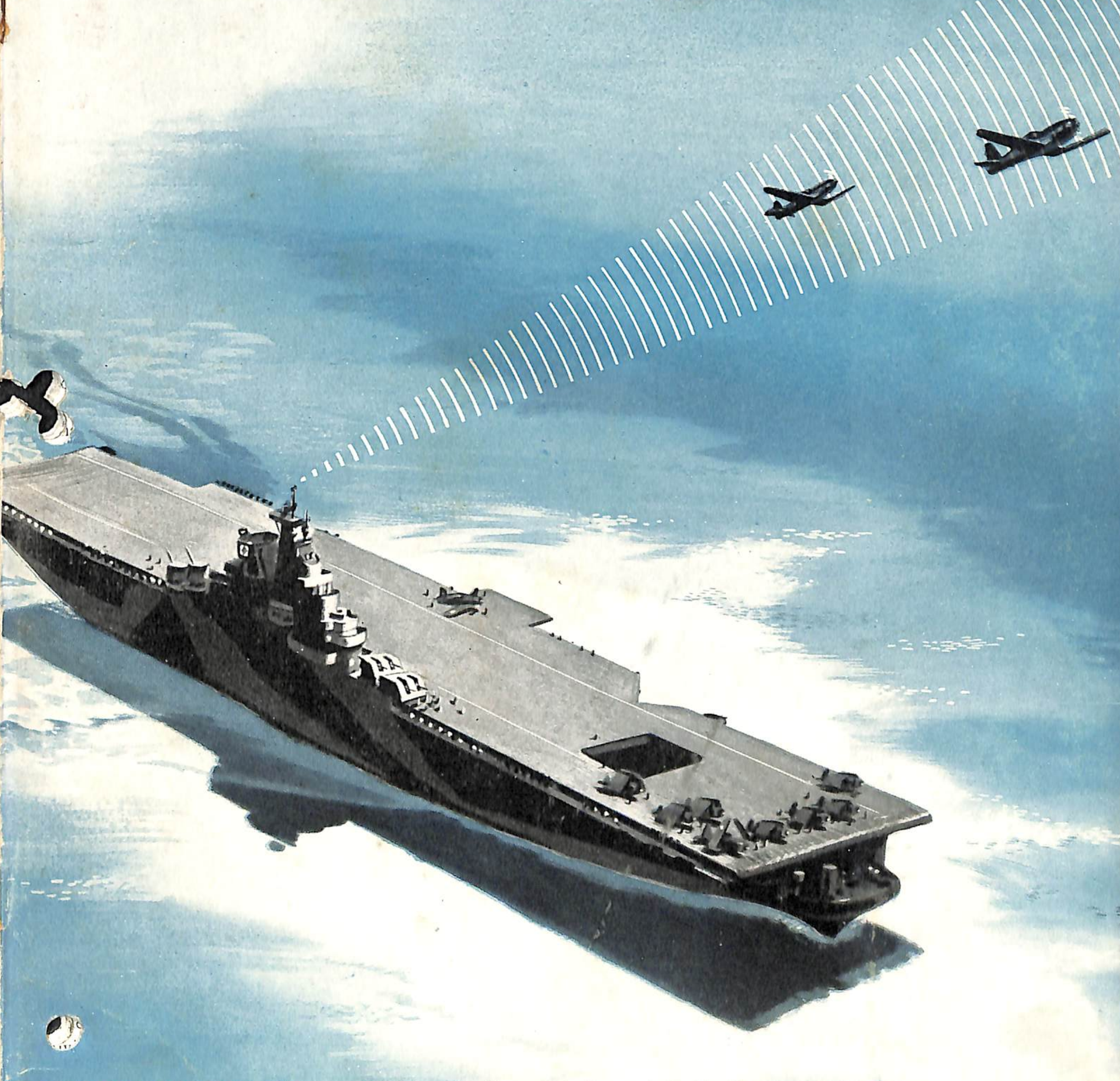
August, 1945 CONFIDENTIAL

BuShips Electron



NAVSHIPS 900, 100 Formerly The Radio and Sound Bulletin

BuShips Electron

A monthly magazine for radio technicians

AUGUST 1945 Vol. 1, No. 2

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CONTRIBUTIONS: Contributions to this magazine are always welcome. All material should be addressed to

The Editor, BuShips ELECTRON
Bureau of Ships (Code 993)
Navy Department
Washington 25, D. C.

and forwarded via the commanding officer. Whenever possible articles should be accompanied by appropriate sketches, diagrams, or photographs (preferably negatives).

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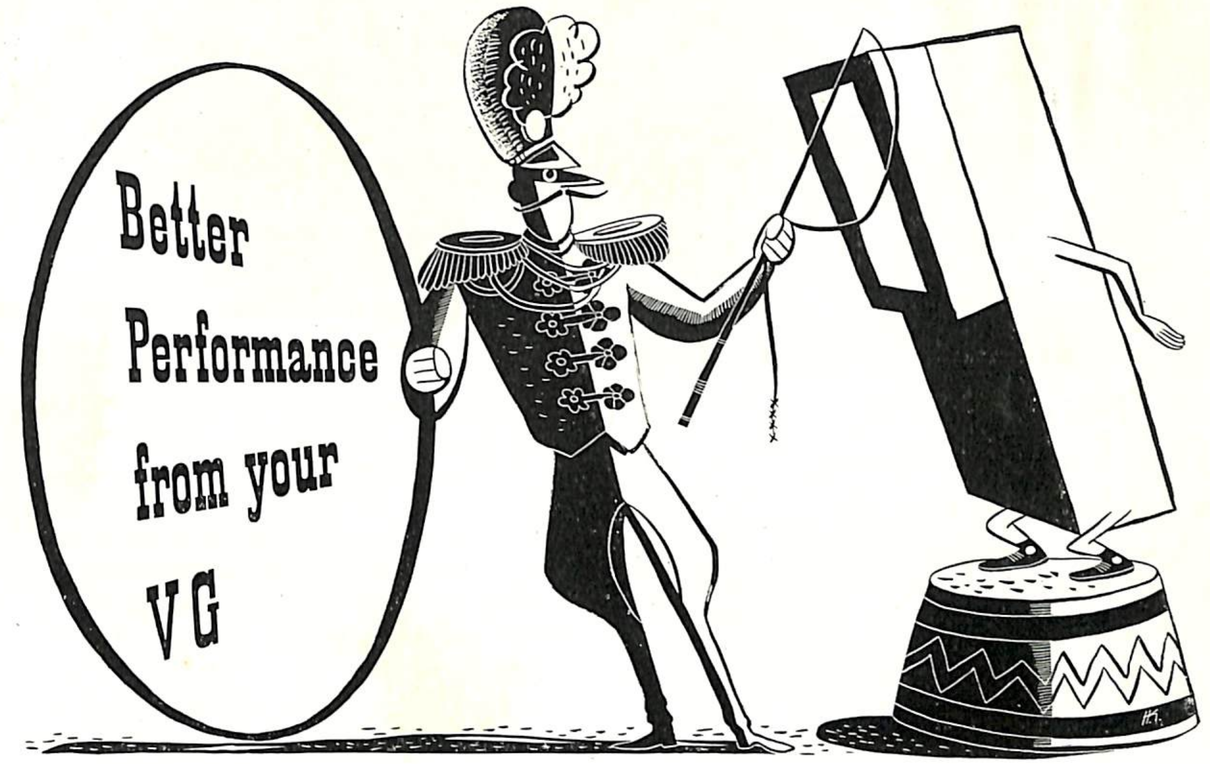
BUREAU OF SHIPS • NAVY DEPARTMENT



■ Six field changes have been authorized in the VG Radar Indicating equipment to date. These changes are to be incorporated at the first opportunity, in order to maintain your VG at its optimum tactical value. They may be summarized as follows:

1. Removal of the spoke or cartwheel effect on VG/VG-1 radar repeaters.
2. Elimination of burning of 4AP10 tube center.
3. Replacement of optical unit heat filter.
4. Replacement of SPEER resistors.
5. Addition of synchro capacitors.
6. Addition of asbestos pads to protect the condenser lens immediately in front of the projection lamp.

FIELD CHANGE No. 1—Removing "Spoke" or "Cartwheel" Effect

Several reports to the Bureau have indicated that a "cartwheel" pattern appears on the VG/VG-1 radar repeaters during line voltage fluctuations (not to be confused with spoking caused by low repetition rates and jerky antenna motion). The Bureau therefore authorized a trial installation of a Navy type CRP-301222 voltage regulating transformer in conjunction with a VG series equipment. This installation has achieved the desired results.

Subsequent to this trial installation the Bureau was informed by the General Electric Company that voltage regulating transformers should not be required to eliminate the "cartwheel effect" if the servo amplifier sensitivity were increased and provided the line voltage fluctuations do not exceed ±10% and occur within this range at an oscillatory rate not to exceed 30 cycles per minute.

The General Electric Company has therefore made the following minor changes in the servo amplifier in VG equipments after serial #125 and VG-1 equipments after serial #145 (all VG-2 equipments have this change):

(a) Remove C-1511 and C-1512 from ground and reconnect in parallel to pin No. 6 of V-1502 as in Figure 1.

(b) The capacitors C-1511 and C-1512 may have been connected to pin No. 5 of V-1503 in some earlier equipments. In this event they should be removed from V-1503 and connected to V-1502.

(c) Change R-1515 to 1.0 Megohms, ½ watt, ±5% (same as R-1505 available in spares).

(d) Change R-1516 to 2.2 Megohms, ½ watt, ±10% (same as R-6188 and R-6189 available in spares).

The above changes may also be made to GE servo amplifiers in VC/VC-1, SC/SK series equipments, and 50162A synchro amplifiers. The Bureau of Ships desires that the above alterations be made in equipments on which the cartwheel indications are apparent.

If the "cartwheel effect" is apparent on the subject equipments after the servo unit has been modified, the Bureau desires that a voltage regulating transformer Navy type CRP-301222, 301605, or 302115 be installed with the VG/VG-1 equipment. Additional regulating transformers are under procurement and by March 1945 will be available at yards and bases.

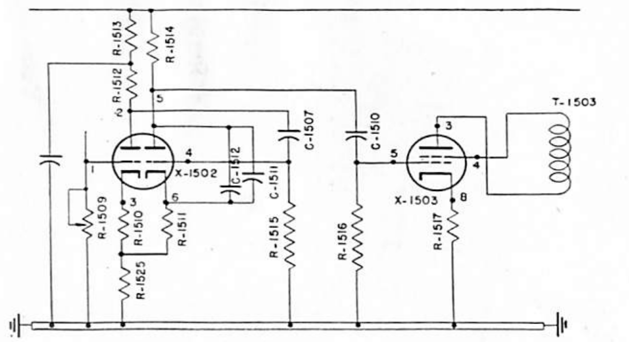


FIGURE 1.—*Schematic diagram for Field Change No. 1.*

FIELD CHANGE No. 2—Eliminate Burning of 4AP10 Center

It was found in operation that the center of the cathode ray tube (4AP10) had a tendency to burn. This condition was prevalent on all VG equipments. Field Change No. 2 was authorized to correct this condition. The following material is required:

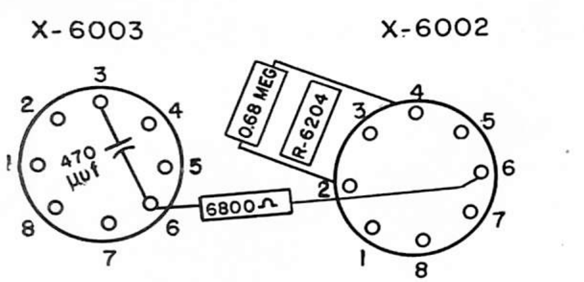


FIGURE 2.—*Schematic diagram for Field Change No. 2.*

1 470 $\mu\mu$f capacitor (can be found in spares as C6103 or C6113)

1 6800 ohm ± 10%, ½ watt carbon resistor

1 0.68 meg ± 10%, ½ watt carbon resistor (can be found in spares as R6110)

The capacitor should be connected between pin 3 and pin 6 of X6003. The 6800 ohm resistor is to be connected from pin 6 of X6003 to pin 6 of X6002. Add the .68 meg resistor in parallel with R6204 as shown in figure 2.

This change should be made only when it is needed, as it tends to weaken the trace out to about 1 mile and therefore obscures weak close-in targets. If it is desired to see targets within this range, the cathode ray tube bias control may be turned clock-wise to overcome this center suppression.

FIELD CHANGE No. 3—Replacement of Optical Unit Heater Filters

Breakage due to heat has caused considerable operating trouble in VG equipments. A new type of filter which has a longer life and a greater safety factor with respect to heat breakage has been made available. This change affects the following equipment:

VG Serial Nos. 0-230 inclusive, except 222 and plus 237.
VG-1 Serial Nos. 0-218 inclusive, plus 220, 221, 222, 224, 229, 230, 235.
VG-2 Serial Nos. 0-21 inclusive, plus 27 and 44.
VG-3 Serial Nos. 0-71 inclusive.

The replacement of heat filters is accomplished as follows: Set the picture erase control to Erase. Remove the cotter pin and washers from the filter carrier, spring the link back off the pin on the filter carrier and remove the carrier. Remove the glass by taking out the four retaining screws, and replace with the new glass. Replace the carrier reversing the above procedure. Leave the glass loose in its mounting to permit expansion. Lock the glass retainer screws with Glyptal or similar cement. Oil the slide rail with a light grease if necessary, and see that the filter carrier rides in and out freely.

A more detailed set of installation instructions are supplied with the new glass filter.

FIELD CHANGE No. 4—Replacement of Speer Resistors

Speer resistors have proved to be of doubtful tolerance. Therefore, to eliminate any future troubles, they are being replaced with resistors of correct tolerance rating. The equipments involved will be:

VG serial No. 1-49 inclusive
VG-1 serial No. 1-49 inclusive
VG-3 serial No. 1-18 inclusive

There are sixteen of these resistors in each equipment. No replacements need be made in any equipment in operation unless one or more of the following defects are plainly evident: 1. Sweep lengths outside of adjustment range of potentiometers; 2. Gate lengths outside of adjustment range; 3. Gate bias adjustment for satisfactory triggering outside of range gate bias potentiometers; 4. Unstable operation of range mark oscillator.

The trouble should be isolated to the responsible circuit before the resistor under suspicion is changed. Readjustment of that particular circuit will be necessary after replacement of a resistor.

FIELD CHANGE No. 5—Addition of Synchro Capacitors

In the early serial numbers of the VG there was an omission of the three synchro capacitors, both in the instruction book and in the equipment itself. Field change no. 5 is an authorized correction of this oversight. The three .6 μf capacitors supplied in the field

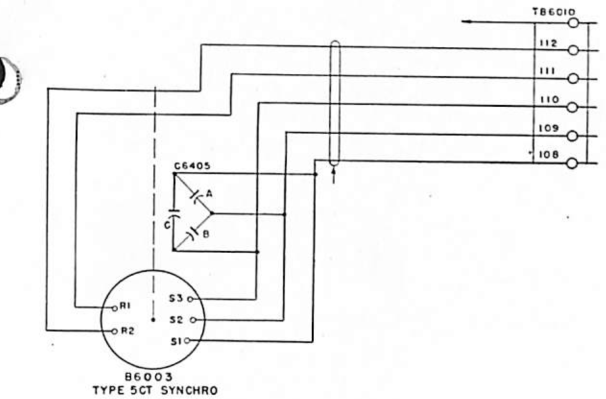


FIGURE 3.—*Field Change No. 5. Compensating capacitors are added in the conventional manner.*

change kit are to be added in the circuit in a conventional manner as shown in figure 3. The leads from C-6405 are wired across terminals S1, S2 and S3 of the 5CT synchro B-6003 for correcting the power factor. If this change is made from spare parts available, it is very important to make sure that VG and VG-1 equipment subsequent to serial #S67 have been fixed in production. The three capacitors do not differ in capacity from each other by more than ±1 percent. They may, however, be .6 μf ±10%.

FIELD CHANGE No. 6—Failures of Parabolic Condenser Lens (1) 101

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 lens mounting.

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 heats 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.

To correct this trouble it is recommended that asbestos pads be placed 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.

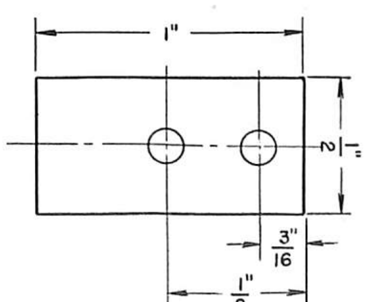
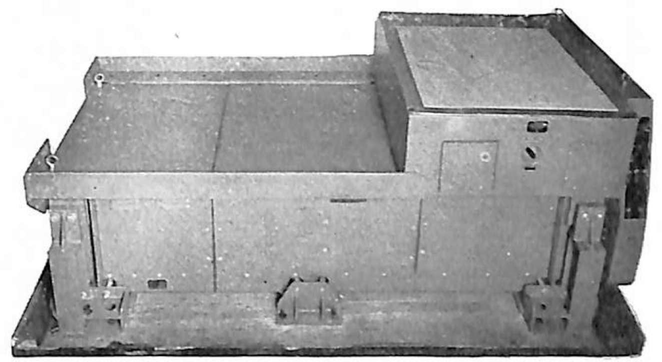
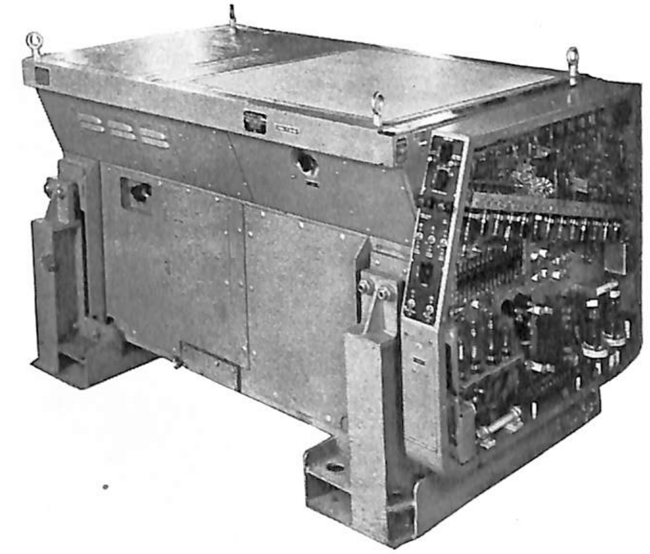


FIGURE 4.—*Dimensions of asbestos pad.*

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



A Front View of the VG-2 Remote Indicating Equipment showing controls at extreme right.



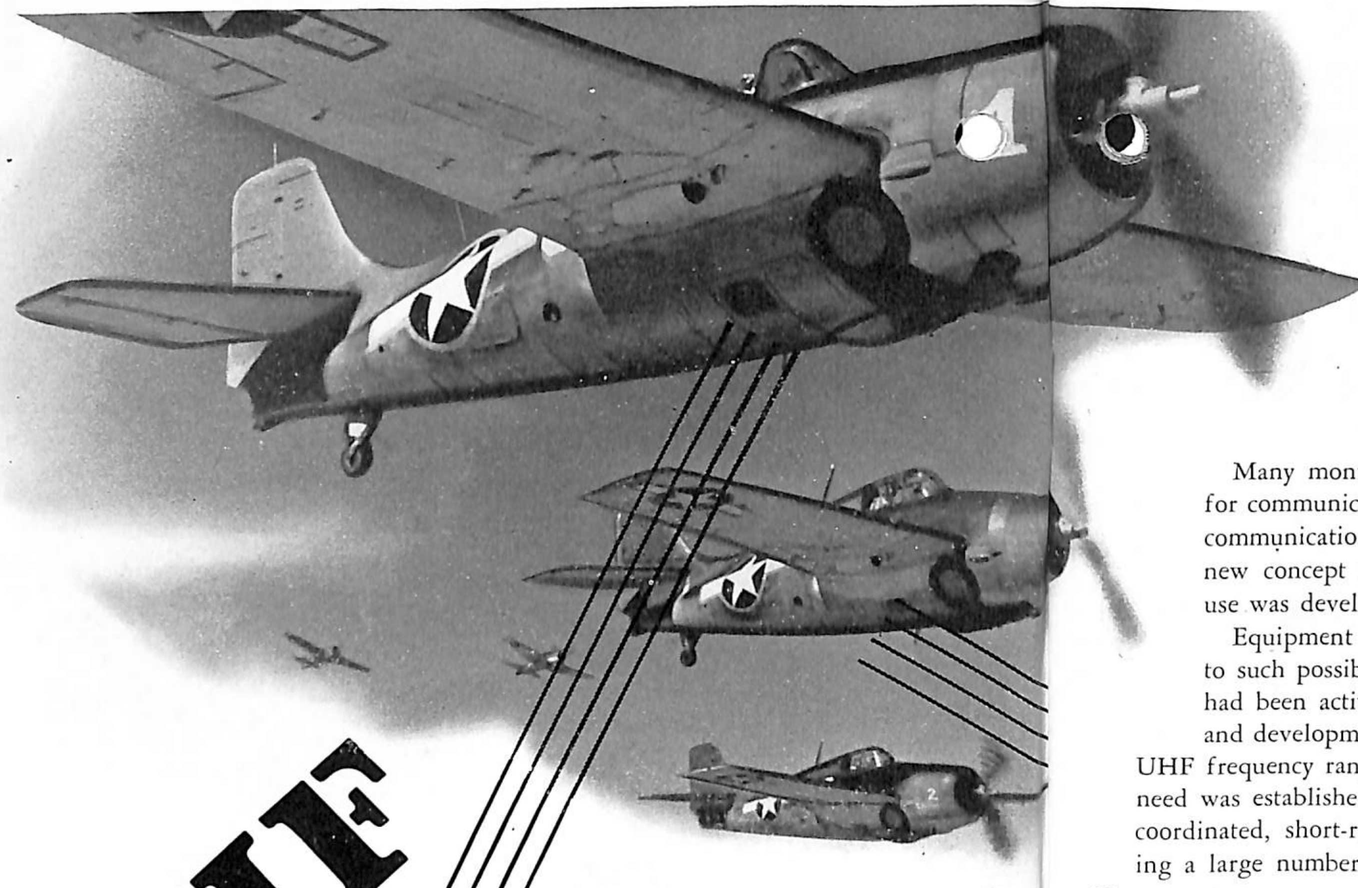
Oblique View of VG Remote Indicating Equipment with end cover removed.

When re-assemblying the lens, care should be taken to see that there is at least ¼ 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.

The General Electric Company Field Engineers have been supplied with asbestos pads and spare lenses. If the lens is defective, a replacement may be obtained at the Navy Yard through the Electronics Officer.

When one or more of the above changes are made it is important that the diagram in the instruction book be corrected, the change be shown in the Radar Log, and the Bureau of Ships be notified in the monthly radar report.

The current issue of C.I.C. magazine includes an article on the operational and tactical use of VG equipment.



The new UHF communication program

■ Perhaps few of us realize the tremendous amount of research and development that is represented by each piece of new equipment which we uncrate and install. But let us try to trace one of the many projects from its infancy—that of the new UHF communication equipment.

THE BACKGROUND

Many months ago the organization responsible for communication planning and for the design of communication equipment saw that an entirely new concept of communications for short range use was developing.

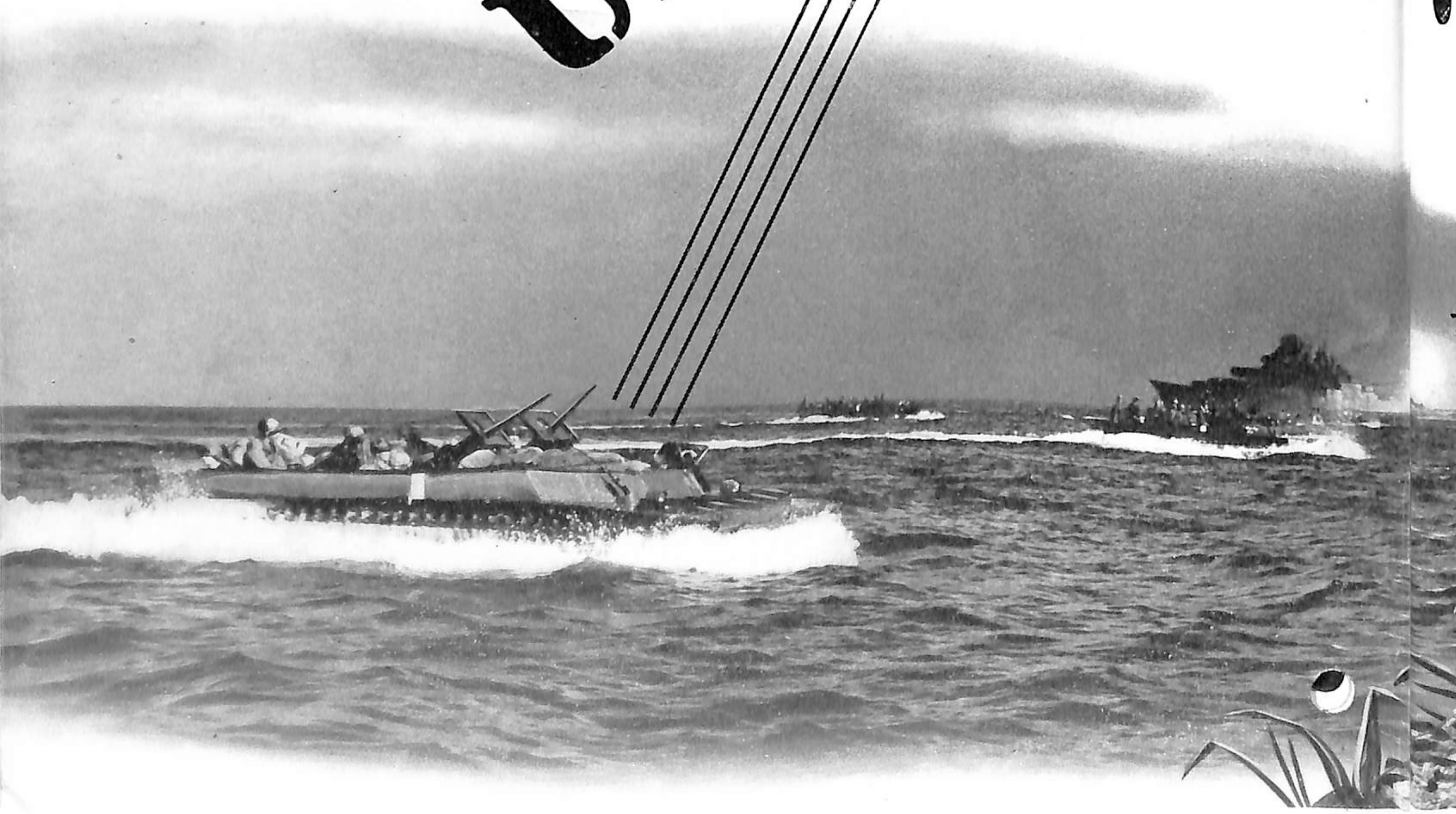
Equipment research groups had not been blind to such possible applications and as early as 1931 had been actively engaged in a program of study and development of radio equipment in the VHF/UHF frequency range. Thus, in 1942, when an urgent need was established by our early war experience for a coordinated, short-range communication system providing a large number of useable channels, a sound basis was available for the selection of frequencies and the design of equipment which would best meet fleet needs.

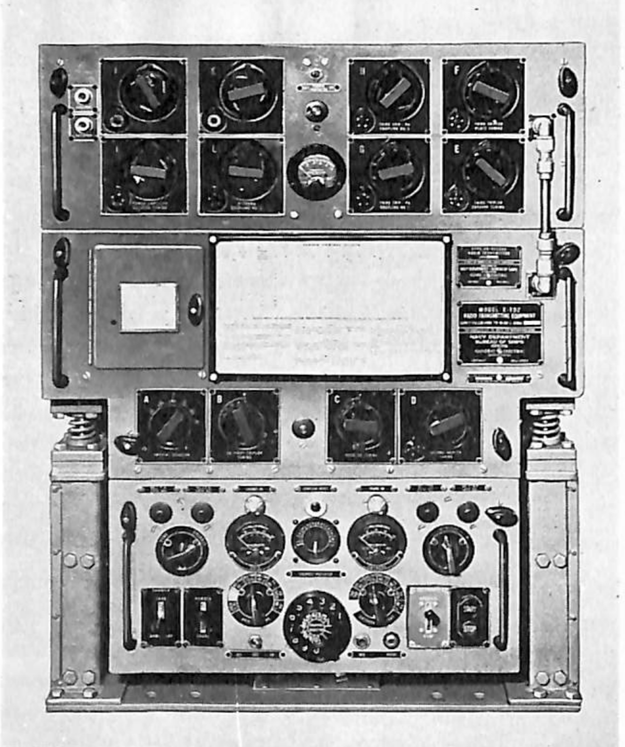
After evaluation of the numerous factors involved in establishing such a comprehensive system, the band between 225 and 400 megacycles was selected for these reasons: (*a*) It was a frequency range where current techniques and components could be utilized to provide a satisfactory production design. (If a band above 500 megacycles had been selected such extensive development of components would have been required that the time delay would have been excessive.) (*b*) It was comparatively free from sporadic long-range propagation; thus communications within a limited area would be relatively secure from interception outside that area. (*c*) It was a frequency range that might be made available for post-war use. (*d*) Techniques permitted a channel spacing which would provide an adequate number of channels for a flexible, coordinated, complete communication system adapted to large fleet operations.

