SYNCHRO ALIGNMENT OF ROTATING WAVEGUIDE SECTION

Use the following procedure for aligning the scanner nozzle.

Place the SX in operation and remove power from the amplidyne so that the scanner motor cannot run.

Place a 0-100 vold d-c voltmeter on terminals E3407-1 and E-3407-4 (ground) in the antenna control unit. This will measure the sweep voltage. Similarly, a 0-150 volt d-c voltmeter on terminals E3407-2 and E3407-4 will measure the blanking voltage.

As the elevation handwheel is turned in a clockwise direction, the sweep voltage should rise slowly to a maximum and drop rapidly to a minimum.

Adjust C-3407 (maximum sweep voltage adjustment) to give a maximum of 60 ± 5 volts.

Adjust R-3411 (zero adjustment) to give a minimum of 0-5 volts.

The gears under the front panel should be meshed, and the commutator in the rear of the unit adjusted so that the sweep voltage is maximum at 11° on the dial and minimum at 0°. The blanking voltage should jump to 100 volts at 11° and drop to 0 volts at 0° and should remain at 0 volts from 0° to 11°.

C-3407 and R-3411 should be readjusted to give a sweep voltage of 44 volts at 8° and 0 volts at 2 small divisions before 0° in the red portion of the dial.

With the complete system turned on, the 5HG synchro in the Robinson Horn should be readjusted as follows:

Set the elevation dial in the antenna control unit at 0°.

Turn the 5HG so that the rotating wave guide is on the edge of the cross-over region in the Robinson Horn. This region is evidenced by a "squealing" noise made by the r-f power going into the resistance material. CAUTION.—Do not leave in this position any longer than necessary.

Turn the elevation dial to 1/2°. This should eliminate the squealing at the horn. If the squealing is still heard the 5HG has been aligned on the wrong side of the crossover region. Repeat the process with this in mind.

AZIMUTH GEAR TRAIN FAILURE IN SX ANTENNA ASSEMBLY

There have been several reports of azimuth gear train failure in the SX Antenna Assembly.

In cases where the antenna assembly has been overhauled the source of trouble may be improper reassembly of the azimuth gear train.

In centering the large bull gear several shims are employed to hold tolerances to within one-thousandth of an inch. These shims are held in place by locking bolts in such a way that they normally would not be disturbed during disassembly. However, due to lack of distributed information those not entirely familiar with this portion of the SX equipment will probably loosen the locking bolts, thinking it necessary for removal of the bull gear. This will allow the shims to fall into the oil case when the gear is removed. If the gear train is reassembled without the shims, the large bull gear will be free to move slightly as the antenna rotates, resulting in damage to the gear train and breakage of the small synchro drive gears. This trouble will be recurrent as long as the bull gear is free to move in the absence of the shims.

Another possible source of trouble which must be avoided is damage to the small synchro gears, arising from the application of certain heavy types of grease to the gear teeth. Application of types of lubricants heavier than that listed below to gears of 20 pitch or smaller will in some cases cause serious bending of the gear teeth. Experiments conducted by the manufacturer with heavy types of grease show that while most of the grease will squeeze out as the gears are meshed, some will remain trapped in such a way that it cannot be moved of further compressed as the gear turns. This results in bending of the teeth.

Lubrication of the azimuth train gear box should be in accordance with the SX Technical Manual, Ships 379, Volume 1, figure 3-15 (sheet 3 of 3), which specifies oil which conforms to Specifications OS-1113, newly designated as BuOrd Specification 51F23 (ORD). Federal Standard Stock Catalog numbers for this lubricant are 51-F-546 for a 5-gallon can; 51-F-547 for a 55-gallon drum.

LOCAL OSCILLATOR TUNING RODS

Two types of tuning rods were distributed with the Model SX radar for adjustment of the Type 35ACB local oscillator assembly. The rods supplied with the earlier SX equipments are made of dark fiber and have been reported to be subject to breakage. Later SX equipments were furnished with a superior type plastic rod which is "milky" in color and easily distinguishable from the old type due to its lighter color.

Vessels having only the old-type rods should request one new-type rod for each oscillator assembly on hand. The request should be sent to the Bureau of Ships. Any increase over normal ships maintenance repair parts allowance of oscillator assemblies (created as a result of

previous requisitions for tuning rod replacements and receipt of the oscillator assembly) should be returned to stock.

ANTENNA OVERHAUL

The SX radar antenna manufacturer has suggested the following remedies to common troubles found during overhaul of the SX antenna.

a. Trouble: Strainer to Bijous plunger-pump supplying oil to bearing in azimuth, level and cross-level gear trains fouls and becomes closed in from one to three months. Remedy: Manufacture and install a filter bag of approximately 25 square inches in area. Bag to be made of filter felt and installed with a drawstring around neck of intake. The old filter screen would be clean and left in place for additional protection.

b. Trouble: Moisture in azimuth tear chamber due, possibly, to condensation in upper chamber leaking through Garlock seal. Remedy: Reverse Garlock seal. This seal was originally installed to prevent oil from splashing from lower chamber into upper chamber. Experience has shown there is no tendency for this to occur; therefore reversing the seal can do no harm and will perform a useful function.

c. Trouble: Drive shaft on scanner assembly failed because a third (self-alining) bearing was left on shaft during the final phase of manufacture. This bearing was originally intended to aid in positioning the Robinson feed horn but subsequently made rigid and the bearing should have been removed. Remedy: Remove the self-alining bearing (bearing nearest feed horn where three bearings remain). It is believed that this change is applicable to the first four serial numbers only.

d. Trouble: Ball bearing to bull gear in level and cross-level gear trains were worn. This bearing is subject to considerable strain and wear. Remedy: Replace this bearing in both gear trains at each major antenna overhaul as a preventative maintenance procedure.

e. Trouble: Spacing shims on adjustable gear in azimuth gear train dropped out, resulting in misalinment of the gear train which in turn caused failure of synchro gears. In two instances this fault caused bolts and dowels on bull gear to be sheared off. Remedy: Replace U-shaped shims with either a circular shim after fit is achieved or with a self-hanging type shim made of laminated material for ease of adjustment.

MAINTENANCE NOTES—TRANSMITTER, RECEIVER AND INDICATOR SYSTEMS

Synchronizer: It has been found that the blocking oscillator circuits that are used in the dividers in this unit are somewhat tube selective. JAN-6SN7-W's are specified; however, a new and good tube will not always work in all sockets. It is sometimes necessary to try several tubes (three or four) before one is found that will operate correctly within the adjustment range of the blocking oscillator. If more than three or four are tried with no success the trouble is probable elsewhere.

If more than two SX's on the same frequency are operating in close proximity, objectionable interference may appear on the PPI. The amount of interference will depend upon the frequency difference between the crystals in the two synchronizers, and the rotation rate of the antenna. Synchronizer control crystals are cut within a tolerance of 0.01 percent permitting a maximum deviation of 16 cycles between any two crystals. Under these conditions with the antenna rotating at 4 rpm, a spoke will appear on the PPI either crawling from the center out to the periphery or from the outside toward the center, on each revolution. The following formula gives a good approximation of the difference in frequency between two synchronizing crystals:

$$\Delta F = 3.5 \times S \times R.$$

Where ΔF = difference in frequency of crystals.
S = Number of spokes observed per antenna revolution.
R = Rotation on antenna in rev/min.

If the interfering SX has a higher crystal frequency the interference will appear to move toward the center; if lower, the spokes will start from the center and move out. In one case when the three SX's were operating in company, the interference pattern was very bad and gave about 20 spokes per revolution at 3 rpm. A check revealed that the crystal in the synchronizer of one of them was considerably off frequency. Replacing the crystal remedied the trouble.

An excellent way for setting up the count down circuits in the synchronizer is to use a Dumont type 251B A & R Range Scope. The 4,500-microsecond sweep enables the technician to see the entire 210-mile sweep without resorting to the delay circuit in the synchroscope. The R sweep also permits accurate measurement of the position of the various triggers on the sweep.

It is not generally realized that in order to synchronize the 20-mile markers with the search sweep, it is necessary to feed back every search pulse to the 20-mile marker circuit. When 20-mile marks appear to be ten-mile marks the trouble is often in this feedback circuit and not in the 20-mile marker blocking oscillator counter itself.

For dependable operation the synchronizer should be bench-checked every 500 hours of operation.

Modulators: The modulators are designed to recycle automatically in case they do not begin to fire when the start button is pushed momentarily. Most installations do not usually operate this way. The modulators will not recycle if wired as shown on the schematics, and the actual wiring in the modulators conforms to these schematic diagrams. For proper operation the wiring should be reconnected as shown in figure 1.

With reference to figure 1, all relays and contacts are shown in their normal (i. e., not operated) position. The initial series designation, K35- or K36-, denoting whether the relay is in the height or search modulator, is not shown, since the diagram applies to both modulators.

It is assumed that the modulator is in the stand-by condition and the contact 06B operated by the time delay relay are closed. When the radiate button is depressed, power is applied to the relay (01A) which closes contacts 01, B, C, and D (not shown) in the three-phase line to the high-voltage rectifier. If magnetron current begins to flow, relay 10A is energized and the main contactor relay 01A is sealed across the line by contacts 01E and 10E. If magnetron current does not flow, contacts 10E do not close and relay 01A is not sealed across the line; meanwhile, the recycling

circuits begin to operate. Recycling will also take place if contacts 12B are opened by the negative reflection throw-out relay or by action of the magnetron undercurrent relay. If recycling does become necessary, the operation is as follows: When the radiate button is depressed, power is also applied to relay 13A through the normally closed contacts 13C. Relay 13A closes its contacts 13B and 13G, sealing 13A across the line through the normally closed contacts of 14C, and also applies power to relays 15A and 16A through 13G. Normally closed contacts 10B are closed because of nonoperation of the magnetron current relay, 10A. After contacts 13B and 13G close, contacts 13C open. The operation of relay 15A closes contacts 15E and opens contacts 15F. Power is then applied to the long-time motor, relay 14A and 14B, a reversible motor type relay, through contacts 14C and 15E, causing it to rotate in a CCW direction from its normally fully CW position. As soon as the motor begins to rotate in a CCW direction it operates contacts 14E, closing them. While the long-time motor rotates in a CCW direction, contact 14C remains closed sealing in relay 13A. However, as soon as the motor reaches its extreme CCW position contact 14C opens, allowing relay 13A to drop out. This opens contacts 13G and removes all power from the actual recycling circuits. Thus, the total number of times the modulator may recycle and attempt to radiate is determined by the long-time motor, since it determines how long relay 13A is energized following the initial pushing of the radiate button. When the motor does reach the fully CCW position, contact 14C opens, power is removed from relay 13A, which in turn removes power from relay 15A. Contacts 15E and F return to their normal positions, and power is available to rotate the motor 14A and 14B back to its original fully CW position through contacts 15F and 14E; 14E closes as soon as the motor starts in a CCW direction.

The closing of contacts 13G also operates relay 16A through the normally closed contacts of 17F. As shown in schematic diagram in the instruction book, this would operate contacts 16B to seal 16A across the line, unless the wiring is modified as shown in figure 1. Subsequent discussion will reveal that if 16A is sealed across the line ,the recycling circuit will not function properly, assuming that the change is made as shown in figure 1. The operation then is as follows: Relay contacts 16B close, sealing relay 16A across the line through the normally closed contacts of 17C. This closes contacts 16E and opens contacts 16F. Power is then applied to the short-time motor, 17A and 17B, another reversible motor type relay (similar to the long-time motor) through contacts 17C. The motor begins rotating in a ccw direction. This immediately opens contacts 17F and closes 17E. When this motor reaches the ccw limit of its travel, it opens contacts 17C and closes 17D. The closing of 17D again applies power to relay O1A, and if operation is successful, relay 10A is energized operating contacts 10B which disable the recycling circuit. If operation is not successful, power is removed from relay 16A because of the opening of 17C. Contacts 16B drop out and since contacts 17F were opened at the start of the ccw rotation, contacts 16E and 16F return to their normal positions. Power is now available through contacts 17E and 16F to rotate the motor through its relay section 17A in a clockwise direction. When the motor reaches its clockwise limit, it opens 17E and closes 17F. Closing 17F applies to relay 16A and the cycle begins again. Contacts 17C and 17D returned to their normal position as soon as the short-time motor began its clockwise rotation. This cyclic operation continues until contacts 13G are opened by the action of the long-time motor previously described, or until the magnetron current operates relay 10A. The long-time motor usually takes 6 seconds to travel to its ccw limit, and the short-time motor one second to rotate to its limit in each direction. Thus the modulator attemps to recycle at 1, 3, and 5 seconds after the radiate button is pushed. Beyond this time, relay 13A has dropped out and it is necessary to push the radiate button again.

Contacts 14A, 14B, 17A, and 17B, are motor operated SPDT microswitches. These motors, as previously described, are fully turned in their clockwise positions when at rest.

Overload relays 02, 03, 04, and 05 often give trouble by failing to stay reset after the standby button has been pressed following an overload. This is indicated by failure of the standby indicator light to go on after the standby button has been pressed. Each of these relays has a toggle arm with two rollers at the outer end which are supposed to roll past a hump on each side of a die cast bracket and remain in place, held by the hump, when the relay is reset. The position of this bracket is rather critical for proper resetting action; i. e., if it is moved too far back (in, toward the rollers) the rollers and arm will pop back up to the overload position instead of resetting properly. This bracket is located under the red flag overload indicator in the relay. Adjust this bracket to its proper position by gently tapping it in the desired direction. Loosen the mounting screws slightly if the bracket will not move when tapped; however, do not leave the screws so loose that the bracket can work loose and give further trouble.

The UG-36/U plugs on the ends of the pulse cables between the modulators and pulse joint require a standard procedure in installation if they are to be satisfactory. NavShips 900, 081, Installation and Maintenance of Transmission Lines, Waveguides, and Fittings, explains this process. Dow-Corning No. 4 ignition sealing compound, should be used to fill the rear section of the plug after installation. On aircraft carriers this compound can usually be obtained in an emergency from the aircraft engine or ignition shop where it is used for sealing ignition systems against water.

Pulse Joint: Considerable trouble has been experienced on several occasions with pulse joints and for this reason a separate section is devoted to them.

It has been found that it is possible to get communication interference from a faulty pulse joint if there is internal arcing. On one ship interference was observed at several points in the 2- to 5-megacycle band. In this case it was known that one of the rotating posts had a defective insulator and was arcing to the ground plane, internally.

A second cause of pulse joint failure is the collection of finely divided metal particles, much like metal dust, in the joint. This is caused by wear of the brush faces and should be regularly removed. Effective preventive main-

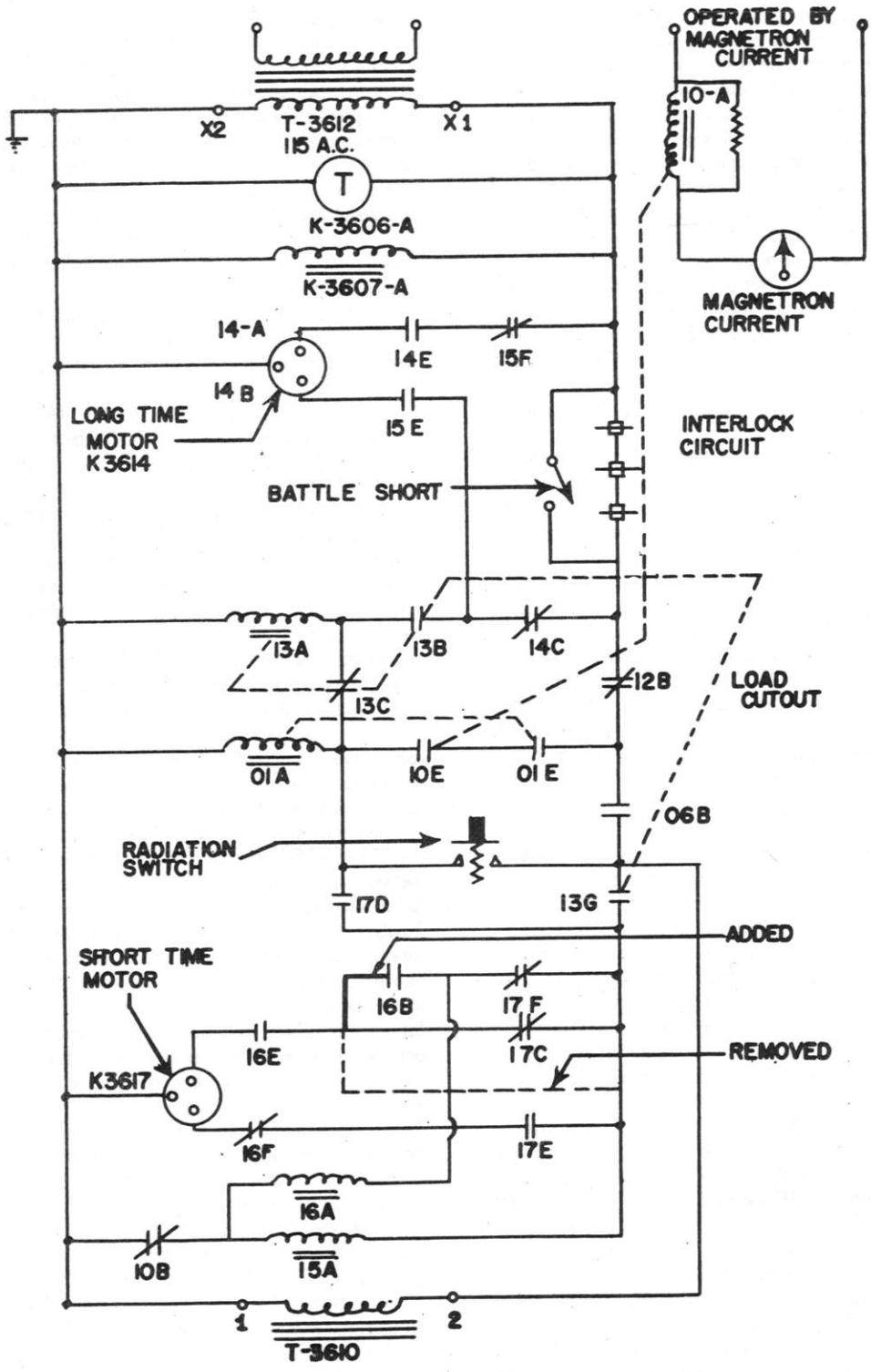


FIGURE 1.—Modulation recycling relays.

tenance of the SX should include removal and inspection of the pulse joint after stated periods of operation. The instruction book does not suggest any particular interval but a check after every 1,000 hours of search system operation should be sufficient, and is recommended.

Newer type pulse joints now being supplied as Field Change 8 have the same type brushes as the original types but the springs are weaker than those originally supplied. This results in less arcing at the brush face and contributes to longer brush life. A still later modification of the brushes will be a change from the present coil type of brush spring to a leaf-type spring and a smaller brush.

ADDITIONAL MAINTENANCE INSTRUCTIONS (THIS SHOULD BE DONE IN SHOP OR REPAIR ROOM)

(1) Periodic maintenance should be made every 6 months or equivalent period. Dust should be removed from housing, and the high-voltage slip ring condition inspected. See figure 5. (Do not clean rings if the surface has a bright finish.) It is desirable to have the brushes deposit a film of graphite on the ring. If polishing is necessary use a No. 1 emery cloth followed by a polishing paper.

(2) Brushes should be replaced after wearing half the original length.

(a) Small brushes have 1/4-inch length, E3023.

(b) Ground brushes have 9/32-inch length, E3024.

(3) For the mounting of new brushes, see figure 4. The brush holes should be carefully cleaned of grease and chips before placing brushes in the holders.

(4) When storing the joint for future use, replace dust caps to keep from damaging threads and inside insulators. Dust caps will also seal the joint from moisture.

Transmitter: One of the most recurrent troubles with transmitters is magnetron failure. If the magnetron becomes gassy, it is often possible to salvage it by merely "baking" it with filament voltage only applied. This practice is especially good for new tubes which are removed from stock and are gassy when first installed. Some activities bake any new magnetron before installation, utilizing the filament transformer provided in maintenance repair parts. This procedure is highly recommended. Sometimes a new magnetron, even though "baked," will not operate at full power until after a few minutes at reduced power.

A second cause of magnetron failure is overheating. The magnetrons must be supplied with a steady air flow directly across the cavity. If the blowers become clogged or dirty and insufficient air flow results, the solder will melt out of the magnetron and the tube will be useless after a few hours of operation. The blowers should be checked, especially after the ventilation modification to the igloo is made by a shipyard (ShipAlt CV/CVB 57). In at least two cases the shipyard has sealed the magnetron blower external inlets without providing internal inlets within the igloo. The wire screen cap on the blower, immediately behind the magnetron cavity, often becomes clogged with soot particles from the stack in ship installations and thus shuts off the air supply. Since the air for the blowers is usually taken from inside the igloo, after the ventilation modification this difficulty is then eliminated.

If the external inlet is still in use on your SX, the following information may prove helpful. There are no maintenance repair parts provided for the 10 x 10 x 3/4-inch metal mesh filters used on the inlet. To properly remove all particles and dirt from these is difficult. One ship has solved this difficulty by using standard 10 x 10 x 1-inch throwaway-type dust-stop filters. By reducing the cardboard edge of the filter in a vise to three-quarter-inch, it will fit satisfactorily and may be thrown away when it becomes clogged.

As was mentioned previously, Field Change 7 will provide for switching a resistor in series with the filament transformer of the search system when the magnetron has begun to operate properly, in order to reduce the filament voltage. This circuit was incorporated in the height system as a part of the original equipment and the change will apply only to the search system.

The two echo boxes supplied with the equipment are very useful for daily checks of transmitter operation, giving indications of relative power, frequency, and quality of the magnetron spectrum. The directional coupler has a crystal rectifier connected to it in both systems and is used to display the RF pulse on the synchroscope. This must be disconnected as the echo box already contains a crystal rectifier. There is no figure given for the proper amount of coupling between the directional coupler and the waveguide but, since the receiver sensitivity is better checked with the noise insertion klystrons than by measurement of echo box ring time, this is not too important. In connection with using the echo boxes it is noted that when checking one transmitter, it is necessary to have the other transmitter door open. It is well to take extra precautions to assure that the transmitter whose door is open is not in operation. THE VERY HIGH-VOLTAGE PULSE HAS A TENDENCY TO JUMP THROUGH SPACE TO ANY GROUNDED OBJECTS WHICH APPROACH CLOSE ENOUGH TO IT AND THIS INCLUDES TECHNICIANS.

Magnetrons will sometimes have a tendency to double mode after 1,000 hours of operation. Look for evidence of double moding when making a spectrum check with the echo box.

Duplexer: The most important single aid in the maintenance of good receiver performance is the use of noise insertion klystrons. Experience bears this out. When the receiver noise figure is low, as shown by the noise insertion generator, those distant air targets show up. If a new JAN 417A noise klystron is installed to replace one of those originally supplied with the equipment, the absolute standard of sensitivity is lost. However, the relative indication is still excellent. At the present time, no charts are supplied with each klystron to indicate the relation between the amount of klystron current necessary to increase receiver noise by a factor of two, and receiver noise figure. The charts that were originally supplied on the search system transmitter door indicate that the chart is valid only for one particular klystron. Therefore, once the klystron is changed there is no longer an absolute standard of sensitivity.

The advantages of the noise insertion klystrons over echo box ringtime for measuring receiver sensitivity are many. If the ship is at sea and the equipment is operating properly, no ringtime can be seen because of sea return; if in port, ringtime is often obscured by ground clutter.

The noise klystrons have the advantage of being usable at any time. The noise klystrons give an indication of the receiver performance only and are not dependent upon transmitter performance. Another disadvantage of using ringtime as a measure of receiver sensitivity is that the recovery time of the pre-TR and anti-TR tubes may be longer than the ringtime, depending upon the total radiated power and the individual tubes in the circuit. Since the amount of coupling between the directional coupler and the waveguide is not known, no absolute standard for ringtime could be calculated. While the echo-box ring time is not as useful as the noise insertion klystron as an indication of receiver sensitivity, it is an excellent indication of relative system performance and should be measured as part of the daily system check.

The components which most directly affect receiver sensitivity are crystals, TR tubes, and pre-TR tubes, respectively. To a lesser extent the anti-TR tubes also have an effect. In attempting to increase receiver sensitivity after tuning, it is advisable to try several crystals and pick the one which gives the best receiver performance as determined by noise insertion klystron checks on each crystal. To a lesser extent this is also true of TR's and pre-TR's. If the ATR's are changed at regular intervals of operation, little trouble will be experienced with them. In connection with crystals, it is important to set the crystal current to the value which gives the best signal-to-noise ratio. The curves below indicate the manner in which noise and signal amplitude should vary with the crystal current. These curves are representative of a good crystal.

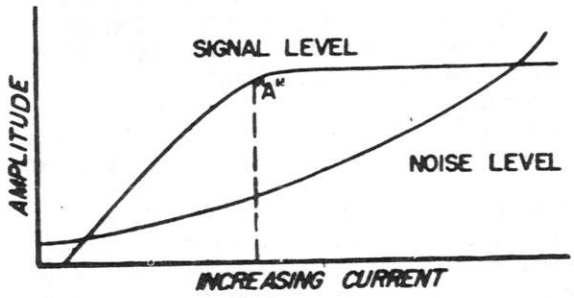


FIGURE 2.

From figure 2 it is obvious that maximum signal-to-noise ratio will occur at point A. The crystal current corresponding to this point depends upon the individual crystal. For Sylvania JAN 1N21B's, it is usually in the vicinity of 0.2 ma. One way of finding this point, if signals are available, is as follows:

a. Increase the local oscillator coupling to the crystal from a minimum, keeping the amount of grass on the synchroscope at constant amplitude with the IF gain control.

b. The point that gives maximum signal is the correct operating point. If no variation can be found, and signal and noise increase at the same rate, the crystal is not operating correctly and should be changed.

A trouble often experienced with crystal mixers is that no matter how many crystals are tried, insufficient crystal current for proper operation results. In some cases the reason for this is that the sleeve and rod assembly inside the mixer make poor contact. The sleeve couples the local oscillator signal to the rod, which in turn couples it capacitively to the mixer. A cutaway view of the mixer is shown in figure 3. The sleeve (pt. 1) is cut on each end into four sections which should make good spring contact on the rod. When these contacts become loose it is not possible to adjust them to insure good contact with the insure good contact with the rod without unsoldering the rod. A better way is to file a notch in the rod (pt. 2) at each end (points A and B). Sliding the coupling sleeve up to notch A, each of the four fingers on the end may be squeezed into the notch individually. A similar process carried out at the other end of the rod tightens the sleeve at both ends and the mixer is again in serviceable condition. However, if the LO coupling probe is badly bent due to being jammed against the crystal coupling prove, it is advisable to unsolder the knurled knob from the coupling probe rod and straighten the rod, being careful not to nick or mar the surface of the rod. Then bend the contact fingers in slightly on the sliding tee connector so that it makes firm contact on the rod, reassemble the LO coupling probe, and resolder the knob to the rod. Most of the troubles with the mixer assemblies are caused by jamming the LO coupling probe into the crystal probe in attempting to raise the crystal current. To prevent the LO probe from jamming when screwed in all the way, install a washer between the locknut and outer knurled portion of the knob. This washer should be about one-thirty-second-inch thick in most mixers and have a three-eights-inch hole with an outer diameter of one-half inch. By removing the crystal you can see whether or not the washer is the correct thickness to prevent the LO coupling probe from jamming when it is screwed in all the way.

It has been found that TR tubes must be well secured in their cavities if they are to work properly. When installing new TR tubes, the technician must insure that the clamping rings are fully tightened and all shims and washers are installed. TR tubes change their tuning slightly as they age and should be checked for tuning daily. Sometimes it is possible to tune the TR tube more sharply on the noise from the noise insertion klystrons than on signals. At least there is a tendency for a slight increase in receiver detector current by moving the TR tuning knob slightly, while maintaining constant noise input. The only reason advanced for this is that the random noise output of the klystron has a narrower overall bandwidth than the return echo from a target.

If the high voltage switch, S2607, in the lower right-hand corner of the local control unit is thrown to the "Off" position, and the meter immediately above it is switched to the XI scale, the meter should read approximately 40 microamps. This is the total keep-alive current drawn by the two TR tubes, each tube drawing about half of the total. It is wise to check this regularly. Handling of the Amphenol plug on the end of the clamping sleeve, which carries the keep-alive current to the TR, sometimes breaks the wire inside the plug. No evidence of this fault exists externally except that the sensitivity decreases because of inadequate crystal protection.

