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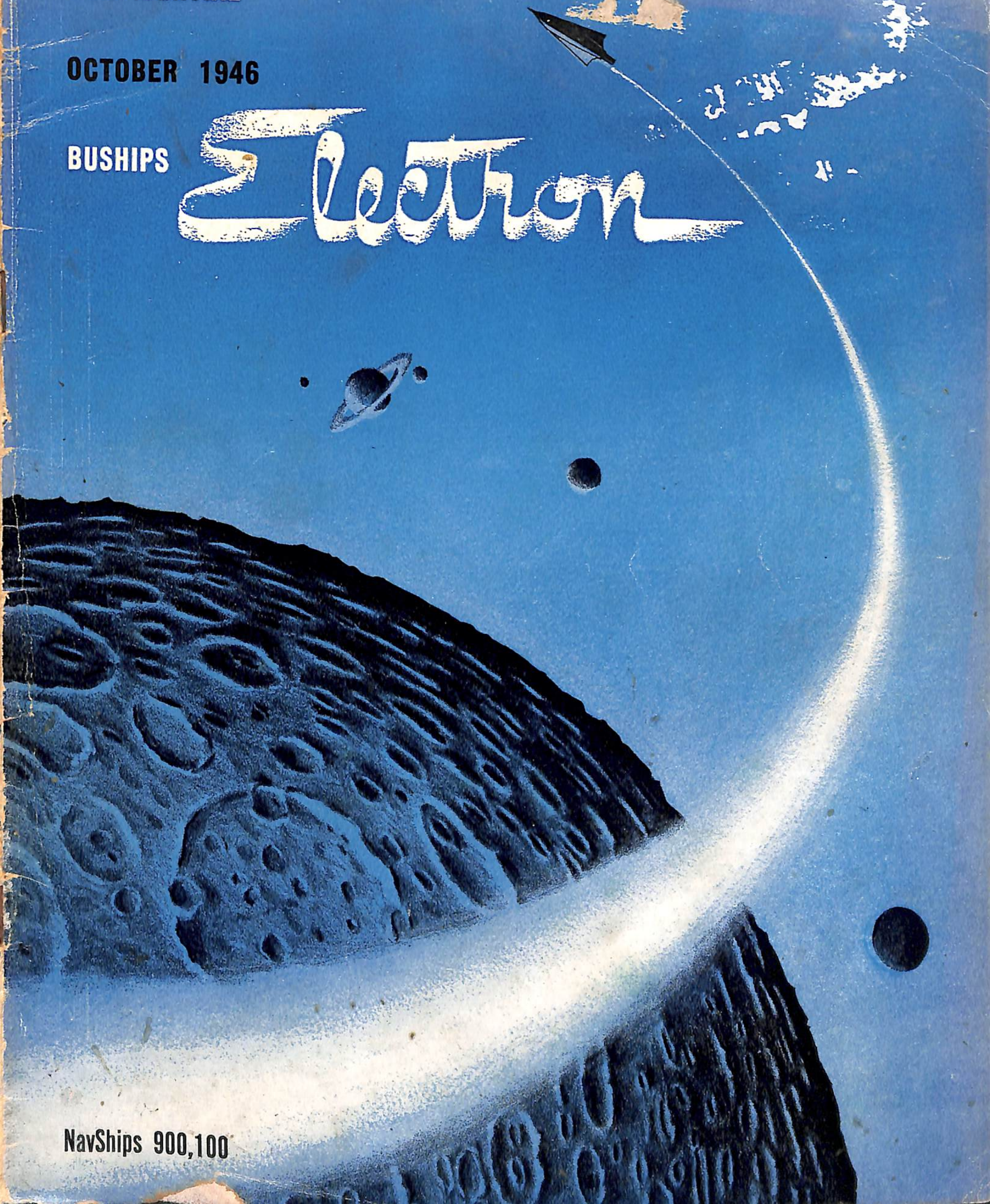
OCTOBER 1946

