages which does not appear in the instruction book.

Radiation off, receiver gain control fully CW, AFC on.

	GRID	SCREEN	PLATE	PLATE	CATHODE	CATHODE
V-3112	0	112	112		1.2	
V-3113			−0.28	−0.28	0	0
V-3114	0	46	170		1.5	
V-3115	−225		[1] 0 to 40		[1] −226	
V-3116	−250		[1] −20 to −195			

Radiation off, receiver gain control fully CW, manual

	TUNING GRID	PLATE	CATHODE
V-3115	−225	−200	−225
V-3116	−249	−170	

Radiation on, receiver gain control fully CW, AFC on, signals received

	GRID	PLATE	CATHODE
V-3115	−230	[2] −105	−230
V-3116	−248	−112	

Normal operation, gain control fully CW

	GRID	SCREEN	PLATE	CATHODE
V-3104, V-3109	0	112	105	1.5
V-3101			−525 to −725	

[1] Voltages vary as search tube searches.

[2] Voltage varies slightly due to control tube action.

All voltages are to ground as measured with n 20,000 ohm per volt meter.

NOTE: Do not grease or lubricate the plunger.

e. In very early types, the plunger had a pin near the front end that worked into a slotted arm operating the shutter. If binding is due to a bent pin in this type, replace the entire assembly with the latter type.

ELECTRICAL BREAKDOWNS ON PANELS P-307J AND J-307J

Occasional electrical breakdowns have occurred between terminals 30 and 33 on panels P-3076J and J-307J under field operation (SO-1, SO-8 transmitter-receiver).

To eliminate this trouble a slot 1/4 x 1 inch may be cut between terminals 30 and 33.

SPOKING EFFECT (SO-8 PPI)

Spoking effect on the indicator PPI tube at times is caused by inductive pickup in the Navy cable between the rectifier power unit and the transmitter receiver. This condition has been reported in a number of installations where the length of the cable was greater than usual.

An effective cure for this particular problem can be made by changing the filter capacitor C-348 from 0.001 μfd 500v ±10% stores No. 35-5036 to 0.01 μfd 500v ±10%, stores No. 35-5427.

INCREASING INTENSITY OF 5FP7, PPI TUBE

The 5FP7 type PPI tubes that have recently been used in SO equipment vary in intensity when inserted in the same equipment. These tubes with low intensity cannot be compensated for when the brilliancy is increased by adjusting R-459. In cases where this trouble is encountered, remove R-469; thereby increasing the voltage across the brilliance control R-459.

SO-2 VOLTAGE REGULATOR FAILURES

Cases of higher alternator output and failure of the voltage regulator to regulate on SO-2 equipments, have been reported by several bases. In every case all components and wiring checked perfectly. The basic trouble seems to be due to a peculiar characteristic of the smoothing choke L-102, whereby the inductance rises to an abnormal value with a particular value of current. When the normal operating current is within the critical region, the regulator refuses to work, the regulator adjustments have little or no effect, and the output voltage is high (about 150v.).

Replacing the choke usually restores regulation; however, if the first replacement does not remedy the trouble, 1 or 2 more chokes should be tried. In an attempt to restore regulation, some equipments have had unauthorized changes made on them such as addition of a larger C-105, and the grounding of one side of the 400-cycle circuit. These equipments should be repaired and restored to their original circuit.

REACTIVATING PROTEK PLUGS

Reports from forces afloat indicate that moisture is getting into the equipment, causing operational difficulties. Too much stress cannot be placed upon the necessity for checking all indicators and transmitter-receiver units for air leaks. The radar transmitter-receiver units for air leaks. The radar transmitter-receiver and PPI of SO Series equipments are mounted within watertight cases and silica-gel dehydrators (Protek plugs) are provided to keep the units dry inside. A few reports have stated that condensation appears on the scope after the equipment has operated for a few hours and disappears after the unit is shut down and allowed to cool. This is an indication that the heat in the equipment has driven the moisture out of the dehydrator plugs.

The instruction books request that the dehydrator plugs be changed when they have turned from deep blue when dry, to a light pink after they absorb moisture and are near saturation.

All cable terminating tubes should be repacked if there are signs of moisture leakage. The plugs sealing up the unused entrance holes in the rear of the indicator should be removed and sealed as they are screwed back in place. Tighten all captive screws around panels. After replacing a dehydrator, check the equipment over a period of at least 12 hours in order to prevent a recurrence of trouble due to moisture.

If replacement Protek plugs are not available, they can be reactivated. This type plug was designed to be discarded when they become saturated with moisture; however, if replacements are not on hand, they should be reactivated and used again.

A simple device for drying the plugs is shown in figure 1 and consists of a wooden box (dimensions given are approximate) with hinged cover. The front panel has two holes drilled out for air vents. Two shelves are mounted in the box as shown in drawings. The holes for holding the Protek plugs are 1-3/16 inches or just large enough for the insertion and removal of the plugs with ease. Two ordinary 100 watt light lamps are used to generate the heat.

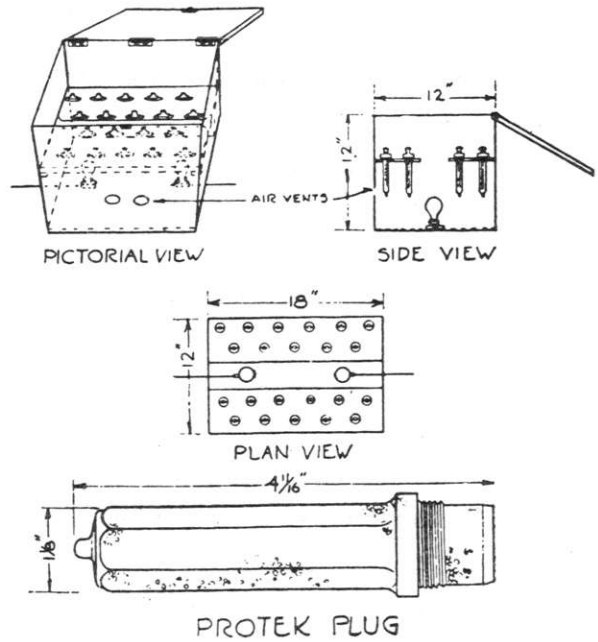


FIGURE 1.—Device for drying Protek plug.

a. Place the pink plugs in vertical position on shelves.

b. Light the lamps and close the cover.

c. When the Protek plugs turn blue the reactivating process is completed.

d. Seal the open end of the Protek plugs with scotch tape or similar material to keep the ends sealed until they are inserted in the equipment.

In order to prevent the Protek plugs from becoming saturated while servicing the equipment, it is suggested that the ends be sealed; however, before placing the equipment in operation again make certain the seal has been removed.

WARNING. Protek plugs are made from a transparent, moisture impervious plastic capable of withstanding temperatures up to 150° F. Never allow temperature to rise above 150° F.

DEHYDRATOR SERVICE NOTE

Radar personnel are cautioned to remove the sealing caps from the dehydrator plugs when making replacements. This particularly applies to the transmitter-receiver units having access doors.

ACCESSORY CONTROL UNIT SERVICE NOTE (SO–3, SO–4)

The coupling condenser C-717 in X-band ACU's has been increased from 0.01 to 0.1 μf. This change was made to eliminate fluctuations in the tuning meter reading while tuning the remote resonance chamber. If trouble from this cause is experienced in the field, changing C-717 may eliminate the trouble. The following equipments employ 0.01 μf. coupling condensers:

SO-3	All
SO-4	1-90

INDICATOR TEST CABLE IN SP–4 MAINTENANCE PARTS

Some confusion has arisen in the field regarding the indicator test cable included in SO-4 spaces. It will be noted in the maintenance parts table that three cables are listed; two indicator test cables, and one auxiliary test cable. One of the indicator test cables is the short PPI subassembly test cable, and the other is the long five-row test cable that is a part of field engineer's tools. Since the ACU has 5 rows of jacks, and the 60-cycle indicator has 6, a single cable cannot be used, therefore, it is necessary to use the so-called auxiliary test cable in conjunction with the standard 5-row cable when testing the indicator. When connecting the cables, make certain they are polarized properly.

CARE OF LOCAL–OSCILLATOR TUBE AND CAVITY

Purpose: To provide approved maintenance procedures.
Equipments Affected: All SO S-Band equipments.
General: The relatively large number of S-band local-oscillator cavity failures reported during the past year points to the need for more detailed maintenance instructions, since it is felt that most of these failures result from improper assembly. It is the purpose of this bulletin to provide such additional instructions.

At present there are three major types of S-band local-oscillator cavities in the field. (See figs. 1 and 3.)

The cavity shown in figure 1A appears in the greatest quantity in the field and is giving the most trouble. As can be seem in the illustration, there is an undercut on the outside of the cavity lips, at the base of the threaded portion. This undercut so weakens the cavity mechanically that if the knurled rings are over-tightened, the split washers bend the cavity lips inward. This bending changes the volume and natural frequency of the cavity, and if the bending is severe, the cavity lips will actually short-circuit against the vanes or tuning plug. Other bad effects from over-tightening of the knurled rings are intermittent operation of the system due to intermittent short circuiting of the vanes, failure of the local-oscillator tube due to fin-seal strains and leaks set up by deformation of the fins, and instability of the local oscillator due to temperature and volume changes.

In an effort to improve the cavity mechanically and to reduce the number of failures, the undercut was omitted on the improved-type cavity (see fig. 1B). This greatly reduced the tendency toward bending, but bending will still occur if the knurled rings are over-tightened.

The third type of cavity, shown in figure 3, is of a completely new design in which the tendency toward bending of the lips is virtually eliminated. It is likely, however, that the new cavity, with a suitable adapter (see fig. 3), will be used as a field replacement for the early types. Although the lips in the new cavity are not likely to bend, it is possible to strip the threads of the tuning plugs if the plug locknuts are over-tightened.

Salvaging Best Cavities: Most of the early cavities may be reclaimed by carefully straightening the lips. This is best done by means of a cavity expander, which is, or shortly will be, available at all SO bases. The expander should be used only as follows (see fig. 2):

a. Remove the tube from the cavity and separate the cavity into its two halves. Remove the output fitting and the tuning plug.

b. Adjust the vanes so that they are all paralled with the lips, and so that the vane shanks are flush with the inside wall of the cavity.

c. Remove the expander setscrew and insert the 2 expander disks in 1 cavity half, 1 on each side of the vanes and each lip. The flat sides of the disks should face each other. Assemble the second cavity half and replace the 6-32 securing screws.

d. Insert the expander setscrew and run it in until the disks are pressed outward against the lips. Carefully tighten the setscrew until the lips are restored to their original position.

e. Loosen the setscrew and disassemble the cavity. Clean the lips with carbon tetrachloride (or as below), then wipe them with a clean dry cloth. Reassemble the cavity and tube.

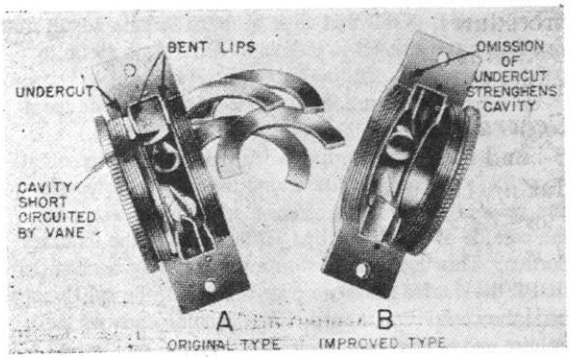


FIGURE 1.

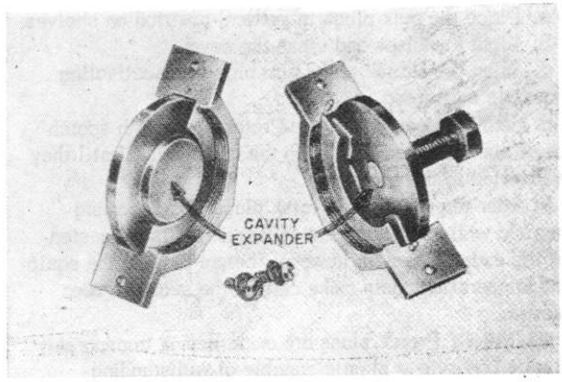


FIGURE 2.

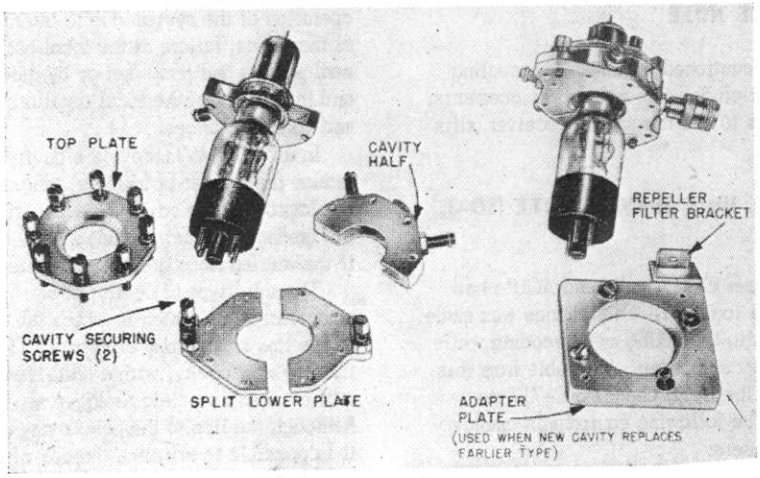


FIGURE 3.

Cleaning Before Assembly: In the past, local-oscillator tube fins have been either silver plated or gold plated; at present all production tube fins are gold plated. Silver-plated fins are subject to tarnish and frequently require cleaning before installation. Gold plating, while a poorer conductor, does not corrode, except when acted upon by powerful reagents; and elaborate cleaning procedures are therefore unnecessary.

Various methods are used in cleaning fins. The method most frequently used seems to be rubbing the fins with a rubber eraser, then rinsing with a solvent. This method should be discontinued as it has the following disadvantages: First, excessive rubbing with an eraser removes the thin plating, exposing the more corrodible copper base. Secondly, some erasers contain free sulfur or sulfide which actually causes the fins to become more tarnished than before.

The following cleaning methods are approved for the fins and lips of all local-oscillator and TR tubes:

According to reports from the tube division, mild soap and fresh water are the best cleansers, except where corrosion is present.

Since gold does not tarnish readily, cleaning with dry cleaning solvent should be sufficient for gold-plated parts. On silver-plated fins where corrosion is present, the fins should be cleaned with a mild, neutral liquid silver polish. Avoid too much rubbing and too much pressure, or the plating is liable to be removed. Use a small brush similar to a toothbrush. After cleaning with polish, clean with a mild soap and rinse well in fresh water. After the fins are dry, wipe with a clean dry cloth.

In order to keep the tube fins clean, all maintenance repair fin-type tubes are now being shipped sealed in air-tight plastic bags filled with dry nitrogen. With such tubes, thorough cleaning with dry cleaning solvent followed by wiping with a clean dry cloth will be the only cleaning ever required. Unless the tube fins show signs of grease or have been handled, no cleaning is necessary.

It is equally essential to keep the cavity clean and free from grease and tarnish. If the cavity shows little or no tarnish, it should be sufficient to clean the cavity lips and other electrical contact surfaces with carbon tetrachloride, finally wiping with a clean dry cloth. If tarnish is observed, polish with a mild neutral silver polish, as recommended for the fins. The plugs, output fitting, and vanes should be removed before the cavity is rinsed in fresh water. Too frequent cleaning will destroy the thin plating and should be avoided. Do not touch cleaned parts with the fingers—use tweezers if available.

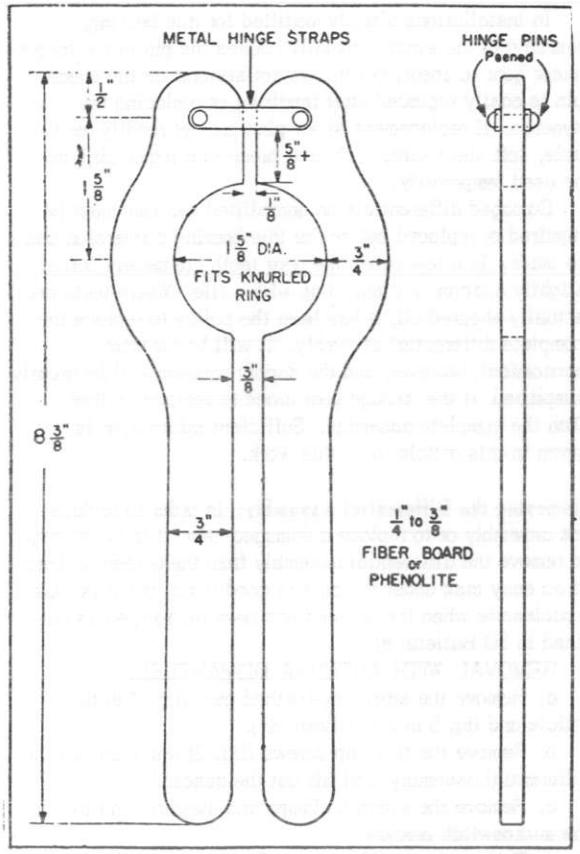


FIGURE 4

Assembling Early-Type Tubes and Cavities: The procedure for assembling tubes and cavities is well known since it is covered in all instruction books; however, it is felt a few words of caution should be added. Above all, remember that the cavity is delicate and should be handled and treated accordingly. Likewise, for reliable and trouble-free operation, it must be kept clean. Adjustment procedures should be followed to the letter to insure optimum performance.

A great many cavity failures could be avoided if the knurled rings were properly tightened. If the cavity parts and tube fins are clean, only enough pressure is required on the fins to keep the tube from shifting. When reassembling, first tighten the rings with the fingers, then tighten a fraction of a turn more with water-pump pliers or cavity pliers (see fig.4). Tighten only enough to keep the rings from loosening from vibration. Cavity pliers are recommended for this purpose since they do not damage the plating and there is less risk of breaking the tube.

CAUTION: Do not substitute excessive tightening for proper cleaning.

Assembly Procedure for New-Type Cavities: The new-style cavity (fig. 3) differs mechanically from the early types and therefore requires a different assembly procedure. To replace a defective local-oscillator tube, proceed as follows:

a. With the transmitter-receiver cover removed, remove repeller plate lead and drop the local-oscillator socket shield. Disconnect the output fitting and pull the socket off the local-oscillator tube.

b. Loosen the two cavity securing screws and lift out the tube and cavity. (These screws are located on opposite sides of the cavity—one near the repeller filter assembly and the other near the output fitting.)

c. Loosen the eight securing screws on the top of the cavity and lift off the top plate. Carefully remove the split lower plate, and pull the cavity halves apart.

d. Secure a new tube and clean both the tube and cavity as outlined under "Cleaning Before Assembly."

e. Carefully assemble the cavity half containing the output fitting to the tube, making sure that the fins are on the outside of the cavity lips and the output fitting is opposite the base locating pin. The dowel pin on the cavity must be on the bottom.

f. Install the second cavity half on the tube with the dowel pin down.

NOTE: The assembling of the cavity halves on the tube must be done carefully to prevent damage to the thin fins.

g. Place the top plate on the cavity halves with the eight screws through the halves.

h. Install one of the split lower plates on the bottom of the cavity so that one of the dowel pins in the cavity fits into the dowel-pin hole in the plate. Start several of the eight securing screws in the lower plate. Install the second split plate, matching the dowel pin and hole. Start the remaining securing screws.

i. Press together the two halves of the cavity so that the gap between the two halves is fully closed. Tighten the eight securing screws evenly.

j. Reinstall the tube and cavity into the equipment by reversing steps a and b.

k. Tune the cavity to the proper frequency by adjusting any or all of the tuning plugs. The tuning plug opposite the output fitting should be about halfway in at the correct frequency so that future minor cavity adjustments may be easily made. The other plugs should be adjusted to about the same depth. The locknuts on the plugs should not be tightened more than is necessary to prevent their working loose under vibration, since excessive tightening will strip the threads in the cavity lips or plugs.

l. If the position of the pickup loop in the output fitting has been disturbed, remove the fitting and replace, threading in five turns. Lock with the output fitting slot up. If this does not provide the proper coupling, readjust until it is possible to obtain a crystal current of 1 ma. at J-302 when the local oscillator coupling at the mixer is maximum. When proper coupling has been established, loosen the coupling at the mixer until 0.4 to 0.6 ma. is obtained at J-302.

Tuning Early-Type Local-Oscillator Assemblies: Practically all tuning procedures recommend that the vanes be kept in the same plane, but unfortunately this is not always done. It is admitted that it is much easier and more convenient to tune only one vane in the cavity, but this practice may lead to other troubles. PPI spokes, local oscillator instability, critical tuning, and drifting are often caused by improper tuning of the vanes. For optimum results, adjust the cavity so that all vanes are in the same plane (as indicated by the screwdriver slots in the adjustment) and the tuning plug is about halfway in when the local oscillator is on the proper frequency.

Another cause of unsatisfactory local-oscillator operation is improper coupling out of the cavity. This coupling

is effected by a small loop and is adjusted by threading the loop into the cavity. Overcoupling will result in erratic operation; undercoupling will result in low crystal current and less than optimum conversion at the receiver mixer.

In general there are two types of output fittings on cavities in the field, differing only in the size of their coupling loops. With the larger loop, optimum coupling is obtained when the fitting is screwed about two turns into the cavity; with the smaller loop, 3 to 4 turns are necessary. In either case, the slot milled into the output fitting must be in the plane of the tube axis in order to orient the loop properly.

If there is doubt as to which type of loop is in use, screw the loop into the cavity a complete turn at a time, until it is possible to obtain a maximum of 1 ma. crystal current (at J-302) when the coupling is maximum at the mixer. (See instruction book for adjusting local-oscillator coupling at mixer.) When the proper coupling is found, lock the cavity output fitting with the slot up (in the same plane as the tube axis) and readjust the crystal current at the mixer for 0.4 to 0.6 ma.

Outline of Local-Oscillator Care: Before assembly, make sure that all parts are clean and free from grease. If soap and water are used, rinse well in fresh water and polish with a clean dry cloth when the parts are dry.

Use a mild neutral silver polish (preferably liquid) on corroded parts. To prevent damage to the plating, avoid excessive rubbing and too frequeny application. Make sure that all traces of the polish are removed before assembly.

Examine early-type cavities for deformed cavity lips. Re-form with a cavity expander.

On early types, avoid excessive tightening of the knurled rings. Use cavity pliers where possible. Do not substitute excessive tightening for proper cleaning.

When tuning early-type cavities, keep all vanes in the same plane. Adjustments should be made so that the main plug is about halfway in when tuned to the proper frequency. At the completion of the tuning procedure, lock all tuning adjustments.

REPAIR OF SO–1 TRUE BEARING DIFFERENTIAL

Purpose: To provide overhauling procedure and part numbers.

Equipments Affected: All SO-1 equipments having CRP-55AGE/"AHS antennas.

Action Required: Removing and dismantling the differential assembly, and replacing defective parts.

Time Required: Determined by extent of work.

General: Many of the Bendix 5SF synchros used in Equipments Affected have been failing because of defective bearings (see SO Bulletin 112-Navy Field Change 96). Bearing failure usually causes the synchro to lock, which results in the breaking of the weekest mechanical link between the antenna and the synchro. In antennas not yet modified for true bearing (CRP-66AGE), the weakest link seems to be the gear that is locked by the small clip (see item 10 in fig. 1; and fig. 3). When the synchro jams on these antennas, the clip strips the teeth off the gear.

In installations already modified for true bearing, jamming of the synchro usually causes the pin in the torque-motor gear to shear, but this is not serious as the shear-pin is easily replaced after repairing or replacing the synchro. If replacement shear-pins are not readily available, soft steel wire, such as a piece of a paper clip, may be used temporarily.

Damaged differentials on unmodified systems must be repaired or replaced before the true-bearing conversion can be made. In a few cases the gear teeth are merely burred slightly and can be cleaned up with a file. Where teeth are actually sheared off, it has been the policy to replace the complete differential assembly. It will be far more economical, however, and the supply problem will be greatly simplified, if the damage gear alone is replaced rather than the complete assembly. Sufficient information is given in this article to do this work.

Removing the Differential Assembly: In order to replace the assembly or to replace a damaged gear, it is necessary to remove the differential assembly from the antenna. This is no easy task under the best of conditions, but it is less troublesome when the antenna has been dismantled as outlined in SO Bulletin 81.

REMOVAL WITH ANTENNA DISMANTLED:

a. Remove the large fine-toothed gear (fig. 2 in this article and fig. 5 in SO Bulletin 81).

b. Remove the four cap screws (fig. 2) which secure the differential assembly, and lift out the assembly.

c. Remove the synchro clamps and synchro, and loosen the microswitch bracket.

d. Take the assembly to a workbench for overhauling.

REMOVAL WITH ANTENNA NOT DISMANTLED:

a. With the equipment secured and the main line switch off, remove the "Switch Access" and "Synchro" cover plates from the antenna.

b. Working through the switch access, remove the cotter pin and nut (fig. 2) from the large fine-toothed gear which is located behind the flasher microswitches. Raise the gear to free it from its shaft. Be careful not to lose the woodruff key.

c. Working through the synchro access, remove the torque unit (if installed) and disconnect its cable at the Amphenol connector.

d. Remove the cleats holding the synchro in place and carefully remove the synchro, letting it hang out of the door on its leads. Loosen the two microswitch bracket screws, and work the switch and bracket out of the differential.

e. Remove the four cap screws (fig. 2) which secure the differential assembly, and let the assembly drop down until the upper shaft clears the casting, then twist the assembly slightly and withdraw it through the door.

NOTE: Three of these caps screws may be seen through the door (two located behind the terminal strip and the third located to the left of the synchro) and can be removed without too much difficulty; but the fourth one (located center rear) cannot be seem and must be found by feeling with the hand.

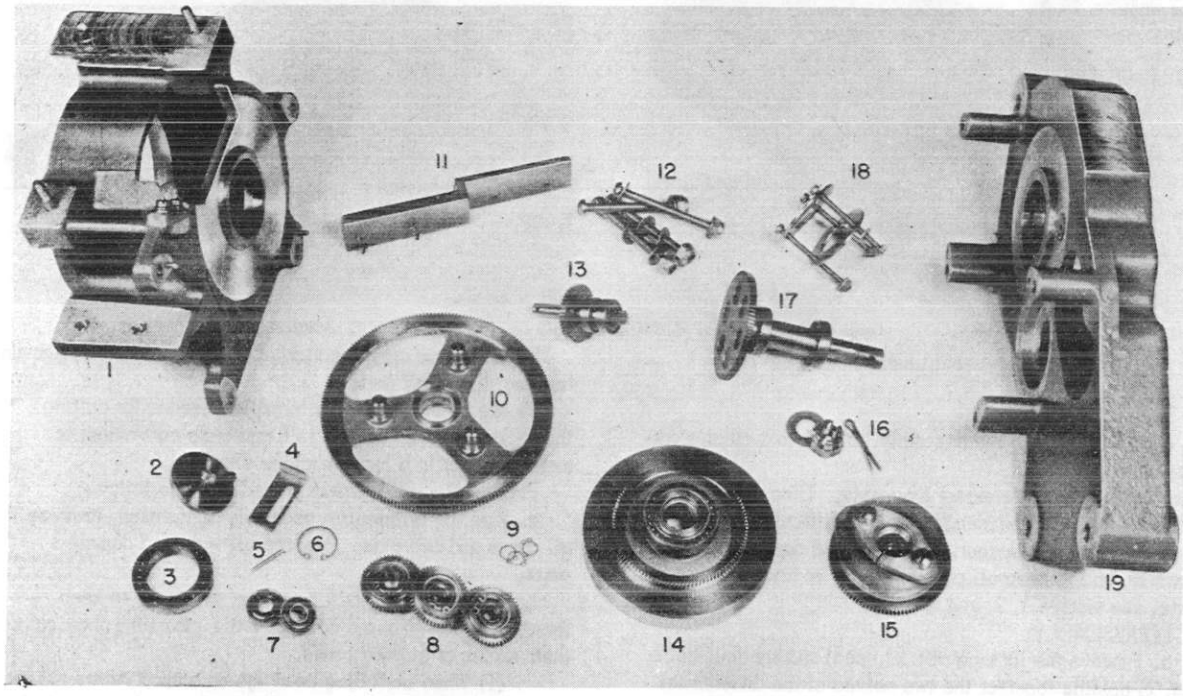


FIGURE 1.—Nomenclature of parts.

ITEM NO.	QUANTITY	PART	PART NO.
1	1	Lower half differential housing	14A7-X346G1
	2	Locking clip screws	6-32×¼ Fil. SS
	3	Torque unit screws	10-24×7/16 Fil. SS
	3	Lockwashers	#10
	1	Coupling (for synchro)	14A7-L189
	1	Spacer (for synchro)	14A7-L278
	4	Synchro clips	14A7-L240
	4	Screws	8-32×7/16 Fil. SS
	4	Lockwashers	#8
	1	Torque unit gear	14A7-U82
2	1	Coupling half	14A7-L226
	1	Drive pin	14A7-L227
3	1	Locked gear large bearing	NH-B-540
4	1	Gear locking clip	14A7-L125
5	1	Coupling dowel pin	6/10×½ LG
6	1	Tru-arc retaining ring	#62 type A
7	2	Pinion shaft bearings	NH #XA-134
8	3	Planetary gears	14A7-V80
	3	Planetary gear bearings	NH #XA-134
	3	Tru-arc retaining rings	#62 type A
9	3	Tru-arc retaining rings	#62 type A
10	1	Locked (driver) gear	14A7-V79
	3	Gear studs	14A7-L118
11	1	Microswitch bracket	14A7-U347
	2	Captive screws	8-32×7/16 Fil. SS
12	4	Differential housing securing bolts, flat washers	10-24×2 RH SS
	8	Flat washers	#10
	4	Elastic stopnuts	10-24
13	1	Pinion gear and shaft	14A7-U228
	2	Pinion shaft bearings	NH #XA-134
	1	Tru-arc retaining ring	#62 type A

ITEM NO.	QUANTITY	PART	PART NO.
	1	Sun gear	14A7-U85
	1	Spacer	14A7-L93
	1	Woodruff key	#201
	1	Spacer	14A7-L328
	1	Tru-arc retaining ring	#25 type B
14	1	Spider gear	14A7-W81
	1	Spider gear large bearing	NH #B-540
15	1	Cam gear	14A7-U76
	2	Cam gear bearings	NH #4666
	1	Spacer	14A7-L96
	1	Cam	14A7-U348
	1	Cam lock	14A7-L359
	2	Lockwashers	#10
	2	Cam locking screws	#10-32×7/16 Fil. SS
	1	Snap ring	14A7-L271
16	1	Castellated nut	5/8-24 SS
	1	Washer	13/32×13/16×1/16 SS
	1	Cotter pin	3/32×5/8
17	1	Idler gear and shaft	14A9-U88
	2	Bearings	NH #S-3-R-PP
	1	Spacer	14A9-L162
18	2	Retaining rings	14A9-L161
	3	Screws	6-32×¾ Fil. SS
	3	Nuts	6-32 SS
	3	Lockwashers	#6
19	1	Upper half differential housing	14A7-X346G2
	1	Stud (cam gear)	14A7-L281
	2	Nuts	#10-32 SS
	1	Retainer	14A7-L95
	1	Gear (large fine-toothed)	14A9-V160
	1	Woodruff key	#304

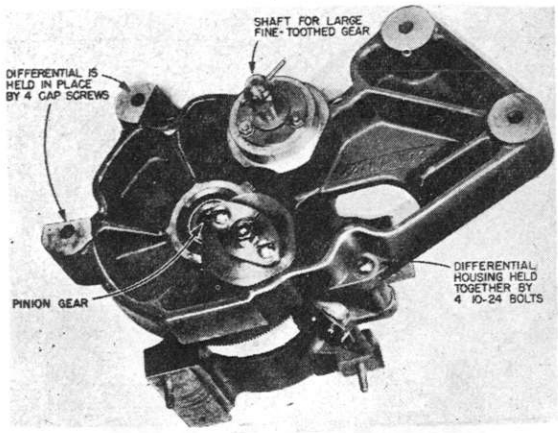


FIGURE 2.

f. After removing the assembly, take it to a clean workbench for repairs.

Overhauling the Differential Assembly. Disassembly, replacing parts, and reassembly are not difficult if care is taken to locate all washers, spacers, and dowel pins properly, and to keep all parts clean. For nomenclature of parts, see figures 1, 2, and 3.

DISASSEMBLY:

a. Remove the locking clip (if used) and the four bolts (fig. 2) holding together the two halves of the differential casting. Carefully separate these two halves by prying evenly on opposite sides.

b. Remove the gear assembly from whichever half of the housing it remains in. (A light tapping with a screwdriver handle will help loosen the bearing race from the bearing bore.)

c. Holding the gear assembly by the spider gear (gear having both inside and outside teeth), lightly tap the end of the shaft opposite the synchro coupling with a screwdriver handle until the spider gear comes free.

d. Remove the spring tru-arc bearing retainers on the inner race of the three planetary gears, and lift off these gears. (If necessary, pry cautiously with a pair of screwdrivers on opposite sides of the gears.)

e. Drive the dowel pin out of the synchro coupling and lift off the synchro coupling half. Pull the shaft out of the locked gear. Remove the large ball bearings by prying evenly on opposite sides.

f. Remove the large tru-arc retainer in the center of the locked gear, and drive out the two ball bearings by lightly tapping the outer races from the retainer side.

g. If it is desired to remove the idler gear shaft and gearings in the upper half of the housing, remove the three long 6-32 bolts and pull out the shaft from the bottom. The bearings and spacers will usually come out with the shaft.

h. If it is desired to remove the cam gear, remove the two nuts on the gear shaft and lift off the gear.

REPLACING PARTS: Figure 1 illustrates and names most of the differential parts, indicating the Raytheon part numbers and the quantities required. Replacement parts should be ordered by parts numbers only.

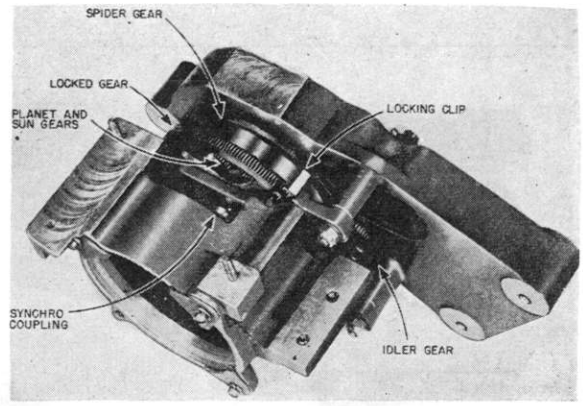


FIGURE 3.

Figure 4 is a cross section of the gear assembly, showing the position of all parts.

Figure 5 gives all the information needed for cutting the locked gear, in case it is found more convenient to make the gear in a local machine shop.

Briefly, the replacement procedure is as follows:

a. With the differential assembly dismantled, examine all gears and bearings. Replace all worn and damaged parts.

b. When replacing ball bearings, take care to keep them clean and to avoid damage while installing them on their shafts or in their bores.

(1) When installing bearings on a shaft, drive them on by using a piece of tubing slightly larger than the shaft so that the pressure is against the inner race.

(2) When driving bearings into a bore, use a tube slightly smaller than the bore so that the pressure is against the outer race.

c. While reassembling unsealed bearings, lubricate them with Navy type OS-814E (Univis P-48) oil.

REASSEMBLY:

a. Replace the cam gear, making sure that the flat washer is on top and that the gear is secured with the two nuts (see fig. 2).

b. Replace and secure the idler gear and shaft as follows:

(1) Place one retaining ring next to the gear, then a bearing, then the spacer, and then the other bearing.

(2) Insert the shaft from the inside of the housing half, and place the second retainer on the outside of the housing.