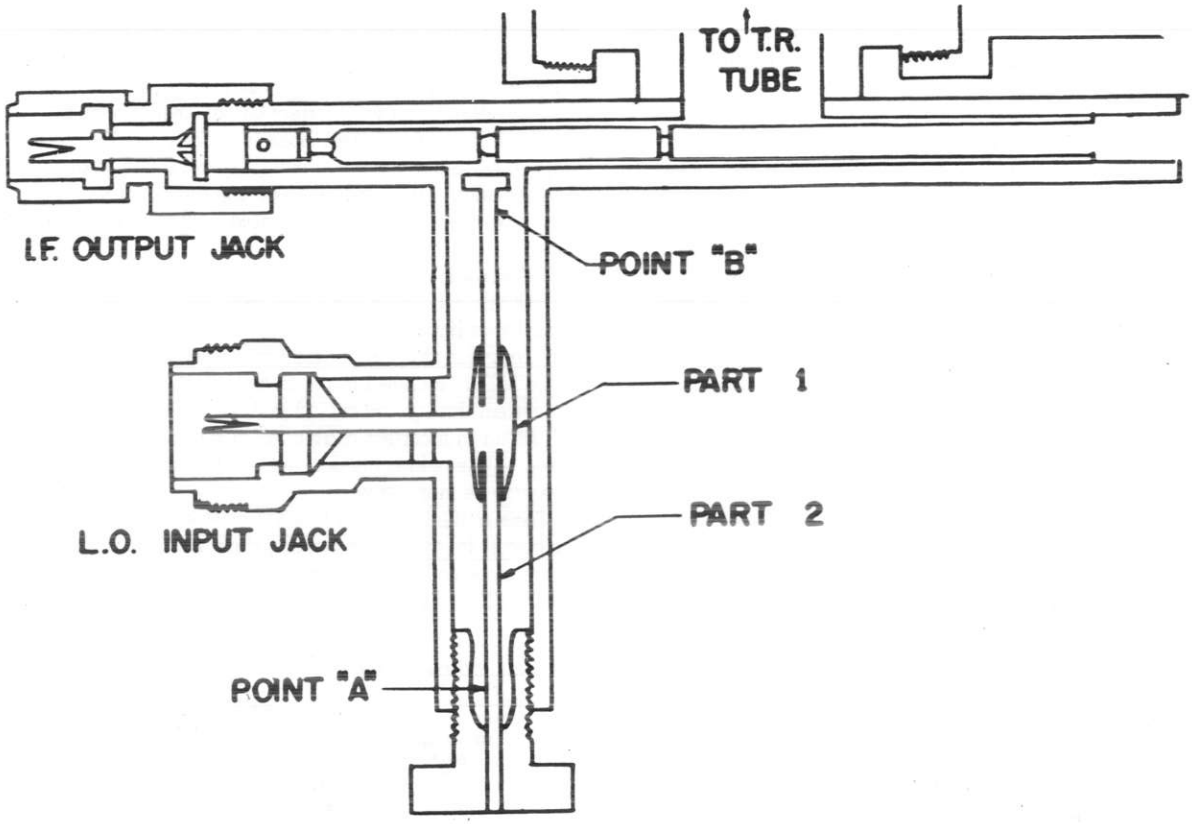


FIGURE 3.—LO coupling adjustment.

The TR tube affects the Q of the TR cavity; since the cavity is tuned to the magnetron frequency while the LO introduces its noise voltage at a frequency 30 mc higher, different TR tubes, by affecting TR cavity Q, will cause variations (usually less than 2 db) in the receiver noise figure.

The average life of the TR tubes (if changed when show 1 d-b loss) is approximately 300 hours. Broad tuning is one indication of a bad TR and interaction is another. Interaction exists if tuning is dependent on the presence of keep-alive voltage. Measurements of the noise figure with the keep-alive both connected and disconnected will check for interaction. If the noise figure improves, interaction is occurring and the tube should be replaced. The worst tubes will also show detuning with the keep-alive disconnected.

If sensitivity of the receiver is still poor after the TR and crystals have been checked, it is advisable to change the pre-TR's. As these tubes age, they become less transparent to signals. On at least two occasions ships found them so insensitive that they passed no radar signals whatsoever. No data is available as to change in recovery time which might account for the above condition.

Considerable trouble has been experienced with ATR's burning out immediately after installation or within a very hours after installation. Usually the face of the tube becomes molten and finally ruptures. This has been especially true with height system ATR's. The U.S.S. Philippine Sea has found that if the rubber gaskets originally supplied with the duplexer are used this trouble is obviated.

A recurrent trouble, more annoying than important, is the failure of the tuning shafts on the local oscillator at the point where the insulating material joins the metal screwdriver slot. Many ships have made replacement shafts entirely of insulating material. However, the screwdriver slot in the end usually wears out very rapidly if this is done.

Local oscillators also have an effect on receiver sensitivity, some being more noisy at particular frequencies than others. In attempting to obtain maximum sensitivity it is desirable to try 2 or 3 tubes to obtain the best noise figure.

A final word of caution when servicing the r-f section: If for any reason it is necessary to turn the transmitter on with the core removed from the crystal shutter solenoid (as for example to observe the firing of the pre-TR tube) the transmitter should be turned on for as short a time as possible. The solenoid has considerably less inductance with the core removed and draws more than its rated current from the a-c line when operated without the core.

TR cavities should be kept very clean inside on this, as well as all other radars. Previous practice was to use a red Ruby pencil eraser. A recent publication stated that the sulphur compounds in the eraser would cause further corrosion of the plating inside the cavity. However, if eraser dust is removed with a soft cloth moistened with carbon tetrachloride, no harm should result. The use of metal polish is not recommended. The height system pre-TR's can be attached to the waveguide with 4 of the 10 bolts provided. A new type 1B54 with a steel case may be used to replace

the brass type previously provided. A simple method of determining the metal used in the shell of any of these tubes is by use of a magnet.

Antennas:

SEARCH ANTENNA: The Electron for August 1948 contained an article on the correct placement of the search antenna feed horns. The consensus by fleet personnel who have had experience with feed horn placement seems to be that while dimensions are specified to within one-hundredth of an inch, one-tenth of an inch is perfectly satisfactory. Checking the position with a tape calibrated in one-eighth inch and positioning the feed horns in accordance with the dimensions specified by the manufacturer has resulted in satisfactory operations. These dimensions are given in the Electron article mentioned above.

The equipments manufactured under the contract NXsr 76195 were not supplied with the two replaceable waveguide sections, one for 4J32 and a second for 4J31 and 4J33 magnetrons. These sections were "tailor made" for each of the equipments supplied under the contract NXsr 96353. Each of these first four equipments have been modified to include a flexible waveguide section extending from the end of the waveguide to the feed horns. This permits feed-horn adjustment for all types of magnetrons. At some date in the future, if the "tailor made" sections are lost on the later contracts, flexible sections will be provided so that all installations will eventually be the same. It would be well to stamp the appropriate type number with metal stamps into each of the waveguide sections. If the antenna is painted while the section is installed, a painted number would be obliterated. The longer of the two sections is used for 4J32's.

Another suggestion that may be of value is to bore a hole approximately one-fourth inch diameter, in the lowest point of the search waveguide as a drain for condensed moisture in the waveguide. After the hole is drilled, care must be taken to remove all sharp edges to prevent arcing.

HEIGHT ANTENNA: Very little trouble has been experienced with the height antenna. One point to remember is that if for any reason it becomes necessary to remove the height feed horn, it should be lifted only with eyes screwed into the tapped holes provided. If lifted with a sling damage may result to the very thin walls of the Robinson horn.

Receivers: The first IF tube is critical insofar as receiver sensitivity is concerned since a good tube increases the sensitivity by as much as one-half db over a poor one. The gain of the IF strip may sometimes be increased by trying several JAN 6AC7's in each socket. In effect, this amounts to "tuning" the IF strips since each tube has slightly different interelectrode capacitances and the tube which gives best response tunes the IF transformer most nearly to resonance.

The external I discriminator adjustment should be tuned only when the signals are slightly lower on AFC than when tuned manually. The internal discriminator adjustments are factory set and no attempt should be made to set them with the receiver installed. In most cases when the AFC fails to lock properly it can be traced to a faulty crystal mixer setting, wrong local oscillator setting, magnetron double modding, or faulty tubes in the AFC strip in the receiver. In very rare cases has it been due to discriminator misadjustment. In this connection, it has been found that if a local oscillator will give correct output frequency at two cavity settings, the correct mode is usually the one corresponding to the most counterclockwise setting of the cavity control, rather than the one corresponding to the most clockwise position as is stated in the SX instruction book.

Miscellaneous:

LOCAL AND REMOTE CONTROL UNIT: The bulb (12601) that lights in the "XTAL TEST" position should only be replaced by one of the same type. The filament of of the bulb is included in the circuit which is used to test the current through the crystal and a different type bulb will result in incorrect calibration of the crystal test meter. If the bulb burns out, the crystal test circuit will of course be inoperative.

Some confusion seems to exist as to exactly what is the circuit for the ship's heading flasher. This circuit is shown incorrectly in the instruction book and on the cable running diagrams. A corrected diagram is shown in figure 4.

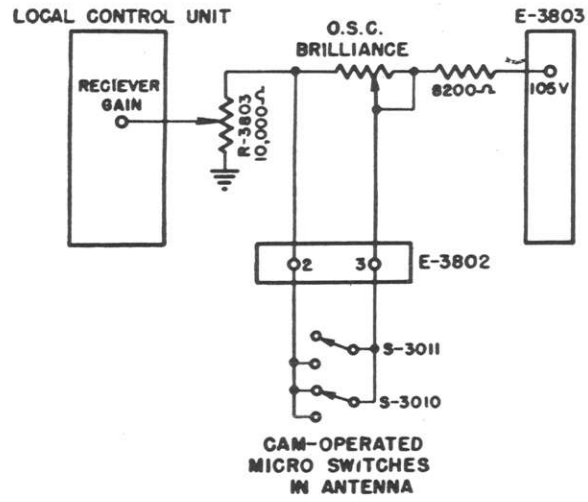


FIGURE 4.

RADAR REPEATER ADAPTER: In order to obtain proper search ranges on a precision repeater such as the VF, there is a trigger delay line in the lower left-hand corner of each of these units which will delay the radar trigger up to 360 yards. This is accomplished by moving the wire from the center of the delay line to the various taps on the circumference. Care should be taken to insure that the wire is soldered on the selected tap since this has on several occasions been the cause of loss of sweep on all repeaters.

RADAR DISTRIBUTION SWITCHBOARD: ComAirLant ltr ser 713/3241 of March 1949, authorized all ships of the CV and CVB classes in the Atlantic Fleet, which are presently using Bendix type synchro amplifiers to the gyro

OSC signal, to bypass these and feed the switchboard directly from the OSC line. This results in improved performance on the SX without overloading the ship's OSC line. The modification instructions provided with the letter apply only to the older type switchboard (Navy type CM-23AFL). If it is desired to modify a newer type switchboard (CV-23AGU), it will be necessary to change the instructions slightly. The same modification to the OSC information applies except that the terminal board numbers are slightly different. It is suggested that the deviation alarm presently installed in the newer type switchboard be completely disconnected and the procedure suggested in the above letter be followed for providing a new deviation alarm. The deviation alarm in the newer type switchboard is composed of two synchro followers, one following the OSC input from the ship's gyro and the other following the output from the Bendix synchro amplifier. If they do not follow exactly in step, a clutch arrangement closes a pair of switch contacts, closing a relay which lights the alarm light and sounds a buzzer.

Obviously, if the synchros were left connected in the new system, they would both be following the same synchro signal. A new relay mounted in the switchboard with the coil wired into the reference voltage from the gyro input will serve as a gyro alarm signal, although it will not be a deviation alarm in the true sense. A double-pole, normally closed, 100-volt, 60-cycle relay of the type required for this gyro alarm can be found in repair parts. The above relay, used with the light and buzzer circuits in the presently installed deviation alarm, will give a satisfactory gyro alarm.

CONSOLES: Consoles manufactured under contract NXsr 96353 are slightly different than those manufactured under NXsr 76195. This difference occurs in the height gate multivibrator circuit. Pulse transformer, T- 101, is used as a coupling circuit in NXsr 76195 consoles but is replaced by a resistance capacitance coupling in the NXsr 96353 consoles.

Consoles are usually trouble free. There are, however, two things concerning the Off Center PPI which merit mentioning. This first is that the OCPPI will not usually function properly unless the delay gate length and counter gate length controls, which are located in the second row of adjustments under the PPI, are properly set. The instructions for setting these are given in the instruction book, as is a complete line-up procedure for the consoles. However, some ships have reported console trouble which investigation proved to be only the result of maladjustment of these controls.

Another point of interest concerning the OCPPI is the failure of the range sweep to start for 2 or 3 miles following the range of the delay trigger as indicated on the range delay potentiometer. This seems to be present in all consoles to varying degrees and may be inherent in the sweep circuit.

The console circuits, especially multivibrator and shut-off circuits, are tube selective. Care should be exercised when replacing tubes in these circuits. If tubes are checked as part of a routing maintenance check, they should be replaced in the exact socket from which they were removed should they check good. V170, a 6AG7 in the delay circuit, is particularly sensitive.

In connection with the tubes in the consoles, it should be noted that although the 807's in the sweep circuits sometimes emit a bluish-purple glow, they are not necessarily defective. If the tube is good, an inspection of the tube will reveal that this glow appears to be on the inner surface of the tube's envelope. However, a bright blue glow in the central portion of the tube, in or around the electrodes, will indicate a definitely gassy tube.

A frequent check should be made of all power supplies which have tubes in parallel. If one tube fails, the additional load on the others will cause them to fail rapidly.

Inasmuch as four consoles are not generally in use at one time, operating personnel should be instructed to use all the consoles an equal amount, rather than one or two consoles exclusively. If this is not done, the unused consoles rapidly get out of adjustment and many failures occur which would be avoided if the consoles were in use. In any event, the unused consoles, as well as all other major units of the equipment, should be left in stand-by rather than completely shut down.

ANTENNA CONTROL SYSTEMS: Figures 6, 7, and 8 are three block diagrams showing the interconnections of the rotation systems. Level and cross-level systems are identical except for component and terminal numbers. These diagrams may be an aid in trouble-shooting and will certainly be an aid in instructing new personnel. It is suggested that a detailed diagram showing cable interconnections, terminal boards, etc., be made up by each ship for each system in its own installation. This will save a great deal of time and trouble when it becomes necessary to look for trouble in a system. Most installations do not conform to the cable running list in the instruction book; therefore, the yard installation cable running lists must be used in making up such a set of diagrams.

AMPLIDYNES: It seems almost superfluous to mention the importance of checking the brushes of the amplidyne regularly. However, expensive and laborious repair jobs have resulted on at least two occasions because the amplidynes were allowed to operate until the brushes wore down to the springs, scoring the commutator and resulting in a complete casualty. BUREAU COMMENT: Examine condition and length of brushes; discard after worn one-half length.

If it does become necessary to disassemble the amplidyne, do not remove the brass disk on the motor end of the unit. This disk is approximately 2 inches in diameter and about 3/8-inch thick. Several holes of varying depth are drilled into the circumference. This is the balance collar. Once removed, it is necessary to ship the amplidyne to a navy yard or other repair facility for rebalancing in a dynamic balancer. The exploded views in Section VII of the instruction book of the various "Motor-Dynamo Amplifiers" are very helpful for reference when disassembling and reassembling the amplidynes. Reassembling the amplidyne can be made much simpler if a tool such as the one shown in figure 5 is constructed.

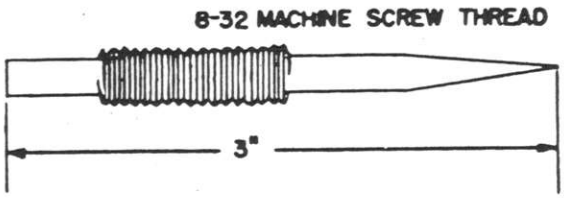


FIGURE 5.

This tool will aid in holding the grease retainer ring in place during assembly until one or two of the bolts in the end bell holding this ring are started from outside the end bell. The tool may then be removed and replaced with a bolt.

Many amplidynes have overheated and burned out because the screen filters have been allowed to clog. These openings permit the only ventilation available to the machines and must be checked and cleaned regularly.

The thermal overload switches on the amplidynes, motors, etc., throughout the equipment, which energize the overload indicator lights on the main control unit, are of very poor quality. When the temperature of the unit returns to normal the switch should open, and thus extinguish the indicator light. However, as the switches seldom return to normal, it is usually necessary to reset them manually.

A check of amplidyne output should be made while it is performing satisfactorily, by measuring the output voltage (load disconnected) with a small d-c voltage applied to the input as signal. This known performance factor can then be used in isolating trouble later. A known current test under load would also help.

CONTROL AMPLIFIERS: Amplifier adjustment should be relatively easy. If extreme difficulty is experienced in adjusting the amplifier, and a check of the amplifier itself reveals no obvious defects, the trouble probably is in another part of the system. The amplifier output tubes should be selected so that they are approximately matched, and the bias control adjusted to make the amplidyne output zero with shorted amplifier input. The gain control usually has to be advanced about one-third of the way, and the stabilizer controls should be set as stated in section 3B, paragraph 67, of the technical manual. The current limit adjustment, which may cause serious hunting troubles, may be adjusted without using an ammeter. Disconnect the drive motor field and measure the IR drop across the drive motor compensating field (interpoles). This IR drop appears across terminals 7 and 9 of the control amplifier. Connect a d-c voltmeter across terminals 7 and 9 are set the current limit adjustment for the following meter readings: Train: 10.5 v., Elevation and Cross level: 7 v. Reconnect the drive motor field. Low speed cut-in adjustment is operative on the train system only when the "Stow-Normal-Stable Element Off" switch is in the "Stow" position. This adjustment should be such that the antenna will rotate to 000° relative when the antenna is stowed, and not lock in at any other 36-speed zero. There is no indicator for setting the low-speed cut-in on the level and cross level systems. The adjustment will be correct if the low speed cut-in relay switches to the 21-speed control circuit when the 2-speed error voltage (measured at the input to the control amplifier) is about 4 volts. A check on the low-speed cut-in adjustment can be made as follows:

(a) Switch off the amplidynes at the PDC, removing power from the antenna and allowing it to fall into the stops.

(b) Set antenna control switch in either "Stow" or "SE Off" position.

(c) Switch on the amplidynes. If the antenna rises from its limits to a level position with respect to the ship, the low speed cut-in adjustment on both level and cross-level amplifiers is set within a satisfactory working range. The system should stabilize with the 36X speed system in control. Switching from 2X speed to 36X will be evidenced by the action of the low-speed cut-in or current-limit adjustment. The height scanner system, having only one speed control, has neither low-speed cut-in nor current-limit adjustments.

A glass 6L6 used in the control amplifier should be replaced if it glows in a manner similar to that described for the 807's in the console. The glow indicates either a gassy tube or a very great unbalance in the amplifier. If tube replacement does not cure the blue glow, the amplifier should be rebalanced as previously described.

TRAIN SYSTEM: In most shipboard installations the Deck Tilt Correction system in the C. G. Synchro Amplifier is mechanically locked at zero, and the corresponding control amplifier is disabled. This was done because an erratic or jumpy signal from this system combined with the poor OSC signal from the Bendix Synchro Amplifiers often caused the antenna to fall out of synchronism with the driving CT in the antenna control panel resulting in reverse rotation. With the modification to by-pass the Bendix synchro amplifiers it may be possible to use the Deck Tilt Correction satisfactorily. In this connection, one ship found that one phase of the OSC voltage, through a wiring error in the Main Control Unit, was across the 700-watt heater in the top section of the main control unit. Correcting this and removing the Bendix amplifiers has enabled them to use the DTC.

The SX technical manual does not contain a schematic diagram or the control amplifiers associated with the DG synchro amplifiers. The schematic is contained within the DG synchro amplifier cabinet.

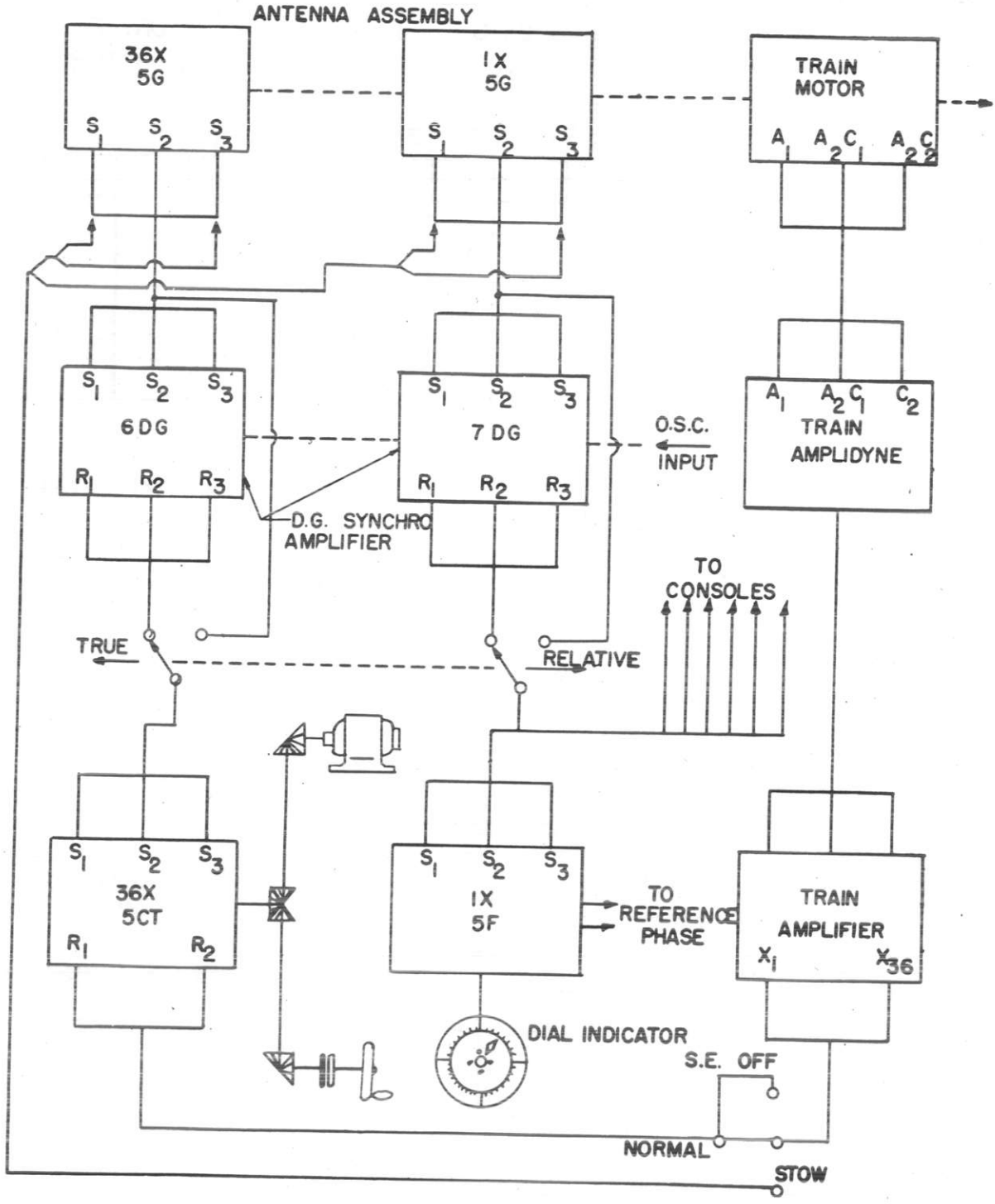


FIGURE 6.—Antenna train system.

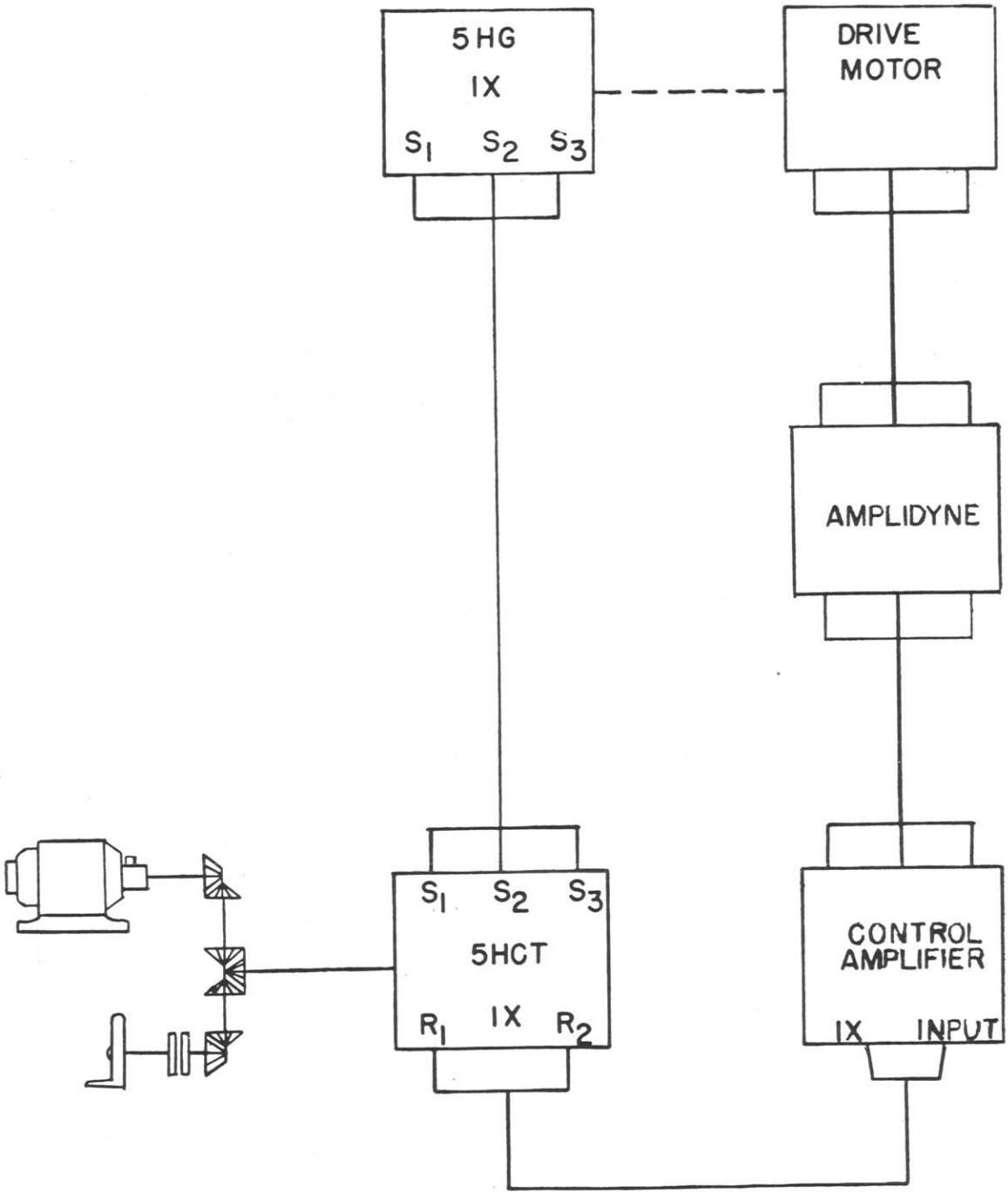


FIGURE 7.—Scanner system.