BUSHIPS Electron



NavShips 900,100

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BUSHIPS Electron

A MONTHLY MAGAZINE FOR RADIO TECHNICIANS

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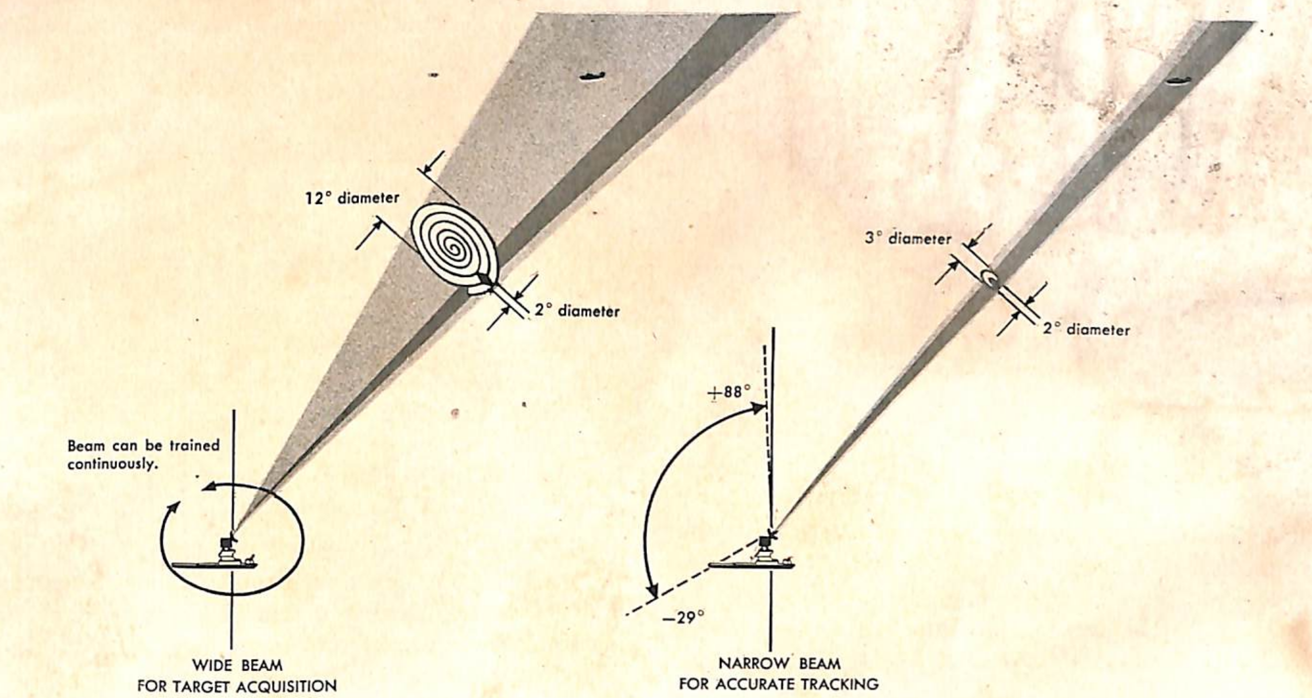


Spiral and conical scan employed in the Mark 35 for search or acquisition and for tracking. During search or acquisition the 2° beam effectively scans a cone of 12° four times a second. During tracking the beam scans a cone of 3° thirty times a second.

Fire Control Radar Mark 35

Hold your hats boys, here we go again! Yes, it's a new gunfire control system, the Mark 56, incorporating a new fire-control radar, the Mark 35. No doubt many of you wonder when the fire-control radar program will attain perfection and ease up on new models and modifications. Well, that question cannot be answered at the present time but you may rest assured that each new Mark and Mod is a definite step forward in our concentrated efforts towards near-perfection in gunfire control systems. However, as advances in airplane design and tactics are made, so must advances in the art of fire control be made to meet them. The problems of anti-aircraft fire control are numerous and complex. A fire-control system must be able to cope with all types of targets — torpedo-bomber, level-bomber, dive-bomber, suicide bombs, jet planes, guided missiles, and other high-velocity targets, as well as surface craft. The system must be able to operate under all conditions of visibility —sunlight, fog, smoke and darkness. In addition to these requirements the system must be fully stabilized. The Mark 56 gunfire control system includes all features necessary to cope with the above requirements.