(3) Insert the screws through the holes in the gear and secure the lockwashers and nuts.

c. On the locked gear install the large ball bearing. Install the three planetary gears and secure with the tru-arc retainers. Reinstall the large tru-arc retainer and install the two ball bearings in the locked gear from the planetary gear side. Reinstall the synchro coupling half and drive in the dowel pin.

d. Place the spider gear on the shaft and tap this gear until the spider and planetary gears are fully engaged.

e. Place the end of the shaft having the synchro coupling in the lower half of the housing, and work the gear assembly from side to side until the bearing is seated. Lay

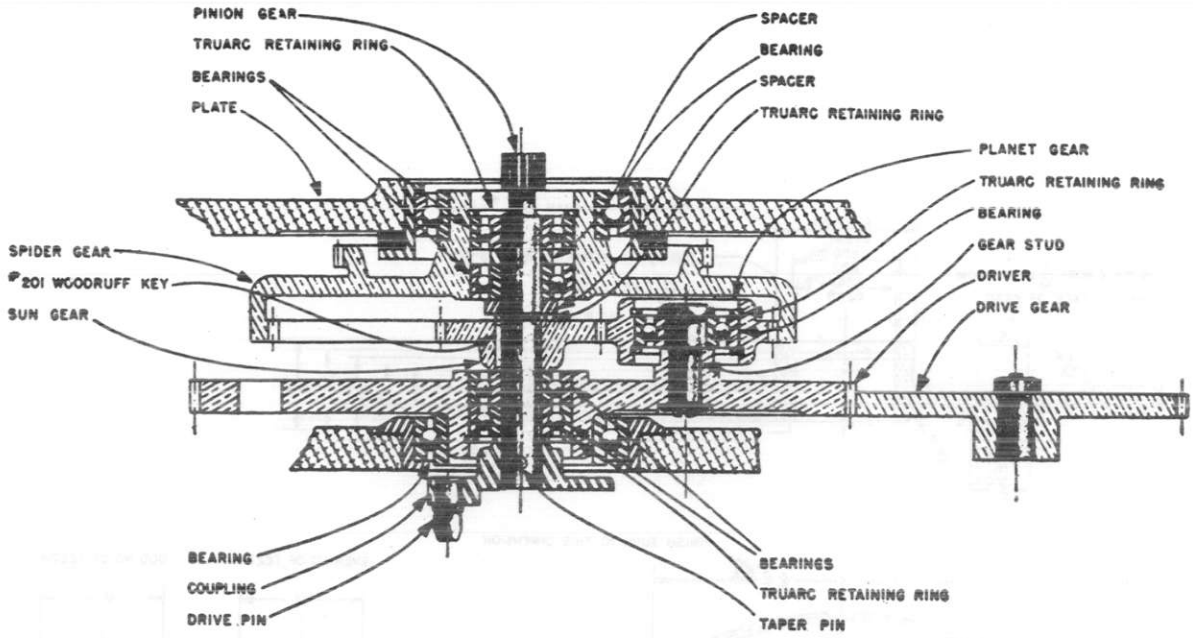


FIGURE 4.—Section of differential gears.

the top half of the housing in place and align the dowel pins in the housings. Lightly tap around the upper housing, while turning the gears, until the housing is seated. Install the long bolts clamping the housing halves together and pull up tight. While tightening, rotate the gear assembly to make sure that nothing is binding.

REINSTALLATION.

a. Reinstall the differential assembly in the antenna by reversing the procedure given under "Removal," making sure of the following points:

(1) When reinstalling the large fine-toothed gear, see that the Woodruff key is in place and that the nut is pulled up tight. (If the nut is not tight, the idler gear will drop down and drag on the spider gear.)

(2) When replacing the synchro, see that the coupling is properly meshed.

(3) When replacing the microswitch bracket, take care to position the bracket correctly to insure proper microswitch action. To do this, temporarily reinstall the microswitch and turn the locked gear until the switch clicks. Rotate the locked gear one full turn and shift the position of the switch bracket until the switch roller just contacts the cam. (This point may be determined by moving the loosened bracket around until the contact is actually heard.) Then tighten the bracket captive screws.

(4) When reinstalling the locking clip; see that the end is inserted all the way down in the locked gear teeth. If a torque unit is used, shim it out until proper gear mesh is obtained.

b. After replacing the differential assembly, realign the synchro system. This is essential. For a relative-bearing system, follow the procedure given for Antenna CRP-66AGE on page 64 of the SO-1 Technical Manual. For a system converted to true bearing, follow SO Bulletin 104—Navy Field Change 41—SO-1.

Routine Instructions: Make a record of the work done in the Service or Installation Report.

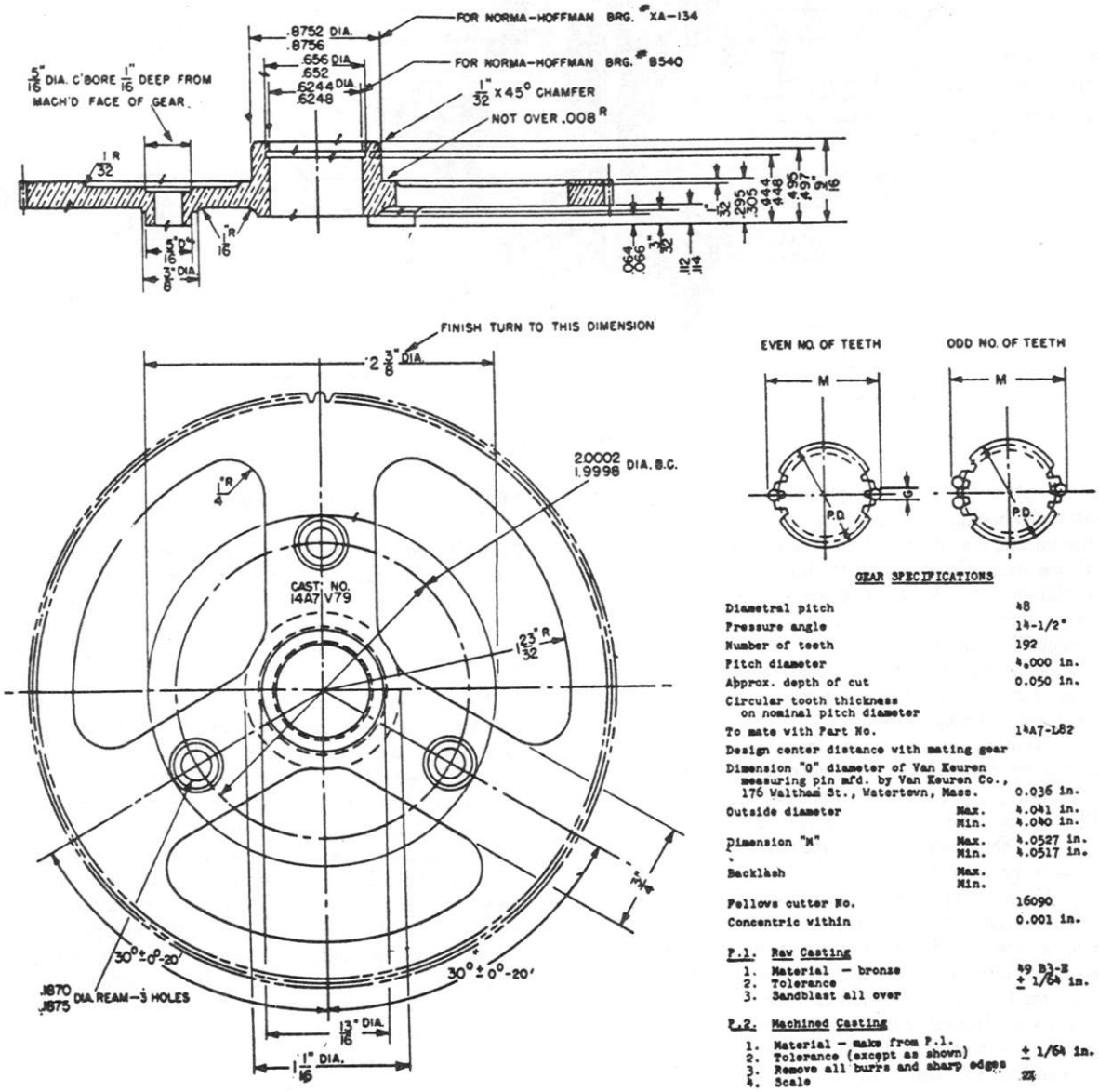
ANTENNA MODIFICATION FOR SP-3'S ON PT'S

General: Numerous complaints have been made concerning inadequate coverage of SO-3 radar systems against high-flying aircraft. As a result of these complaints, the project to broaden the radiation pattern of these equipments in the vertical plane was undertaken by the Radiation Laboratory, M.I.T.

Simplicity of the method used and ease of installation were keynoted, since the change would have to be made in the field from available materials and written instructions. In view of these limitations, it was decided that a flat strip be designed which could be easily attached to the bottom of the reflector. After several tests, it was found that a metal piece, as shown in figure 1, gave good results.

It was necessary to extend the strip two inches up into the main reflector to obtain the desired vertical broadening (see fig. 2). This reduced the gain of the main peak beam 2.5 d-b, which resulted in a theoretical reduction in range to 75 percent of the unmodified system. However, preliminary tests on an SO-3 installed on a PT boat showed no discernible differences in maximum ranges on surface targets with or without the strip attached.

It was found that after the strip was attached the main peak of the beam was tilted downward from 2 to 3 degrees. Since this reduced the net increase in radiation in the vertical plane it became necessary to compensate for this tilt. The compensation was accomplished by inserting 1/16-inch washers or shims beneath the front edges of the two reflector mounting brackets as shown in figure 3. Since original installations may vary slightly from boat to boat,



GEAR SPECIFICATIONS

Diametral pitch		48
Pressure angle		14-1/2°
Number of teeth		192
Pitch diameter		4.000 in.
Approx. depth of cut		0.050 in.
Circular tooth thickness on nominal pitch diameter		
To mate with Part No.		14A7-L82
Design center distance with mating gear		
Dimension "G" diameter of Van Keuren measuring pin mfd. by Van Keuren Co., 176 Waltham St., Watertown, Mass.		0.036 in.
Outside diameter	Max.	4.041 in.
	Min.	4.040 in.
Dimension "M"	Max.	4.0527 in.
	Min.	4.0517 in.
Backlash	Max.	
	Min.	
Fellows cutter No.		16090
Concentric within		0.001 in.

P.1. Raw Casting

1. Material — bronze — 49 B3-E
2. Tolerance — ± 1/64 in.
3. Sandblast all over

P.2. Machined Casting

1. Material — make from P.1.
2. Tolerance (except as shown) — ± 1/64 in.
3. Remove all burrs and sharp edges
4. Scale — 2X

FIGURE 5.—Details of 14A7–V79 gear.

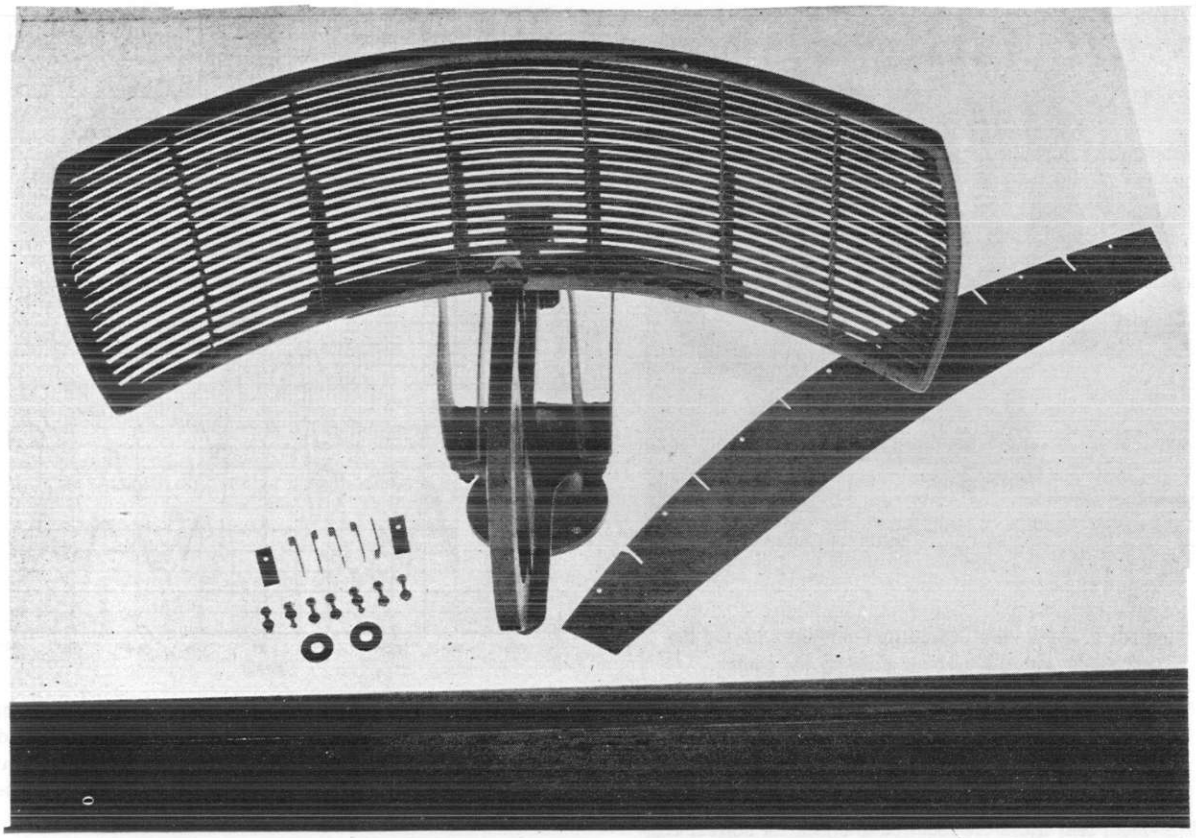


FIGURE 1.—Disassembled view of modified SO-3 antenna. The new reflector strip is shown to the right and mounting hardware to the left. The tapped screw holes along the bottom rim of the main reflector should be disregarded as they are not used in the final strip attachment.

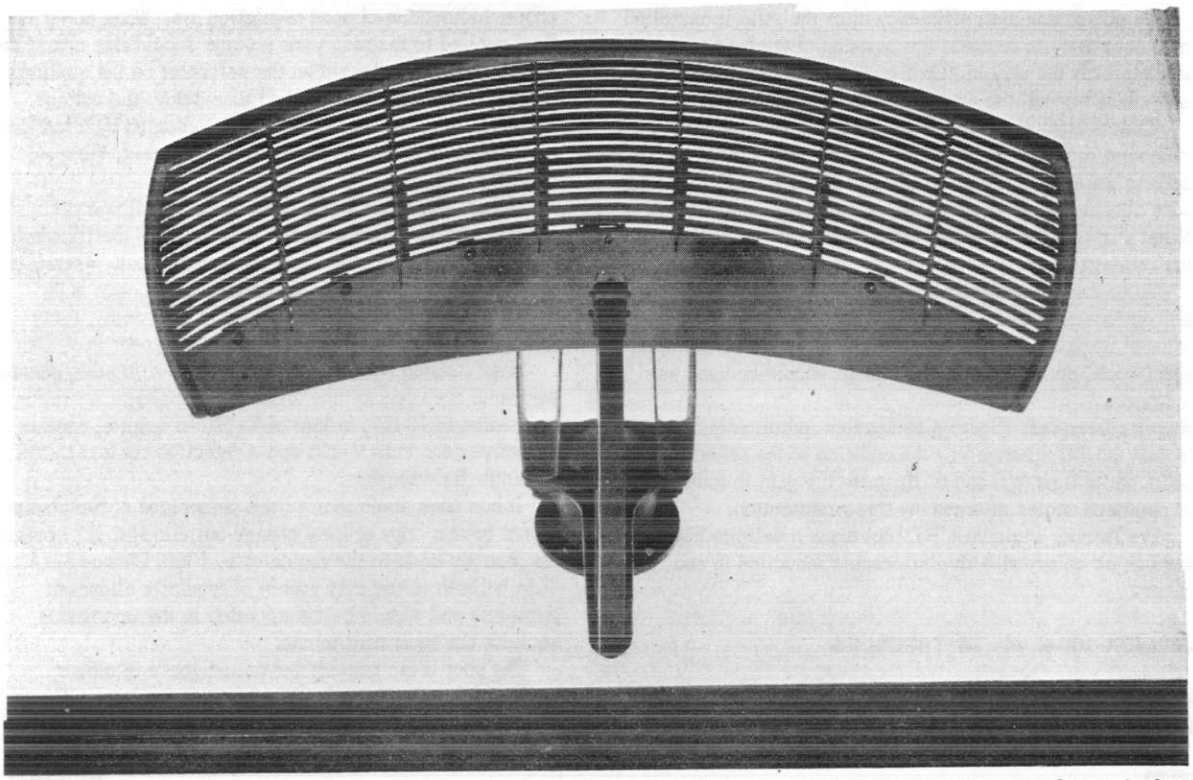


FIGURE 2.—View of modified SO-3 antenna with reflector strip attached. Note that the strip extends two inches up into the main reflector.

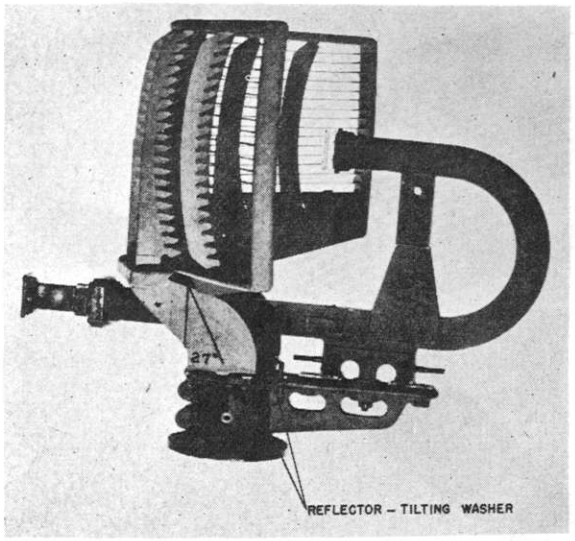


FIGURE 3.–Side view of modified antenna showing the 27° angle with the vertical made by the center section of strip, the reflector tilting washers, and the position of the fastening clamps.

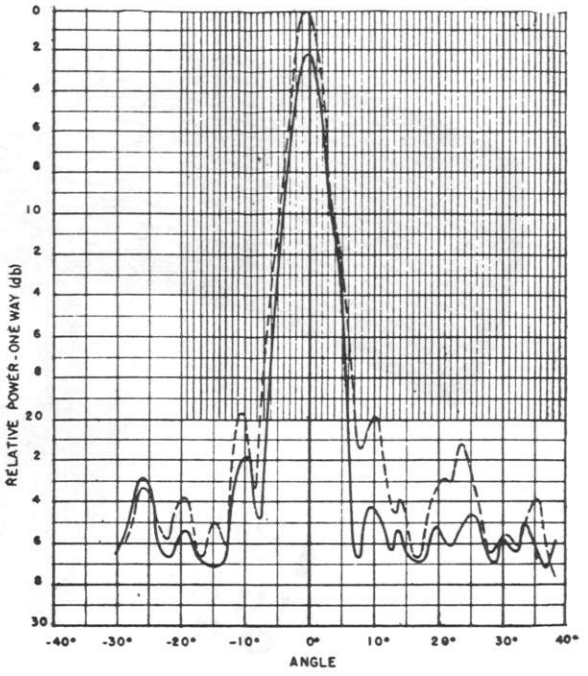


FIGURE 4.—Comparison of radiation in azimuth from the modified reflector (solid line) and the unmodified reflector (dashed line). Note that the normal beam is not affected by the modification except for loss in gain.

individual test trials are required to check for correct compensation. It may be necessary to alter this shim thickness by as much as one or two sixty-fourths to effect the proper tilt, in order to compromise between surface and aircraft target coverage.

To obtain maximum efficiency after the strip is installed it is necessary to readjust the position of the feed horn by sliding it all the way in. On the unmodified system the feed horn should be all the way out for maximum efficiency.

Constructing the Strip: The folded drawing facing the following page may be detached and used as a template for cutting the strip. The metal used is 16 gage (U.S. Standard) pure aluminum (1/16-inch thick) or stainless steel flat sheet stock. When drawn up tight, it assumes the shape of the reflector.

Since the main reflector is made of stainless steel, precautions against corrosion must be taken if aluminum is used by having the strip anodized and painted. Stainless steel bolts, nuts, washers and clamps should be used as fasteners.

Results Obtained: Figure 4 shows that radiation in azimuth is only slightly changed by the addition of the reflector strip, while figures 5 and 6 illustrate the gain in radiation at overhead angles afforded by this modification.

Preliminary trials on a PT boat show a definite improvement in air coverage with a noticeable reduction in sea return.

COMMON SO–a, –1, –8 TROUBLES

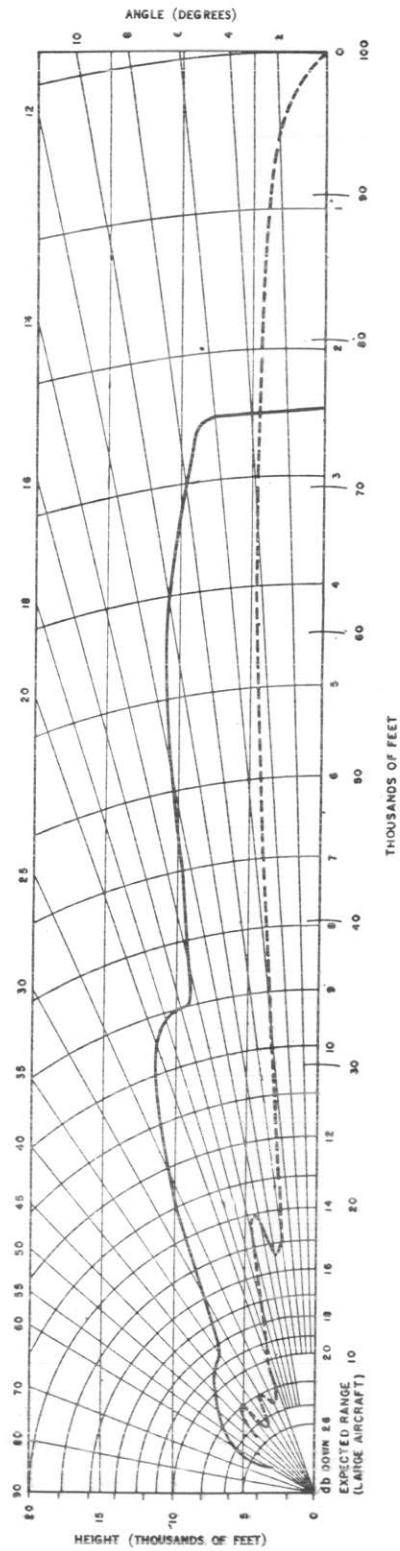
Modulator Generator: The most commom trouble encountered in the modulator generator unit is in the electronic voltage regulator circuit. Complete lack of regulation, poor regulation and incorrect value of output voltage have frequently been noted. Sometimes these faults go unnoticed for long periods of time because the personnel do not know what proper indications of good regulation are. When power is first applied to the radar, the voltage should rise immediately to 105 volts as indicated on the voltmeter on the auxiliary control unit. After a 45-second time delay, the voltage should jump to the normal 115 volts indicated by a red line on the meter. If this sequence does not occur, there is trouble in the regulator circuit.

Normal indications at the regular unit follow a definite sequence also. When power is first applied, the filaments of V-101, V-102, and V-103 will start to heat. When V-102 reaches the point where it will conduct, the neon bulb V-105 will glow. After the 45-second time delay, relay K-110 will close and a purple haze will appear in V-103.

Most common component failures preventing this normal sequence are vacuum tube failures, intermittent operation or opening of R-167, failure of K-110 to operate, aged or defective neon bulb V-105 and a defective contact in the regulator field brushes.

It has been noted that a good percentage of Navy ships do not have a copy of field change bulletin No. 117 covering the changes made in the regulator by Field Change 82-A. This bulletin is the only source of regulator alignment procedure and should be incorporated in the instruction book for the equipment in use.

The poor brush contact mentioned above is also a source of trouble to units other than the regulator. These brushes are difficult to get to and are frequently passed up



in preventive maintenance schedules. If the modulator generator unit is located in a more or less exposed place, the brush holder assembly tends to accumulate rust deposits that freeze the brush in the holder, keeping it from riding on the slip rings. Lubrication of the brush holders at frequent intervals with a rust preventive oil or light coating of grease will keep the brushes free and in good contact with the slip rings. Care must be taken to prevent oil or grease drom dripping down into the windings of the generator or on the slip rings themselves.

A great many technicians carry on routine greasing of the modulator generator unit without ever thinking where the grease they are pumping in is going. In each bearing housing there is a relief plug which, when removed lets the old dirty grease flow out when the new grease is forced in. If lubrication is carried out without removing this plug, the lubricant is forced through the bearing seals into the windings of the field or armature. Over a period of time this can cause a great deal of damage to the unit. Always remember to remove the relief plugs when lubricating any piece of rotating machinery.

Indicator Unit: Aside from the tube failures, there have been very few consistent failures noticed in the indicator unit. Loose cursor dials, however, have been seen occasionally. This, in conjunction with an off-center sweep on the PPI will give extremely inaccurate and erratic bearings. Sweep centering procedure and cursor dial adjustment are covered in the instruction books and should be made as accurately as possible to give good bearings. Sweep centering adjustments should particularly be made after changing the PPI tube.

In some SO radar indicators unauthorized field changes have been made to provide a 2-mile range. Some of these have even been left in when the authorized Field Change 100 was installed. To check for this unauthorized change, throw the ON-OFF switch in the upper left-hand corner of the indicator panel. If the sweep length changes, this modification is present. These changes have been made in different ways so care must be taken in removing them. Usually there are two wires run from the ON-OFF switch to the large register under F-401 or the top of the indicator chasis. Check the circuit before removing any wires.

Transmitter-Receiver Unit: Failure of the waveguide shutter solenoid E-303 is quite common. Check the solenoid for burned sections and overheating. If it is defective, replace it. Do not tie the shutter open if it does not operate. This will result in damage to the receiver.

When measuring current in the receiver, be sure to use a test prod of small enough diameter to prevent spreading the contacts inside J302. If broken, this jack is difficult to replace. Also, good contact of the center conductor must be maintained when the shorting plug is inserted for operation after crystal current is measured.

Considerable trouble has been encountered in tuning SO radar receivers. Field Change 103 is now available to make tuning easier.

Antenna: Water entering the antenna accounts for a lot of troubles by causing decomposition of insulation, rust and decreasing insulation resistance in motors and selsyns. Be sure your gaskets effectively seal out all water and moisture.

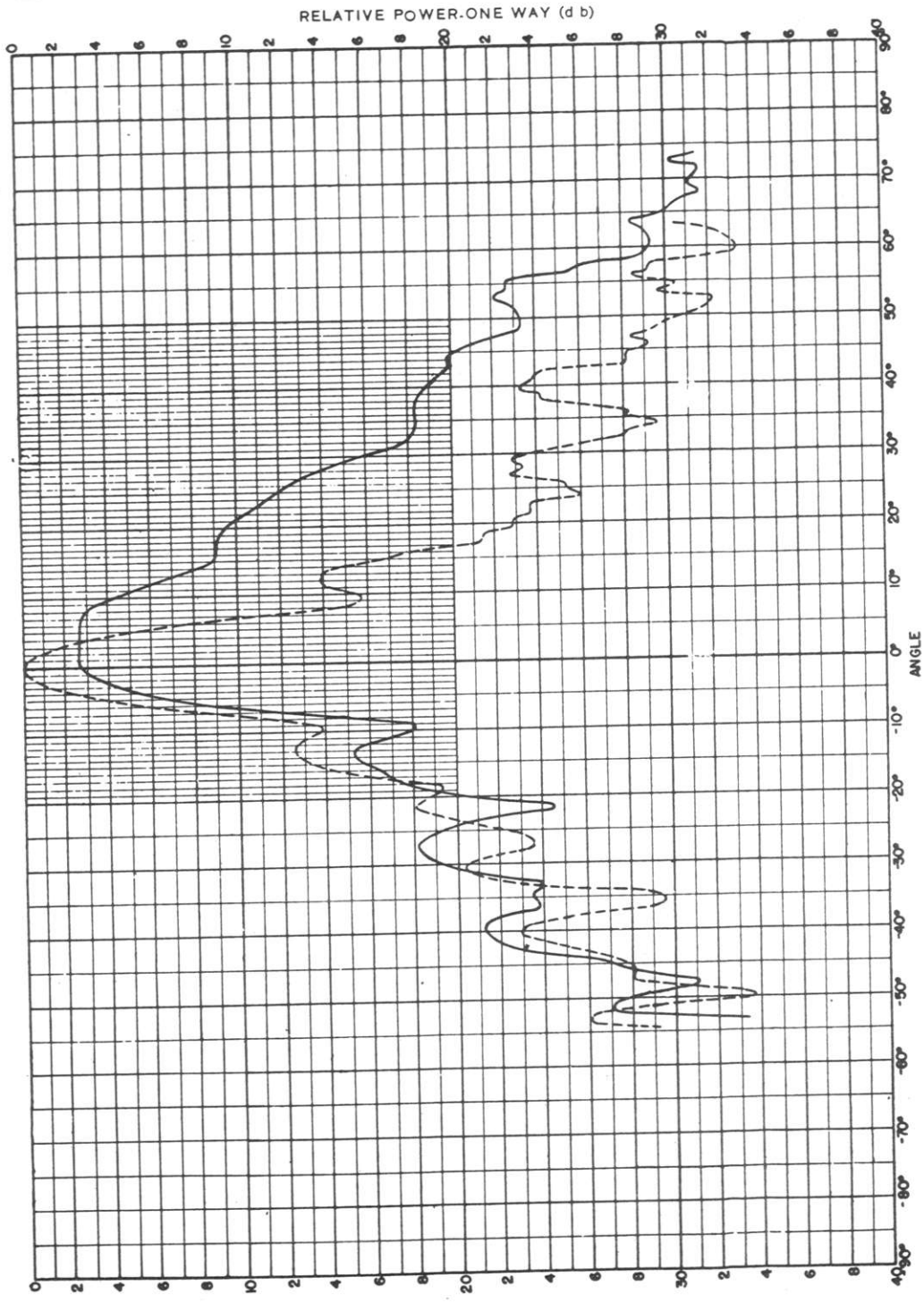


FIGURE 6.—Elevation pattern showing the increase in radiation at overhead angles with the modified reflector (solid line) over the unmodified reflector (dashed line). The water side is on the left and overhead angles to the right on this diagram.

General: Many technicians are not aware of the correcting device built into the SO to keep the antenna and the PPI sweep in step. Correct operation of this feature is important and should be checked along with the preventive maintenance schedule. Failure of this feature will cause no apparent difference in the radar operation, but there is a good change that there will be a bearing error without it. Operation may be checked by removing the indicator unit from its frame and turning the large gear on the PPI assembly about 90°. Replace the unit and start the radar with the antenna rotation switch in the neutral position. When the radar has reached its operating point, rotate the antenna and watch the sweep. If the correcting feature is operating correctly the sweep will rotate to 360 degrees and stop. When the antenna reaches 360°, the PPI sweep will start again and follow the antenna. Try this check with the antenna rotating in the opposite direction just to make sure. After the initial correction the sweep should follow the antenna evenly.

SO-6, -10 ANTENNA FAILURES

From fleet reports and inspection by Bureau of Ships representatives, it has been determined that certain deficiencies exist in the design and construction of the Model SO-6/-10 radar antenna, Type CRP-66AMP.

It has been found that after a short period of service, the Garlock duplex oil seal permits oil leakage from the lower drive gear case into the waveguide. In some cases, inspection prior to installation of the antenna has revealed misalignment and improper meshing tolerances of gears in the drive gear assembly. Also revealed, was improper fastening of securing nuts and screws in the antenna pedestal. In one particular instance, the lock nut and lock nut washer on the lower end of the drive spindle were found to be loose because the fingers of the lock nut washers had not been pressed into notches of the lock nut itself. This was a very critical situation in that had the antenna been installed without inspection and correction, both the lock nut and the lock nut washer would have spun off and dropped into the rotary joint beneath it.

In order to correct oil leakage, the Bureau of Ships has ordered procurement of an improved type, Reich, oil seal which will soon be distributed to activities concerned as a field change, and will replace the presently installed oil seal. To correct other deficiencies as noted, installation activities will be required to conduct a thorough examination of the antenna pedestal and its drive mechanism prior to new installations. It may be necessary in some instances to manufacture a new gear, in order to produce proper meshing and alignment in the gear assembly.

The SO-6/-10 technical manaul, NAVSHIPS 900,860 specifies a quantity of the three quarts of Navy Type No. 9110 oil for lubrication of the main gear box in the antenna pedestal. By recent tests, it was found that this quantity is not entirely sufficient to properly lubricate all gears and bearings, and it is necessary, therefore, that the amount be increased to four quarts. It further has been determined that the No. 10 oil, due to its light weight, has a very low consistency in warm weather, and it is required that No. 20 oil be used in lieu of No. 10 for other than extreme cold weather. It is intended that the changes in quantity and weight of oil be applicable to all equipments, including those already installed.

Personnel responsible for the maintenance of the SO-6/-10 equipment are advised to make frequent inspections of the gear assembly box to ensure that a sufficient oil level is maintained at all times and that gears are functioning smoothly. Either noisy antenna rotation, reduction in maximum ranging distances, or a combination of both, are the usual symptoms indicating troubles within the antenna pedestal.

Pending receipt of the improved type, Reich, oil seal, maintenance personnel are advised to replace the present oil seal with one of the same type from equipment maintenance parts as a temporary measure to prevent oil leakage into the wave-guide, should it exist. Oil leakage can easily be determined by the removal and inspection of the uppermost section of the wave-guide. Evidence of improper gear functioning will require replacement of gears where necessary.

It is requested that the Bureau of Ships be advised immediately of any difficulties experienced in the operation of the subject equipment.

BLOWER MOTOR FOR SO-1 AND SO-8

Records in the Bureau indicate that vessels and activities are still ordering Blower Motor B-301 for Models SO-1 and SO-8 radar equipments even though field change No. 107 has been available since 1946. This field change provides an improved 115 VAC type blower motor (B-302) along with the necessary installation parts and instructions for replacement of the old 115 VDC type blower motor (B-301).

It is recommended that:

1. Whenever blower motor B-301, 115 VDC fails, order field change No. 107.

2. Upon installation of field change No. 107, add the following nomenclature to the instruction book repair parts list: B-302 Motor Blower 6700 RPM, 115 VAC, 400 CPS, Raytheon drawing No. 115-5216 PI, P/O F.C.-107.

3. All models SO-1 and SO-8 equipments presently in use should be inspected to see if field change No. 107 has been accomplished. If the field change has been made, check the technical manual to insure correction of the transmitter schematic as outlined in the Field Change Bulletin, and check for inclusion of repair parts list given in paragraph 2 above.

EXCESSIVE F-108 FAILURE

Considerable difficulty was experienced with Model SO-10 Radar aboard the U.S.S. PCEC 882 from May 1950 until July 1950. Fuse F-108 in the modulator unit failed so frequently that it caused considerable unreliability of the equipment's operation.

Upon investigation by San Francisco Naval Shipyard it was found that 15 amp. standard type fuses were being used instead of the required fusitron type.

Differences between using a fusitron and a standard fuse were examined with the following results:

a. A 10 amp. fusitron will carry 500 percent overload for 10.5 seconds and at the end of 100 seconds it will carry 200 percent overload.

b. A standard 10 amp. fuse will blow immediately when SO-10 equipment is started, especially if insufficient warming-up period is allowed and radiation is started on long pulse (20- or 80-mile ranges) transmission.

In order to minimize possible future trouble with fuse F-108 in Model SO-6 and SO-10 equipments, the following is recommended:

a. That only 10 amps. fuses of the fusitron type be used in the F-108 position.

b. That the equipment be placed in stand-by condition for 5 to 10 minutes prior to energizing the radiation switch.

c. That radiation first be started on a short pulse (2- of 4-mile ranges).