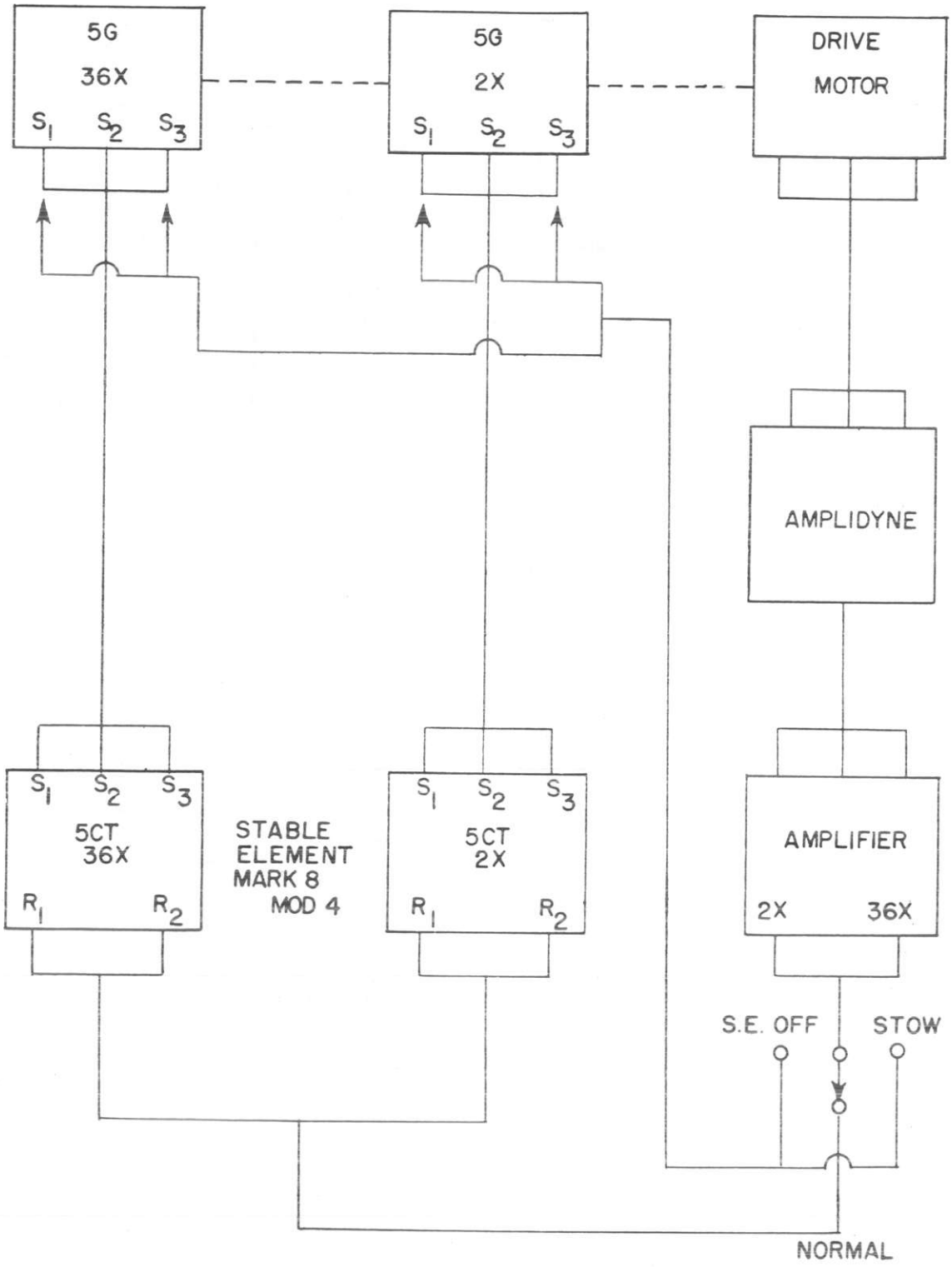


FIGURE 8.—Level or cross-level system.

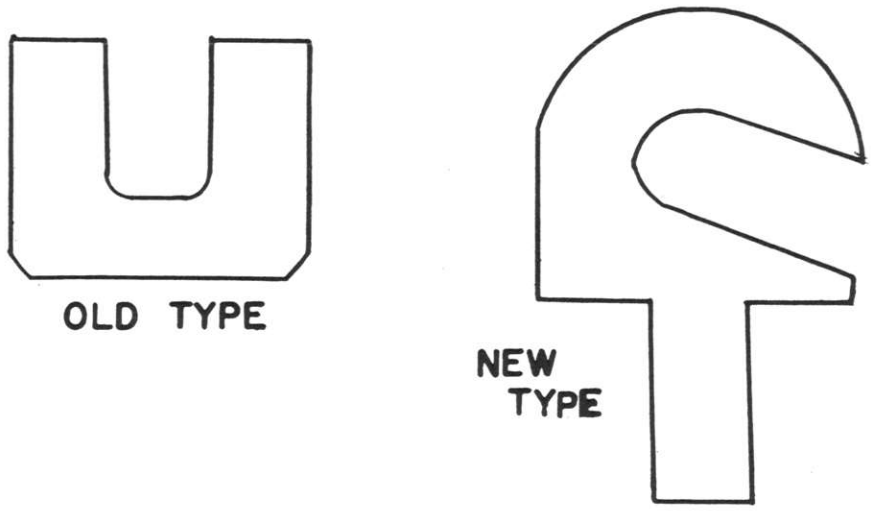


FIGURE 9.

On at least two occasions considerable trouble has been experienced with the azimuth gear train. The lower section of the gear train includes a casting that must be positioned accurately. The space between the bottom plate and the side casting is adjusted with shims. These shims are shaped as shown below.
These shims adjust the mesh of the azimuth reduction gearing. After long periods of operation, these shims may come loose, drop out and cause considerable difficulty with the gear train. Major damage usually results if the shims drop out. Repairs require the removal and replacement of the bolts and dowel pins that hold the main drive gear to the bottom of the torque tube. A second effect, and the usual symptom of the trouble, is a constant "chewing up" of the gears in the synchro well. If one of these gears fails, and has to be replaced again in a short period of time, trouble in the gear train should be suspected. On the first contracts, the gear mesh was adjusted by peeling laminations from one face of the shim, and, when it was the correct size, the shim was driven up between the two castings. It was thought that this would eventually allow the shim to fall out, since the laminations on one face would double up as the shim was driven up. This proved to be the case in the first major failure. In the later contract the laminations were placed between two metal plates, and it was felt that no trouble would be experienced with this type. However, the second major failure of this type was on an antenna manufactured under the new contract. Therefore, it is recommended that any antenna which is undergoing a shipyard overhaul have the present shims replaced by ones shaped as shown above, or by an unslotted shim that cannot fall out.

The first major failure of the azimuth gear train was followed in 9 months by a second major failure of the same antenna. The main thrust bearing on the top of the torque tube failed. The symptoms of failure were an intermittent mechanical binding of the antenna at one particular bearing, accompanied by a fairly loud cracking or rending noise. Some difficulty was experienced with rotation of the train system, but satisfactory clearing of this trouble still left the same indications. The manner in which the bearing failed (the case or retainer holding the rollers broke) did not indicate whether the bearing failed due to a fault, or whether strain put on the bearing by the previous gear train failure was the cause. The bearing manufacturer's representatives indicated that the failure was, to the best of their ability to determine, caused by a fault in the bearing. The second antenna on which azimuth gear train failure has occurred in the Atlantic Fleet has not as yet been placed back in service to determine if the thrust bearing will fail on that one too. Although the thrust bearing is provided in spares, it is obviously the work of a navy yard to disassemble the antenna, replace the bearing, and reassemble the antenna.

It is extremely important not to use "Black Bear" grease on the synchro gears in the antenna. Tests have shown this grease to be so stiff that it will bend the stainless steel gears. Lubriplate 310 or any good standard gear grease, including vaseline, will give satisfactory lubrication.

In case the antenna cannot be stabilized in true bearing, but works satisfactorily in relative, it is possible to use relative bearing for drive with true bearing indication. In an emergency the 36X tube bearing information to the "True-Relative" switch may be disconnected and the "True" and "Relative" positions jumpered together for 36X. The only noticeable effect of this change will be no true stabilization of the antenna in azimuth, and the 36X dial on the antenna control unit will not read correctly. As the antenna rotates continuously in normal usage, this will not seriously hamper operation.

SCANNER SYSTEM: The self-alining bearing on the outboard end of the scanner should be removed if this has not already been done. A close inspection of the scanner diagram in the instruction book will show that the scanner assembly has two bearings on it in addition to the self-alining bearing on the end of the shaft. One is where the shaft is supported as it passes through the wall separating the gear case from the r. f. section, and a second set outside the outer coaxial conductor, which is rigidly attached to the rotating r-f head. The self-alining bearing was originally installed in order to support the end of the Robinson Horn. However, the manufacturer later found another method of supporting the horn externally. The self-alining bearing, if it ceases to function properly, will get out of alinement and cause the shaft to break. It may even sever the outer coaxial conductor.

The scanner velocity error compensating potentiometer, R3406, located in the FDO panel, is mentioned in Section 2 of the instruction book, but no instructions for adjusting it are given. To minimize the velocity error, which occurs when scanning at 600 rpm, use the following procedure. Connect an a-c voltmeter across the R1, R2 leads of the 5HCT at TB 3403 terminals 9 and 11 in the FDO Panel. Throw the "Auto"–"Manual" Switch, S3402, to "Auto" and adjust R3406 for minimum error voltage. This adjustment need by made only after readjusting the speed of rotation of the scanner slewing motor or after extensive readjustment of the control amplifier.

LEVEL AND CROSS-LEVEL GEARING: Two major failures have occurred in the level and cross-level gear trains, in ships of the Atlantic Fleet. In both cases failure of the outboard ball-bearing on the shaft of the third gear and pinion assembly has jammed the gear train and resulted in very costly and laborious repairs. It has been suggested by the antenna manufacturer that both level and cross-level gear trains should be disassembled at every regular shipyard overhaul. This particular bearing should be replaced, and the stops replaced if necessary. All other bearings should be inspected for evidences of wear or imminent failure, and replaced as necessary.

Failure of the limit switches, which resulted in the antenna being driven into the stops under full power, has usually been advanced as the reason for this bearing failure. However, in one of the two cases mentioned the limit switches were in satisfactory operating condition.

The neoprene stops deteriorate with use and will probably always require replacement at each yard overhaul.

Particular care must be exercised in stowing the antenna in level and cross-level. Do not drive the stowing pin in unless the antenna is almost exactly level. The gear reduction is great enough to enable the pin to be driven against the web of the segment gear with sufficient force to bend the shaft of the stowing mechanism. In any event, after such abuse, the stowing wheel will prove difficult to operate. In order to avoid trouble of this nature zero the synchros (5G's) while the stowing pins are properly engaged.

MAINTENANCE OF ANTENNA: Many of the failures which have occurred to SX antennas are due to developments unforseen at the time of manufacture. Failures of this type have been discussed in detail in a letter from ComAirLant to the aircraft carriers having SX's in the Atlantic Fleet (Commander Air Force, Atlantic Fleet, letter 713/11935 of 2 November 1949). These failures are substantially those which have been discussed above.

However, some failures are the direct result of an inadequate preventive maintenance program for the antenna. In order to limit antenna casualties to a minimum, the following maintenance procedures are necessary, in addition to those given in the equipment instruction book. These procedures were suggested by ComAirLant after inspection of two antennas which had been disassembled during regular yard overhauls, and a study of the history of SX antenna failures.

MONTHLY

a. Insure that space-heater circuits are operable. Make check with ammeter, in series, for positive check.

b. Clean vent-pipe filter (where ShipAlt CV/CVB57 has been accomplished). Where original ventilating system is used the magnetron blower filters (located in bulkhead vent and filter screens (in back of magnetrons) must be cleaned.

c. Observe antenna action when deenergized to insure that it is moving into its stops properly. Make electrical check of limit-switch circuits.

QUARTERLY

a. Service limit-switch assemblies (mounted under separate cover on level gear box and on cross-level gear box) as follows:

(1) Remove cover.

(2) Inspect limit switches for positive action. Replace where necessary.

(3) Coat cam lightly with O.S. 1350 grease.

(4) Operate cam follower lever by hand and insure that it operates freely.

(5) Lubricate switch plungers and follower level pivots with a few drops of light oil (2110, 9110 or equivalent).

(6) Using ohmmeter, see that switches operate electrically when actuated by hand.

(7) Inspect cover gasket. Replace if gasket has deteriorated or hardened.

(8) Replace cover. Tighten holding studs evenly.

b. Inspect aluminum tubing on both sails and straighten, by hand, where bent.

c. Service slip-ring junction box as follows:

(1) Remove cover, inspect for leakage of box (presence of water, soot, etc.) and replace gasket if it has deteriorated or hardened.

(2) Tighten all terminal screws. Check clearance between lugs.

(3) Inspect leads thoroughly and redress where necessary.

(4) Insure that space heater is working.

(5) Replace cover.

d. Clean slip rings and brushes on slip-ring assembly.

e. Service safety switch as in c above.

f. Inject, through alemite fitting, one-half pound of grease (O.S. 1350 or equivalent) into upper torque-tube bearing. Then remove fitting and allow 24 hours of antenna rotation before repdcing fitting (to allow for expansion of bearing and grease under operating conditions).

g. Service synchroscope power supply (test all tubes and make output voltage check for proper regulation).

h. Check search system feed-horn measurements.

STABLE ELEMENT: There are two recurrent failures in the stable element. The first of these is the filter capacitor in the power supply for the train amplifier. This is a "paper" replacement for electrolytic capacitor. When this capacitor fails it shows an almost complete short on an ohmmeter and of course blows the fuse on the amplifier. The second common failure is in the train motor-generator set which supplies controlled power to the rotation motor. Adequate preventive maintenance will prevent the damage to this unit caused by the rapid deterioration of the brushes, and the large quantities of carbon dust deposited from the brushes in and around the motor generator.

Most stable elements are not properly balanced. If it is properly balanced, the level bubble should stay within the black circle all the time that the erecting magnet is on, regardless of whether the yoke is scanning or the gimbals are rotating. This should be checked when in a calm anchorage or better yet when the ship is alongside the dock. If it drifts at all with the erecting magnet on, the stable element is not operating correctly, and the balance should be checked. The one minute tolerance that is permitted in adjusting the gyro balance weights does not apply when the erecting magnet is on. In general, if any failures are noted in the gyro system of the stable element which will require rebalancing, no further use should be made of the stable element for antenna stabilization until it is rebalanced. Repair should only by attempted when there will be sufficient time in a calm anchorage to check the balance upon completion of the necessary work.

Another recurrent failure in the stable element occurs in the plate leads of the 807 output tubes in the followup amplifiers. The pigtails of the plate resistors become loose where they are attached to the body of the resistor. This is probably caused by heat generated by the 807's. Care should be exercised in removing and replacing the plate caps since the leads break easily and if trouble occurs in the followup system these resistors should be checked.

RADIO TRANSMITTING BUOY T-347/SRT DISTRESS EQUIPMENT

The Radio Transmitting Buoy is designed for ejection from a sunken or submerged submarine. Its purpose is to transmit a message indicating that a submarine is in distress and to act as a beacon locating the position of the sunken craft.

Recent requests for information and Bureau inspections have indicated that submarine personnel are not familiar with test procedures.

It is recommended that all submarine electronics personnel review the Technical Manual for the T-347/SRT, NAVSHIPS 91636, and periodic checking procedures. In addition, personnel should insure the availability on board of necessary tools, external battery test harness, and the Technical Manual NAVSHIPS 91636 with T-1 to the manual.

LORAN TEST SET MODEL TS-251/UP

Model TS-s51/UP is a portable test set which produces simulated loran signals for testing and alinement of shipboard and aircraft loran receiving equipments (including model LRN series, DAS series, DBS, DBE, AN/APN-4 and AN/APN-9). By means of switches, any of four loran radio frequencies can be selected at any of three standard output levels. The signals are suitable for all indicator and receiver testing which required the use of actual signals, but they are not suited for the training of operators. Signal generators, Navy type CME-60069 or CME-60069-A, are used for that purpose. The test set, including connecting cables and adapters for all models of loran receiving equipment, is housed in a weather-resistant carrying case and the complete set weights 18 pounds. The set operates from 80/115/230 volts ac at any frequency from 50 to 1600 cycles per second and consumes less than 25 watts.

The test set is intended for loran installation and maintenance activities and not for ships having only one loran-receiving equipment aboard. Therefore, as rapidly as equipments are available, distribution will be made as follows:

3 to NYNYK	1 each to AG73-78
3 to NYNOR	3 to NYPS
2 to DISH #32	2 to 8th N.D.
6 to FRAY #32	3 to 11th N.D.
3 to DOTI #32	1 to RMS at NRL
4 to NYMI	1 to RMS at Treasure
2 to NYPHIL	TSland
2 to NYCHARL	1 to 7th N.D.
1 to Casco Bay	3 to ULOD #32
2 to NYBOS	2 to HODE #32
5 to DUVA	2 to KESO #32

Approximately 90 sets are yet to be assigned. Since this equipment is being procurred from the Army, requests from other activities will be placed upon commitments until such times as the Army is in a position to accept delivery destinations. After receiving and inspecting their equipments, the above activities may address requests for additional equipments to the Bureau of Ships, attention Code 955, copy to Code 982A. Such requests should indicate the approximate number of men engaged in loran installation and maintenance and the approximate number of equipments serviced. Other activities servicing shipboard-loran equipment may make similar requests if their work is in line with the above. Distribution to maintenance activities servicing aircraft-loran equipment exclusively, is being made by the Bureau of Aeronautics.

Individual equipment spare part sets for the TS-251/UP are being procured for the equipments under the cognizance of the Bureau of Ships from the Airplance and Marine Instruments Company under Contract NXsr-91901 and will be furnished separately when available.

CABLE ASSEMBLY FOR TS-251/UP TO TEST DBE

Previously, there has been no method by which these equipments could be directly connected for the test purposes other than to insert bare leads into the DBE connectors and to attach these leads to the regular test cable. Possible connector damage, time waste, and faulty test cable connections are avoided by the use of the new test-cable assembly.

The test-cable assembly consists of a 6-inch length of Radio Frequency Cable RG-11/U to which a Plug NT-49195 and a Radio Frequency Plug UG-102/U are attached. (See figure 1).

It is recommended that this test-cable assembly be fabricated locally by activities using the TS-251/UP test set and added to the equipment as an accessory. A field change will not be issued.

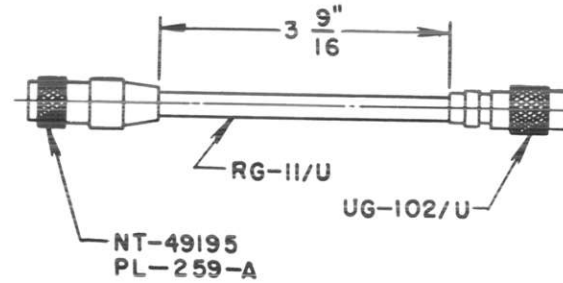


Figure 1

INTERFERENCE TO VC FROM SC-2, SC-3 SYNC PULSE

Regular interference appeared in wide arcs on the VC Remote PPI (CG-55ACD) when used with all radars except the SC-2. This had the effect of completely obscuring signals, or making targets appear to shift inward several miles on the 75-mile range, and occurred in arcs of 15° to 30°. Operations were difficult or impossible when targets were in the area affected.

This interference was found to occur at the time that the SC-2 radar radiated in the direction of the remote PPI. The SC-2 antenna is located about 60 feet from the remote PPI and about 35 feet above.

After it was found impossible to improve the shielding by screening at the remote PPI, additional grounds, and other various methods, the cathode-ray oscilloscope was used to trace the source of interference.

Beginning at the pulse input jack (J-3201), it was observed that in addition to the normal synchronizing pulse from the radar being used, there appeared a smaller pulse which occured at the time the SC-2 antenna was radiating in the direction of the remote PPI. The SC-2 pulse was about one-third the height of the normal radar pulse.

The SC-2 pulse was traced through the circuit from J-3201 and remained about the same size in relation to the synchronizing pulse until it reached the line from the plate of the first multivibrator tube (pin 5 of V-3203) to the grid of the second multivibrator tube (pin 1 of V-3204). At pin 1 of V-3204 it was seen that the SC-2 pulse was several times the magnitude of the normal synchronizing pulse and was obviously triggering the multivibrator, so it was concluded that radiant energy pickup occurred along this line.

Video cable was used to replace the line from pin 1 V-3204 to S-3200F, and also the long lead to the d-c restorer diode (pin 8 of V-3203) from pin 1 V-3204. The cable shields were grounded. This change made operations satisfactory.

REMOTE PPI SWITCHING

Design of Remote PPI's, Models VC and VC-1, contains a slight technical error which may reflect into the synchro bearing and OSC busses, causing errors in the data as read on other systems. This difficulty arises when the PPI power switch is turned off, leaving the selector switch connected to a radar set. Under these conditions the electrical field in the synchro CT rotates with the radar antenna, and the amplifier input impedance is reflected into the synchro secondary bus as a cyclic error whose amplitude is dependent upon the antenna position. This difficulty is also apparent in the synchro amplifier and may be evident in some radars.

The above-mentioned error is not evident as long as the servo mechanism in the PPI is following the incoming signal.

For the reasons stated above, it is suggested that all radar personnel be advised of this difficulty and warned to turn off the PPI selector switch when PPI is not in use; also, the gyro compass transfer switch when a radar is not operating.

It is advantageous for ships to follow the above rule on ALL radars and remote PPI's.

TECHNICIAN'S CHECKOFF LIST

The following daily and weekly checks are suggested for VC and VC-1 units to keep them in top working order.

Daily Checkoff:

a. Calibration of all ranges.
b. Centering of trace.
c. Operation with all master radar equipments.

Weekly Checkoff:

a. Clean rings and fingers.
b. Blow out dust with an air hose or bellows giving particular attention to high-voltage units such as the d-c restorer and power supply.
c. Clean top of cathode-ray tube. Wash plastic scale with soft soap and water. (Do not use carbon tetrachloride or other cleaning fluid on this scale.)

CONVERSION OF REMOTE PLAN REPEATER INDICATOR FOR 12-INCH PPI TUBE

Due to the very short time elapse when low-flying aircraft attack, it has been found advantageous to plot such aircraft attacks on the PPI scope. The 7-inch PPI scope is not satisfactory for this purpose, but the 12-inch scope is.

As an interim measure until installation of the Model VG Projection PPI, forces afloat are authorized to convert Model VC PPI Repeater in CIC as described below. Ships

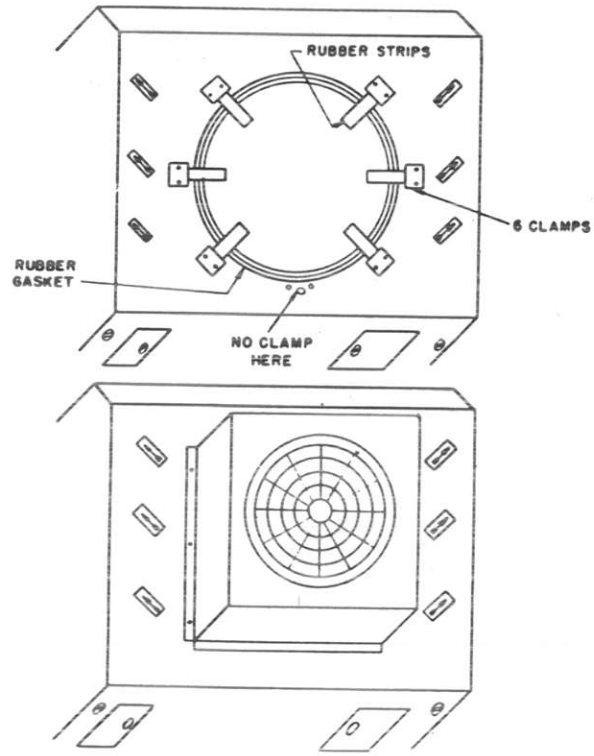


FIGURE 1.—Conversion diagram.

are instructed to use one of the two 12-inch PPI scopes carried as "on board spares" for the Model SC-2 and SC-3 radars; replacement of the spare scope so installed in the Model VC PPI Repeater should be requested from Navy Yard stocks.

Procedure (see fig. 1):

a. Remove the light shield, amber filter and pilot light assembly, as a unit, by loosening the captive screws which hold it to the sliding ring under the panel. Do not remove the rubber gasket from the top panel. Remove the 7-inch tube from the unit.

b. Remove the pedestal screw which supports the tube socket from below. (On some units it will be necessary to bend aside the angle-iron pedestal in which the screw support was placed, in order that the tube may set low enough in the unit.)

c. Remove the seven setscrews which hold the supports for the sliding ring.

d. Replace six of the supports from the sliding ring on top of the unit, by inserting the screws from below the panel. No not replace the sliding ring. Do not replace the clamp in the bottom position, as on the new units the pilot light directly below the tube allows insufficient room for the cover if a clamp is placed there.

e. Insert under each of the clamps a strip of rubber, felt, or other material, approximately 3/4-inch wide, 1/8-inch thick, and at least 1-1/2 inches long. These strips will extend in from the clamps and will bend downward through the hole in the panel. The tube rests on these strips.

f. Insert the 12-inch tube, taking care not to apply any pressure on the neck, and center it in the focus and deflection coils. Then tighten the neck screws.

g. The second anode connections on the two tubes are different, so an adapter must be devised to connect the load to the scope terminal.

h. Range marks should be applied to the face of the tube with india ink and compass. Best accuracy will be obtained if the marks are applied with the master set transmitting calibration marks to the unit.

i. A cover 13 x 14 x 4-3/8 inches should be constructed, with a mounting flange three-eighths inch wide around the bottom edge. A 10-3/4-inch window should be cut in the top and covered with transparent material, such as plexiglass, which is preferable as it will not shatter. Azimuth marks may be placed on the underside of the window.

j. The cover is mounted on the panel with small screws, completing the modification.

REVERSAL OF R1 AND R2 TO OSC

Purpose: To correct a reversal in the R1 and R2 connection of remote and master PPI units; also of the SC-1 PPI adapter. On existing equipments this correction has probably been made; however, if these units are moved or other equipments paralleled with them through a selector switch, these connections should be checked and corrected if necessary.

Equipments Affected: All VC, VC-1, SC-1, PPI Adapter and Master PPI units for SC-2/SK, SC-3/SK-2, and SC-4 equipments. (On existing installations, corrections have been made.)

Procedure: All the above units have their OSC, R1 and R2 connections, reversed with respect to the ship's gyro R1 and R2 excitation leads. However, all these units have had this error compensated for at the factory by rotating the 5CT synchro 180°. This "zero" sets the unit with respect to the ship's gyro which allows the equipment to operate properly. When equipments, other than the above, are connected in parallel with them, such as Models SA, SF, SG, SL, VD, or VF, the R1 and R2 leads for OSC excitation must be reversed. That is, in order to acquire proper synchronizing on true bearing operation when G-E equipments are connected to other equipments through a selector switch, the R1 and R2 connections should be connected to R2 and R1, respectively, from the selector switch. For example, if a VC or VC-1 is connected to operate from an SG, the R1 and R2, TB-94-4 and 5 should go to the R2 and R1, respectively, of the SG.

VARIATION OF TRACE BRIGHTNESS AND LENGTH AT SLOW CYCLIC RATE

A great deal of trouble has been encountered with VC Radar Repeaters when the VC and SC Series equipments have been operating from separate power sources, due to the difference in the frequencies of the sources.

Perhaps a few words of explanation and amplification on this subject are in order at this point. First, the 7BP7 trace lengthens and shortens about an eighth of an inch at a definite slow cyclic rate. Too, the blanking may also be affected causing the trace to dim and brighten at the same cyclic rate. Finally, the servo amplifier may have a slow hunt at this same frequency.

The cause of all this is that the SC equipment is run from one motor generator and triggers at the frequency of that generator. The remote is run from another generator which may, or may not, be supplying a-c of the same frequency as that furnished to the SC.

If the frequencies are the same, everything is fine and dandy. If they are not the same, then one observes the phenomena mentioned above. The sweep length, blanking, and servo amplifier will be affected at a cyclic rate equal to the difference in the frequencies of the separate generators supplying power for the SC and VC equipments.

The cure, of course, is to operate the SC and VC equipments from the same source of power.

LUBRICATION CHART (VC, VC-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
	Blower motor bearings	B3302-A					X		X	Navy Spec. 14-L-3 (INT) Grade B grease.	Ball and roller bearing lubricant Grade 2.	14-L-3 Grade II		Clean and repack annually.
	Yoke driving motor bearings.	B3301-A					X		X	Navy Spec. 14-L-3 (INT) Grade B grease.	Ball and roller bearing lubricant Grade 2.	14-L-3 Grade II		Clean and repack annually.
	Large gear that drives deflection coil yoke.	03308					Q		X	"Lubriplate No. 110"				
	Worm and worm gear in gear box.						Q		X	Beacon M-285 grease (Spec. ANG-3).	M-285	AN-G-3	O. S. 1350	Add grease as required.