It is an acknowledged fact that the introduction of radar into fire control has added operational complications. In general, it has been found impracticable to add radar efficiently to director systems designed originally for optical use. Many who have been charged with the maintenance of fire-control radar equipment on board ship have experienced the difficulties of servicing, operating, and assisting in the overall integration of radar with fire control. You will recall the times when you had to do a maintenance job during an emergency in a Mark 37 gun director during battle conditions, and the accompanying woes and miseries due to space limitation in those directors. Sure, our old Mark 4 and the later Mark 12/22 radar equipments performed nobly under very adverse conditions, but the need for a better system was apparent to those who were vitally concerned with the fire-control program. The Mark-56 gunfire control system is the Navy's first attempt at a fully-integrated system for control of the 5″/38 guns, and includes features designed to increase the efficiency and speed of intercept, ranging, and eventual firing of the guns.

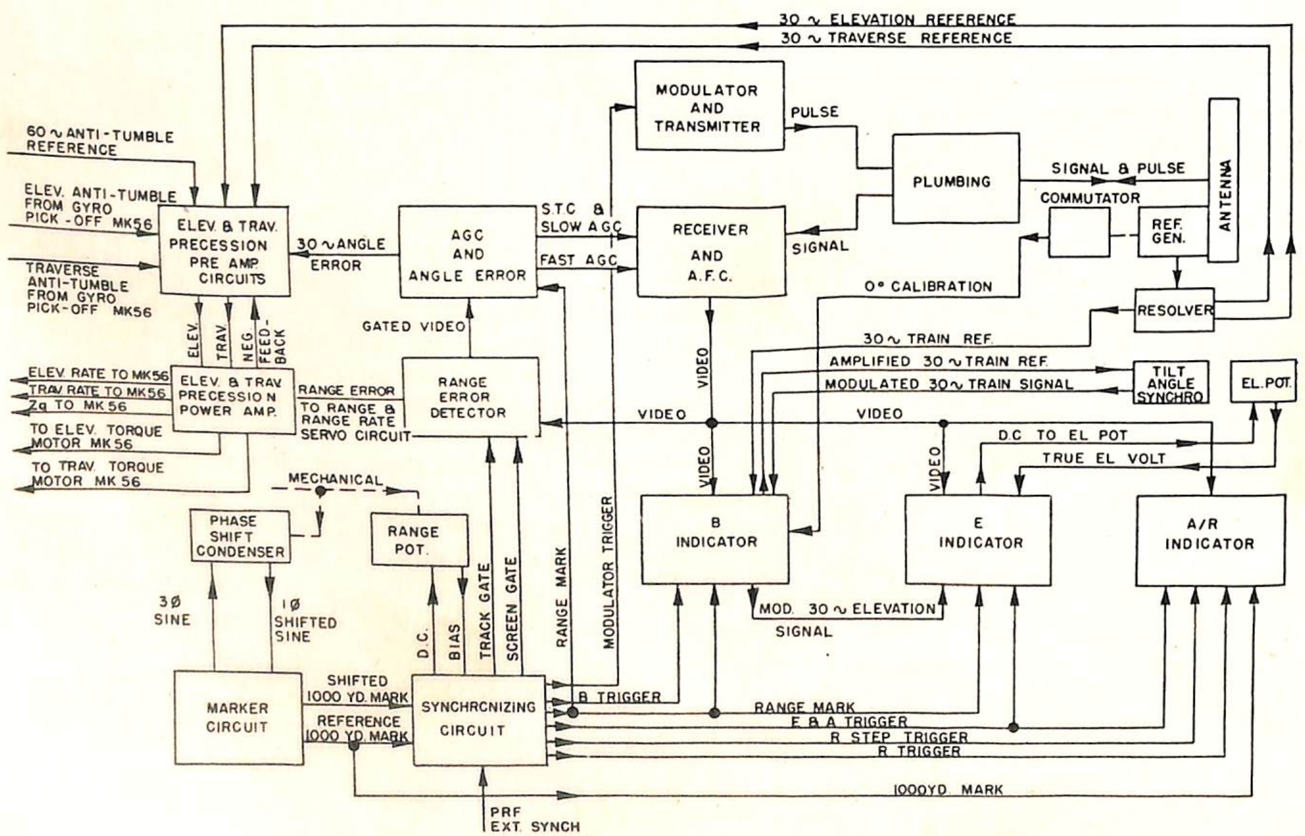
The Mark 35 fire-control radar, as stated above, is an integral part of the Gunfire Control System Mark 56. The function of the radar is to locate and track the target, supplying continuous and accurate rate and position data automatically to the ballistics computer in the Mark 56, which in turn supplies gun orders and fuze-time to the guns. The Mark 35 is thus capable of rendering the Mark 56 system completely blind-firing. The Mark 35 is not designed as a search radar, although it can locate a target within its own range. In general, it will depend on remote target designation. However, from the moment of target acquisition it is completely automatic.