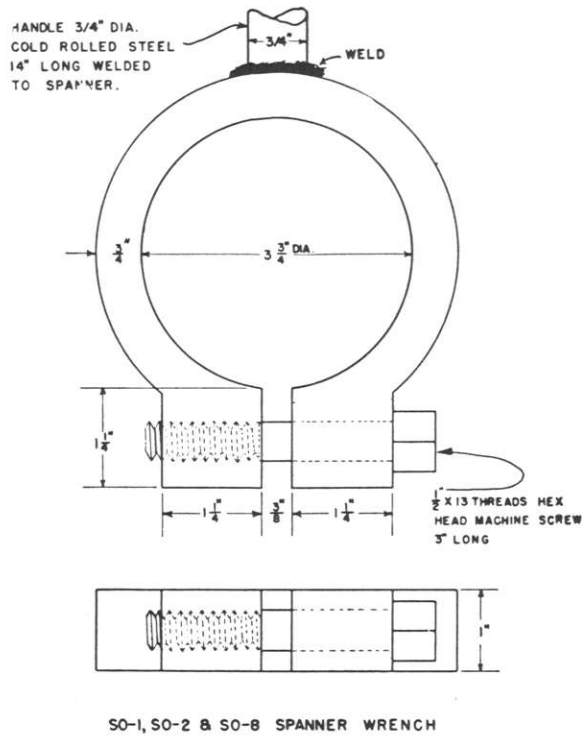
d. That range switching between 4 to 20 miles or 20 or 4 miles br performed with the radiation off.

SPANNER WRENCH

A spanner wrench for removing the exciter armature from Model SO-1, SO-2, and SO-8 motor generators with a minimum of effort and damage has been devised.

To remove an exciter armature with this wrench, clamp the spanner to the laminated iron core of the exciter armature. Then exert a light twisting motion while gently tapping the spanner.

Figure 1 provides all the necessary information for interested activities who may wish to fabricate one of these spanner wrenches.



SO-1, SO-2 & SO-8 SPANNER WRENCH

FIGURE 1.

MODEL SO SERIES TROUBLESHOOTING NOTES

TROUBLESHOOTING HINTS

Motor Alternator Will Not Run:

a. No line voltage—Check line fuses and power source.
b. Open interlock circuit—Check S-301 and S-201.
c. Open fuses—Check as follows:
SO-a, SO-13: F-101, F-402.
SO-1, SO-8: F-105.
SO-2: F-108, F-110.
d. Defective or open thermal overload relay—Check as follows:
SO-a: K-104.
SO-13: K-101.
SO-1, SO-2, SO-8: Thermal overload located in magnetic controller.
e. Defective motor brushes—Check and repair or replace.
f. Defective coils or contacts in magnetic contactors—Check and repair.
g. Defective wiring in the motor control circuits—Check and repair.

No A-C Output But Motor Alternator Running:

SO-a, SO-13:
a. Defective slip rings or brushes on alternator field—Repair or replace.
b. Defective carbon pile assembly in voltage regulator—Check assembly and replace carbon discs or contacts.
c. Defective wiring in the alternator field circuit—Check and repair.

SO-1, SO-8:
a. Defective slip rings or brushes on alternator fields—Repair or replace.
b. Defective exciter commutator or brushes—Repair or replace.
c. Defective R-117—Repair or replace.
d. Defective wiring in the exciter circuit—Check and repair.

SO-2:
a. Defective slip rings or brushes on alternator fields—Repair or replace.
b. Defective exciter commutator or brushes—Repair or replace.
c. Defective R-131 or R-137—Repair or replace.
d. Defective wiring in the exciter circuit—Check and repair.

No A-C Voltage Regulation:

SO-a, SO-13:
a. Carbon pile voltage regulator incorrectly adjusted—Adjust according to instruction book.
b. Carbon pile defective—Replace carbon discs or contacts and readjust.
c. Defective solenoid, R-106 or SR-101—Repair or replace.
d. Defective wiring in the voltage regulator circuit—Check and repair.

SO-1, SO-8:
a. Voltage regulator out of adjustment—Adjust according to instruction book.
b. Defective slip rings or brushes in alternator field No. 2—Repair or replace.
c. Fuse F-104 blown—Locate source of trouble and replace.
d. Tubes V-101, V-102, V-103 defective—Replace.
e. Relay K-110 defective—Replace.
f. Defective R-116, R-117, R-118, R-119, R-123, R-124, C-101, C-102, C-103—Replace.
g. Defective or expended bias battery B-106—Replace.
h. Defective transformer T-104—Replace.
i. Defective wiring in voltage regulator circuit—Check and repair.

SO-2:
a. Voltage regulator out of adjustment—Adjust according to instruction book.
b. Defective slip rings or brushes in alternator field No. 2—Repair or replace.
c. Fuse F-104 blown—Locate source of trouble and replace.
d. Tubes V-101, V-102, V-103 defective—Replace.
e. Relay K-110 defective—Replace.
f. Defective R-117, R-119, R-125, R-126, R-127, R-134, R-135, R-136, C-102, C-105, C-106, L-102—Replace.
g. Defective or expended bias batteries B-106, B-107—Replace.
h. Defective transformer T-107—Replace.
i. Defective relay K-111—Repair or replace.
j. Defective wiring in the voltage regulator circuit—Check and repair.

No Radiation:

a. Switches S-302, S-404, S-405 defective—Repair or replace.
b. Relay K-201 defective—Repair or replace.
c. Fuse F-206 blown (also F-107 in SO-2)—Locate source of trouble and replace.
d. Open interlock circuit—Check S-101.
e. Defective charging transformer—Replace. (T-101 in SO-13) (T-105 in others).
f. Defective rectifier filament transformer—Replace. (T-102 in SO-13) (T-106 in others).
g. Defective H. V. rectifier tube—Replace. (V-101 in SO-13, SO-9) (V-104 in others).
h. Defective pulse line Z-101—Replace.
i. Defective spark gap assembly—Replace broken electrodes, rephase and respace as outlined in instruction book.
j. Defective pulse cable—Check for breakdowns and replace.
k. Defective T-302—Replace.
l. Defective C-342, C-343, C-345—Replace.
m. Defective V-311—Replace.
n. Gap not phased properly (SO only)—Rephase according to instruction book.
o. Wave guide shutter stuck closed—Repair or replace.

Weak Radiation:

a. Defective H.V. rectifier—Replace (V-101 in SO-13) (V-104 in others).
b. Incorrect adjustment of spark gap—Respace according to instruction book.

c. Partially defective pulse line—Replace.

d. Partial short across H. V. side of pulse line and pulse cable—Locate and repair.

e. Defective V-311—Replace.

f. Weak magnet E-303—Replace.

g. Waveguide shutter stuck closed—Repair or replace.

h. Improperly adjusted magnetron tip. Readjust. Replace if burned.

Intermittent Radiation:

a. Switches S-404 or S-405 defective—Clean contacts, repair or replace.

b. Thermal switch S-302 defective or opening due to excessive heat in transmitter—Check by switching from NORMAL to EMERGENCY—Replace or correct conditions in transmitter.

c. Relay K-201 defective—Clean contacts or replace.

d. Interlock S-101 insecure—Repair or replace.

e. Loose connection in H.V. or pulse wiring—Check and repair.

No Sweep But Radiation O. K.:

a. Multivibrator bias control R-429 incorrectly adjusted—Readjust according to instruction book.

b. Check at C-401 with phones or output meter for trigger voltage. If none, check for open or shorted trigger cable, defective wiring connections or defective components R-439, R-101, R-102, R-103, R-104, R-105—Repair or replace.

c. Defective tubes V-401, V-402, V-403—Replace.

d. If sweep OK on other ranges, check for defective switch S-401, sections A, B, and C, or components R-401, R-402, R-403, C-407, C-408, C-409, R-417, R-418, R-419, R-420, R-421, depending on which range is dead.

e. Check at C-404 for multivibrator output with output meter. If OK, check V-402A and V-403 circuit components, particularly L-401, R-422, R-423 and R-424.

f. If sweep circuits OK, check power supplies for defective tubes V-408 and V-409 and circuit components—Replace.

g. Defective deflection coil L-406—Repair or replace.

h. Defective deflection coil slip rings or brushes—clean or replace.

i. Defective cathode ray tube—Replace.

j. Defective wiring or connections in sweep circuits—Check and repair.

No Sweep Rotation But Antenna Turning:

a. Fuse F-403 blown—Replace.

b. Defective synchro B-401 or B-501—Replace.

c. Defective relay K-401—Repair or replace.

d. Defective microswitch S-501—Replace.

e. Synchro B-401 or deflection coil L-406 bearings frozen—Repair or replace.

f. Defective wiring or connection—Check and repair.

g. Loose set screws in B-401 synchro coupling—Tighten.

h. Unlocked differential (true bearing systems only)—Lock.

Unstable Sweep Rotation:

a. Synchro phasing switches S-408, S-501 out of alignment—Realign according to instruction book.

b. S-408, S-501 defective—Replace.

c. Synchro B-401 or deflection coil L-406 bearing binding—Repair or replace.

d. Defective K-401—Repair armature spring or replace.

e. Loose set screws in synchro B-401 coupling—Tighten.

f. Unlocked differential (true bearing system only)—Lock.

Weak or No Signals, Radiation and Sweep OK:

a. Receiver detuned—Retune according to instruction book.

b. Shutter E-303 binding and closed—Repair or replace.

c. Water standing in wave guide or choke—Remove water and dry out wave guide.

d. Antenna r-f section defective—Repair or replace.

e. Video cable open or shorted—Check and repair.

f. V-406 or circuit components defective—Check and replace.

g. Check for crystal current at J-302. If none, check V-310 and R.F. 303—Replace if defective.

h. Check crystal by substitution. If necessary, replace and set crystal current correctly. Replace V-301 to prevent further failure of crystal.

i. Receiver tubes V-301, V-302, V-303, V-304, V-305, V-306, V-307, V-308 defective—Replace.

j. Receiver components defective—Repair or replace receiver.

k. Check receiver voltages. If not normal, check rectifier power unit for trouble.

l. Tubes V-201, V-202, V-205, V-206 and V-207 defective—Replace.

m. Power supply components defective—Replace.

n. Defective wiring or connections in receiver cabling circuits—Check and repair.

No Range Marks But Signals OK:

a. If marks OK on other ranges check TC-401, TC-402, TC-403 and sections D and E of S-401—Repair or replace.

b. Tubes V-402B, V-404 and V-405 or their circuit components defective—Replace.

Unstable Range Marks and Signals:

This condition is generally always caused by fluctuating line voltage.

a. Voltage regulator poorly adjusted and oscillating (mechanically or electronically)—Readjust according to instruction book.

b. Synchros B-401 or associated gears binding mechanically—Repair or replace.

c. R-249 improperly adjusted—Readjust.

No Antenna Rotation, Other Operation Normal:

SO-a, SO-2, SO-8, SO-13:

a. Reversing switch S-402 defective—Repair or replace.

b. Motor B-502 defective—Repair or replace.

c. B-502 gear housing defective—Repair or replace.

d. Defective wiring or connectiong—Check and repair.

SO-1:

a. Reversing switch S-402 defective—Repair or replace.

b. Motor B-503 defective—Repair or replace.

c. Relays K-1301 and K-1302 defective—Repair or replace.

d. R-1304 and R-1305 defective—Replace.
e. B-503 coupling and gear assembly defective—Repair.
f. Fuse F-106 blown—Locate trouble and replace.

Bearing Error:

a. Synchro B-501 body loose in mounting and out of adjustment—Readjust to correct bearings.
b. Synchro phasing switch S-501 incorrectly set—Reset in conjunction with B-501 to correct bearings.
c. Loose synchro B-501 coupling—Tignten.
d. Differential unlocked (true bearing systems only)—Lock.

Signal from Resonance Chamber:

a. Resonance chamber cable defective—Check and repair.
b. Resonance chamber coupling loop open—Replace loop holder or entire chamber.
c. Resonance chamber tuning mechanism defective—Replace chamber.
d. Tuning indicator—I-601 defective—Replace.
e. Resonance chamber pickup in antenna or wave guide defective—Repair.
f. Improperly assembled cable connectors—Reassemble.

Spoke Effect on PPI:

a. Mechanical binding in the antenna or indicator.
b. Dirty slip rings on PPI deflection coil or synchros.
c. Poor voltage regulation.
d. Dragging of magnetron due to misalignment of r-f system.
e. Critical 707B tube.
f. Excessive I-303 coupling and improper adjustment.
g. A-c cable leakage to video cable.

Notes on Recurrent Failures

Antenna Assembly (SO)

NATURE OF OPERATION	TROUBLE FOUND AND REMEDY
Antenna and sweep 180° out of phase.	Adjusted synchro, B–501, until sweep on the PPI tube and antenna were in phase.
Antenna rotation in 1 direction only.	Cleaned dust on contacts of antenna rotation switch and restored proper operation of antenna.
Normal operation when scanning in one direction continuously. Displacement of targets from their normal quadrants when sector scanning. After sector scanning for a few seconds, the synchro system would be out of alinement.	Realignment of the synchro system and tightening the Allen screw of the gear cleared the conditions found above.
Frequency of signal changed when rotating antenna in first quadrant.	Removed and examined RF–513 to rotary joint on antenna. Arcing had occurred in coupling section. Cleaned and reseated properly.
Constant error in relative bearings of targets.	Antenna reflector rubbing dome and microswitches off timing. Filed edge of reflector and reset timing of switches.
Excessive moisture found inside antenna box.	The inside of the antenna box was wiped partially dry, and then dried out in the sun with the cover open.
Antenna had stopped when rotated in clockwise direction.	Removed antenna drive motor, B–503, and made bench test. Found fault was not in motor. Upon further inspection, found adjustable flange on rotating coaxial section was loose. Tightened flange and ran 4 tests on antenna. Left equipment operating normally.
Antenna rotation sluggish. Checked heater circuit. Found O. K.	Reset S–502 (thermostat) to operate at higher temperature (approximately 35° C.).

Magnetic Controller (SO)

Equipment stops after running only 10 minutes.	Checked relay in magnetic controller, cleaned and filed all pitted contacts (CDD–211045).
Main d-c line fuses blew intermittently when magnetic controller push button switch was closed.	Adjusted plunger bar spacing nuts on accelerating relay, K–114, so that the bar in its lowest position had ample clearance from the current coil, K–114C. Adjusted core piece of current coil, K–114C, to maintain correct spacing between it and the plunger bar.

Motor Alternator Modulator and Spark Gap (SO)

CRP–14AAN, resonance chamber inoperative.	Found cable from antenna assembly resonance chamber had slipped out of RMA UHF coaxial connector at antenna assembly. This fitting had been made up so that the shield was not fastened between the ferrule and the connector. Therefore, the shield was not secured and eventually dropped out. Remade connection.
Spark adjsutment turned completely clockwise, still not firing regularly.	Rotated fixed electrodes counterclockwise on shaft.
Voltage reg. VR–101 had no control over voltage, extremely high voltage.	Open resistor (100 ohms) in series with selenium rectifier. Replaced same.

Motor Alternator Modulator and Spark Gap (SO)—Continued

NATURE OF OPERATION	TROUBLE FOUND AND REMEDY
Spark gap no longer adjustable.	Take cover off spark gap assembly and adjust stationary electrode till electrodes just touch, then back ½ turn on OFF position of adjusting screw.
Radarman reported that equipment would cease operating from time to time, and that it was always necessary to reset thermal overload relay before operation could be continued. Due to probable heavy vibration, relay tension set had reached the point where the reset device was no longer effective.	Increasing tension cleared trouble.
No high voltage at spark gap.	Replaced insulating bushing on high voltage lead into spark gap.
Motor alternator speed erratic, unit would race when equipment was first turned on.	Replaced S–107A rotating contactor speed regulator. Corrected racing and erratic speed condition.
Output of alternator 80 volts measured at terminals 1–2 on E–113.	Adjusted excitation control R–113 for approximately 100 volts output from field No. 1. Replaced 6H6 rectifier (V–102) in voltage regulator power supply and adjusted bias control R–117 bringing alternator output to 115 volts.
High voltage arcing across feed through insulator to ground between stationary electrode of spark gap assembly and filament of rectifier tube V–104.	Removed feed through insulator, cleaned it thoroughly and replaced it.
V–103 (C1B) "firing" intermittently.	C1B tube pins making intermittent contact with X–103 socket connections. Replaced X–103, C1B tube socket.
Terrific vibration in motor driving alternator.	Removed drive motor and checked motor. Added shims to motor mount, thereby aligning it with alternator. Vibration set up by motor was found due to motor being mounted too low in relationship with alternator. Aligning motor properly corrected this condition and eliminated excess vibration.
Severe brush chatter in front plate assembly of spark gap.	Removed brush from holder, refaced and reinstalled. Refacing of the brush appears to have cleared the chattering condition.
PPI(SO)	
PPI sweep rotation operating smoothly in clockwise position, but locking and jumping at zero position in counterclockwise position.	Corrected condition, by repairing broken (corroded) terminal No. 41 (S–1 of antenna synchro) at antenna terminal strip. Changed cam positions at antenna and indicator for proper synchronization of antenna and sweep.
Sawtooth or wavy markers on PPI tube (5FP7) (CRS–55ACP).	(S–102H) spark gap and timing adjusted. (CRP–21963). Spark gap setting too wide causing intermittent firing of spark gap.
Sweep and signals disappearing at irregular intervals.	Adjusted spark gap (S–102H) for proper clearance. (VR–101) motor alternator voltage regulator adjusted for proper a-c voltage output from alternator. (115 volts.) Sweep and signals normal after work.

PPI(SO)—Continued

NATURE OF OPERATION	TROUBLE FOUND AND REMEDY
Sweep at PPI jumping and fuse F–401 blowing as cam and microswitch operated. Microswitch, S–501, in Antenna Assembly CRP–66ADN, and microswitch, S–408, in PPI assembly, CRP–55ACP, not synchronized causing sweep to jump at 0° relative, and F–401 to blow. Allen screw at synchro, B–401, and of flexible coupling not tight and allowed shaft to slip.	Reset cam and microswitch, tightened Allen screws securely.
Very weak echoes, maximum range very short.	Check revealed there was no keep alive voltage on V–309 TR tube, this was traced to a shorted bypass condenser C–341.
Intermittent signals and modulated markers on PPI tube, V–407 (CPR–55ACP).	Adjusted spark gap spacing and gap timing for even firing of same.
Relative bearing target indicating vane turned intermittently when crank handle rotated.	Moved eccentric shaft bushing in PPI panel front to permit rubber friction bearing to contact vane drive surface. Resetting of friction bearing cleared intermittent condition of target bearing vane.
Equipment inoperative. Sweeps on PPI tube, 5FP7, without hight voltage on.	Adjusted R–429 multivibrator bias control until sweeps disappeared.
Gap not firing.	This caused by interlock S–101 making poor contact. Bent the male portion which remedied the trouble.
Approximately ½ sweep on 75 miles range.	Replaced C–409, sweep capacitor, which restored normal operation of 75 miles range.
An attempt was made to bring the sweep to focus by adjusting R–468 in front panel of PPI Assembly CRP–55ACP. In so doing a joint was reached in the adjustment of R–468 where the sweep jumped approximately ¼ inch to 1 side of center and the sweep also was very broad.	R–468 was removed and opened and observed to be nearly packed with lubricating grease. Removed the arm from the control and this grease also packed under arm. Cleaned control with carbon tetrachloride and replaced R–468 back in indicator. Replaced assembly in case. After R–468 cleaned and replaced, operation of equipment normal.
Spoke effect as viewed at PPI as though local oscillator were popping in and out of oscillation; when REC.-TUNE potentiometer is detuned slightly from the maximum signal position this spoke effect is apparent. However, when the unit is tuned on the maximum signal position this condition disappears.	Found crystal current too high (0.8 ma). This high crystal current was apparently causing an unstable condition to develop when the unit was detuned from the maximum signal position. Resetting the crystal current to 0.35 ma and returning appears to have cleared the condition as no further spoke effect was noticed after a 2-hour run.
Slight instability of range marks with tendency to multiple marks close to each main marker.	Increased multivibrator bias, R–429, in PPI to clear condition.
Lower plug of duplexing cavity nearest wave guide section of RF–31 unlocked. Plug nearly out of cavity. Signal intensity could be varied when duplexing cavity in RF–301 pushed from side to side.	Tightened locking rings of duplexing cavity securely. Tuned cavity and locked plugs securely. Locking rings at the duplexing cavity must often be tighter than it is possible to tighten by hand in order to insure positive contact between the 2 halves.
Poor ranges.	Poor ranges found due to output loop to 707 oscillator being shorted to casing. Corrected same; conditions normal.

PPI(SO)—Continued

NATURE OF OPERATION	TROUBLE FOUND AND REMEDY
On some indicators it has been found impossible to shift the start of the PPI sweep at the center of the tube when on the 75/80 mile range by means of center control R–421. This is mainly due to slight differences in the characteristics of 807 tubes.	On the CRP–55ADQ indicator this condition may be cured by replacing the 2-parallel, 2,000-ohm resistors R–420 and R–495 with 2 1,500-ohm, ½-watt resistors. On some CRP–55ADS indicators this method will also apply. On CRP–55ADS indicators a single 1,000-ohm resistor R–420 is used in the centering circuit. In this case the condition may be corrected by substituting the two 1,500-ohm, ½-watt resistors in parallel for the single 1,000 ohm resistor. NOTE: *Raytheon Field Engineer's Service and Installation Bulletin No. 6* calls for the addition of a ½ μfd capacitor C–429 in the sweep amplifier plate circuit. All equipment with its centering control R–421 operating normally, before C–429 was added, may now need correcting. Be sure to check the operation of R–421 after performing Bulletin No. 6 addition.
Short sweep for all ranges.	R–415 and R–416 found to have too much resistance. Replaced.
Too many range markers on all ranges.	R–442 found to have too much resistance. Replaced.
Inability to center sweep on 20- and 75-mile ranges.	R–422 (500 ohms) replaced with 250-ohm resistor.
Jittery sweep on all ranges.	Resurfaced bad ground wheel and replaced a-c ground brush in motor alternator.
Inability to center sweep on 75-mile range.	R–420 changed from 1,000 ohms to 500 ohms.
"Cloverleaf" pattern on PPI.	Caused by mal-tuned local oscillator. Retuned.
Signals periodically disappear from screen.	Coaxial cable loose on J–401. Secured.
Normal sweep—no signal. V–204, V–205 and V–206 in power supply not functioning.	Terminals No. 26 and No. 29 on J–401 shorted. Removed and cleaned.
Irregular rotation of sweep.	Insufficient tension of pinion gear to ring gear caused improper meshing of these gears, which in turn resulted in "jumping" rotation of sweep. Increased tension of pinion gear to ring gear.
Interference present, with signals, on screen of V–407, PPI tube.	By-passed B–301 motor leads to ground with 0.1 μfd condensers. Condenser connections made on motor at terminal strip E–304.
No intensity. Range markers but no sweep were visible on screen.	Found R–440 had decreased resistance from 10,000 to 3,000 ohms. Replaced.
Short sweep on 20–75-mile ranges.	Found R–415 had increased in resistance from 500,000 ohms to 1 megohm. Weak 807.
Weak signals, jittery sweep, modulated markers.	Leaky high voltage bushing.
Signals and markers "lacy" on PPI.	Spark gap reset and voltage regulator reset.
Sweep not centered on PPI.	Sweep centered on PPI by adjustment of L–406.
Antenna rotation with no rotation of sweep. This condition was due to switch S–501 not operating due to roller arm being bent from normal position.	Adjustment of this arm provided proper operation of sweep rotation with antenna rotation.

PPI(SO)—Continued

NATURE OF OPERATION	TROUBLE FOUND AND REMEDY
There was considerable r-f feedback noticeable at the PPI. Improper grounding of the receiver due to bolts not being tight often results in erratic operating of the receiver.	Tightened receiver securely to bracket.
Sweep stopped at 0° though antenna continues rotating.	Repaired antenna microswitch which was sticking.
Arcing in lower part of transmitter.	Tightened ground connection on pulse cable shield.
Transmitter pulse but no echo. Arcing heard in r-f unit.	Shutter stuck or inoperative. Fix shutter, and clean burned spot in waveguide and magnetron output feed.
Transmitter pulse sweep but no echo.	Rubber fitting at bottom of waveguide full of water. Draw out water and patch any holes in cover.
Intermittent and poor signals. Upon checking the equipment, it was found that water had accumulated on the plexiglass window of Z–304, r-f coupling choke between the waveguide and transmitter-receiver.	The rubber boot covering this coupling should be lifted at least *once a week* and the plexiglass window wiped thoroughly with a dry cloth. Any salt moisture not removed will form a deposit when dry, resulting in poor signals. *Do not* use any chemical solution such as carbon tetrachloride.
Excessive radio interference on this unit was traced to a leak between the cable shielding and the connection to the indicator housing.	Numerous grounds to the set and cables produced little improvement. Interference was entirely eliminated by tapping the collars securing the cable in the indicator housing and by then inserting screws to bind a ground which was also lead to the cable shielding.
Markers and signals "wavy" in two spots of PPI.	Slip rings for L–401 deflection coil checked. It was found that there were 2 spotted places on the rings which caused the markers and signal condition. After cleaning the rings and refacing the brushes, the condition cleared.
Erratic PPI sweep rotation.	Oiled bearings supporting shaft which carries drive gear for PPI deflection coil assembly.
Radio interference was unbearable with radio gain at zero.	Cables on the indicator were tapped, strapped, and grounded. No interference at last operation.
Circles appear on PPI scope when antenna is rotated.	Replaced Z–103, Thyrite assembly, clearing condition.
Nearby and faraway signals tuning at different settings of the receiver-tune control.	Installed new duplexing tube, V–309.
Range markers leaving wavy trace on PPI tube.	Readjusted voltage regulator, VR–101, in motor alternator and spark gap for better regulation. Adjusted the phasing of the spark gap, S–102, in the motor alternator and spark gap CRP–21963. Readjusting the voltage regulator to a point where the regulation was better, cleared up most of the trouble. The markers completely cleared up by retarding the spark gap phasing adjustment.
Sweep would not rotate on PPI tube.	Loose gear on antenna synchro. Tighten locking screw and reset microswitches.
Lost all targets. Regulator tubes not lit. Fuse F–206 continuously blew when attempting to start set.	Solder on relay K–201 melted over, shorting 110-volt a-c from the primary of T–201 to ground.

PPI(SO)—Continued

NATURE OF OPERATION	TROUBLE FOUND AND REMEDY
Sweep blanks out intermittently. PPI looks like spokes in a wagon wheel.	McNally out of adjustment. Gain too high, spark gap out.
Jumpy sweeps and targets.	Brush on spark gap worn.
Intermittent, spotty flashing on PPI scope.	Found case of C–343 lying against ground and arcing intermittently. Bent supporting bracket to clear ground. Moving condenser cleared flashing on PPI.
Inability to focus within the range of focus control.	R–481 replaced. Its resistance had gone up too many megohms.
No sweep on PPI tube.	High voltage anode lead found grounded to PPI assembly structure.
Sweep jumps when SW–L control is touched.	Replaced defective R–423 potentiometer.
Spark gap goes off when start button is released.	Bad spring in stop side of starting-stop switch. Replaced switch.
When equipment was operated (by holding in, manually, main contactor of magnetic controller) sweep, but no signals, were obtained on PPI.	V–303, 6AC7 tube, third i-f in receiver CRP–46ACA–1 defective. Replaced from ship's spares.
PPI sweep rotating at an uneven rate of speed on screen of V–407.	Lubricated bearing of coupling shaft between B–401 selsyn and sweep rotating gear assembly. The friction caused by dry bearings would not allow sweep rotation gear assembly to rotate until synchro, B–401, developed enough torque to overcome this drag. The condition of this bearing is good but needed a small amount of lubricant to move freely.
Antenna and sweep stopping intermittently when on ccw.	Cleaned S–402 motor switch contacts. Normal condition restored.
Receiver tuning at limit of hand adjustment.	Set tune set control to give maximum crystal current with hand control in mid position. Found it necessary to tune one vane on McNally slightly, and tuning plug in order to permit tuning through resonance with hand control. Signals which had been barely perceptible before were raised to an E–3 quality.
Ship reported inability to start equipment from STOP-START switch.	Traced cause of equipment not starting to open interlock, S–301, in Transmitter-Receiver CRP–43ABY. Engineers found 2 metal and 1 fiber washer between interlock and support. Removed metal washers, mounting and under head of supporting machine screw and left fiber washer as spacer.
Low sensitivity (SO–3).	Several cases of low sensitivity in SO–3 equipments have been traced to a cracked styramic window (disk) in the transmitter to wave guide coupling transformer. This disk is grayish-black in appearance and is used to seal the TR wave guide against moisture. It may be removed for inspection or replacement by taking out the twisted section of wave guide in the TR, then removing RF–302 and RF–303 (see p. 4–28 SO–3 Instruction Book).

PPI(SO)—Continued

NATURE OF OPERATION	TROUBLE FOUND AND REMEDY
"Wavy" markers and unstable sweep.	Adjusted voltage regulator for alternator output of 115-volt a-c.
No trace on PPI scope. PPI indicator checked OK. Trouble traced to lack of trigger pulse caused by failure of modulator to pulse. Actual trouble was connection on terminal strip E–102. The connections on this panel had been changed and one of them had not been soldered.	Unsoldered connection was fastened to terminal and operation of this unit was satisfactory.
Signals drop off sharply as R–497, receiver tune knob, is turned at indicator.	Critical tuning was due to the fact that maximum signals were not produced at maximum crystal current. Adjustment of V–310 (707B) oscillator, so that maximum signals did appear at maximum current, cured condition.
Intermediate range markers were not present in their usual form. The markers were ¼ inch in width and composed of small dots—these "bands" rotated about V–407 in place of usual markers.	Adjustment of R–429, multivibrator bias control, cleared this situation.
Short, wide trace on PPI tube with large owl eye at beginning of trace.	Defective K–110 relay and very low a-c voltage caused the above trouble. Replaced K–110 thermal relay in voltage regulator. (Taken from Equipment Spares.) Adjusted voltage regulator controls for 115-volt output from alternator.
Very bad irregular patterns of wavy lines were noticed when the marks and echoes were present on the PPI tube, V–407.	The wavy lines condition was cleared up by readjusting R–113 (control for field No. 1 of the alternator).

Transmitter Receiver (SO)

Found no r-f output from magnetron.	Adjusted spark gap and equipment operated normally.
Blower motor B–301 in transmitter did not operate causing thermostat S–302 to open.	Found grounded coaxial sheath shorting terminal 23 inside the transmitter unit. Removed short and equipment operated normally.
Equipment operating but no signals being received. Arcing heard inside transmitter receiver cabinet.	Both troubles due to shutter failing to open. Disassembled shutter assembly, cleaned burned spots at top of r-f wave guide assembly, oiled and reassembled shutter assembly and adjusted for proper operation.
Tuning control apparently "open" having no effect on repeller voltage.	Traced tuning control trouble to loose and corroded connections at terminal panel of rectifier power unit. Tightened all such terminals throughout equipment, cleaned tube prongs, and established operation, returning equipment in process. Recommend periodic check-up and tightening of all terminals in equipment, due to presence of salt air atmosphere and vibration of craft.
Poor shutter action on RF–301, r-f assembly.	Adjusted spring tension on shutter, and stop on solenoid plunger of E–303.
Low V–311 magnetron current.	Advanced spark gap. A retarded setting of the spark gap caused low current of about 4 mils. Increased gap to bring about proper current. Signals improved with increased current.

SO-6, -10 ANT PEDESTAL SPINDLE OIL SEAL REPLACEMENT

Refer to SO-6/10 Radar manufacturing drawing microfilm Reel 25237-1, Frame 491. The oil seal, P97 of manufacturing drawing no. X20-5356 "Gear Case Assembly", may be replaced as follows:

If equipment spare (Tag 1606 in Box No. 9 of equipment spares) is not available, replace with substitute oil seal manufactured by Puget Sound Naval Shipyard. Both Puget Sound and Pearl Harbor have found the substitute seal satisfactory. (CAUTION: Less frequent replacement will be needed if extra time is taken to insure that the neoprene flange of the seal if facing downward with the metal portion mating and press fitting carefully up into P7 spindle gear (of X20-5356 drawing) recess.)

SO SERIES IMPROPER CABLE TERMINATION

Cables carrying various signals utilized by a radar equipment are often a potential source of interference. This case, while peculiar to the SO Series, amplifies the necessity for proper installation of cables carrying high-level signals.

An SO-8 equipment installed aboard ship produced high levels of interference during the post overhaul checkout. All receivers were affected, the interference level being as high as 26 db.

The source was traced to the trigger cable whose outer conductor (shield) proved to be incorrectly terminated at the Plan Position Indicator. The error was apparently the result of confusing terminal markings on P-401. The center conductor connects to terminal "C" and the shield connects to terminal "SH". However, there are two "SH" terminals adjacent to "C" terminal. If the shield is connected to the wrong "SH" terminal, continuity of the shield is lost, allowing the pulse to be coupled to other cables attached to the wrong "SH" terminal, continuity of the shield is lost, allowing the pulse to be coupled to other cables attached to the PPI unit.

The cable diagram in the equipment instruction book illustrates proper terminations of the trigger cable and must be followed carefully. All SO Series installations should be checked in this respect to insure against this source of interference. The following list indicates the applicable books and pages which provide the cabling layout for various models in the SO Series. (Add the Caution note as indicated).

Equipment	Publication No.	Page
SO	ENG 195	(external cabling after page 29)
SO-1	SHIPS 238	(external cabling after page 124)
SO-2	NAVSHIPS 91193	(pages 3-3, 7-73, 7-74)
SO-3	SHIPS 260	(external cabling after page 10-5)
SO-4	NAVSHIPS 900, 321A	(pages 3-3, 3-4, 7-123, 7-124)
SO-6/10	NAVSHIPS 900,860	(pages 3-5, 3-6, 7-11,
SO-a/SO-13	SHIPS 237	(external cabling after page 116)
SO-8	NAVSHIPS 91219	(pages 3-2, 7-75, 7-76)

To the above cabling drawings add Note:

CAUTION: Connect plant position indicator shields only as shown. Use of different shield connections has been found to produce radio interference.

SALVAGING RADAR EQUIPMENT SO P.P.I. CASES

The following suggestion for salvaging Radar Equipment SO P.P.I. cases has been adopted as an improved salvage method. The cases are discarded due to loosened or damaged captive-screw nuts.

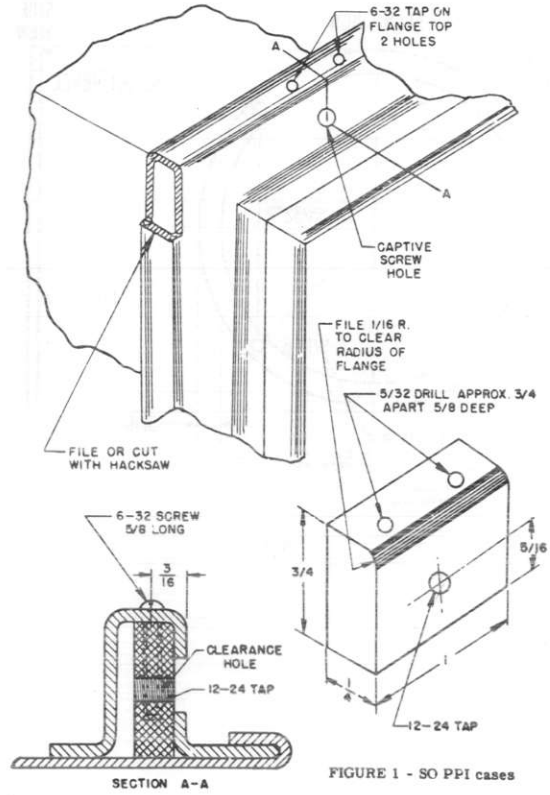


FIGURE 1 - SO PPI cases

Figure 1

The suggested method for replacing broken, damaged, or loose nuts is as follows: (Refer to figure 1). Make new nuts using 3/4-inch x 1/4-inch brass strips. The 1/4-inch width permits the new nut to slide in back of the good nuts on the flange since the internal width of the flange is 3/8-inch. Therefore, only one notch at the corner of the flange is needed to "take care" of the two adjacent sides of the case. The two parallel holes in the top of the nut are slightly oversize to allow the same play of the nut as originally designed. The tapped hole is a standard 12-24 thread. The two securing holes may be drilled entirely through or just far enough to accommodate 5/8-inch long (6-32 thd) screws. Mass production of the nuts can be accomplished by laying out and making the threaded holes first, then cutting the strip into individual nuts.