Q = Quarterly.

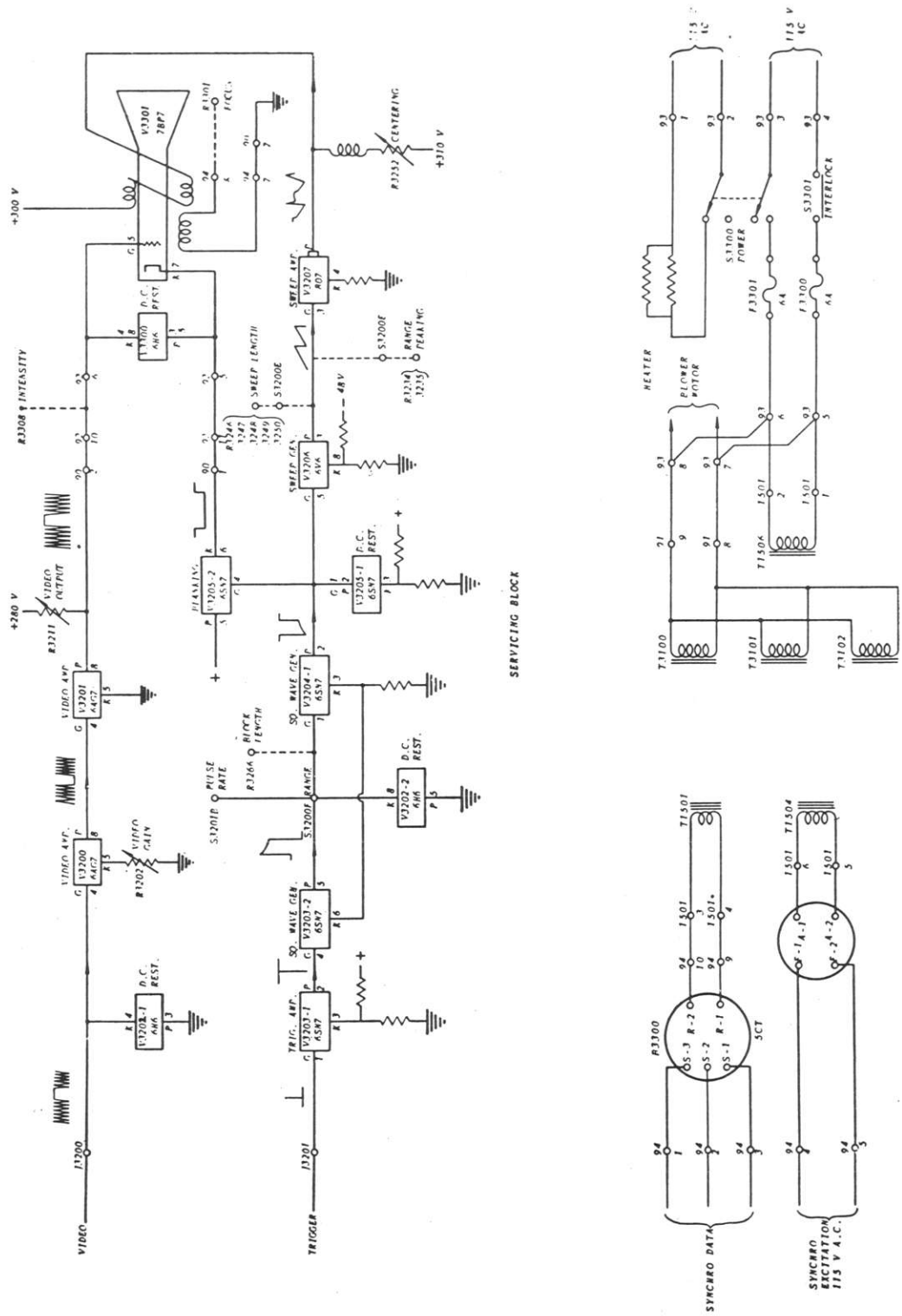


FIGURE 1.—Model VC PPI Repeater Type CG–55ACD.

MODEL VC SERIES TROUBLESHOOTING NOTES

TROUBLESHOOTING HINTS (VC, VC-1)

No Power to RPPI:

a. Open interlock circuit. Interlock bent or broken, cover warped on, wires to interlock broken.

b. Blown fuses. Ascertain cause and replace.

c. Check line voltage to unit.

No Sweep or Spot on Face of Cathode-Ray Tube:

a. Defective cathode-ray tube.

b. Second anode cap off cathode-ray tube.

c. Check high voltage power supply circuit. Rectifiers (2X2) may be defective. Rectifier tube plate caps may be off. High-voltage leads shorted, or filter capacitor shorted.

d. Loose coupling insulator on brilliance potentiometer. Check brilliance control assembly. If it is loose, voltage from brilliance potentiometer will keep cathode-ray tube cut off.

e. Defective socket connections to cathode-ray tube. Check socket. Observe all safety precautions: make continuity tests only with power off.

Spot Present on Tube, No Sweep:

a. No synch pulse. Check selector switch position both as to proper radar selection and proper line termination.

b. Check for synch pulse at J-3201. Check if the preceding unit in the string is operating properly. If so, the unit in question is isolated and synch lost between the units. Check with oscilloscope or as per method described at beginning of section.

c. Open deflection circuit. Check continuity from brush to brush on the contact rings. Resistance should be approximately 90 ohms (2 coils in series). If coils are replaced, be sure they are in series. Check all leads before assuming coils are at fault.

d. Check termination, should be 68 ohms.

e. Check synch cable and connector plugs for continuity.

f. Check connections in selector switch.

g. Transmitter may not have sufficient synch output to trigger the sweep circuits. Advance transmitter synch potentiometer to nearly full position.

h. No plate voltage on sweep circuit. Measure voltage from contact rings to ground. Should be approximately 300 volts dc. Defective 5U4G rectifier and its associated low voltage power supply circuit.

i. Defective sweep tubes. Check 807 and others.

Sweep Present, No Video Modulation:

a. Check selector switch position.

b. Check for video at J-3200. Use a high resistance voltmeter or an oscilloscope. Video should be at least 1-volt peak. Check by means of method outlined at beginning of section.

c. Check video cables and connector plugs for continuity.

d. Check termination. Should be 68 ohms.

e. Check selector switch.

f. Check preceding unit in same string. If it is operating properly the trouble is isolated to the one unit, otherwise check back to master PPI video output.

g. Defective tubes. Replace particularly the 6SN7GT tubes for V-3205, V-3204 or V-3203. Check entire sweep circuit with scope and ohmmeter if necessary for defective components.

h. Video output control R-3211 on front panel turned down too far (counterclockwise).

i. Cathode follower tubes for RPPI output in video chassis of MPPI defective. Replace. Check for video output at each of the four jacks at bottom of chassis.

Sweep Too Short, Will Not Reach Outer Range of Calibration Circle:

a. Defective type 807 (V-3207) in sweep-video chassis. Change 807's; some have greater mutual conductance than others.

b. Defective type 6SN7GT tubes (V-3203-V-3204)—replace. Adjust multivibrator block length control R-3266 as described in instruction book. If unit has no block length adjustment changing tubes is only remedy.

c. Line voltage low. Check that voltage doesn't fall much below nameplate ratings.

d. Cathode-ray tube improperly installed. Check that flare of tube is no more than one-sixteenth inch above deflection coils.

If Video Brighter at End of Sweep Than Near Center of Tube. Cannot Be Controlled with Brilliance Control:

a. Faulty brilliance control R-3308. Check and replace if bad.

b. Defective type 6H6 (V-3300).

c. Faulty operation of d-c restorer circuit. Check all components.

Bright Spot at Beginning of Sweep:

a. Defective 6H6 (V3202).

Dark Spots Instead of Light for Echo Presentation on Screen:

a. Defective 6AG7 (V-3200).

Sweep Pulsates in Length or Brilliance:

a. Shorted choke L-3201 or resistor R-3265 in plate circuit of 807 in sweep circuit.

b. Intermittent short in d-c restorer.

c. Intermittent shorts in high voltage supply.

d. Shorted C-3300 or C-3301, replace.

Double Spot on Cathode-Ray Tube:

a. Defective tube. Emulsive material may be lying on grid. Replace 7BP7.

NOTE: Slight tapping of the neck of the tube may release any emulsive material that may be lying on the grid.

Cathode-Ray Tube Focus Changes with Rotation of Trace:

a. Electron gun bent inside of cathode-ray tube. Replace tube (7BP7).

Sweep Does Not Pivot at Center of Calibrated Ring:

a. Tube not properly aligned and centered. Recenter as per instructions in book.

Sweeps and Video Present But No Rotation of Sweep:

a. Check that other units in the same string do not rotate also. If others do, trouble lies in the one particular unit or the cabling between the preceding and questionable units. If all have same ailment check the synchro output from the MPPI to the RPPI's.

b. Check input to RPPI. Varying stator voltages 0-50 volts should be found across terminals TB-94-1 to TB-94-2, and TB-94-3.

c. Check selector switch setting and selector switch cabling.

d. Check input to servoamplifier (output of 5CT synchro) across terminals TB-1501-3, TB-1501-4. Should be varying a-c order of 1 volt. Shut down equipment, check continuity of 5CT rotors. Replace if necessary.

e. Check servoamplifier for output across terminals TB-1501-5 and TB-1501-6. A-c varying voltage of 40 to 70 volts. If no output, check tubes in servoamplifier. Resistance check servoamplifier to locate defective components.

f. Defective 5U4G rectifier on servo chassis. Check and replace if necessary.

g. Yoke driving motor inoperative. Check input to driving motor armature.

h. Check input to driving motor field across terminals TB-94-4 and TB-94.5. Should be 115 volts a-c.

i. Check mechanical assembly of yoke and gears to see that nothing is binding or any set screws loose. Be sure the yoke driving assembly is free to turn by rotating the driving motor shaft at the rubber coupling to the gear box.

Jerky Rotation.

a. Servoamplifier tubes defective. Replace systematically.

b. Yoke driving assembly binds. Be sure that gear assembly is free to turn and does not bind. Check by rotating the driving motor shaft at the rubber coupling to gear box.

c. Servoamplifier requires adjustment. Check these adjustments as per instruction book only after exhausting other possibilities.

Rotation From One Radar, None From Another:

a. Check selector switch on the radar supply from which the RPPI does not operate.

No Calibration Markers on VC-1 Model:

a. Reduce video gain and increase marker gain. Defective tubes in calibrator chassis.

b. Screen of the second video amplifier V-3201, 6AG7 is held down by a bleeder composed of R-3212 and R-3213. Disconnect the grounded end of R-3213 and connect to B+ thus raising screen voltage.

Notes on Recurrent Failures

NATURE OF OPERATION	TROUBLE FOUND AND REMEDY
RPPI had intermittent sweep.	Traced to *cold soldered* joint on C–3207. Repaired.
The remote plan position indicator yoke followup system did not operate.	Turning the yoke-driving motor B–3301 manually with the power off indicated that there was mechanical binding between the adjustable focus coil L–3302 and the deflecting coil yoke L–3300. The focus coil was adjusted to give adequate clearance between the two coils. The centering of the trace pivot point was then adjusted and the calibration of the unit checked.
Remote plan indicator gear drive binding.	Motor coupling riding against reduction gear drive housing. Corrected.
Sweep on remote plan indicator would not focus.	Wrong pulse rate on remote. This caused poor focusing.
The sweep was found to be short.	This was traced to dirt between the sliprings. Cleaned the sliprings and adjusted the unit for peak performance.
Short sweep.	Cleaned and greased sliprings. Changed the 5U4G tube.
Off center.	Centered tube with 3 thumbscrews.
Short and jumpy sweep.	Adjusted antihunt control to take out jumpy effect. Change (2) 6SN7 tubes in adapter to lengthen sweep.
Found sweep showing in CR tube without radar transmitter on.	This was found to be caused by the fact that the metal cover over the d-c restorer had beer left off. A cover was taken from another unit and used. This cleared the sweep from the CR tube.
Remote plan indicator working on SG but not on SC–2.	Video line loose on terminal No. 6 of selector switch. Tightened all connections in selector switch.
Radar laboratory reported no video voltage to remote PPI.	Found short in heater circuit of remote. Video voltage to remote was found to be normal. D-c supply to heaters disconnected so that remote could be used.
Rotation of the trace in the new remote PPI was very jumpy and in certain positions friction would not allow it to move at all.	The rubber coupling between the motor and the gear box exerted too much pressure on the bearing of the gear box. This was remedied by removing the washer between them. This allowed it to run smoothly except in certain angular positions. It was found that the focus coil had been screwed up too far on 1 side and was rubbing on the gear that drives the focus coil. This was lowered and smooth rotation obtained.
Jumpy trace on 75-mile range.	Trouble cleared with proper adjustment of R–3266 (Block length control pot).
Ship reported sweep on one of the remote PPI units would oscillate when master PPI was at rest (with power on).	This was due to bad adjustment of Wien bridge. Adjusting Wien bridge cleared the trouble.
Remote would operate properly when the SG was on the 15,000-yard scale, but would not sweep at all if the SG was operated on the 75,000-yard scale.	Inasmuch as the SG was working properly on both ranges, it was deemed logical to change the triggering pulse cathode follower in the SG adapter before proceeding further. This eliminated the trouble.

Notes on Recurrent Failures—Continued

NATURE OF OPERATION	TROUBLE FOUND AND REMEDY
Remote PPI in radar plot failed to rotate in step with master PPI. Remote PPI on bridge was satisfactory. Both remote PPI's operated satisfactorily with SG.	Voltage check showed that SG supplied somewhat higher synchro voltage to remote PPI's than the SK, accounting for proper operation with SG. It was concluded that trouble was mechanical. The flexible coupling between the synchro motor and drive gear of scope in remote PPI was loosened and the shafts were slightly separated so that they would not bind each other. Remote PPI then operated satisfactorily.
Remote PPI units not rotating.	Driving motor in remote PPI was binding. This was centered and trouble cleared up.
Remote PPI rotation sluggish.	Not enough gain to servoamp. Remote PPI sluggishness corrected by advancing setting of R–1501.
Sluggish rotation of the remote PPI.	Tuned up the Wien bridge output, R–1501, on the remote PPI, which corrected the faulty rotation of that unit.
7BP7 was found to be scraped by the deflection coil. Failure of focus control to allow maximum control.	7BP7 tube was removed and realined. Focus modification Field Change 2 was made in power supply chassis. Equipment was tested and calibrated.
Lucite disk dusty.	Lucite disk removed and cleaned.
The sweep was erratic at repeat spots on 7BP7 tube.	The sliprings and brushes of the sweep coil circuit were cleaned and cleared of all high resistance contacts responsible for the erratic sweep. The unit was calibrated and checked for operation on signals.
Poor focus.	The selection of a vacuum tube, type 5U4G, used in socket X–3301 of the power supply, is critical in its effect on sweep focus.
Uneven rotation of sweep.	Slewing motor was loosened to eliminate binding.
Jarring the unit caused intensity to increase momentarily.	Replaced V–3201 (6AG7). This tube caused trouble as shown by tapping.
Unable to reduce brilliancy of sweep with intensity control.	Tested resistors in power supply and found R–3103 and R–3111 defective. Replacing R–3103 had no appreciable effect but when R–3111 was replaced the intensity controllers again normal.
No sweep rotation.	In checking servo amplifier found that no current was being applied to motor. Check revealed broken lead which was replaced.
Sweep on the 7BP7 tube was blanked out for about 10°	Caused by dirty sliprings. The CR tube was rubbing against the coil form. The plug on the sync cable was replaced with a male plug, the CR tube was recentered and the sliprings cleaned.
Remote PPI was not focusing properly and that trace could not be centered.	Check of equipment operation revealed that kinescope tube was not centered properly physically. Recentered tube and had no difficulty alining center of trace.

Notes on Recurrent Failures—Continued

NATURE OF OPERATION	TROUBLE FOUND AND REMEDY
Plan position indicator was centered and immediately thereafter, no sweep rotation developed.	The focus coil had been drawn up to the extent that binding existed between this coil housing and the yoke bearing assembly, which introduced excessive "drag" on the motor. Readjustment of the focus coil gave proper clearance and eliminated the binding.
The "snow" on the cathode tube was so strong that it obliterated the signals from the SG.	It was found that the condition referred to was, in actuality, a solid echo such as is encountered when ranging on large land masses. This was caused by incorrect setting of the gain, and on reducing the gain proper resolution of targets was readily obtained.
The synch voltage supply to the remote PPI was intermittent.	The intermittent synch voltage supply was due to a poor 6SN7 tube in the SG adaptor unit. After this tube was replaced, the operation of the equipment was satisfactory.
The sweep was short on the 7BP7 CR tube V–3301.	Caused by dirt and metal filings between the slip rings of the sweep coils.
All centering adjustments at base of CR tube loose. Tube lifting bolt loose allowing tube to drop down till neck was hitting deflection coil.	Recentered tube with centering bolts and locked same securely to prevent working loose again.
No sweep appeared on the remote PPI.	P–2006, of the coax line connected at J–2006 in the transmitter, had a broken inner conductor. It was replaced by a similar one on hand.
Low picture brilliancy.	The glasses that protect the cathode ray tube should be cleaned occasionally. Dust collecting on these glasses cuts down considerably the brilliance of the picture.
Remote PPI had jumpy rotation.	The Wien bridge controls (R–1502 and R–1503) were badly in need of adjustment.
Pronounced vibration in VC during rotation of antenna. Examination showed that cathode ray tube was rubbing on deflection coil, throwing excessive load on slewing motor.	Recentered tube in deflection coil.
G. E. remote PPI not triggering on long range. Trigger trace poor, modulator pulse low.	Readjusted R–430, R–418 and 2050 bias control for proper trigger and pulse picture.
T–3101 burned out.	Found rubber support bumpers for 7BP7 had been knocked off while replacing tube. Replaced with new bumpers (Field Change 7).

VARIATION IN 7BP7 TUBES

Difficulty has been experienced in centering the spot on the PPI tube when installing a new tube in the VD series equipment. This is found to be due to the fact that there is considerable variation between tubes in the normal position of the spot.

Present specifications accept any tube in which the normal position of the spot falls within 15 mm. (one-half inch) of the center of the tube. The limits on this have recently been changed, therefore there probably will be a considerable number of these tubes in the field outside of these limits.

If difficulty is experienced in centering the spot by adjustment of the focus coil, the normal position of the spot should be checked as follows:

a. Open the circuit to the focus coil by disconnecting the wire from terminal 25 of E-202.

b. Short circuit the deflection coil by strapping terminal 37 and 38 of E-203.

c. Advance the intensity control until an unfocused spot appears on the screen of 7BP7 tube. The center of this spot should fall within one-half inch of the center of the tube. If it is more than one-half inch from the center of the tube, reject the tube as unusable in this equipment.

When installing a VD series equipment, it is preferable to use the tube which is shipped with the equipment in the installation spares since the unit has been lined up at the factory using this tube. This will facilitate the alignment procedure since very little adjustment will be necessary if this tube is used.

Since the allowable variation in the normal location of the spot is one-half inch from the center of the tube, it is possible to have the spot off center as much as 1 inch when installing a new tube. This, of course, would be an extreme case. There is enough movement available in the focus coil to compensate for this amount of variation. Tubes which fall on the extreme limits are not expected to give as good results as those which have a normal spot nearer the center of the tube. This is due to a slight distortion caused by the unsymmetrical condition of the electron beam.

Technician's Checkoff Lists

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

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

VD and VD–1 Equipment

	Year___											
	Month_											
	Week__	1	2	3	4	1	2	3	4	1	2	3	4
MAIN UNIT													
1. Blow the dust out of the unit with dry compressed air and wipe off remaining dust with a clean cloth.													
2. Inspect tube socket connections and tube locks for snugness of fitting.			X	X	X		X	X	X		X	X	X
3. Inspect and clean ferrule resistors, fuses, and clips.			X	X	X	X	X	X	X	X	X	X	X
4. Inspect and burnish interlock contacts.			X	X	X	X	X	X	X	X	X	X	X
5. Check all screw and lug connections for tightness.			X	X	X	X	X	X	X	X	X	X	X
6. Inspect flexible interassembly cabling for worn insulation.			X	X	X	X	X	X	X	X	X	X	X
INDICATOR TUBE ASSEMBLY													
1. Lubricate ball bearings on bearing dial and bearing vane. See instruction book and lubrication chart.			X	X	X		X	X	X		X	X	X
2. Check the screws clamping the servo motor and 5CT synchro for tightness.			X	X	X		X	X	X		X	X	X
3. Check the clamping screws on the bellows coupling for tightness.			X	X	X		X	X	X		X	X	X
4. Inspect brushes and rotating contacts on the drive motor and PPI deflection coil.			X	X	X	X	X	X	X	X	X	X	X
5. Wash out and relubricate the PPI gear transmission and gear transmission ball bearings. See instruction book and lubrication chart.	ANNUALLY												
6. Disassemble drive motor, clean bearings, commutator, etc., and relubricate. See instruction book and lubrication chart.	ANNUALLY												

Technician's Checkoff Lists—Continued

VD–2 Equipment

	Year___											
	Month_											
	Week__	1	2	3	4	1	2	3	4	1	2	3	4
MAIN UNIT													
1. Blow the dust out of the unit with dry compressed air, and wipe off any remaining dust with a clean dry cloth.													
2. Check all metal parts for corrosion.													
3. Inspect and clean ferrule resistors, fuses, and clips.		X	X	X	X	X	X	X	X	X	X	X	X
4. Inspect and burnish interlock contacts.		X	X	X	X	X	X	X	X	X	X	X	X
5. Check all screw and lug connections for tightness.		X	X	X	X	X	X	X	X	X	X	X	X
6. Inspect flexible interassembly cabling for worn insulation.		X	X	X	X	X	X	X	X	X	X	X	X
INDICATOR TUBE ASSEMBLY													
1. Lubricate ball bearings on bearing dial. See instruction book and lubrication chart.		X	X	X		X	X	X		X	X	X	
2. Inspect deflection coil brushes and drive gears. See instruction book.	ANNUALLY												
3. Disassemble and lubricate bearing cursor drive gear bearings. See instruction book and lubrication chart.	ANNUALLY												

LUBRICATION CHART (VD, VD–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
Bearing dial	Ball bearing race					X		X		Light machine oil			N. S. 9110, N. S. 2110, O. S. 1362.	
Drive motor	Ball bearings						X		X	Colonial Beacon Andok C			14–L–3 Grade 2	
Gear transmission	Ball bearings		1,000						X	Colonial Beacon Andok C			14–L–3 Grade 3	
Gear transmission	Gears		1,000						X	Colonial Beacon M–285			O. S. 1350	
Bearing vane	Ball bearings					X		X		Univis P–48			N. S. 9110, N. S. 2110, O. S. 1362.	

LUBRICATION CHART (VD–2)

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
Bearing dial	Ball bearing					X		X		Univis P–48			N. S. 9110, N. S. 2110, O. S. 1362.	
Bearing vane	Ball bearing						X	X		Univis P–48			N. S. 9110, N. S. 2110, O. S. 1362.	

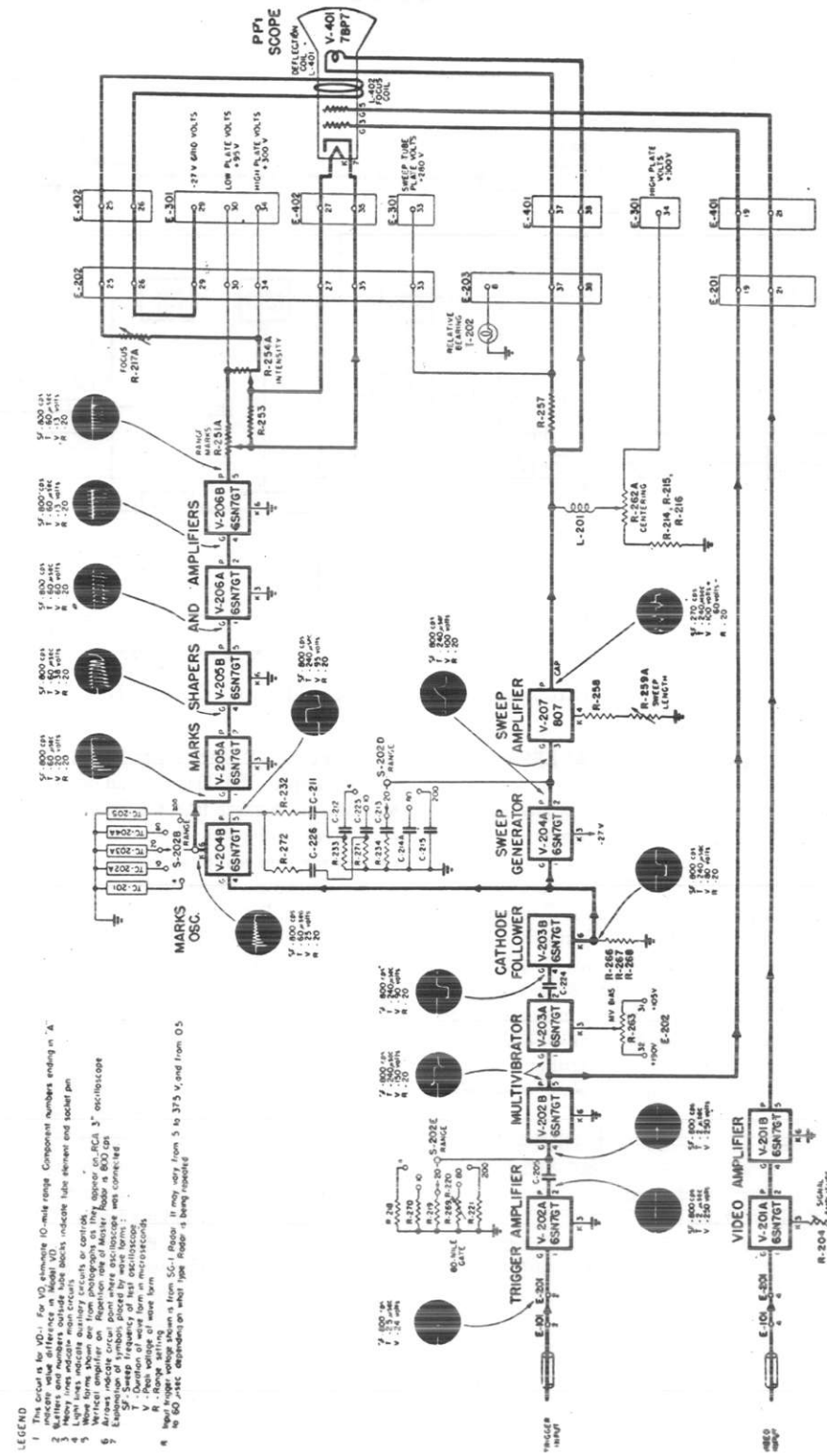


FIGURE 1.—PPI repeater servicing block. Model VD (CRP–55ACY), Model VD–1 (CRP–55AEE).