An extensive study of master-oscillator, continuously-variable equipments revealed that they could not meet the needs of a comprehensive communication system. Development, therefore, of a new series of crystal-controlled quick-shift equipments was indicated. In order to insure that a complete system would be provided, yet hold the number of separate equipments to the minimum necessary to meet the needs of the service, four general categories of equipments were established:

1. Ship and shore (for general service application aboard ship or at established shore stations).
2. Portable-vehicular-landing craft.
3. Pack set.
4. Aircraft.

Because of the nature of the operations which the Navy had undertaken in the Pacific it was considered undesirable, and in many cases impracticable, to impose geographical limitations on the use of channels or frequencies. Furthermore, extreme flexibility and rapid chan-





Front panel of the TDZ, Transmitter. Note the telephone dial and channel indicator on the bottom panel.

nel-shift were considered necessary to provide communications adapted to the extremely fluid movements of units in large task forces. For these reasons each equipment has been designed to operate on any assigned channel in the 225-390 megacycle range, and incorporates quick-shift features which permit rapid shifting between a number of preset channels (four in the pack set and ten in the larger equipments).

THE PROGRAM STARTS

This communication system had been developing in the minds of the planners for some time but it was not until early January 1944, at a conference between CNO, BuShips and BuAer, that it began to take formal shape. After much discussion of the problems involved, the program was formally launched by a CNO directive issued in February 1944, establishing military characteristics for the basic equipments and directing that quantity production of these equipments be started in 1945. Specifications were prepared by BuAer and BuShips, and contracts awarded for the development of models. Production in the more urgent categories was authorized on a high-priority basis to expedite delivery to the fleet.

Development of 10-channel equipments with the required characteristics was at first considered impossible by the industry in the short time that was available. It is true that basic techniques had been investigated, but a multitude of very serious problems immediately presented themselves. Many new components which were basic to the design of the equipment had to be evolved. High-stability crystals were required to provide the necessary number of channels—crystals so radical in design that no one could foresee all the ramifications of the design. The hermetically-sealed CR-7 type was the final result of much development work. Tubes for transmitters and receivers were the next problem. The 2C39 tube development promises to be adequate from the transmitter standpoint, but completely satisfactory receiving tubes are still a problem. A new design of remote-control equipment which is capable of integration with equipments already available in the fleet has been developed. These are but a few of the problems which were presented to the designers.

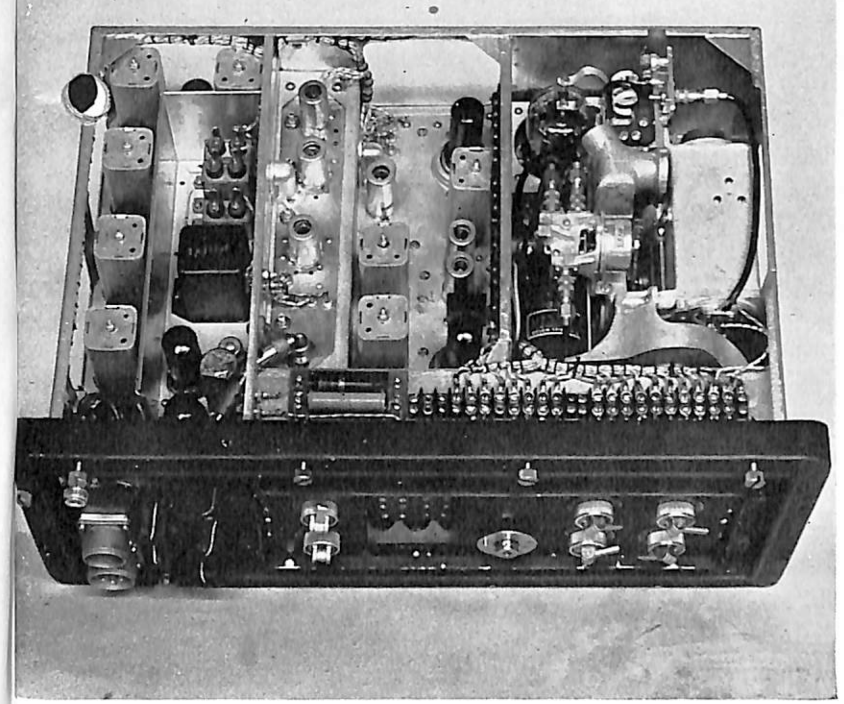
Adequate maintenance was the next problem which had to be faced. Test gear was necessary which would adhere to the same rigid standards that were set up for the equipment. Inasmuch as no such equipment was available, these items had to be developed. The problem of mutual interference (interference from images, spurious emissions, and cross-modulation) was one of the most serious. It has been impossible to obtain performance equal to that of lower-frequency equipments from this standpoint, but already developments are in progress in an effort to attain that goal.

FEATURES

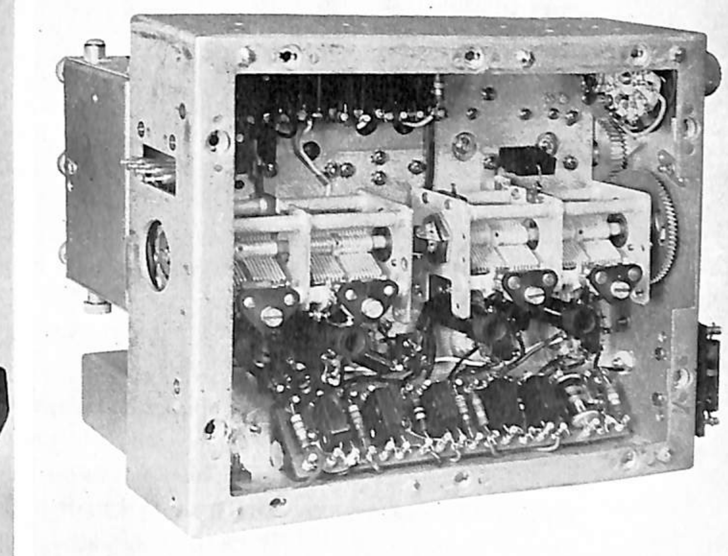
The complete program presents a coordinated series of equipments, with an eye always kept on the interchangeability of components. The same antenna is used for all equipments. Power and many receiving tubes are interchangeable, as are many other integral components. Crystals are interchangeable when frequency-range permits, and all crystal holders and crystal ovens are identical. A common type of remote-control system may be employed, if desired, or the specialized controls which are provided for individual equipments may be used.

Three types of equipments will first be seen in the fleet; the MAR transmitter-receiver, the TDZ transmitter, and its companion receiver the RDZ. A little later the MAY, a one-man pack-set, and the RDR receiver, companion of the MAR, will make their appearance. These models are being given the highest priority to

Functional design is the keynote of this new receiver, Model RDZ.



Compact, miniature construction packs a lot of radio in a small package in the Model MAR.



Rugged construction is exemplified by this RDZ pre-selector chassis.

meet the needs of amphibious and surface communications. Other models will soon go into production,—aircraft equipment, monitor and direction finding equipment, and single-channel equipment for guard-receiver and air-station tower use.

Not only is this equipment in a new band, to meet a new concept of communications, but the design is new, —from inside out. New and improved components inside, to meet the high standards of stability and performance. Streamlined cabinets outside, to overcome the deficiencies of previous housings. Quick-shift mechanisms are built into the equipments, so that channel selection and indication can be accomplished either at the equipment, or from a remote point.

Every time a new piece of electronic gear is placed aboard a naval vessel, weight and space compensation is required. Space requirements of this equipment are reduced by compact construction and by using file-cabinet type slide drawers to eliminate the necessity for side and back access. Weight is reduced wherever practicable without sacificing reliability.

The ship receiver is completely modern in design and appearance; a marked departure from the conventional "black box" which has housed receivers in the past. Every feature of design has been considered from the *functional* standpoint with the result that:

(a) The cabinet is streamlined to eliminate sharp edges and corners on the cabinet-mounted enclosures. An added advantage of this design is the elimination of a source of possible injury to operating personnel.

(b) Control knobs are recessed to protect them against accidental movement.

(c) Servicing is facilitated by file-cabinet construction, since all components are accessible from the front of the cabinet.

(d) Captive, quick-acting fastening devices are used for securing shield plates, eliminating a multitude of loose screws.

(e) Thumb screws to hold the front panel are eliminated by a simple, positive, quick-acting locking device.

Many other features will become evident upon a more detailed study of the equipment.

Portable and pack equipments utilize miniature components and techniques to get maximum performance in a minimum of space and weight. Cases are specially designed to be of the proper form and weight for ease in carrying, bearing in mind that they must be submergence proof in transport condition, and waterproof in operating condition.

THE NEW EQUIPMENTS

Now for a quick look at some of the actual equipments. Only a brief description is given since they will all be discussed in detail in future articles.

Model TDZ is a crystal controlled, general purpose, ship-and-shore transmitter. Initially, crystals for one hundred frequencies are being shipped with the equipment. It has the highest power output, 30 watts, of any transmitter in the series; covers the range 225-400 megacycles; utilizes an Autotune mechanism to provide ten preset channels anywhere in the band, and can shift to any one of these channels in thirty seconds from either a local or remote channel-selector-indicator unit.

Model RDZ is the companion receiver for the TDZ. It is being shipped initially with crystals for operation on the same one hundred frequencies of the TDZ. It covers the range 225-500 megacycles, has a sensitivity of approximately 10 microvolts at 10 db signal-to-noise ratio, and utilizes an Autotune system to provide ten preset channels anywhere in the band. It can shift to any one of these channels in less than ten seconds from either a local or remote control.

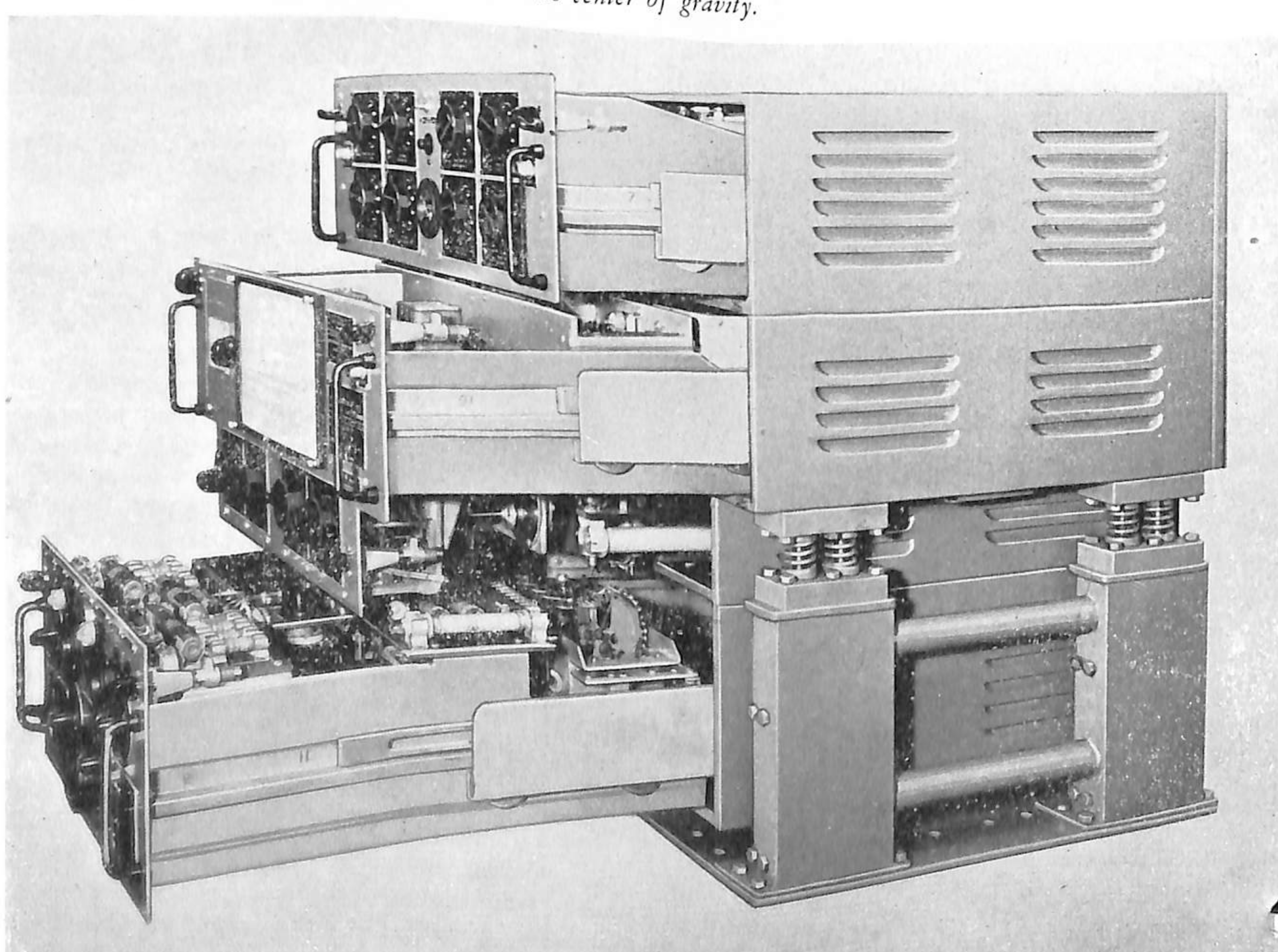
Model MAR is a versatile, portable transmitter-receiver for landing craft, vehicular, and field use. Two basic cases are required for operation from a 12-volt supply, but accessory cases are furnished so that a combination may be selected to meet almost any condition or power source. It is being shipped with crystals for operation on the same one hundred frequencies as the TDZ-RDZ. It covers the range 225-390 megacycles, and has a quick-shift mechanism which provides ten preset channels in any portion of the band. Transmitter power output is approximately 8 watts, and receiver sensitivity is of the same order as realized in the RDZ. A unique case and careful design has made this equipment waterproof in operating condition, and submergence proof when the covers are on for transport.

Model RDR is a companion receiver for the MAR, developed to meet the requirement when two receivers are used with each transmitter. In reality it is the receiver portion of the MAR, with slight alterations in arrangement of connectors and power-supply components.

Model MAY is a pack transmitter-receiver designed for one-man carry on a standard pack-board. It covers the range 225-400 megacycles. A turret assembly provides four channels which may be preset anywhere in the band, any one of which may be selected instantly. Transmitter power output is approximately 2 watts.

Look for more on UHF communication equipment in future issues.

Model TDZ has "file cabinet" arrangement of units, and a new shock-mount which suspends entire unit at its center of gravity.



RMA preferred numbers

■ Newcomers to the field of electronics are often perplexed at the Navy's use of apparently odd-sized values of small resistors and capacitors in electronic equipment. They wonder why a 4700- or a 5100-ohm resistor is specified, when actually the choice of a nominal 5000-ohm unit would seem more logical. For the answer it is necessary to go back to the time when resistor values were picked from a list of nice, round numbers,—such as 1000, 1500, 2000, 2500, etc. These values were quite satisfactory for many purposes, but in circuits calculated for use with vacuum tubes the results very seldom fell very close to these "standard" values, and special tailor-made resistors were often required. Additional values were added from time to time, but designers were still generally unable to pick values from stock to fill critical needs.

Several years ago, RMA (Radio Manufacturers Association) introduced their list of "Preferred Number Values of Fixed Composition Resistors". This coordinated system provided stock items within 5% of any conceivable value without adding to the quantity of items which must be carried in stock. The system met with universal appeal among designers and manufacturers alike and is now in general use. It is standard in the Navy for all small molded-composition resistors, and for small mica- and ceramic-dielectric capacitors.

Basically it is derived from a list of numbers from 10 to 100, the numbers being spaced so that each differs uniformly from the next by 10%, accurate to two significant figures. These numbers are shown in the first column of the accompanying partial table, and represent only the significant figures of the complete list. Thus, in the complete list, the number 12 is expanded to represent values of 1.2, 12, 120, 1200, 12000, etc. As adjacent values taken from the table are separated by 10%, any value will fall within 5% of one of these standard values. This accuracy is quite satisfactory even for some of the more fussy applications, such as cathode-bias resistors, critical voltage dividers, and certain meter multipliers, etc. For general use in the average run of electronic equipment, however, an accuracy of ±10% is quite satisfactory, and in many cases a tolerance of even 20% may be permitted. Therefore, only certain of the numbers are used in the 10% and 20% tolerance groups so as to reduce the number of stock items required. Thus, resistors having a 10% tolerance are available only in sizes listed in the 10% column of the table, but *any* resistance will still fall within 10% of some value in that column. Parts having the greater tolerance are generally used because they are much more likely to be found in stock, and are therefore more easily or quickly obtained. They are also somewhat cheaper.

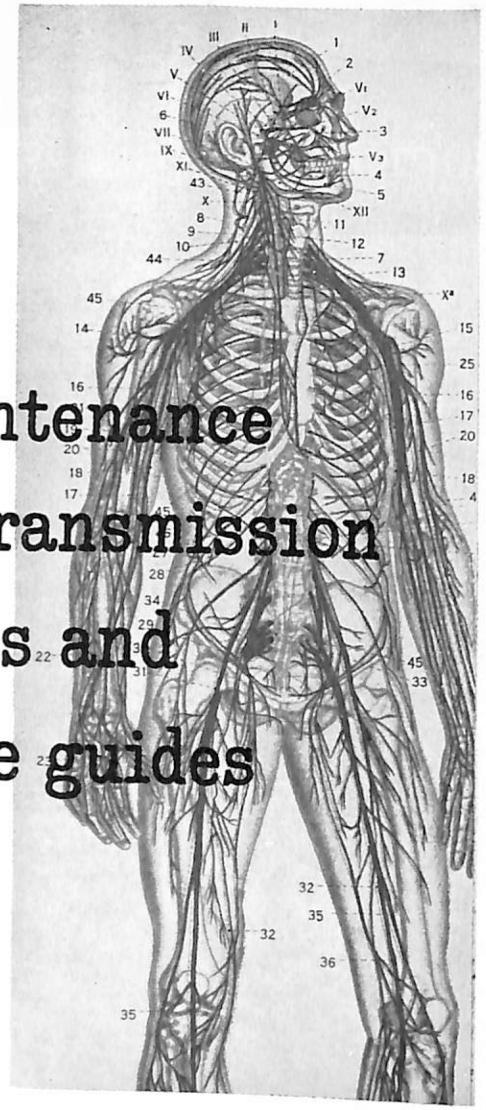
Certain standard procedures should be pointed out with reference to the indicating of resistor values. On circuit diagrams it is not standard to use the word *ohms,* or a symbol to represent that word, as numbers adjacent to resistor symbols should always be considered as indicating the value directly in ohms unless otherwise noted. In all other applications the word "ohms" may be spelled out, or it may be indicated by the symbol Ω the capital Greek-letter *omega.* The small-letter, or lower-case omega (ω) should never be used for this purpose. To obviate the writing of so many zeros, it is quite common to use abbreviations, it being standard to use the letter *k* (kilo-) to denote thousand. Thus 470,000 ohms may be written in abbreviated form, if desired, as 470 k. Ω. Next to a resistor symbol on a diagram it would be written simply as 470k. The Roman-numeral *M* also means thousand, but it is not standard and should never be associated with resistor values because it might be erroneously interpreted as a symbol for megohms (M=Mega-, million). It is therefore standard to indicate megohms by an abbreviation of the word, as 3.3 Meg., etc.

Table of Significant Figures of the RMA Preferred Number System

Tolerance Group		
±5%	±10%	±20%
10	10	10
11		
12	12	
13		
15	15	15
16		
18	18	
20		
22	22	22
24		
27	27	
30		
33	33	33
36		
39	39	
43		
47	47	47
51		
56	56	
62		
68	68	68
75		
82	82	
91		

WHAT BAND?

■ In case you're having trouble remembering the designations of the radar bands, try memorizing this bit of scandal: King Xerxes Seduces Lovely Princess.

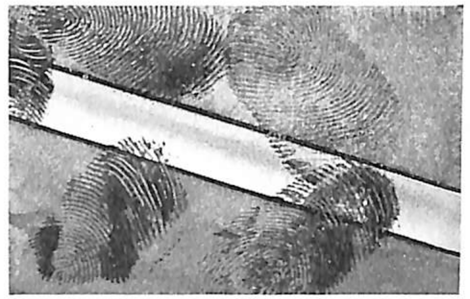


Maintenance of transmission lines and wave guides

■ There is so much information contained in the recent Bureau of Ships' publication "Installation and Maintenance of Transmission Lines, Waveguides and Fittings" (NavShips 900,081) that there is a good chance of the RT throwing up his hands in horror and steering entirely clear of the book. So we have taken the book and boiled out all the material primarily concerning installation personnel, and are printing here only the maintenance dope that you should know. If you want the complete story, dig up NavShips 900,081. Copies were sent to almost all classes of ships and most shore stations.

Transmission lines, waevguides, and their associated connectors, form the very nerve system of electronic gear. They receive the signals from the transmitter and carry them to the antenna, they bring back the signals from the antenna. They tie the equipment together in much the same manner as the nerves of the human body. When they fail, the equipment fails, if they are poorly assembled the gear is inefficient, and the trouble is exceedingly difficult to trace. *No radio or radar system is better than its transmission lines and waveguides.*

It is impossible to over-emphasize the importance of cleanliness in coaxial transmission lines or waveguides. When called upon to make any repairs or adjustments, you should be conscious of the effects of dirt, copper particles, solder, solder paste, or any foreign matter. These can cause lowered insulation resistance with increased attenuation, reduce the conductivity of conducting surfaces such as the inner surface of a waveguide, or initiate an arc which can quickly establish a carbonized path between conductors of a coaxial cable, making it into a useless piece of junk.



CONCENTRIC BEAD SUPPORTED LINES

These lines, commonly called "Coax", have good electrical characteristics, but lack flexibility, must be maintained with air-tight integrity, and are difficult to service without leaving at least one set of finger prints on the innter conductor and beads. Since the beads are wax-impregnated to prevent water pick-up, the insulation resistance depends upon the spacing between conductors, as well as the complete cleanliness of the beads. One finger print can establish a low resistance path, so that the electrical spacing between the conductors is reduced. Arcing begins, the bead carbonizes and further reduces the insulation resistance, and a "shorted" line results. Obviously dirt, grease, copper filings, other foreign particles, can have the same effect. If to this condition we add the presence of moisture in the lines, the possibility of breakdown is increased.

Bead supported "Coax" lines must be maintained so that any water can be quickly and conveniently removed.

The insulation resistance of a dry, well assembled line should read infinity on your megger. If this resistance drops to less than 100 megohms, the line should be dried by purging with dry nitrogen, or air that is known to be dry. If the resistance is still under 100 megohms, we can safely assume that the line is dirty, or that a low resistance carbonized path has been established across the beads when water was present in the line. The line should therefore be taken apart and cleaned as soon as time permits.

The line will operate satisfactorily if the pressure is only one pound per square inch. However, if the pressure guage indicates about 15 pounds per square inch, a change in pressure is more easily noted, thus giving advance warning of trouble ahead.

There are several methods of locating leaks in a coaxial cable.

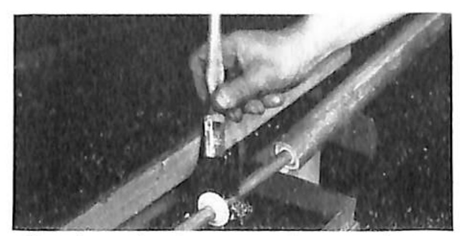
1. *The soap and water method.* Prepare a soap solution, and brush it around the area suspected of leaking. Since the solution dries rapidly, this method is effective only if the leak is large.

2. *The Freon gas method.* Freon gas is available on every vessel having refrigeration as standard equipment. Introduce a small amount of Freon gas into the line through the compressor intake. Test the suspected joint or section of Coax by use of a detector such as the "Turner Torch", "Prestolite", "Frigidair" and "Just-rite". Attach a rubber hose to the air intake tube, and use this hose as a probe. When Freon gas is present, the flame changes color from its normal yellow or blue to a bright green. This test is very sensitive, and very fast. The Freon gas should not be used when the line is powered, and must be thoroughly removed by flowing nitrogen or air through the line until the tester used for checking shows no trace of Freon at the open escape valve.

3. *The Lacquer Method.* Brush with Laquer and watch for formation of bubbles. This method is superior to soap and water, for when the lacquer dries, the bubble retains its shape.

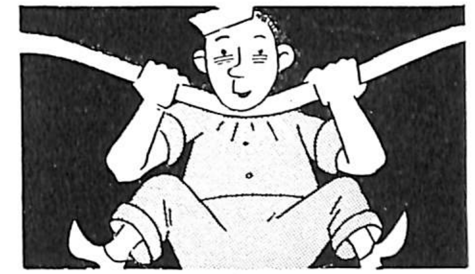
In each case the pressure within the line is increased to 30-35 pounds to make the leak easier to locate.

It is recommended that each vessel carrying an SA, SC, or SK, or SR-2 carry aboard an assembly consisting of a 25 foot piece of RG-18/U complete with fittings at both ends. Repairs can then be made rapidly by sawing out damaged sections of the line and connecting the RG-18/U with the solderless couplings. If such assembly is not available, emergency repairs may still be made. If the line is completely cut, with a missing piece, it is best to cut back the outer conductor ½ to ¾ inches beyond the inner conductor, and splice the inner conductor with a piece of pipe or tube the right size. Such a tube can be formed quickly of sheet metal or copper, or from a length of braid soldered into place. For the outer conductor a section of pipe the correct size may be used, or a tube formed from sheet metal soldered or taped into place.



Cleaning the inner conductor of a coaxial transmission line.

If the hole is small, under ¾", wrap it with friction tape to keep water out. If the inner conductor is intact, a large hole in the outer conductor may be repaired by thin sheet metal tightly taped over the hole. When the inner conductor is injured, it may be necessary to enlarge the hole in the outer conductor, before the inner conductor can be repaired.



STUB-SUPPORTED LINES

Stub-supported lines are concentric lines containing no dielectric in the electrical field, and are thus highly efficient.

Prefabricated sections should be carried in stock, as well as special coupling elements depending on the installation. These sections usually consist of 12-ft. sections of stub-supported transmission line with stub distances of from 21 to 27 inches. Installation notes and tables of coupling types for stub-supported lines may be found in NavShips 900,081, pp. 21-26.

Should it be found necessary to make emergency repairs while at sea, great care should be taken to avoid any relative shift between inner and outer conductor. The stubs are soldered to both inner and outer conductor, and such displacement can easily break a stub loose. Care must be taken to leave no extra solder in the line, for this will initiate an arc or cause the line to go into corona when power is applied. These lines are not pressurized, thus dirt and moisture can enter them. The lines should therefore be maintained in a condition permitting a continuous flow of air through them at all times.

Exercise the greatest care in the storage of spare lengths and couplings. When any part of the line is exposed to misuse it should be protected by a sheet-metal hood or other means. Do not use the stubs as hand grips or ladder steps, as they are essential to the electrical operation of the system.

SOLID DIELECTRIC COAXIAL CABLES

Solid dielectric cables were developed to meet a need for a line with good electrical characteristics which requires little maintenance, and a minimum of skill in handling.

The outer braid is generally of standard copper wire, sometimes tinned or silver coated. The angles of the outer conductor (braid) with respect to the axis of the cable are held to close tolerances to lower high frequency loss, and these should not be greatly disturbed, especially when assembling cable to connectors. These cables have a high resistance to breaking from constant twist, an incidental result when the braided outer conductor was designed for minimum electrical loss.

When looking for trouble remember this little statement: Cables used primarily for flexing work will break the inner conductor; those used primarily for twisting work will break the outer conductor.

In making installations or repairs some general precautions are necessary.

1. *Avoid hot spots.* These include hot air intakes, steam pipes, points exposed to stack gases, galleys and galley vents, etc.

2. *Avoid bends* which have a bending radius of less than 10 times the diameter of the cable. This may involve making brackets for support. The appearance of sharp bends is not as important as effectiveness of the lines. This applies also to patch cords.

3. *Avoid exposing cable to points of constant abrasion.* Give this a little thought, especially when the cables come out of the equipment, or go around sharp corners. Use grommets, sleeving, tape, etc.

4. *Do not use cable as a tow cord.* While the cables can take a lot of punishment, the less damage they sustain, the less repair they will need. Remember, in disconnecting from a socket, to pull on the plug, not the cable. Minor breaks in the outer conductor result in microphone crackles, unsteady signals, noise.

5. *Use short lines.* Power loss (attenuation) in any line increases with its length. Use a longer line, however, if it is necessary to avoid hot spots.