The above method of rebuilding the indicator unit case, for complete radar overhaul, avoids complete reconstruction of a new case, and gives a satisfactory rebuilt construction suitable for several years of further use.

SO, SO-a, SO-1, SO-2 AND SO-0 RADAR PPI TUBE WINDOW SUPPORT RING

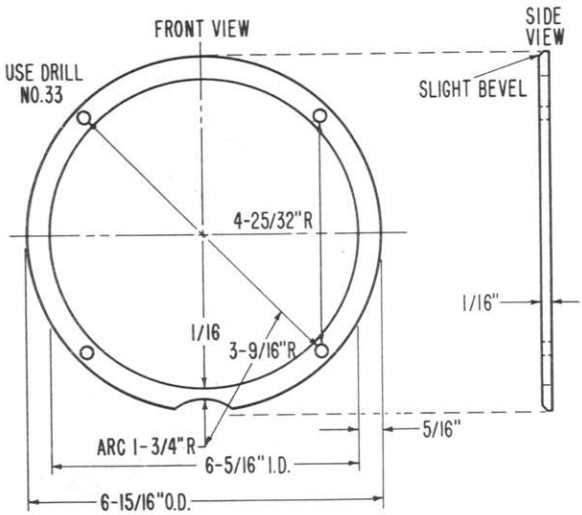


Figure 1

A suggestion for improvement of the support of the PPI tube window rubber mount has been submitted.

A support ring should be fabricated from 1/16" aluminum shown in figure 1. Using the support ring as a template, mark and drill mounting holes through the rubber mount using a No. 33 drill. Utilizing the presently-installed four front-panel screws, mount the support ring over the rubber mount.

SO SERIES DRILLING HOLE ON BEARING CONTROL UNIT

A modification of the amplifier box of Bearing Control Unit NT-23AEK and NT-23AEJ (added by Field Changes 38-SO, 38-SO-a, 41-SO-1, 95-SO-3, 60-SO-8, 85-SO-9, 38-SO-13) has been suggested. Page 4 of the above field change bulletins shows the bearing control unit with cover removed. Note that the amplifier gain adjustment access hole permits screwdriver adjustment of amplifier gain. Note also the + (plus) mark with the note, "Balance adjustment at this point inside case."

An access hole to adjust the amplifier balance potentiometer is suggested. Drilling this access hole may be authorized locally by Shipyard or Repair Activities.

SO-10 RADAR INCORRECT MODULATOR WIRING

Incorrect wiring in the modulator of SO-10 radar, which results in 95 volts being applied to the magnetron filament on long pulse operation, in lieu of the desired 72 volts has been reported. Correct by removing the jumper from H-209 on E-115 to H-309 on E-115 and/or Terminal "C" on T-108 and install jumper from H-209 on E-115 to terminal "B" on T-108.

Pen-and-ink corrections should be made to Figure 7-12 of NAVSHIPS 900-860 to show the above change.

MAINTENANCE LO PREAMP AND AFC UNITS

Maintenance Local Oscillator Preamplifier and AFC Units are now available for all SP Radar-equipped ships that desire one for their equipment maintenance parts.

Radar personnel are advised to contact the Electronics Officer at one of the repair activities listed below:

Mare Island Naval Shipyard
Puget Sound Naval Shipyard
San Diego Naval Repair Base
Oakland, Calif., NSD
Norfolk Naval Shipyard
New York Naval Shipyard
Boston Naval Shipyard
Bayonne, N.J., NSD

COUNTERWEIGHT FOR 6-FOOT ANTENNAS

When the SP 6-foot antennas were first shipped to installation activities, antenna counterweights were not included.

It was soon apparent that without counterweights, a twin axis unbalance existed in the antenna. Installation activities were advised to fabricate counterweights and install them on SP 6-foot antennas. SP 6-foot antennas now in service are equipped with these counterweights.

Counterweights have been fabricated by the equipment manufacturer and distributed to the following Naval repair activities:

Philadelphia Naval Shipyard
Boston Naval Shipyard
New York Naval Shipyard
Mare Island Naval Shipyard
Puget Sound Naval Shipyard
Oakland, Calif., NSD
Mechanicsburg, Pa., NSD

Radar personnel of SP-equipped ships experiencing unsatisfactory performance with the present counterweights should contact the electronics officers at the foregoing activities and request that new ones be installed.

VIDEO OUTPUT TO REMOTE PPI'S AND VG'S

It has been brought to our attention that the operation of remote PPI's and VG's is very unsatisfactory when the SP gain is kept too low. In order for the video to be properly presented in the remote indicators, the SP grass should be kept to about 1/2 inch.

There may be a circuit change in the SP radar in the near future. However, if similar trouble is experienced, the VG can be operated from J-104 instead of the usual remote output circuits. J-104 will give enough video to furnish a good picture on the VG even when the "A" scope grass level is low.

DOUBLE-DITCH TROUBLE ON THE R SCOPE

Reports from the field indicate some trouble has been experienced from a "double ditch" appearing on the "R" scope of SP equipment. The trouble is present when the following combinations of conditions exist: Coarse range handwheel on 5 miles, PPI range selector on 4 miles, and the IFF equipment operating.

At the request of the Bureau, the manufacturer made an investigation and as a result prepared the following corrective measures to be taken when the combination of conditions exist as stated above.

Changes affect auxiliary power unit type CG-20ACR (see fig. 1.)

a. Disconnect wire from R-709 going to X-701.

b. Disconnect bus wire between R-709 and R-715.

c. Reconnect wire taken from R-709 and connect it to R-715.

d. Add a piece of bus wire jumper between free end of R-709 to adjacent terminal of R-748.

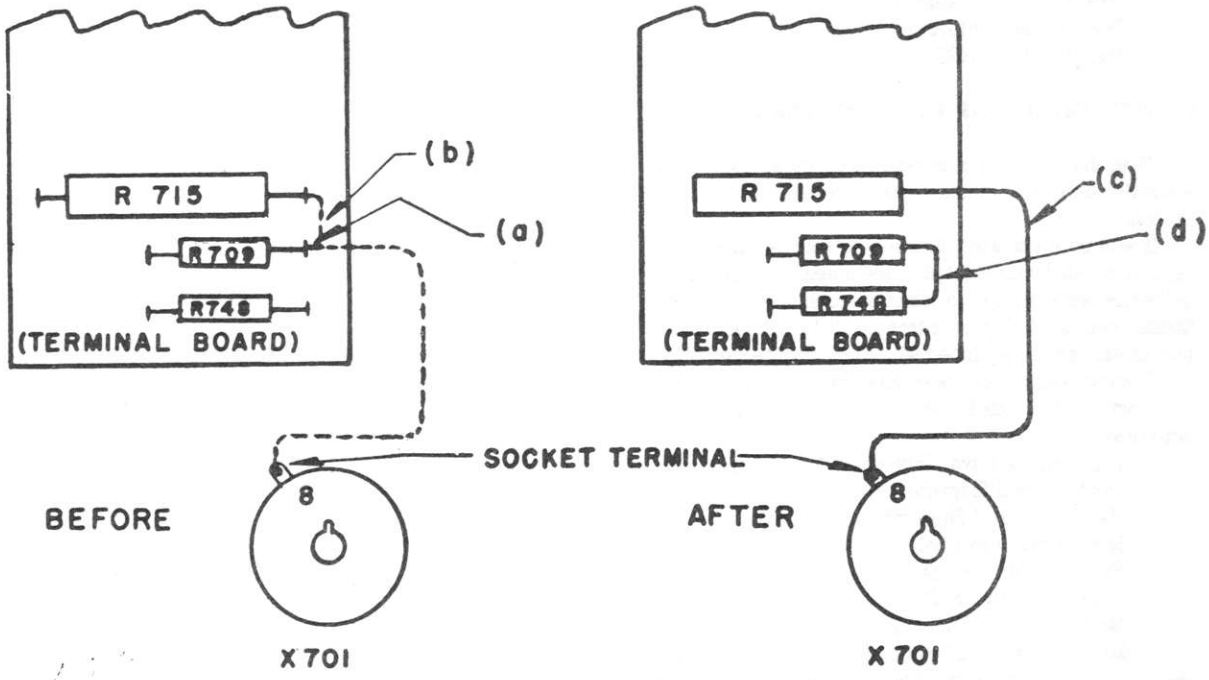


FIGURE 1.—Bottom view of auxiliary power unit.

INSTRUCTIONS FOR INSTALLING COUNTERWEIGHTS ON 6-FOOT ANTENNAS

The following instructions together with the Bureau of Ships drawing RE 10F610A will be of assistance in the installation of counterweights on the SP 6-foot antenna.

1. Remove rear cover of cross levels box by removing acorn nuts and bolts (see side view of drawing).

2. Locate by means of dimensions shown on drawing and drill four 9/16" holes.

3. Bolt the assembled counterweight to cross level box. Seal bolts as per note No. 2 on drawing.

4. Replace cover on rear of cross level box and tighten acorn nuts.

5. Coat counterweights with finish paint and touch up acorn nuts on rear of cross level box cover.

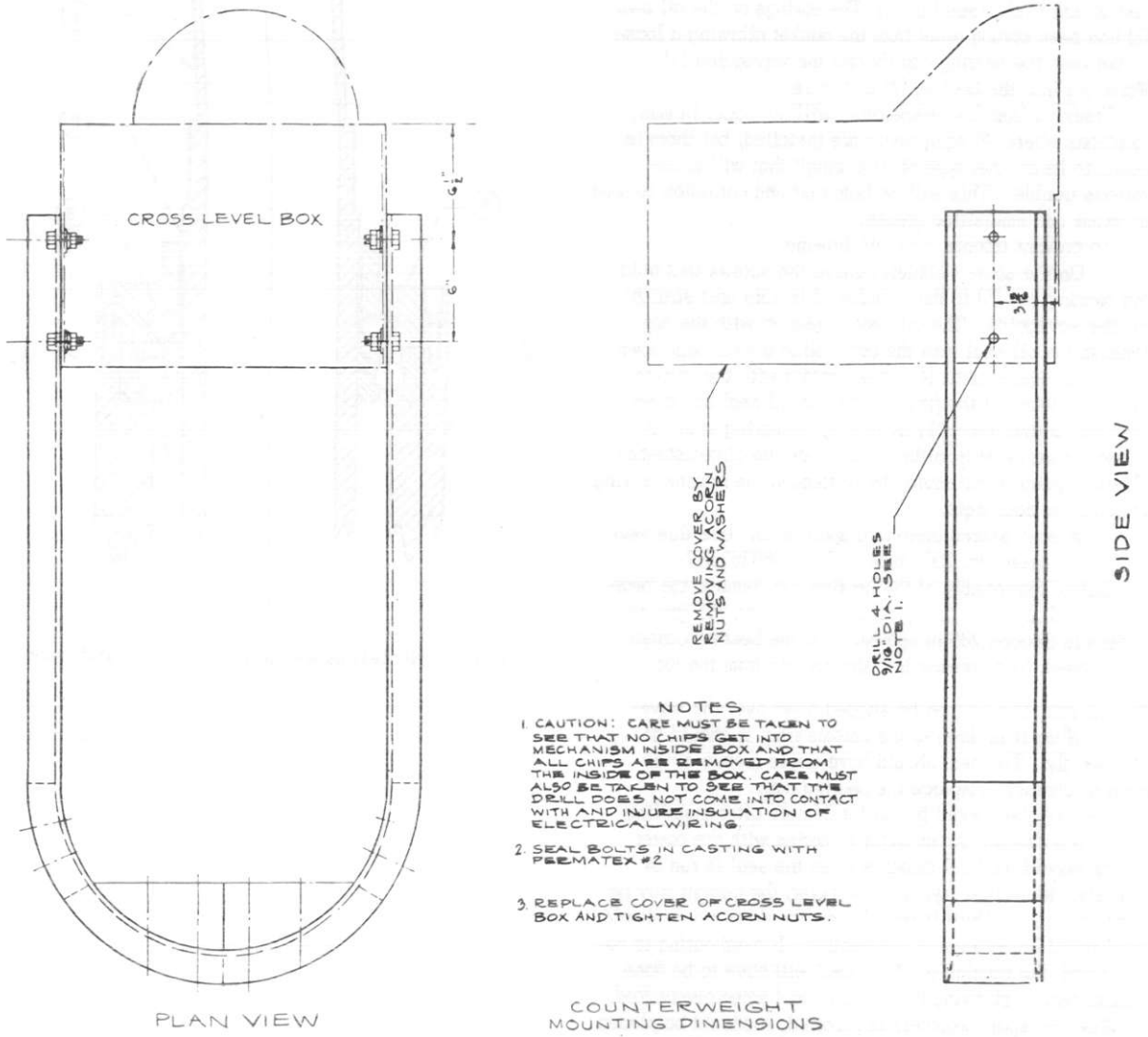


FIGURE 1.—Bureau of Ships Drawing RE 10F610A.

SP WOBBLER—PREVENTIVE MAINTENANCE

As preventive maintenance, the procedure below should be applied to all SP equipments including the spare wobbler with each equipment.

It was discovered on the SP equipments installed at the Naval Research Laboratory, Washington, D.C., that the wobblers failed to rotate after a rain and a freeze.

Investigation showed that water had run into the wobbler at point (2). (see fig. 1.) The springs on the oil seal (3) had been sprung away from the gasket allowing a loose fit between the bearing cap (5) and the waveguide (1). Water got into the bearing (4) and froze.

Freezing from low temperature will not occur in many locations where SP equipments are installed, but there is bound to be another type of "freezing" that will cause serious trouble. This will be from rust and corrosion caused by water and emulsified grease.

To prevent trouble, do the following:

On the spare wobbler, remove the screws that hold the bearing cap (5) to the wobbler. Lift this unit straight off the waveguide. The oil seal comes off with the cap. Remove the oil seal from the cap. Slide the oil seal down on the waveguide until it makes contact with the chrome-plated surface. It the fit is loose, the oil seal has been damaged during assembly by having the spring steel retainer forced away from the seal. Under no circumstances should repairs be attempted by re-forming the retainer spring to make the seal tight.

In antenna spares there is a spare seal. Use this seal: Garlock Klozure No. 2501 type L G. E. 8682678P7.

Before reassembly of the bearing cap, remove the bearing (4) and give it a heavy coating of Beacon 285 grease. (There is Beacon 285 in spares.) If the bearing cannot be removed, force grease into the bearing from the top.

The oil seal should then be slipped down over the waveguide. When it is down to the chrome ring, it should fit very snugly. The seal should have ample grease at the point of contact. Replace the bearing cap.

The wobbler should be run for 3 hours after installing it on the pedestal. An ammeter in series with the power source should read 2.1 amperes when the seal is run in properly. When first trying the wobbler, the current may be higher than 2.1. Until it goes lower, the drive motor should be checked for excessive overheating. If overheating is encountered, the running in of the seal will have to be done intermittently, allowing the motor to cool when overheated.

When the spare wobblers is repaired, it should be placed on the array, replacing the one that has been used.

The replaced wobbler should be taken apart and checked as described above. In addition, if the oil seal is found defective, the complete wobbler should be disassembled and inspected for rust, corrosion, dampness and emulsified grease. If any indications of these are found, the entire wobbler should be cleaned and the bearings inspected for damage.

All SP equipments in the field must have this preventive maintenance performed without delay.

Replacement oil seals are available.

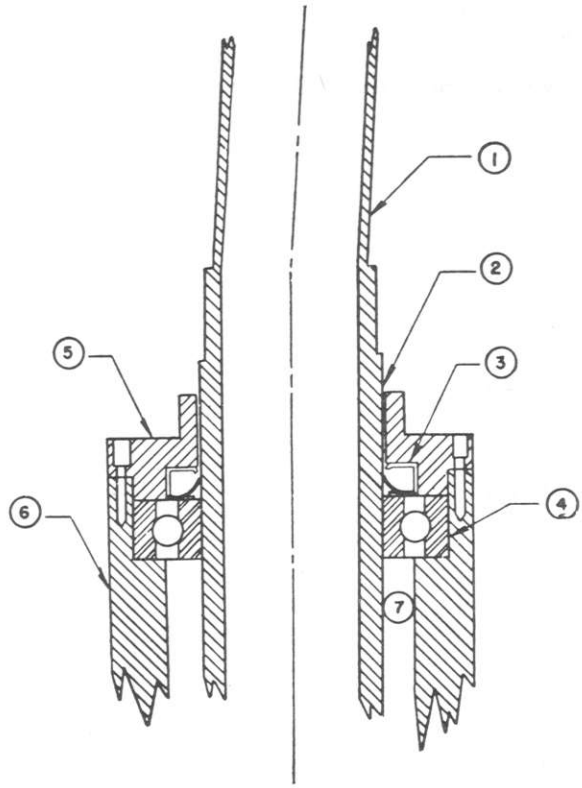


FIGURE 1.—Rotating waveguide, oil seal, and bearing.

UNSTABILIZED TRUE BEARING SP OPERATION

When a failure occurs in the stable element of the SP Radar, it is necessary to shift to "Emergency" operation which places the equipment in an unstabilized, relative bearing, operating condition. When operating in this condition, one of the main features of the SP, the height determining ability, is lost and in addition its usefulness as a long range surface search radar is limited. Unfortunately the loss of the height determining feature must be acknowledged but the decrease in usefulness as a long range surface search radar can be eliminated. A simple alteration of the wiring, well within the capabilities of the technician, will afford a condition of true bearing operation even when the unit is operated in the "Emergency" position. When this wiring change is made no equipment additions are necessary, and component loadings are substantially the same as when operating normally.

This alteration places selector switch No. 1 in control of stabilization only. Control of true-relative bearing operation is vested solely in the true-relative switch on the console. Through the use of these two switches, plainly marked, any of four conditions of operations may be achieved. The red relative bearing pilot lamp is lighted only under relative bearing operating conditions. By effecting this change in the wiring, an "unstabilized-true bearing" condition of operation permits stable element maintenance and balancing without sacrificing the search value of the equipment.

To accomplish the necessary alteration in wiring proceed as follows:

With entire system deenergized, remove jumpers between T3213-1 and T3211-H1 and between T3213-2 and T3211-H2. Energize the entire system including antenna. Measure the normal voltage at terminals 1 and 2 on elevation and cross level amplifiers (TB3351) using a 150-volt a-c voltmeter. Zero voltage should be obtained at terminals 1 and 2 on azimuth amplifier (TB3301), at TB3201 terminals 1 and 2, and at T3213 terminals 1 and 2. This is to insure isolation of azimuth amplifier and T3213 from previous a-c power supply.

DEENERGIZE THE EQUIPMENT

At selector switch No. 1, transfer the leads carrying bearing information to the console direct to OSC leads entering the selector switch (leads on wafers 1, 2, 3, and 4, contacts B and F to contacts A and E, respectively). This places console switch S-1801 in sole control of bearin information. Next rewire wafer 15 (spare) to switch the power supply for the azimuth amplifier to the source of azimuth synchro excitation in accordance with the mode of operation.

Remove the console OSC switch assembly and break the jumper between TB2116 and T-1801. Rewire this connection through one of the two spare microswitches on S-1801, the switch half closed in relative position to be used. This change permits a relative bearing pilot indication only in relative bearing. Replace the switch assembly. To complete the rewiring, utilize the spare wires in the present interunit cables.

After the wiring changes are completed, energize the system and test for proper azimuth positioning. If any 180° errors are present and new wiring is correct in terminal to terminal interconnections, examine old wiring to locate double errors that were formerly self-compensating.

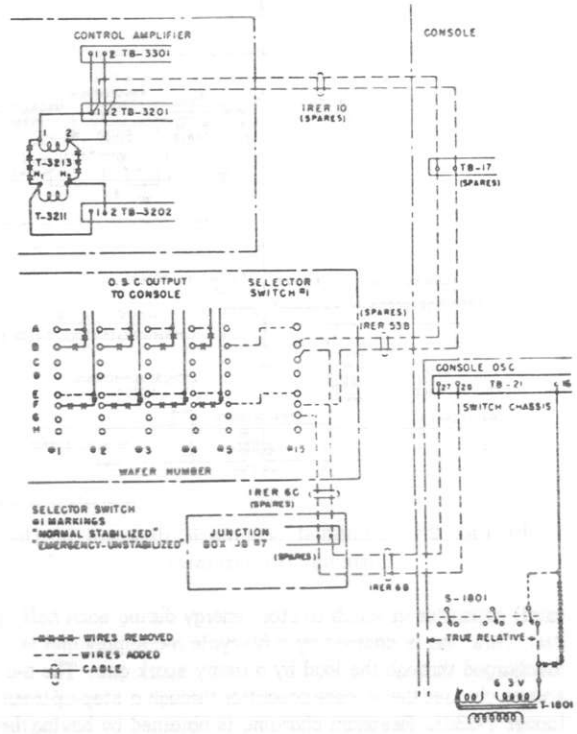


FIGURE 1.—Schematic wiring diagram in SP Selector Switch No. 1 and accompanying components showing method of making changes necessary to accomplish unstabilized, true-bearing operation.

B-MODULATOR OPERATION

SP and SP-1M radars are equipped with two modulators in order to secure optimum results for the two special functions of height-finding and long-range searching. The A-modulator, which is employed while height finding, has performed in a fairly satisfactory manner. Long-range search operation employing the B-modulator, however, has been generally unsatisfactory due to instability. A modification to the original version of the B-modulator was designed and tested, and has been incorporated in some of the later models. Field Change 26 made this modification available for equipments which have not been modified at the factory.

Original Circuit: Block diagram and simplified schematic drawings of the original circuit appear in figures 1 and 2, respectively. Modulator B is a line modulator which utilizes the capacity of an artificial transmission line (E-2301) as a

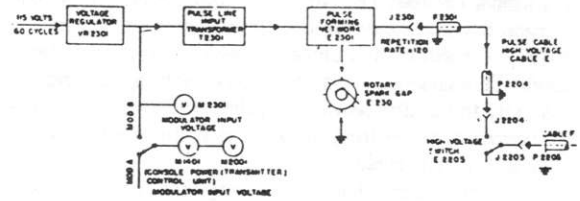


FIGURE 1.—Simplified block diagram of the original SP/SP-1M *B*-Modulator.

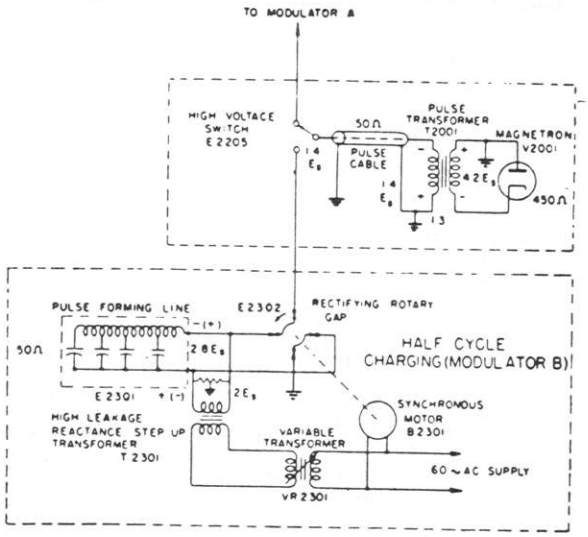


FIGURE 2.—Simplified schematic diagram of the original *B*-modulator.

small capacitor in which to store energy during each half cycle. This line is charged by a 60-cycle a-c supply and is discharged through the load by a rotary spark gap. The a-c source charges the storage capacitor through a step-up transformer T-2301. Resonant charging is obtained by having the charging inductance (leakage reactance of the step-up transformer) and storage capacitance resonant at the impressed 60-cycle frequency. A family of curves showing a variation of charging current and storage capacitor voltage increase as a function of time is presented in figure 3. The maximum value of current, and therefore the capacitor voltage, is limited only by the resistance of the circuit.

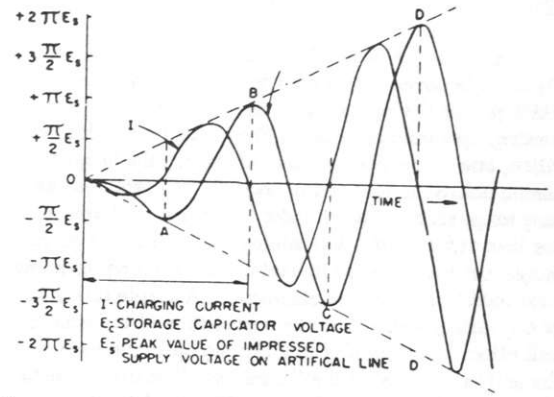


FIGURE 3.—Curves illustrating the variation of charging current and storage capacitor voltages as a function of time.

The speed of the rotary spark gap (1,800 rpm) is such that half-cycle operation gives a repetition rate of 120 cycles. For half-cycle operation, point A in figure 3 is used for the discharge of the capacitor into the load, as it is a point of fairly constant voltage. After the first charge and discharge, the charging current reverses polarity and the capacitor is charged to the opposite polarity on the second charge as shown in figure 4. Repeating this cycle results in successive charges and discharges of alternate polarity. As the magnetron load can only take negative pulses, rectifier or commutator action is supplied by the commutator-type rotary spark gap (E-2302A) to utilize both positive and negative discharges.

Pulse shaping is accomplished by having an artificial transmission line (E-2301) having an impedance equal to the load resistance. Under this condition, at the instant of discharge one-half the voltage on the line appears across the load resistance and the remaining voltage initiates a traveling wave of —E/2 that travels down the line. When this wave reaches the open end of the line, the line is charged to E/2. This traveling is reflected back without change of polarity. During the time the traveling wave was

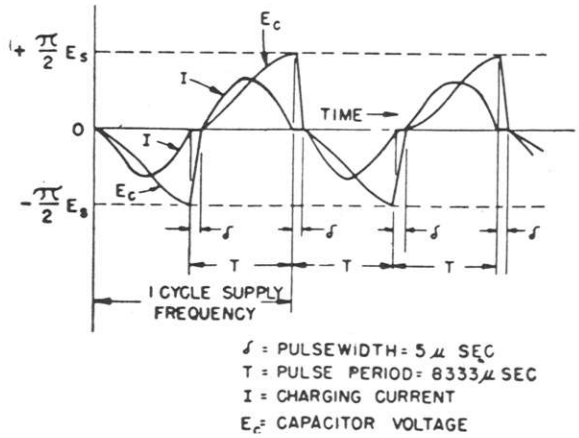


FIGURE 4.—Charging current and storage capacitor voltage waveforms during half-cycle operation, showing the reversal of polarity with each charge and discharge of the circuit.

proceeding to the open end of the line and being reflected back to the starting point, a constant voltage of E/2 has existed across the load resistance as shown in figure 5.

When the reflected wave of $-E/2$ reaches the starting point it cancels out the E/2 across the load resistance, thus terminating the pulse.

Since an artificial line is used, the pulse is not quite rectangular but has a slight rise and fall time, rounded

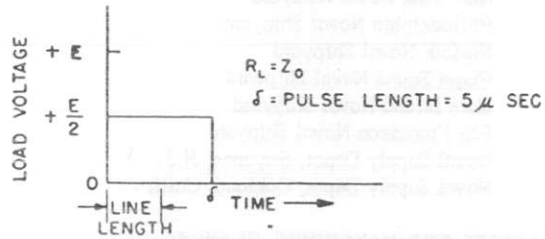


FIGURE 5.—Development of the pulse across the load resistance. During the time the impressed voltage wave travels the length of the line and back, a constant voltage of $E/2$ is impressed across the load resistance. The returning wave being equal to $-E/2$ cancels the impressed voltage, terminating the pulse.

corners, and voltage variations on top of the pulse. The output is approximately 10,000 volts which is stepped up by the pulse transformer T-2001 to the necessary voltage for correct magnetron operation.

Voltage regulator VR-2301 permits adjustment of the modulator voltage by adjusting the voltage input to the primary of T-2301. The output of T-2301 is $2E_s$ where E_s is the peak voltage to ground of the transformer secondary. This charges the line to πE_s which is reduced to $2.8E_s$ by circuit losses. Pulse line E-2301 will then furnish a 5-microsecond pulse of E/2 or $1.4E_s$ to the transmitter.

Most of the modulator trouble is caused by failure of the rotary gap to fire. The gap is actually a rectifying device with 4 gaps in series, and is, in effect, a synchronous rectifier. The voltages across all gaps are about the same, and are equal to approximately one-quarter of the charging voltage which, when shorted by the gap, applies a pulse of twice the normal voltage. This erratic operation is very objectionable and eventually ruins the magnetron.

Modified Modulator: Field Change 26 adds a double-diode spark-gap stabilizer (V-2301 and V-2302), a despiker network (R-2310 and C-3404), and changes 3 of the 4 stationary pins of 120-mil diameter to new pins of 80-mil diameter. The addition of the double diodes causes the full charging voltage to be placed across 2 gaps in series instead of 4 as shown in figure 6. When point A is positive and point B is negative, diode 2 conducts, effectively grounding point B through a 1-megohm resistor and allowing point A to rise full charging voltage E_c. This voltage is grounded through 2 rotary pins C, which places a negative pulse of value $E_c/2$ through pins D across the magnetron to ground. On the next half-cycle the polarity of the transformer is reversed and tube 1 grounds point A through a 1-megohm resistor and point B rises to full E_c, is then grounded by pins C and the pulse line applies a negative pulse to the

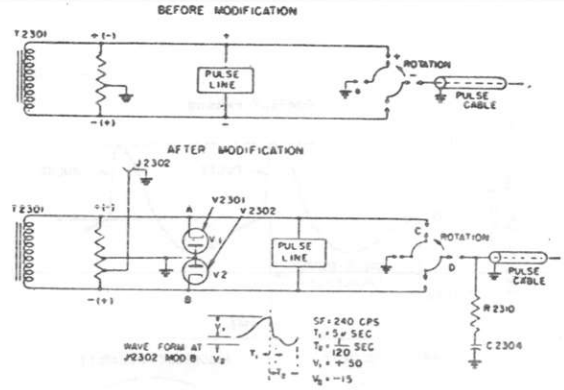


FIGURE 6.—Simplified schematic diagram of a portion of the *B*-modulator before and after Field Change 26 has been installed.

magnetron of value $E_c/2$ through pins D. Therefore it is seen that the cycle of break-down is always started by a positive voltage of value E_c to ground, which permits stable arcing. Negative voltage polarity will not accomplish this.

The despiker consists of R-2310 and C-2304 in series, as shown in figure 6. This is placed so as to take energy out of the front of the pulse, thereby reducing its rate of rise. This is necessary since the magnetron is not a constant-impedance device but presents practically an open circuit to the front of the wave and, due to the time delay in firing of the magnetron, the voltage may exceed the normal operating voltage before the magnetron fires. This causes a spike on the front of the wave which, if large, will reduce the tube life. Slowing down the rate of rise reduces the height to which this spike can increase before the tube operates. Replacing the 120-mil pins with 80-mil pins increases the voltage gradient in the gap space and improves firing.

One method of phasing is to place a signal from the magnetron current circuit on an oscilloscope. This can be taken at the undercurrent relay potentiometer R-2008. The phasing is then adjusted until the sawtooth voltage at this point has the same amplitude on alternate voltage rises.

Rotor pins can be replaced by rotor pins from the A-modulator. This permits the stationary pins to protrude an additional amount without excessive overlap and permits easier removal. An overlay of one-eighth inch is recommended. All spark gap pins should be cleaned when dirty, but care must be taken not to cut through the special protective finish on the surface of these pins. When they become pitted they should be replaced.

It is necessary to allow at least 5 minutes for filament-heating time before radiating. It is then advisable to radiate first at 20 milliamperes, increasing the current slowly to 28 milliamperes over a period of 5 minutes. The magnetron should operate satisfactorily up to 28 milliamperes, although some will arc at that high a value. If this condition is present it indicates that the magnetron requires additional aging. Many magnetrons that fail in the B-modulator will work satisfactorily in the A-modulator. To reduce arc-over, the magnetron must be exactly centered in the magnet jaws. It is also very important to have adequate ventilation through the gap and over the magnetron.

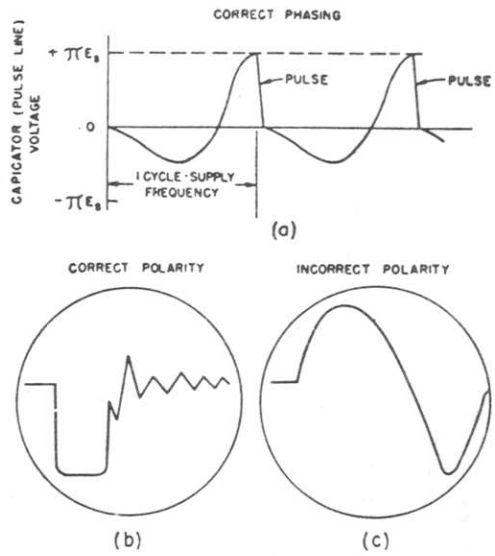
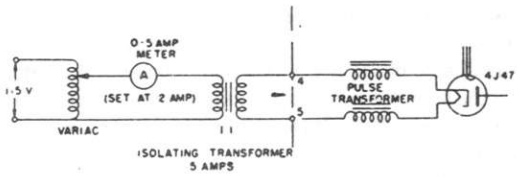


FIGURE 7.—Wave shapes as viewed on the transmitter synchroscope showing (*a*) correct phasing, (*b*) correct polarity, and (*c*) incorrect polarity.



The 4J47 magnetrons can be aged in the B-modulator by raising the filament current to 2.0 amperes and plate current to 28 milliamperes. The excitation is then raised over a period of half an hour to a plate current of 40 milliamperes. This should be accomplished slowly, so that arcing inside the magnetron does not cause the transmitter to drop off the line. When 40 milliamperes is reached, it should be held for about one minute and then reduced to 28 milliamperes. To permit the filament current to be set at 2.0 amperes, it is necessary to add an isolating transformer and Variac as shown in figure 8.

The synchroscope in its present form does not reproduce some wave shapes correctly. A modification is in process of distribution which will improve this operation. The echo box should not be used with the B-modulator.

Technical personnel charged with operation and maintenance of SP equipments should carefully study the above notes and endeavor to follow them in servicing the units in the future.

SPECIAL TOOLS FOR 8-FOOT ANTENNA

A supply of special tools for the assembly and maintenance of SP 8-foot antennas are available. Radar personnel of SP-equipped vessels desirous of acquiring a set of these tools should request them from the Electronics Officers at one of the following Naval activities:

Boston Naval Shipyard
New York Naval Shipyard
Philadelphia Naval Shipyard
Norfolk Naval Shipyard
Puget Sound Naval Shipyard
Mare Island Naval Shipyard
San Francisco Naval Shipyard
Naval Supply Depot, Bayonne, N.J.
Naval Supply Depot, Oakland, Calif.

GASKETS FOR WAVEGUIDE FLANGES

A report received from a Naval Shipyard indicated that a particular SP radar had not operated with any degree of efficiency for many months.

Investigation by engineers led to the conclusion that a defective rotary joint existed in the antenna. Removal of the antenna revealed that hard asbestos gaskets were installed between the waveguide angle connector to stub tuner section and the vertical waveguide. Further inspection of the waveguide run below the antenna revealed similar gaskets, located in each of four successive waveguide flange connections. The rotary joint was in good condition, but deposits were found between the waveguide flange and gaskets. After the proper gaskets were installed the operating efficiency of the equipment was greatly increased.

The proper gaskets for use on Model SP Waveguide flanges are made of neoprene. As emphasized by the above incident, it is inadvisable to install substitute gaskets except as an emergency measure. If such a measure is taken, it is requested that a tag indicating the type of gasket used be wired to each waveguide junction where a substitute gasket is installed.