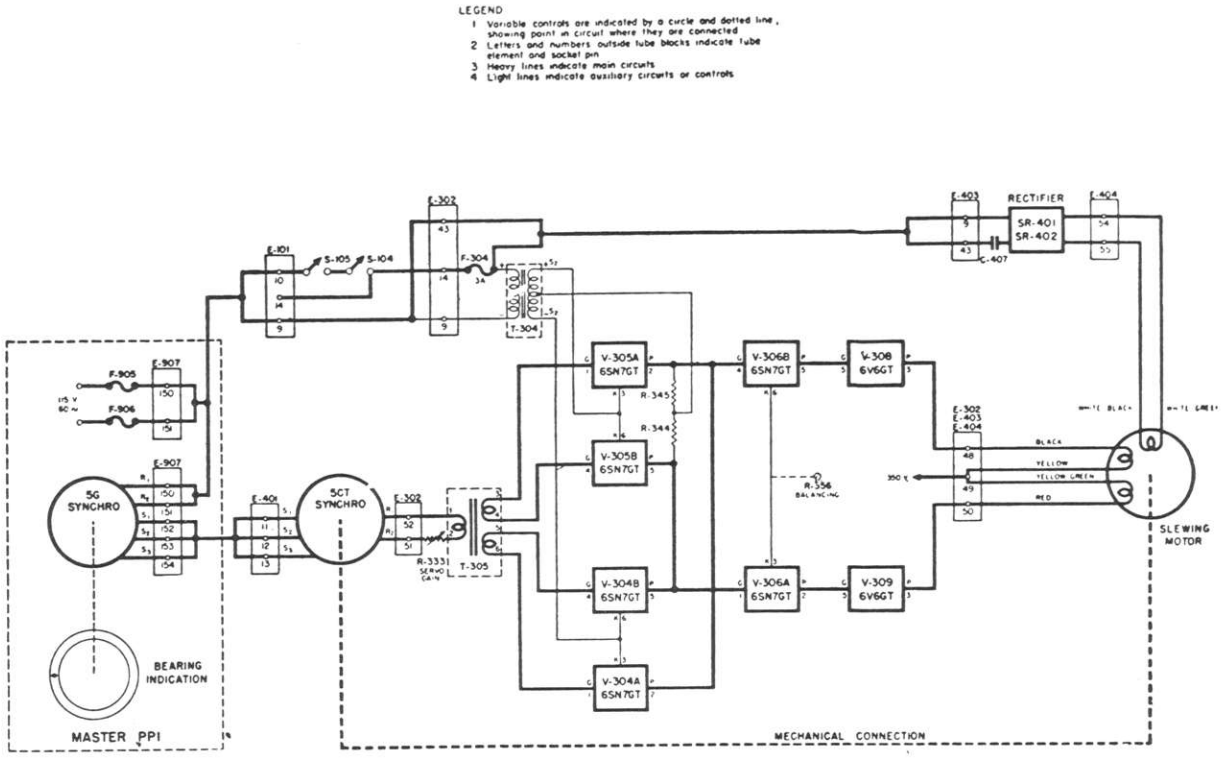


FIGURE 2.—Synchro system servicing block, Models VD and VD–1.

CALIBRATION OF VD SERIES PPI REPEATERS

Purpose: To provide a standardized calibration procedure.
Equipments Affected: All VD-series PPI repeaters.
Action Required: Calibration when required.

The spacing of the range marks on VD-series repeaters is controlled by the resonant frequency of an L-C tuned network which is adjusted by varying the inductance of the coil. A separate tuned circuit is used for each range. Each coil must be adjusted by comparing the range marks on the repeater with properly calibrated range marks obtained from a master radar. Any radar which provides suitably spaced range marks can be used for this calibration. Procedures are given below for calibrating VD-series repeaters from SG-series, SL, and SA radars.

NOTE: Always check the azimuth reading of the repeater with the master radars at 0°, 90°, 180°, and 270°. Also check for correct direction of rotation.

Calibration From SG Series Radar:

a. Set the SG range switch to 15,000 yards. Set the VD range switch to 4 miles and adjust TC-201 until the marker from the SG lines up halfway between the second and third markers on the VD.

b. Set the VD range switch to 10 miles and adjust TC-202A until the first four markers from the SG line up with the first four markers on the VD.

c. Set the VD range switch to 20 miles and adjust TC-203A until every other marker from the SG lines up with a marker on the VD.

d. Set the VD range switch to 80 miles. Set the SG range switch to 75,000 yards and adjust TC-204A until the 8th and 16th markers from the SG line up with the 1st and 2d markers on the VD.

Calibration from Model SL Radar:

a. Set the SL range ring to 4 miles. Set the VD range switch to 4 miles and adjust TC-201 until the 4th marker on the VD lines up with the marker from the SL.

b. Set the SL range ring to 10 miles. Set the VD range switch to 10 miles and adjust TC-202A until the fourth marker on the VD lines up with the marker from the SL.

c. Set the SL range ring to 20 miles. Set the VD range switch to 20 miles and adjust TC-203A until the fourth marker on the VD lines up with the Marker from the SL.

d. Leave the SL range ring on 20 miles. Set the VD range switch to 80 miles and adjust TC-204A until the first marker on the VD coincides with the marker from the SL.

NOTE: This range should ordinarily be calibrated from a master radar having markers beyond 20 miles.

Calibration from Model SA Radar:

The first marker provided by the SA radar is 5 miles. If a radar with shorter range markers is not available, the VD may be calibrated on short range from the SA radar as follows:

a. Set the SA range switch to 20 miles. Set the VD range switch to 4 miles and adjust TC-201 until the fifth marker on the VD coincides with the first marker from the SA. (The sweep length on the VD may have to be adjusted to make the fifth marker visible.)

b. Set the SA range switch to 20 miles. Set the VD range switch to 20 miles and adjust TC-202A until the second and fourth markers on the VD coincide with the first and second markers from the SA.

c. Set the SA range switch to 20 miles. Set the VD range switch to 20 miles and adjust TC-203A until the first 4 markers on the VD coincide with the first 4 markers from the SA.

d. Set the SA range switch to 80 miles. Set the VD range switch to 80 miles and adjust TC-204A until the first 4 markers on the VD coincide with the first 4 markers from the SA.

e. Set the SA range switch to 200 miles and adjust TC-205 until the first 4 markers on the VD coincide with the first 4 markers from the SA.

EFFECT ON SWEEP OF CRP-301222 VOLTAGE STABILIZING TRANSFORMER FIELD

Reports from the field have described the effect on VD-series repeater performance of the stray field surrounding the Voltage Stabilizing Transformer, CRP-301222 currently supplied with VD-2 equipments.

At the request of the Bureau, the Naval Research Laboratory has made measurements of the magnetic field surrounding subject transformer.

As a result of these tests, the following recommendations are made:

a. The transformer should be mounted at least 18 inches, preferably 24 inches, from the repeater.

b. If practicable, the transformer should be bulkhead mounted near the deck, with the long axis in the horizontal plane. This will cause the magnetic field to be nearly parallel to the axis of the cathode ray tube in the repeater. (Ships are cautioned against installing in this manner as the mounting feet are not designed for heavy shocks.)

If the VD equipment aboard ship is being affected by stray fields from the voltage stabilizing transformer, contact the RMO at the next Navy yard availability to make the above change.

REPLACEMENT OF DEFLECTION COIL IN INDICATOR TUBE ASSEMBLY

Purposes:

To provide replacement procedures.

Action Required:

Replacement when necessary.

Equipments Affected:

All VD-Series PPI Repeaters.

General:

Two types of deflection coils have been used in VD-series PPI repeaters. All VD/VD-1 repeaters, as well as VD-2 repeaters Nos. 1-250, were shipped with a G.E. type 68G576 coil (Raytheon No. 92-5085 P2). VD-2 repeaters beginning with No. 251 were shipped with an improved coil, G. E. type 80G52 (Raytheon No. 92-5085 P4). The two types of coils may be used interchangeably for replacement by providing a sweep amplifier cathode resistor R-258 of the correct value, as shown below:

Type of Coil	Resistance of R-258
G. E. Type 68G576	500 ohms
G. E. Type 80G52	400 ohms

Since both types of coils will be found in tender maintenance repair parts, and since the value of R-258 affects the sweep length, the value of R-258 must be checked and made to correspond with the type of maintenance repair coil when the replacement is made.

Replacing the Coil in VD/VD-1 Repeaters:

Remove the indicator tube assembly from the case and take apart the lower portion of this assembly, including the focusing coil. Then remove the deflection coil through the bottom of its housing by taking off the coil-retaining collar. To install the new coil, reverse this procedure.

Replacing the Coil in VD-2 Repeaters:

The deflection coil can be replaced in the VD-2 repeater without removing the indicator tube assembly. The procedure follows:

a. Remove the bearing dial assembly and the PPI tube.

b. Remove the four fillister-head screws from the retaining ring at the top of the deflection coil assembly.

c. Remove the deflection coil brushes.

d. Withdraw the coil assembly from its housing. The upper bearing will slide out with the coil assembly, and the lower bearing will remain in the housing.

e. From the bottom of the coil assembly remove the four screws holding the coil-retaining collar, and remove this collar from the coil housing.

f. Remove the coil-retaining washer and insulating washer, and unsolder the coil leads from the slipring studs.

g. Slip the coil out of its housing.

To install a new coil, reverse the above procedure. After installing the coil-retaining collar, tighten the three screws in this collar snugly against the coil-retaining washer, and tighten the locknuts. When reinserting the deflection coil assembly into its housing, mesh the two gears so that the "O" marks on the gear faces coincide.

Should the lower bearing of the coil assembly have to be replaced, it will be necessary to remove the focusing coil. The bearing can then be withdrawn from the bottom of the housing after removing the retaining collar which is secured by four screws.

SERIAL NUMBERS

Some confusion has existed in regard to the proper serial number of a VF system. There are two serial numbers on a VF cabinet. The one on the front of the power unit servo chassis is the serial number of the VF repeater. The serial number on the top control panel is the serial number of the entire VF system. Always use the number on the top control panel, which is the VF serial number.

ANTIJAM-NORMAL SWITCH

Purpose:

Use of switch to combat jamming of display tubes.

Equipments Affected:

All VF and Mark 33 Equipments.

The video amplifier of the VF is provided with an ANTIJAM-NORMAL switch on the top of the video chassis. Access to this switch is provided by raising the top control panel. When Set to the ANTIJAM position, this switch disconnects the d. c. restorer in the cathode circuit of both the PPI and the B-scope, thus allowing a positive bias to build up as a result of a block of negative video signals. The result is to reduce the intensity of the display tubes during the time that the signals are being impressed on the cathode.

This feature is provided for combating jamming of the i. c. w. (pulsed) type. It is useful for combating blooming of the tube caused by large blocks of cloud or sea return or noise jamming in certain sectors. If jamming is of the kind that appears over the entire tube, the intensity control should be turned back to a point where the tube does not bloom. If, however, the noise or jamming appears only on certain sectors, the operator should try using the ANTIJAM-NORMAL switch to determine whether this improves the presentation. If so, operation may be continued with the switch in the ANTIJAM position. Since however, there will be a shadow effect on the PPI and B-scope caused by a positive overshoot in the cathode voltage, this switch position should be used only so long as the interference persists.

TRIGGER DELAY LINES (TYPE CRP 14-ABD)

Trigger delay lines are intended for use with radar systems incorporating radar repeaters of the VF series (Precision PPI). They are used for the purpose of delaying radar trigger pulses. A typical example of installation is given by means of artificial lumped constant lines. A delay of the trigger pulse is necessary when most search radar systems are feeding on VF repeater, if accurate range readings are to be obtained on the repeater, since the delay of the video through the receiver, wave guide and, in some cases through the difference in length of video and trigger cable runs, causes an appreciable difference in time that the video and trigger are applied to the PPI tube.

The delay line consists of a multiplicity of T sections in series, each section having the necessary amount of series inductance and shunt capacitance to provide the required characteristics. The nominal characteristic impedance of the delay line is 75 ohms and it is to be used with standard Navy RG-12/U coaxial cable. A number of sections constitutes one delay line, each section having a delay of 0.05 microsecond with a total delay of 2.4 microseconds per line. Each section will not only be marked in microseconds delay, but in equivalent yardage (6.2 yards per 0.05 microsecond). The method of setting the line to the proper delay is shown in the "Trigger Delay Line" instruction book. To determine the amount of delay the instruction book should be consulted.

One delay line may be used with each search radar that is connected to Radar Repeater VF. The proper place of insertion is between the receiver and the PPI adapter, junction box, or equivalent radar repeater feed unit. A typical example of installation is given in the Radar Installation Plan, Change No. 40, page D-V-44.

The delay line is mounted in a drip-proof case 4-1/2" x 15-1/4" x 9" and the total weight is 17 pounds. It employs Navy type 49194 coaxial connectors for input and output connections. A typical example of installation is given in the Radar Installation Plan, Change No. 40, page D-V-43.

Trigger delay lines are manufactured by Ratheon Manufacturing Company under contract NXsr 73830 and may be obtained from FMO pools. Sufficient quantities are now available to insure installation of delay lines in all radar systems where VD Radar Repeaters are to be used.

SYNCHRO SWITCHING SYSTEM — 1-AND 36-SPEED SELECTOR RELAYS

Conducted tests indicate the probable necessity for a routine check of 1-speed, 36-speed, synchro selector systems. Tube rejections indicate that a portion of the difficulty to be encountered may be due to improper relay adjustment.

The 1-speed, 36-speed selector relays, K-502 and K-504, are rotating armature type relays used to select the correct error voltage for controlling rotation of the sweep and relative bearing dial.

When the standby switch S-1003 is thrown to the ON position, relay K-501, at first, remains deenergized and the servo system is controlled by the reference voltage supplied from transformer T-503. The 1-speed error voltage is always applied to the control grid of V-501 and as this voltage increases the resultant increased plate current of V-501 closes relay K-502. Relay K-502 switches the 1-speed error voltage to relay K-501 and at the same time closes relay K-501. This disconnects the reference voltage from the servo amplifier input and connects the 1-speed error voltage to the amplifier input. Relay K-501 being a hold type relay is held in until the supply is interrupted at either the selector switch S-1518 or at the standby switch S-1003. The servo system continues to operate on 1-speed information until the error voltage is reduced to approximately 1 volt near 0°. At this point the current through relay K-502 drops to the "dropout" value and the relay opens. When relay K-502 opens at this point, the error voltage produced by the 36-speed system is applied to the

Technician's Checkoff List (VF)

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
1. Blow out main frame, control chassis, power and servo chassis, and cable drawer with main dry compressed air, or clean with dry brushes and cloth.													
2. Check condition of dust stops (air filters) on rear of main frame, and replace if clogged with dirt.													
3. Wipe off all high-voltage components, particularly rectifier tubes and insulators, using a clean dry cloth.													
4. Check operation of all controls on top control panel and on exposed front panel of control chassis.													
5. Clean display tube windows with lens tissue.													
6. Check all cables (including coax) and their connections. Tighten all screw-type connections, dressing them to prevent short circuits and chafing contact with moving parts. Repair worn cable insulation.		X	X	X		X	X	X		X	X	X
7. Brush off exposed gear teeth in B range and PPI azimuth assemblies.		X	X	X		X	X	X		X	X	X
8. Check metal parts for corrosion and clean if necessary.		X	X	X		X	X	X		X	X	X
9. Seat all tubes firmly in their sockets and check locking devices.		X	X	X		X	X	X		X	X	X
10. Check all shaft couplings for looseness and tighten if necessary. CAUTION—Do not loosen. Realignment may be required unless extreme care is taken.		X	X	X		X	X	X		X	X	X
11. Check calibration of PPI range marks.		X	X	X		X	X	X		X	X	X
12. Check oven thermostat for proper operation by measuring oven temperature.		X	X	X		X	X	X		X	X	X
13. Inspect ferrule resistors and clips, and burnish if necessary.		X	X	X	X	X	X	X	X	X	X	X
14. Inspect interlock contacts, and clean and tighten if necessary.		X	X	X	X	X	X	X	X	X	X	X
15. Inspect relay contacts, and burnish if necessary.		X	X	X	X	X	X	X	X	X	X	X
16. Remove fuses one at a time and check operation of blown fuse indicators (neon lamps). Clean and burnish all fuses before replacing.		X	X	X	X	X	X	X	X	X	X	X
17. Check brushes, brush holders, and slip rings on PPI deflection coil and magnetic clutches, and clean if necessary. Replace brushes if required.		X	X	X	X	X	X	X	X	X	X	X
18. Inspect tube pins and socket connections, and clean if necessary.		X	X	X	X	X	X	X	X	X	X	X
19. Check gain setting on servoamplifier.		X	X	X	X	X	X	X	X	X	X	X
20. Check auxiliary rectifier for d-c output.			X	X	X	X	X	X	X	X	X	X

grid of V-501 and the servo system is controlled during normal operation by 36-speed information. If the plate current, of V-501 with zero 1-speed error voltage, becomes abnormally high the servo system will be continuously controlled by 1-speed information and the accuracy to be obtained from the 36-speed system is lost.

The solenoid current at which the rotating armature type relay operates is determined by the spring tension placed on the armature.

Tests are now being conducted on an enclosed type plug-in relay which may supplement the present selector relay in the near future. It will not be possible to make any adjustment to the new type relay. Any failure will be corrected by replacement. The following table of voltage and resistance measurements may be used to check the synchro switching system in accordance with its factory alignment.

Supply voltage to coil.....275v d. c.
Coil resistance..... 1,900 ohms.
Resistance from coil to pin No.
8 of V-501.....2,233 ohms±10%.
Relay closing current..... 13 to 19 mils d. c.
Relay drop-out current.....9 to 13 mils d. c.
Zero error voltage current.....5 to 7 mils d. c.
Voltage across coil:
Closing.....24.7 to 36.1 volts d. c.
Opening..... 17.1 to 24.7 volts d. c.
Zero error voltage.....9.5 to 13.3 volts d. c.
Fixed grid bias, V-501 or V-504
(pin No. 4 to ground).....6 volts d. c.

To determine the coil current at relay closing and drop-out, connect a voltmeter across the relay coil terminals at the relay and remove the servo-motor control tube V-507 or V-503. This will permit rotating the PPI deflection coil gear or the SOC indicating dial by hand. With V-507 or V-503 in place, the servo-motor torque in very high and "off zero" rotation is difficult. It will be necessary to remove the PPI dial light shield to rotate the OSC dial-control gear. As the system is rotated from electrical zero, the error voltage to the grid of the synchro switching control tube V-501 will increase, resulting in an increase in plate current. Note that in either system, with all tubes in place and the servo system at rest, the current through the coil is at a minimum.

Calculation of the relay coil current may be made by measuring the voltage drop across the coil and interpolating. With a coil resistance of 1,900 ohms the following potentials represent the indicated current.

5.7 volts d. c. 3 mils
11.4 volts d. c. 6 mils
17 volts d. c. 9 mils
22.8 volts d. c. 12 mils
28.5 volts d. c. 15 mils
34.7 volts d. c. 18 mils
40 volts d. c. 21 mils

Assuming all current and resistance measurements to be correct, improper relay operation will normally be due to incorrect armature spring tension. To correct the tension:

a. Remove the machine screw securing the rotating fiber block. Avoid damaging the relay moving contact springs. Since the relay body contains stops within the assembly, sufficient pressure may be applied to loosen or tighten the screw without grasping the armature block.

b. Remove the two screws used to secure the relay circuit terminal block and raise the terminal block from the relay.

c. Remove the four screws holding the top armature bearing plate and remove the bearing plate. This will make the relay tension spring accessible.

d. Slip the spring out of the mounting holes and adjust its tension by expanding or decreasing the diameter of the spring. Expanding the diameter of the tension spring will raise the amount of current necessary to operate the relay. Sharp bends should not be used to accomplish a change. Since the top armature bearing cover plate must be in position to assure free armature movement, it may be necessary to replace and remove this plate several times to obtain the correct adjustment.

In a few cases, with zero error voltage applied to the grids of V-501 or V-504 the plate current has exceeded the normal relay coil dropout current. In such cases, choose a tube whose plate current under normal operating conditions is lower than the coil dropout current.

Reports received indicate that due to the excessive plate current of V-501 or V-504, some units may be operating only on single speed information although 36-speed information is available. Check all units as they become available to assure correct operation.

DRAWER SLIDES

Several reports have indicated that some trouble has been experienced with the drawer slides jamming. An investigation has shown that the sharp edges on the rollers are cutting into the track thereby jamming the roller so that it could not move. A redesigned drawer slide which seems to have completely eliminated this trouble has been incorporated in current production beginning with VF unit number 220.

The present drawer slides may be repaired by taking the following steps:

a. Remove the drawer from the cabinet section in which the defective drawer slide is located.

a. To secure smooth drawer slide operation it is necessary that all washers, etc., be replaced in their correct location upon reinstalling the repaired unit. Four screws are used to mount the slide. One lockwasher is used on each top screw and placed next to the head of the screw. On each bottom mounting screw a flat washer and a lockwasher are used. The drawer slide is placed against the main cabinet. The screw is projected through the mounting bracket hole with the screw head toward the inside of the cabinet. The flat washer fits next to the mounting bracket slot and the lockwasher between the screw head and the flat washer.

To remove the drawer slide, loosen the bottom screws; since the bottom bracket screw holes are slotted it is not necessary to remove the screws completely. Remove the top mounting screws completely and remove the drawer slide from the cabinet.

c. Lay the slide on a flat surface, mounting brackets down. Hold the outer and inner sections of the slide in place and pull the center slide as far to the front as possible. Remove the rollers between the inner and center sections of the slide. NOTE: The roller stops are indented near the center of the center slide. In replacing the repaired roller the indentation is located between the rollers.

d. Round off the rollers and remove burrs from the slides as described in a previous paragraph. To repair the rollers between the center and the outer slide, it is necessary to separate the two slides. This required bending or removing the spot-welded stub, mounted at the rear of the outer slide to permit the center slide to slip out of the rear end of the outer slide, making the rollers accessible. In replacing these rollers they are inserted in the track with the indentation in the outer slide between rollers

REPLACING HELIPOT

The equipment maintenance parts on the VF unit contain three helipot and stop-washer assemblies properly set in relation to each other. When this unit is installed in a VF, it is only necessary to set the range crank at 2,375 yards and set the helipot and stop washer assembly against its zero stop. Then insert the coupling on the stop washer assembly into the coupling half in the gear box and set the helipot and stop washer assembly so that it stops at exactly 2,375 yards.

In order to accomplish this, remove the old helipot and install a new helipot on the stop washer assembly so that the resistance in the helipot is 250 ohms between the top two terminals on the helipot when the stop washer assembly is against its zero stop. This assures that the helipot will not be damaged and also that when the unit is calibrated, the calibration will be on the first thousand yard marker and not on the second. Note that the arm of the helipot is the terminal at the top of the unit.

HELIPOTS IN EQUIPMENT MAINTENANCE PARTS; OSCILLATOR COIL L-301

a. On several occasions when maintenance helipots (R-1102) were desired, the maintenance parts list has been consulted and found that none are listed in equipment maintenance parts, the only maintenance parts being in tender and stock maintenance parts.

The maintenance helipots in equipment maintenance parts are supplied as a helipot and stop washer assembly. These are listed under "assemblies" on page 39 of the maintenance parts list as Z-1102. There are 3 of these with each equipment maintenance parts box, 4 in tender maintenance parts, and 9 in stock maintenance parts.

Helipots individually were not included in equipment maintenance parts because of the difficulty involved in properly installing this unit. The entire assembly is easily replaced when the helipot is properly set on the stop washer assembly. It was intended that when a ship found it necessary to replace a helipot the entire assembly would be replaced and the defective unit would be turned in to the RMO where a new helipot would be installed on the stop washer assembly. The whole assembly would then be put back in tender maintenance parts for future replacement.

b. Several reports have indicated trouble experienced with oscillator coil L-301 opening. Investigation reveals that the coils used in VF equipments up to No. 210 were of an inferior quality and that the trouble has been generally due to poor soldering of the coil leads to the Chess man lugs.

An improved design coil was used in production starting with VF No. 210 (approximately) and to date no trouble has been reported with these coils. Their only disadvantage is that the iron core cannot be removed if the screw driver slot in the shaft is broken.

If difficulty is experienced with these coils they should be replaced from maintenance parts.

SETTING LOW-RANGE MICROSWITCH

A microswitch which opens the magnetic clutch circuit on the range unit and lights the low-range warning light (I-1005) when the range counter is below 2,400 yards, is located between the 1- and 36-speed remote range transmission synchros, B-1101 and B-1102. This switch is operated from a cam on the shaft of the 1-speed range transmission synchro, B-1101, through a lever mounted on a plate. The position of this lever can be adjusted, thereby controlling the range at which the switch operates. The switch is supposed to remain closed at all ranges above 2,400 yards and open below 2,400 yards. If, due to wear or other causes, the adjustment of the cam causes the switch to open at ranges above 2,400 yards, it will be impossible to move the spot vertically on the B tube. All other features of operation will be normal and ranging accuracy will not be affected.

To adjust this low-range microswitch, loosen the two screws holding the clamping clips on each side of the adjustable plate and move this plate forward or backward until the switch is actuated by the cam at 2,400 yards. Check to be sure the microswitch is mounted securely to its bracket and there is no looseness in the operating mechanism.

VOLTAGE REGULATING TRANSFORMER (TYPE CRP-301407)

The stray field around this transformer is quite high and will be sufficient to seriously modulate any cathode ray tube located within 6 feet of it. This stray field is strongest when the input voltage is highest. Satisfactory results have been obtained in some cases by installing a one-quarter inch steep plate between the regulating transformer and the unit being modulated.

AUXILIARY RECTIFIER FUSE F-606

The value of F-606 appearing on early diagrams was 5 amps. while the fuse value installed in the equipment was 2 amps. This fuse supplies power to the auxiliary rectifier which normally draws about 1 amp. maximum from the line. The proper value of this fuse is 2 amps. The error

has been collected on the diagrams and later issues will show the proper value.

The manufacturer advises that occasionally when the main switch is thrown ON there is a current surge which will cause the fuse to blow. In this case the fuse should be replaced with the same size in order to provide protection for the transformer. If a 2-amp. fuse will not hold in this circuit, there is indication of something wrong and investigation should be made to determine what fault exists.

SPOKE EFFECTS ON ONE SIDE OF B TUBE ONLY

Some trouble has been experienced with what appeared to be spoke effects quite widely spaced on the left-hand side of the B tube when the unit is rotating clockwise. Investigation showed that this was due to the spot scan microswitch closing almost coincident with the appearance of the first azimuth mark. The first azimuth mark then appears while the sweep is moving from the center of the tube off to the left and since this movement is very rapid, the appearance on the tube was that of widely spaced spokes. The intensity of the spokes was slightly less than the azimuth markers.

If this condition is found on a unit in operation, the proper cure is to readjust the spot scan microswitch S-1201 which is located directly beneath the azimuth scan synchro in the back left-hand corner of the unit. Ordinarily, it is necessary to move this switch in only slightly to make the proper correction.

ELIMINATION OF DOUBLE TRACE ON PPI TUBE

In the past there was a varying degree of trouble on the VF PPI tube due to a broadening of the sweep in certain sectors. This is caused by circulating ground currents and is now eliminated in all production units by the addition of a ground strap. This ground strap consists of a piece of copper braid about 4-3/4 inches long protected by transflex tubing and having suitable lugs. This strap is connected from terminal 100 on E-1204 to a screw on the azimuth gear case directly under the relay chassis. The use of a ground wire in this location has proven ineffective, but the use of the heavy braid connection has eliminated the trouble in every case.

If trouble of this nature is experienced in the field it is suggested that a ground strap be tried similar to that used now in production.

RANGING METHODS

Equipments Affected: All VF and Mark 33 Equipments.
Purpose: To describe errors in various ranging methods.
Action Required: None.

There are two methods of determining range in general use on the VF equipments. Each of these methods introduces certain inherent errors under some conditions. These two methods are described and the errors involved are outlined below:

Ranging on the Leading Edge of a Target: In this method, the leading edge (edge nearest operator) of the target echo is brought to the center of the B tube. Fundamentally, this is the correct method of ranging since the position of the leading edge of the echo indicates the the true position of the target and is not affected by the pulse length. However, due to the limited bandpass of most current radar receivers and video systems, the leading edge of the echo received from a target may not be sharp. This causes the position of the leading edge of the echo on the B tube to change when the receiver gain control is changed. It may also fluctuate seriously due to fading. Experience indicates that the range indication of a target may change in excess of 100 yards due to variation of the receiver gain control and that variation due to fading may be from 50 to 75 yards. This means that accurate results cannot always be obtained when ranging on the leading edge of a target echo.

Ranging on the Center of a Target: In this method, the center of a target echo is brought to the center of the B tube. When the VF is repeating from a radar with the limited bandpass now generally available, and with no antijam features in its receiver, this method of ranging has proved to be satisfactory. Errors resulting from the limited bandpass which would be caused by variation in receiver gain control setting, or by fading, are completely eliminated and range interpretation can be duplicated consistently with a high degree of accuracy.