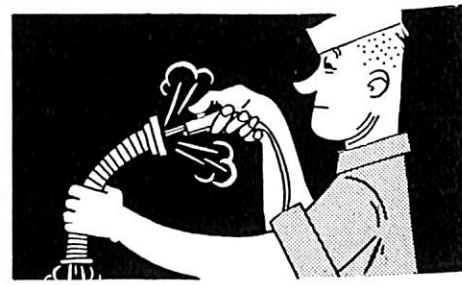
6. *Run lines separately.* Whenever possible and practicable, running lines along separate paths will minimize the destructive effects of enemy gun fire.

Cable procurement regulations require that the cable be supplied in 500- 2000 foot reels, with shortest lengths applied to the reels last. When using a length of cable longer than the shortest one on the reel, be sure to replace the unused lengths before leaving the reel. Store in a cool dry location, not exceeding 125°. Low temperatures produce no deleterious effects, but the cable should be warmed up slowly to avoid moisture absorption by condensation and to avoid cracking the jacket which, like the insulation, becomes stiffer with decreasing temperature. Of course, the cable should not be subject to rough wear or deformation while in storage.

You should keep in mind that designations differ with different manufacturers. For example, RG-8/U is called K-340104-1 by General Electric, 73-5097 by Raytheon, K-99208-1 by RCA, etc.; when used as a parts number associated with specific equipment. This information is tabulated on pages 34-37 of NavShips 900,081.

When making emergency repairs and time is too short or no connectors are available, the two ends of the severed cable can be assembled as follows: Cut back the insulation enough to permit twisting the inner conductors together. Make the twist tight. Wrap with wire, then with friction tape to a diameter about 1/3 larger than the original cable. Then pull the two braids together, one over the other and serve with wire tightly. Wrap the entire assembly with tape, and then tackle another job.

For making a "really" emergency splice for larger cables, the inner conductors may be joined by wrapping the two butting ends of the conductors with a layer of copper tape, soldering if possible. If not, serve with copper wire, whipping the ends under to reduce corona. Wrap tightly with electrical tape until the diameter is at least 30% larger than the original dielectric diameter. Apply Dow-Corning #4, vaseline, cup grease, or other high voltage resistant material to reduce the tendency toward breakdown of the tape. Pull the two braids together, one over the other, serve tightly with copper wire. Wrap the assembly with tape, and tackle another job.



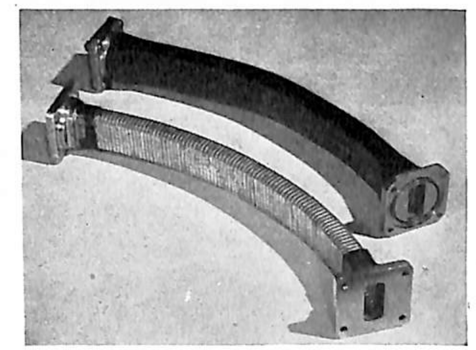
WAVEGUIDES

Waveguides are, at present, the most efficient means of transmitting electrical energy at high frequencies. They were adopted by the designers for use where losses in coaxial lines would be too high to consider.

Dirt and dust settles in waveguides rather easily, but they may be cleaned by using a blower converted into a vacuum cleaner by reversal of the air direction. A length of rubber hose inserted with the waveguide at elbows, particularly the lowest one of the installation, will remove the undesirable stuff in a few seconds. Never use the ship's compressed air system to blow the line clear, for this air may be loaded with rust, scale, oil, water, and dust. When arcing occurs in the line, it may be necessary to clean it by pulling a clean rag saturated with carbon tetrachloride through the guide. Repeat until a clean cloth shows no more dirt, and then repeat once again with chemically pure carbon tetrachloride. When carbon tetrachloride is not chemically pure it will leave a deposit on the surface.

As moisture condenses on the inner surfaces of the guide, it becomes a poorer conductor, and loss increases rapidly with a corresponding decrease in range. Be sure that a drain hole is drilled in the guide at its lowest level.

In general, the technician will not be expected to do installation work aboard ship while at sea, but repairs and replacement of sections of waveguides are not rare. When a section is replaced, care must be taken in alignment, and the weight of the pipe must not be borne by the transmitter, or duplexer. Emergency repairs of holes in the waveguide can be effectively made by reaming out the hole smoothly and securing a metal patch over it, leaving no uneven surfaces on the inside.



Sections of flexible waveguide simplify the problem of emergency repairs.

guide may be cut at an angle and soldered, the mating piece being cut to fit the two open ends. A piece of 3-inch brass pipe, formed into rectangular sections at the ends may be used to mate two pieces of 3″ x 1½″ guide.

When the waveguide is damaged at a bend or a twist it would be made inoperative. Rigid repairs require considerable time and skill. A short section of flexible guide may be used.

CORROSION

Corrosion differs from the weather in that in addition to talking about it you can also do something about it. But first you should know what it is. For the purposes of this article, corrosion may be defined as any change, usually visible, which takes place on the surface of a metal resulting in a color change, or in decomposition of surface from an original clean metallic appearance. Moisture, conducting materials, other metals nearby, or in direct contact, increase the rate of corrosion at any given temperature.

To avoid or to minimize corrosion, follow the good practice of keeping the parts clean, dry, and separate where possible; paint dissimilar metals to isolate them, or paint over the contact points when they have been bonded, keep the parts cool, and above all, take time out and examine the complete system. A look in time is worth a lot of cussing after the damage.

Because a chart helps to tie in a lot of words, the following is given:

TRANSMISSION LINE METAL	USE WITH	AVOID	IF NOT POSSIBLE TO AVOID
Copper, brass bronze.	Copper, brass, bronze, silver.	Zinc, iron, aluminum, tin.	Tin the copper or alloy surface. Insert lead shim. Keep dry. Paint over to keep dry.
Galvanized iron or steel.	Zinc or cadmium plate.	Copper, brass, bronze.	Use tinned copper or alloy surface. Use lead shims. Paint between contacting surfaces. Paint over contacting surfaces if bonding is called for to keep dry.
Silver, silver plate.	Silver, copper, brass.	Iron, tin, zinc, aluminum, cadmium plate.	Silver plate the non-silver material. Use lead shim. Paint over contacting surface to keep dry.

If the hole is small, leave it alone if other repairs require your attention. Operation will not be badly affected unless jagged edges project into the tube. Cover with tape to keep water out, if that possibility exists. For a large hole, 2 inches in diameter to half of the guide shot away for six inches to a foot, you will need to cut off and smooth over the ragged edges that protrude into the guide, and cover the hole with a formed piece of sheet metal. When a foot or more guide is shot away, even up the edges with a hacksaw. Push a rag into the lower section to keep filings out. Use a splice of flexible or rigid waveguide, either soldered or banded tightly, and if neither is available, form a piece of sheet metal using the original guide as a form, solder the vertical seam (which should be at the center of the guide dimension), secure with bands or solder when properly aligned. When the damage is at a bend, flexible guide is easily used to repair the damage. Solid

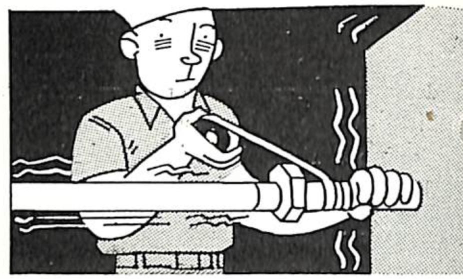
PREVENTIVE MAINTENANCE

This part of the story depends upon the maintenance men. If you do it well, it means that major jobs—not counting battle damage—will be few and really far between. It involes setting a schedule for yourself, if one is not already available, based on the common sense of the job. Make your check-off list complete, follow it with care. It will pay off well in longer periods of "routine operation". Here are a few hints that may help you work up your own list of things to watch:

In concentric lines. Check gas pressure. Tighten all solderless couplings. Check the entire line for evidence of corrosion; if found, scrape, clean and paint. Check the bonding of the line at mounting points. Make sure that the lines are being supported by the mounting straps. Be sure that the dehydrator is working properly.

For flexible cables and connectors. Check all ground and bonding points for corrosion. Look for frayed and broken jackets, particularly around corners of equipment, cable coming out of holes in the chassis, cables coming from bulkhead in sharp angles, etc. Check all loose sleeving used with connectors and individual wires to see that they cover what they are supposed to protect. Look for cold-solder joints. Use the DC resistance bridge or the megger for every lead which may give trouble. Gradual change in insulation resistance are signs of potential trouble. Where vibration is expected, or is present, it is advisable to tape over the coupling rings of the connectors. Support all cables which are limp and which can be caught and broken accidentally. Don't let them hang in front of instruments. Check the cable runs which go through storage compartments. Make sure that no supplies are packed around them. They need air and air circulation to keep them cool, particularly if they are carrying appreciable power. Do not allow cables to kink. Check stuffing tubes for water tightness.

For rubber and pulse cables and connectors. Check the soldering of the pulse connector, and the shield of



the pulse cable. If the job is not well done, the system will radiate power which will interfere with adjacent radio equipment. Protect the cable from any crushing which might loosen the inner conductor from the first layer of rubber. When air enters the line, it can start corona. Check the bonding of the outer shield of the cable to the ship's structure. Make sure the cables do not run too closely to hot vacuum tubes.

For Waveguides. Check contact surfaces for mating flanges of waveguides. Make sure that gaskets are properly seated. Make sure that the water drain hole is clear and free to drain. Check the store rooms to see that heavy supplies are not packed around the waveguide. Make sure that the supports are bearing the weight of the waveguide, and that it is not slipping.

Remember that the primary responsibility for the radar and radio technician is to keep his equipment on the air for the largest possible percentage of the time. An emergency repair kit should be assembled and kept readily accessible, when the need for such repairs is anticipated. But remember that "haywire fixes" are not good practice, and complete and proper repairs should be made at the earliest possible moment, even if the system seems to be working well.

SP—FOR POST WAR HUNTERS

Lieutenant Canady reports the following important operational data:

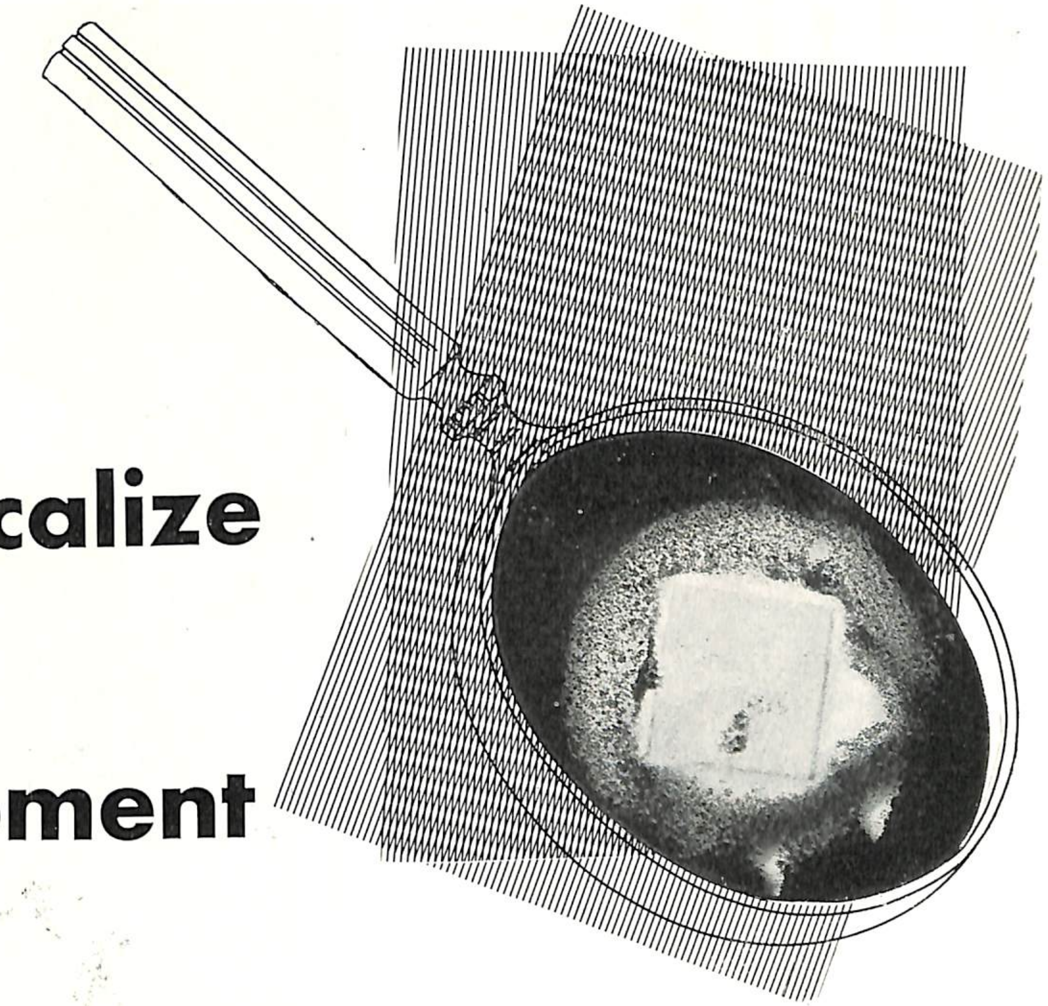
"A flock of geese was picked up on the SP at 11,000 yards, appeared on the SG at 9000 yards, was tracked at 25 knots to cross ship's course about 1 mile ahead!"

Editor's Note.—We think this equipment should be improved to the extent that the breed of geese may be determined. . . .

STACK GAS

Recently at Boston a Yard electrician succumbed to an illness which was traced to inhalation of "stack gas," and at another yard, a contractor's engineer discovered his rating assistant passed out on the mast and it was necessary to lower him with ropes to a lower deck and administer artificial respiration. Stack gas has a pungent, unmistakable odor, and a few 'whiffs' leave the throat raw and a nauseating feeling in the stomach.

Tropicalize Your Equipment



When you were in SoPac your capacitors shorted, mould grew gray and green on the cotton at the ends of your acetate coated insulation, and little piles of "crud" developed on the terminal blocks and in hidden corners of your equipment. When you were creeping up the Slot watching for the Tokyo Express, or listening to "Washing-Machine Charlie" doing his regular run over Torokina, you cursed the heavy heat and high humidity of the tropics, and remembered that you were made for a temperate climate. But did you realize that the radios and radars, the sound gear and the wiring and the meters were also made for operation in a temperate climate? As the shield cans and cases expand and contract with the changing heat they breathe the moisture-laden air, and the metal surfaces corrode in the presence of moisture. It was soon found that heaters had to be left on at all hours, and that even at best receivers lost sensitivity, cases rusted and fittings corroded, filter condensers and transformers burned out or shorted. After you had been in the tropics long enough, you learned to take trouble for granted; you cursed the area and got on with the job. We now know more about the problem, and it is no longer necessary for you to take the effects of the tropics lying down. When you dig an i-f transformer out of spares, it need no longer remind you of the box of cookies and nuts that Sweetie-Pie sent you last October and which you received this May. It need not, that is, if you "tropicalize your equipment".

Let us first see what is being done here at home, with the new gear that is now coming off the production lines. First of all, exhaustive experiments were made by armies of experts under field conditions, armed with assorted poisons, varnishes and lacquers, microscopes and Latin dictionaries. Spots of corrosion were scrutinized, tropical mould spores were isolated and examined until their private lives were as well understood as that of the common house fly, and the effects of moisture upon the various materials used in electronic equipment was studied. Reports, specifications, more reports, recommendations, experiments, procedures, and plans for still more experimentation poured in. We are not interested in the details of this research, except to assure ourselves that it was done, and is continuously being carried forward. Following the lead of the United States Army Signal Corps, this war behind the war is being waged wherever American equipment goes into operation.

As far as practicable all Navy and Marine Corps gear now coming off the production lines is being tropicalized. This consists of (1) potting in sealed cans all materials such as fixed condensers and components not requiring adjustment; (2) treating the surfaces of all exposed elements not involving electrical contacts with moisture resistant varnish or lacquer which contains a fungicide; (3) treating felt and similar materials whose characteristics would be destroyed by varnish to provide immunization against moisture and at the same time preserving their electrical and physical characteristics. The "Ceraseal treatment" is one method frequently used to accomplish this result. (4) Use of insulation not liable to surface leakage through condensation or the growth of fungus; (5) prevention of corrosion from electrolysis by sealing all soldered joints in the wiring with insulating varnishes and lacquers; (6) treatment to prevent corrosion of metal surfaces of switches, contacts, capacitor plates, etc., as the result of salt spray. Some units are inclosed in waterproof cases.

How effective is this treatment? Before the Army began to tropicalize its field equipment, the famous walkie-talkie (SCR 536) had an average field life of just two days. This has been extended to an average field life of three months by tropicalization. In addition to this longer life, the sensitivity of the receiver has been greatly improved. Recent reports indicate that sensitivity is generally improved, in some cases by as much as 1000%.

It is just as necessary to protect the insides of electronic gear as it is to protect the hulls and guns and other components of our fighting ships. A DD is painted time after time, a radio is painted once on the outside, yet is infinitely more vulnerable and delicate. And certainly the problem is no nearer solution if we are content to curse the humidity of the combat zone or the corrosive salt of the sea.

The program of tropicalization is fundamentally a fight against the effects of moisture. Fungus growth requires an atmosphere of 70% to 80% relative humidity. When gear is kept dry there is no fungus problem. Air that is saturated (100% R. H.) at 90° F is at 55% relative humidity when the temperature is raised 20° F. A good working rule, therefore, is to maintain all the equipment at 20° F above ambient temperature.

Most equipment designed for operation in exposed locations, even in the pre-tropicalization days, included heaters for keeping the temperature inside the cabinets well above the outside temperature. These heaters should be on when the gear is not in operation, except when leaving them hot would interfere with actual maintenance work. For equipment not so designed, simple heaters consisting of heating elements or light bulbs can usually be improvised. Cabinets need to be constructed for the proper stowage of test instruments and spare units. These "hot boxes" are as necessary for your tube checker and voltmeter as they are for your uniforms. They can be easily constructed of plywood, with staggered shelves so that hot air is caused to circulate from a heat source placed at the lowest compartment of the cabinet. Remember, when you tie up your PT at the base, the heaters must be left on (this may require a wiring modification) if you expect the gear to be in a healthy condition when you are ordered out next time. And it is safer, easier, and quicker to keep the moisture out to begin with than it is to cook it out later on. Of course, high voltages must never be applied until the unit has been dried out to remove all the dampness which has settled in the box due to fog, dew, and condensation. The power supply for

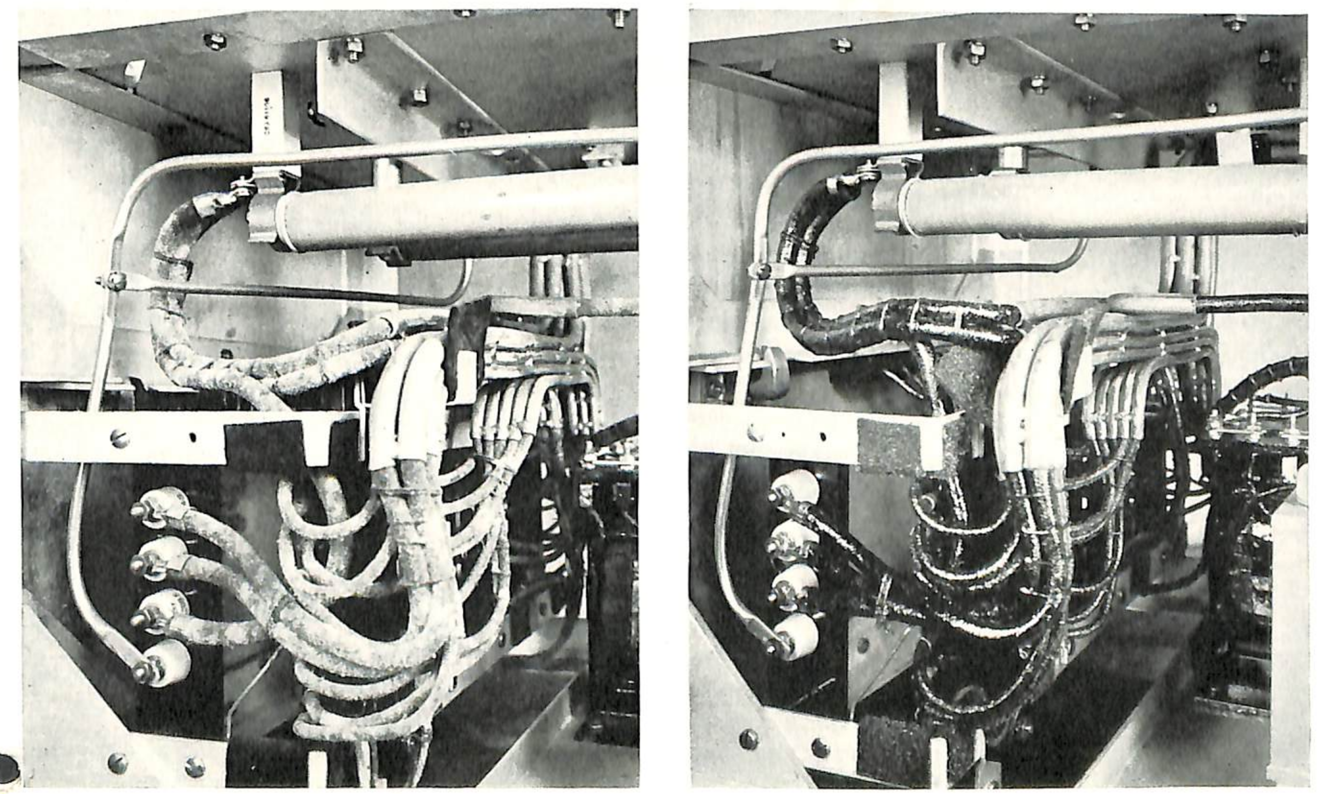
Equipment being tropicalized at the factory before delivery to the services.

heaters may have to be obtained from shore sources. Gasoline heaters, such as that furnished with the SCR 527, or small auxiliary engine generator units may be stowed ashore and broken out when the ship's supply is not available.

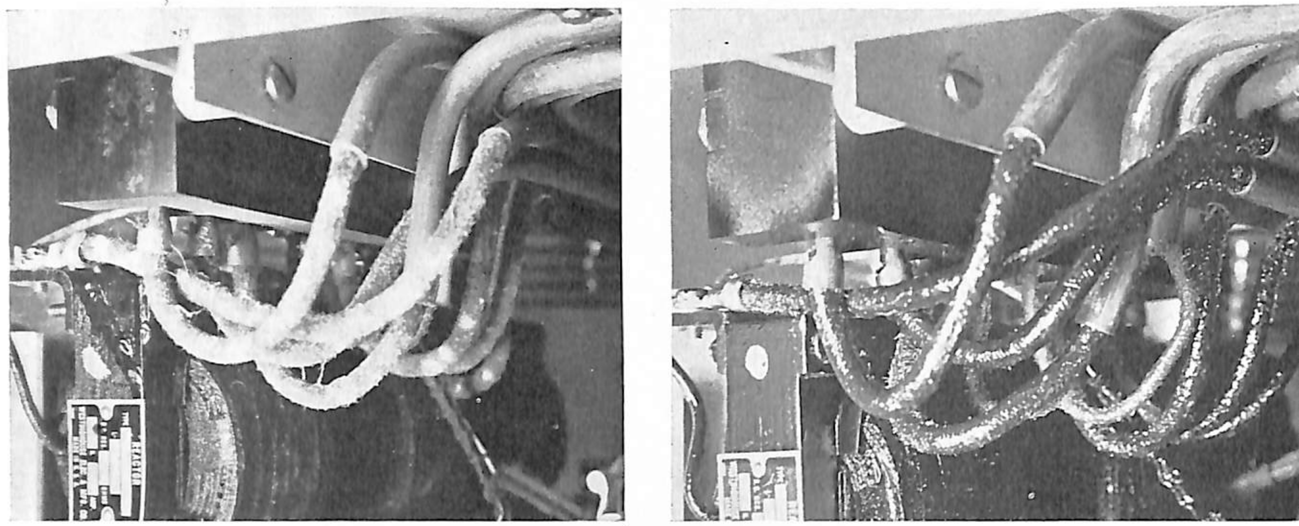
Special varnishes and lacquers have been developed and approved and are now available by requests placed through your electronics officer to The Bureau of Ships. When procuring moisture and fungus resistant coating materials for the treatment of communications, electronic, and associated electrical equipment, simply indicate any varnish approved under Specification JAN-C-173 and whether it is to be used in the vicinity of selenium rectifiers. These rectifiers are sensitive to a Mercurial varnish. This commodity is furnished in one-gallon cans, five-gallon pails, and in 55-gallon drums. The Army prefers a rapid drying lacquer, while the Navy recommends the use of a resin varnish, preferably one containing mercurial fungicide. If the approved materials are not available, Navy varnish Cat. No. 52-V-1680 (Spec. 52V12) or Air Corps varnish Cat. No. R-52-V-2900 (Spec. ANTTV-118) may be used. These varnishes are actually superior to the fungicidal varnishes in moisture resistance qualities and while not fungicidal act as a deterrent to fungus growth by excluding moisture. If there are Signal Corps units nearby, they may be able to furnish you suitable material from the kits that have been issued them.

Before varnish is applied to electronic equipment, the existing mould must be eliminated. The mould plants and spores can be killed by heating the gear to about 120° F. But this is not, in itself, enough. New spores can live on the residue of this dead mould, and the gear will soon be as bad as ever if this source of fungus food is not removed. By using care and doing a thorough job of cleaning, using a brush and following with cleansing fluids such as white gasoline or carbon tetrachloride, equipment can literally be brought back from the dead. Heat does more than kill the mould. It is needed to remove water that has been absorbed by components. 140° F. of heat should be the upper limit to avoid injury to waxed components. Apply this heat for two hours (add two hours for each 10° less than 140°), to assure thorough drying. It will be necessary to construct a drying oven, but this need not be a major obstacle. Lamps are the best source of heat, canvas can be stretched over a frame satisfactorily, for it easily stands 140°. Plywood can be used. But watch the temperature constantly, and do not risk injuring your gear by overheating.

Meters have been taken from salvage depots and made to function like new equipment, and entire radar systems saved from survey by a thorough cleaning job followed by moisture-proofing. Don't throw up your hands in horror at the first sniff of the musty stench that boils out of a unit that has been left too long in



Right side of bottom deck of a TBM-10 Modulator Unit before and after the tropicalization treatment. This is new equipment being unpacked and treated before going into service with the fleet.



TBM-10 Modulator Unit before and after tropicalization. Note that all cloth covered wires to the modulator transformer T-405 have been attacked by fungus growth.

the unequal battle with the jungle. You will be surprised at the few replacements that will be needed once the equipment is thoroughly cleaned and treated.

The varnish may be sprayed on, or applied with a brush. If a spray is used, the gear must be disassembled so that all components are accessible. Elements that are not to be covered with varnish must be masked. The surfaces must be clean and dry and the equipment should still be warm from the drying out ovens, so that no condensation has taken place. When the masking is removed, there will be some touch-up work to do with a brush, and the equipment must be allowed to dry. Then the equipment is assembled, realigned, and tested.

The brush method, which will be more widely used in the field, requires more time and more labor, but less equipment. Open up the cabinets, disassemble as necessary, until all components are accessible. Bake out moisture and brush on the varnish as desired, age and reassemble, align and test. The aging process is sometimes necessary before realignment, as there is likely to be some frequency shift as the varnish dries out. Do not forget to treat the spare units and the test equipment which suffer more since no heaters are provided for keeping this part of your gear in operating condition.