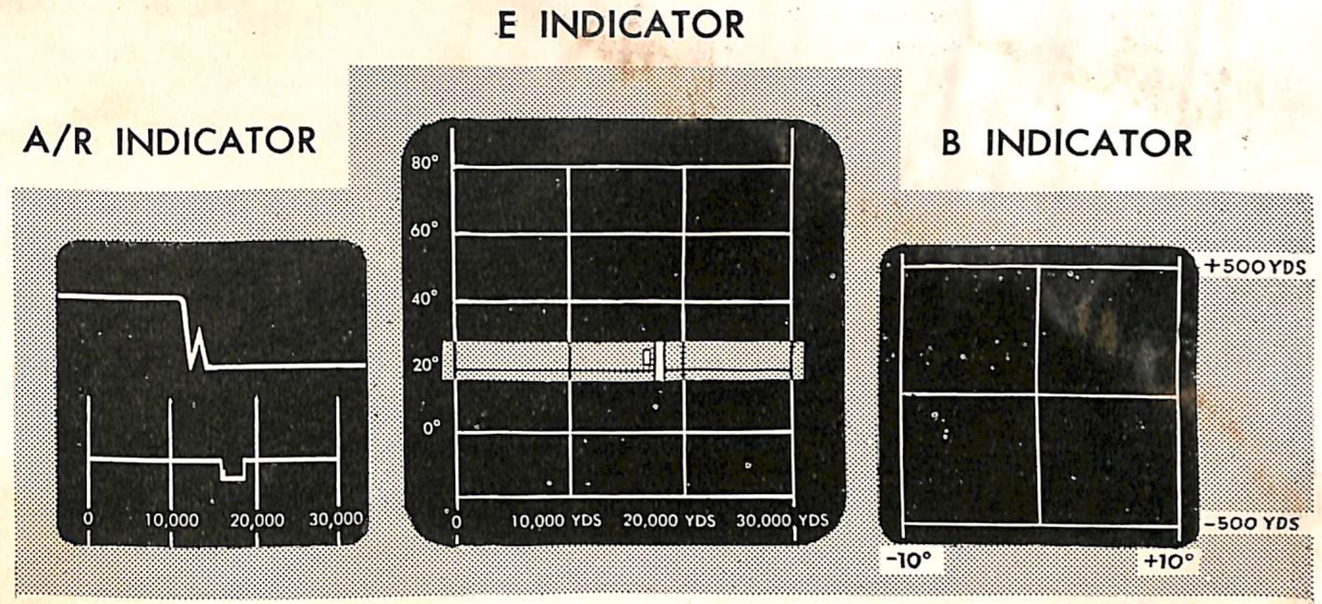
The Mark 35 consists of seven major components—antenna feed and reflector, modulator-transmitter-receiver, *A/R* indicator, *E* indicator, *B* indicator, synchronizer-and-timer, synchronizer-and-demodulator. These components are scattered throughout the Mark-56 system. The antenna reflector is mounted on the front of the director. Also mounted on the director, but in separate compartments, are the modulator-transmitter-receiver, radar junction box, r-f power bridge, and associated power supplies. In the console below decks are located the three indicators, the synchronizer-and-timer, and the synchronizer-and-demodulator. In the Control Panel Mark 28 are located the positive and negative regulated power supplies.