When the VF is repeated from a radar with a wider video bandpass and with antijam features and variable pulse length, ranging on the center of the target will not be satisfactory. When any of the anitjam controls are used, such as fast time constant (FTC) or instantaneous automatic volume control (IAVC) the width of the echo appearing on the B tube changes with variation of the antijam controls. Furthermore, if the radar has variable pulse length, proper adjustment of the delay line can be made for only one pulse length, and an error in range is introduced when the radar is operating on any other pulse length. It, therefore, becomes quite impossible to determine accurate range under all conditions when using the center of the target echo. Thus, when a radar having the aforementioned features is driving a VF, it becomes necessary to range on the leading edge of the target echo. Since the method of ranging of the VF, to obtain most accurate results, will depend largely upon the radar equipment involved, the method to be used in any particular case is left to the discretion of the officer in charge, bearing in mind the above information.

Summary: RANGING ON THE LEADING EDGE OF A TARGET ECHO: The leading edge (edge nearest operator) of the target echo is brought to the center of the B tube.

Advantages:

a. Good accuracy can be obtained when wide band i. f. and video are available.

b. Accuracy is not affected by variable pulse length.

c. Accuracy is not affected by instantaneous automatic volume control (IAVC) or fact time constant coupling (FTC).

Disadvantages:

a. With narrow band width video, as available in

most current radar equipments, errors up to 100 yards will result from receiver gain control changes and fading.

b. Error is introduced by variable video band width.

c. Error is introduced by sensitivity time control (STC) if used in conjunction with narrow bandpass video.

RANGING ON THE CENTER OF A TARGET ECHO. The center of the target echo is brought to the center of the B tube.

Advantages:

a. With narrow bandpass now available on most radars, no error is introduced by fading or changes in receiver gain.

b. No error is introduced by sensitivity time control (STC).

c. No error will result from variable video band width.

Disadvantages:

a. Error will result if it is used with variable pulse length.

b. Error will result if it is used with instantaneous automatic volume control (IAVC) or fast time constant coupling (FTC) antijam controls.

CONTROL CIRCUIT VOLTAGES

Equipment Affected: All VF equipments.
Purpose: To provide additional voltage information.
Action Required: None.

To facilitate the location of troubles in VF equipments, normal voltages in the various voltage-divider and control circuits are given below on breakdown schematics.

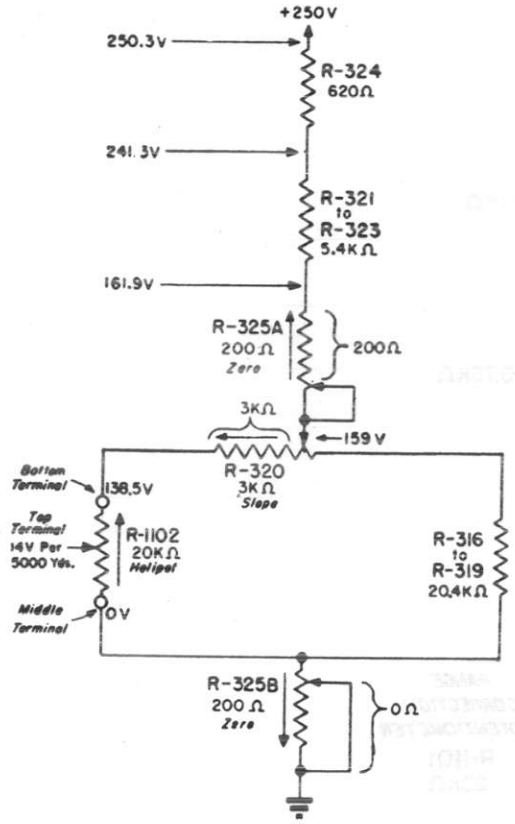
All components are shown, together with their resistance values and normal d-c voltages at each circuit point. The arrow at each variable control indicates its action for clockwise rotation. To obtain the voltages shown at variable controls, each control must be set to the resistance value shown at the bracket.

All measurements should be made with a 20,000-ohms-per-volt meter between the points indicated and ground.

INTERNAL CABLING TERMINATIONS

Purpose: To facilitate circuit tracing.
Equipments Affected: All VF equipments.

To simplify the tracing of circuits through the unit cabling, the table starting on page 2-10 has been prepared. Each lead is shown with its function and the terminal strip number on which it terminates in each of the units. The columns for the control chassis and the power and servo chassis give both the system wire number and the pin number on the Cannon plug. All other location columns give the lead number and the terminal strip number.
Example: Lead 43 serves to cut out the 36-speed azimuth drive. It connects to terminal 43 on terminal strip E-109 at the cable entrance on the main frame, and to pin 28 of the Cannon plug on the power and servo chassis. This lead also connects to terminal 43 on terminal strip E-1309 at the cable drawer, and to the 14th wafer (S-1519) of the selector switch.



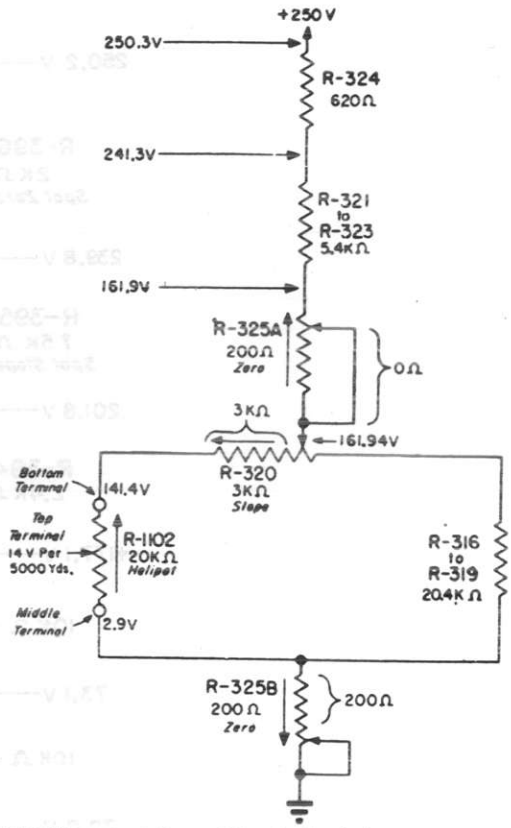


FIGURE 1.—Helipot, Slope, and Zero controls. Potentiometers in position indicated.

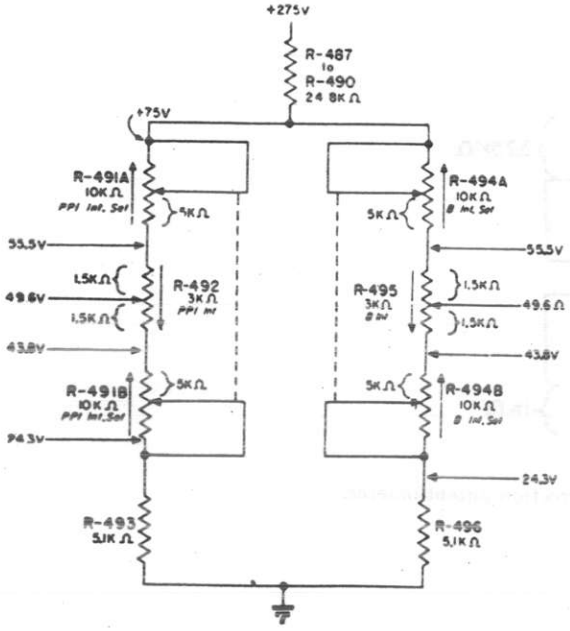


FIGURE 2.—PPI and B scope Int. and Int. Set controls.

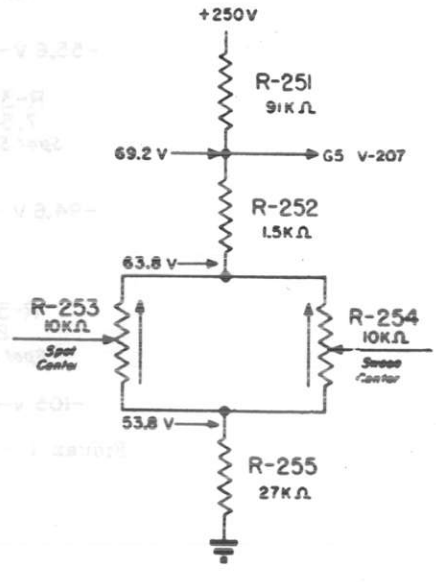


FIGURE 3.—B tube horizontal spot and sweep center controls.

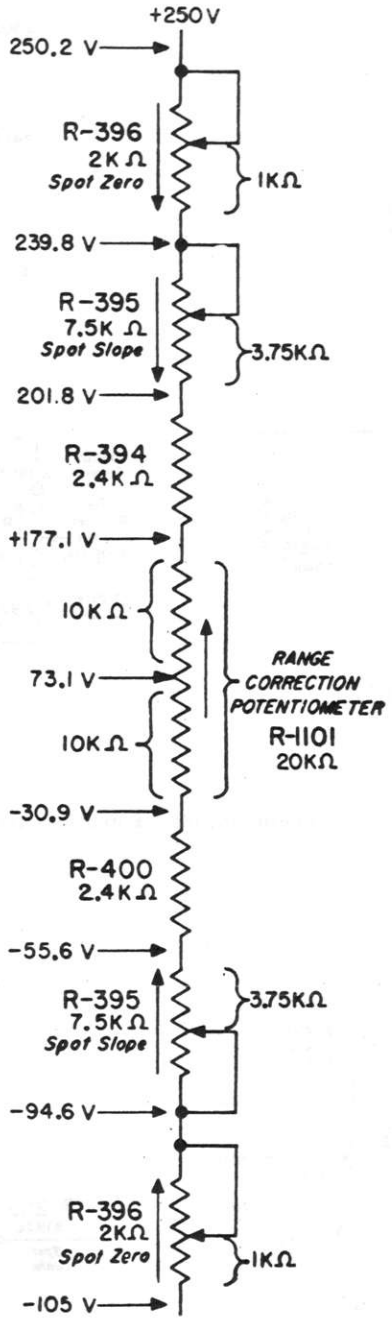


FIGURE 4.—Range correction potentiometer.

INTERNAL CABLING TERMINATIONS

LEAD	FUNCTION	FRAME AND NAVY CABLE TERMINALS (100)	CONTROL CHASSIS (200–400)		POWER AND SERVO CHASSIS (500–600)		VIDEO CHASSIS (700)	PHASING BRIDGE AND AMPLIFIER (600)	MOTOR CAPACITOR CHASSIS (900)	TOP CONTROL PANEL (1000)	B-RANGE ASSEMBLY (1100)	PPI AZIMUTH ASSEMBLY (1200)	CABLE DRAWER (1300)	AUXILIARY RECTIFIER (1400)	SELECTOR SWITCH (1500)			VOLTAGE REGULATOR (1600)
			LEAD	PIN	LEAD	PIN									WIRE	SWITCH	WAFER	
1	S1 OSC 1X	1 E-103										1 E-1206	1 E-1303		1	S-1510	5	
2	S2 OSC 1X	2 E-103										2 E-1206	2 E-1303		2	S-1511	6	
3	S3 OSC 1X	3 E-103										3 E-1206	3 E-1303		3	S-1512	7	
4	R1 OSC ref. v	4 E-103											4 E-1303		4	S-1513	8	
5	R2 OSC ref. v	5 E-104											5 E-1304		5	S-1514	9	
6	S1 OSC 36X	6 E-104										6 E-1206	6 E-1304		6	S-1515	10	
7	S2 OSC 36X	7 E-104										7 E-1206	7 E-1304		7	S-1516	11	
8	S3 OSC 36X	8 E-104										8 E-1206	8 E-1304		8	S-1517	12	
9	1X reset	9 E-106											9 E-1306		9	S-1518	13	
10	1X reset	10 E-106			10	(21)							10 E-1306		10	S-1518	13	
11	S1 azimuth 1X	11 E-106										11–E-1201	11 E-1306		11	S-1520	15	
12	S2 azimuth 1X	12 E-106										12 E-1201	12 E-1306		12	S-1521	16	
13	S3 azimuth 1X	13 E-106										13 E-1201	13 E-1306		13	S-1522	17	
14	R1 azimuth ref. v	14 E-106											14 E-1306		14	S-1523	18	
15	R2 azimuth ref. v	15 E-107			15	(30)			15 E-901				15 E-1307		15	S-1524	19	
16	S1 azimuth 36X	16 E-107										16 E-1201	16 E-1307		16	S-1525	20	
17	S2 azimuth 36X	17 E-107										17 E-1201	17 E-1307		17	S-1526	21	
18	S3 azimuth 36X	18 E-107										18 E-1201	18 E-1307		18	S-1527	22	
19	Azimuth 36X cut-out	19 E-106			19	(38)							19 E-1306		19	S-1519	14	
20	Rel. bearing light	20 E-102											20 E-1302		20	S-1509	4	
21	S1 } 36X remote target	21 E-102										21 E-1204	21 E-1302					
22	S2 } bearing	22 E-102										22 E-1204	22 E-1302					
23	S3 }	23 E-102										23 E-1204	23 E-1302					
24	R1 } remote bearing ref. v	24 E-102										24 E-1204	24 E-1302					
25	R2 }	25 E-102										25 E-1204	25 E-1302					
26	S1 } 1X remote target	26 E-103										26 E-1204	26 E-1303					
27	S2 } bearing	27 E-103										27 E-1204	27 E-1303					
28	S3 }	28 E-103										28 E-1204	28 E-1303					
29	} Remote bearing buzzer	29 E-101								29 E-1001			29 E-1301					
30	}	30 E-101								30 E-1001			30 E-1301					
31	S1 } 36X remote target	31 E-107									31 E-1101		31 E-1307					
32	S2 } range	32 E-107									32 E-1101		32 E-1307					
33	S3 }	33 E-107									33 E-1101		33 E-1307					
34	R1 } Remote range ref. v	34 E-106									34 E-1101		34 E-1308					
35	R2 }	35 E-106									35 E-1101		35 E-1308					
36	S1 } 1X remote target	36 E-106									36 E-1101		36 E-1308					
37	S2 } range	37 E-106									37 E-1101		37 E-1308					
38	S3 }	38 E-106									38 E-1101		38 E-1308					
39	} Remote range buzzer	39 E-101								39 E-1001			39 E-1301					
40	}	40 E-101								40 E-1001			40 E-1301					
41	R1 OSC ref. v				41	(15)						41 E-1206	41 E-1308					
42	R1 azimuth ref. v				42	(14)						42 E-1201	42 E-1308					
43	Azimuth 36X cut-out	43 E-109			43	(28)							43 E-1309		43	S-1519	14	
44	–24 v	44 E-109	44	(1)							44 E-1104	44 E-1203	44 E-1309	44 E-1402				
45	+24 v	45 E-109									45 E-1103	45 E-1203	45 E-1309	45 E-1402				

46	R2 OSC ref. v	46	E-113			46	(31)			46	E-901					46	E-1309								
47	115 v. 60 cy	47	E-109	47	(28)											47	E-1309	47	E-1402 E-1401					47	E-1601
48	115 v. 60 cy. reg	48	E-105 E-110			48	(37)									48	E-1305							48	E-1601
49	115 v. 60 cy. reg	49	E-105 E-110			49	(20)									49	E-1305							49	E-1601
50	Rel. bearing light	50	E-102													50	E-1302		50	S-1508	3				
51	115 v. to Aux. Rect. and v. reg	51	E-109			51	(36)									51	E-1309	51	E-1402					51	E-1601
52	OSC 36X cut-out					52	(6)									52	E-1309								
57	115 v. 60 cycles	57	E-105	57	(34)											57	E-1304	57	E-1401					57	E-1601

INTERNAL CABLING TERMINATIONS—Continued

LEAD	FUNCTION	FRAME AND NAVY CABLE TERMINALS (100)	CONTROL CHASSIS (200–400)		POWER AND SERVO CHASSIS (500–600)		VIDEO CHASSIS (700)	PHASING BRIDGE AND AMPLIFIER (800)	MOTOR CAPACITOR CHASSIS (900)	TOP CONTROL PANELS (1000)	B-RANGE ASSEMBLY (1100)	PPI AZIMUTH ASSEMBLY (1200)	CABLE DRAWER (1300)	AUXILIARY RECTIFIER (1400)	SELECTOR SWITCH (1500)	VOLTAGE REGULATOR (1600)
			LEAD	PIN	LEAD	PIN										
90	B+ ground return		90	(58)	90	(34)	90 E-701	90 E-801			90 E-1104	90 E-1205 90 E-1202				
91	6.3 v.: operates pilot light				91	(29)										
92	PPI video ampl. B+ screen				92	(2)	92 E-701				92 E-1104					
93	B vid. ampl. B+ screen				93	(10)	93 E-701				93 E-1104					
94	Video B+				94	(9)	94 E-701				94 E-1102					
95	−6 v. d. c.		95	(13)	95	(35)										
96	+105 v.		96	(4)	96	(26)										
97	+250 v. reg.		97	(56)	97	(33)	97 (33)	97 E-801			97 E-1102	97 E-1203				
98	+275 v.		98	(62)	98	(1)					98 E-1102	98 E-1205				
99	+400 v.		99	(26)	99	(17)										
100	6.3 v. gnd. ret.		100	(53)	100	(22)	100 E-701	100 E-801		100 E-1001	100 E-1104	100 E-1204				
101	6.3 v.		101	(52)			101 E-701	101 E-801		101 E-1001	101 E-1102	101 E-1205				
102	Spot scan 24 v.		102	(21)							102 E-1103	102 E-1203				
103	24 v. range limit relay										103 E-1103	103 E-1205				
104	24 v. azimuth limit relay											104 E-1203				
105	24 v. range clutch										105 E-1104	105 E-1205				
106	24 v. azimuth clutch											106 E-1203				
107	24 v. low range relay										107 E-1104	107 E-1205				
108																
109	Low range pilot light								109 E-901			109 E-1205				
110									110 E-901							
111																
112																
113																
114																
115	115 v. from S-1003 before interlocks.				115	(12)										
116																
117																
118	115 v. after interlocks				118	(5)							118 E-1304			
119	115 v. F-604		119	(51)	119	(4)										
120	115 v. F-605		120	(12)	120	(11)										
121	Helipot (−)		121	(10)							121 E-1102					
122	Helipot (arm)		122	(20)							122 E-1102					
123	Helipot (+)		123	(19)							123 E-1102					
124	Range corr. pot. (+)		124	(54)							124 E-1102					
125	Range corr. pot. (arm)		125	(5)							125 E-1102					
126	Range corr. pot. (−)		126	(14)							126 E-1102					
127	B vert. defl.		127	J-208							127 E-1103					
128	B vert. defl. ret.		128	(31)							128 E-1103					
129	B vert. defl.		129	(30)							129 E-1103					
130	B horizontal, deflection		130	(18)							130 E-1103					
131			131	(17)							131 E-1103					
132	B focus		132	(40)							132 E-1103					
133	PPI deflection		133	(55)								133 E-1205				

134	PPI focus		134	(39)								134 E-1205				
135	Azimuth corr. pot		135	(43)								135 E-1203				
136	Azimuth corr. pot. arm		136	(42)								136 E-1203				
137	Azimuth corr. pot		137	(41)								137 E-1203				
138	1X OSC error v				138	(8)						138 E-1206				
139	OSC error v. com				139	(28)						139 E-1206				
140	36X OSC error v				140	(16)						140 E-1206				
141	1X az. error v				141	(40)						141 E-1201				
142	Az. error v. com				142	(24)						142 E-1201				
143	36 X ax. error v				143	(32)						143 E-1201				
144	S1 B sweep sync		144	(46)								144 E-1202				
145	S2 B sweep sync		145	(45)								145 E-1202				
146																
147	R1 B sweep sync		147	(36)								147 E-1202				
148	R2 B sweep sync		148	(35)								148 E-1202				
149	OSC servo motor field								149 E-901			149 E-1206				
150	OSC servo ampl. output				150	(39)						150 E-1206				
151	Az. servo motor field								151 E-901			151 E-1201				
152	Az. servo ampl. output				152	(7)						152 E-1201				
153	6.3 v. PPI dial lights											153 E-1204				
154	6.3 v. counter and vernier lights										154 E-1104	154 E-1204				
155																
156	Range switch (4-mile)		156	(29)												
157	Range switch (20-mile)		157	(22)												
158	Range switch (80-mile)		158	(25)												
159	Range switch (200-mile)		159	(11)												
160	6-microsecond gate		160	(47)			160 E-701				160 E-1104					
161	Plate-angle marks ampl		161	(50)								161 E-1202				
162	PPI grid		162	(48)								162 E-1202				
163	PPI unblanking		163	(61)								163 E-1202				
164	B tube grid		164	J-311							164 E-1103					
165	B tube 1st anode		165	J-207							165 E-1103					
166	PPI intensity		166	(38)			166 E-701				166 E-1101					
167	B intensity		167	(37)			167 E-701				167 E-1101					
168	24 v. video blanking relay						168 E-701				168 E-1104	168 E-1202				
169																
170	115 v. from S-1003 Aux. rect. fuse		170	(27)												

MODEL VF SYNCHRO SWITCHING RELAYS

In early Radar Indicator VF, synchro switching relay K-502 and K-504 of the servo amplifier and rectifier power unit, were found to be extremely sensitive. Accordingly, it was usually necessary to "circuit select" the 6AG7 tubes of this unit, in order to obtain proper operation. This fact was not generally known by field personnel and usually resulted in unnecessary adjusting of the relays.

Beginning with serial No. 643, VF equipments were supplied with less critical hermetically sealed, plug-in type relays. While this new type relay was not supplied as a retroactive field change for the early models, a quantity of them, together with the mounting brackets necessary for replacing the old type relays, were supplied in VF tender and stock spares under tag no. 1615. If satisfactory operation of the old type relays cannot be obtained after adjusting them in accordance with the procedure, a complete new relay should be installed.

It should be noted that the new type relays are also supplied in equipment, tender and stock spares, less the mounting bracket, under tag no. 503. This item should be used when replacement of a new type relay becomes necessary.

At the same time that the old type relays are replaced with the hermetically sealed units, the value of capacitors C-502 and C-512 should be changed from 1 microfarad to 2 microfarads. Also, on equipments bearing serial nos. 585 to 643, resistors R-296 and R-297 should be changed to 620 ohms and 390 ohms, respectively.

LOW-RANGE WINDUP SPRING FOR MODEL VF RADAR REPEATER

Considerable difficulty has been experienced with the low-range windup spring used in Model VF radar repeater and until recently this spring was not available either in equipment spare parts or in Navy stocking activities.

The low-range windup spring is now in the Navy Supply system and is identified by the following nomenclature:

N5840-313-1701

SPRING: motor type, low range windup 0.010 inch thick, spring steel, 11/32 inch long x 1/2 inch wide x 1-7/16 inches outside diameter (Overall), outside terminal ends in 5/32 inch inside diameter loop, inside terminal bent diametrically for insertion in split in, mounting in metal case as an assembly; P/O VF Equip.; Raytheon dwg No. L88-5340-P1 sub. 2, Raytheon part No. M-26A16-U-141561-P-2.

This spring can be ordered through normal supply channels whenever replacement is required.

MODEL VF ANODE CONNECTORS

It has been suggested that improved PPI anode connectors be provided for use with Model VF equipment.

If the anode connectors of Model VF require replacement, an improved type may be ordered through routine supply channels, however; in using this anode connector an insulating cover, stock number **N5840-309-8354** must also be ordered and used.

VF REPLACEMENT PART INFORMATION

The following information on the VF equipment was forwarded to the Bureau. A replacement part was ordered to replace C-711 (50 Mfd.-50 Vdc.) cathode bypass capacitor for V-701 in the Video Amplifier subchassis of the VF equipment. The part received had the correct values and physical sizes, but the polarities were reversed figure 1. It was necessary to reroute the wiring to the capacitor in order to make use of the replacement part. The same difficulty was experienced with cathode bypass capacitor C-707. Make sure you check the polarity before installing the parts.

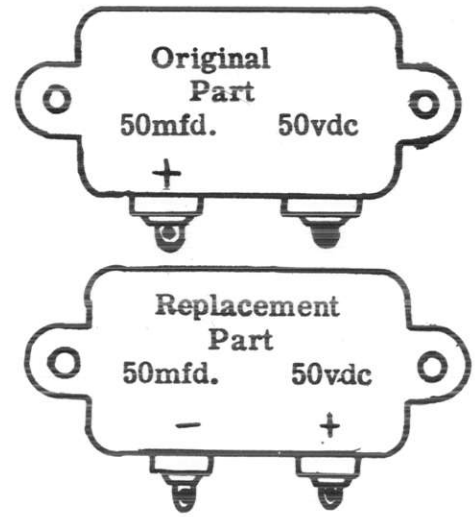


Figure 1

FAILURES OF PARABOLIC CONDENSER LENS

Many condenser lenses (1) 101 of the VG Series of equipments have cracked because of excessive heat. This is not a fault of the lens but is caused by the mounting of lens.

The lens is held in place by metal clamps which project slightly over the edge of the lens. Since metal is a better conductor of heat than glass, the clamps conduct the heat to the portions of the lens they touch. This causes an uneven distribution of heat about the surface of the lens and internal stresses are set up which will eventually cause the lens to crack. Also, as the lens heat up, it expands. It bears against these metal clamps, which tend to keep the lens from expanding in the places held by these clamps; again, stresses are set up tending to crack the lens.

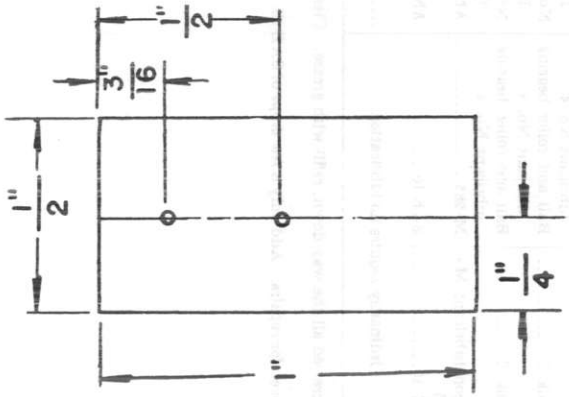


FIGURE 1.—Dimensions of pad. Made of 1/32-inch asbestos stock. Holes are 5/32-inch in diameter.

A proposed cure is to place asbestos pads between the clamps and the lens. These pads will compress a slight amount as the lens expands and will also serve to insulate the lens from the clamps giving a more even heat distribution about the surface of the lens.

a. The dimensions of the pads are given below:
   Made of 1/32-inch asbestos stock.
   Holes 5/32-inch diameter.

It is imperative that these pads be added to all VG series equipments.

When reassembling the lens, care should be taken to see that there is at least one-fourth inch of air space between the lens and projection lamp. Also, it is very important that the air filters be kept clean to insure a continuous flow of air in the unit. Instructions for cleaning the filters will be found on page 74 of the VG Preliminary Technical Manual, SHIPS 261.

The General Electric Co. Field engineers have been supplied with asbestos pads and spare lenses. If a lens has cracked, a replacement may be obtained at the Navy yard through the Electronics Office.

REMOVING AND ALINING 4AP10 CRT

A procedure for removing the 4AP10 from the VG and an outline of the optical alinement procedure to use after changing the CR tube are given below. In both outlines, the numbers refer to the parts so marked on figure 56, page 82 of the VG Technical Manual.

Procedure for Removing Tube:

a. Remove CRT socket (12).
b. Remove CRT socket clamp (11).
c. Remove CRT clamp (10).
d. Remove high voltage lead (27).
e. Remove tube mask (28).
f. Loosen shaft at universal joint.
g. Unscrew thumb nuts at antirotation ring.
h. Loosen bristo cap screws (6).
i. Remove tube.

Procedure for Optical alinement:

a. Loosen tube clamp (11).
b. Line up dots angularly.
c. Secure tube clamp (11).
d. Loosen bristo cap screws.
e. Adjust focusing ring (9).
f. Adjust any two opposite angular adjustment thumbscrews (24).
g. Adjust other two opposite angular adjustment thumbscrews (24).
h. Repeat e,f, and g until satisfied with focus.
i. Secure bristo cap screws (6) and thumbscrews (24).

VG ERASE TIME

Tests have shown that after 200 hours of life, a deposit forms on the inside of the projection lamp bulb which does not decrease the visible light output to a noticeable extent, but decreases the heat output to such an extent that the temperature on the face of the 4AP may drop as much as 20° to 30°C.

Inasmuch as the persistence of the 4AP10 depends largely on the temperature at which it is operated, this may be the cause for the numerous complaints of long persistence even when the heat controls are at maximum.

It is suggested that whenever the erase time is too long even with the controls set for maximum heating, the projection lamp be changed as a possible remedy.