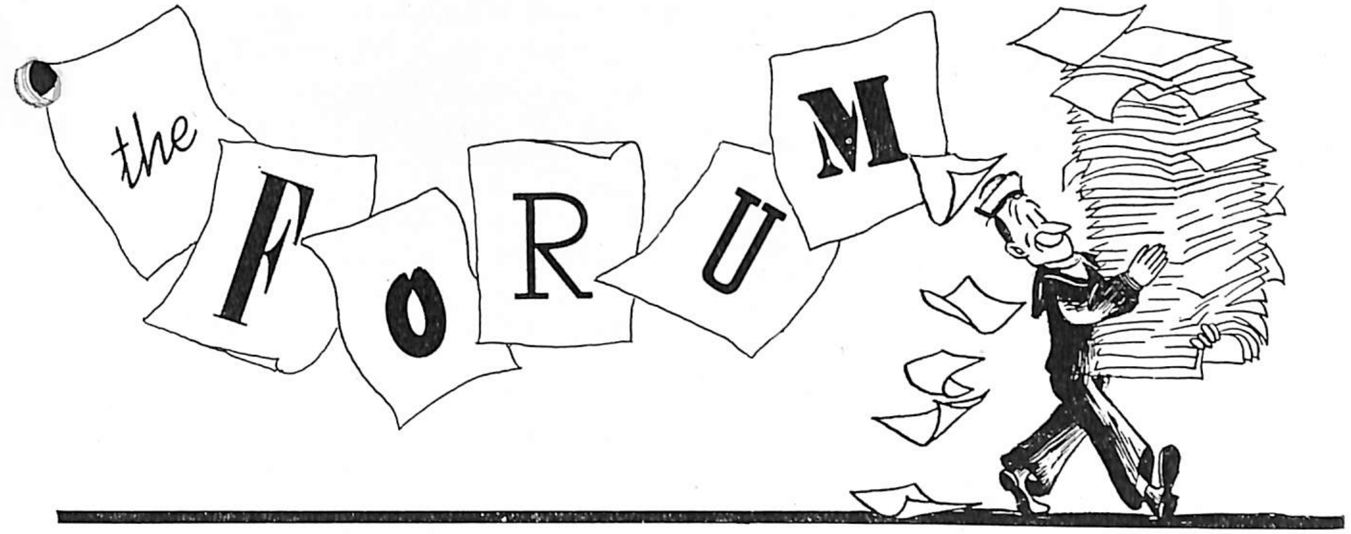
All surfaces supporting circuit elements (resistors, capacitors, coils, etc.) and all circuit elements and interconnecting wiring should be covered with the coating material, as also should be the nonvarnished and nonpainted metallic surfaces including shield cans, cases and covers. The varnish should not, of course, be applied to any surfaces where it will interfere with the operation of the equipment. Such surfaces include the contact portions of relays, sockets, jacks, test points, plugs, keys, binding posts, connectors, surfaces which rub together for electrical contact: bearings, potentiometers, variacs, contact fingers, shafts; mechanical parts, ceramic insulators and terminals subjected to more than 600 volts where danger of flashover exists; windows, lenses; rotating equipment, resistors where wattage dissipation is undesirably affected, or where coating material may become carbonized. The polar relay of teletype equipment should not be varnished. In general, all you have to do is approach the project with intelligence, and do not put the varnish where it obviously would do harm.

High voltage terminals and insulators may be treated with Dow-Corning Compound #4, a vaseline-like substance available almost everywhere. This substance has high dielectric strength, low dielectric constant, is water repellent, and has a high insulation resistance. It can be used in connectors where there is a possibility for water entering the equipment, such as type N fittings, Jones plugs, Cannon plugs, etc.

Much of the field work will consist in improvising drying ovens, using substitute materials, devising gadgets. When the special varnishes are not available, visit the Signal Corps and "borrow" lacquer. Remember that the harder you attack this problem, the easier your own life will be in the long run.

To Summarize:

1. Keep your gear hot and dry.
2. Keep it clean of dust and possible mould supporting materials.
3. Paint your gear with varnish—particularly if operating conditions are bad.
4. If necessary—bake out each unit of equipment periodically to drive out absorbed moisture.
5. Report any conditions that may be of help in this program.



ISOLATING TROUBLE IN LORAN RECEIVERS

By Lt. (j.g.) John L. Holahan, USNR, Escort Division 36

The counter test patchcord, which is normally used in aligning the DAS-3 indicator, can be used to serve the function of a signal generator in isolating trouble in some particular stages of the receiver. One end of the cord is plugged into the second counter (hole No. 2) on the indicator unit and the other end, which is normally plugged into the "counter-test" jack on the receiver, is touched to the signal grid of V-301, V-302, V-303, V-304, V-305 and V-307. If the stage being tested as well as the stages following it are OK, then a signal will show up on the indicator screen. By starting with V-307 and working back, the troublesome stage can be determined almost immediately, without the aid of additional equipment.

Bureau Comment: The suggestion is equally applicable to Models LRN-1, LRN-1A, DAS-1 and DAS-3. Use the No. 2 test jack as a source of divider waveform output and apply this output to each stage in turn, starting with the video amplifier and working back toward the RF amplifier. In the DAS-4 the lead from the second divider at the TEST-OPERATE switch is a convenient source (this lead is the shielded one). The switch should be kept in the OPERATE position. Of course, the divider output can not be used for receiver alignment.

The outputs of the divider (counter) circuits in Loran indicators are very rich in harmonics which will pass through and be amplified by the receiver. Incidentally, accidental pickup of this output may produce very confusing indications on the indicator screen, since the appearance is often quite similar to actual signals. Divider output pickup, however, may be distinguished from actual signals because it occurs at regular intervals across the screen, and is not affected by the movement of the OSCILLATOR-FREQUENCY (DRIFT) control.

BLEEDER RESISTOR FAILURE IN MODEL QCJ-9 SONAR EQUIPMENT

E. S. Wuest, CRT, U.S.S. Owen (DD 536)

1. The sound gear recently suffered a casualty in the driver. The symptoms were:
   (a) A fifty percent increase in oscillator plate current.
   (b) An arc-over in the driver tuning condenser.

2. While checking over the equipment, it was discovered that the oscillator plate voltage was in excess of one thousand volts. Normal plate voltage is 550 to 750 volts. This increase in plate voltage caused so much more r-f swing in the oscillator tank circuit that the tuning condenser spacing was inadequate and r-f arc-over occurred between stator and rotor plates.

3. Investigation of the power supply showed that R433, a 5000 ohm, 60 watt resistor in the bleeder circuit was

burned out. The circuit was checked but no cause of failure could be assigned other than excessive heating, yet the driver blower was running and steel mesh covers had been installed almost a year previous to the failure.

4. A new resistor was installed. All voltages checked normal but the new resistor smoked slightly for about an hour after the equipment was turned in. It did not char or discolor, so the equipment was left in operation.

5. The cause of failure seems to be the inadequate wattage rating (60 watts) of R433.

6. Computations indicate that the driver bleeder circuit operates R433 at a 60% plus overload in normal running. Actual figures obtained are as follows:

Not keying	103.68 watts
Keying, 1000 yard scale	101.95 watts
Keying, 2000 yard scale	102.81 watts
Keying, 5000 yard scale	102.16 watts
Rated wattage	60 watts

7. The part failed after 8000 hours of operation and standby. Only 19 months of the "two years of service" guarantee period had elapsed.

Bureau Comment: While the rated wattage of this resistor is lower than would appear necessary from calculations, the tolerance is such that the performance as measured by failure reports has been satisfactory over a considerable period of war time operation. This resistor will be found in Models QCJ-9, QCL-8, QCO-3, QCN-4, QCR-1, QCQ-1, QCS, QCT, QCS-1, and QCT-1 Sonar Equipments. Technicians charged with the maintenance of any of these equipments should pay attention to this resistor as a possible source of trouble. Where possible, it is recommended that Grade I, Type 1 resistors be used for replacement. Failure reports should be made promptly.

DAMAGED VOLUME-CONTROL CABLE

Edmund S. Wuest, CRT, USNR, U.S.S. *Owen*

The type CRV-49131C Speaker Amplifier frequently develops an intermittent or steady hum caused by grounds in the five-wire cable leading to the volume control. The pressed steel edge of the amplifier tube shelf rubs the cable, frays the shield and insulation, and drives the shield ends into the conductors. As these wires are in the amplifier grid circuit, an annoying 60-cycle hum signal is introduced.

It is usually impractical to repair the damaged cable assembly. The writer has been making up a five-wire cable and pulling a braided copper shield over the conductors, as a replacement. This seems to be entirely satisfactory.

The replacement cable is made shorter than the original cable. To install it, the volume control case is rotated one-half turn to position the terminals down. The cable does not pass between the amplifier shelf and the cover. The units now in service could be altered by rotating the control a half-turn. The excess cable can be looped below the volume control. There is plenty of space for this change.

Possibly some one else has reported similar "bugs" but the writer has not run across any mention in the excellent publications put out by the Bureau of Ships. *(Thanks.—Ed.)*

Bureau Comment: All 49131- series amplifiers are out of production and will gradually be replaced by later designs as they become available. The Bureau has no objection to the proposed alteration. The use of an additional clamp to secure the cable to the front panel just below the amplifier shelf may also prevent the cable from rubbing on the amplifier shelf.

Correct that AN/UPM-1B Antenna Error

There is a possibility that the AN/UPM-1B low frequency antenna bearing Navy designation AT-50/U with serial numbers of CIH-1 through CIH-222 were assembled incorrectly. This can be determined and corrected if necessary in the following manner:

(1) Disconnect any cable going to the antenna in question.

(2) With an ohmmeter or any continuity checker, check to see if there is continuity between the two quarter-wave elements of the antenna, by touching one test prod to the coaxial connector in the base of the antenna. There should be no continuity.

(3) If continuity exists, the antenna is assembled incorrectly.

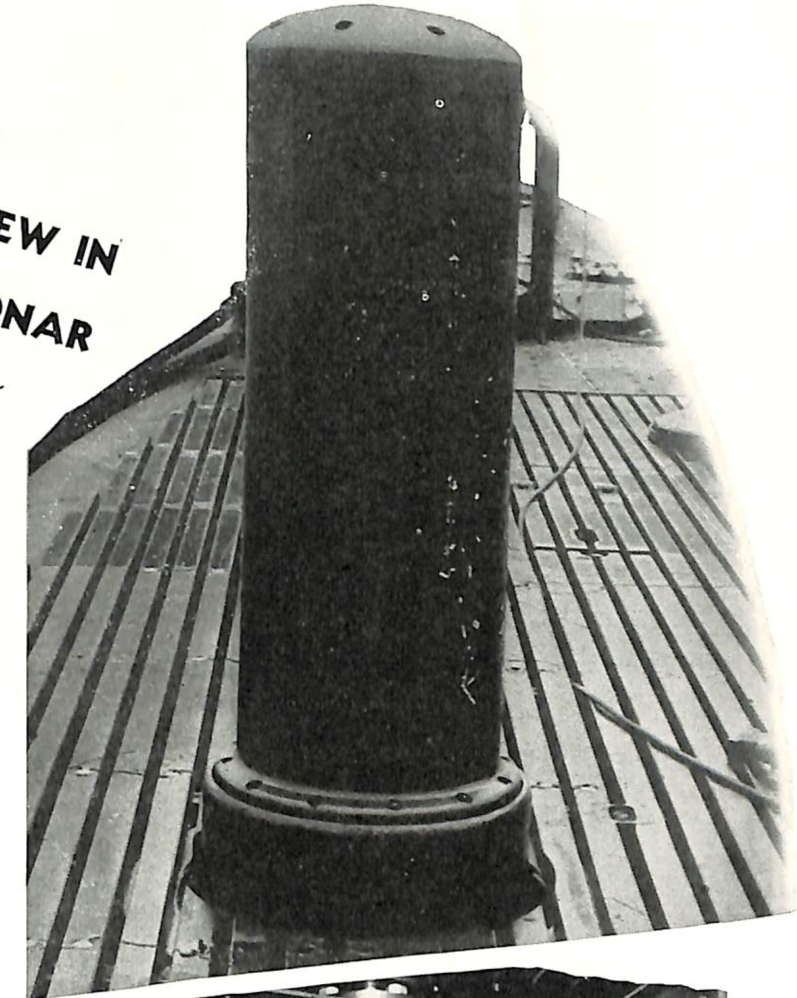
(4) To correct this, remove the two quarter-wave sections from the antenna column by removing the four nuts and lockwashers. Rotate the antenna elements ninety degrees with respect to the top plate (in either direction) and remount on the column.

(5) There should now be no continuity between the quarter-wave elements, and the antenna should be correctly assembled.

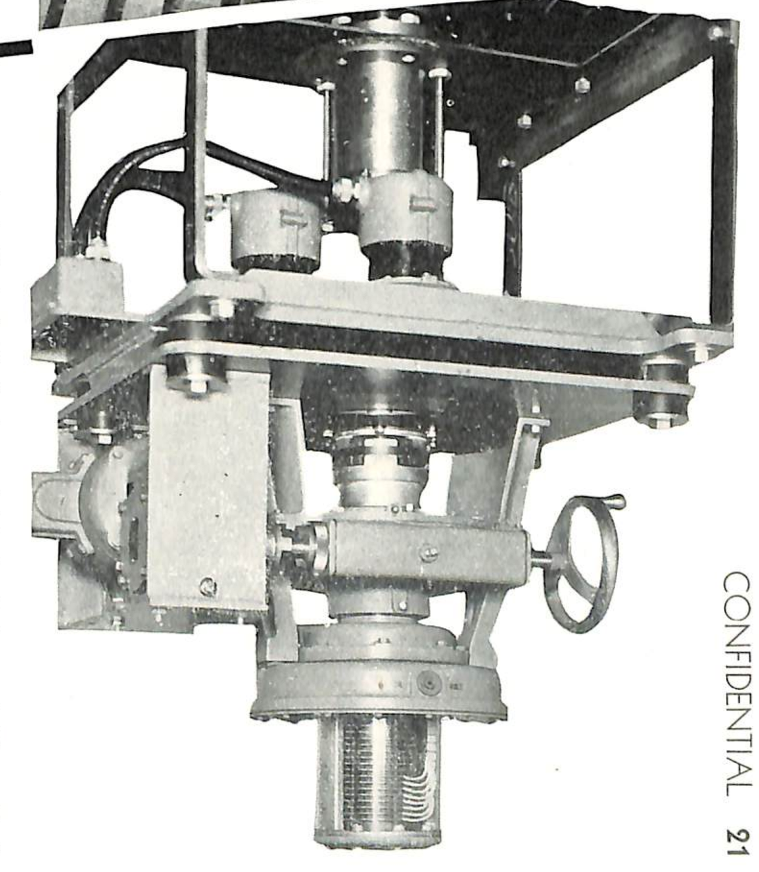
(6) With continuity checker, check between outer shell of coaxial connector under base of antenna and one of the quarter-wave elements. There should be continuity: Also check between center contact of coaxial connector and other quarter-wave element. There should be continuity.

WFA

SOMETHING NEW IN SUBMARINE SONAR



Model WFA Echo Ranging, Listening, Sounding Equipment, now being installed on new construction fleet submarines, represents one of the first sonar installations incorporating many of the newer advancements and devices in pro-submarine sonar.

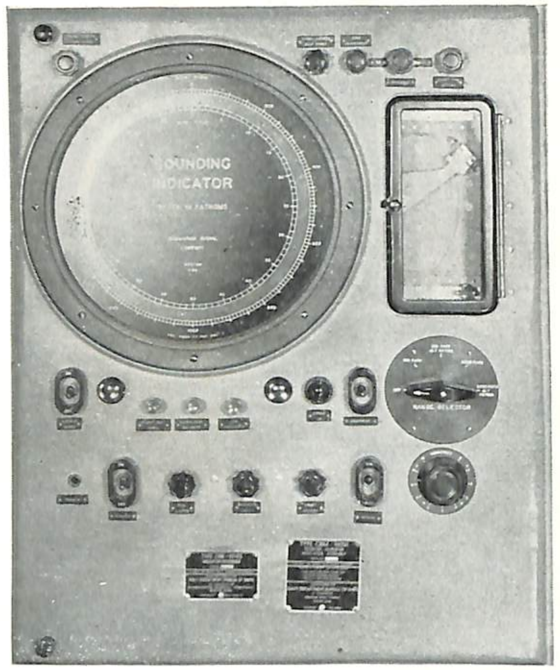


■ Specifically designed for submarine warfare and including in the installation many of the newer advancements of sonar equipment formerly supplied as field changes or as modifications to the original sonar installation, Model WFA Echo Ranging—Listening—Sounding Equipment, manufactured by the Submarine Signal Company, offers a good example of some of the modern advancements that have been made in submarine sonar during the present war.

Model WFA may be considered as a dual unit multi-frequency echo ranging-listening equipment, combined with a dual frequency echo sounding equipment. Although classified as a part of the complete installation, the echo sounding equipment operates entirely independently of the echo ranging-listening equipment.

Among the newer features found in WFA, the following represent some of the modern advancements incorporated in this single installation.

1. Listening over the complete range from 100 cycles to 100 kilocycles. A retractable streamline dome, in



Sounding indicator in control room

which is housed the bottomside projector, enables listening for enemy torpedoes at speeds up to 15 knots while the submarine is on the surface.

2. One-ping echo ranging, designed to reduce the probability of betraying the submarine's position.

3. Torpedo detection, enabling the submarine sonar equipment to be constantly on the alert for enemy torpedoes while the submarine is on the surface.

4. Three ADP crystal projectors, one mounted topside, another bottomside projector housed in a retractable streamline dome which can be electrically hoisted and lowered, and a third ADP sounding projector installed in the bottom of the submarine.

5. Bearing Deviation Indicator Meters, or Phase Actuated Locators (PAL), designed to enable accurate bearing determination when listening.

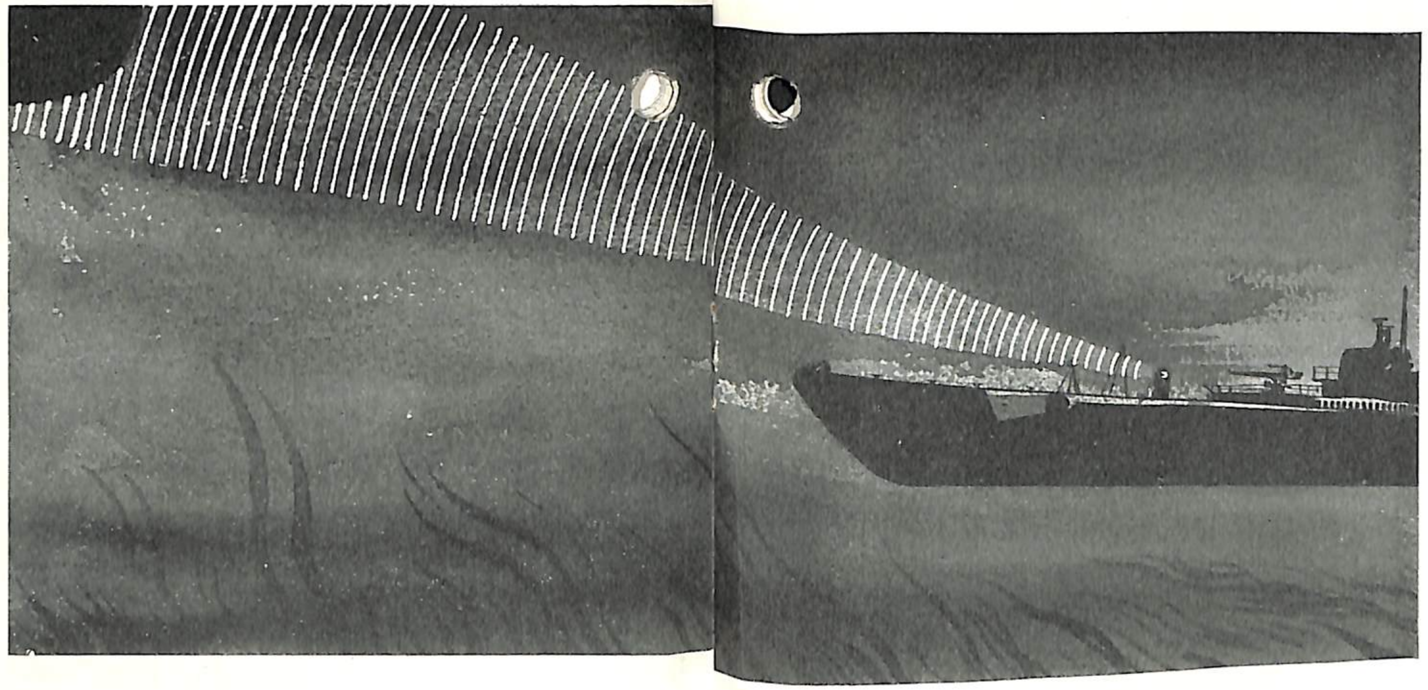
6. Maintenance of True Bearing (MTB), which automatically holds the projector on the true bearing on which it has already been set, regardless of changes in the direction of the submarine's heading, until the operator changes the bearing.

7. Improved and complete intercom features for use by operating personnel in both the remote and local control stations.

8. Dual echo-sounding frequencies for improved security reasons, including emergency alarm systems to indicate when the depth of water is under 200 feet and between 40 and 100 feet.

9. Complete interconnection systems between local and remote control stations to give greater flexibility and speed in both listening and echo ranging operations.

10. Emergency provisions for complete transfer of



all conning tower functions to forward torpedo room in case of casualty to this central control station.

GENERAL DESCRIPTION OF EQUIPMENT

Model WFA is primarily a dual installation, with the master control in the conning tower, commonly referred to as the remote control station, and the other control in the forward torpedo room, the local control station.

In the conning tower are located the remote control stack, consisting of the remote range recorder, the listening amplifier, the remote control unit, and the receiver amplifier.

The remote range recorder contains the mechanism for timing the signal sent out by the ranging driver, a loud speaker, and a recorder mechanism with two scales, 1500 and 3750 yards. A cam operated mechanism in the range recorder circuit provides an additional 600 yard flyback control on the 1500 yard scale for small object detection.

Two internally adjusted signal lengths are available, one for single signal ping ranging, which is obtained when the recorder is on the 3750 yard position, and the other for use with the 1500 and 600 yard positions. Experience indicates that optimum results are obtained on small objects, such as three foot mine cases, when the short pulse is adjusted to seven to ten milliseconds in length. This can be measured by observing the length of the pulse as received and recorded on the recorder. Moreover, the recorder is provided with two styluses, each operating at different input levels so that the dynamic recording range is increased. By this arrangement, weak echoes may be recorded on the stylus operating at the higher gain level, whereas strong echoes may be recorded on the stylus operating at the lower gain level.

When in the standby condition prior to taking a single ping range, the recorder styluses are in motion so that the operator can adjust his receiver gain setting to optimum. Experience thus far indicates that this optimum setting is accomplished when the stylus operating at the higher level is just recording the peaks of target noise.

Although constructed as a single unit, the listening amplifier is, in effect, two separate channel amplifiers, with a common power supply.

The supersonic channel covering the range of 12.5 to 100 kc is used for listening with either the deck or bottomside projector. It is a superheterodyne circuit and can be continuously tuned by a variable capacitor tuning control graduated in kilocycles.

The sonic channel, covering the range of 100 cycles to 15 kc, is used for listening with the deck projector only. It consists of four stages of straight audio frequency amplification. Between the second and third stages is a filter which provides five different audio characteristics. This is accomplished by a bank of low pass, band pass, and high pass filters which are fixed tuned.

The remote control unit contains the necessary controls for hoisting the bottomside projector and for training either the deck or bottomside projectors.

A feature of the training system is the maintenance true bearing (MTB) which automatically holds the projector on the true bearing, on which it has already been set, regardless of changes in the direction of the ship's heading, until the operator changes the projector bearing. The remote control unit also contains a gyro compass and relative bearing repeater and the two BDI or phase actuated locator (PAL) meters, each having red light illumination of dials. One of these BDI amplifier circuits is used with the topside projector and the other with the bottomside projector. Each of these BDI circuits provides an indication on a zero center meter which shows the projector bearing deviation when it is not trained directly on the target.

The receiver-amplifier unit consists of a superheterodyne amplifier used to amplify the echo signal voltage to a value sufficient to operate the range recorder and loud speaker or phones. The frequency range covers 18 to 46 kc, and is continuously tuned by variable air capacitors, which simultaneously tune the ranging driver. An additional feature is the reverberation control of gain (RCG) circuit for substantially reducing the gain of the amplifier during keying and for a short interval immediately after keying.

Separately mounted in the conning tower are a bearing repeater unit and a rectifier power unit which furnishes power for the receiver-amplifier.

In the forward torpedo room are lôcated the local control units of the echo ranging equipments.

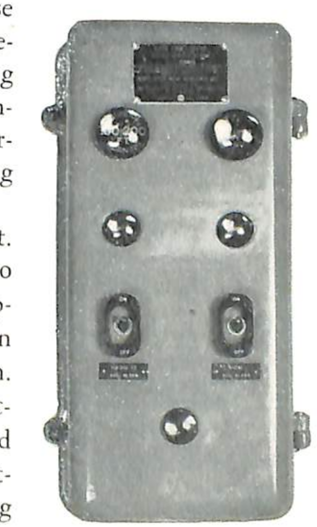
In the local control stack are the local range recorder, listening amplifier, local control unit, and the receiver amplifier. These units are similarly arranged and practically identical to the corresponding units of the conning tower stack.

In addition to this control stack, the following units are stacked in the forward torpedo room:

1. Transfer Relay and BDI Amplifier. This unit contains the relays which are used to transfer the projectors, amplifiers, and driver from receiving to transmitting and vice versa. These relays also connect the desired projector for ranging and connect either the conning tower or forward torpedo room as the controlling station.

2. Training Power Unit. This unit consists of two thyraton training power supplies. They are identical in construction and operation. One controls the deck projector training mechanism and the other controls the bottomside projector training mechanism.

3. Ranging Driver. This unit generates the signal for



Visual-audible sounding alarm WFA Sonar Equipment echo ranging and is tuned over a range of 18 to 46 kc by the main tuning control on the receiver amplifier unit.

A bearing repeater unit and suitable rectifier power units are also mounted in the forward torpedo room.

The deck projector is housed in a cylindrical case above the superstructure deck and is commonly referred to as the topside projector. The various listening and transmitting frequencies of the equipment require the use of three separate ADP crystal sub-assemblies or transducer elements mounted in the topside projector. The ranges of these three transducer elements are as follows:

(a) Audio listening assembly for listening to noises between 100 cycles and 12.5 kilocycles.

(b) Intermediate frequency (supersonic) assembly; listening or receiving at 12.5 to 31 kc and transmitting at 18 to 31 kc.

(c) High frequency assembly; listening or receiving at 31 to 100 kc and transmitting at 31 to 46 kc.

The Train Mechanism provides a rigid mounting for the deck or topside projector and includes the necessary inboard training mechanism. The training motor is controlled by either the remote or local control unit through the training power unit. A scale on the bottom of the projector shaft, graduated from zero to 360 degrees, gives the projector bearing. A synchro system transmits this bearing to the other units of the equipment. An oil immersed slip ring assembly permits the projector to be trained continuously in either direction.

The bottomside hull projector is mounted inside a streamline dome on the bottomside hoist-train mechanism. It consists of a single ADP crystal assembly which transmits received signals over the band of 18 to 46 kc. This assembly operates efficiently in two bands: 18 to 31 kc and 37 to 46 kc.

A Hoist-Train Mechanism unit provides a means of lowering the bottomside projector and its streamline dome beneath the keel of the submarine and for retracting them within the hull when the gear is not in use. It also trains the projector in azimuth. A slip ring assembly permits continuous training in either direction.

Separate motors are mounted on the hoist-train mechanism for hoisting and training but both operations are controlled at either the remote or local training control unit. Handwheels are provided for manual hoisting and training in case of power failure. Under power, the dome and projector may be raised or fully lowered in less than 25 seconds.

A Magnetic Controller for the hoist motor, mounted on the bulkhead of the forward torpedo room, provides the necessary controls for the 7HP 175-345 volt d-c hoist motor and controls the hoisting and lowering of the bottomside projector.

Additional units separately mounted on the bulkheads of the forward torpedo room include:

(a) Emergency Stop Switch, provided to stop the hoisting or lowering of the bottomside projector.

(b) A Brake Release Switch, to allow manual control of the hoist-lower operations.

(c) Junction Box, containing an emergency cut out switch and also serving as a distribution point for the gyro repeater, bearing repeater, control, and signal output circuits to the local and remote control stacks. The emergency cut out switch is a multiple rotary type switch which may be used to disconnect the conning tower in case of damage to that stack or the cables leading to it.

TORPEDO DETECTION UNIT

By means of these units, mounted above each sonar stack, the submarine sonar equipment is constantly on the alert against attack. The unit consists of a means for rotating the bottomside projector at a controlled speed of 12 rpm, at the same time controlling the range recorders so that their styluses traverse the charts once each revolution of the projector. This mechanism enables all bearings to be scanned by the search beam of the projector at intervals of approximately five seconds. The unit enables detection of the high frequency sounds caused by approaching torpedoes and other sources of sounds such as ship targets. It may also be used for normal listening search. It enables the operator to observe the bearing of many targets simultaneously by both visual and audible means.

ECHO SOUNDING EQUIPMENT

The echo sounding equipment is entirely independent of the echo ranging-listening equipment. While an integral part of a complete Model WFA installation, the echo sounding unit is sometimes installed with other equipments. In such cases, it receives the designation NGA.

Two frequencies are provided in the sounding equipment. Normal sounding operations are performed at 67 kc. This higher frequency gives a narrow beam pattern, and higher attenuation in the water. These factors tend to give greater security to the submarine during sounding operations. The usual low frequency of 20 kc is used to obtain depths in the same manner as in standard echo sounding equipment. The following major units of the echo sounding equipment are provided:

1. Receiver-Amplifier Indicator Assembly. This unit is the rack on which are mounted the sounding-indicator-recorder and sounding receiver-amplifier with its power unit. The rack is usually installed in the control room of the submarine.

2. The Sounding Driver, generally located at the bottom of the stack in the forward torpedo room, is designed to operate at the two spot frequencies, a relay selecting the desired operating frequency. Normal operation is at approximately 67 kc. In order to operate the relay to select the 20 kc frequency, it is necessary to operate the frequency control switch on the front panel of the unit.

3. Sounding Projector. This unit is an ADP crystal rectangular transducer with a flat, sound transparent, rubber diaphragm designed for keel mounting. It is installed in the bottom of the hull.