The radar operates in two bands, X_L and X_S, with a pulse repetition rate of 3000 $\pm 10\%$ and a pulse duration of 0.12 microsecond. The peak power output is 50 kw and the average power output is 0.15 kw. A tunable magnetron is used as a source of r-f energy, while a hydrogen thyratron is employed as the pulse tube. Provisions are made for measuring various voltages in the transmitting and receiving circuits by the inclusion of a meter in the modulator. The receiver is a conventional superheterodyne employing 13 stages of i-f and 4 stages of video amplification. A Shepherd-Pierce tube is used as a local oscillator and the intermediate frequency is set at 60 Mc, with an i-f band width of 12 Mc.

The parabolic reflector is four feet in diameter, and produces a vertically-polarized beam 2 degrees wide, with a choice of either spiral or conical scan. In spiral scan, which is used for search and target acquisition, the beam scans a 12-degree spiral four times a second at a rotational frequency of 30 cycles per second. In other words the radiating end of the waveguide is *nutating* about the center line of sight of the antenna reflector at a speed of 30 revolutions per second, while at the same time it is being moved by a cam arrangement from an inner reference point of 0.6° to an angle of 7.5° with respect to the center line of sight of the antenna, and back to the 0.6° point, two times per second. Thus during one second there will be four scans of the 12-degree cone, one for each outward movement and one for each inward movement of the radiating element due to the cam arrangement. In conical scan, which is used when tracking a target, the beam scans a 3-degree cone 30

Radar Mark 35 block diagram showing input, interconnecting, and output functions of the various units.





Types of presentation used in the Radar Mark 35. The two sweeps on the A/R indicator are identified as the R sweep (upper) and the A sweep (lower). The E indicator presents range versus elevation while the B indicator presents range versus traverse angles and is used for target acquisition.

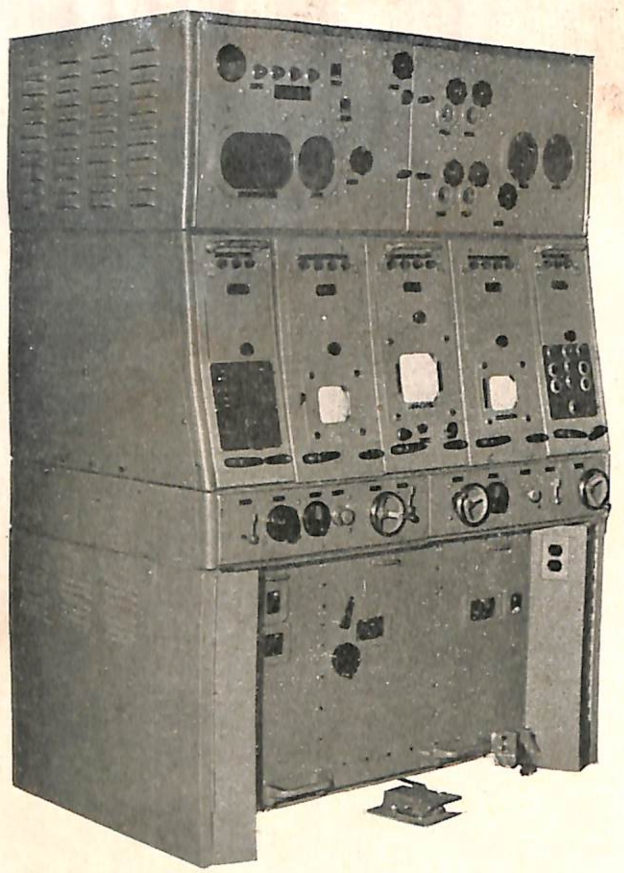
times per second. The main reason for using a nutating antenna system is to obtain a spiral or conical scan while at the same time maintaining the same polarization of the output.

Two antenna feeds are utilized to cover the two-band tuning range, one for the lower (X_L) and the other for the upper (X_S) band. Reference voltages in deck coordinates (level and cross-level) are generated by a reference generator on the antenna. These reference voltages are converted to true coordinates by means of a two-phase resolver mounted in the gyro assembly. These true-traverse and true-elevation reference voltages are then supplied to the *B* and *E* indicators, and to the precession preamplifiers.