LUBRICATION CHART (VG, VG–1, VG–2, VG–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
.....	Blower motor bearings.....	B6004...	...	...	...	X	...	...	X	Andok C.....	Ball and roller bearing lubricant No. 4.	No. 14–L–3 Grade III.	.....	Repack. See Note 1.
.....	Yoke driving motor bearings..	B6001...	...	...	...	...	X	...	X	Andok C.....	Ball and roller bearing lubricant No. 4.	No. 14–L–3 Grade III.	.....	Repack annually.
.....	Rotation indicator bearings...	B6002...	...	...	...	...	X	...	X	Andok C.....	Ball and roller bearing lubricant No. 4.	No. 14–L–3 Grade III.	.....	Repack annually.
.....	Rotation indicator—Driving motor gear box.	.....	As required					...	X	Beacon lubricant M–285.	M–285.....	AN–G–3A.....	O. S. 1350.....	See Note 2.
.....	Miter gear box.....	.....	...	...	B	...	...	X	...	SAE 10.....	SAE 10.....	AN–O–4.....	N. S. 2110, N. S. 9110.	Add a few drops.
.....	Worm shaft gears.....	.....	...	...	...	...	...	...	...	Ordinarily require no lubrication.		.....	.....	See Note 3.

NOTE 1.—Turn grease cups one complete turn clockwise monthly. When cups have been screwed all the way down, refill with grease. Clean bearings annually as described in SHIPS 261.

NOTE 2.—Keep lower half of gear case filled to within 1½ inches from top.

NOTE 3.—These gears should be lubricated only if 5CT or focus and centering coils are removed for repairs. Add only a *few drops* of SAE 10.

TRANSFORMER T-601

Many reports have been received in the Bureau stating that transformer T-601 fails continually in VJ equipment.

Field Change 1 added plotting accessories to model VJ and when it was installed on the equipment, the six pilot lamps of the reflection plotter were wired to the secondary of transformer T-601. This resulted in overload and frequent failure.

This fault was corrected in manufacture of VJ-1 equipby increasing the secondary rating of transformer T-601 from 2.5 amps to 6.0 amps.

This redesigned transformer will be furnished as part of a modernization kit for model VJ equipment. However, it will be some time before these kits are available. In the interim, it is recommended that this redesigned transformer T-601 be replaced.

The redesigned transformer is identical to the old with exception of the increased secondary rating and the mounting screws. The old transformer had 10-32 mounting screws whereas the redesigned transformer has 8-32 mounting screws.

The new transformer may be ordered through routine supply channels by the following nomenclature: stock no. N17-T-71997-6750.

Transformer, power, fil type, input 115v, 60 cyc., secd.; 6 v at 6.0 amps, manufacturer No. UX-13233, contr. No. 92-598oPl.

TROUBLESHOOTING THE VJ REPEATER PHANTASTRON CIRCUIT

When the minimum range of the VJ repeater movable range is excessively long, the phantastron circuit can be the cause. But very often the trouble may be found in amplifier V-509.

This amplifier, normally saturated, cuts off rapidly at the beginning of the phantastron circuit action and returns to the saturated condition quickly at the end of the phantastron cycle. The trailing edge of its output is differentiated, and the resulting spike serves as the delay trigger for the delay multivibrator. If this trailing edge is not steep, excessively long minimum range of the movable range mark can result. Any improper operating condition in the amplifier could sufficiently distort the trailing edge to create this condition

When an excessively long minimum range is evident, a five-minute check of the phantastron delay circuit is as follows: Disconnect terminal B-94 from terminal strip E-501 in the delay unit. This disconnects the phantastron pick-off or control voltage from the range helipot at the PPI. Shunt a high-resistance potentiometer (100,000 ohms, 2 watts for example) from the 275-volt bus to ground and connect the potentiometer arm to the lead from B-94. This will provide simulated range information for the circuit.

As the arm of the potentiometer is moved toward ground, the phantastron delay should decrease. The movable mark will drop out if the phantastron is operating normally. should it drop out above the minimum specified range, as indicated on the PPI, the phantastron amplifier could be suspected. Irregular movement of the mark could indicate faulty phantastron operation, while normal movement of the mark would indicate a possible faulty helipot or associated circuitry.

Do not forget to reconnect terminal B-94 to terminal strip E-501 in the delay unit after the check.

VJ RADAR TEST HARNESS TERMINAL BOARD CONNECTIONS

A simplified and time saving method has been suggested to expedite connecting test cables to various VJ components for performance checks.

The method devised is to place each wire that is to be connected to a certain terminal strip on an improved "plug", so arranged and mounted that the contacts slip into the proper contact on the terminal strip with no chance of error as they are fixed. In this manner, a group of wires could be "plugged" into their terminals in the same amount of time it would take to connect one without error, and no time would be spent in identifying each lead by number, etc., in order to determine its purpose and terminal. (See figure 1.)

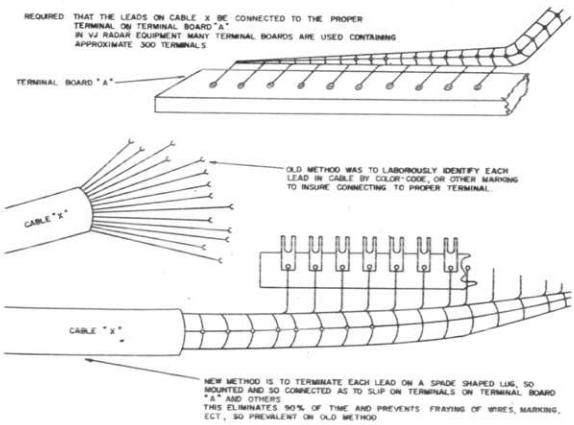


Figure 1

NEW VK ALINEMENT PROCEDURE

The VK alinement procedure as given originally in the technical manual is difficult to follow and some of the adjustments are interactive. A new procedure developed by GE engineers has proved much more satisfactory. This new procedure follows below in detail.

An up-to-date schematic of the VK Repeater incorporating all the latest changes is shown on the next page. For those who desire or have use for a large print of this schematic, write to the nearest naval shipyard or look for the first revision of the VK Technical Manual.

PRELIMINARY

Range marks are used as the basis for this alinement, therefore in a preliminary adjustment, the linearity control is adjusted first to give equal spacing between range marks.

Then the speed of the 4-mile sweep at the input to the N-S sweep amplifier is adjusted to match the fixed voltage (South) side of the N-S (O-C) pot (i. e., so that 40 miles of sweep voltage = 40 miles of O-C voltage.) The 4-mile sweep at the input to the E-W sweep amplifier is adjusted to match the fixed voltage (West) side of the E-W O-C pot.

Next the adjustable sides (North and East of both the N-S and E-W O-C controls are matched to the 4-mile sweeps at the inputs of the N-S and E-W sweep amplifiers.

Then the 10-, 20-, 40-, 80-, and 200 mile Sweep Speed controls are adjusted to match these sweeps to the South O-C control.

Zero and gain of both sweep amplifiers are then adjusted on the 10-mile centered range to give the desired centered and balanced appearance to the display.

DETAILED ALINEMENT PROCEDURE

1- With unit operating on 20-mile range, adjust linearity control R360, to obtain equal spacing on all range markers.

2- Remove cap from slewing motor shaft. Rotate shaft of slewing motor to obtain 360° bearing of sweep. On 10-mile centered presentation, adjust N-S and E-W Zero controls (R400 and R456) to give approximate centering of start of trace. With wax pencil, pen, or what-have-you, accurately mark position of sweep origin. Make as small a mark as possible and be careful of parallax.

3- Switch to 4-mile O-C presentation. Make sure the centered range selector is not on 4-mile position. (When both centered and offcentered range selectors are on the same range, a slight inaccuracy develops due to added distributed capacity. Therefore, in this alinement, the range selectors should always be kept on different ranges.)

4- Offcenter 40 miles South as carefully read on N-S O-C dial. Check 40th mile marker and identify it with the range ring marker.

5- Adjust the 4-mile Sweep Speed control, R372, to place the 40th marker under the mark made for the origin. Be careful of parallax. Recheck origin, or center mark by switching back to 10-mile centered presentation. If center has drifted from under the center mark, bring it back using N-S and E-W Zero controls (R400 and R456). Recheck 40th marker.

6- Using slewing motor shaft, change trace bearing to 90°. Using N-S and E-W centering (zero) controls, make sure that origin falls directly under the center mark on 10-mile centered presentation.

7- On 4-mile O-C presentation, offcenter 40 miles West. Adjust balance control, R449. Check for drift as in (5) above.

8- Repeat (6) only using a bearing of 180°.

9- On 4-mile O-C presentation, offcenter 40 miles North. Adjust N-S O-C adjustment, R434, to place 40th mile marker under mark.

10- Repeat (6) with a bearing of 270°.

11- On 4-mile O-C presentation, offcenter 40 miles East. Adjust E-W O-C adjustment, R490, to place 40th mile marker under the center mark.

12- On 10-mile O-C presentation (with trace bearing 360° and centered range selector on some range other than 10 miles), offcenter 80 miles South and, with 10-mile Sweep Speed control, R385, bring the 32d 2½-mile marker directly under the center mark. Center drift should be checked as in (5) above.

13- Repeat (12) for 20-, 40-, 80-, and 200-mile ranges to adjust R387, R389, R390, and R391, the 20-, 40-, 80-, and 200-mile Sweep Speed controls. Offcenter 80 miles for 20-, 40-, and 80-mile ranges to correspond to the 16th 5-mile marker, 8th 10-mile marker, and 4th 20-mile marker respectively.

14- On centered, 10-mile position, 360° bearing of trace, adjust N-S Gain control, R419, and N-S Zero (centering) control, R400, so that the 4th marker is about one-quarter from edge of engraved bearing and the origin is accurately centered.

15- At 90° bearing, repeat above adjustment using E-W Gain, R475, and E-W Zero, R456.

IDLER GEAR BINDING

A condition of jittery sweep was observed between 180° and 270°. The gear train was removed which connects the slewing motor, sweep resolver and the 1CT syncro in the servo followup assembly. The gears were cleaned with carbon tetrachloride and reassembled. The trouble was then found to be a slight binding on the support for the bearings of the idler gear. This idler gear has two bearings which are held in the bearing support with two screws. Loosening the bottom screw removed the binding effect in this gear train. Similar troubles have been experienced in other units of this type.

Cursor line was observed to be 180° out of phase with the sweep. Trouble was corrected by removing the cursor dial and rotating 180° to aline.

SAFETY HAZARD IN VK

Mounting VK repeaters at an angle greater than 15° causes excessive forces which often result in damage to the stop pins. In such installations, these stop pins often become bent. This frees the master chassis so that it may slide completely out of the case when the front cover is opened for servicing.

In one instance a radarman was pinned beneath the master chassis.

To avoid possible injury to operating or service personnel, it is recommended that the master chassis stop pins be inspected regularly and repaired when necessary.

Upon inspection, should the stop pins show indication of excessive wear, it is further recommended that they be strengthened by welding the pins to their brackets.

CALIBRATING VK-2

The Boston Naval Shipyard points out that the range ring generator in the radar repeater VK-2 is very inconvenient to calibrate in that it is necessary to stoop each time 1 of the 9 adjustments is made, then to stand to view the scope picture to determine the result of the adjustment. Since these adjustments interact, sometimes 25 or 30 adjustments may be necessary during the calibration procedure.

It is suggested that an aluminum or stainless steel strap be fabricated as shown in figure 1, and mounted on the repeater, during calibration, by utilizing existing

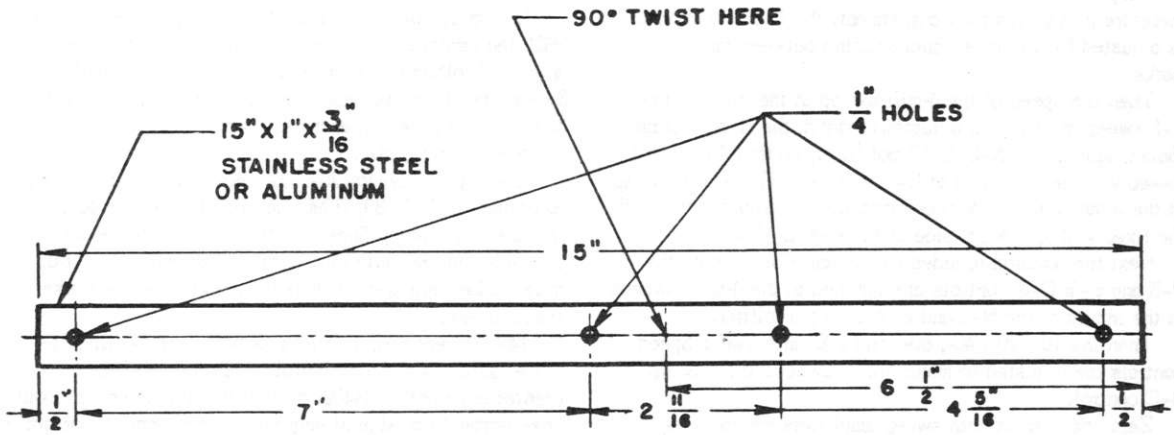


FIGURE 1

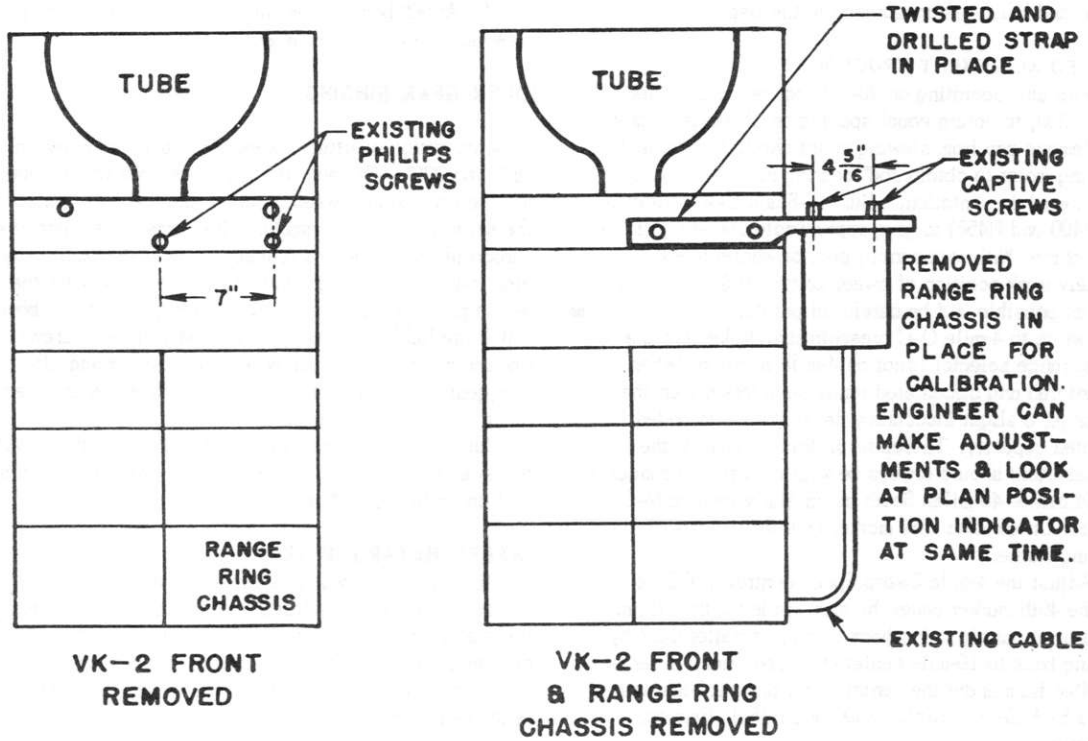


FIGURE 3

Philips screws as shown in figures 2 and 3. The range ring chassis is then mounted on the strap by means of the captivated screws and suitable wingnuts. This places the chassis in a position so that adjustments may be made and the scope picture may be seen without stooping.

This position of the range ring chassis is somewhat precarious, however, in that it is easy to come in contact with the open wiring underneath the chassis. To avoid this risk, cut a thin piece of rubber or other suitable insulating material 8 inches wide by about 34 inches long, and punch one-quarter-inch holes on one end and about 1 inch from the end with 4 5/16 inches between center of holes. Split the rubber up the center, starting at the other end, to within about 14 inches of the end with the holes. Secure the perforated end of this rubber shield to bracket and chassis and bring it down to cover under side of chassis (facing forward in test position), and pull back to cover all terminal strips. The slit in the rubber will provide for cable access. Crisscross the two sides of the rubber in the back, draw to the front and tie securely. This will prevent accidental contact with hot wiring in the chassis.

FUSEHOLDERS IN VK-4

The HCM type fuseholder is designed to use either type 3AG or 4AG fuses. When these fuseholders are purchased by a contractor from the manufacturer, the size of fuse to be used is indicated by the order. In the case of the VK-4 and VK-5, 3AG fuses were specified. The manufacturer then supplied the fuse cap with the "crimp" in it. Fuseholders intended for 4AG fuses are not crimped.

The crimp is not made, as is generally supposed, for purposes of electrical contact. The sole purpose of the crimp is to extract the fuse. Electrical contact is by spring-loaded end pressure. Laboratory tests indicate that this pressure is in excess of 7 pounds, and quite adequate.

A number of reports of hot fuseholders have been received. The fuse element melts at approximately 200° C. The average 10-ampere fuse of the type used in the VK-4 blows at from 115 to 135 percent of its rated value. When the fuse is operated near rated current, the fuse element operates at a high temperature (near 200° C.) and can only dissipate the generated heat to the fuseholder. Laboratory tests show that in normal operation the fuseholder temperature may rise as much as 29° C. above ambient. In a compartment with an ambient temperature of 30° C., the fuseholder can therefore run at about 140° F. and still be operating normally.

Reports have been received of fuses welded into the fuseholder. Laboratory attempts to duplicate this condition indicate that the only probable way this can happen is by inserting or attempting to extract the fuse while the equipment is turned on. The current normally drawn through the subject 10-ampere fuse is sufficient to cause severe arcing and possible welding of the fuse to the fuseholder. The surge current in these circuits is considerably higher than the rated 10 amperes, which means that to reinsert the fuse with the equipment turned-on invites very severe arcing.

ORIGINAL

Because of added current requirements, ratings in the VK-5 have been increased to 12 amperes. This is also done in the forthcoming Field Change 3-VK-4. Cooler operating fuseholders should result. However, the larger fuse will not remove the necessity for turning off the equipment when removing or replacing fuses.

PILOT LIGHT REPLACEMENT IN VK-4

Some difficulty has been reported in replacing the counter pilot lights at the rear of the VK-4 console. To replace these lights it is necessary to remove the cathode ray tube housing. Removal of the tube housing requires only a few minutes if done properly. The process is described fully in the Technical Manual for Radar Repeater Equipment VK-4, NAVSHIPS 91563 (B), section 5, paragraph 2b (2).

The counterpilot lights are supported on triangular reflecting brackets with the pilot light toward the rear of the console. The light socket is fastened to the reflector by means of a right-angle bracket with a long slotted opening. By loosening the screw near the bottom of the reflector, the right-angle bracket may be lowered and twisted sideways. This manipulation makes it relatively easy to replace the light bulb.

In order to replace the bulbs in the edge-lighted plastic at the right-hand side of the console, the six control knobs and a number of cap screws which secure the plastic and cover must be removed. The bulbs are then exposed for replacements.

In the case of the edge-lighted plastic at the left-hand side of the console, three control knobs are removed, and the bulb replaced in the same manner as described above.

REMOVAL OF AIR FILTER IN VK-4

The air filter in Radar Repeater Equipment VK-4 is very difficult to remove for cleaning. It is secured to the bottom of the indicator console by six screws; one at each corner and one in the center of each long side. With the lower row of subchassis removed, the center screws are readily accessible. The two rear screws, though less approachable, may be removed with a stub screwdriver and a little patience. The two screws in front, covered entirely by a cable fastened to the front crossrail of the console, are reached by detaching the cable and moving it aside.

As the procedure for removing an air filter outlined above involves considerable work; it is suggested that after all screws have been removed from the filter, only the two center screws be replaced. These two screws are entirely adequate for holding the filter. Between the console and the filter is a rubber gasket. If rubber cement is available, it is advisable to cement this gasket to the console.

HARD TURNING RANGE AND BEARING COUNTERS IN VK-4

It has been determined that easy operation of the range miles counter flexible shaft (O-174) depends to a large extent upon the condition of the flexible shaft as it leaves

the driving coupling. The shaft must be as straight as practical in the vicinity of the coupling since even a moderate twist on the coupling will cause binding in the pair of helical gears which drive the shaft. Binding exists when there is a binding or grabbing load on the hand knob or when brass scraping is detected under the helical gears.

The following procedure is recommended for detecting and correcting binding of the range counter:

1. Check the area under the helical gears O-120B and O-121, which drive the range miles counter, for the presence of brass scrapings. If any of these are present, examine the teeth of O-120B with a flashlight. If the teeth are badly chipped or worn the pair should be replaced.

2. Examine the coupling which connects the range miles flex shaft O-174 to the steel shaft driven by O-121. If this coupling is so positioned as to allow excessive play along the axis of the shaft, this play may cause the gears to bind as the direction of drive is reversed. If this condition exists, the coupling should be moved up closer against its thrust bearing. The face of the coupling and the bearing should be checked for burs or rough edges which might cause binding.

3. The flex shaft casing should be carefully centered on the flex shaft and clamped far enough behind the end fittings to make certain that it does not bind the end fitting or the coupling.

4. The flex shaft (O-174) must leave the driving coupling in as nearly a straight line as possible, curvature should not begin for at least 3 inches past the coupling and should begin very gradually. Near the center of the shaft an increase in curvature is not nearly so likely to put a twist on the coupling as sharp curvature near the end.

5. In order to achieve maximum ease of operation in this shaft an amount of trial and error adjustment is usually necessary. This is done by loosening the shaft fastening and adjusting the route and curvature of the shaft lightly until the hand knob turns freely. By careful adjustment the torque on the hand knob may be reduced to the present factory limit of 4½ pounds.

6. The range yards flexible shaft (O-173) is much less likely to be the cause of trouble than the O-174. It should be checked for drag on the end fittings as described in paragraph 3, above, and should be adjusted for route and curvature as described in paragraph 5. This shaft will run best if its curvature is kept at a minimum. If it should be necessary to replace O-173, it should be replaced with O-175, the 19 7/8 shaft from spares, or an O-173 which has been shortened to 19 7/8 inches. Instructions for shortening are given in a later paragraph.

The following procedure is recommended for detecting and correcting binding of the bearing counter:

1. Check the flex shaft (O-175) casing for interference with the end coupling as described in paragraph 3.

2. Check the routing and curvature of the shaft as described in paragraph 4 as above.

3. If the shaft is still difficult to turn, measure its length with a flexible tape. If it is 24 5/8 inches long it should be replaced by an O-175, 19 7/8 inches long flex shaft from spares, or the shaft should be shortened by the following procedure:

a The flex shaft is removed from its casing and the area where the cut is to be made is coated with solder for a distance of 1 inch with a soldering iron or by dipping in a pot of molten lead or solder.

b The shaft is then cut with a hacksaw in the center of the coated area.

c The cut end of the shaft must then be swaged to a square cross section. This can best be done with a simple die which will form that cross section; however, as a substitute, the shaft end may be carefully peened square with a hammer.

d The end fitting is then placed on the squared end of the shaft. The body of the end fitting is then swaged square over the flex shaft end. Again this may be done by peening with a hammer.

e The casing is then cut off to a suitable length and replaced.

GROUNDING OF L607 IN VK-4

The Bureau has received reports that the range mark peaking coil (L-607) terminals, in the range marker generator unit of Radar Repeater Equipment VK-4, have sometimes been grounded to a cross-brace in the IP-172 frame. This grounding usually occurs while removing or inserting the range marker generator drawer. Where this condition exists, take the following corrective action:

1. Remove nuts holding L-607 to chassis.

2. Remove and discard the two nuts between the case of L-607 and the chassis. Since the two halves of the coil case are bonded together, the retaining nuts may be removed if due care is exercised in handling the coil case.

3. Remount coil case using the original screws and original mounting nuts.

This action gives an additional three-sixteenths inch clearance and this is enough to prevent interference between the drawer and the equipment frame.

PROPER USE OF PRECENTERING MAGNET IN VK-4

Insufficient magnetism in the precentering magnet has been reported on Radar Repeater Equipment VK-4. This condition may be caused by trying to use this magnet to center the beam on the cathode-ray tube. The magnet is not intended for that purpose. Its object is to place the beam through the magnetic center of the focus coil in order to prevent any focusing action from deflecting the beam, and to obtain optimum focus.

The precentering magnet adjustment is outlined in the ORIGINAL pages of the Technical Manual for Radar Repeater Equipment VK-4 on pages 7-68 and 7-69, paragraph 9 b (2), steps 1 through 10. Step 8 states incorrectly that the sharply defined dot should be "at the center of the PPI-scope." Change to: "near the center of the PPI-scope." To confirm proper precentering magnet adjustment, rotate FOCUS control (R-114) through its range. As the FOCUS control is rotated there should be a minimum of deflection of the sweep origin.

In general, the sweep origin will not be centered.

Centering of the origin is accomplished by adjusting the E-W and N-S Centering Potentiometers (R-165 and R-166) as outlined in the technical manual. Refer to pages 4-3 and 4-4, paragraph 3 a (27) and (28); page 4-5, paragraph 4 a (12).

SERVICING SWEEP CONTROL CHASSIS IN VK-4a, VK-5

In drafting technical manuals for Radar Repeater Equipment VK-4a and Radar Repeater Equipment VK-5, no procedure for removing the sweep control chassis was incorporated as it was believed that the removal of this chassis was not necessary for servicing. However, should it become desirable to withdraw this chassis, it can be done by the following procedure:

1. Withdraw the video amplifier, servo amplifier, sweep generator and sweep amplifier chassis and disconnect attached cables at the subunits to prevent cable damage.

2. Remove the four bolts located on each corner of the sweep control chassis, holding it to the cross-rails in the console. Retain these bolts for reassembly. The chassis can be drawn forward about 2 inches or twisted for servicing, without further disassembly.

Caution: Extreme care must be exercised to avoid damage to the gears on the bottom of the sweep control chassis. Damage to these gears may result in an inoperative wandering cursor.

3. For further withdrawal of the chassis, Flexible Shafts O-1356 to potentiometer R-1301; O-1358 to potentiometer R-1302; and O-1357 to drive resolver (B-1301) must be removed at the component end of shaft. This is accomplished by loosening the Allen head set screws on each shaft. Care should be taken to prevent loss of these set screws.

By following the above procedure the sweep control chassis may be withdrawn from the console for servicing for almost the length of the chassis. However, since it will be necessary to realine the three flexible shafts after reassembly, this procedure is estimated to consume more time than directly servicing the affected component. All components on the chassis may be serviced WITHOUT drawing the chassis forward at all, as follows:

1. To service R-1314 or R-1315:

a. Remove the two screws holding bracket A131 to the chassis.

b. After this has been accomplished, the bracket may be rotated to obtain access to the wiring of the potentiometers and the potentiometers can be removed from the bracket.

c. After servicing the potentiometers, the bracket is replaced with the two screws removed in step 1a.

2. To service R-1301 or R-1302:

a. Remove the video and servoamplifiers.

b. Disconnect Flexible Shaft O-1356 (or O-1358) at the potentiometer.

c. Disconnect the leads on R-1301 (or R-1302), tagging each lead for identification as they are removed.

d. Note orientation of R-1301 (or R-1302) and remove potentiometer by removing the three servo mounting screws holding the potentiometer to the chassis.

e. To reinstall potentiometer, relocate it, orienting the terminals as noted in step 2d and replace the three servo mounting screws.

f. Reconnect the leads disconnected in step 2c.

g. Reconnect the Flexible Shaft O-1356 (or O-1358) and realign the center tap of the potentiometer in the following manner:

(1) Set NORMAL (or OFFCENTER) RANGE DIAL to 8-mile range. Check the end of the Flexible Shaft (O-1356 or O-1358) near the Switchette Assembly (E-138 or E-139) to see if an Allen set screw on the flexible shaft coupling near the switchette assembly is accessible. If not, loosen both Allen set screws and rotate the flexible shaft until one is approximately in the middle of the accessible range when the NORMAL (or OFFCENTER) RANGE DIAL is at 8-miles range. Retighten the accessible set screws.