NEW NAMEPLATE FOR TYPE CG-21ACN MOTOR DYNAMO AMPLIFIER UNIT

The Bureau has been advised that the Type CG-21ACN Motor Dynamo Amplifier Units of the SP radar equipment were furnished with improper nameplates reading CG-21ACH.

Nameplates with the proper nomenclature, CG-21ACN are available for all SP radar equipments. The new nameplates do not include the serial number of the equipment but have been provided with a blank space for this purpose. Before installing the new nameplate the serial number of the equipment should be stamped in this space.

All vessels equipped with the SP equipment are requested to requisition the new nameplates from the electronics officer at any of the following naval shipyards:

Boston	Philadelphia
Norfolk	
New York	Puget Sound
San Francisco	Mare Island

CONDITIONING FIELD CHANGE 61-SP

During initial operation of SP radar antenna, after installation, it was observed that the nutating drive mechanism was noisy. The measured nutating drive motor current was 25 amperes. Disassembly of Field Change 61 revealed that the bearings in the waveguide were defective and the grease in the bearings was hard and dry, thus preventing proper lubrication of the bearings.

A spare nutating assembly was disassembled and the grease in its bearings was also found to be hard and dry. The bearings were cleaned, properly lubricated, and assembled in the housing. The field change then performed satisfactorily and the drive motor current measured normal.

It is requested that all United States naval shipyards stocking Navy Field Change 61-SP check the field change, and if it is determined that it has been in stock for one year, it should be removed from stock and conditioned. Included with the field change bulletin is G.E. Dwg. No. W-9076755, figure 25. The bearings and gears should be cleaned and lubricated in accordance with the instructions of note 8 on the aforementioned drawing. The field change should then be reassembled and placed back in stock. NOTE: Naval shipyards that receive this field change from N.S.D., Mechanicsburg, and N. S. D., Clearfield, should inquire from these activities as to the length of time Navy Field Change 61-SP was held in their stock prior to releasing.

TESTS OF "B" MODULATOR

Radar Equipments SP and SP-1M are provided with two modulators, the A-modulator for 1-microsecond pulses and the B for 5-microsecond pulses. The A-modulator has been satisfactory, but operation with the B-modulator has been reported to result in very short 4J47 magnetron life due to internal arcing. At least part of this trouble was originally due to failure of the rotary spark gap to fire consistently; a misfire caused the next modulator pulse to tend to be at twice the normal voltage. In spite of a field change provided by the manufacturer to help insure steady firing of the gap, and other work by the manufacturer and by the Electronics Field Service Group at the Naval Research Laboratory, the trouble is reported to have persisted to such an extent that the B-modulator is rarely used in the fleet or the field.

The Naval Research Laboratory has been investigating the B-modulator problem for some time. Continuous-operation tests using the B-modulator were first made with new magnetrons to obtain the life expectancy, but no failures whatsoever occurred, and these tests were discontinued after it became apparent that lives of several hundred hours, at least, were to be expected. Attention was then concentrated on producing internal arcs in the magnetrons. It was found that, with the rotary spark gap in proper condition and with the use of approximately normal pulse voltage, arcs can be produced only by applying pulse voltage before sufficient cathode-heating time has elapsed. The heating time required to prevent arcing decreases rapidly from the value of a few minutes characteristic of a new tube to about 20 seconds with a well-aged tube. Of most importance is the fact that the tubes are able to stand many repeated instances of heavy arcing. Only a small percentage have failed.

The most significant observation has been that at low pulse voltages (below about the 20-ma plate-current level) the magnetron, due apparently to oscillation in an improper mode, couples very little power into the waveguide, and there is increased r-f leakage power on the cathode lead. Corona and sparking in the jelly filling of the protective glass tube around this lead results. (There will also be occasional r-f sparks from the anode block to the magnet, due again to leakage of r-f power.) This r-f corona and sparking in the cathode lead tube looks very much like the flash due to reflection of the light from a true internal arc within the magnetron, but is easily distinguished from the latter in a number of ways: (1) The flash from the r-f effect will be seen on the cathode lead only, and not on the other filament lead, whereas a true internal arc is seen by reflection in both filament lead tubes; (2) The r-f effect will cause no change in the appearance of the modulator pulse seen on the monitor scope, but a true arc short-circuits this pulse, so that it "misses" when an arc occurs. This miss can be seen easily when the arcing occurs occasionally. If the arcing occurs very frequently, but not on every pulse, the normal pulse shape will be seen but with the sweep baseline extending across the bottom of the pulse. (3) A true arc will cause the standing-wave-indicator needle to jump, but the r-f sparking and corona will not.

The r-f corona and sparking will cease as the pulse voltage is raised. It is thought that much of the trouble reported from the field has been due to observation of this r-f effect. A new magnetron would normally be started with low pulse voltage (particularly now that the belief is prevalent that the tubes are frequently with the B-modulator). This would produce the r-f corona which might be mistaken for internal arcing. The voltage would then certainly not be raised. When the "arcing" did not clear up, the tube might be discarded as having failed.

The sistuation is slightly complicated by the fact that at very low pulse voltages, in addition to the r-f sparking, there will occasionally also be some actual internal arcing in the magnetron. This is due to the fact that the voltage is so low that the rotary spark-gap may misfire occasionally, causing the following pulse to be at too high a voltage. If the magnetron is not actually defective, this arcing also will cease when the pulse voltage is raised—it does not indicate a poor magnetron.

The Naval Research Laboratory has been attempting to obtain field-used magnetrons which are reported "inoperable with the B-modulator but satisfactory with the A-modulator". Of twelve such tubes received so far, nine operate normally with the B-modulator. This lot of twelve tubes included five type 720CY tubes, of which two were failures, and three non-factory-aged type 4J4/720CY tubes, of which one was no good, accounting for all the bad tubes. The Naval Research Laboratory is still interested in testing such field-used tubes which are reported inoperable with the B-modulator but satisfactory with the A-modulator. A very

brief history of such tubes, accompanying them, would be appreciated. Please address tubes to: Naval Research Laboratory, Anacostia 20, D.C.

The following procedure is recommended for use with the B-modulator: Whenever it is possible, the magnetron should be allowed to warm up for two or three minutes with just the filament voltage alone applied (adjust it to 12.5 v) before the high voltage is applied. This should be done, even though, as noted above, it is not strictly necessary with tubes which have been broken in. A new tube should be given a warmup period of about 10 minutes before high voltage is applied. In the case of magnetrons which have been used previously, the pulse voltage usually can be applied at the full operating value, without the necessity for starting at low voltages. If any internal arcing is observed, the pulse voltage should be reduced somewhat, for a time. New tubes should be started at lower voltages, preferably at about the 20-ma. plate-current level. If lower voltages are used, and the r-f corona and sparking (and perhaps some internal arcing) are observed, the pulse voltage should be raised. Increasing the voltage to the point where the plate current is about 18 to 20 ma. will generally stop the corona and any internal arcing. Above this level, if any internal arcing (which can be distinguished from the r-f corona as explained previously) persists, the pulse voltage should not be raised higher until the arcing stops. It may be well to turn off the high voltage for a few minutes, and it should then be reapplied intermittently at the same level for short periods until the arcing ceases. Any new magnetron will have a tendency to arc occasionally, and intermittent operation at intermediate pulse voltages is best if the arcing is frequent.

The rotary spark gap should be kept in good condition. The points should be clean and the gaps correctly adjusted. The V-2301 and V-2302 tubes and R-2308 and R-2309 resistors of Field Change 26 should be checked if persistent magnetron arcing develops. A failure of one of these components is very likely to cause arcing. The small-diameter fixed pins supplied by this field change also help to prevent arcing (provided the gaps are correctly adjusted), but most of the improvement is provided by the tube circuits.

The air-cooling channel for the magnetron should be kept clean. The dust filter at the air intake may become clogged, and when the circulation is reduced the magnetron will run excessively hot.

Factory-aged 4J47/720CY tubes can be operated up to 30-ma. plate current, and the older type 720CY and non-factory-aged 4J47/720CY tubes up to about 28-ma. without arcing. In addition, after the non-factory-aged 4J47/720CY magnetrons have been operated for a while, their place current can be raised to 30-ma.

A-MODULATOR MOTOR FAILURE

Certain SP radar-equipped vessels have reported failures in the A-modulator motor caused by creeping of the rotor vanes. This condition was disclosed by failure of the stator winding as a result of scraping. In another case the rotor could not be removed from the housing due to the increased radius of the vanes. The vanes which failed are on the side of the motor rotor next to the generator section. The vanes on the other side are shorter and therefore not subject to failure.

It is recommended that all A-modulator motors be examined for creep of the aluminum vanes during each availability. All lengthened vanes should be shortened in the shipyard machine shop, after which the rotor must be rebalanced.

OVERHAUL OF ANTENNAS

All activities are requested to examine SP radar antenna installations to determine whether or not the supporting base is blanked off to prevent corrosive stack gases and moisture from attacking the waveguide tuner assembly and microswitches.

Installations with open pedestal bottoms should be corrected at first availability or antenna overhaul.

When an SP radar antenna that has had extensive use is being overhauled, all the microswitches should be replaced to reduce later possible failures.

The improved stowing lock manufactured as shown on New York Naval Shipyard Plan Bureau of Ships No. S6705-325988, should be installed on all type 66AHP antennas for radar picket ships. This lock is available upon request to the Bureau of Ships, Code 684.

ANTENNA DIFFICULTIES

Scanner motor had burned out on the nutator assembly. The ship was in port under cancelled orders so the ship's force had replaced the motor. Inspection revealed the scanner assembly was frozen. This assembly was removed and taken to the shop in the yard where it was determined that the large double row self-aligning bearing at the front of the wave-guide assembly was frozen due to salt water corrosion and lack of lubrication. Since no new bearings were available in maintenance parts or at the base, the bearing was removed with great difficulty, washed and cleaned thoroughly, relubricated and reassembled. This disassembly was difficult due to a shortage of the proper tools although the ship had ordered an antenna tool kit some time previous but same had never been received. Fortunately this tool kit was delivered while repairs were being made on the assembly and proved to be very useful when making the reassembly. Heavy fiber grease had been used in lubricating the assembly at some previous time and this could have been a contributing factor to the motor failure. A thorough search disclosed a small amount of the proper lubriplate for this assembly and when reassembled this lubriplate was used instead of the heavy fiber grease.

The ship also had two train amplidynes which had burned out (motor fields). The last failure of these two was carefully examined which disclosed that the starting winding was badly burned but the main or running winding was in apparently good condition. The starting switch was also

charred but the contacts were not harmed. The centrifugal mechanism was operating satisfactorily. Both the motor failures had occurred during severe weather conditions—near typhoon—with the train system locked in 1 speed. It is not known how the current limit potentiometer had been set, and other higher priority work prohibited checking this particular item. The line voltage was normal during the time failure occurred insofar as memory and records could determine. The only explanation for amplidyne failures was that perhaps during heavy weather with 1-speed operation, excessive hunting may have occurred, and with the possibility of the current limit potentiometer being misadjusted, may have caused sufficient overload to burn out the motor. The other possibility is that the motor speed was low due to excessive load, low line voltage, or mechanical drag and stuck in the starting position.

I next inspected the repaired train amplidyne and found that the motor did not turn freely by hand. After removal of the motor and bell the rotor still seemed to be dragging and in addition the brushes were riding over the end of the commutator. There were no shims in the motor and bell. It appeared as if the motor field assembly had some extra varnish on the inside and in addition may have been misaligned slightly causing some dragging.

Ship reported that after having spent several days on the SP installations, they were unable to get the antenna to rotate. In addition to nonrotation, the elevation system would not function.

Investigation disclosed an 1,800-ohm resistance to ground from the armature winding output lead on the train amplidyne. Further investigation showed that the trouble was in the No. 2 brush. The insulating sleeve had a voltage breakdown, resulting in a burned hole approximately the size of a penny. The 1,800-ohm resistance was caused by the carbon path across the burned spot. The amplidyne was disassembled and a new brush and insulating sleeve were installed which corrected the trouble.

The elevation servo system was causing a loud noise in the amplidyne indicating an extra heavy load on same. A check revealed a low reading on the elevation drive motor armature. Disassembly of the motor revealed the armature was burned beyond further use. All of the insulation on the armature wires had been burned off. A new motor was installed and the SP was again in an operating condition.

RADAR EQUIPMENT SP STUB TUNER GEAR

It has been suggested that stub tuner gears on 6-foot and 8-foot antennas for Radar Equipment SP be fabricated of nylon to give them greater durability.

Present stub tuner gears are made of fiber. This gear is identified as Piece no. 16 of BUSHIPS drawing T-8601755.

Bureau authorization is granted to local installing and overhaul activities to use this suggestion at their discretion. Accomplishment may be effected during overhaul of SP equipments.

MODEL SP SERIES TROUBLESHOOTING NOTES

Notes on Recurrent Failures

Stable Element

NATURE OF OPERATION	TROUBLE FOUND AND REMEDY
Considerable trouble was experienced in unstable operation in train when operating from stable element. Smooth rotation could not be obtained regardless how accurate the stable element train amplifier was adjusted.	This trouble was traced to Bendix synchro amplifier. The power leads furnishing 115 ac to electronic portion of amplifier were in same cable with c. t. voltage leads. The gyro supply and amplifier power supply were from separate sources, therefore, were not at same frequency. This resulted in enough pickup in c. t. wires from power leads to cause considerable hunting of stable element train system. This condition was corrected by wiring a separate cable to furnish power to amplifier of Bendix.

Antenna System (SP)

NATURE OF OPERATION	TROUBLE FOUND AND REMEDY
Moisture was located between the mica sheets of the moisture shield in the wobbler snout. Arcing was caused at this point. Additional arcing was located in the waveguide at the coupling between the elevation rotary joint and the wobbler gearing cover. Poor performance indicated other points of arcing which because of lack of time were not located.	The mica disc in the wobbler snout was replaced. The rubber gasket at the coupling was poorly installed such that it overlapped the quarter wave stand off and caused arcing. The gasket was replaced.

Antenna Elevation Assembly (SP)

The wing spot did not follow the azimuth and elevation handwheels, moving exactly opposite to the direction of the SP in the radar school and confusing the operators.	To correct the trouble, leads 803–39 and 40 were interchanged and RB 803–37 and 38 were interchanged.

Antenna Control System (SP)

The equipment was accurate at tracking speeds but would not meet specifications at training speeds. The error voltage in 36 speed was 12 volts at 6 revolutions per minute.	The 36 speed input was dropped from tap 4 to tap 3 on T–3301. This caused an increase in gain and the system hunted. It was extremely difficult to find an adjustment to keep the system from hunting. The lead was put back to tap 4. The field voltage measured in the control amplifier assembly at TB–3205 3 and 4 was 125 volts; measured at the antenna at 3133 4 and 5 it was 123 volts. The lead in T–3210 tap 3 was moved to tap 4 increasing the a-c voltage on CR–3210. The output voltage of the rectifier was raised to 135 volts or 133 volts at the antenna. With the field voltage the amplifier was realigned and the error voltage at 6 rpm was dropped to 4 volts.

Transmitter (SP)

With transmitter on standby and AFC-MANUAL switch on AFC, AFC would not lock in when transmitter was thrown to radiate. Crystal current would rise quickly to full scale deflection and then drop slowly to almost a minimum reading by starting out with the AFC-MANUAL switch on MANUAL and then going to RADIATE, the AFC would lock in when the AFC-MANUAL switch was thrown to AFC about 75 percent of the time. When the AFC refused to lock in, by waving a hand in front of the standing wave probe slot in the wave guide we could usually cause the AFC to lock in. A check was made and as nearly as we could tell all field changes proposed to increase AFC stability had been made.	A new shielded unit was secured from another equipment. When it was installed, all trouble with the AFC ceased.

MAXIMUM OPERATING VOLTAGE

The Bureau of Ships directs that until further notice, Radar Equipment SR be operated at a maximum plate voltage of 11 kv.

ANTENNA SERVICE NOTES

The antenna and pedestal as supplied with SR radar equipment is a low pressure system. It is only necessary to maintain a positive pressure of a few ounces to permit the system to breathe out, thus making it impossible for the line to take in moisture laden air or spray which would eventually corrode or freeze, causing damage to the line.

The 3-inch line incorporated in the pedestal design is of sufficient size to permit operation of the equipment at full power output without arc-overs. This is in sharp contrast with the 1-5/8-inch line in general use at this time on other equipments. The 1 5/8-inch line is a high pressure system requiring pressures up to 10 pounds of dehydrated air to prevent arc-overs at normal power outputs.

The test specification which applies to the SR system calls for a maximum pressure of 5 pounds to be applied and that the pressure shall remain positive for 30 minutes. If the antenna meets this test it is satisfactory.

Disassembly for shipment and assembly for installation will undoubtedly cause some leaks in the line; therefore, a thorough check, at time of installation, of all couplings and seals will be necessary. If any leaks do develop observe the following:

a. The rotating joint at top of pedestal dome should be inspected, making sure the oilite bearing between the antenna T section and the vertical line in the pedestal is clean and undamaged. Also check the bellows retainer ring.

b. The gland nuts at bottom of pedestal T section should be checked, using the large spanner wrench to be found in antenna tool kit. These nuts muste be pulled down with extreme pressure to insure against leaks at lead seal.

PRECISION PPI TRIGGER DELAY LINE TYPE CRP-14ABD

When precision remote PPIs, VF or similar precision remote equipments are used in conjunction with SR radar, it is necessary to compensate for the delay presented by the receivers, video circuits, coax lines, etc., to realize full accuracy from these equipments. Compensation may be accomplished by inserting a variable trigger delay between the transceiver and console of the SR equipment, thereby delaying the trigger by the same amount to all units, i.e., units of the SR console and all remotes. This will furnish accurate correction for those remotes with coax lines of the same length and partial correction for the balance dependent upon the length of the remote lines.

A variable delay trigger unit is available at Naval activities for bulkhead mounting and should be connected into the trigger circuit by feeding trigger from J-106 of the transceiver to the input of the delay trigger unit and connecting the output of the delay trigger unit to the SR console trigger input terminals No. 80 and No. 01. Make sure the termination of the unit is 70 ohms. To compensate fully for the delay in the SR system, a trigger delay of approximately 0.7 microsecond is necessary.

SERVO AMPLIFIER ADJUSTMENT

Since the transmitter room has been established as the location for the rotation control unit, the following step by step procedure using an a-c meter for indication when making correct adjustments of the GAIN, BALANCE and ANTI-HUNT controls of the servo amplifier will be found useful.

If Navy Field Change 17 (changing V-1101 to a 6SL7 and reducing antenna rotation to 2-1/2 rpm) has been made, the voltage in item e will be approximately 28 volts a-c. If the change has not been made the voltage will read 14 volts a-c.

a. Turn GAIN CONTROL to full clockwise position.

b. Turn ANTIHUNT CONTROL to approximately three-fourths clockwise position.

c. Connect the 50 volt range of meter to terminals 63 and 64.

d. Adjust BALANCE CONTROL until steady voltage is obtained.

e. Turn SLEWING CONTROL switch to 1-1/4 rpm position, advance GAIN CONTROL slowly until antenna follows in both clockwise and counter clockwise rotation. Voltage fluctuating at approximately 42 cycles per minute indicates that the antenna is not following. If voltage fluctuates rapidly and antenna is following, hunting is indicated. Adjust ANTIHUNT CONTROL until fluctuation disappears. Adjust GAIN CONTROL until meter reads as indicated in the second paragraph.

f. Turn SLEWING CONTROL to high speed position and check whether antenna follows in both clockwise and counterclockwise rotation. Correct following will be indicated by needle remaining steady. If antenna does not follow, turn SLEWING MOTOR SWITCH to off position, increase gain slightly and repeat.

g. Adjust BALANCE CONTROL until voltage reads the same in both directions of rotation. Hunting in one direction and not the other indicates improper adjustment of the BALANCE CONTROL.

h. As a final adjustment for hunting, connect a-c voltmeter, using a .5 microfarad condenser in series with one lead, to terminals 68 and 69. Adjust ANTIHUNT CONTROL for minimum reading.

i. Lock potentiometers.

SYNCHRO AMPLIFIER MAINTENANCE PARTS

Equipment maintenance parts for the Bendix Synchro Amplifier used with Radar Equipments SR Serial Nos. 1 through 168 are available at EO pools. All of these amplifiers were originally shipped without the maintenance parts.

ANTENNA MOTOR MAINTENANCE PARTS

Purpose: To obtain proper equipment maintenance parts.
Action Required: Immediate identification of equipments in error and correction of same.

Equipments Affected: Radar Equipments SR Serial Nos. 87 through 150. (Contact NXss-30306).

Through error, a number of Ohio Electric Co. motor parts were shipped as equipment maintenance parts with units having GE pedestal motors and vice versa. It is the purpose of this bulletin to outline the procedure for obtaining the proper maintenance parts for the equipment in which this error was made. It will involve the identification of the maintenance parts as GE or Ohio Electric motor parts, checking to determine whether these are the correct maintenance parts for the equipment, and replacing the incorrect maintenance parts with proper parts.

Procedure:

a. Determine the kind of motor on the equipment. This can be done by comparison of the motor with the photographs in figures 1 and 2.

General Electric motors are used in Serials 1 through 87, 89, 91, 93, 94, 98, 100, 105, 117, and 118.

Ohio Electric motors are used in Serials 88, 90, 92, 95, 96, 97, 99, 101 through 104, 106 through 116, 119, and up.

b. Identify the type of motor parts in the equipment maintenance parts by means of figures 3 and 4 and their respective parts lists. It will require unpacking the pedestal motor maintenance parts in order to compare the parts with the photographs.

ELIMINATION OF SERVO MG END PLAY

Purpose: To correct servo MG set starting switch failures.
Equipments Affected: All SR and SR-a equipments.
Action Required: Procedure outlined below, as necessary.

Trouble has been experienced in early equipments with failures of the a-c drive motor to start. Investigation showed, in most cases, that excessive end play in the shaft prevented tripping of the starting switch to the closed position at the end of the previous operation, thus depriving the starting winding of power.

Fiber thrust washers are used at both ends of the motor shaft to hold the end play within a tolerance; if the washer on the opposite end of the shaft from the switch is defective, the aforementioned trouble will occur. Apparently the reason for the washer to hold a tolerance and then become defective is that the edges of the washer were "turned" enough during stamping to allow the required tolerance. The "turned" edges will obviously wear off in a short time and the necessary tolerance is lost.

The recommended repair measures are (1) the washer be replaced, or (2) an additional washer be used along with the one already installed. The defective washer may be replaced by a 3/64-inch washer, or a 1/64-inch washer may be added to the existing one. In extreme cases additional washers to those already mentioned may be needed.

To minimize such trouble in the field, the units are now given a breaking-in period on the test floor. Each unit is operated for a 12-hour period while mounted in a vertical position, the a-c motor on top. During the run, the motor is stopped and started periodically to check the switching action. It seems certain that defective washers will become evident in a short time under such test conditions.

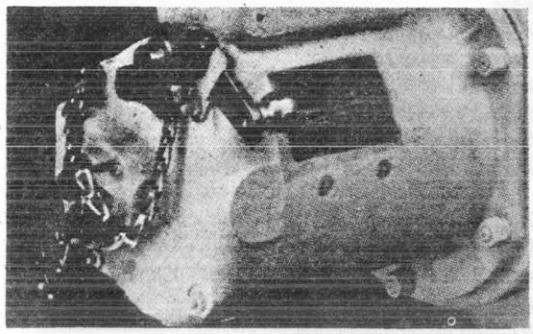


FIGURE 1.—General Electric Motor.

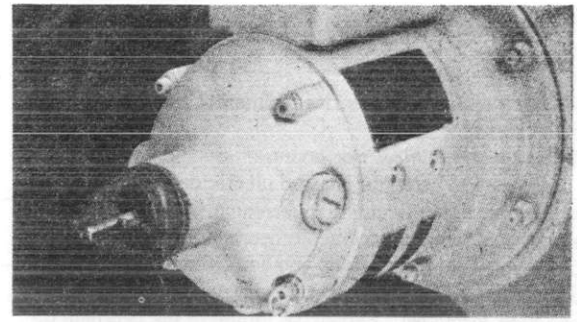


FIGURE 2.—Ohio Electric Motor.

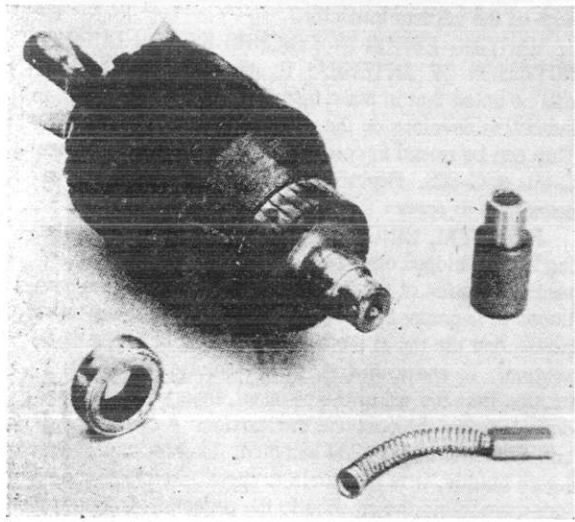


FIGURE 3.—General Electric Parts.

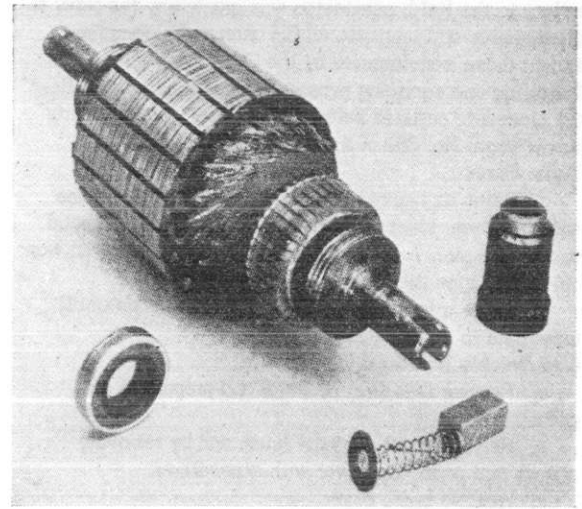


FIGURE 4.—Ohio Electric Parts.

GENERAL ELECTRIC MOTOR—B–1303—CG–211179

7611852:		E	T	S
P2_____	B1303A, Armature_____	1	1	2
P3_____	B1303B, Field Coils Set (two Main and two Commutating).	1	2	4
P4_____	B1303C, Brushes with springs (two per set).	8	15	24
P5_____	B1303D, set of brush holders with cap 5898031 AA2.	2	4	6
P6_____	B1303E, New Departure bearings ND–7503.	2	4	6
P7_____	B1303F, Garlock, shaft oil, Seal K–8104558 AC6.	1	2	4
7415134:				
146____	01382, Wire Manifold ass'y., #32554.	0	0	1
205____	013218, Crank Hand ass'y., #22562.	0	1	2

7611852:		E	T	S
56_____	B1306A, Armatures W.I. 3368 C–65066.	1	1	2
57	B1306B, Field Coils Set (two main, two interpole).	1	2	4
58_____	B1306C, Brushes with springs, ass'y., 5013.	20	45	65
59_____	B1306D, Brush Boxes D–5723 with brush box cap D–3688.	4	8	12
60_____	B1306E, New Departure bearings NC–77503.	2	4	12
61_____	B1306F, Shaft oil seal #4233.	1	2	4
7415134:				
213____	0–13220, Wire manifold ass'y., #32596.	0	0	1
214____	0–13221, Crank ass'y., C5781.	0	1	2

PEDESTAL SYNCHRO AND SYNCHRO GEAR MAINTENANCE

Purpose: To prevent damage to synchro gear train.
Equipments Affected: Radar Equipments SR/SR-a Serials Nos. 1 through 300.
Action Required: Preventive maintenance and lubrication as outlined below.
Time Required: Four man-hours.

Damage to pedestal synchro cluster gears after use of equipment at sea is due to loosening gear taper pins and/or sticking or freezing of synchro bearings. Synchros are Government furnished items and heretofore lubrication of these units by regular operating and maintenance personnel has been forbidden. Excessive failure of the bearings of these synchros indicates that lubrication should be checked and a lubricant added when necessary. To prevent further failure in the field, permission was granted by the Navy to disassemble and lubricate all SR antenna DG synchros, except those manufactured by the Control Instrument Co. Installing and servicing personnel are requested to follow the procedure outlined below on all SR/SR-a equipments below Serial No. 301 at the first opportunity.

Taper Pins:

a. Using as heavy backing as possible, tap the one speed DG gear taper pin gently with a hammer to expand and secure pin. A loose pin on this synchro gear will work out and damage the idler gear beyond repair.

b. Place a large drop of glyptal on both ends of all taper pins in cluster gear assembly.

6DG Synchro Bearings:

a. Remove DGs from pedestal and prepare to disassemble.

b. Remove cover opposite brush end by removing screws and prying off cover with screwdriver.

c. Remove brush cover.

d. Holding unit horizontally, remove rotor gently keeping brushes clear of slip rings.

e. If it is necessary to remove parts from the shaft, note their position and return exactly as they were before they were removed.

f. If balls or races are dirty or gummy, wash thoroughly in solvent dry-cleaning fluid, Federal Spec. PS661, and wipe dry on a clean lint free cloth such as viscose Rayon twill, Spec. C-7-8271, dyed white.

g. Wipe slip rings clean with cloth similar to above.

h. If needed, apply just enouth grease into spaces between balls to bring the grease up flush with the top of the ball race. NOTE: Use only Navy Type 14L3 Grade III (Standard Oil Company's Andox "C") or Navy Type 14L3 Grade II.

i. Replace rotor, nolding brushes clear of the slip rings until rotor is in place. Reassemble the synchro carefully.

j. Check and reseal the synchro before installing in pedestal. CAUTION: Do not use emery cloth on any part of a synchro. Do not attempt to lubricate or service a synchro manufactured by Control Instrument Co.

Miscellaneous: To prevent duplication, make sure that an entry in the ship's RADAR Log indicates completion of this maintenance.

SERVICE NOTES

Antenna:

SHIP'S HEAD MARKER INOPERATIVE: If the ship's head marker sweep is absent on the PPI, check the following items: 01 and 101 reversed; marker pin sheared off due to insufficient clearance between the pedestal housing and the ring gear; bent microswitch arm.

CRITICAL ANTIHUNT ADJUSTMENT: Taking up the play in the synchro gear train in the pedestal has aided in eliminating critical hunting adjustment.

INTERMITTENT ANTENNA ROTATION: Stopping of the antenna at definite points when rotating may be corrected by removing the drive motor brush block and freeing the sticking brush holder arm so that the brushes will make contact on the slip rings at all times. This condition may also be caused by bent or loose arms riding on the edge of the micarta insulator.

VARYING ERROR IN SYNCHRO SYSTEM DURING ROTATION OF ANTENNA: By careful observation, it will be noted that in some installations a varying error in indication develops as the antenna is rotated through 360°. This can be traced to defective compensating capacitors C-802 or C-803. Replacement of the faulty capacitor is necessary to correct this condition.

PEDESTAL BINDING: On several installations binding has developed after several hours of operation, preventing rotation of the antenna. This condition has been traced to improper clearance between the stationary post, 52301, and the top of the synchro housing at the bellows section. To check this, it is necessary to remove the T section from the top of the pedestal, insert a feeler gage down between the post and the housing. A clearance of one-sixteenth inch should be noted. In order to prevent future trouble, it is advisable to check this clearance before assembling the antenna to the pedestal. If insufficient clearance is noted, ream out the hole in the housing to proper size.

Servo Generator:

CLOCKWISE ROTATION OF THE ANTENNA ONLY. The antenna would rotate clockwise but not counterclockwise. The servo generator would groan when trying to rotate CCW as though under a heavy load. The trouble was traced to the sticking of the normal emergency relay in the emergency position, placing the rectox rectifiers across the servo generator output, offering a high resistance when rotating in one direction and a low resistance in the opposite direction.

CHATTERING OF THE SERVO GENERATOR WHEN STOPPING: The starting capacitor is connected in series with the starting winding and centrifugal switch. When the generator picks up speed, the centrifugal switch opens and the capacitor cannot discharge. When the centrifugal switch closes as the servo generator slows down, the capacitor discharges through the starting winding. This sets up a field resulting in the chattering noise. This is a normal condition and no harmful effects result.

CENTRIFUGAL SWITCH FAILURE: Several cases of servo generator centrifugal switch failures have been remedied by placing small smooth washers under the micarta block supporting the switch.

Transmitter:

OVERLOAD RELAY SETTING: 100 ma. is the correct setting of the plate overload relay K-105A.

527 INSERTION DIFFICULTY: If difficulty is encountered in inserting the 527 tubes, check the socket for burs. This condition has occurred in serial Nos. close to 150 and over.

WARNING WHEN PRESSING THE VOLTAGE RAISE BUTTON: When turning on the transmitter or in case the overload relay kicks out, the voltage raise button should not be pressed until the Variac has recycled to the low voltage position. This is indicated by the lighting of the PLATE VOLTAGE ON indicator light at the transceiver and the TRANSMITTER ON indicator light at the console. Pressing of the RAISE button before the recycling is complete results in energizing both raise and lower windings of the Variac drive motor. This may result in the burning out of one of the windings.

VARIAC JAMMING DUE TO FAILURE OF S-109: When the Variac jams due to failure of S-109 to open, motor can be used to bring Variac out of jammed condition if the following procedure is used: Loosen S-111 cam and move to position closing S-111; this will permit energizing of K-101 and the opening of recycling switch K-101H. Push POWER ON button and K-101H should open. Push RAISE button and Variac should cycle out of jam position. It may be necessary to push RAISE button several times. Check S-109 for defect and replace if necessary; reset S-111 cam to proper position.

MICROSWITCH CAM ADJUSTMENT: On the SR, the microswitch cams should be adjusted to operate at the following voltages: S-109 should be open below 500 volts, S-110 should open at 11,000 volts, S-111 should be closed at 600-700 volts or below, and S-119 should open when above 5,000-7,000 volts.

On the SRa the microswitch cams should be adjusted to operate at the following voltages: S-109 (and S-119 when used in series with S-109) should be open when the meter reads 500 volts and less, S-110 should open at 5,000 volts, and S-111 should be closed below 600-700 volts.

BONDING OF THE TRANSCEIVER TO THE DECK: It has been recommended by the Bureau that the transceiver be bonded to the deck in a symmetrical manner. For a check to see if this is necessary, ground one end of the transceiver frame to the deck with a screwdriver. If a spark occurs or if any of the meter readings change, the transceiver must be ground with heavy straps in two or more places. This is being taken care of in production in serial numbers about 200 and over by grounding the shock mounts to the transceiver frame.

Plate Modulator:

SRa OPERATION WARNING: Place RADIATION switch to RADIATION OFF during warm up period of the 5C22 hydrogen thyratron tube. This shorts the grid of the 5C22 to ground.

Turn the RADIATION switch to RADIATION ON before raising the oscillator plate voltage.

UG-36/U CONNECTOR BREAKDOWN: Several reports have been received reporting the breakdown of the UG 36/U connector used on the RG-27/U cable to the SRa modulator. Investigation discloses that the breakdowns have resulted because of the failure to cut back and remove layer of conducting rubber which lies between the inner shielding braid and the dielectric. This conducting rubber layer must be removed to a distance of three-sixteenths inch from the brass washer on the connector. Figure 1 illustrates a section of RG-27/U cable showing the various layers with the conducting layer to be removed.

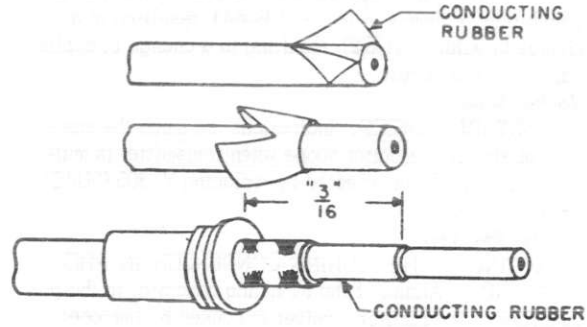


FIGURE 1.