4. Visual-Audible Alarms. One of those two units is mounted in the conning tower and the other in the control room. As the name suggests, these units act as both visual and audible alarms. Whenever the depth of the water under the ship is between 100 and 200 feet a light flashes intermittently and a buzzer sounds. When the depth is between 40 to 100 feet, another light flashes and a chime rings. The two alarm signals are operated by a pair of grid-controlled rectifier tubes in the indicator-recorder unit.

FLEXIBILITY OF WFA OPERATION

Model WFA enables the conning officer to have complete control of the operation of the entire equipment.

The following operating combinations are possible:

1. If the conning tower operator selects to train the bottomside projector for echo-ranging or listening, the forward torpedo room training control is automatically shifted to the topside projector.

2. If the conning tower operator selects to train the topside projector for echo-ranging or listening, the forward torpedo room training control is automatically shifted to the bottomside projector.

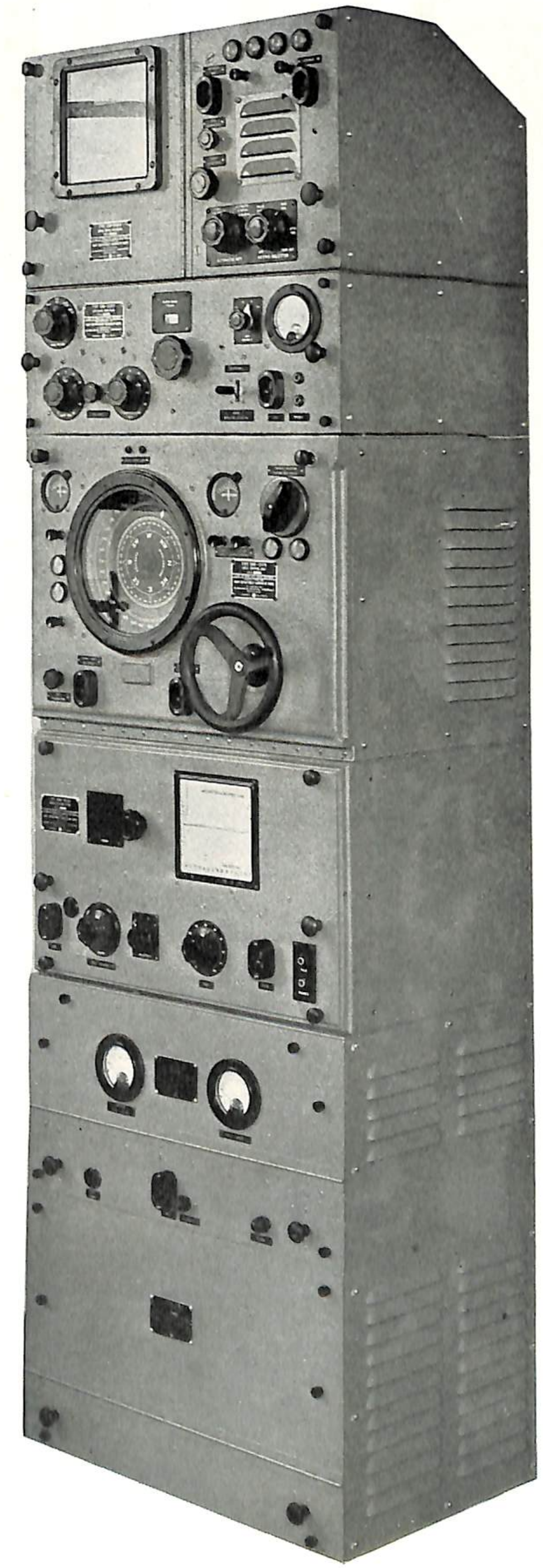
3. Either control station may listen while the other station is echo ranging. Thus, one target may be tracked by listening while the other station is simultaneously echo ranging on another target.

4. The conning officer can monitor the operation of either station at all times.

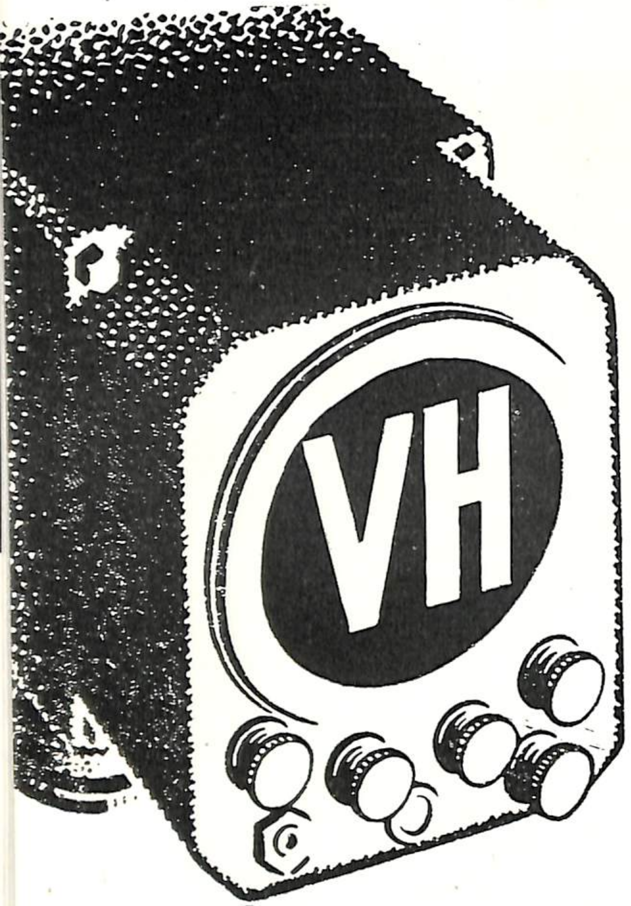
An emergency disconnect switch is provided in the forward torpedo room to permit all functions to be performed by the forward torpedo room stack, completely separate from the conning tower. This emergency operation is used in the event the conning tower suffers a casualty which makes that control station partly or totally inoperative.

An intercommunication system is provided which will permit the conning officer located in the conning tower to talk to both sonar operators with a "press-to-talk" microphone. The operators may talk to the conning officer by means of a loud speaker located in the conning tower.

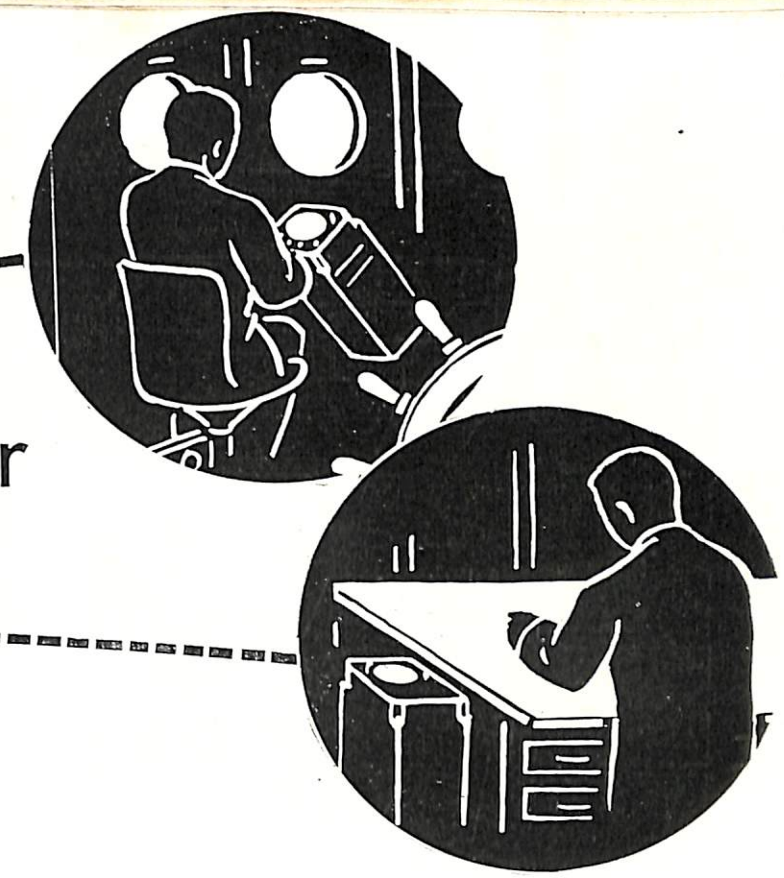
This flexibility and versatility, coupled with intelligent operation, should make Model WFA equipment one of the most effective yet designed in the field of submarine sonar.



Forward torpedo room sonar stack



a new compact radar repeater



■ Need for a radar repeater compact enough for mounting in tough spaces will be met by the new model VH. Only a little longer than the over-all dimensions of its five inch PPI tube, the indicator unit is 7½ inches wide, 9½ inches high, and 21½ inches long. This reduced size has been accomplished by separating the PPI assembly from the rest of the control and power circuits. A highly flexible mounting system permits a wide choice of installation positions. The weatherproof construction of the indication unit permits installation in exposed locations.

PRESENTATION

The Model VH Radar Repeater is a remote indicator designed for use with any type of search radar equipment capable of transmitting PPI information.

Targets are presented on a five-inch PPI tube. Range is estimated by means of the range marks provided; bearing, electrically transmitted from the Master radar, is determined on a dial by means of a manually-operated cursor.

A 2-mile range scale is provided in addition to the usual ranges of 4, 10, 20, 80, and 200 miles.

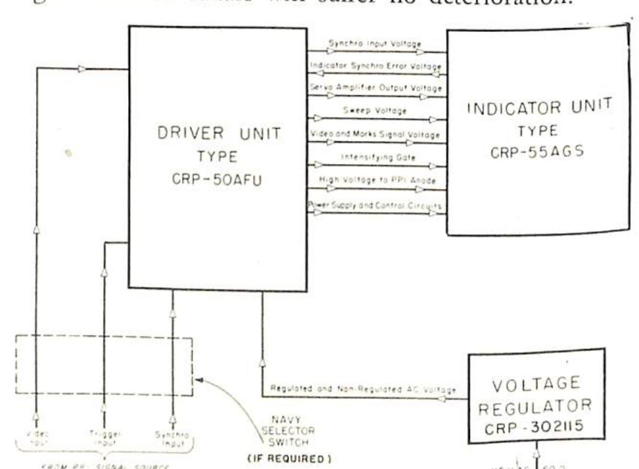
COMPONENT UNITS

The relation of the component units is shown in the block diagram.

The driver unit includes associated power supplies, sweep-generator circuits, and video and servo amplifiers.

THE CIRCUITS

The VH installation arrangements are conventional. The selector switch (not furnished) must be mounted within 4 feet of the driver unit for proper operation. The inputs are the standard video input of positive polarity between 1 and 2.5 volts and standard trigger input of positive polarity between 5 and 50 volts. The circuits have been stabilized; e.g., focus-stabilization has been achieved by the use of a 6AG7 for constant-focus current and sweep stabilization has been provided so that the sweep will remain the same for different repetition rates and different pulse lengths. The video amplifiers have a bandpass of 6 Mc so that signals from high resolution radars will suffer no deterioration.



Basic functional block diagram

WEIGHTS AND DIMENSIONS OF UNITS

Name of Unit	Weight (Approx.)	Type of Mounting	Cable Entrances	Dimensions (Inches)					
				Width		Height		Depth	
				Unit Only	With Mount	Unit Only	With Mount	Unit Only	With Mount
Driver Unit	270 lbs.	Bulkhead	Top and bottom	18	19½	36¼	36¼	13	15
Plan Position Indicator	90 lbs.	Adjustable	Rear end (Adjustable)	8	10	9½	11½	21½	21½
Voltage Regulator	85 lbs.	Bulkhead	Either side near top	9¾	9¾	14	14	8	9¼

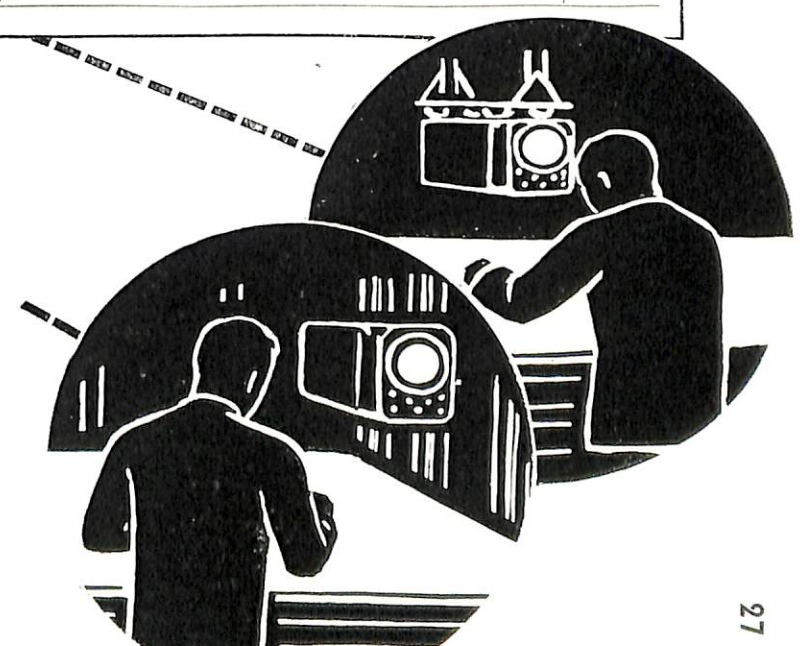
The detailed functional diagram indicates the relation of the various circuits. The equipment draws about 5 amps. at 115 volts, 60 cycles.

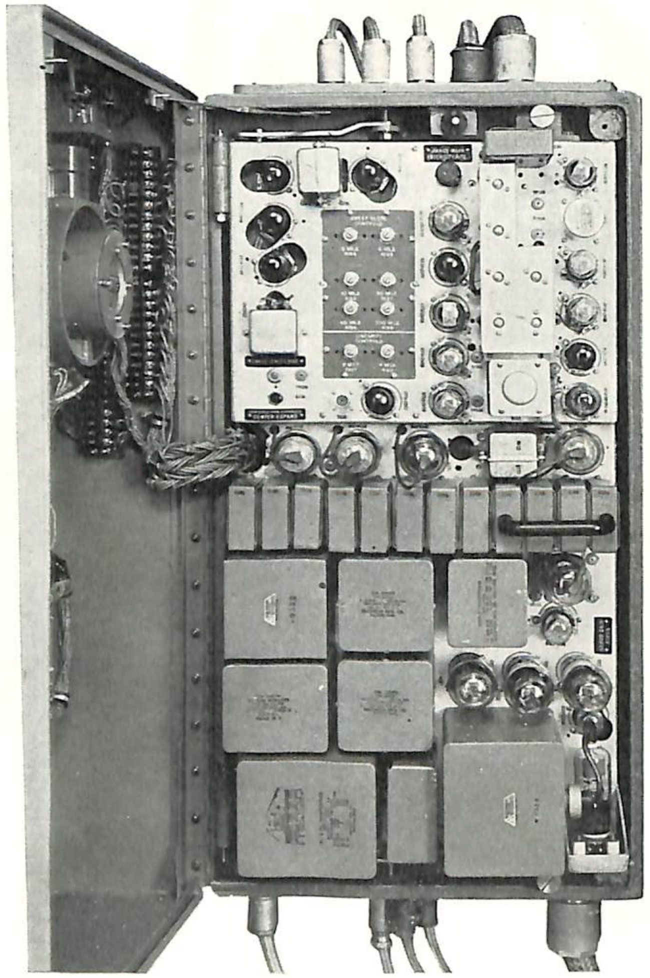
OPERATION

Operation of the VH is relatively simple.

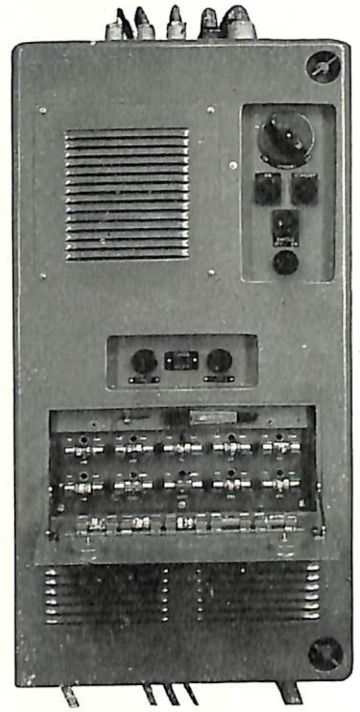
Six controls on the indicator unit provide for all operating adjustments, except that the brilliance of the range marks must be pre-adjusted at the driver unit. These controls include a range selector switch, focus control, video gain control, range-marks switch, bearing cursor, and intensity control. Of these, only the intensity control is screwdriver-adjusted.

The range selector switch provides remote control of a motor-driven switch in the driver unit which selects any desired range of 2, 4, 10, 20, 80, or 200 miles.





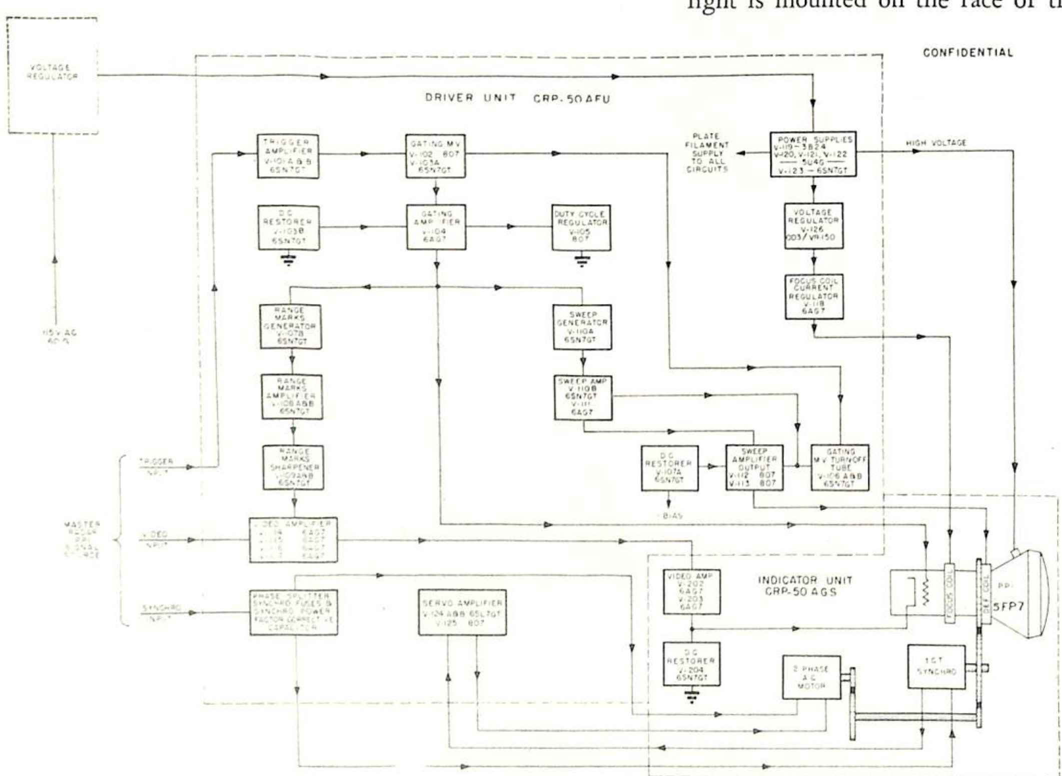
The front panel of the driver unit, when opened, presents a neat arrangement and easy accessibility to all tubes and screwdriver controls.



A front view of the driver unit shows how controls and switches are recessed in the equipment. Dropping door provides easy access to all fuses.

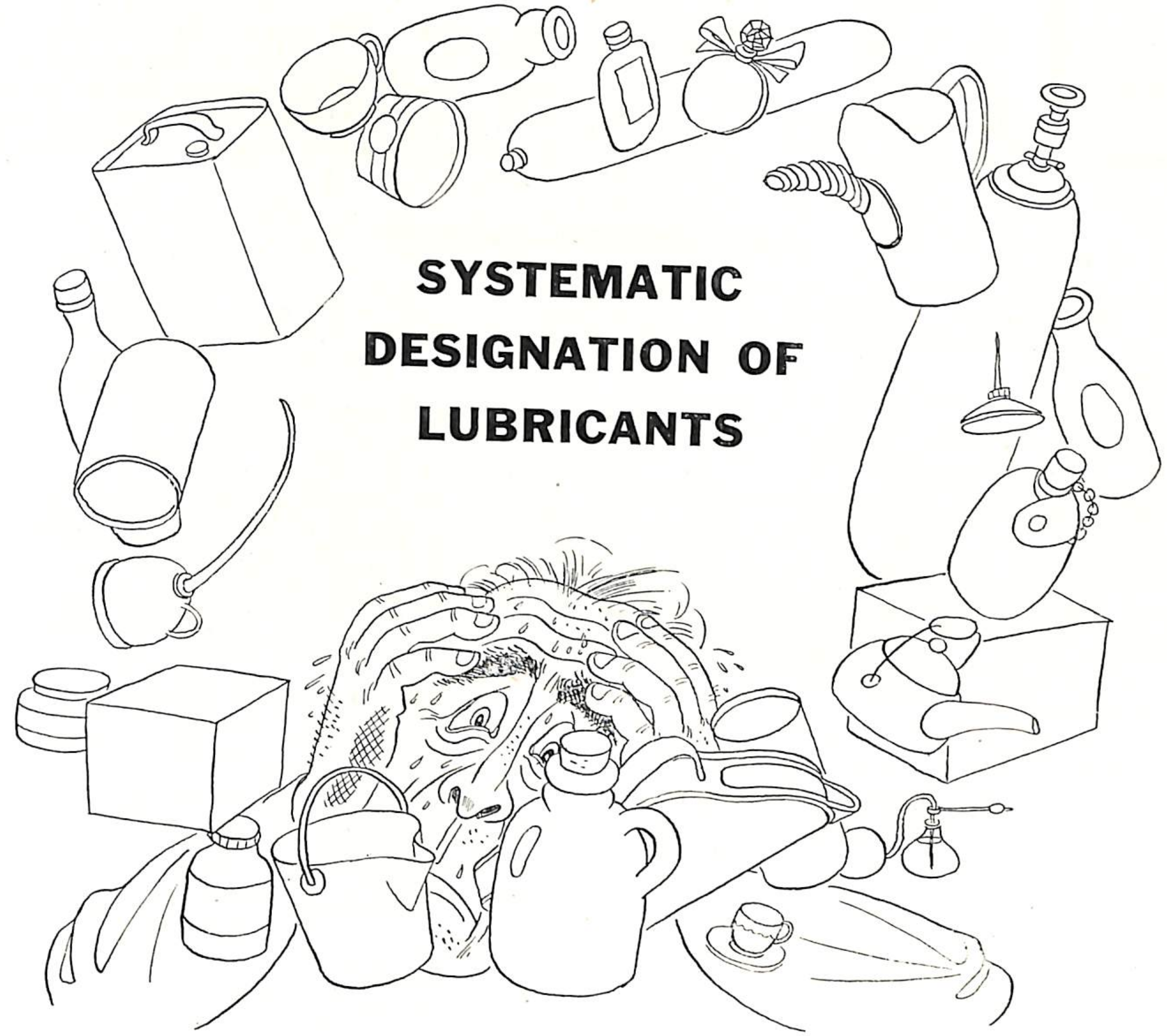
Target bearing is indicated by means of the manually operated bearing cursor. Bearing accuracy is that of any normal one-speed servo system. It is generally within 1 degree of the incoming bearing information. Target range is estimated by means of range marks, four of which appear at each range setting.

As with other types of radar repeaters, normal (true-bearing) operation of the master PPI will provide true-bearing readings at the VH. To indicate when the master radar is operating on relative bearing, a warning light is mounted on the face of the indicator unit.



Detailed functional diagram

SYSTEMATIC DESIGNATION OF LUBRICANTS



■ Have you ever submitted a requisition for a certain type of lubricant using the manufacturer's arm-length designation? If so, do you remember who caught you on the first bounce from the supply office? Probably there is a good reason for manufacturers using a commercial specification. When a company designs a piece of equipment, it solicits the help of oil company experts who specify a certain type of oil or grease to fulfill all the lubrication requirements for each bearing, gear mechanism, etc. The manufacturer then agrees to guarantee this equipment for one year, if the specified lubricant is used.

But, let's look at the practical side of the situation for a moment. Joe the RT, in good faith, makes out a requisition. He adheres strictly to the information furnished in the instruction book when he writes "Beacon Type 285" grease. The supply officer checks this against his list of lubricants which include such designations as 14L4 Grade 90, O.S. 1350, and 14-P-2. Seeing no resemblance, he indicates on Joe's chit that the material ordered is not in stock. O.S. 1350 is, however, the Navy Specification Designation for an oil which contains all the properties of "Beacon Type 285".

In parallel with the vastly expanded production of various pieces of electronic equipment is the simultaneous increase in different commercial types of oils and greases. Many of these lubricants are very similar and may be interchanged. But due to the tremendous space necessary, it would be virtually impossible for a repair or supply ship to stock these hundreds of commercial types. Therefore, there was an urgent need for a comparatively few types of oil which would serve equally as well as those specified by the manufacturer. Because of this need, the lubrication sections of the Bureau of Ships are at work on the task of giving a Navy Specification Designation to each type of lubricant used in the various equipments. An oil or grease with a Navy Specification Designation may have the properties of several commercial lubricants. Thus, the stocking of an oil for every need is greatly simplified.

In order that lubricants may be more easily obtained, instruction books, after March 1945, include in their list of oils and greases used for that particular equipment, a Navy Specification Designation for each lubricant required.

In an effort further to assist the technicians in the selection of correct lubricants for radar equipments, the following information has been compiled and is submitted in chart form. Similar charts for radio equipment will be included in subsequent issues of BuShips Electron.

LUBRICATION—GREASES

Instruction Book Designation	Commercial Designation	Navy Spec. Designation	Nearest Navy Equivalent	Equipments in Which Used
Andok C	B&R Bearing Lubricant No. 4		14L3 Grade III	VG#SP series, ST, Mark 8 Mod 2, Mark 28
Andok C			14L3 Grade III	SL, SO-1
Andok C	Andok C		14L3 Grade III Alt. O.S. 1350	SF/SF-1
Andok Type C	B & R Bearing Grease Grade III		14L3 Grade III	SA-1
AN-G-3A			14L3 Grade III	SL
Beacon M285	Soft Gear Grease		O.S. 1350	SD-3
Beacon M-285 Grease Spec ANG-3	M-285	AN-G-3	O.S. 1350	SC/SC-1, SC-2, 3, 4, 5; VC, VC-1, SK series
Beacon Type M-285	B & R Bearing Grease No. 1		O.S. 1350	SA-1, SP
Beaconlube M-285			O.S. 1350	SO-1, 3, SOa/SO-13, SGa/SG-1
Beaconlube M-285 Royco #8			O.S. 1350	SGa/SG-1
Beaconlubricant M-285	M-285	AN-G-3A	O.S. 1350	VG series, Mark 8 Mod 2
Beacon #10 M-285	M-285		ANG-3 Alt. O.S. 1350	SF/SF-1
Colonial Beacon M-285			O.S. 1350	SO-1, VD, VD-1
Colonial Beacon Andok C			14L3 Grade III	SO-1, 2, 3, 8, 9; SOa/SO-13, VD, VD-1
Gear Grease	SAE #90		14L4 Grade 90 A-2-105	SA, SA-2
Light Ball Bearing Lubricant	B & R Bearing Grade II		14L3 Grade I	SA-1
Lubrike M6	Lubrike 6		14L3 Grade III	SP
Lubriplate No. 110		14L3 Grade III		VC-1, VC, SP
M-285			O.S. 1350	SO-1, 2, 8 and 9
Navy ANG-3	Ball Bearing Grease #1		O.S. 1350	SA-2
Navy ANG-3	Soft Gear Grease		O.S. 1350	SA-2
Navy Spec 14L3 (INT) Grade B Grease	B & R Bearing Lubricant Grade 2	14L3 Grade II		SC/SC-1, SC-2, 3, 4, 5; SK series, VC, VC-1, Mark 8 Mod 2
Navy Spec 14L3-C (INT) Grease	B & R Bearing Lubricant Grade 4		14L3 Grade III	SC-3, 4, 5
Norma Hoffman C-66 Beacon M-285			ANG-3	SL
Petrolatum	Petrolatum		14P1	SA, SA-1, SA-2, SD-3
Petrolatum Jelly			14P1	SA, SA-1, SA-2, SD-3
Singer Grease			ANG-3 Alt. or O.S. 1350	SF/SF-1
Socony BRB No. 1	Ball Bearing Grease #1		O.S. 1350	SA
Socony Vacuum Gargoyle No. 1	Semi-Fluid Grease		14L3 Grade II	SD-3
Spermicetti Wax			VV-P-121	SL
Tenacious Gear Grease	SAE 90		14L4 Grade 90 or A-2-105	SA, SA-2
Thin Coat of Grease			O.S. 1350	SGa/SG-1
Tocan #1 or M-285			O.S. 1350	SO-2, 8, 9

LUBRICATION—OIL

Instruction Book Designation	Commercial Designation	Navy Spec. Designation	Nearest Navy Equivalent	Equipments in Which Used
Boyol D			14K1b	SL
Light Machine Oil	SAE 20-30		2190, 2190-T, 9250	SC/SC-1
Light Machine Oil	SAE 20	N.S. 3050	N.S. 9250 N.S. 9110	SGa/SG-1
Light Machine Oil			N.S. 9110 N.S. 2110 O.S. 1362	VD, VD-1
Light Machine Oil—Nat Heavier than SEA 40	SAE 20-30		2190, 2190-T, 9250	SC/SC-1, SC-2, 3, 4, 5, SK
Light Oil	SAE 20		3050, 9170	SA; SD/SDa, 1, 2, 3
Light Oil Navy Symbol 5065	SAE 30-40		3065, 9250, 2250	SC/SC-1, SC-2, 3, 4, 5; SK
Navy 1042	SAE 10W	2075, 9110		SA-2
Navy 2250 or 3065 Univis No. 60	SAE 30	3065, 9250		SD-3
Navy 3050	SAE 20	9170, 3050		SA-2
Navy Type 3050, SAE 20	SAE 20	9170, 3050		SA-2, SD-4, 5
Navy 5190 or 6135 #600 W Oil	600W	5190, 6135		SD-3
N.T. 9250		9250		SK
Nyes External Low Temperature Clock Oil			O.S. 1362	SGa/SG-1
Oil #10	SAE 10		2110 alt. 9110	SF/SF-1
SAE 10	SEA 10	AN-O-4	N.S. 2110 N.S. 9110	VG series
SAE 20	SAE 20	3050, 9170		SA, SA-1, 2
SAE-30 with Rust Inhibitor			O.S. 1363 2190T, 9250	SC series
Socony Vacuum Type 600W	600W	5190, 6135		SA-1
Univis No. 40			2075	SL
Univis No. 48			O.S. 1113	SC/SC-1, SC-2, 3, 4, 5
Univis No. 48 or Mineral Oil			O.S. 1113	SL
Univis No. 54			O.S. 1113	SL
Univis No. P-48			N.S. 9110 N.S. 2110 O.S. 1362	SO-1, 2, 3, 8, 9, SOa/SO-13; VD/VD-1; VD-2
Univis No. P-48	SAE 10W	O.S. 1113	O.S. 2943	SP

GREASES

Navy Specification Designation	Federal Standard Stock Catalog No.	Standard Package
A-2-105	14-L-188-5	5 gal.
O.S. 1350	14-G-715	10 lbs.
VV-P-121	14-P-65	1 lb.
14L3 Grade I	14-L-131	1 lb.
14L3 Grade II	14-L-90-15	1 lb.
14L3 Grade III	14-L-85-5	1 lb.
14P1	14-P-100	5 lbs.