(2) Connect an ohmmeter between contacts C-2 and C-4 of the potentiometer (R-1301 or R-1302) and rotate the potentiometer to obtain a null reading on the ohmmeter, maintaining NORMAL (or OFFCENTER) RANGE DIAL at 8-mile range. Reconnect the disconnected end of the Flexible Shaft (O-1356 or O-1358) near the potentiometer. This is only a coarse adjustment since replacement of the flexible shaft will disturb the potentiometer setting.

(3) Set NORMAL (or OFFCENTER) RANGE DIAL to exactly 8 miles. Loosen Allen set screw on Flexible Shaft (O-1356 or O-1358) near the Switchette Assembly (E-138 or E-139) and holding the NORMAL (or OFFCENTER) RANGE DIAL on exactly 8 miles, rotate Flexible Shaft (O-1356 or O-1358) until a null reading (below 50 ohms) is obtained in the ohmmeter (connected between C-2 and C-4 or R-1301 or R-1302). Tighten both Allen set screws on the flexible shaft coupling near the switchette assembly. Remove ohmmeter from Potentiometer R-1301 (or R-1302).

h. Replace the video and servo amplifiers.

3. To Service Resolver B-1301:

a. Remove the video amplifier, servo amplifier, sweep generator, and sweep amplifier.

b. Remove Gear (O-1380) on the bottom of the sweep control chassis.

c. Remove the three servo mounting screws holding the Resolver (B-1301) to the chassis and after disconnecting the Resolver Cap (P-1301) the resolver may be removed.

d. Replace the resolver in the reverse manner as removed. Realign the wandering cursor as outlined in VK-5 Instruction Book, section 7, paragraph 2i (2) (a). (Also the wandering cursor may be realigned by rotating the resolver housing, after the servo mounting screws have been loosened, such that the counter and the trace agree in bearing.)

4. To Service Resistor Board E-1301:

a. Remove Resolver (B-1301) per paragraph 3 and the resistor board will be open for servicing. Note: Some components can be serviced without removing the resolver.

b. By removing the screws holding the resistor board to the chassis the board may be laid over for servicing the wiring to it.

c. After servicing the board or the wiring replace the hardware removed in step 4b and replace Resolver (B-1301).

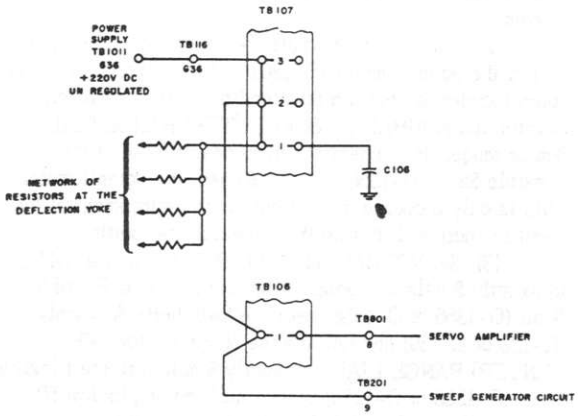
5. To service Resistor Board E-1302:

a. Remove the CRT housing and the board may be serviced through the opening.

b. After servicing, replace the CRT housing.

VK-4, VK-5 SIMPLIFIED POWER SUPPLY SCHEMATICS

The following set of simplified schematics of the power supplies for VK-4 and VK-5 be useful as a means of saving time in circuit tracing and are published herewith for this purpose. Note that the diagrams are not complete schematics and are intended only as a servicing aid.



NOTE.—This drawing is intended for use in isolating troubles; it is not a complete drawing.

FIGURE 1.—VK-4 pos. 220 v dc regulated.

INTERCONNECTION CABLES FOR VK-5

There have been instances reported where during the installation of Radar Repeater Equipment VK-5, the external armored cables have not only been inserted into the equipment through the side cable entrance plates, but have been passed through the legs of the cradle in order to gain access to the side plates. This method of installation completely prevents employing the tilt effect for which the cradle was intended.

In the VK-5 installation, when using cradle mounting, use only the rear cable entrance plate for cable access into the equipment. For this purpose one drilled cable entrance plate is supplied with each equipment.

The installing activity should take precautions to ascertain that enough slack is allowed in the cabling at the rear of the VK-5 to allow a 45° forward tilt of the console.

One suggested method of installation is to bring the armored cables up from the deck along side of the cradle, on the right side of the console. The cables should be secured at the top cross-piece of the cradle (where the Allen-wrench is mounted) and then looped up and down behind the console to give both proper entry into the rear cable entrance plate and to allow tilting of the console.

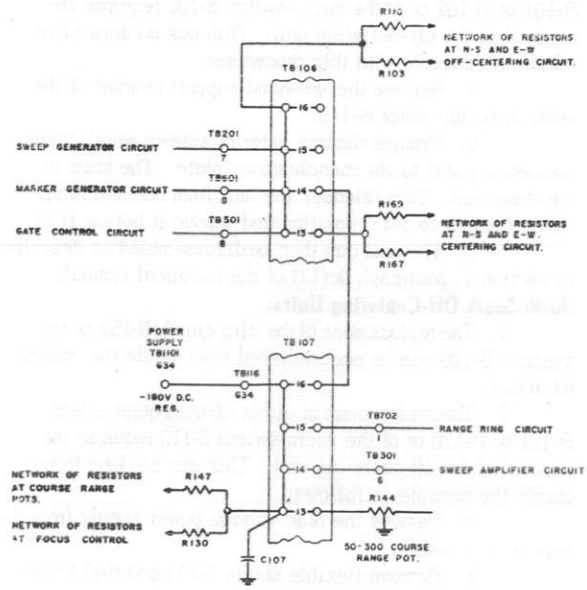
The above information applies only where MCSA-type cable, for which the VK-5 equipment was designed, is available. However, at present there exists at several installation activities a shortage of MSCA-type cable; therefore, MHFA cable must be substituted. Use of the MHFA cable, which is larger in diameter than MSCA, negates using only the rear cable entrance plate for cable entrance into the VK-5.

The following procedure is recommended where the VK-5 is cradle installed using the large diameter MHFA cable: Note that both side entrance plates can be utilized. However only one cable can be inserted through the entrance plate on the left side of the console. It is recommended that the MHFA-24 cable which uses a size M stuffing tube be routed through the extreme top rear corner of the left side cable entrance plate. This is necessitated by the presence of C107 mounted inside the back wall of the console in close proximity to the left cable entrance plate.

On the right side of the cable entrance plate, only the rear half of the plate should be drilled for stuffing tubes. If the front half of this is used, the VK-5 console cannot be tilted. Note figure 3–1 on page 3–2 of Technical Manual NAVSHIPS 917860 for VK-5.

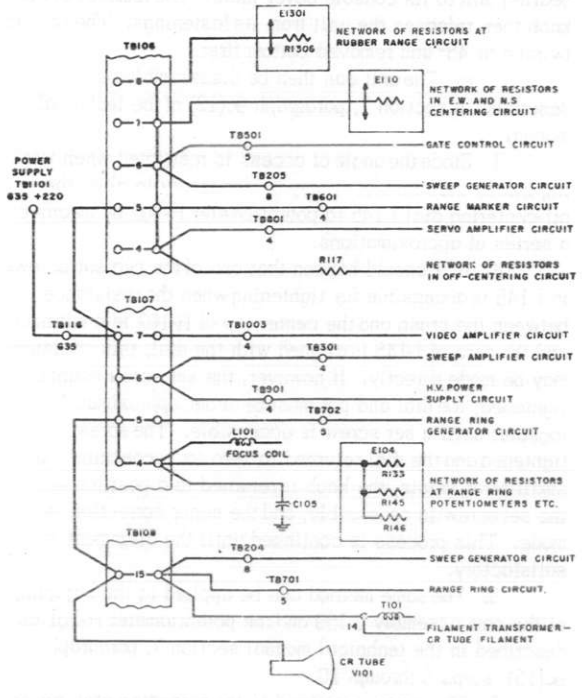
When using MHFA cable, the drilled cable entrance plate supplied with the equipment is discarded after removing Z101, which is mounted on this plate. Z101 should then be mounted on the bracket which is welded to a plate, shipped with the equipment as the left side cable entrance plate. As previously stated, the cabling should never pass through the cradle legs and enough cable slack must be allowed for a 45° forward tilt of the console from a vertical position.

Another method of inserting external armored cables, successfully employed at the San Francisco Naval Shipyard, is particularly advantageous when the VK-5 is mounted above a false deck: An external terminal strip connection box is mounted along the back of the VK-5 console and wired into the internal terminal boards. The external armored cables are brought along the bottom of the false deck, passed under the VK-5 from rear to front, then looped back up under the console–passing over the rear cross bar of the cradle and entering the bottom of the manufactured terminal box through 90° stuffing tubes. The cables should be clamped to the bottom of the VK-5 console close by their entry into the stuffing tubes. The external connection box should be installed at the very lowest possible level on the back of the console to prevent blocking of the hot air exhaust at the back of the console.



NOTE.—This drawing is intended for use in isolating troubles; it is not a complete diagram.

FIGURE 2.—VK–4 neg. 180 v dc power circuit.



NOTE.—This diagram is intended as an aid in isolating troubles; it is not a complete schematic of the +220 dc power circuit.

FIGURE 3.—VK–4 pos. 220 v dc regulated power circuit.

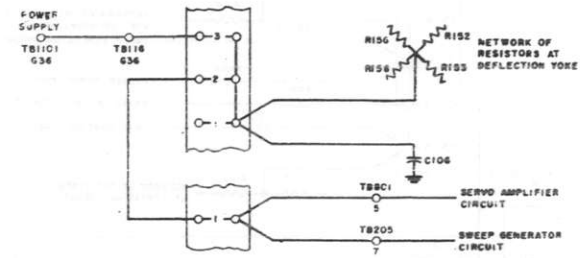
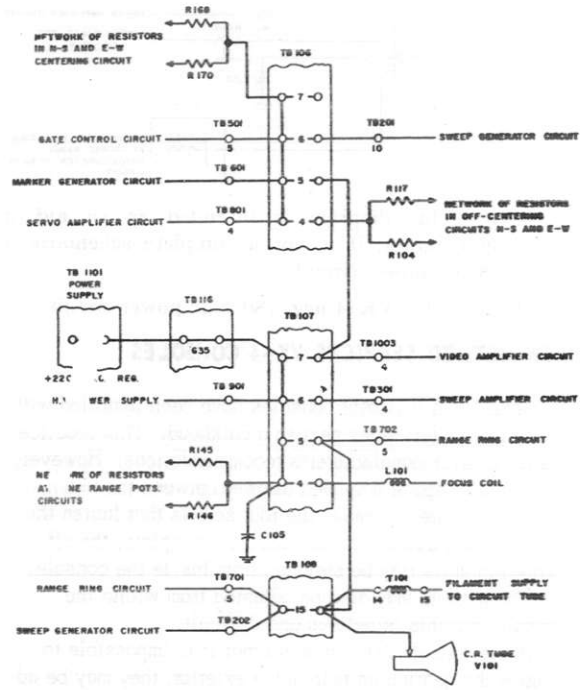
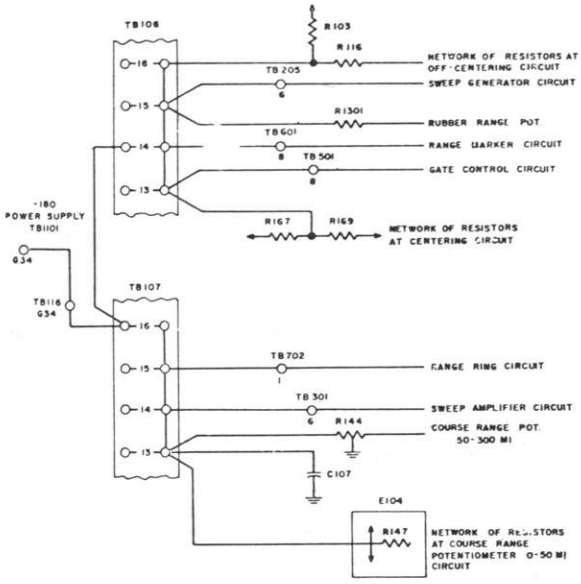


FIGURE 4.—VK–5 pos. 220 v dc unregulated power circuit.



NOTE.—This diagram is intended for use in isolating troubles; it is not a complete diagram.

FIGURE 5.—VK–5 pos. 220 v dc power circuit, regulated.



NOTE.—This diagram is intended as an aid in isolating troubles; it is not a complete schematic of the —180-dc power circuit.

FIGURE 6.—VK-4 neg. 180 v dc power circuit.

NEW METHOD SERVICES VK-4 CONSOLES

Some VK-4 indicator consoles have been installed with their right or left sides next to a bulkhead. This practice conflicts with manufacturer's recommendations. However, if sufficient space has been allowed between the bulkhead and the console to remove the four screws that fasten the off-centering casting to the console coverplate, the off-centering units may be serviced from inside the console.

These units may also be adjusted from within the console, but this is tedious and difficult.

If the console is mounted so that it is impossible to remove the gearing units from the exterior, they may be adjusted as follows:

1. The tube housing is removed as described in the Instruction Book in Section 5, Paragraph 2b(2).

2. The adjustments are performed as described in section 7, paragraph 9c(15) of the technical manual. However, the work is done through the opening of the tube housing. The presence of cabling in front of the off-centering units makes work difficult.

Replacement of the components of the off-centering units can also be accomplished from inside the console by this method:

1. The tube housing is removed as described in the technical manual in section 5, paragraph 2b(2).

2. The instruction for the disassembly of these components is given in section 7, paragraph 9c(12) of the technical manual. These should be referred to and followed generally except for these special instructions:

East-West Off Centering Unit:

1. The slip clutch 0-153 or the synchro B-101 can be reached from inside the console.

2. The replacement of either of the potentiometers R-101 or R-102 or of the micro-switch S-101 requires the removal of the off-centering unit. This can be done from inside the console with this procedure:

a. Remove the left-hand support bracket of the ventilating fan motor B-110.

b. Remove the four exterior screws which fasten the gearing unit to its console cover plate. The knob is then removed. This releases the unit from its fastening. Twist the unit to a 45° position and remove it bottom first.

c. The unit can then be disassembled as described in section 7, paragraph 9c(12) of the technical manual.

North-South Off-Centering Units:

1. The replacement of the slip clutch 0-153 or the synchro B-109 can be accomplished from inside the console as above.

2. The replacement of either of the potentiometers R-121 or R-120 or of the micro-switch S-110 requires the removal of the off-centering unit. This can be done from inside the console as follows:

a. Remove the high voltage power supply from the rear of the console.

b. Remove flexible shafts 0-173 and 0-174 from the drives of counters I-143 and I-144.

c. Remove the right hand support bracket from the ventilating fan motor B-110.

d. Remove the four screws which fasten the gearing unit to its console cover plate. The removal of the knob then releases the unit from its fastenings. The unit is twisted at 45° and removed bottom first.

e. The unit can then be disassembled as described in section 7, paragraph 9c(12) of the technical manual.

3. Since the angle of access is restricted when working inside the console, it may be necessary to align the off-centering dial I-145 to potentiometer R-102 by means of a series of approximations.

4. If it should happen that one of the two set screws in I-145 is accessible for tightening when the resistance between the brush and the center tap of R-102 is a minimum and the zero of I-145 is aligned with the dial, this adjustment may be made directly. If however, the set screw cannot be tightened, the dial and pot must be turned approximately together until a set screw is accessible. The screw is tightened and the dial returned to zero for rechecking. If a small error exists, the knob is returned to a position where the set screw is accessible, and the minor correction is made. This process is continued until the alignment is satisfactory.

5. The same method can be applied to the adjustment of the cam assembly 0-159 and the potentiometer R-101 as described in the technical manual section 7, paragraph 9c(15), steps 5 through 10.

6. The parts mentioned in the preceding step are in the east-west off centering units. The procedure for aligning the north-south unit is the same. For parts correlation between the two units, see figure 7-31 of the technical manual.

VK REPEATERS

The use of a CRT Cradle when testing VK radar repeaters has been suggested. During repair and calibration, it is necessary to remove the cathode-ray tube from its mounting in the VK, creating a safety hazard, space problem, and possible material waste due to breakage. The cradle may be constructed of 1/4" material, either metal or nonconductor approximately 9-1/2" long, 2-1/2" wide, and using 3/8" round stock for the supports between panels. Suitable available material may be used for "sandwiching". A cradle should be cut in the front and rear panels to accommodate the front and rear curvature of the cathode-ray tube. Figure 1 shows the CRT Cradle alone, while figure 2 depicts the CRT Cradle supporting a cathode-ray tube.

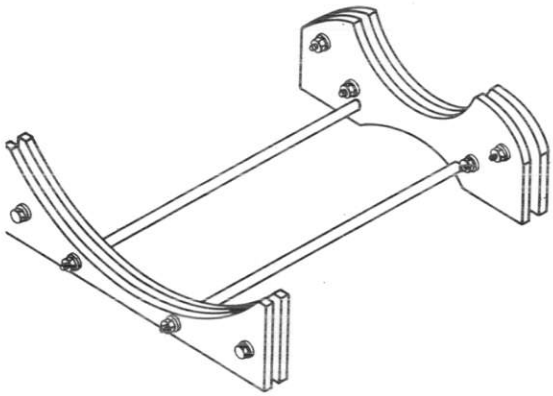


Figure 1

In favorably commenting on the suggestion, the Bureau points out that this type of cradle would be useful in any other application where cathode-ray tubes are operated outside their normal mounting.

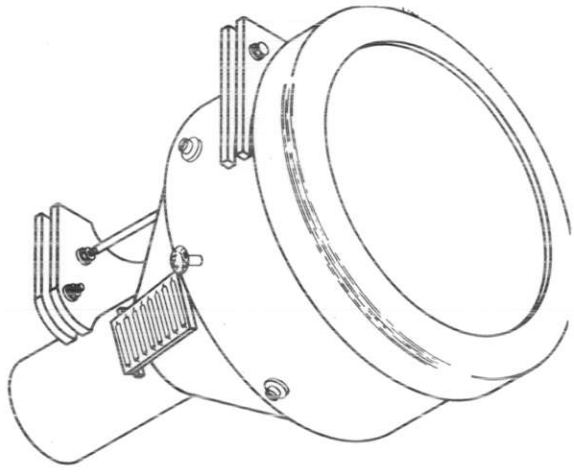


Figure 2

VK-4 SWEEP AMPLIFIER PLATE LEAD IDENTIFICATION

It has been pointed out that all the cap leads to the eight, type-807 tubes used in the sweep amplifier chassis of the VK-4 equipments are the same color, causing confusion in identifying the proper lead for each 807 tube.

The suggestors propose that this difficulty be avoided by removing the plate caps from the lead and placing a short piece of spaghetti over the lead. The spaghetti should have the tube symbol stamped on it. The plate caps should then be resoldered to the leads.

VK-4, VK-5 FAILURE OF SWEEP GATE GENERATOR (V-201)

A number of failures have been reported indicating that the Sweep Gate Generator (V-201) fails to respond to off-trigger pulses when they drop below the critical value necessary for gate operation. This reduction in the off-trigger level is usually caused by component failure or excessive loading of the off-trigger generator.

Since the off-trigger is fed to five different chassis, off-trigger loading occuring in any one of these units can affect the amplitude of the off-trigger reaching the other units. The sweep gate generator (V-201) is most sensitive to the off-trigger amplitude because the attenuation through the isolation resistor (R-209) to the cathode of V-201 is greater than in any other gate circuit; consequently, loading occurring in any chassis would first affect the functioning of the sweep gate generator.

Off-trigger loading by other circuits may not be readily apparent because production tests have shown that one chassis can load the off-trigger, yet function normally in all other respects.

To isolate this type of fault, disconnect the off-trigger from each chassis in turn until the sweep gate generator functions normally. The trouble will most likely be found in the isolation resistor or the cathode resistor of the faulty chassis.

VL–1 FRONT PANEL FASTENERS

When Radar Repeaters VL–1 is mounted in a tilted position and the front panel has been removed for servicing, the two center panel-fastening devices sometimes come forward and make contact with the 220-volt buss, causing a short to ground.

It is recommended that a spring-type clamp such as a fuse clip be installed on the cabinet to hold the fasteners and prevent shorting of the 220-volt buss to ground. This suggestion is approved and recommended for adoption by activities encountering this type of trouble.

VL–1 SLEWING MOTOR

In some installations of the VL–1 (range height indicator) which may be sector controlled by synchro signal from an associated off-center PPI, the 2-phase slewing motor (B-201) has developed a low resistance fault between phase windings, with the result that the motor had to be replaced.

When the VL–1 is de-energized with the sector control switch (S–205) in the "Remote" position, one winding of the 2-phase motor associated with sector control (B-201) continues to be energized if excitation is obtained from the associated off-center PPI.

In installations where the VL–1 sectoring is synchro-controlled from the bearing cursor of an off-center PPI, the synchro excitation (and B-201 excitation) should be supplied from the VL-1. This is done by placing jumpers between TB-206 terminals 3 and 5, and TB-201 terminals 1 and 2.

CAUTION: Make sure the associated off-center PPI is not supplying excitation to the VL–1 slewing motor. If it is, remove the appropriate jumpers in the off-center PPI and make the connections described previously.

PORTABLE BRIDGE FOR VL–1 ANGLE MARK CALIBRATION

A suggestion has been submitted concerning the test equipment used in setting the angle mark of the VL–1.

It is recommended that equipment similar to that shown in figure 1 be built into a portable carrying case so that the equipment may be readily available.

The Bureau approves the use of such portable test equipment.

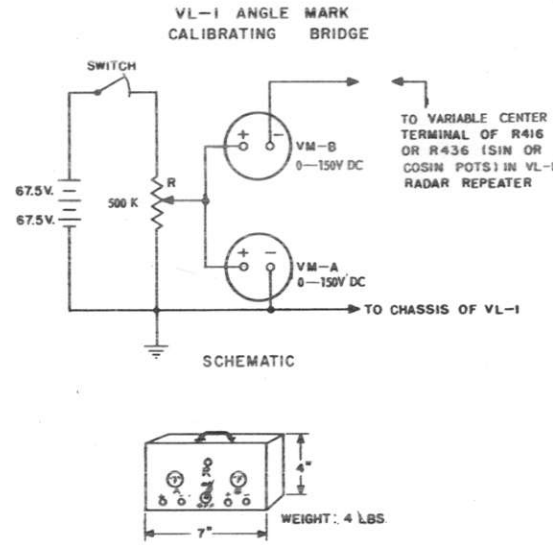


FIGURE 1

14ABH SERIES ANTENNAS

The following method for inner shell lubrication of periscope adapter was submitted by Western Electric Company:

1. Lubricate every two months.
2. Retract adapter.
3. Apply MIL-F-16908 bearing grease to Zerk grease fitting for inner shell lubrication (Commercial equivalent: ESSO Beacon P-305).
4. Do not use MIL-G-3278 lubricant, as it is a di-ester (high solvent) lubricant, which would soften neoprene and synthetic parts and cause swelling and deterioration of fittings.

TYPE CGP-14ABB, CGP-14ABH AND CGP-14ABH-1 PERISCOPE ADAPTERS

Frequently, the upper section of the rotary coupler has become bent at the choke joint through normal use and will not mate properly with the lower section of the rotary coupler.

The number of couplers damaged and the types of damage incurred, indicated a need for tools to reform the waveguide, choke joint, and packing retainer walls. A set of tools which fill this need, has been designed to facilitate the repair of limited damage with a minimum of difficulty. Voltage standing wave ratio in the trombone section of adapters is usually substantially reduced and the number of trombone sections salvaged has been greatly increased. Other activities repairing periscope adapters will benefit from the use of tools similar to these described:

Figure 1 shows an average damaged coupler installed in an adapter. Condition of the average coupler, as received for repairs, is shown to the left and condition to which it may be restored is shown to the right in figure 2. The tools manufactured to effect repairs are shown as tools 1, 2, 3, 4 and 5 in figure 3 and figure 4. All tools are used in the manner of punches.

Tool 1: Tool, steel - .505" OD X 2" long. All edges beveled to prevent stripping of coupler metal. Use: To reform inner wall waveguide.

Tool 2: Tool, steel - .550" ID X .690" OD X 1-3/8" long. All edges beveled.

Use: to reform outer wall of waveguide and inner wall of choke joint.

Tool 3: Tool, steel - .740" ID X 1-1/4" OD X 1-1/4" long. All edges beveled.

Use: To reform outer wall of choke joint.

Tool 4: Tool, steel - 1" ID X 1-7/16" OD X 1-5/8" long. all edges beveled.

Use: To reform inner wall of packing retainer.

Tool 5: Tool, steel - 1-5/" ID X 2" OD X 1-1/2" long. All edges beveled.

Use: to reform outer wall of packing retainer.

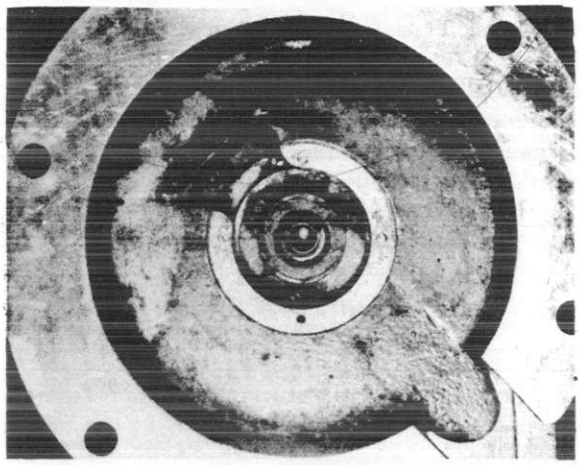


Figure 1

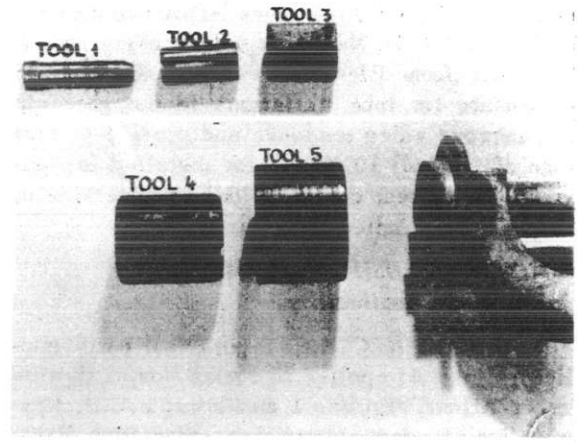


Figure 3

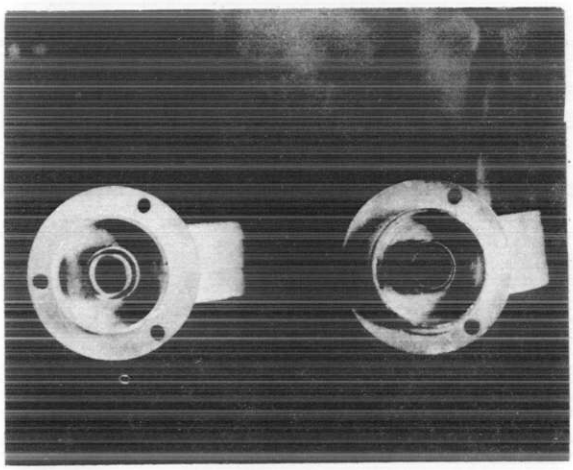


Figure 2

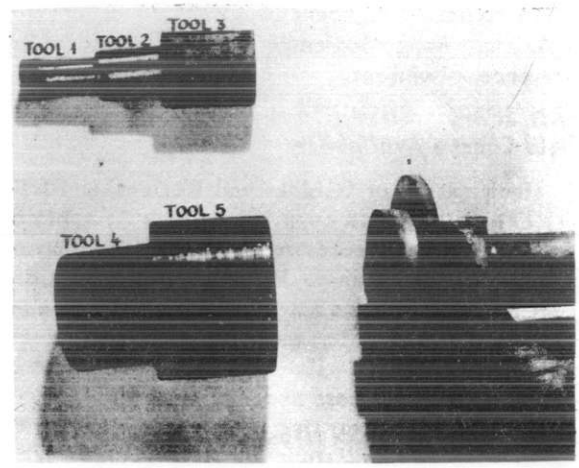


Figure 4

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