THYRATRON GRID JACK ARCOVERS: Plate modulators between Serial Nos. 5 and 10 are equipped with thyratron grid jacks which have a tendency to arc over. Check these equipments for defective jacks and replace.

Console Receiver:

OSCILLATIONS IN CONSOLE RECEIVERS: Some oscillations can originate because ground connections are not solid. Receiver is constructed with numerous screwed down ground connections. Several cases of oscillation troubles were cleared by tightening all screw connections.

Range Scope:

RAISE AT THE END OF THE SWEEP: If the sweep on the range scope turns up at the end, check for defective T-601. The resistance measurement across the secondary of a new transformer is 7,000 ohms. If the secondary has shorted turns, it will be indicated by a lower resistance reading. In an actual case of turned up sweep, the resistance across the secondary was found to be 6,500 ohms.

HV POWER TRANSFORMER FAILURE: Short circuit conditions in transformer T-601 will sometimes show the symptoms by the target pips growing to abnormal size; apparently caused by reduced voltages on the tube allowing the deflection sensitivity to increase.

80-MILE STEP: On certain installations, the step on the 80-mile sweep will not coincide with the veeder counter after Navy Field Change 24 has been made. Paralleling C-650 with a 100 $\mu\mu$f. silver mica capacitor will remedy this difficulty on most installations.

OSCILLATIONS APPEARING AFTER MARKERS ON SWEEP: If oscillations occur after the range pip on the range scope sweep, observe closely the sweep and if a

single sweep is seen, the trouble may be traced to one of the following: Open R-682, defective L-605, open R-677, defective C-629 or C-628 being inductive.

OSCILLATION ON SWEEP WHEN VIDEO LINE IS OPEN: When attempting to operate the range scope with the video line disconnected, it will be necessary to ground terminal 80 to prevent oscillation appearing on the sweep line.

CONTINUOUS OPERATION OF PHANTASTRON: If the phantastron continues to function after the phantastron switch S-601 has been turned off, check R-620, R-6011, and R-622 for correct value.

INTERMITTENT PHANTASTRON OPERATION: A cause of intermittent operation of the phantastron has been found to be a change in value of R-643, resulting in a change in value of R-643, resulting in a change in applied voltage to the circuit.

Monitor Scope:

UNSTABLE SWEEP: Indications are much the same as that shown on monitor scope when transmitter is multiple-pulsing. Sweep cleared by replacing V-305 (5U4G) rectifier tube.

Monitor Receiver:

ARCING OF R-F TUNING CONDENSER IN PRE-AMPLIFIER: Arcing of the r-f tuning capacitor in the pre-amplifier of the monitor receiver is caused by improper setting of the suplexer spark gaps. The spark gaps should have a spacing of from 1/16 to 1/32 inch.

KIT FOR FIELD CHANGE 19: It has been reported from the field that several kits for Field Charge 19 have been received minus the chokes L-215 and L-216. In case of shortage, notify the Bureau of Ships, Code 982 B.

In case of short availability, where it will be necessary to wind the missing chokes, the following information will be found helpful.

The chokes consist of 44 turns of No. 36 enameled wire, wound on a form 1/8 by 1/2 inch. After completion, the coil should be impregnated with Zophar-Mills wax No. 456F.

PPI:

SWEEP INTENSITY CHANGE: An increase in the intensity near the end of the PPI sweep is the result of a defective yoke coil. A slight increase is desirable. If the increase is excessive, replace the yoke coil L-515 Drawing P-7713032 Group 1.

CURVED SWEEP: If the sweep on the PPI is not a radial straight line, the cause may be traced to an open winding on the yoke coil. This condition may also be caused by dirty brushes and slip rings.

The coil is constructed of four windings around a circular core in a series parallel combination. Each winding measures 90 ohms. The total resistance across the four coils is 90 ohms. If one winding is open the resistance will measure 180 ohms. The opening of any one of the four windings will cause the S-shaped sweep. See figure 2 for a simple schematic.

NONLINEAR SWEEP: The difficulty is most prevalent on the 4-mile range. If the first marker dot is not reasonably spaced on the sweep, check the values of the gate differentiating resistor and capacitor and coupling condensers C-514 and C-515. Any exceeding large stray capacity between the sweep circuit components and ground will cause the sweep to start slowly.

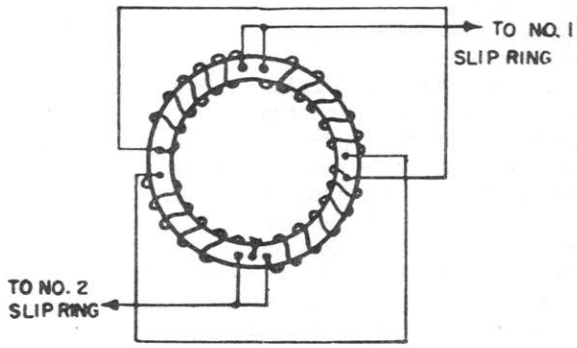


FIGURE 2.

MARKERS CHANGING POSITION: If the speed of the PPI sweep seems to vary as indicated by the marker dots moving in and out, the servo voltage regulator V-517 (VR 150-30) may not be functioning. If V-517 is out of order the servo load will kick back to the power supply which will particularly affect the sweep on the 4-mile range.

ERRATIC FOLLOWING OF SWEEP: Leakage between the windings of the Diehl motor B-501, will cause erratic following of the PPI sweep. It is most noticeable at high speeds. Disconnect the leads from 1, 2, 3, and 4. Measure between the windings of the motor with the high range of the ohmmeter, infinite resistance should be noted between the two windings.

180° ERROR IN PPI AND BEARING INDICATOR: If the PPI and bearing indicator show an error of 180°, check leads Nos. 94 and 95 and reverse if necessary.

INCORRECT ROTATION OF PPI AND BEARING INDICATOR DIALS: If the PPI and bearing indicator dials rotate in opposite direction to the antenna, check terminals Nos. 151 and 153 on E-1008 and reverse.

ONE MARKER NEAR END OF PPI SWEEP: Low value or shorted R-5010 or R-535 in the cathode of V-504 in the PPI will speed up the sweep, causing the second marker to appear near the edge of the PPI cathode-ray tube.

SECONDARY MARKERS: Secondary markers which appear approximately half-way between the main markers (usually on one range only) are caused by an open circuit in the marker coil. Secondary markers, immediately after the main markers, may be caused by defective biasing resistors R-5012 and R-5013 on V-507A.

RKR 72 CLAMP ARCING: The clamp securing the high voltage rectifier V-511 (RKR-72) in the PPI is insulated from ground. In some units an arc occurs between the clamp and ground, resulting in flashing of the PPI sweep. Bend the clamp so that sufficient clearance is obtained to stop arcing. In some cases it has been necessary to cut off the pin of the tube.

BLANK SPACE AFTER THE TARGET: The blank space appearing after the target on the PPI can be eliminated by Field Change 13.

Motor Generator:

D.C. TO A.C. MOTOR GENERATOR SPEED: If the speed of the motor generator set used for primary power in d-c ships is lower than the specified 1,800 rpm the output frequency is lowered causing excessive current to the voltage stabilizer and excessive voltage to be applied to the SR. In one installation, the MG speed was 1,200 rpm and generating 40-cycle output, this resulted in burning out of the voltage stabilizer and the fuses in the SR unit. Investigation revealed that someone had reset the series field resistor taps on the second shunt field of the main d-c motor.

Antenna Freezing:

On TRUE the antenna rotation froze at irregular intervals and on different relative and true bearings. This condition could arise on any speed of rotation and in either direction of rotation. Normal operation could be immediately regained by switching S-801 to the OFF position and back to any of the ON positions. The followinc characteristics were noted while tracing the trouble.

a. When the antenna froze, the servo generator hunted.

b. Voltages to the 6DG 36-speed in the antenna as measured at the terminal board in the rotational control unit were apparently normal in magnitude but erratic.

c. When a change of ship's course was fed in from the synchro amplifier, the antenna moved counterclockwise relative to the ship regardless of the direction of the change of ship's course.

d. The freeze occured when one of the 36-speed pickup arms on the commutator transformer of the synchro amplifier was physically opposite one of the 1-speed arms.

The trouble was due to an open between terminal point 156 on the rotational control unit and terminal point 156 on the antenna base. This is the connection to S3 of the 36-speed 6 DG. It was found by resistance measurements between terminal points 154, 155, and 156 on the rotational control unit. It is noteworthy that the trouble would occur if there was an open anywhere in the circuit of S3.

CHECKING AND ALIGNING SR-2 SYNCHROS

As a rule the technician on board ship is not directly concerned with checking and aligning synchro system during an installation which is accomplished by a naval shipyard or other repair activity. However, after the installation has been completed and checked the equipment upkeep and maintenance then becomes the direct responsibility of the shipboard personnel. At a later date there may be reason to believe that the synchro system is not properly aligned. RCA has promulgated complete instructions to their field engineers for carrying out this checking and alignment. These instructions are considered of special interest and value to technicians and are outlined in the following paragraphs.

The synchro system of the SR-2 radar will normally be properly aligned on electrical zero reference at the factory. Thus installation and maintenance problems should, in most cases, be limited to correct phasing when interconnecting the various elements of the system. Occasionally stator and rotor leads get mixed up during the installation resulting in such conditions as reversed rotation, overheating of synchro units, or fixed errors of 180°, 120°, etc. These conditions are fairly obvious to those experienced in the art and can be located and corrected if the technician is familiar with the system as a whole and individual locations of components that make up the system. To perform the checking and alignment of the system, the technician should adhere to the following instructions:

1. Place the SR-2 in complete operation, including the DG Synchro Amplifier which is usually on a separate power supply. It will be necessary to have the transmitter actually radiating in order to observe the PPI sweep trace.

2. Assure that ship's gyro is energized in order that gyro information can be transmitted to the radar equipment.

3. With True-Relative switch on bearing indicator unit in RELATIVE position, rotate antenna with handwheel until antenna relative bearing indicator reads 000. The true bearing indicator and PPI should also read 000 since synchro motors B-802 and B-804 as well as control transformer B-502 are controlled directly by synchro generator B-1301 when the "True-Relative" switch is in the "Relative" position. As a check on interconnections, direction of rotation of the various units used should be observed while the antenna is being positioned for 000 reading. If the rotation of the hand crank is clockwise, the antenna, relative bearing indicator, true bearing indicator and PPI sweep should all rotate in the direction of increased readings. If any unit deviates from this rule the wiring to that unit should be checked and corrected. If, after this condition has been established, all three synchro units do not read 000, one of the two synchro motors should be electrically zeroed by any one of the procedures outlined in the Synchro Manual. Experience has proved that the easiest method of zeroing a free synchro is as follows:

a. Turn off power.

b. Isolate questionable synchro from external circuit by removing synchro leads from terminal board E-804. (Leads on terminals R57, R58, R59, D102A and D-403A are S1, S2, S3, R1, and R2 respectively for B-802. Leads on terminals B-83, B-81, D-102B and D-403B are S1, S2, S3, R1, and R2, respectively.)

c. Jumper together terminals R1 and S2.

d. Jumper together terminals R2, S1, and S3.

e. Apply 115 volts a-c between R1 and R2. The rotor of the synchro motor will instantly lock in zero position.

f. Loosen clamps on body of synchro and rotate until indicator reads 000.

g. Reclamp body of synchro, rechecking zero when clamped.

h. Remove power and jumpers from synchro. Replace external connections.

i. Place equipment back in operation.

After the one synchro has been electrically zeroed, compare readings between it and the other two synchro units. If error of 180, 240, 060, etc., is observed, check external wiring. If wiring is correct or error is of such value that it could not be caused by incorrect polarity of windings, shift synchros in mountings until reading agrees with unit known to be on electrical zero. The synchros to

be adjusted are B-802 for antenna bearing, B-804 for true bearing indicator, and B-502 for PPI sweep trace. Interlocks will have to be shorted out to energize equipment for comparison of reading while adjusting position of PPI sweep.

4. At this point it is advisable to check the antenna position to determine whether the antenna relative bearing indicator readings are correct. Due to extremely sharp beam characteristics of the SR-2 antenna as compared to the SA antenna, it will be necessary to use more care in alignment. To align the antenna, it is suggested that the system be energized as above, and the antenna slewing motor handle turned to align the relative indicator dial on 000. Turn the antenna safety switch OFF at the antenna pedestal before making any further excursions in this vicinity. By climbing on rear support member of antenna frame, sight through the centerline of same and align line of sight across the dipole centers in "basket" assembly. Antenna should be moved physically until this line of sight lies along the centerline of the ship. On usual types of ships, the jack staff on the box will be a handy reference. However, on carriers where the most is off the centerline, some other reference must be selected. The line of sight through the antenna should, in all cases, be parallel to keel or centerline of the ship. Inasmuch as any corrective movement of the antenna will shift the antenna relative bearing indicator on the bearing indicator unit, it will be necessary to make a corresponding readjustment of synchro generator B-1301, in the pedestal, to bring the antenna information into alignment with the system.

This can be accomplished by loosening the spanner-type lock ring that secures this synchro and rotating body of same until the indicator relative bearing dial again reads zero. If no communication is available between pedestal and console, an a-c voltmeter can be connected across terminals R57 and R59 (terminal board E-1302 in pedestal) and synchro body adjusted for absolute minimum voltage reading, using low scale (5-10 volts full scale) for final adjustment. The technician is cautioned that it is possible to be 180° in error when this method is used, therefore a check should be made at the console to make sure correct minimum has been obtained and that the relative bearing indicator reads 000. Before leaving the antenna platform be sure to close safety switches.

5. With the equipment set up as specified at the beginning of step 3, throw the True-Relative switch to TRUE position. The antenna relative bearing indicator may shift as much as 3° but when it is reset by handwheel to read 000, the true bearing indicator and PPI sweep should read the ship's gyro heading. The actual ship's heading can be ascertained by observing the reading on bearing repeaters that are usually located nearby or by calling the gyro room. If ship's gyro system should happed to be setting on zero, no shift should take place and observations will not be too conclusive. In most cases the gyro electrician will precess the compass to give another reading when and if requested.

If the new reading on the PPI sweep and true bearing indicator do not agree with the ship's heading, it is fairly certain that the DG synchro amplifier has been incorrectly zeroed. Before further checks are made, be sure that the O-1915 stowing device is completely unlocked and that microswitch interlock S-1902 is making contact. To eliminate the possibility of wiring errors it will be necessary to have the compass precessed or make observations while the ship is underway. While the compass is being precessed, all indicators should be checked for relative direction of rotation and fixed error.

With the SR-2 equipment in full true operation (antenna train TRUE, emergency train NORMAL, and slewing motor OFF), the PPI sweep trace and true bearing indicator dial should not move when the compass is precessed. The relative indicator dial should, however, move in the opposite direction to the gyro. That is, when the gyro dial is showing increasing readings, the relative bearing indicator should show decreasing readings. If any of the units show reversed direction of rotation, the check should be interrupted long enough to correct the wiring error, then resumed to make sure that the trouble has been cleared. If a fixed error exists, the gyro should be set at 000.

6. The following checks will be helpful in locating trouble in the DG Amplifier:

a. With the gyro thus set and information being transmitted to the SR-2 Radar System, connect an a-c voltmeter between terminals 51 and 53 of the DG Amplifier terminal board K-1901. The voltmeter should read zero volts during this check. If the indicated voltage is zero, it means that the correct information is being fed into the DG synchro amplifier system. If this condition is not obtained, the indication is that ship's gyro is not properly set at 000 or that errors exist in the wiring between unit and gyro system.

b. If proper gyro information is being received at the terminal board of the DG amplifier, a reading should be taken at terminals R-57 and R-59 or terminal board E-1903. If the antenna is still in 000 position, the voltage reading obtained here should also be zero. If not, check and correct wiring to pedestal.

c. Check voltage between terminals T-57 and T-59 of terminal board E-1903. If a zero-voltage reading is not obtained, the error lies in the DG amplifier unit and can be due to either synchro amplifier circuit trouble, synchro controls B-1903 and B-1904 not correctly zeroed, synchro B-1901 not correctly zeroed, or defective motor B-1905.

The data on the DG synchro amplifier incorporated in the SR-2 instruction book in section VII, Corrective Maintenance, paragraph 22A through 22C, should be studied carefully before attempting any adjustments to the DG amplifier.

Operating personnel have in 1 or 2 instances reported that it was necessary to retune the transmitter when pulse length was changed. This condition has been carefully investigated on existing shipboard installations. In all cases, it was found that maximum output and freedom from frequency shift with pulse change were obtainable at any frequency within range of equipment when correct tuning procedure was used.

To insure maximum stability particular attention should be given to load stub adjustments. One of these stubs, No. 1 in particular, can be shifted several dial divisions

out of tune, yet cathode tuning will peak up the output reading on the reflectometer to practically normal value; but change of pulse length will require repeaking. The following tuning procedure is recommended:

1. Make all tuning adjustments on the long pulse length.
2. Set anode dial to approximate frequency desired, as read from chart.
3. Tune cathode for maximum incident reading of the reflectometer.
4. Further maximize reflectometer reading by tuning load stubs.
5. Repeat (2) and (3) until no improvement can be made in output.

SR-2 TRANSMITTER TUNING

6. Tune receiver and duplexer cavities for maximum echo response. In case of doubt about duplexer operation, remove side shield of transmitter and make certain that the gaps are firing properly.
7. Switch to short pulse length. First check receiver tuning to see whether any change is necessary to maximize echo response. Then check tuning of transmitter cathode circuit to determine whether any change is necessary to get maximum reading on the reflectometer.
8. If (7) indicates any change of tuning, the load stubes, again No. 1 in particular, should be shifted to other settings. After each of these shifts, the cathode, receiver, and duplexer should be retuned and the test of (7) repeated. By this procedure, an operator should quickly arrive at the correct setting.
9. Should some paradoxical condition exist whereby the above procedure does not give desired stability, a slight change of frequency can be made, and entire procedure repeated.

It was noted in one installation that data on load stub settings had been recorded on the adjustment chart on the front of the transmitter by the factory test group. Such data should be ignored on new installations or reinstallations, as the correct settings are dependent on characteristics of transmission lines.

SR-2 PEDESTAL BLOWER MOTOR (B1303B) COLOR CODE

During production SR-2 equipments the color coding of the B-1303B pedestal blower motor leads was changed. As shown in preliminary prints, the motors were supplied with four leads. Later, however, one lead was eliminated and color coding of remaining leads changed so that they are no longer connected in the same sequence. Due to these changes the following color code should be followed where installing blower motors:

1. Four-lead motor:
   Yellow lead to D-102
   Red lead and black lead to D-403
   Green lead to G-18
2. Three-lead motor:
   Red lead to D-102
   Yellow lead to D-403
   Black lead to G-18

R-F ARCING IN THE MODEL SR-2 RADAR

Failure reports from vessels equipped with Model SR-2 radar equipments indicate that r-f arcing in the transmitter unit is causing considerable trouble. The arcing is of two types: power arcing and grid-ring arcing.

Power arcing is encountered when the equipment is operated with excessive plate voltage on the 4C33 tubes. It usually occurs in the oscillator circuit, and results in a breakdown between the antenna coupling loop and the plate of the right-hand 4C33 tube (as viewed when facing the transmitter). Serious damage to the equipment may result if this type of arcing is allowed to occur frequently. Holes may be burned through the glass of the 4C33 tubes at or near the plate seal, thus destroying the usefulness of the tubes, or damage may be done to the modulator circuits.

Power arcing can be detected in several ways. Loud pops and singing noises can be heard, or flashes can be seen through the tube access door. Bright railings and hash appear on the monitor scope in the transmitter and on the A scope in the indicator console.

Experience has indicated that approximately 6.5 kv is the maximum plate voltage that can be applied to the 4C33 tubes without danger of arcing. In order to eliminate arcing due to excessive plate voltage, it is suggested that plate transformer taps be disconnected from the stopping relay in such a manner as to limit the maximum voltage to approximately 6.5 kv.

This can be accomplished by removing the leads from taps G-38, G-39, G-40, and G-41 on transfromer T-2302. Next tape these leads together, being careful to insulate them from possible contact with the transformer case, and tuck them away under the main cable to prevent whipping or motion under conditions of shock and vibration. Now remove the leads from taps G-38, G-39, G-40, and G-41 on relay K-2302. Tape the ends and tuck them away neatly. Finally, connect a length of tinned bare copper wire between terminals G-38, G-39, G-40, G-41, and G-42 on relay K-2302 so that all these terminals are shorted together and connected to G-42.

Now operation of the "raise" pushbutton on either the transmitter or the indicator-console will allow voltages up to approximately 6.5 kv, in four steps, while further depression of the button will cause no additional increase in modulator voltage.

Power arcing can also be eliminated or lessened by carrying out several other corrective measures. One of these is to carefully tune the cathode and load stubs to the position of best operation. Another is to check to insure that the dehydrator and the compressor which pressurize the coaxial cable and the antenna system are operating properly. Should moisture seep into the system at any point, proper loading of the transmitter may become impossible.

In the case of installations where antennas are located near large masses of metal (such as the ship's mast or other obstruction) so that at one or more points energy from

the antenna is directed squarely into the mass of the metal, reflected energy may upset the antenna loading sufficiently to cause power arcing within the transmitter. Ship personnel cautioned against operating the equipment with the antenna stationary in those positions that cause trouble. This danger can be eliminated by reducing the modulator voltage and accepting the resulting slight sacrifice of range.

Several methods of eliminating grid ring arcing are currently being investigated by the Bureau of Ships. One of these, a new type grid ring contact, is undergoing laboratory tests. Progress along these lines will be reported in the future.

MODEL SR-3 ANTENNA TRAIN MOTOR FAILURE

A letter to the Bureau of Ships from a naval vessel reported the failure of the antenna train motor of its Model SR-3 Radar Set. In view of the considerable difficulty experienced in locating the cause of the failure, the following information, quoted from this letter, is given. In the event that other SR-3 equipped vessels experience a similar failure, it is hoped that this information will permit it to be remedied expeditiously.

"Considerable difficulty has been encountered in the antenna drive motor of the Model SR-3 Radar Set installed on this vessel. On applying power, the antenna started normal rotation in automatic train, but immediately reduced to a low speed. In manual operation the same action was observed. From past experience the brushes were immediately suspected of being worn down and making poor contact. On checking they were found to be pitted but only moderately worn. On replacing them, the condition was not improved. Voltage checks were then made of the output of the train control amplifier. It was found that the voltage was far below normal. The field terminals 70 and 71 on terminal strip E-1108 showed 20 volts at 5 rpm, and the armature terminals 168 and 169 on terminal strip E-1108 showed 15 volts output. Continuity checks were made of the entire circuit but no trouble was found. The Rectox unit (CR-1102) supplying d-c voltage to the drive motor armature was suspected of causing the trouble. Considerable time was spent in checking this unit but it was found to be satisfactory. Finally the motor was removed from the pedestal and disassembled. Resistance checks of the series and shunt fields proved them normal. Upon complete cleaning of the motor it was found that one of the plastic bruch holders had been considerably burned and charred. It had escaped detection because the charring had occurred inside the metal casing that surrounds the brush holder. This charring had formed a resistance path to ground. After replacement of the holder, the motor was reinstalled and satisfactory operation resulted."

In view of the foregoing, too much emphasis cannot be placed on the importance of routine preventive maintenance and periodic checks of all antenna pedestals.

SILVER SOLDERING FLANGES TO THE WAVEGUIDE OF MODELS SR-6 AND AN/SPS-6

The Bureau of Ships has received many requests from installation and field activities for a procedure for silver soldering flanges to the stainless steel waveguide used with the Models SR-6 and AN/SPS-6 series radar equipments. The following is the procedure used by the contractor:

1. Make a steel block 1/2 x 1 x 6-3/8 inches and a steel block 1/2 x 1 x 3-1/8 inches.
2. Clean thoroughly the inside edges of the flanges and the outside edges of the stainless steel guide where the two pieces are to be soldered.
3. Flux the stainless steel guide and the flange mating surfaces with "Handy and Hamon" silver solder flux which has been thinned with water to the consistency of table cream, and is free from lumps. Place the flange on the end of the guide in its proper position, making sure it is square with the axis of the guide.
4. Clamp the flange to the guide with two C-clamps using the 1/2 x 1 x 6-3/8-inch block to hold the guide to the flange. The 1/2-inch dimension of the block should be in contact with the guide and flush with it and the flange.
5. Heat the flange on the side away from the guide, making sure that no heat reaches the guide behind the flange. Also do not use more heat than is necessary to melt the silver solder.
6. When the flange is up to temperature apply silver solder that melts at 1,140° F. or lower to the outside of the flange (under flame) until the silver solder flows into the cracks between the guide and flange.
7. Allow the guide and flange to cool in air. Do not cool by special means as this will cause the guide to buckle.
8. Remove the C-clamps and the block, and repeat the above procedure on the opposite side of the guide. Then solder the two narrow sides of the guide, using the 1/2 x 1 x 3-1/8-inch block.

The performance of the entire radar set depends upon silver soldering the flanges and guide properly. Therefore, extreme care should be taken both in silver soldering and handling to make sure that a minimum of buckling occurs. A waveguide installation may be considered good if the waveguide dimensions have not been changed over one-sixteenth of an inch from the original dimensions after soldering and installing.

The Bureau of Ships has 16-millimeter movie films that cover the procedure for silver soldering stainless steel waveguide, as applied by the contractor of Models SR-6 and AN/SPS-6 series radar equipments.

MODEL SR-6 ANTENNA MAINTENANCE

During tests of a Model SR-6 installation, the antenna stopped rotating. Upon investigation it was found that the Garlock Packing Ring, Symbol Designation U-1307, located in the groove of Top Cover Plate O-1342, had worked its way out of the groove. Inspection revealed the packing ring was chewed up, due to improper installation. After the antenna was removed from the ship and a new packing ring was installed, no further antenna trouble of this nature was experienced.

There are two possible ways in which the Garlock Packing Ring can be installed into the groove. One side of the packing has a slightly larger dimension than the opposite side. The proper way to install the packing is to insert the side with the larger dimension first as shown in figure 1. It will have to be forced into the groove before it is seated. Also make certain that the two ends of the packing ring are cut clean at a 45° angle. Any frayed edges should be trimmed.

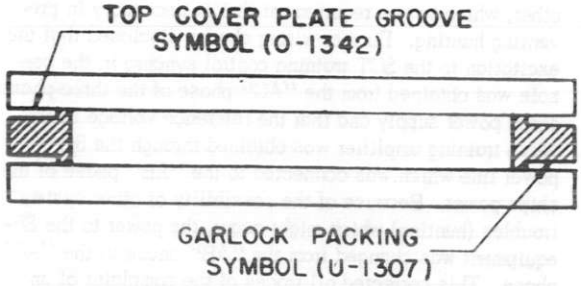


FIGURE 1.—Cross-sectional view showing Garlock Packing Ring properly installed with wide dimension against bottom of groove in top cover plate.

Installation of the Garlock packing cannot be checked without removing the antenna and pedestal. However, if the antenna stops rotating or becomes unusually sluggish, the Garlock Packing Ring should be inspected.

SR-2 T-201 TRANSFORMERS

A fleet performance and operational report advised that transformer T-201 in the receiver unit of the SR-2 radar equipment had failed. The following excerpt is taken from this report:

"Fuse F-202A in the receiver unit failed. Found T-201 in the receiver unit with secondary No. 3 open and secondaries Nos. 1 and 4 shorted. Transformer was swollen, apparently due to overheating. Replacement transformer from spare parts had a note that secondaries Nos. 2 and 3 were reversed. It is believed that the original transformer had this reversal but had not been wired to compensate for the error. The result was that all 6.3-volt tubes were supplied with a filament voltage of 5 volts, and vice versa. In addition, the 5-volt, 3-ampere secondary was overloaded 300 percent to 400 percent, and probably caused the overheating and final failure of T-201. Transformer was replaced and correctly wired. The receiver operated normally."

It is suggested that if other ships with SR-2 radar installations encounter similar failures, the T-201 transformer filament voltages be checked for proper terminal connections.

WAVEGUIDE FLANGE GASKETS

The waveguide gaskets inserted between the flanges of SR-3 and SR-6 are fabricated so that electrical continuity is maintained throughout the entire waveguide run. Before the waveguide is installed, the gaskets should be cleaned bright with a cloth in order to assure good electrical contact between the flanges. The gaskets should never be coated with glyptal, shellac, or any other material in order to hold the gaskets in position or to obtain a tight fit.

ADJUSTMENT OF STC CONTROLS ON MODELS AN/SPS-6, SR-3 AND SR-6 SERIES

Fleet tests on the subject equipment indicate that the tracking of small close-in targets can be greatly enhanced by an optimum setting of the STC circuit.

The following adjustment settings appear to give the best results:

a. Duration—Maximum setting.

b. Flat—One-fourth of full swing of the potentiometers.

c. Depression—One-fourth of full swing of the potentiometers.

Personnel responsible for this adjustment should be careful not to use too great a setting of the depression and flat controls as this will result in small targets such as buoys being suppressed. When making the adjustments long range and close in small targets should be observed and settings made accordingly to give optimum detection of both. In all cases, duration should be set a maximum.

REPLACING B-1303 IN AN/SPS-6, SR-3 AND SR-6 SERIES RADARS

The following is the approved procedure for replacing the drive motor, B-1303, in the antenna mounting AB-146/SPS-6 used with the following radars: AN/SPS-6 series, SR-3 with Field Change 6 and SR-6 with Field Change 5.

Unscrew the antenna mounting switch box cover and turn electrical stow switch to OFF. Mechanically stow the antenna. Drain the oil from the main and gearmotor housings. While the oil is draining, open the antenna mounting terminal box and disconnect leads 168 and 60 and 71 on E-1302.

Loosen the conduit tube at the motor and at the terminal box, and remove it, slipping out the four motor leads. Remove drive motor B-1303 from the main mounting housing by removing the eight hex bolts which retain it. Jacking screws are provided for loosening this motor in its seat. Note that a laminated shim, symbol No. O-1351 is installed between the motor mounting flange and its seat in the main housing. Do not destroy this shim. It provides the necessary backlash adjustment between the gearmotor output pinion and main drive gear O-1350.

Remove the shim O-1351 from the motor which has just been taken out of the mounting and place it in position on the replacement motor. With this shim in place install the motor. Do not reinstall the condiut tube nor reconnect the motor leads yet. Wait until after the backlash has been properly adjusted.

Measure the backlash between the main drive gear O-1351 and the output pinion of the drive motor as follows:

a. Lift the mechanical stowing lock, freeing the antenna for rotation.

b. Insert lead wire about one thirty-second inch in diameter into the mesh of the gears. Turn the antenna by hand, drawing the lead wire into one side of the gear mesh and forcing it out the other. The lead wire will be flattened in spots.

c. Measure the thickness of the wire at two adjacent flattened places with a micrometer. The sum of these two thicknesses is the backlash of the gears. This backlash should not be more than 0.003 inch nor less than 0.001 inch. If the sum of the thicknesses of two adjacent flat points of the lead wire does not lie within these limits, the backlash must be adjusted.

If the backlash is greater than 0.003 inch, the thickness of shim O-1351 must be decreased. Remove the motor from the mounting and examine shim O-1351. It appears to be made of solid sheet, but is actually made up of 0.002 inch thick laminations which can be peeled off after one spot is loosened with a jackknife. Removal of one such lamination (0.002 inch thick) will decrease the backlash by about 0.0018 inch. Remove the number of laminations required to bring the backlash within the specified limits of 0.001 inch to 0.003 inch. Reinstall the motor and again check the backlash. Repeat this process until a suitable reading of backlash is obtained.

If the difference is less than 0.001 inch, the thickness of shim O-1351 must be increased. To do this laminations peeled from a shim taken from maintenance parts must be added to shim O-1351 until the proper backlash is obtained. The same procedure for measuring backlash as that outlined in paragraph E should be followed.

When the proper backlash adjustment has been obtained, reinstall the motor conduit tube. Connect motor lead A2 to terminal 168, F2 to 170, A1 to 69 and F1 to 71. Close the terminal box cover, turn the electrical stow switch to ON, and screw the switch box cover on. The mounting is now ready for operation, except that it has not been refilled with oil. This is of the utmost importance. Fill Both the oil reservoirs, the main housing reservoir and the gear-motor reservoir, immediately. Operation of the mount, even for a few minutes, without lubrication will cause failure.

HUNTING OF ANTENNA AND PPI

Excessive hunting of the antenna and PPI was noted when the equipment was operated in the NORMAL training position. From the symptoms present, a check of the phasing of the synchro control excitation and the training servo amplifier reference voltage was made with an oscilloscope. The findings from these checks indicated that these two voltages were definitely not in phase with each other, which is one requirement that is necessary in preventing hunting. Further wiring checks disclosed that the excitation to the 5CT training control synchro in the console was obtained from the "AC" phase of the three-phase ships power supply and that the reference voltage to the servo training amplifier was obtained through the SR-a power line which was connected to the "AB" phase of the ships power. Because of the possibility of other system troubles (hunting) which might occur, the power to the SR-a equipment was changed from the "AB" phase to the "AC" phase. This corrected all traces of the complaint of antenna hunting.

NEOPRENE BOOTS FOR MODELS SR-3, SG-6 AND AN/SPS-6 SERIES RADAR

Field Changes 16-SR-3A, 16-SR-3B, 16-SR-3C, Field Changes 18-SR-6, 18-6A, 18-SR-6B and Field Changes 19-AN/SPG-6, 19-AN/SPS-6A, 19-AN/SPS-6B have been installed aboard many vessels. These field changes add a new feed horn assembly to the antenna and contain an open flexible section of waveguide which exposes the internal waveguide surfaces to the damaging effects of weather.

A neoprene boot to cover the open flexible section of waveguide is available. All ships and activities having a Model SR-3, SR-6, or AN/SPS-6 series radar with one of the field changes installed should order this boot through the routine supply channels by Standard Navy Stock No. 16-B-700001-134; and install it upon receipt. A field change for installation of this boot will not be issued.

CONDENSATION IN SR, SRa RADAR ANTENNA PEDESTAL

To reduce the condensation of moisture and corrosion of the synchro units and associated equipment in Model SR/SRa Radar Antenna Pedestal, the, Mare Island Naval Shipyard has suggested that ventilation holes be drilled in the separation plates between the upper and lower part, as detailed in figure 1, to allow warm air from the lower section to circulate through the upper dome. This is an easy way to keep the dome dry and it is suggested that the holes be drilled during the next antenna overhaul.

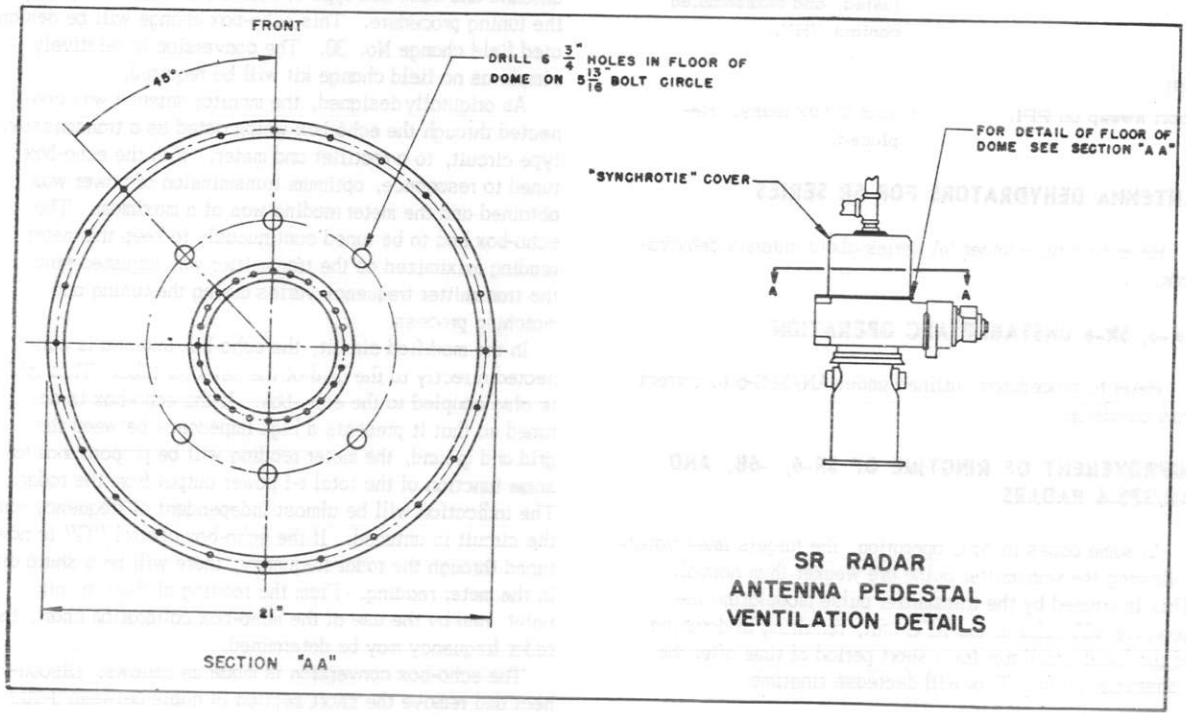


FIGURE 1.