OILS

Navy Specification Designation	Federal Standard Stock Catalog No.	Standard Package
AN-O-4	14-O-2390	1 gal.
O.S. 1113	14-O-884-10	5 gals.
O.S. 1362	14-O-2833-65	5 gals.
2075	14-O-2586	5 gals.
2110	14-O-2595	5 gals.
2190	14-O-2625	5 gals.
2190-T	14-O-2879	5 gals.
3050	14-O-2662	5 gals.
3065	14-O-2663-8	5 gals.
5190	14-O-2760	5 gals.
6135	14-O-2775	5 gals.
9110	14-O-2162	5 gals.
9170	14-O-2170	5 gals.
9250	14-O-2187	5 gals.

Magic Eye Tuning for Model QGA Sonar

SONAR MONITORING SYSTEM FOR FIXED DOMES ENABLES VISUAL TUNING OF MODEL QGA SONAR EQUIPMENT

■ A method of "seeing" if the frequency of the driver is adjusted for maximum transmitted signal and if the transmitted signal level is normal has been designed by the Bureau of Ships for ships having model QGA sonar equipment.

The equipment is a permanently mounted installation which can be used at all times to check the frequency of the driver and to determine whether the equipment is correctly tuned for maximum operating efficiency.

This "magic-eye" tuning monitor is known as Sonar Monitoring Equipment for Fixed Domes. It consists of two major units, a hydrophone and an indicator, each identified by a Navy type number. The hydrophone, type CQJ-51061, is similar to that supplied with the model OAX testing equipment and is permanently mounted in the after end of the 100 inch keel-mounted fixed dome which houses the projectors of the model QGA sonar equipment. The tuning indicator, type CQJ-55162, is mounted permanently near the sound stacks of the echo ranging equipment where it can be viewed by the sonar operator while adjusting the control dials.

The CQJ-51061 hydrophone consists of an Alnico permanent magnet surrounded by two semi-circular forms on which the field coils are wound. An annealed nickel shell, one and one half inches long outside diameter, six inches long, properly mounted and made waterproof by duprene gaskets, surrounds this electromagnet circuit. The unit is permanently mounted in the after end of the 100 inch fixed dome and connections are made by a two-conductor shielded duprene insulated cable.

The hydrophone converts the energy of the underwater sound waves impinging upon its acoustically active face into electric wave energy. Having an approximately flat frequency-response characteristic, the voltage developed across its terminals is proportional to the amplitude of the impinging sound waves. Its output depends upon whether or not the monitored projector, or source of sound waves, is trained directly toward the hydrophone and also, whether or not the frequency of the signal is adjusted for maximum transmission.

The CQJ-55162 Tuning Indicator, permanently mounted near the sonar stacks where it can be viewed and controlled by the sonar operator while adjusting the tuning dial, consists of an amplifier stage, a signal rectifier stage, and an electron-ray, "magic-eye", type 1629 indicator. The equipment requires a 110-115 volt source, either direct current or single phase 60 cycle alternating current. The equipment draws 20 watts.

The "magic-eye" indicator, a gain control switch, and a power switch are located on the front panel of the indicator unit.

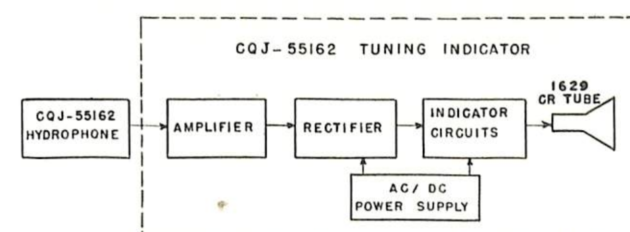
The output of the hydrophone circuit is amplified and the signal rectified by means of a 12SQ7 tube. This rectified voltage is then applied to the grid of the 1629 electron-ray tube. The shadow angle of the indicator is thus controlled by the voltage initially developed across the terminals of the hydrophone mounted in the fixed dome.

Complete unit diagrams, as well as maintenance information, is given in the manufacturer's instruction book accompanying the installation.

Installation of the Sonar Monitoring Equipment must take place when the ship is in drydock. Units have been distributed to the Navy Yards at Boston, New York, Mare Island, Puget Sound, and Pearl Harbor for installation. Additional information on the availability of these units can be secured from the RMO or Radio Supply Office.

Calibration of the equipment must be made at the time of installation. These reference readings serve as the arbitrary measures of normal output and the standards of comparison for subsequent tuning and checking of the equipment. Detailed instructions for calibration and operation of the equipment are given in the manufacturer's instruction book.

A similar type of tuning monitor is being designed for Sonar equipment having retractable domes. Complete details of this monitor will be announced as soon as the units are available.



Block diagram of the tuning indicator.

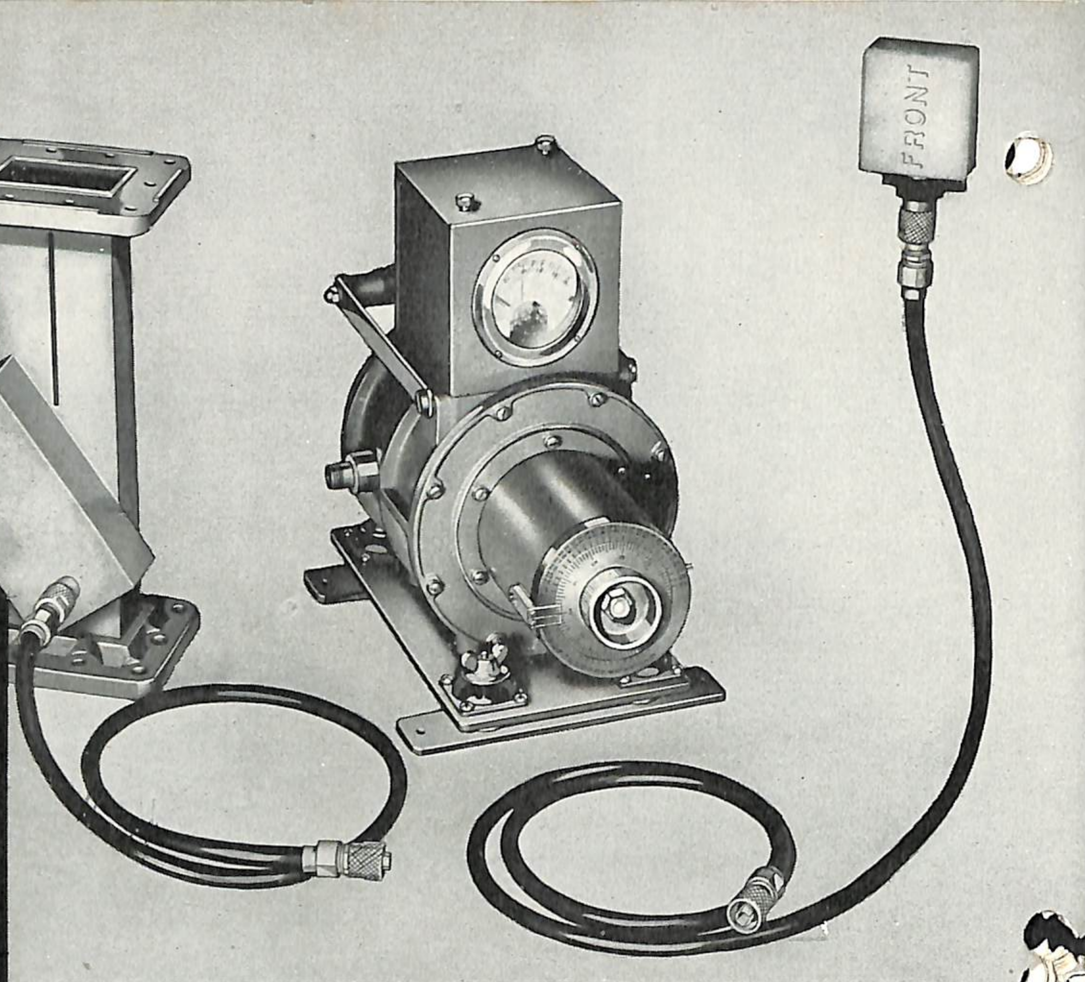


FIGURE 1.—*One model echo box test set, the OBU-3, is shown with a directional coupler to the left and a pickup dipole to the right.*

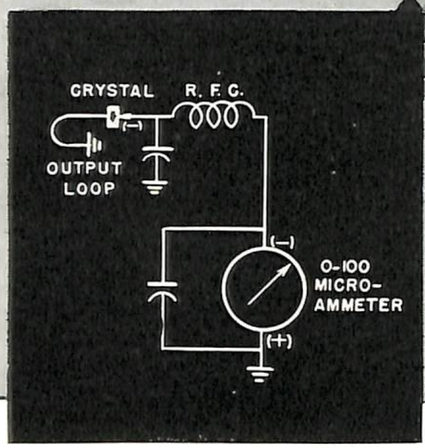


FIGURE 2.—*Schematic diagram of the echo box.*

How good is your RADAR?

THE ECHO BOX MEANS BETTER PERFORMANCE

Lt. D. M. May, Bureau of Ships

■ "Sail ho. . . . two points abaft the port galley stanchion", reported the lookout, and the radar operator viewed a scope—void of everything but a trace. Yet to the average RT the equipment seemed to be operating normally. Perhaps this statement is somewhat exaggerated, but it has been definitely proven by extensive tests in the Fleet that even the most competent technical personnel cannot determine by visual indications on the scope whether or not they are receiving optimum performance from their radar. Some means of measuring actual performance of radar is necessary, and the echo box solves this problem.

The echo box and its advantages have been known for some time, but until recently they were not available in large quantities. Now that production of these boxes is rapidly increasing, their importance to the proper maintenance of radar cannot be overemphasized. The echo box not only indicates overall performance of a radar, but specifically acts as a frequency meter, power indicator, spectrum analyzer, and trouble shooter. In short it is a super test set.

This echo box is essentially a hand-tuned resonant cavity with an output meter circuit. One type of box is shown in figure 1. It consists of a cast bronze cavity with removable bronze end plates. The plunger is activated by means of the adjusting screw and the tuning dial. The tuning mechanism is mounted on the housing and a preloaded ball bearing reduces the backlash to a negligible amount. Gears are so arranged that the outer dial travels one of its divisions while the inner dial makes one revolution (a one-to-ten ratio). The gears merely operate the outer dial and have no connection with the driving of the plunger. The indicating meter, a micro-ammeter, is mounted on top of the main casting. An input loop is inserted in the left side of the main casting. It is installed with a gasket and is adjusted at the factory for maximum ringing time. The ouput loop and crystal holder is inserted into the top of the casting under the meter cover. This loop may be adjusted by means of a knurled sleeve provided. The whole assembly may be fastened to a shock-mounted base or carried by a handle. Figure 2 shows the schematic circuit, the simplicity of which makes further comment unnecessary. Note the positive side of the meter is grounded.

Among the several methods of coupling the transmitter to the echo box are the directional coupler and the pick-up dipole. The principal purpose of both is to make a certain percentage of the r-f power from the radar available for power measurements and provide a convenient method of feeding a test signal into the radar receiver.

Directional couplers are superior to other coupling devices in one or more of the following aspects.

1. The power pickup in a directional coupler is not dependent upon the position of the coupler relative to the standing wave maxima and minima in the r-f line because a directional coupler does not respond to the reflected wave that produces standing waves, but rather picks up only the wave proceeding from the transmitter. Conversely, when power is introduced into the radar line by means of a directional coupler, as when testing the receiver, the power comes only in the direction of the receiver.

2. The fraction of power that is picked up is both known and constant from day to day.

3. In any sort of power measurement, it is most desirable that the r-f inpedance presented to the test equipment be good. With a directional coupler, there is provided a test point that is matched. This is not the case with simple probes inserted into the transmission line.

The dipole may be used very effectively, but requires a calculation of the space loss. This space loss will vary with the type of radar equipment being tested and with the position and spacing of the test dipole. Formulas and other information for calculating space loss are explained fully in the echo-box instruction book.

The primary use of the echo box is to measure overall performance of radars; that is, to determine whether the transmitter is delivering its maximum energy to the antenna and whether the receiver is functioning at maximum sensitivity. This is accomplished in the following manner:

The directional coupler or dipole picks up about 1/100, or less, of the transmitter pulse energy and feeds this energy to the input of the echo box through an RG-8/U coaxial cable, 5 to 20 feet in length. This cable is kept short to reduce energy loss and to make testing more reliable. The r-f power delivered to the echo box cavity varies with radar power, pulse length, PRF and the length of coupling cable used. Therefore, adjust the coupling unit, if necessary, so that a reading of 40-80 microamperes is obtained with the cavity tuned to resonance. After the initial setting at the time of installation, the coupling is left fixed so that readings taken from time to time may be compared and relative performance determined.

The r-f energy fed to the cavity excites oscillations when the cavity is tuned to resonance. This timing is accomplished by turning the dial on the echo box until the micro-ammeter reading is maximum. "Rocking" first to one side of resonance and then to the other insures a more accurate reading. This reading, when compared with initial readings taken when the equipment was known to be operating at maximum, will furnish a reliable indication of the relative operation of the equipment at the time of the test. This is the test for proper transmitter performance.

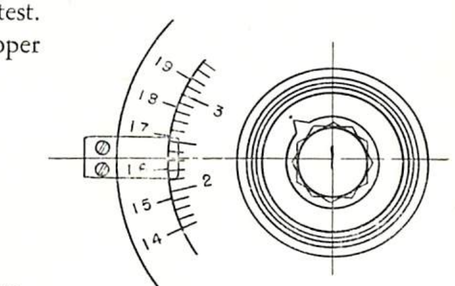


FIGURE 3.—*A section of the echo box tuning dial. Outer dial moves one division when inner dial is turned one complete revolution. Reading above would be approximately 1623.*

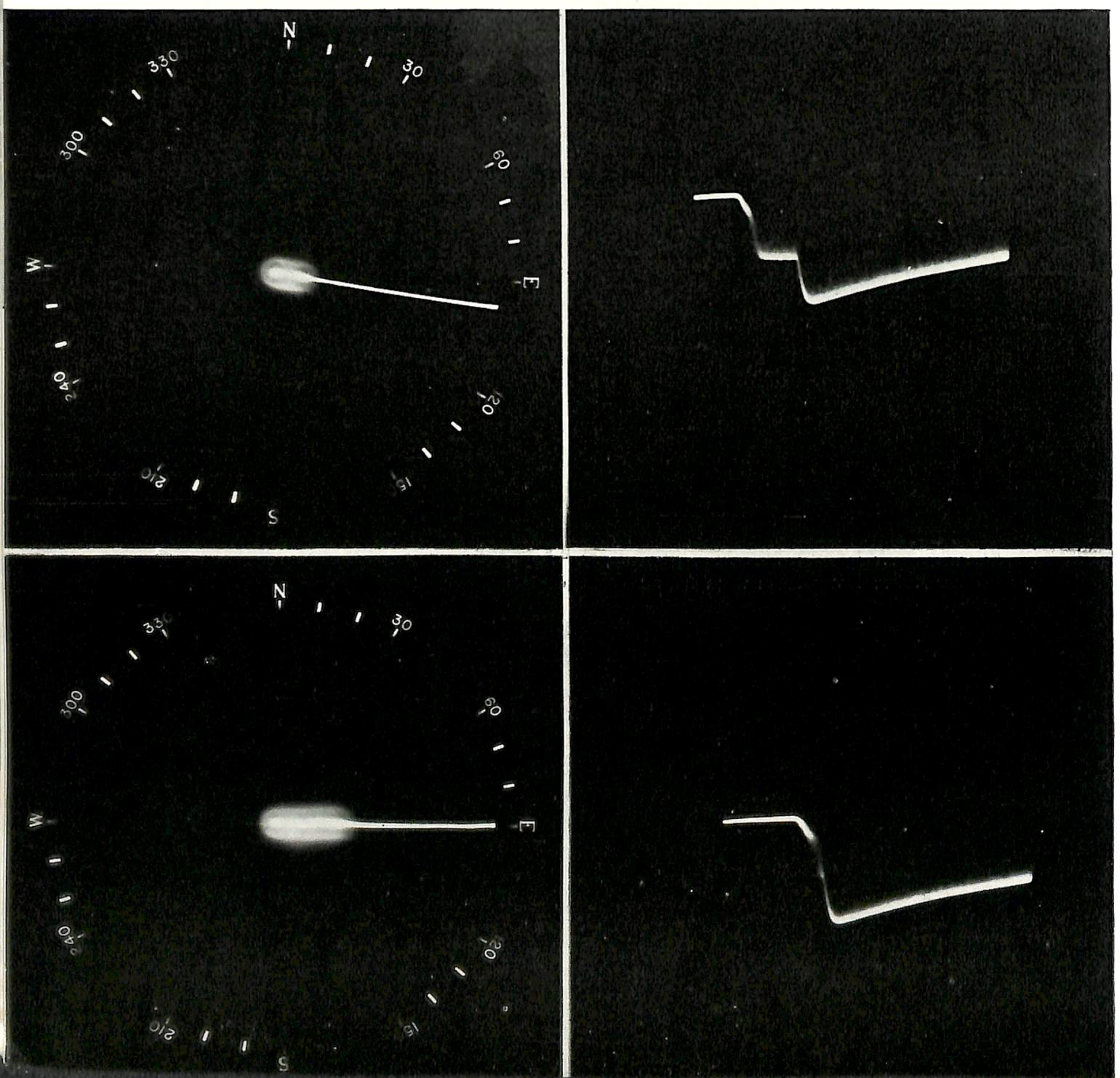
CHECKING RECEIVER SENSITIVITY

Energy created by oscillations in the cavity may be fed to the input of the receiver via the same coupler or dipole. This energy causes a saturated signal, known as ringing, to appear on the scope. The performance of the radar is measured by a comparison of the expected ringing time (ERT) and the actual ringing time. The expected ringing time depends on the way the echo box is installed; for example, whether a directional coupler or a dipole is used; upon the length of RG-8/U cable used; on the individual ringing ability of the echo box employed; on the frequency of the radar; and on the temperature of the echo box at the time of testing. Corrections are made for all of these factors, and procedures for obtaining ERT are explained fully in the instruction book.

The appearance of a good ringing time pattern on an A-scope is illustrated below (lower-right). The receiver gain should be set so that the "grass" is one-quarter to one-third the height of the saturated signal. The exact end of ringing time occurs at the furthest point to the right where the top of the grass is noticeably above the general level of the rest of the grass. Do not judge the time by the bottom of the grass, or by the end of the saturated portion of the ringing time, because these items are influenced by receiver gain setting and other factors. Measurements of ringing time on A-scopes are more accurate and easier to read when the antenna is not rotating.

In measuring ringing time on a PPI scope, the same general principles apply and the following procedure may be used.

The scope photographs below show a ringing time of 3000 (upper) and 5000 yards (lower) on the A-scope and PPI indicator. The step in the A-scope pictures appear at 5000 yards, which is the normal ringing time for this particular equipment. The low ringing time shown in the two upper photographs was caused by a slightly defective duplexer and a receiver which was not peaked.



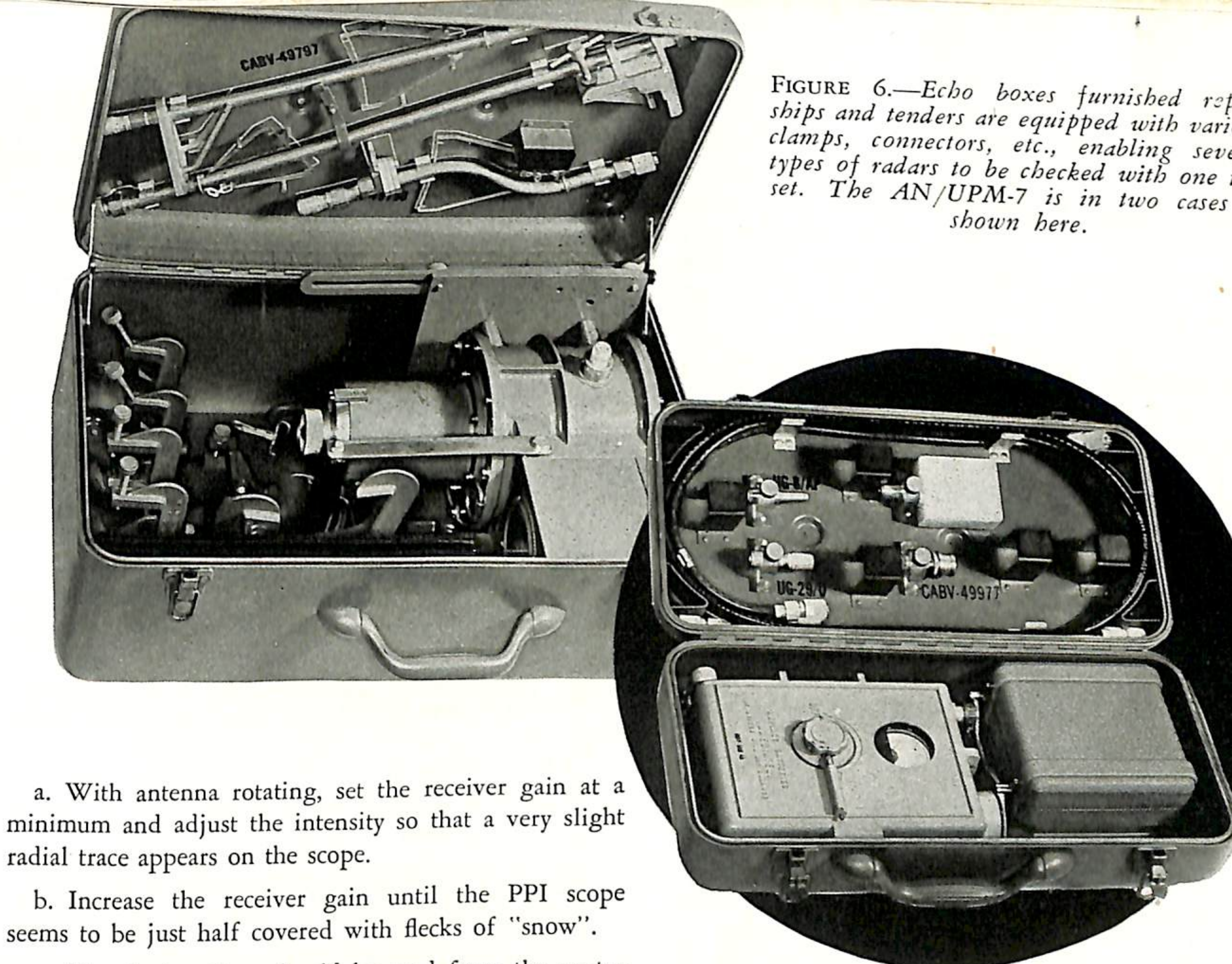


FIGURE 6.—*Echo boxes furnished repair ships and tenders are equipped with various clamps, connectors, etc., enabling several types of radars to be checked with one test set. The AN/UPM-7 is in two cases as shown here.*

a. With antenna rotating, set the receiver gain at a minimum and adjust the intensity so that a very slight radial trace appears on the scope.

b. Increase the receiver gain until the PPI scope seems to be just half covered with flecks of "snow".

c. The ringing time should be read from the center of the scope to the extreme tip of the pattern where it fades into the background noise, and not from the end of the bright portion of the pattern.

It should be remembered that a small loss in ringing time represents a great loss in effective range. In one model of echo box, each 80-yard loss in ringing time is the equivalent to a 1 db. loss in performance.

FREQUENCY MEASUREMENT

As stated above, the echo box may be used as an accurate frequency meter. When the tuning dial on the unit is rotated until the micro-ammeter indicates maximum, the cavity is tuned to resonance. On some models of echo boxes the frequency may then be obtained directly from the dial reading. On others, it is necessary to apply this dial reading to a calibration curve which is furnished with the unit. In either case, the dial is read by reading the outer dial number followed by the inner dial number, as illustrated in figure 3 (page 35).

SPECTRUM ANALYSIS

A natural and inevitable result of pulse modulation is the creation of sideband frequencies, and their power must be kept relatively low. Spectrum graphing is one method of analyzing these pulse frequencies, and a graph may be prepared in the following manner:

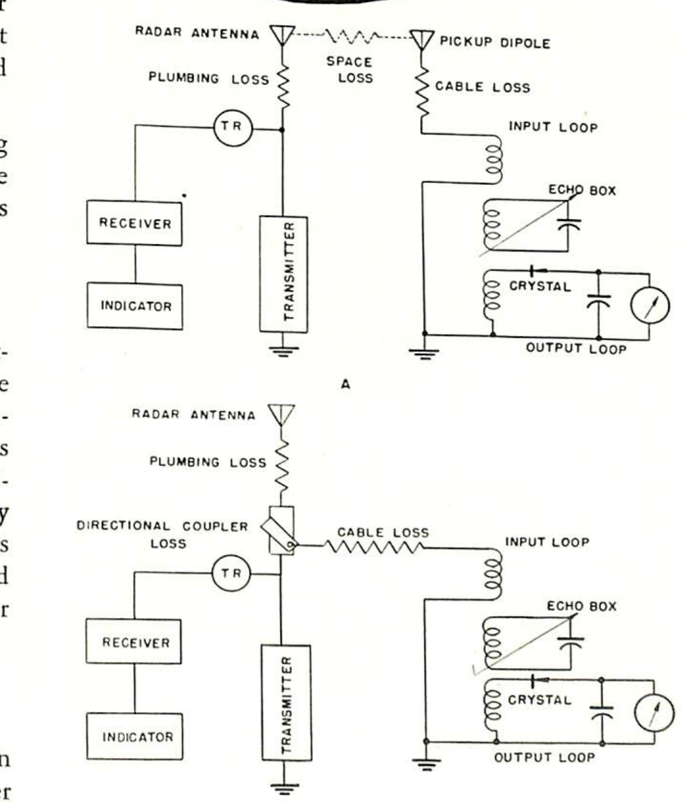


FIGURE 5.—*Two methods of feeding the echo box are illustrated above. Note that when the directional coupler is used, the plumbing loss is not present.*

The tuning control of the test set is first turned until a maximum output meter deflection is obtained, then turned slowly from a point well below this maximum to a point well above it. While this is being done, the output meter readings are noted for various settings of the tuning control. It is good practice to cover the frequency range desired by rotating the tuning dial continuously in the same direction from well to one side of the main parts frequency to well on the other side. This will minimize the chance of error due to any backlash presented. A reading should be taken about every two hundredth revolution of the tuning knob.

Finally, an accurate graph may be constructed with the meter readings plotted against the tuning control dial settings.

A periodic check on performance will often times prevent serious difficulties that may otherwise occur. Correct use of the echo box and knowledge of its reliability will make repair and proper upkeep of radar a much easier problem.

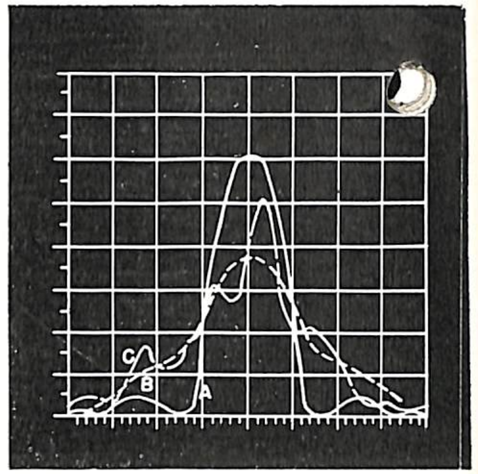
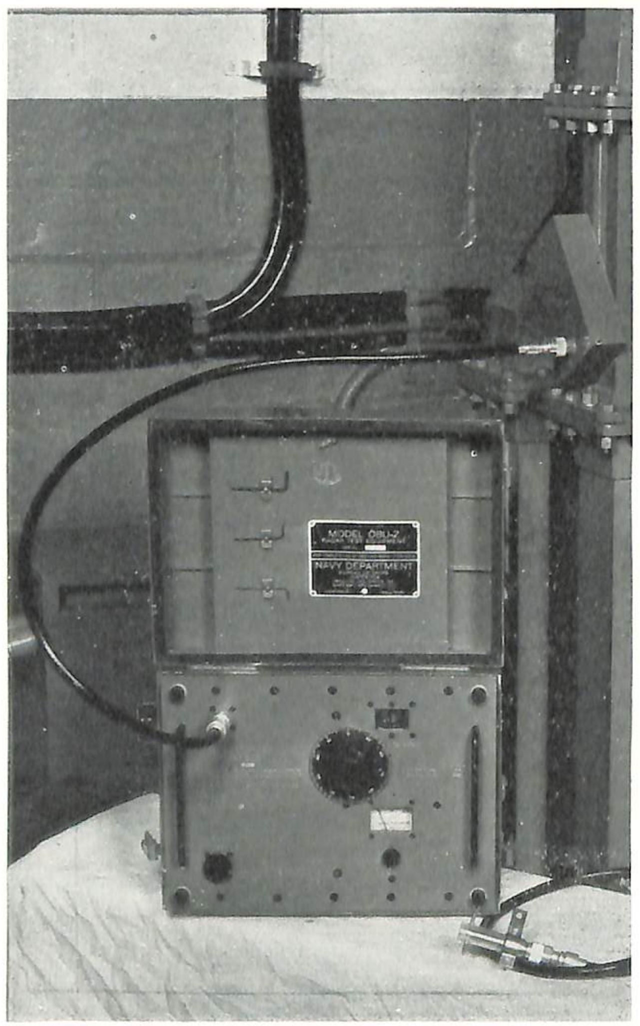


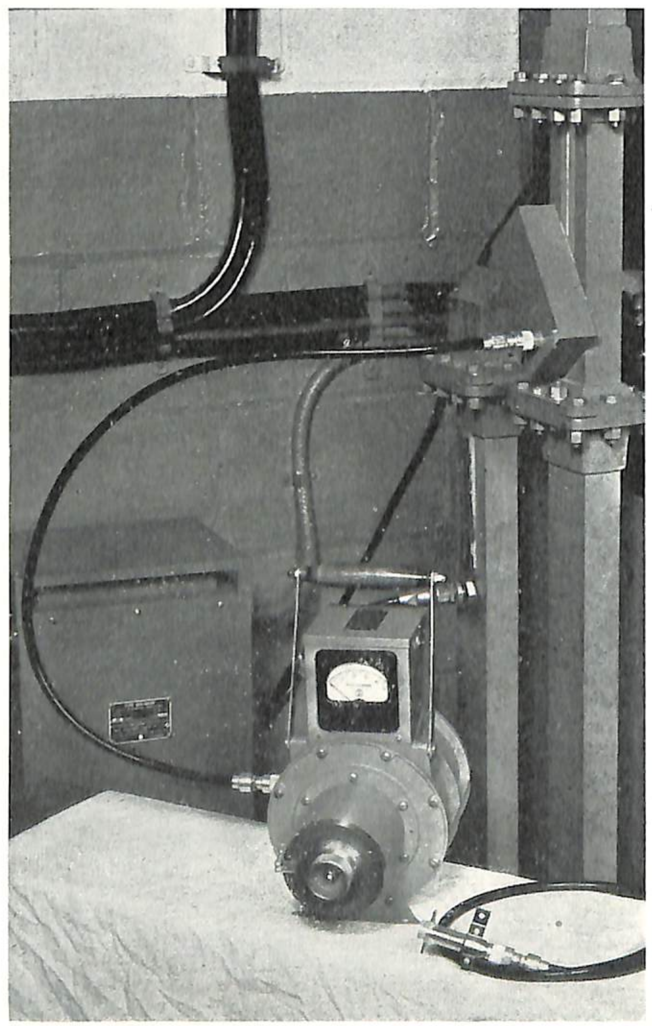
FIGURE 4.—*A spectrum graph gives a good indication of transmitter performance. Curves A, B, and C represent good, fair, and poor performance respectively.*

POWER OUTPUT

The output meter reading is closely proportional to the average radar power picked up by the echo box when the echo box is tuned to the maximum of the spectrum. If the pulse length is long, the spectrum curve is consequently high and narrow, and the meter reading high. Where the pulse length is shorter the spectrum curve is flatter and the meter reading will be lower.

The OBU-2 (left) and OUB-3 (right) Echo Boxes are shown coupled to a directional coupler. A pick-up dipole similar to that shown to the right of the echo boxes may be used instead of the directional coupler.





CVE-91 reports YE-2 troubles

A report received from the U.S.S. MAKASSA STRAIT (CVE-91) is an excellent example of good reporting of troubles and maintenance procedures. Similar reports from other units afloat and ashore are needed if other ships are to benefit by the experience and ideas of your crew.

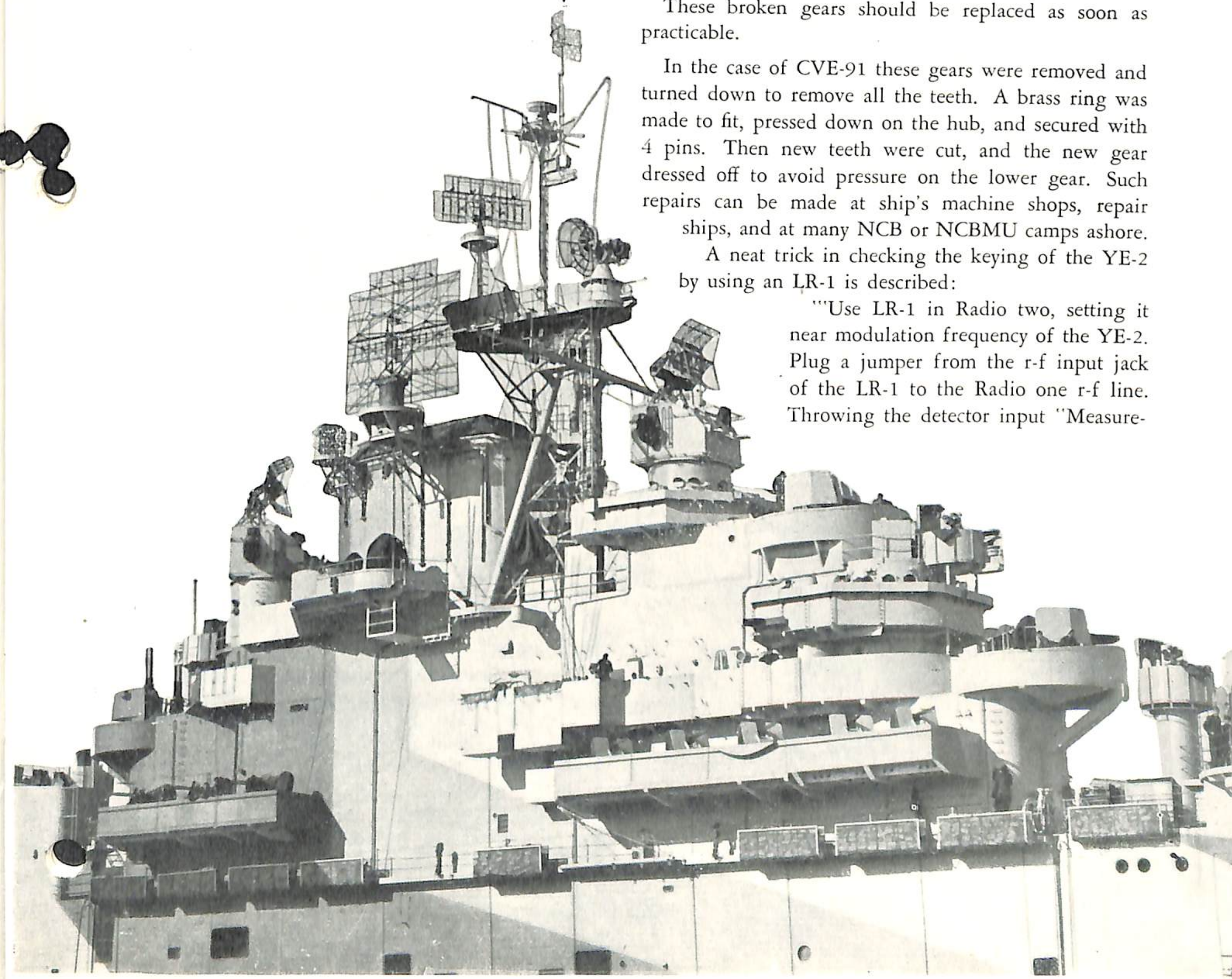
"The YE-2 antenna would not rotate. The control unit was checked, and everything was normal. A check of the antenna drive unit showed that the antenna was jammed. This was due to a broken tooth from the antenna drive tube gear that had pressed itself into the gear driving it. Four other teeth were broken, and in such a state that they could be removed by pulling on them with one's fingers. The drive tube gear was resting on the surface of the dual gear driving it. Marks indicated that the teeth of the drive tube gear had dug in at a point where the teeth end and the surface of the lower gear starts. For this to happen, the drive tube gear had to be at an angle causing the tooth to bite into solid metal and break. Since this casualty occurred during heavy seas, it was probably due to vibrations. The broken tooth and the metal from the loose teeth were removed, and the gears were greased, but we were unable to lift the gear driving it. Since the equipment is vital to operations, it is being used as it is. The gears in the drive box unit run smoothly even in this condition."

These broken gears should be replaced as soon as practicable.

In the case of CVE-91 these gears were removed and turned down to remove all the teeth. A brass ring was made to fit, pressed down on the hub, and secured with 4 pins. Then new teeth were cut, and the new gear dressed off to avoid pressure on the lower gear. Such repairs can be made at ship's machine shops, repair ships, and at many NCB or NCBMU camps ashore.

A neat trick in checking the keying of the YE-2 by using an LR-1 is described:

"'Use LR-1 in Radio two, setting it near modulation frequency of the YE-2. Plug a jumper from the r-f input jack of the LR-1 to the Radio one r-f line. Throwing the detector input "Measure-



Match" switch to "Match", we can check the YE-2 keying by plugging a head set into the audio output of the frequency meter and listening to the beat note of the LR-1 against the modulation frequency.

A modified heater circuit which will be on when the gear is not being used is described in the report. "We have modified the heater circuit by making use of two spare leads in the drive box to the antenna control unit. The two spare leads picked up there were wired to two spares leading to the transmitter. At the transmitter these leads were connected to the a.c. in Radio two. This will keep the antenna drive unit at the temperature set on the regulator, even when the gear system is not energized. The circuit draws 1.65 amperes, and it requires about 1½ hours to bring the equipment up to temperature".

This heater modification has been approved by the Bureau, and is being made by RCA engineers in the field. The connections through Radio two, however, are not recommended. At the transmitter these leads can be connected to terminals 1C and 4A. This modification is important, and should be made as soon as practicable.

And the ever present menace of water finds its way into the report: "We found that the drive shaft was the drive shaft, and entering the drive unit between the he drive shaft, and entering the drive unit between the drive shaft and the bearing indicator dial. The drive shaft was tapped as far down as the top of the bearing indicator dial, and glyptoled. This unit had been checked for moisture while in port".

AN-Connectors for Frequency-Shift Keying Equipment

A change is being made in the transmitter connector panels for frequency-shift keying. The purpose of the change is to eliminate the Jones connector used for the keying signal and replace it with a type AN-3102-14s-1S connector, thus making all equipments uniform. All future transmitter connector panels supplied in kits or in transmitters as well as frequency-shift keyer cable terminations will have the AN-type connector and plug.

Equipments which have been delivered should be modified by the addition of the AN-type connector. The modification may be made by utilizing the present panel, enlarging the present square mounting hole with a rat-tail file and drilling the necessary mounting holes to accommodate the type AN-3102-14s-1S connector. This change should not be made on installations which utilize the AN/FGC-1A keyer together with a coupler unit which requires plate and filament power from the keyer, unless separate provision is made to obtain such power from the transmitter.

The equipments and symbol designations of connectors affected by this change are as follows:

Equipment	*Symbol Designation*
AN/FGC-1A	
Keyer Connector Panel	P-1616
TBA Panel	J-1605
TBC Panel	J-1605
TDU Panel	J-1803
TEB	J-118
TEC	J-1101
TBK Coupler Kit	J-605
TBA Coupler Kit	J-605
96C Coupler Kit	4 connectors and 4 plugs
FSB Connector Cable	P-15

Parts required for this modification are as follows:

1	Connector	AN-3102-14s-1S
1	Plug	AN-3106-14s-1P
1	Clamp	AN-3057-6
4	Machine Screws	⅜" No. 4/40 round head, with hex nuts and lock washers.

Hints on the VG for the RT

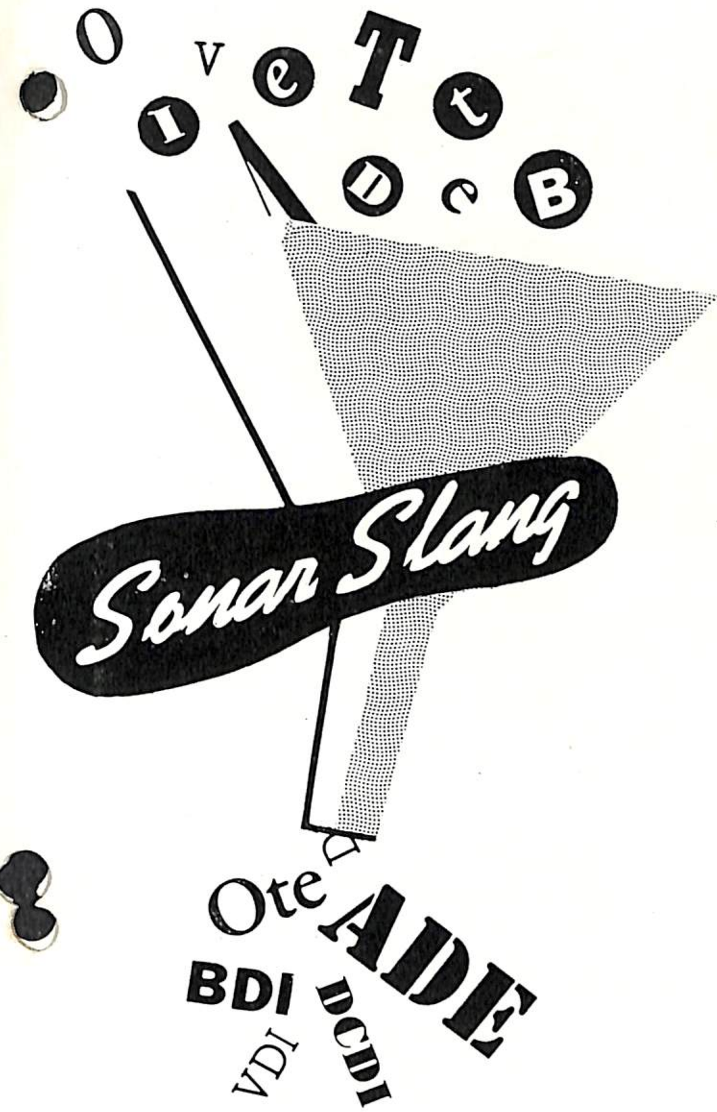
The radio technician should be aware of the following maintenance and operational information on the VG remote PPI repeater in order that maximum performance may be obtained:

1. The air filters should be kept clean. They are cleaned every month or 500 hours with gas and saturated with luboil, Navy Symbol No. 3100.

2. The cathode ray tube is to be operated hot when a fast erase is desired. It is better to operate the tube warm, or even hot, to prevent severe burning.

3. When the image is severely burned into the face of the scope, erasing may be accomplished by swinging to the SG which has a high repetition rate, defocusing, and increasing the intensity. The video should be "OFF" when erasing the screen.

4. In order to prolong the life of the OSC projector lamp, it should be run at as low a voltage as possible consistent with good visibility.



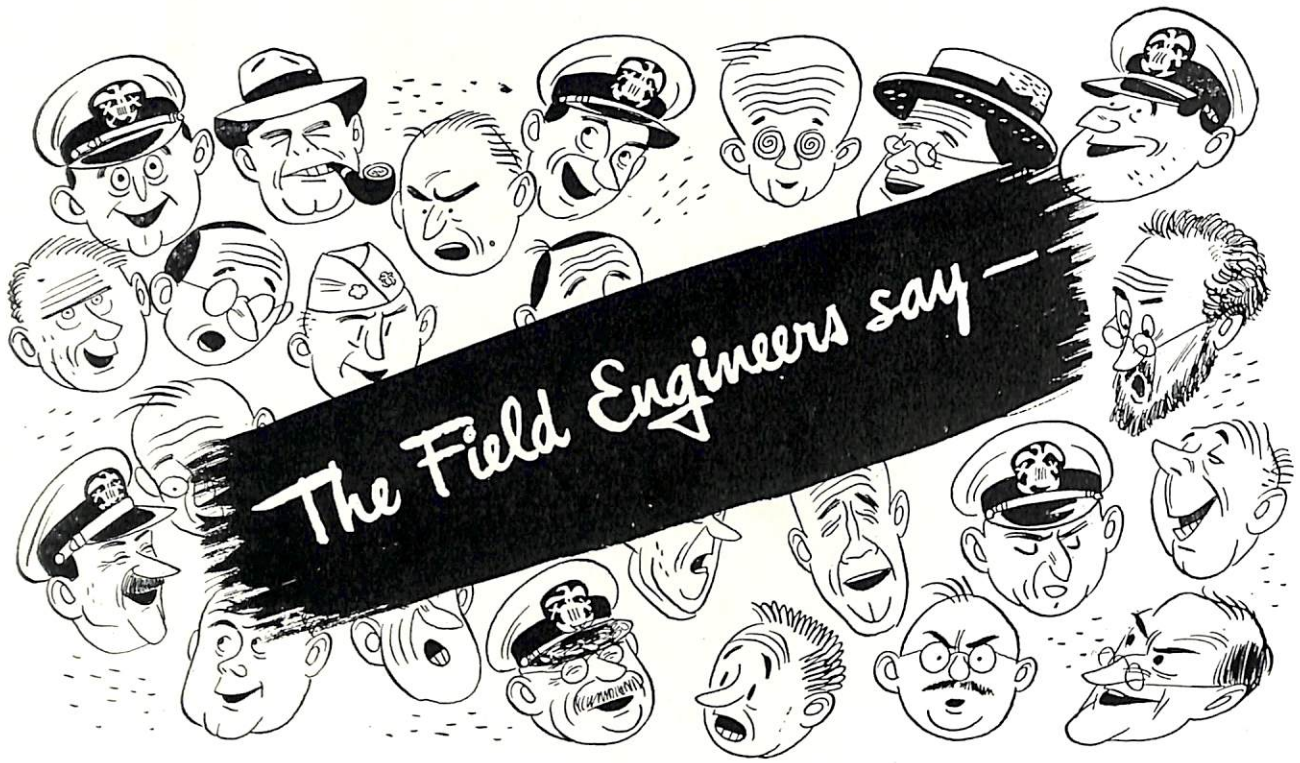
Everyone seems to be familiar with such expressions as SNAFU, SISFU, etc., and the use of such terms is becoming so widespread that ultimately many of the more common abbreviated terms will become an integral part of our language.

Moreover, the use of such abbreviations has become so common in every field of electronics that each branch has gradually built up a vocabulary of the more common abbreviations used in that particular field. While all of the abbreviations do not form words which can possibly be pronounced, nor can they be found in any dictionary, the use of these abbreviations to designate equipments, instruments, procedures, publications, etc., has resulted in quite an imposing list.

The use of such coined phrases and abbreviations has become so common that the practice of turning gobs of the alphabet around instead of speaking English has practically resulted in a new language, requiring considerable interpretation to those who hear the peculiar letterings and unusual words. In many cases the purpose of the use of the abbreviation has been defeated by the time and trouble necessary to explain the meaning of the terms. There is also quite a tendency on the part of those who both use and coin such abbreviations to assume that everyone knows the meaning inferred by the three or four letter abbreviations. Such is by no means the case, and confusion is very apt to result from their usage.

In the field of sonar, which incidentally is itself an abbreviation, a considerable collection of these abbreviations has been built up. Every day some new abbreviated term is coined, and its use gradually becomes a part of "Sonar Slang". The following list included some of the more common abbreviations often referred to. Let us hope that this list does not grow and that no "addenda" will ever be necessary.

AD	*Attack Director*
ADE	*Audible Doppler Enhancer*
ADP	*Ammonium Dihydrogen Phosphate*
ALT	*Advanced Listening Teacher*
ATT	*Automatic Target Training*
ATU	*Automatic Training Unit*
BDI	*Bearing Deviation Indicator*
BT	*Bathythermograph*
CR SONAR	*Capacitance Rotated Scanning System*
DCDI	*Depth Charge Direction Indicator*
DCG	*Doppler Control Gain*
DRA	*Dead Reckoning Analyzer*
DRT	*Dead Reckoning Tracer*
EAS	*Electronic Automatic Search*
ERB	*Echo-Ranging Booster*
ER SONAR	*Electronically Rotated Scanning System*
FM SONAR	*Frequency Modulated Sonar*
GLT	*Group Listening Teacher*
GOT	*Group Operator Trainer*
IRR	*Indicating Range Recorder*
MATD	*Mine and Torpedo Detection*
MDC	*Maintenance Deep Contact*
MCC	*Maintenance of Close Contact*
MTB	*Maintenance of True Bearing*
ODN	*Own Doppler Nullifier*
OL	*Object Locator or Overside Listening*
OTE	*Operational Test Equipment*
PAL	*Phase Actuated Locator*
PP-BDI	*Plan Position-Bearing Deviation Indicator*
PPI	*Plan Position Indicator*
PRT	*Phonograph Recorder Trainer*
RCG	*Reverberation Control of Gain*
RSF	*Reverberation Suppression Filter*
SASAT	*Shipboard Anti-Submarine Attack Trainer*
SGM	*Sound Gear Monitor*
SOD	*Small Object Detection*
SSI	*Sector Scan Indicator*
SSOT	*Shipboard Sound Operator Trainer*
TDM	*Torpedo Detection Modification*
TDM-OL	*Torpedo Detection Modification–Object Locator*
TRL	*Triangulation Listening Ranging*
TDI	*Target Doppler Indicator*
TVG	*Time Varied Gain or Time Variation of Gain*
VDI	*Visual Doppler Indicator*



Lt. (jg) J. A. Callner of EFSG reports that an NK-7 portable projector assembly was rigged for operation on an AMc(U). When the unit was turned on, no signal trace appeared on the recorder paper. All interconnections between power supply, projectors and indicating unit were checked. Plugs used for connecting the projectors to the driver receiver indicator unit were found to be corroded. After cleaning the contacts of the plugs, good signal traces were recorded. As these plugs are subject to salt water spray, it is necessary to keep them protected when the projector assembly is secured. Two dummy receptacles for these plugs are being mounted near the projector assembly so that they will have protection when the fathometer is not in use.

Good soundings were obtained when the projectors were about four to five feet below the surface of the water. This position of the projectors enables the equipment to record satisfactory depths as the ship made speeds from one to eight knots.

—*E. F. S. G.*

■

CONTACTS

In the Western Electric Weekly Technical Newsletter, D. F. Sanders reported that during the past week 3 QJA equipments arriving at his location have needed repair due to the same cause—namely badly worn contactors K301, K302, K303, etc. Mr. F. J. Case, the engineer handling these jobs, believes that these items are being overlooked in various Navy Yards and suggests that the word be passed along.

Inasmuch as this trouble will undoubtedly appear on most equipments after considerable time in service, it appears that the cleaning of these items should be given more attention. The effect of these contactors being worn or broken makes the adjust of the zero set and pulse length a difficult job.

—*Western Electric*

■

MARK 22

Corosion in coaxial connections on the Mark 22 may be prevented in the following manner:

Jacks J305-1, J305-3, J304-2, and their corresponding plugs, P-1601, P-1602, and P-1604 are weatherproofed with Dow Corning #4 Ignition Sealing Compound. The connection is first placed inside the plugs and jacks wherever a union is made. Caution is exercised to keep the compound away from the center conductor. After the connectors are put together, the compound is smeared wherever there is a chance for monsture to enter the fitting. Finally, the connector is sealed with two layers of rubber tape, two layers of linen tape, and a couple of coats of insulating varnish is applied.

—*Western Electric*

■

MARK 8 TRANSMITTERS

Due to the numerous failures of C-22A in the D-150960 transmitter, which are evidently caused by an excessive surge of voltage when the transmitter is turned on, it has been decided to disconnect this capacitor.

C-22A is in the middle bypass of a 3-section RC smoothing filter in the bias generator circuit. C-22A and B capacitors are built as one unit and *only* the "A" side is to be disconnected. This change applies to all D-150960 transmitters.

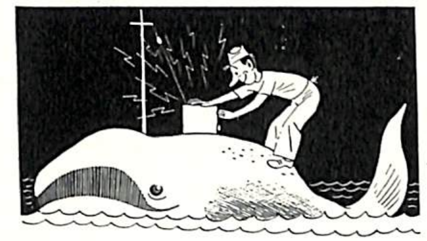
—*Western Electric*

■

MARK 22 TUNING AT SEA

Because of insufficient time in port, it has proven necessary to be able to tune the Mark 22 radars while underway at sea.

After a fair degree of accuracy has been obtained by information as given in the instruction book, the tuning may be accurately peaked up through the use of the TS-33/AP as a tunable "X" band echo box, as follows:



The TS-33/AP is coupled into one of the waveguide taps of the Mark 22 system. Using sufficient attentuation, i.e. minimum sensitivity, in order to prevent crystal damage, the magnetron frequency is determined. Then, in order to protect the TS-33/AP crystal detector while using this instrument as an echo box, its crystal is unscrewed from the socket until the crystal current drops of zero. In order to obtain maximum ringing time, the TS-33/AP sensitivity control is set to maximum. As the unscrewing of the crystal from its socket will produce detuning of the frequency meter, the micrometer head will have to be set to a new value as determined on the Mark 22 radar. Once the micrometer head on the TS-33/AP has been set to give ringing on the Mark 22 the r-f adjustments may then be tuned for maximum ringing range.

—*E. F. S. G.*

■

RADAR EQUIPMENT MARK 22

Interference was observed on all bands of the RBO Receiver when the Mark 12 pulse was terminated in the dummy load. Maximum interference occurred around .95 mc, 1.9 mc, 3.8 mc. It was radiated principally by the power cable to the Mark 22. All interference ceased when the Mark 22 transmitter housing was bonded to the Mark 12 antenna frame, shunting around the upper right shock mount.

—*Western Electric*

■

D-150960 TRANSMITTER-RECEIVER

Regarding MK 8 field change #29; MK 16, MK 27 field change #17; SJ-1 field change #46.

It has been found that the bracket supplied to mount the coil L(1)1 is not tapped as shown on the drawing and must be done before installation. The drawing also fails to show a white-blue wire from the condenser. This omission may confuse the technician trying to make the modification. The wire is connected between the 33-ohm resistor and the coil.

—*Western Electric*

■

MARK 13

The following circuit changes will make the range line controlled by the Meacham range unit dotted and the range line controlled by the long rang unit solid.

Referring to switch S1 on the long range unit wiring diagram, Figure 7-9, in the instruction book SHIPS 327.

(a) Transfer wire #52 (white-blue-brown) to the LR terminal to which wire #54 (white-yellow) is connected.

(b) Transfer wire #53 (white-brown-orange) to the adjacent unused LR terminal of the same switch section.