MODEL SR SERIES TROUBLESHOOTING NOTES

Nature of Operation	Trouble Found and Remedy
Range Scope:	
Range step unstable on 20-mile range. Step ON/OFF switch not positive in control.	Found capacitor C-611 open and resistor R-662 wrong value. Checked "helopot" R-632 and found intermittent contact between moving arm and resistance element. Corrected same.
Transceiver:	
Could not turn transceiver on. Found motor driven Variac in HIGH position. Would not recycle to LOW position.	Placed Variac in LOW position manually. Checked control circuits. Found contact "H" of relay K-101 not making positive contact. Cleaned, readjusted, and reassembled contact "H".
PPI:	
Short sweep on PPI.	Found C-507 leaky. Replaced.

ANTENNA DEHYDRATORS FOR SR SERIES

Refer to article under SA series about antenna dehydrators.

SR-3, SR-6 UNSTABLE AFC OPERATION

Refer to procedures outlined under AN/SPS-6 to correct this condition.

IMPROVEMENT OF RINGTIME OF SR-6, -6B, AND AN/SPS-6 RADARS

In some cases in AFC operation, the targets immediately following the transmitter pulse are weaker than normal. This is caused by the transmitter pulse modulating the negative 400 volts in the AFC unit, resulting in detuning of the local oscillator for a short period of time after the transmitter pulse. This will decrease ringtime.

SR-a/SR-b AMPLIDYNE SUBSTITUTION

When the CAY-211192 Servo Generator used with the SR-a/SR-b radars needs replacing and none are available for replacement, a CG-21ABU Amplidyne may be used to advantage. Connect as follows:

Connect CG-21ABU	to	SRa/SRb Ant Control Unit
Lead Wire T4 and T3	to	Terminal 802
Lead Wire T2 and T1	to	Terminal 803
Lead Wire F4	to	Terminal 65
Lead Wire F2- & F3+	to	Terminal 66
Lead Wire F1+	to	Terminal 67
Lead Wire C1-	to	Terminal 68
Lead Wire C4+	to	Terminal 69

SRa MODIFIED ECHO BOX AND TUNING PROCEDURE

Considerable trouble has been experienced in endeavoring to tune the SRa equipments. The full capabilities of of the systems have not been realized in numerous cases due to improper or incomplete tuning procedures employed. A tuning procedure developed by E. F. S. G. and Westinghouse has been endorsed by BuShips and is printed herewith for information and guidance.

General

The conversion of the SR to the SRa has eliminated the critical gridkeyer adjustments and the reaction of the oscillator tuning controls on the keyer circuit. This reduces the possibility of damage to the 527-type oscillator tubes during the tuning process. A modification of the monitor-antenna and echo-box type of indication further simplifies the tuning procedure. This echo-box change will be designated field change No. 30. The conversion is relatively simple as no field change kit will be required.

As originally designed, the monitor antenna was connected through the echo-box which acted as a transmission-type circuit, to a rectifier and meter. With the echo-box tuned to resonance, optimum transmission of power was obtained and the meter reading was at a maximum. The echo-box had to be tuned continuously to keep the meter reading maximized as the transmitter was adjusted since the transmitter frequency varies during the tuning and matching process.

In the modified circuit, the echo-box antenna is connected directly to the grid of the detector tube. This grid is also coupled to the echo-box. If the echo-box is detuned so that it presents a high impedance between the grid and ground, the meter reading will be proportional to some function of the total r-f power output from the radar. The indication will be almost independent of frequency since the circuit is untuned. If the echo-box control "G" is now tuned through the radar frequency, there will be a sharp dip in the meter reading. From the reading of "G" at this point, and by the use of the echo-box calibration chart, the radar frequency may be determined.

The echo-box conversion is made as follows: Disconnect and remove the short section of cable between J-203 in the monitor receiver and the echo-box. The connector at the echo-box may be left open. From the monitor receiver spares, obtain the spare for either J-201 or J-202. This spare connector is already made up with a short section of shielded cable. Remove the cover over the 955 detector and connect the section of spare cable between J-203 and the grid of the 955. Connect the shield of the cable to the ground terminal located near the grid pin of the tube. Cut a slot in the top of the removable cover to allow the cable to pass through and replace the cover. An alternate method is to drill a hole in the shield box around the tube and bring the cable in through this hole.

Before attempting to tune the equipment, the following points should be checked: Read and thoroughly understand these instructions before attempting to tune the transmitter. Insert the transmitting tubes, making sure that no mechanical strain is placed on the glass and that all connections are tight. Check the antenna to see whether it is in the blue or the green-yellow frequency band. In the blue band, both grid-shorting straps are to be used on the 527 oscillator tube grid terminals. In the green-yellow band, place the shorting strap across the lower grid connections, and coronal balls on the two upper grid terminals. Check the duplexer lengths. When operating in the blue band, adjust the duplexer length so that the distance between the lower edge of the upper casting and the center of the spark gap adjustment knob is 9-7/8". For the green-yellow band the distance should be approximately 11-5/8". This adjustment is available when the upper rear cover of the transceiver is removed. When tuning for the first time, check the settings of the duplexer spark gaps. They should be open between 1/32" and 1/16". This is roughly 1.25 turns on the adjustment knob which is located on the stub itself above the gap. Access to the spark gaps is obtained by pulling the monitor receiver chassis forward and removing one of the side panels. Controls are provided on the front of the transmitter unit for adjusting the unit for proper oscillator operation.

The main controls are as follows: "A" Grid tuning control. Main control for setting the oscillator frequency. "B" and "C" Impedance matching stubs. These control oscillator frequency. "D" & "E" Duplexer controls. When properly set, control "D" prevents the received signal from being dissipated in the transmitter portion of the circuit. Control "E" prevents the loss of the transmitter energy in the receiver circuits. "F"–Receiver tuning control. "G"–Echo-box tuning control.

Transmitter Tuning:

With the radiation switch off, set all dials according to the chart for the center frequency of the antenna being used except "G", which should be set at 0. Apply power to the set and push the "Power On" button. After the 5-minute time delay relay has operated, adjust the filament voltage to 10 volts. Turn radiation switch on and raise the plate voltage to 3.5 kv. (The plate voltage is left at 3.5 kv instead of 5 kv during tuning in order to avoid excessive arcing.) Rotate the antenna until it is facing the monitor antenna, so that the echo-box meter reading is a maximum. Tune echo-box dial "G" until a dip occurs in the echo-box meter, and obtain frequency of operation from the calibration chart. The frequency should be kept within the antenna band (plus or minus 5 mc of the center frequency). Turn the "RF Tune" control on the monitor receiver panel to 0 and tune "D" and "E" for proper firing of the spark gaps. The spark gaps may be observed through openings in the duplexers by either removing the blank panel below the monitor receiver or by removing the top side panel and pulling the monitor receiver chassis forward. Detune the echo-box (control "G") so that the frequency of the oscillator will not affect the echo-box meter readings. Tune "A" for maximum reading of the echo-box meter. It will be observed that a series of maximum points may be obtained at definite frequency intervals. Set "A" on the point of maximum response nearest the center of the antenna band. Adjust "B" and "C" for maximum reading of the echo-box meter. Readjust "A", "B", and "C" for maximum reading of the echo-box meter. Raise plate voltage to 5 kv. If any r-f arcing occurs at the oscillator, it may be decreased by backing off the "B" dial setting slightly. If it persists, a different tuning point (combination of "B" and "C") may have to be used. Tune the echo-box for dips in the meter and check the frequency. If the frequency is out of the band, shift the "A" dial tuning to a point of maximum response within the correct range. Note that the frequency of operation cannot be set to any arbitrary value; it must be tuned on one point of maximum response. Tune dial "F" for maximum indication on the monitor scope. Tune dials "D" and "E" for maximum monitor scope, indication. The "RF-Tune" knob should be set to 0 when tuning "E". Tune the duplexer spark gaps for maximum monitor scope indication. Make a final adjustment on dials "D", "E", "F", and "RF Tune" knob for maximum echoes.

A set of typical meter readings when properly tuned would be similar to the following:

Filament	Plate	Plate Current	Grid Current
10 v.	5 kv.	20–30 ma.	4–8 ma.

Console Receiver Tuning:

Adjust the "I-F" Tune" knob on console receiver for maximum echo response on the range scope. This should be checked by the operator at the beginning of each watch.

Mistakes in SR Tuning:

On one ship, the SR was tuned following the new procedure (see p. 25) until the monitor antenna meter reading was maximum. The echo response on the A-scope however, was considerably poorer than for serval other tuning points for which the r-f power output was indicated to be less. This phenomenon proved somewhat baffling to the RT's. What they had neglected to do was to check and determine whether all of their power output at this point was at the same frequency. Since the monitor antenna in this procedure is connected directly to a rectifier and is untuned, it will indicate the sum of the power outputs at both frequencies. For this system, the maximum meter reading was obtained at that point, although the power output at either of the two frequencies alone was considerably less than the optimum value. The system was returned to give maximum output at a single frequency.

RADAR SETS SRa, SRb, AN/SPS-28- USE OF TUBE TYPE 527

NOTE:

All present and future tubes type 527 or 527A manufactured by Penta Laboratories are to be operated at a filament voltage of 11.0 volts only.

Tube type 527 as manufactured by Penta Laboratories, the sole source, does not give the power output required by the AN/SPS-28 radar at 225 megacycles since the present tube specification is based on operation of the SRa and SRb with a maximum power output at 185 megacycles. The present tube specification is being revised to reflect operation under the AN/SPS-28 conditions. Modifications are being incorporated which change the anode fin configuration and grid to plate capacitance. The modified tube type will be designated as 527A, and will give 300 kilowatts of peak power output at 225 megacycles with a good spectrum. Unmodified Penta tubes will give about 20 percent less power than modified tubes when the transmitter is tuned properly. At lower frequencies power decrease will not be as great.

In many cases power output readings taken with the R.F. Monitor IP-411/SPS-28 are misleading and inconsistent. A calibration method for this unit will be the subject of a separate article.

SRa
BALANCE CONVERTER INSULATOR

A suggestion has been made to the ceramic insulator in the balance converter on the SRa antenna with one made of teflon. This can be done during overhaul and should make the replacement easier and quicker. Teflon, being flexible, will provide a better air pressure seal since it will conform to the irregularities of the conductor surfaces.

MAINTENANCE NOTES

Erratic Operation of Synchronization System of SS Radar:

a. Erratic output of the sync system of SS radar modulation generator resulted in no range step, no "B" scan, and no precision sweep.

b. Erratic waveforms were found at J-1 and Grid pin 4 of V-4 sync pulse multivibrator tube.

c. Direct cause was found to be faulty capacitor C-6, intermittently breaking down. Trouble remedied by replacement of C-6 from equipment maintenance repair parts.

Open Center on Plan Position Indicator Scope With Open Center Switch in the Off Position on SS Radar:

a. Open center condition was found to be caused by grounding of one wire connecting to toggle switch, thus, creating the effect of the switch being in the ON position.

b. Condition remedied by re-routing both wires to this switch and provision of additional insulation around connections to switch.

Four Range Circles (Similar to PPI Range Mark in Presentation) 500 Yards Apart, Starting at Center of Plan Position Indicator and Working Outward, on Indicator Console of SS Rader. Also 3 to 4 Sweeps Appearing as 1 Main Sweep and 2 Shadow Sweeps—1 Long and the Other Short—Directly Following the Main Sweep of Correct Length:

a. Condition remedied by replacing resistor R (1C) 42 in plan position indicator circuit, which had changed value to 1,150 ohms from its rated value of 1,000. Increase in resistance was enough to prevent triggering of PPI sweep system properly. Also this resistor was replaced with a 1-watt instead of the regular one-half-watt size.

Low Sensitivity (3,000 Yards Ringtime on SS/ST-A Radar):

a. Low sensitivity in SS radar system and ST-A, was caused by the following effect:

(1) Open capacitor C (2E) 5 in PRE-I.F. Amplifier output. Replaced.

(3) Faulty transmit-receive tube V-11, 1B24, carbonized points. Replaced.

(4) Broken coax cable connection to PRE-I.F. Amplifier unit 2-E in transmitter. Jack J-3. Repaired.

(5) Open C (IG) 10 in I.F. Amplifier strip. Replaced.

No 8,000-Yard Sweep on Tuning Indicator Scope of SS Radar Transmitter Receiver Unit:

a. Normal 40,000-yard sweep.

b. Shorted C(2b)8. Replaced, resulting in a normal sweep.

No Bearing Lines on "B" Scan of SS Indicator Console:

a. Open R(IE)37 in bearing sweep oscillator V-5 plate supply circuit.

b. Replaced R-37 with normal operation.

Erratic Lighting of Range Error Warning Lamp on Front Panel of SS Indicator Console:

a. Faulty capacitor C(IK)26 in indicator console range unit.

b. Replaced capacitor C-26 with normal operation resulting.

Drifting of SS Radar Transmitter Frequency, Excessive:

a. Faulty blower-motor B(2)1 in transmitter-receiver unit. Armature blower unit was rotating at proper speed but due to vibration, rotor section of blower had slipped over against housing from loss of set screws in rotor collar thereby permitting armature of motor to rotate inside of rotor collar. Net result was overheating of magnetron. Removed blower, cleaned and oiled, renewed set screws and replaced. Normal operation resulted.

Zero Range Set Control Has No Effect in Any Position:

a. Faulty potentiometer R(1M)20 in indicator console on hinged panel of unit. Found movable arm on pot did not make contact with resistance unit. Repaired with normal operation.

Excessive Backlash in SS Radar Training Control Unit:

a. Attemped to tighten Allen set screws in handle of training control unit with no success as these Allen screws are too small for the correct amount of pressure needed to hold handle on the shaft. New Allen screws have been tried with no success. Main fault lies in the fact that with the loosening of the Allen screws, the handle eventually comes off and then the loss of the woodruff key. Shaft then was drilled for a taper pin, installed and unit now in proper operation. Removing shaft now requires only driving out taper pin with a drift punch.

Range Line on Both Plan Position Indicator and "A-B" Scan ("B Scan in Particular) of SS Radar Indicator Console Presented as a Sine Wave:

a. Checking of regulated rectifiers showed high voltage output and with adjusting of voltage adjustment pot R(7)10 output and with adjusting of voltage adjustment pot R(7)10 no change resuled. With the replacement of Tube V3, normal operation of R-10 was restored. Output voltage of regulated rectifier was then decreased to 295 volts, at which point the sine wave presentation disappeared.

Indicator Console "B" Scan Bearing Lines Show up Proper Length, but Either Too Close Together, or Only One Trace Is Vivible. Range Line Is Still Visible:

a. Faulty bearing oscillator V-5 Type 6SN7 in the prevideo and bearing sweep amplifier chassis. Replaced with normal operation.

In Operation of Automatic Frequency Unit on SS Radar Transmitter-Receiver Unit:

a. Caused by faulty capacitor C(2C)24 in automatic frequency chassis of transmitter-receiver unit. Capacitor checked shorted. Replaced with normal operation.

Repeated Blowing of High Voltage Fuses:

a. Intermittent ground on plate supply lead to tube 6L6-GA V6 modulation Generator unit. Failure of V-6 removed all Bias from 5D21's and V-8. Replaced lead to plate of V-6 with normal operation.

RESISTOR CHANGE IN MODELS SS AND SV—1

As a safety precaution to eliminate possibility of dangerous high-voltage shock, it is strongly recommended that resistors symbol R-4(1H) and R-5(1H) located in the PPI power supply of Model SS and SV-1 radar equipment consoles, be changed.

In view of their particular location, 1/2-watt resistors symbols R-4(1H) and R-5(1H) (see fig. 1, schematic-dotted lines) are considered very fragile. They are frequently broken when unit IH of either Model SS or Model SV-1 consoles is placed into the rack. These two resistors are

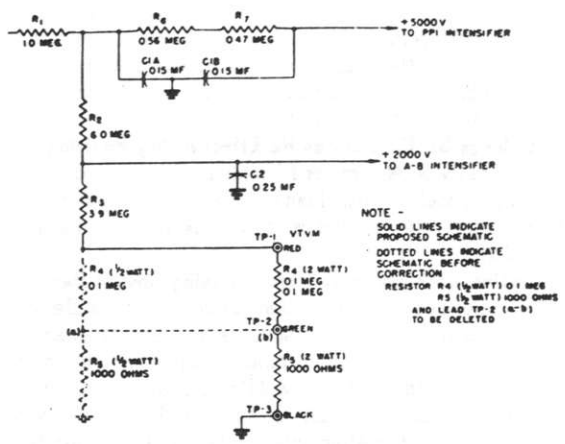


FIGURE 1.—Schematic.

connected in series and make up the bleeder for the 5,000-volt cathode-ray tube power supply in the PPI section of the console. If either of these resistors is broken or burns out, the bleeder path is broken and condensers C-1A and C-1B which are charged to 5,000 volts and condenser C-2 which is charged to 2,000 volts, have no discharge to ground. After the equipment is turned off, the charge remains in the condensers for several hours. Personnel servicing the equipment may come in contact with the condensers or associated leads, and receive a severe or possibly fatal shock.

It is recommended that the 1/2-watt resistors R-4(1H) and R-5(1H) be removed from their present location back of the power supply chassis and placed in stock or discarded. Two 2-watt resistors, R-4(1H) 0.1 megohm, and R-5(1H) 1,000 ohms, should be requisitioned from stock repositioned in series (see fig. 1, schematic-solid lines), so that R-4(1H) is between test terminals TP-2 and TP-3 behind panel.

In the corrected schematic, the following will be deleted:

R-4(1H) 1/2 watt.
R-5(1H) 1/2 watt.
Lead a-b from terminal TP-2.

See figure 7-94 of SV-1 Technical Manual Ships 341 and figure 7-72 of SS Technical Manual Ships 335).

WAVEGUIDE SWITCH HUMMING

A considerable number of waveguide switches in Model SS radar installations have been examined to determine the possible causes of an annoying "hum" when operated. It has been observed that the switches are physically mounted in different ways. Some are right side up, some up-side down (with reference to the engraving) and some are on their sides. This difference in mounting seems to be one factor in the "humming" situation. If the switch is mounted right side up, the plunger is drawn down into the coil and normally does not "hum." If the switch is mounted upside down the plunger is drawn up and very often hums. Those mounted on their sides seem to cause more trouble than switches right side up. It is not particularly practical or desirable to change the mounting as various problems exist in different installations but this item will at least serve to explain possible reasons for the "hum."

Lubrication (preferably graphite powder) of the moving parts of the switch mechanism will often help. Spring tension is also important and a new spring will sometimes remedy this situation.

MAGNETRON DATA

Radar Equipment SS uses a Type 2J50 magnetron which has the following characteristics:

Frequency ..... 8825 Mc (±75 Mc)
Gauss 5650
Power output ..... 56 kw.

This magnetron is also used in the ST radar, Fire Control Radars Mark 8 Mods 3 and 4, Mark 13 Mods 0-3 and Mark 34 Mods 0-4.

The SV and SV-1 radars use magnetron Types 4J36 through 4J41 having the following characteristics:

Frequency ..... 4J36 3675 Mc (±25 Mc)
Frequency ..... 4J37 3625 Mc (±25 Mc)
Frequency ..... 4J38 3575 Mc (±25 Mc)
Frequency ..... 4J39 3525 Mc (±25 Mc)
Frequency ..... 4J40 3475 Mc (±25 Mc)
Frequency ..... 4J41 3425 Mc (±25 Mc)

Power output is 750 kw for all the above-listed magnetrons.

Gauss is 2,500 for all the above listed magnetrons.

4J36 through 4J38 are used in the SV, SV-1 and SG-3 radars.

4J39 is used in the SV-1 and SX radars.

3J40 and 4J41 are used in the SV and SV-1 radars.

The information given above may come in handy some day, especially if you should happen to need a magnetron in an emergency. The other equipments listed may be available in the area if such an emergency should arise.

RESISTOR MATCHING—BEARING SWEEP GENERATOR

An odd trouble has been encountered at the Bell Telephone Laboratories. During factory tests on a prevideo amplifier and bearing sweep generator trouble developed with centering on the A-B scope and during B presentation.

when voltage is measured between J10A and ground it should be equal to but of opposite polarity to the voltage measured from J10B to ground provided the modulating capacitor C1 is so adjusted that the capacities of the two sections are equal. In the case in question the voltages were not equal and the trouble was traced to resistors R40 and R41. These resistors have 10 percent tolerance which is satisfactory as far as the circuit is concerned since the actual resistor value is not critical. However, in order to maintain proper balance in the circuit, it is necessary that these resistors be selected in pairs so that the difference in their resistance does not exceed 2 percent. The same holds true for the pair of resistors R38 and R39.

ERRATIC CRYSTAL CURRENT

If you are troubled with erratic crystal current, remove the entire signal crystal assembly (it unscrews). You will then notice a small ring which is removable and normally fits snugly up around the crystal as one contact. The crystal does not always seat properly when plugged in; thus when you have this assembly apart, fit the small ring into the crystal. Next, screw the assembly back into place making certain it is tight. Your signal crystal current will probably be steady if this is correctly accomplished. Avoid removing the crystal unless absolutely necessary, as it may not always seat properly when plugged back in.

SS SERIES AND AN/BPS-1 DELAYED VIDEO ON PPI

A Western Electric Representative reports encountering what appeared to be delayed video on the 20,000 and 40,000-yard sweeps. In some cases, reducing the repetition rate brought the transmitter pulse and targets temporarily back to the start of the sweep. In other cases, this cure was ineffective.

It was discovered that the sweep was triggered by the beginning of the ontime pulse instead of the transmitter pulse. In any case of apparently delayed video, it is suggested that the following points be checked:

1. Tubes in related circuits.
2. Repetition Rate.
3. Proper value and connections of R(1) 32, R(1C) 51, R(2D) 57, R(1C) 38, R(1C) 39, and R(1C) 41.
4. Clean firm connections on modulator tubes in the transmitter (base and plate clip assembly.)

SS SERIES AN/BPS-1 INVERTED TERMINAL STRIP COVER PLATE IN REGULATED RECTIFIER

Before installing the D-154061 (CW-20ADN-1) Regulated Rectifier, Electronic Shop mechanics are cautioned that unless cable connections to the 12-connection terminal strips are made in accordance with the terminal designation on the protective cover plate when the plate is held so that the stencilled words "This side for (SS-1) (SS-2) (AN/BPS-1)" are inverted, all of the connections will be wrong.

Several cases have been reported where the wiring was put in to agree with the plate turned so that the words were not inverted. Similar cases can easily occur as the designations on this side of the plate are the only ones shown which are applicable to the above systems.

The designations on the reverse side of the cover plate pertain to the SV-3 system, and this is also true of the designations on the chassis adjacent to the terminal strip and on wiring diagrams appearing in the instruction books.

Wiring diagrams incorrectly marked are:
Figure 7-183 in NAVSHIPS 91281.3 (SS-1)
Figure 7-186 in NAVSHIPS 91513. (SS-2)
Figure 7-209 in NAVSHIPS 91400 (AN/BPS-1)

Beginning with the terminal nearest the front of chassis, the terminals are: SS-1, SS-2, and AN/BPS-1

17	SV-3
18	102-1
1	103-1
2	302
3	303
4	702
5	703
6	103-2
7	102-2
8	1903
9	2003
10	01

Based on material compiled by C.B. Slaughter (Field Engineer) and appearing in W.E.C.O. Service Notes issue of 1 November 1955.

RADAR EQUIPMENT SS EXCESSIVE ANTENNA SCAN SPEEDS

There have been many cases where the PPI has failed to follow the antenna. This trouble resulted from antenna scan speeds in excess of the 8-9 RPM for which the servo system was designed. For normal operation, the maximum output of the Motor Controller should be 116 plus or minus 4 volts. Use of the 135 volts maximum output (incorrectly shown in instruction book drawings) will cause excessive antenna speeds. The 135 volts is applicable to the SV equipment.

Setting of the maximum voltages at the factory for the SS and SV equipments is accomplished by positioning a stop block for the scotch yoke of the Motor Controller. The illustration shows correct stop-block settings for SS and SV equipments. In NAVSHIPS 91513, page 7-421, figure 7-230, the block position shown is for the SV equipment only.

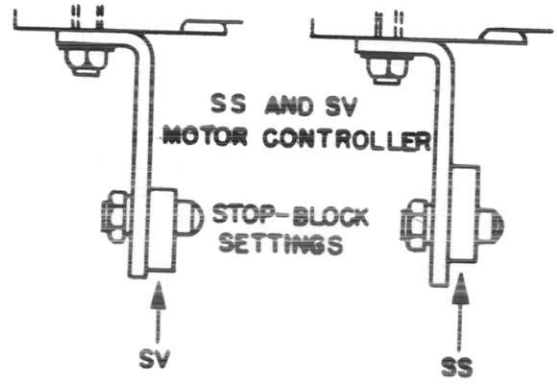


Figure 1

SS SERIES RADAR GASKET 0 (19) 106

The Bureau has received a report of stock issuance of Gasket 0 (19) 106, FSN N5310-209-0186, made of cardboard in lieu of nickel plated copper. Ensure that a copper gasket is used for replacements.

SS-a, SS-1, SS-2 MAINTENANCE KIT FOR INDICATOR CONSOLE

An unusual number of requisitions for maintenance kits for the Indicator Console of the SS-a, SS-1 and SS-2 equipments have been reclined.

The component parts of Tool Kit, symbol 0(1)137, appearing in Section 8, page 8-15 of the Technical Manual NAVSHIPS 91513, Vol. II, are identified as symbols H(1)102 through H(1)121. When replacement is necessary, the individual tools should be requisitioned.

SS, SV-1 AND AN/BPS-1 CONSOLES INSTALLATION AND MAINTENANCE SIMPLIFICATION

The following procedure will facilitate the installation of the flexible control shafts for focus and intensity potentiometers.

1. Drill two, one-half inch diameter holes over the Allen set screws in the cover that shields the potentiometers.
2. Secure the shafts to the console lid before it is placed on the console in lieu of first connecting shafts to potentiometers.
3. Place the lid on the console.
4. Connect the remaining shaft ends to the potentiometers. The new one-half inch holes will facilitate tightening the Allen Set screws.
5. Cover the added holes with standard one-half inch snap-in hole plugs.

BRACKET FOR SS RADAR MAST

A suggestion has been submitted for a bracket, as shown in figure 1, mounted near the lower end of the mast, to prevent the waveguide from dropping out during installation.

BRACKET FOR S.S. RADAR MAST

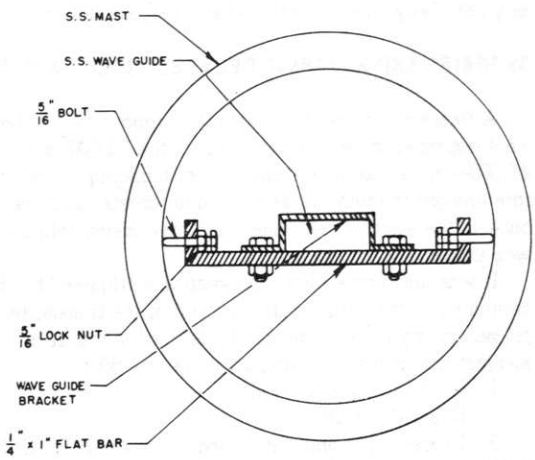


Figure 1.

INTERFERENCE TO SONAR EQUIPMENT FROM SJ AND ST RADARS

Interference to sonar equipment from the SJ and ST radars in the form of a high-pitched hum at the repetition rate frequency of the radars have been encountered.

This interference has been eliminated by putting a lead sheathing on the radar cables which cross the sonar leads in the conning tower bilge near the lower conning hatch coaming. About 4 feet of shielding was necessary.

SERVICE NOTES

Installation of ATR Tube: The 724B tube used in the ATR cavity should be installed with the keep-alive electrode to the rear so that accidental connection of the TR keep-alive lead will not occur.

Jittery Sweep on Range Indicator: A horizontal jitter of about 1/16 inch has been observed during operation of the ST. This jitter occurs only when the ST is being used, and is caused by 60 c/s pickup on the fine pulse rate line running to the selector control unit. The difficulty can be cleared by the addition of a 4 μf capacitor placed in parallel with capacitor C-12 in the selector unit.

Deterioration of R—40A and R—40B in the Range Indicator: Deterioration of R—40A and R—40B in the range indicator (as modified for ST) will cause low i-f gain on both the SJ and ST equipments. Overheating of these resistors causes a decrease in resistance thus lowering the plate voltage and gain of the i-f amplifier. When it is necessary to replace these resistors, a higher wattage rating of the combination should be used.

Difficulty in Tuning of Beat Oscillator: The 723A/B tube often operates more stably at one separation frequency than the other, i. e., at +60 mc/s rather than —60mc/s (or vice versa) from the transmitter frequency. It is important to keep the beat oscillator loosely coupled when tuning and continuously to tune the crystal line plugs while maximizing repeller and cavity adjustments. The 723A/B should be replaced if the above does not correct difficulty.

PERISCOPE WINDOWS FOR ST ANTENNAS

When ordering new radar windows during periscope overhaul, several locations have received a frosted glass instead of clear glass. This has raised questions as to the interchangeability.

Both the frosted and the clear glass are Corning No. 774 and they may be used interchangeably without altering the spacing between the window and the slotted antenna.

ST-1 WAVEGUIDE STOP SWITCH WATER SHIELD

A method has been suggested to prevent arcing which may be found occuring at the gap between the NT-14ABH-1 periscope adapter (ST-1) and the NT-23AGO waveguide stop due to salt water leakage from the periscope well. (This arcing has resulted in a burned out waveguide window.)

The method involves fabricating a water shield and strapping it on the waveguide to deflect water drops away from the air gap coupling (see figures 1 and 2). The line drawing provides the necessary details for manufacturing the water shield.

The Technical Manual for Radar Equipment SS, SHIPS 335, section 1, page 1, "Model SS Radar System Diagram" shows this waveguide coupling gap. SHIPS 335 shows the waveguide stop on page 19 and the periscope adapter on page 31. The suggestion applies to any ST-1 system using the below-deck units of any SS Series equipment and is approved for use by yard and repair facilities at their discretion.

ST SERIES (LARGE) REDUCTION IN WEIGHT OF BOTTOM PLATE ASSEMBLY

Some submarines have a large periscope well for number one periscope, making it necessary to use a large bottom plate assembly on the ST periscope adapter. The large bottom plate assemblies are manufactured by the various installing yards.

The large bottom plate assembly is 19 inches in diameter, compared to 14-3/4 inches for the standard, WE Company manufactured, G-201898, bottom plate assembly. The standard plate weighs 35 pounds without the guide bars, while the large plate weighs 65 pounds.

Experience has shown that this increase in weight is sufficient to allow the inner barrel of the periscope adapter to turn when the periscope is partially lowered, i.e., in a position below where the guide bars are effective, but above the periscope well bumper. This can result in severe damage to the waveguide stop. Also, this additional weight can lead repair personnel to think the adapter springs, item 18, figure 7-149, NAVSHIPS 91513, are weak, resulting in unnecessary replacement of the springs.

A solution to this problem is to remove 10 lbs. of the additional weight by cutting 9 holes. A 6-inch diameter hole is cut in the center and eight, 2-inch diameter holes are cut as shown in figure 1. The strength of this number is not critically affected by cutting these holes.

Further lightening of the bottom plate assembly can be accomplished by removing a triangular shaped piece of metal from each guide flange. This would help relieve the weight unbalance of the bottom assembly.

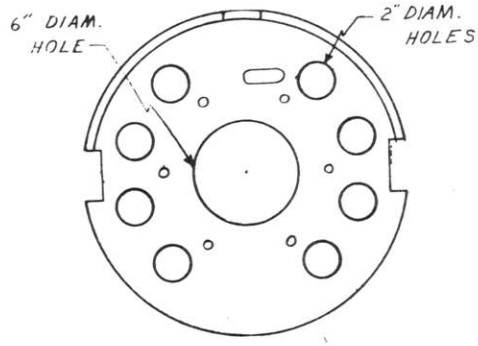


Figure 1

PAINTING ANTENNA RADOMES

Painting the SU/SU-1 antenna radomes with more than one coat of paint seriously affects the radar performance.

When repainting is required, it is recommended that the paint be removed from the domes by sandblasting. However, if sandblasting facilities are not readily available, liquid paint remover may be used.

After an old paint has been removed, it is recommended that one thin smooth coat of nonmetallic paint be applied with a paint spray gun in preference to a brush, since a spray gun will result in a more even and thinner film of paint on the surface.

To prevent additional coats of paint being applied to the radome the following words, "DO NOT PAINT HOOD," should be stenciled at two opposite places about ten inches above the bottom edge.

POSITIONING AND SECURING PPI TUBES

The JAN specifications for PPI tubes (type 5FP7) allow the tube manufacturers a variation in the length of tubes up to 3/4". It is reported that some difficulty is being experienced in positioning and securing the shorter tubes in the SU/SU-1 equipments, the trouble being that when the base of the tube is placed in the positioning plate, the face of the tube does not extend to the front panel and the tube is free to twist, causing the anode connection to be pulled off.

In order to position the short tubes so that their faces rest firmly against the mount on the rear of the front panel, it may be necessary in some instances to relocate the positioning plate either by placing washers between the positioning plate and the three knurled nuts or by extending the threaded portions of the three bolts sufficiently to permit further movement of the knurled nuts in the direction of the front panel.

TR KEEP-ALIVE VOLTAGE

Due to conflicting reports emanating from the field, there seems to be a general misunderstanding relative to the TR keep-alive voltage. The information as stated in Field Change No. 15 is correct. In order to determine whether or not the TR tube should be replaced, measure the voltage between the cap of the tube and ground. If it is between −325 and −450, as measured with a 20,000 ohms per volt meter, or if the current is between 100 and 200 microamperes, the tube does not need to be replaced. If the appropriate meter is not available or if the voltage or current is not correct, the TR tube should be replaced. The above is the correct value and should be adhered to.

MAINTENANCE OF MOTOR-GENERATOR SERVO, B-405

The motor-generator servo, B-405, which is mounted on the yoke of the antenna assembly, 974 and 974A, is a vital part of the line-of-sight stabilization system. Because it rotates at very high speed (approx. 14,000 rpm). The following maintenance schedule must be maintained:

a. After each 1,000 hours of operation, replace both brushes on the generator end of the machine.

b. After each 2,000 hours of operation, disassemble the machine and clean it carefully to remove all small particles which have accumulated. Carbon tetrachloride or its equivalent may be used for this purpose.

If the maintenance schedule is followed, continuous operation of this machine is virtually assured for many thousands of hours.

TUNING MODELS SU, SU-1 TRANSMITTER-RECEIVERS

Tuning the transmitter-receiver of the SU, SU-1 radar equipments requires two men. While one man tunes the transmitter-receiver, the second man observes the scope on the indicator. Due to lack of communications or other reasons, it is often unsatisfactory to tune the equipment even when two men are available. To provide a tuning indicator for use at the transmitter-receiver an adapter was devised for tuning the Model SO series transmitter-receivers where a similar situation exists. It was distributed as Navy Field Change 103-SO. This field change is also applicable to the SU-1 radar equipments.