—*E. F. S. G.*

■

WCA POWER SUPPLY DIAGRAM

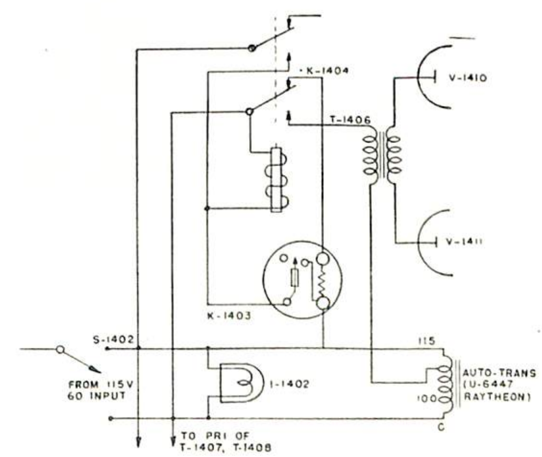
Lt. (jg) A. D. Jones of the EFSG submits the accompanying diagram to show the actual wiring of the A.C. supply to T-1406 in the rectifier section of the QB (CBM 52252) Driver Rectifier of WCA/WCA-1 equipments. He states that all available schematics show T-1406 connected directly across the A.C. line. The auto transformer shown (U-6447) was installed to reduce the primary voltage to 100 volts because the secondary voltage of T-1406 was too high for the equipment. A large number of the equipments he has checked showed the presence of the auto-transformer coupled as per diagram.

SubSig. states that T-1406 was Raytheon U-6319 and that it was replaced with U-6319A on all later equipments. However, all instruction books still list the characteristics T-1406 as U-6319 instead of U-6319A. Here are the characteristics of the two transformers:

	S.S. 803-303 Raytheon U-6319		*S.S. 803-303 Raytheon U-6319A*	
	Pri	Sec	Pri	Sec
Turns	130	2420/CT1210	130	2100/CT1050
Wire	15E	26E	15E	26E
D.C. Res.	0.44	138	0.44	125
Volts	115	2020	115	1760
Amps.		0.25		0.21

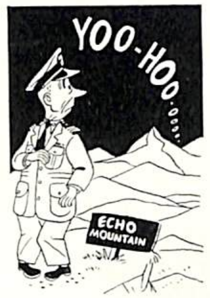
On all equipments in which the auto-transformer U-6447 is not installed, T-1406 should be Raytheon U-6319A having specifications as listed above and replacements should conform to those specifications.

—*E. F. S. G.*



FALSE ECHOES IN D-150960 TRANSMITTER-RECEIVER

A series of false pips, approximately 200 yards apart, and of decaying amplitude, have been noticed on the range indicator in several SJ/SJ-a/SJ-1 equipments, particularly when the BO was detuned. Elimination of this condition can be accomplished by replacing the .01 μf capacitor across the crystal current meter with a capacitor whose value is somewhere in the vicinity of .003 μf. The value is critical and a little trial and error may be necessary for your particular equipment. Information of your trials and results will be appreciated.



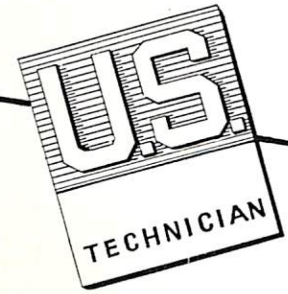
—*Western Electric*

ELECTRON TUBE TYPES 2K25 AND 723A/B

Electron tube type 2K25 has been designed to permit broader hand tuning and to be usable in place of the 723A/B in all present or contemplated equipment applications. This tube has been branded 2K25/723A/B to indicate that 2K25 tubes should be employed in the changeover where 723A/B tubes will not operate satisfactorily. It is intended that the double branding will be eliminated in the forthcoming "JAN" specification for this type, which will henceforth be designated as Type 2K25. Current stocks of Type 723A/B should be used until exhausted in those equipments in which their performance is satisfactory.

—*BuShips*

The Field Engineer in the Field



Every time a technician goes aboard a ship of different class from his last billet (or sometimes a different ship of the same class), he comes face to face with gear that is not familiar to him. If it isn't a new model, it may be a modified equipment. Change has been the order of the day since the war began, and each new installation and modification brings its own peculiar set of problems. As a result of this condition, it is almost impossible for the technician to stay abreast of the developments in his field. For this reason, the Bureau of Ships has sponsored a program of field engineering available to naval activities for consultation and advice on problems concerning installations, maintenance and operation of electronic equipment. These groups are composed primarily of the factory field representatives and of the Electronics Field Service Group (EFSG) personnel.

The factory field representative is a civilian. Perhaps you have seen him around, wearing his shield-shaped collar insignia bearing the legend "U. S. Technician." Perhaps you have wondered on whose authority he is in the yard, at the advanced base, or aboard the AKA headed for "Island X." Regulations governing technicians, published by the Office of Naval Operations in conformance with the Secretary of the Navy's letter Op-30-S-4, serial 223630, dated 19 November, 1943 says in part: "In order that manufacturers' and contractors' field representatives—hereinafter referred to as "Technicians"—may be properly accredited for overseas journeys to combat areas, or overseas areas under naval control or in which naval forces are operating, the following orders will govern. . . . . " He is there " . . . for the purpose of observing the operation or installation of equipment and armament, and/or assisting in the maintenance and repair of such equipment, and for scientific research." There are at present some 1100 of these factory representatives, about 250 of whom are serving overseas, at advanced bases, repair ships, tenders, and at various points for special work as directed by FMO, ComServPac. These engineers are representatives of seven companies: Hazeltine, General Electric, RCA, Raytheon, Submarine Signal, Western Electric, or Westinghouse. They interest themselves in the equipment manufactured by the company they represent.

One of the difficulties of this system of "civilian in uniform" is that his status is not always understood by military personnel. To quote further from the CNO regulations, he is " . . . . normally treated as a commissioned officer in such matters as messing, living accommodations, and transportation. . . . " He may " . . . be granted the privileges of ship's service activities aboard ship and at shore stations outside the United States." He "shall be considered as officially attached to the Naval Force or Vessel to which he reports."

The factory field engineer is trained by his home company, at company operated training schools and at the factory. He is expected to know his firm's equipments from top to bottom — testing, aligning, and trouble shooting. He is expected to know what new equipment his company is developing, and be able to make field modifications as they are authorized. He maintains a close liaison with his employer which results in rapid dissemination of the latest operational and maintenance information in the field. He instructs Naval personnel in the operation and maintenance of his company's devices.

The program is at present expanding, the bulk of the increase being earmarked for overseas duty. Over 200 letters of commendation have been received from satisfied commanding officers.

On the strictly Navy side of this story, we find the EFSG program. It was designed to bring immediate technical aid to the fleet, wherever and whenever it is needed, to give full instruction on installation of any new Naval equipment, its maintenance and operational procedures and the use of the latest test sets. The group is in business to assist fleet administrative officers, and electronics officers, in getting technical knowledge and skill to the point where it is needed. The personnel of the Electronics Field Service Group are selected for their practical knowledge as well as familiarity with research and development programs now under way. They must work closely with the manufacturers, and their knowledge and experience must fit them to assist technical personnel of the Navy in mastering new gear. They include graduate electrical engineers as well as men trained in Naval electronic schools. Many of them have recently returned from the Fleet, and so have a first-hand knowledge of, and sympathy with, Fleet problems. When assigned to EFSG the engineer is trained by special courses in Naval schools on ship and shore radar, sonar, radio and navigational aid equipment. Special training is given in the plants where the equipment is produced.

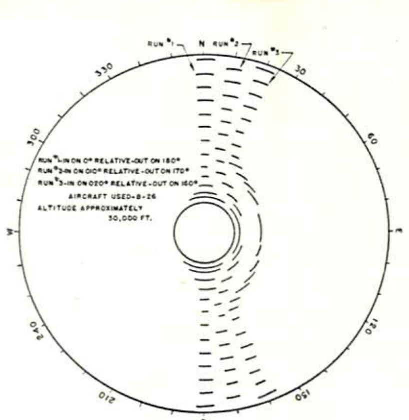
The services of the EFSG are available to assist in installation of equipment, to accompany it on shakedown cruises, to go from ship to ship under way, always seeing that the maximum benefits are being realized from the equipment of all of the ships of the division. They will see that the operators understand the capabilities and the limitations of their equipment.

EFSG engineers report back to the Service Forces and to the Bureau of Ships all the problems they encounter. These field reports make it possible for the overall electronics picture to be viewed at one time—new installation problems, troubles peculiar to various classes of ships, to differing climates, and field conditions.

When a new piece of equipment passes the design stage and contracts are let for its production, EFSG engineers are assigned to observe its manufacture, and to act as consultants. Here men with fleet experience present the Navy point of view to the factory. Not only are modifications introduced, but instruction manuals are written or revised. These same men are available to serve in the field as instructors and as installation experts when the equipment is ready. In this way the Navy has its own experts on new and complex equipment. When an EFSG man goes aboard a vessel, he is equipped to handle any and all of the electronics jobs of that ship, regardless of the firm producing the gear.

To obtain the services of EFSG, application should be made through the chain of command to the Commanding Officer of the Electronics Field Service Group, Naval Research Laboratory, Washington, D. C., with a copy of the request to the Bureau of Ships. This may be by letter, dispatch, or telephone as appropriate. Liaison between EFSG and the Service Force and between factory representatives and the Service Force is maintained at all times so that an engineer near at hand may be dispatched to the spot; thus the time delay is cut to a minimum.

Zenith Watch Radar



Drawing made from a Zenith-Watch Scope showing the presentation of three different plane runs. The first run passed directly overhead; in the other two the plane passed the antenna to starboard.

REMOVING THE OVERHEAD SHADOW

ROBERT HECKSHER, ENGINEER, BUREAU OF SHIPS

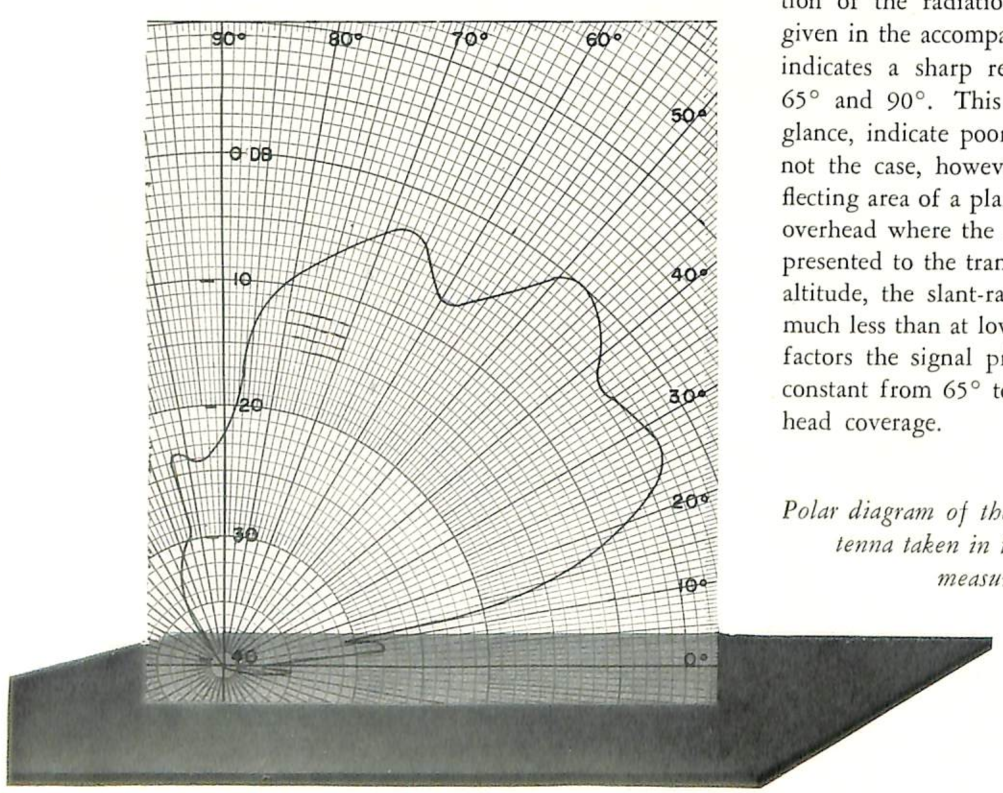
■ Ships equipped with surface-search radar are familiar with the problem of the "hole" in their coverage in the area overhead. This hole or shadow-area results from the low angle of the radiation pattern. The higher the plane, the sooner it will pass into this safe area of non-detection as it approaches the radar. It is clear, then, that some means of detecting high-altitude planes at short ranges must be provided.

Relief for this situation is now available to ships having two SG's in the form of a field change which converts one of them into an equipment which will provide overhead coverage. Such a converted radar carries the colorful and descriptive title of "Zenith Watch." Specifically, this modification is known as Field Change No. 54 and is applicable to SGa, SG-1, SG-b, and SG-1b radars. It consists of a replacement of the antenna reflector and RF feed, but does not affect the pedestal. The modified antenna is known as Navy Type CRP-66AK2. Just to keep the record straight, here is what the equipment model letters turn into after modification:

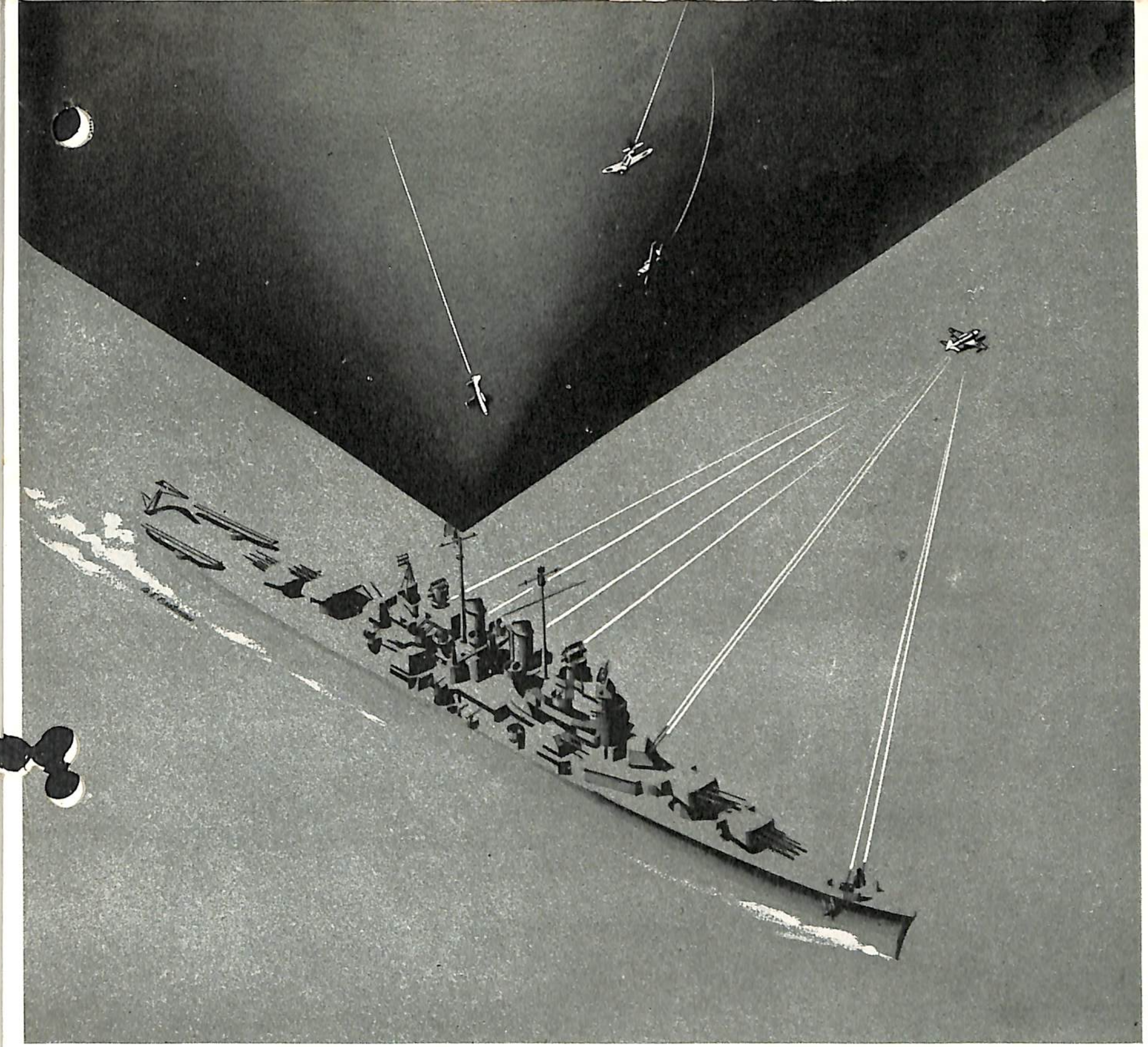
SGa becomes SGc
SG-1 becomes SG-1c
SG-b becomes SGd
SG-1b becomes SG-1d

Because this upward-looking radar will not permit the use of standard targets for tuning, the modification is accompanied by the installation of an OBU-2 Echo Box. To make the modification should require about six hours plus about four hours to install the echo box. It is possible to make the conversion without the aid of Navy Yard facilities if competent personnel are available, but if this is done, extreme caution should be observed when working aloft. Complete instructions accompany the modification kit.

Although the term Zenith Watch suggests that the radar is "looking" directly up, actually the beam width in the vertical plane provides coverage from 20° to 90°, measured from the horizon. This coverage is, of course, affected by the roll and pitch of the ship. An indication of the radiation pattern in the vertical plane is given in the accompanying polar diagram. The diagram indicates a sharp reduction in field strength between 65° and 90°. This decrease in power would, at first glance, indicate poor coverage near the zenith. Such is not the case, however, for two reasons: (1) The reflecting area of a plane increases very rapidly as it comes overhead where the full wing and fuselage surfaces are presented to the transmitted beam, and (2) for a given altitude, the slant-range of a plane nearly overhead is much less than at lower angles. As a result of these two factors the signal presented on the scope is essentially constant from 65° to 90°, thus assuring adequate overhead coverage.



Polar diagram of the field strength of the modified antenna taken in the vertical plane. Degrees are measured from the horizon.

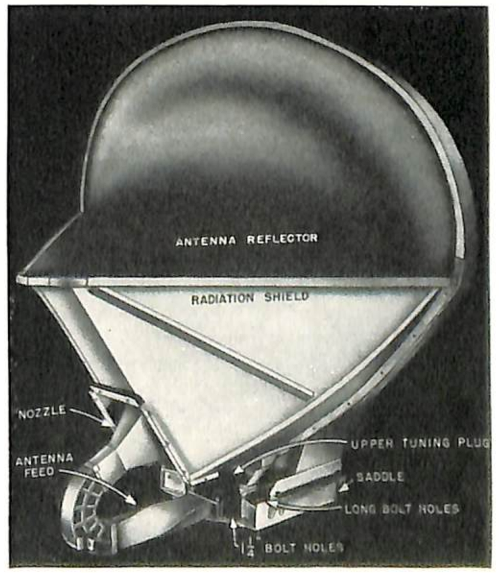


SG radar is converted into Zenith Watch by this modified antenna reflector and r-f feed. The antenna pedestal is not affected.

In the horizontal plane the antenna beam width is 5½ degrees (measured from half-power points).

The zenith-watch antenna is so designed that there is no reflection obtained from surface targets unless they are very large and close.

The PPI presents the target conventionally at the longer ranges. However, as the target approaches an overhead position, the indications increase into arcs of considerable size, until when overhead a complete circle is formed. This circle results from the back radiation which, although not sufficient to cause confusing signals, results in a solid cone of coverage in the overhead region regardless of antenna orientation. The radius of this circle gives the altitude of the aircraft as it passes overhead.



PUBLICATION NEWS

RECENT INSTRUCTION BOOK DISTRIBUTIONS

The instruction books listed below have been distributed during the period of 15 May to 27 June 1945. Those books which have "SHIPS" short titles are available at the Registered Publications Issuing Offices, and the others may be obtained from Radio Material Officers.

Preliminary editions should be replaced with final editions where they are indicated as available.

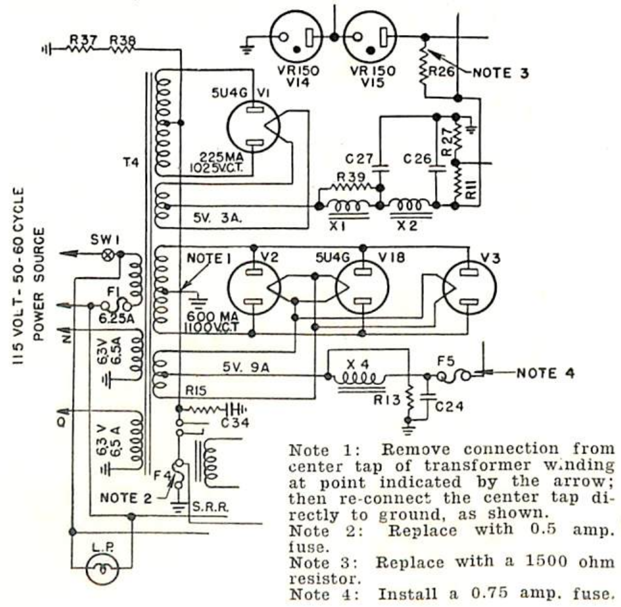
MODEL	SHORT TITLE	EDITION
AN/CPN-3	SHIPS 287	F
AN/CPN-6	SHIPS 290	P
AN/UPM-1 and AN/UPM-18.	SHIPS 236	P
BN	SHIPS 232A	F
BP	SHIPS 285	P
CXES	NAVSHIPS 900,399	F
CXGJ		Comm.
DAS-4	SHIPS 322	F
Dumont Type #233 Cathode Ray Oscillograph.		F
F-20/UPR Wave Trap	NAVSHIPS 900,582	IM
LAJ	NAVSHIPS 900,378	P
LO-3	NAVSHIPS 900,285	F
MAM	NAVSHIPS 900,588	P
MBM	NAVSHIPS 900,581	F
OBO	NAVSHIPS 900,562A.	F
NK-2		F
NJ-4	NAVSHIPS 900,431	F
OBL	NAVSHIPS 900,471	F
OBL-1	NAVSHIPS 900,227	P
OBU-3	SHIPS 308A	P
PN-1	SHIPS 323	P
QCL-4, QCL-5, QCO-2, QCJ-6, QCN-3.	NAVSHIPS 900,522	F
QCL-8, QCJ-9, QCN-4, QCO-3.	NAVSHIPS 900,523	F
RCO		F
RDE		F
RDF		F
RDM		F
RDP	NAVSHIPS 900,555	F
Remote Control Equipment for SCR-573A and SCR-574A.	NAVSHIPS 900,297	F
SU		P
TDN-2/3/4		P
TDO-2	NAVSHIFS 900,271	F
Teletype Model 19, Instruction Manual #26.		II
TS-15A/AP	CO-AN 08-35TS 15-2.	F
*TS-28/UPN	NAVSHIPS 900,521	P
TS-34A/AP	AN 08-35TS34-4	F
TS-102/AP and TS-102A/AP.		F
Type CAGQ-66AFU-1 Submarine Antenna Assembly.		F
Type CAIH-23408 YG True Bearing Control Unit.	NAVSHIPS 900,397	P
Type CAQT-47438 Antenna Coupling Assembly.	NAVSHIPS 900,403A.	F
Type CBM-50AFO Radar Repeater Adapter.	SHIPS 305	P
Type CCI-60063 Frequency Alignment Oscillator.	NAVSHIPS 900,487	F
Types CDU-55ADP and CDU-50ACU Plan Position Indicator.	SHIPS 354	F
Types CG-24275 and CG-24257 Selector Switches.		F
Type CG-62141 Auxiliary Junction Box.	NAVSHIPS 900,393	II
Type CHT-211141 Motor Generator, Type CHT-211142 Motor Controller.	NAVSHIPS 900,467	F
Type CHT-211204 Motor Generator Set.	NAVSHIPS 900,506	F
Type CHT-211271 Motor Generator Set.	NAVSHIPS 900,401	F
Type CHT-211275 Motor Generator Set.	NAVSHIPS 900,571	F
Types CRV-35047 for RBB-1 and CRV-35048 for RBC-1 Receivers Crystal Control Adaptors.	NAVSHIPS 900,530	F
Type CTZ-10415 Radio Direction Finder Prefabricated Shelter.	NAVSHIPS 900,665	F
Type CYJ-10443 Dummy Load for 108 T Series Transmitters.		P
Type NMA-3A UHF Field Strength and Noise Meter.		F
WCA-3	NAVSHIPS 900,525	P

*—Available only through Bureau of Ships—Code 250F
F—Final
P—Preliminary
II—Installation Instruction
IM—Instruction Manual

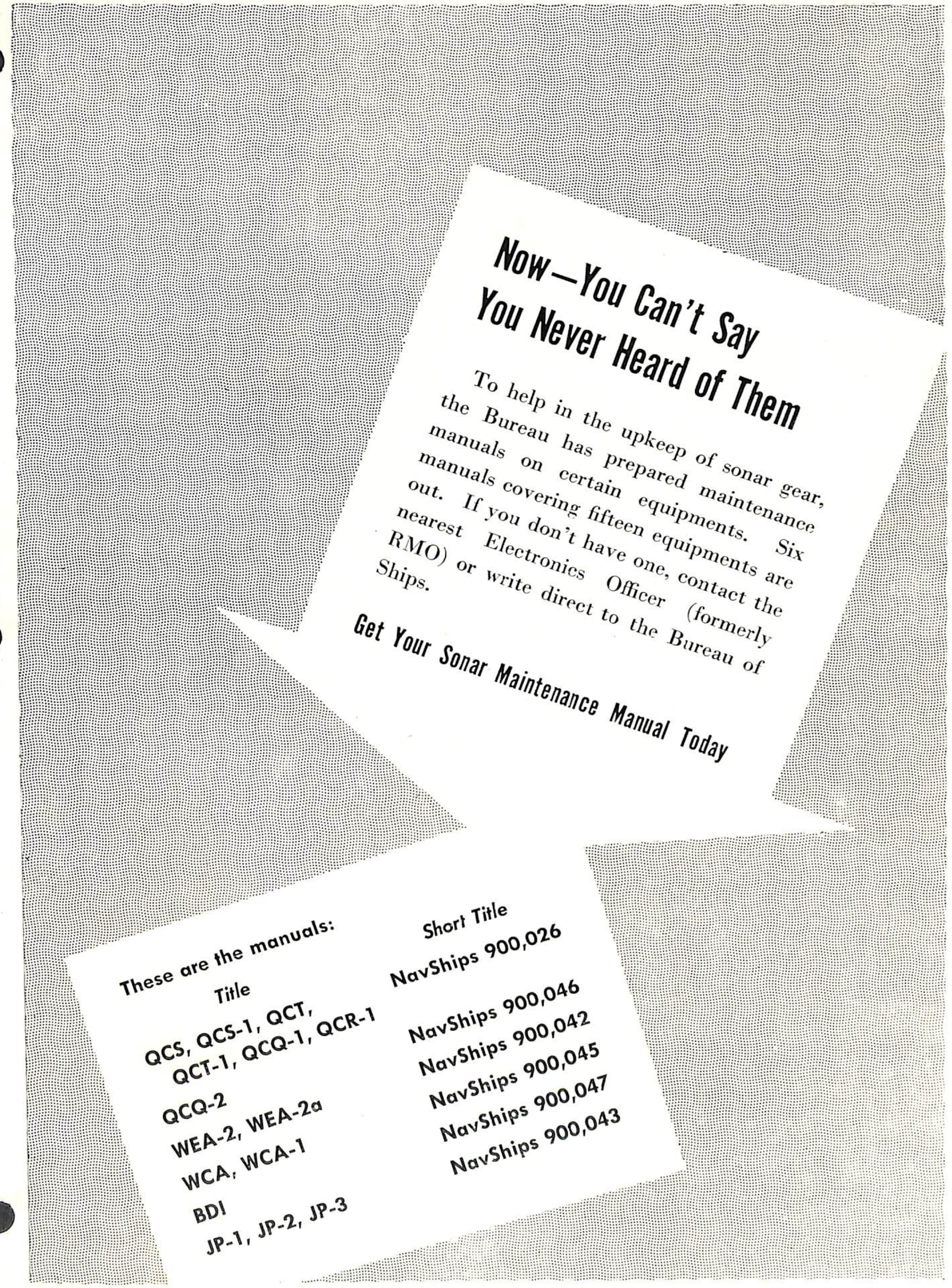
MODIFICATION OF TDT TRANSMITTER REDUCES EXCESSIVE CURRENT

It has been reported that during normal operation of the model TDT equipment the contacts of the slow-release relay SRR have burned out, apparently due to excessive current through the small contacts of this type of relay. Field activities may, if desired, modify the equipment as shown in the accompanying diagram.

Modification of Model TDT Transmitter



Note 1: Remove connection from center tap of transformer winding at point indicated by the arrow; then re-connect the center tap directly to ground, as shown.
Note 2: Replace with 0.5 amp. fuse.
Note 3: Replace with a 1500 ohm resistor.
Note 4: Install a 0.75 amp. fuse.




Don't bury it---
HERE LIES
give it a chance