The adapter furnished in the field change kit must be used in conjunction with an a-c output voltmeter having a sensitivity of 1,000 ohms-per-volt. If the meter does have an "output" position, it will be necessary to use a blocking capacitor (.005 mf) in series with the center conductor of the adapter output cord so that the d-c plate voltage will not be impressed on the meter.

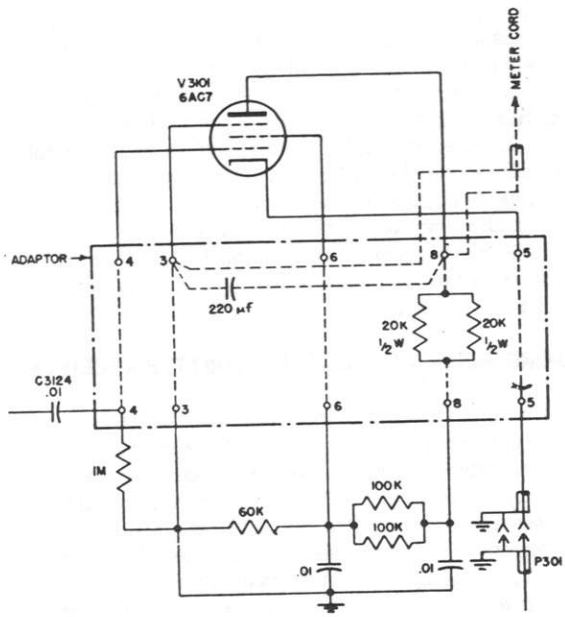
The receiver output cathode-followers tube V-3111 is removed from socket X-3111 and inserted in the adapter. The adapter is then inserted in the X-3111 output socket. The output cathode-follower tube has now been converted to an amplifier tube by the insertion of a resistor in the plate circuit as shown below, and is ready for operation.

The Bureau of Ships approves the issuance of Field Change 103-SO for use with SU-1 radar equipments. It is suggested that, where the supply is short and time is available, these adapters be fabricated for the SU-1 equipments.

RECEIVER TUNING

It is stated in the technical manual, "The LO TUNING CONTROL must be set reasonably close to the correct operating point in order that the AFC (automatic frequency control) channel may function properly and maintain the proper LO frequency, which should be 30 megacycles higher than the magnetron frequency."

It is absolutely necessary that the above condition exists. Here is why: Let us say the transmitter is operating on 9000 megacycles, then the LO should be operating on 9030 megacycles giving us an i-f (or difference) frequency of 30 megacycles. Now if the LO frequency dropped to 9029 megacycles giving a difference frequency of 29



megacycles input to the i-f strip and the AFC channel, the AFC channel will try to increase the frequency of the LO until a difference frequency of 30 megacycles is obtained. If the difference frequency is over 30 megacycles the AFC channel has a tendency to lower the LO frequency consequently if the LO is operating on the lower side of the magnetron frequency the AFC channel will have exactly the opposite effect. Instead of correcting the error in the LO frequency it will only throw it farther off frequency, or in other words the AFC channel will pull the LO in the wrong direction and all the signals will disappear. So if your radar loses all the signals when the LO control is thrown from MANUAL TO AFC, there is a pretty good chance that the LO frequency is on the wrong side of the magnetron frequency.

Important items which affect the maximum range of your SU radar are the TR and ATR tubes and cavities. The purpose of the TR tube and cavity is to protect the crystal mixer from the high r-f power present for the duration of the transmitted pulse and to match the crystal to the waveguide during the receive time, thus obtaining as much voltage as is possible from the received signal. Therefore, the tuning of the TR tube and cavity is of the utmost importance.

The purpose of the ATR tube and cavity is to keep the magnetron from absorbing any of the received signal and to aid in matching the TR cavity and the crystal to the waveguide. Thus we have maximum received signal transferred from the waveguide to the crystal mixer only when the TR and ATR are properly tuned.

The presence of Keep-Alive should be checked if the equipment blows crystals excessively, as crystals should last 300 or 400 hours minimum. If the TR tube does not have a definite peak in the response as indicated by an increase in echo amplitude, it should be changed.

Duplexers should never be allowed to become dirty and new one should be cleaned before installation. This should be done with brightwork polish, however, all of the polish must be removed; this is especially true of the ATR tube fins. Never use carbon tetrachloride to clean these tubes or cavities.

It is good to tune the cavities on the echo box for maximum ring time but it is much better to make the final adjustment on a distant steady echo such as a land target.

PREVENTIVE MAINTENANCE

Cleaning radar equipment is something that is often neglected. Periodic cleaning is necessary and the routine should be carried out. It is well to check all terminal boards and tighten all loose terminals about every 90 days. Lubricate in accordane with Table IX page 6-2 of the SU instruction book.

Small tubes should be tested on a monthly basis if the proper testing equipment is available; large tubes should be cleaned and inspected..

All insulators, including the porcelain standoff type should be perfectly clean at all times.

CORRECTIVE MAINTENANCE

Some recent casualties and remedies are listed here to aid the service technician should these casualties occur in his equipment.

Case No. 1.—The Range Step MIN SET controls would not bring the range step far enough to the left to calibrate properly:

First check the 300 volts at the hot side of R-614. This is the supply side of the range resistor network and should read 300 volts d.c. ± plus or minus 10 volts. If the voltage is right and the range potentiometer is good then R-614 is probably at fault, having changed value, and should be replaced.

Case No. 2.—Fauly antenna stabilization:

In this case the antenna operates properly in the STOW position but not in the STABILIZE position, which eliminates the fact that the elevation motor might be at fault.

First, all the supply voltages to the stabilization unit should be checked at the antenna where possible. The supply voltages to the servo-generator should be checked. Next the input to the gyroscope motor and the 24 volts d.c. at terminal 25 should be checked.

If all the above voltages are present and are of the correct value ant the antenna operates properly in the STOW position but not in the STABILIZE position, then the gyro unit should be changed.

Case No. 3.—Modulator or magnetron trouble:

Check for the proper primary supply voltages first. Is the AC POWER ON light burning? If not check fuse F-203. Be sure the OPERATE—STANDBY SWITCH S-510 is in the OPERATE position, HIGH VOLTAGE ON switch S-207 in the ON position, after 3 minutes have elapsed. The HIGH VOLTAGE ON light I-203 should light. If it does not, check the lamp and the fuse F-205.

If none of the above remedies cure the trouble, change the magnetron and the tubes in the modulator, one

at a time, checking for proper operation after changing each one. Since a large percentage of the trouble is caused by tube casualty, this will more than likely correct the trouble.

MODEL SU SERIES TROUBLESHOOTING NOTES

TROUBLESHOOTING HINTS

Antenna M-G, 288Z, Fails to Start When Equipment Is Turned On:

a. Input voltage at antenna M-G terminals 34 and 35. Should be 115v, 60-cycle alternating current.

b. Read motor resistance by removing cable connections to either terminals 34 or 35 and measuring between terminals 34 and 35. Should be approximately 0.6 ohms.

c. Motor condenser C-101.

No. 25v D-C Output at Terminals 24 (+) and 25 (—) of the Antenna M-G 288Z:

a. Fuses F-101 and F-102.

b. Resistance across terminals 24 and 25. Should be approximately 2.0 ohms.

c. Read D-C generator armature resistance by removing either F-101 or F-102 and measuring across fuse blocks. Should measure approximately 2.0 ohms. There may be brush or commutator trouble.

d. R-103 (D-C voltage adjustment) by isolating it from circuit.

e. Check D-C generator field by removing cable connection to terminals 25, removing either fuse, and measuring between terminal 25 and R-103 tap. Should measure approximately 25 ohms.

f. Check C-102 across terminals 24 and 25.

High or Low D-C Output at Terminals 24 (—) and 25 (+) of the Antenna M-G 288Z:

a. D-c generator field as in (e) the above paragraph.

b. D-C generator armature as in (c) in the above paragraph.

c. Setting of R-103 tap, and increase or decrease resistance in generator field circuit by sliding tap on R-103.

No. 115v, 240-Cycle, 3-Phase Output at Terminals 26, 27, and 28 of Antenna M-G, 288Z With S-515 at Indicator in "Stabilized" Position:

a. 24v d-c output at terminals 24 (—) and 25 (+).

b. Contacts of relay K-101.

c. Check holding coil of relay K-101 by removing cable connection to terminal 39 and measuring resistance across terminals 39 and 24. Should be approximately 300 ohms.

d. Check a-c generator field circuit (not generator field) by measuring resistance across R-102. Should be approximately 10 ohms.

e. Read a-c generator field resistance by removing connection of either F1 or F2 to R-102 or R-101 respectively. Should measure approximately 9 ohms.

f. Check R-101 by isolating it from the circuit. Should be 15 ohms.

g. Check R-102 by isolating it from the circuit. Should be 250 ohms.

h. Check a-c generator armature by removing cable connections to terminals 26, 27, and 28 and measuring resistances between terminals 26 and 27, 27 and 28, and 26 and 28. Should be approximately 10 ohms.

High or Low A-C Output at Terminal 26, 27, and 28 of Antenna M-G, 288Z, With S-515 at Indicator in "Stabilized" Position:

Check the following:

a. 24v d-c output at terminals 24 (—) and 25 (+)

b. A-C generator field circuit as in d above.

c. Setting of R-101 tap, and increase or decrease resistance in generator field circuit by sliding tap on R-101 until correct a-c voltage output is obtained.

Antenna Fails to Stow Properly:

Check the following:

a. D-C voltage (24v) at terminals 24 (—) and 25 (+) on antenna main terminal board.

b. D-C connections between main terminal board and terminal box on rotating assembly. Terminal 25 to terminal I and terminal 24 to terminal J. May be brush trouble.

c. Contacts of K-402 in terminal box on rotating assembly.

d. Operation of stow switches S-403 and S-404.

e. Field of elevation motor B-403 at prongs B and C of cable plug connecting motor to terminal box. Should measure 85 ohms.

f. Armature of elevation motor B-403 at prongs A and D of cable plug. Resistance may vary considerably because of differences in brush spring tension. Should not measure over 100 ohms.

Stabilization Indicator M-501 at Control and Range Unit and PPI Fails To Function Properly in Either "Stabilized" or "Stow" Position of S-515:

Check the following:

a. 24v d-c at terminals 24 (—) and (+) at antenna main terminal board. Be sure that terminal 24 is grounded.

b. Resistance of meter coils by removing connections to terminals 3 and 4 on right-hand main terminal panel and measuring between terminals 3 and 4, 3 and 6 and 4 and 6. Should measure 500 ohms.

c. Position transmitter connections between antenna main terminal board and terminal box on rotating assembly. Terminal 4 to terminal A, terminal 3 to terminal B, and terminal 6 to terminal C. May be brush trouble.

d. Positive 24v d-c connection between antenna main terminal board and terminal box on rotating assembly. Terminal 24 to terminal I. May be brush trouble.

e. Resistance of position transmitter R-401 at prongs A, B, and C of cable plug connecting R-401 to terminal box. A to B, B to C, and A to C should measure 550 ohms when plug is removed at terminal box.

f. Resistance between prong D of cable plug connecting R-401 to terminal box and ground. Should be 600 ohms.

Stabilization Indicator M-501 at the Indicator, 972, Shows No Change When S-515 Is Switched from "Stow" to "Stabilized" While the Vessel Is Pitching and Rolling:

Check the following:

a. 117v, 240-cycle, a-c supply at terminal box on

antenna rotating assembly between terminals D and E, D and F, and E and F. If no a-c check S-515 at indicator and K-101 at antenna main terminal board and terminal box on rotating assembly for continuity from 26 to D, 27 to E, and 28 to F.

b. Resistance of gyroscope motor if it fails to rotate. Measure at gyroscope cable plug between prongs A and B, A and C, and B and C. Each should be 55 ohms.

c. Resistance of M-G servo motor if it fails to rotate. Measure at M-G servo cable plug between prongs A and B, A and C, and B and C. Each should be 55 ohms.

d. Operation and contacts of K-402 in terminal box on rotating assembly. Should close with S-515 in "stabilized" position.

e. Split field of M-G servo generator at cable plug between prongs F and E, and F and D. Each should be approximately 40 ohms.

f. Silverstat resistances at gyro box cable plug between prongs F and E, F and D. Each should be approximately 500 ohms if antenna is leveled or between 0 and 500 ohms if not leveled. Should never be infinity.

g. Armature of M-G servo generator at cable plug between prongs G and H. Should measure 10 to 25 ohms. Value may vary with brush tension.

h. Armature of elevation motor, B-403, at cable plug between prongs A and D. Value may vary with brush spring tension, but should not be over 100 ohms.

i. Field of elevation motor, B-403, at cable plug between prongs B and C. Should measure 85 ohms.

Stabilization Indicator M-501 at Indicator, 972, Shows High "Up" or "Down" Angle at All Times, Seldom or Never Reaching or Passing Through the Zero Position, After S-515 Has Been in the "Stabilized" Position for About 15 Minutes:

Check the following:

a. Split field of M-G servo generator at cable plug between prongs F and E, and F and D. Both sections of the field must be balanced, each reading approximately 40 ohms.

b. Silverstat resistance at gyro box cable plug between prongs F and E, and F and D. It should be possible to position the reflector by hand so that readings of 500 ohms are obtained. If trouble is with silverstat, replace entire gyroscope box.

c. Settings of limit switch cams and operation of limit switches.

Stabilization Indicator M-501 at Indicator, 972, Shows Satisfactory Stabilization (Movement Synchronized With the Pitch and Roll of the Vessel):

a. Direction of antenna rotation on "automatic training." Be sure that it is clockwise.

b. Phase sequence of 115 v, 240-cycle, 3-phase supply by removing a brush from the small motor generator servo unit in the antenna assembly and observing the direction of rotation. It must be counter-clockwise as viewed from the commutator end. This will automatically assure correct rotation of the gyro motor, which is clockwise looking down at the flywheel. A reversal in the direction of automatic training or in the direction of gyroscope rotation will result in erratic operation of the stabilizer.

Stabilization Indicator M-501 at Indicator, 972, Shows a Rapid Movement Through Zero With S-515 in the "Stabilized" Position—This Movement Not Synchronized with the Pitch and Roll of the Vessel:

a. Damper and pinion on shaft of elevation motor, B-403. Replace damper if necessary by removing elevation motor, loosening Allen set screws, holding damper and pinion to motor shaft, and sliding assembly off the shaft. When assembling new damper and pinion, do not attempt to force it on the shaft; if it fails to go on easily, remove burrs from shaft and damper. Damper and pinion assembly should be set on shaft so that end of pinion extends one-sixteenth inch beyond end of motor shaft. To line up the pinion and gear teeth, move gyro control slightly. Allow elevation motor to bottom on recess in housing; then clamp in place.

b. Power supply to gyro motor.

c. Resistance of gyro motor at cable plug for gyro control box between prongs A and B, A and C, and B and C. Each should measure 55 ohms. If not, check plug connections.

d. Direction of gyro motor rotation as in second b above.

e. If all preceding checks fail ro reveal source of trouble, difficulty may be inside gyro control box. Replace gyro control box if replacement is available. If not, make the following checks inside the box.

f. Gyro motor input leads and contact points. The positions of the three flexible wires inside the box should not be changed, since the balance of the gyroscope will be disturbed.

g. Friction plate and friction pins (shoes) which slide on the friction plate. The pins may be too tight or too loose. Adjust, if necessary, to a maximum of 0.001-inch clearance. The friction plate may require cleaning with alcohol or carbon tetrachloride. If the plate has been damaged and is rough, the gyro box should be replaced.

Stabilization Indicator M-501 at Indicator, 972, Shows a Slow Movement Through Zero Which Is Not Synchronized With the Roll of the Vessel When the Antenna Is Directed to Either Port or Starboard and After S-515 Has Been in the "Stabilized" Position for About 15 Minutes. (Gyroscope Precessing Because of Excessive Friction):

a. Contacts of relay K-402 in terminal box.

b. Binding between antenna elevation drive gear and sector gear. (Units No. 1-No. 99.) Allow a very slight backlash in sector gear. In units No. 100 and up look for binding between gyro box drive link and antenna dish and between cam sector gear and drive gear. There should be some clearance between sector gear and housing.

c. Friction between position transmitter R-401 and its link. The wire-wound potentiometer may be broken and the contact arm may be partially jammed.

d. Friction between elevation motor damper and cover of gear case. Incorrect location of damper on motor shaft will cause this trouble. Damper and pinion assembly should be set on motor shaft so that end of pinion extends one-sixteenth inch beyond end of motor shaft.

Caution: Do not force damper on motor shaft. Slightest pressure on end of shaft may materially change alignment of motor armature in housing.

e. Friction in bearings of elevation motor.

f. Friction or excessive backlash of gears in gear box. If gear teeth are worn, resulting in excessive backlash, a new sector of the large micarta gear may be used. It is necessary only to remove the four studs holding the gyro box mounting plate, remove the plate, rotate the main gear 180 degrees, and replace the plate.

g. If the above checks fail to reveal the trouble, replace the gyro box if a replacement is available. Otherwise proceed with the following checks inside the gyro box.

h. Friction plate and friction pins which slide on plate. If plate is dirty, clean with alcohol or carbon tetrachloride. The slightest amount of grease on this plate may cause trouble. If friction pins are too tight or too loose, adjust to a maximum of 0.001-inch clearance.

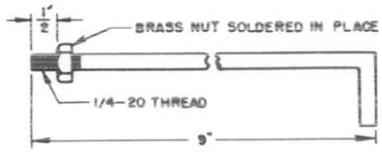
i. Mounting of gimbal bracket (movable frame outside of gyroscope and inside gyro box). If loose in its pivots, bring loosened bearing pin over sufficiently to remove end play without introducing friction, maintaining proper clearance between gimbal bracket and friction plate at both ends. Tighten clamp screws.

j. Mounting of gyro motor. If loose in its pivots, note which bearing pin is tight. The loosened pin usually can be detected by the fact that the gyro rotor, when moved toward it will generally touch or come very close to the bearing support arm. Move the gyro toward the tight pin, bring the loosened pin over snug (not tight) against the gyro motor, and retighten the clamp. Gyro must not have noticeable side-play on its pins, but it must be free in its swing when moved.

SU BRASS RODS FOR TRANSFORMER FACILITATE MAGNETRON REPLACEMENT

It has been suggested that the inboard screws holding down the magnetron pulse transformer be replaced with threaded brass rods (see figure 1) to facilitate magnetron replacement.

The proposal is unique in that it is not necessary to use a nonmagnetic screwdriver for magnetron replacement. The use of the brass rods will save much time in magnetron replacement and will prevent the magnet from possible losing its strength.



"HOLD DOWN ROD" FOR MAGNETRON PULSE TRANSFORMER ASSEMBLY. TWO REQUIRED. MADE FROM 1/4" BRASS ROD.

Figure 1

SU LOCAL CONTROL UNIT FOR TUNING

A suggestion has been submitted for the fabrication of a local control unit to assist in tuning the SU equipment.

The Bureau considers this proposal to have definite merit. It is published in the following paragraphs as submitted, for adoption by vessels and other activities at their discretion.

"This devise was designed to be of assistance in tuning the SU radar receivers. This unit will eliminate the need for sound powered phone communication or movement between the indicator control unit and the transmitter-receiver when assistance is not available.

The 'Local Control Unit', as the device has been termed, will give the technician control of L.O. tuning and A.F.C. manual switching at the transmitter-receiver. Included in the unit are two milliameters to read the A.F.C. and receiver crystal currents. One of the meters doubles as a voltmeter to read the L.O. repeller voltage. The L.O. tuning circuit, R-1, R-2, and C-1, in the local control unit is identical to that used in the SU indicator and is merely substituted for that circuit when tuning.

The switch, S-1, is simply placed in parallel with the A.F.C. manual switch in the indicator. One meter has its negative lead going to ground and the positive lead terminates at one of the meter jacks. The other meter is connected through switch S-2, which changes it from a milliameter to a voltmeter. With the switch in one position, the positive lead is grounded and the negative lead goes to the arm of the potentiometer, R-1, through a one-megohm resistor, R-3, the L.O. tuning control. In this manner the repeller voltage, which appears at terminal No. 16 on E-3101, is read. By placing the switch S-2 in the other position, the negative lead is grounded and the positive lead terminates at a meter jack.

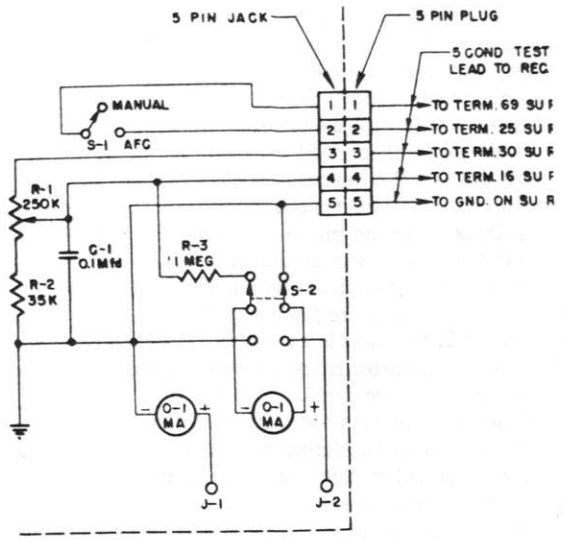
The voltmeter in the local control unit is a 1,000-ohm per-volt meter and will therefore indicate a lower voltage than a 20,000-ohm per-volt meter, the use of which is specified in the technical manual. The meter is first calibrated by setting the repeller voltage to -140-volts using a 20,000-ohm per-volt meter. This voltage is then read on the units meter and the voltage indicated is marked on the meter as the proper value.

To place the LOCAL CONTROL UNIT in operation, seven leads are connected to the receiver, two of which are test leads to measure the crystal currents. The existing lead on terminal No. 16, on E-3103, is removed and one of the control units leads is connected to this terminal. The remaining leads are connected in parallel with the existing leads on the terminal board.

Tuning is accomplished in the manner set forth in the technical manual except that A.F.C.-manual switching and L.O. tuning is done at the transmitter-receiver unit instead of at the indicator. The A.F.C. manual switch at the indicator control unit must be placed in the manual position in order to have control at the local-control unit.

The 'TR' and 'ATR' tubes can be more accurately tuned when targets are observed at the transmitter-receiver unit. A synchroscope, such as the TS-34/AP, can be connected to the video output jack through a 'tee' connector. A trigger pulse can be obtained from either terminals, A or B, located on the front of the magnetron pulse transformer assembly.

The use of the LOCAL CONTROL UNIT is simple and quits satisfactory, giving accuracy in tuning which is difficult to achieve by other means.



SU "Local Control Unit"; Schematic

Notes on Recurrent Failures

NATURE OF DIFFICULTY	TROUBLE FOUND AND REMEDY
Modulator (SU)	
Antenna failed to come to stow position	Stow switches S–403 and S–404 failed to make contact. Adjusted contacts on both switches which restored operation.
Modulator (SU)	
No high voltage supply to pulse jack 203	Replaced V–202 and V–205. Both tubes found shorted.
Control Rectifier (SU)	
Slight unbalance of thyratrons V–905 and V–904 was giving rise to small intermittent training error and hunting.	Adjusted R–904 and R–903 for proper balance.
Transmitter (SU)	
Close in targets could not be seen because the main bank from the transmitter was covering them up.	Checked and found that the radar operators were not detuning the echo box after they had used it. This condition caused the close in targets to be covered up by the ringing time of the echo box. With the echo box detuned the equipment operated correctly on close in targets.
Motor Generator (SU)	
The 288Z motor generator was found to be supplying only 21 volts instead of the required 24 volts.	Adjusted R–103 which corrected this condition.
Control and Range Unit (SU)	
No sweep on either scope	Replaced defective V–512.
Double trace and poor step definition, dropping out at 4,000 yards on low range.	Adjusted 300 volt bus. Both deficiencies corrected.
Calibration markers too large in amplitude on long range.	Replaced V–531 which corrected amplitude of markers.
After heavy gunfire, the radar screen showed a blanking of targets for about 10 of the antenna sweep while equipment was operated on AFC. On MANUAL tuning the operation was normal for the entire sweep. Blanking appeared from about bearing 245 to bearing 255 relative.	Inspection of the AFC circuit revealed the screw holding the AFC crystal in its socket was not completely dogged down. Screw was tightened and trouble disappeared.
The 972 indicator was found to be unstable if the 300 volt bus were set above 265 volts.	V–504 and V–505 were interchanged with two other 6SN7GT's in the unit and all instability disappeared.

Note on Recurrent Failures—Continued

NATURE OF DIFFICULTY	TROUBLE FOUND AND REMEDY
***Control and Range Unit (SU)*—Continued**	
Oscillation was encountered in the sweep circuits.	This was finally cured by several replacement tubes being tried in V–524 and V–528 sockets.
Error of 6 in bearing between the remote PPI and PPI.	Rotated body of selsyn SG 501 to deliver zero voltage at remote when remote and PPI were set on zero. Antenna was corrected accordingly.
Step would not measure under 1,000 yards upon occasion.	Readjustment of 300 volt plate supply of control and PPI unit was made.
Bug was dragging on PPI tube and causing training wheel slippage.	Removed plastic part over PPI tube and bent bug into position such that it did not drag.
Loss of calibration on four mile range on "A" scope.	Adjusted R–502 and R–509 which restored calibration.

POLYSTYRENE WINDOWS FOR SV/SV-1

As a matter of information to the Submarine Fleet, attention is invited to the fact that the polystyrene windows used in the waveguide flange of SV and SV-1 Radar Equipments are interchangeable. They are listed in maintenance repair parts sections of the technical manual as Item 746, Contractors Drawing Number BL-53196 for SV and Item 1003, Contractors Drawing Number BL-53196 for SV-1. An ample supply of SV-1 Equipment, Tender, and Stock Maintenance Repair Parts is available.

The rectangular polystyrene windows used in the projector of SV and SV-1 under Item Nos. 766 and 1026 respectively are also interchangeable.

OMISSION OF POLYSTYRENE WINDOWS

Several SV radar-equipped vessels have reported loss of power output from their equipment. After spending many hours trying to locate the trouble, it was finally found at the waveguide window in the base of the mast.

It was determined that the polystyrene window and choke had been left off during installation of the equipment, thus causing a mismatch in the transmission line.

Naval installation and overhaul activities are requested to take particular caution during installation or repair of SV series radar equipment to be certain that the polystyrene window and choke are installed in the base of the mast.

MAINTENANCE NOTES

Excessive Backlash in SV Training Control Unit, Also Creeping of Antenna in Either Direction With Training Control Handle in "OFF" Position:

a. Similar to backlash fault in SS training control unit except that creeping was caused by misadjustment of microswitch units in training control unit. Readjustment of microswitches eliminated creeping.

Inoperation of Automatic Frequency Unit of SV Radar Transmitter-Receiver Unit:

a. Inoperation of this unit caused by failure of potentiometer R-18 in A.F.C. chassis. Replaced, resulting in normal operation

Low Intensity on Range Indicator Scope:

a. Caused by a faulty intensity potentiometer P-11 in the range indicator unit of SV Radar. Replaced with normal operation.

Low Sensitivity in SV Radar System Caused by the Following:

a. Faulty connection to crystal housing in transmitter-receiver unit, giving high resistance to connection on small end of crystal unit in waveguide. Repaired.

b. Low output of magnetron in transmitter receiver unit. Replaced.

c. High output of 300-volt regulated rectifier. Adjusted.

RESISTOR CHANGE IN MODEL SV-1

See the article entitled "Resistor Change in Models SS and SV-1" in "SS" series.

SV SERVICING NOTES

Rep-Rate Setting: Setting Rep-rate on SV to correct 400 PPS can be easily done by turning fine control to MAXIMUM and setting scope sweep to 60 cycles; then set course control to show 7 pips from test sync jack, or 420 PPS MAXIMUM. Gained 1,200 yards ringtime on one system after making this adjustment.

Transmitter 5,000 Volt Supply: Trouble in the SV Transmitter 5,000 volt supply which is using the carbon plate type of 371-B rectifier tube show as symptoms:

a. Jittery voltage reading on position 7 of the test meter.

b. Variations from 4,000 to 5,000 volts.

c. One of the 371-B tubes showing a considerable amount of color. These have been traced, in all cases, to a loose plate cap on the 371-B tube. The cap on the carbon plate tubes is soldered to the lead-through wire and this soldered connection is either poor or intermittent when the tube is new or develops this condition with use.

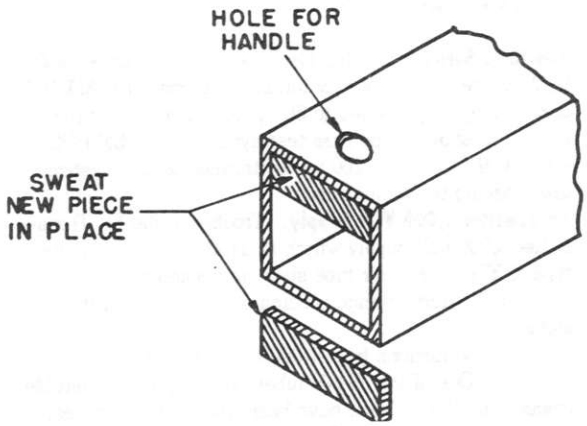
Low or Intermittent Magnetron Current: Occassionally a trouble condition shows up as low or intermittent magnetron current in the SV transmitter. When this happens check R(2)18 which is mounted on the magnetron mounting bracket. Connect an ohmmeter across this resistor and heat the body of the resistor with a soldering iron. In some cases this meter shunt dropped from its normal 6.25 ohms down to value of 2 ohms.

Arcing or Overheating of 5D21 Tubes: Here is another case of meter shunt trouble. With the SV Transmitter ON TIME control adjusted to 170 ma the four 5D21 tubes started to arc and get hot. It was found that the meter shunt R(2)24 had changed enough to give an error of 35 ma. Since this happened to be on the high side it meant that the 5D21's were adjusted to an ON TIME current of 205 ma which was causing the aforementioned arcing and excessive plate dissipation. Unless a resistance bridge is available this meter shunt is difficult to check because its normal value is 0.625 ohms, 2 percent tolerance. This is not the only reason for arcing or hot 5D21's but is one of the factors that must be taken into consideration when this trouble is encountered.

BRUTE FORCE DAMAGES WAVEGUIDE SWITCH

The switch block inside the SV waveguide switch becomes damaged when too much enthusiasm is used in sliding the switch from one position to another. If the switch handle is not pulled out far enough to release it from the detent and force is used to try to operate the switch, the walls of the switch block become bent near the point where the handle is attached to the block. When this has happened, the thing to do is remove the block from the switch and straighten the bent portion, getting it as nearly square as possible, and then reinforcing it with a new piece sweated in place at the end where the damage has taken place.

After the new piece has been added, the block will look something like the sketch above.



This trouble was brought to the attention of the Bell Laboratories and they advise that a reinforcing member has been added in later production to avoid recurrence of this damage to the block.

SV/SV-1 RADAR MODULATION NETWORKS

Various instructions pertaining to replacement and disposition of defective SV/SV-1 Radar Modulation Networks are reviewed to inform all concerned.

The Navy Type 53347 networks originally supplied in SV/SV-1 radars and associated repair parts were found to be defective in operation. Replacement of the type 53347 is made with a new and improved network known as Navy Type 53347-A. All the Type 53347-A networks bear serial numbers of 1000 and up. This new network can be repaired and the contractor will repair any of this type that fail.

The Navy Type 53347 networks, which bear serial numbers below 1000, cannot be repaired by the contractor. However, the Bureau of Ships has committed all defective networks of this type to the Atomic Energy Commission. It is, therefore, necessary that the Bureau of Ships be advised whenever any defective SV/SV-1 networks, either NT 53347 or NT 53347-A, are available for disposition.

It is also imperative that the Bureau of Ships receive failure reports on all defective networks. This report should indicate the type and serial number, life hours, and a brief description of the failure.

REINSERTION OF RESISTOR R(2)75 IN CW-43ACW TRANSMITTER RECEIVER IN SV, SV-1, SV-2

From investigations made by the Bureau of Ships it has been determined that the presence of the arc suppression resistor R(2)75 in the modulator tube circuit tends to keep the high voltage across the 5D21 tubes at a minimum during arcing within these tubes and thereby reduces possible failures of the 5D21 tubes and the modulator network.

Due to the original shortage of this resistor the Bureau of Ships authorized its removal from the circuit. At the time of removal of this resistor, leads connected to terminal No. 3 of plate transformer T-1 (KS-9668) were to be removed and connected to terminal No. 4 of same transformer.

As sufficient supply of this resistor is in stock to maintain the present number of active equipments, it is requested that R(2)75 be reinserted in the modulator tube circuit and the lead connected to terminal No. 4 of the plate transformer (T-1) be reconnected to terminal No. 3 of the transformer.

MODEL SV AND SV-3 MAGNETRON RINGS

In the SV and SV-3 radars the magnetron is insulated from ground by phenolic insulating rings and insulating bushings. This is necessary in order to obtain magnetron current readings on the test meter. When these bushings become damaged or the rings broken the magnetron frame becomes grounded and current readings are unobtainable. Furthermore, these bushings and rings are not in spare parts and replacement becomes very difficult.

To enable maintenance personnel to fabricate these rings and bushings locally the following manufacturing data is supplied. Two magnetron insulators, two insulating bushings 7/32 inch high and eight insulating bushings 5/32 inch high are required.

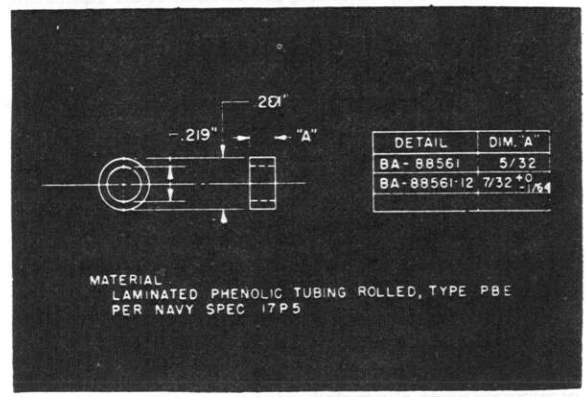


FIGURE 1.—Insulating bushing.

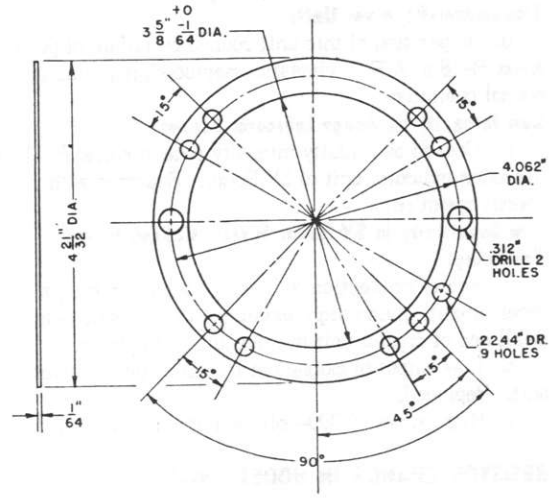


FIGURE 2.—Magnetron insulator.

INTERFERENCE ABOARD SUBMARINES

One of the major causes of interference in SV equipment aboard submarines has been improper spacing of the waveguide choke flange air gap. The manufacturers' specifications state that the length of this gap is not to exceed one-tenth of the wavelength of r-f fundamental frequency or three-sixteenths inch clearance between the two waveguide sections plus one-sixteenth inch minus 0-inch tolerance. In every instance where this specification was followed, no interference to the electronic equipments was detected.

Check air-gap clearances frequently. Hull distortion during dives can very easily change the physical dimensions of the choke flange air gap. In addition, check the waveguide choke flange alignment frequently and adjust for a minimum SWR with the four adjusting screws on the waveguide mounting bracket. Install Field Change 2-SV as an additional interference reduction measure.