After a target is picked up by the system it can be transferred from radar to optics or vice versa. For example, a plane temporarily obscured can be transferred from optical tracking to radar tracking and back to optical tracking. The director officer can search visually for unexpected targets while the operator is engaged, and can take over control if he deems it necessary. Target confusion between operators is reduced to a minimum by the use of a single optical pointer-trainer, by use of a narrow radar beam for the radar range operator, by indicating to the radar range operator that the plane is in the center of the beam, by telephone circuits between director operators and below-deck operators, and by presenting a stabilized three-dimensional radar picture below deck. The completeness of the integration has resulted in minimizing the total work load on the operators and at the same time in distributing the load equitably among the four operators.

Various types of anti-jamming features are included in the system, including variable scan rate, short pulse duration, short range gate (0.12 microseconds), manual and automatic tuning, sensitivity time control, and automatic gain control. In general, the smaller the volume in space from which reflected energy can be received at any given instant, the smaller will be the signal caused by material in that space compared to the target signal. For this reason the narrow beam width and short pulse length are effective against window or rope jamming. Due to the critical beam width and spacing of elements, the system receives radiation only from that portion of space which is being scanned by the antenna beam. Thus, electronic jamming will not be effective unless the jammer is carried in the target plane or another very close to it.

Information is presented on three indicators, a *B* indicator, an *E* indicator, and an *A/R* indicator. The *B* and *E* indicators, which present range against traverse angle and range against elevation angle, respectively, are used primarily for search and acquisition. The *A/R* indicator is used principally as a monitoring indicator when in automatic control and for manual range tracking. It has a step in the *R* sweep and a pedestal or notch in the *A* sweep. The effective tracking range of the Mark 35 on a medium bomber is 30,000 yards with an accuracy of 20 yards. The short pulse permits good range resolution, while the narrow beam facilitates good angular resolution and permits tracking of targets one degree above the surface of the water or one degree away from the nearest land targets. When the desired target is too close to other targets to permit automatic range tracking, aided range tracking may be used.



Radar Mark 35 console which contains all components necessary for timing, synchronization, etc. This console is mounted below decks and requires two operators who have telephone communication with director personnel.

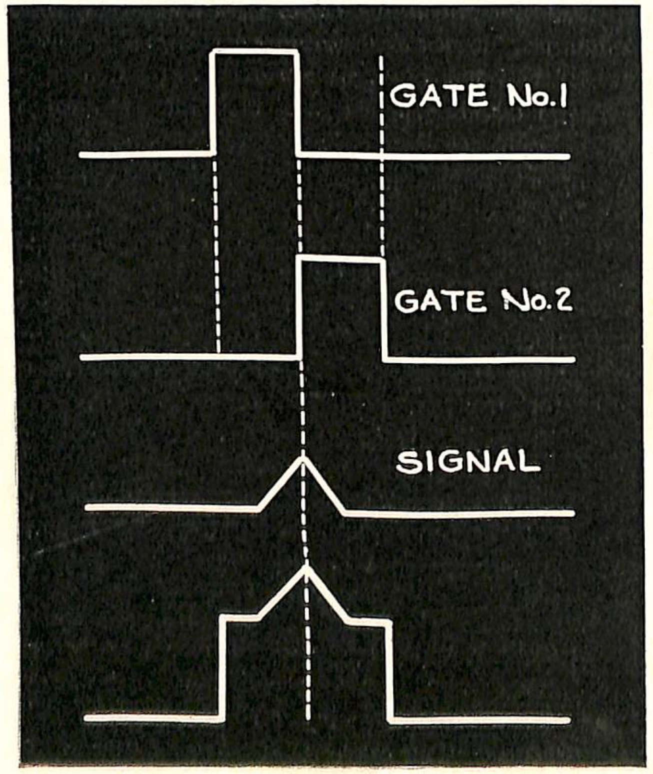
The *A/R* indicator presentation consists of two vertically-separated traces on a single 5-inch scope. The lower trace or *A* sweep is a 30,000-yard sweep which is triggered 2000 yards before the modulator. The pedestal or notch is movable, so that it is variable and can be set on a given target signal. The upper trace or *R* sweep is a 1000-yard sweep with a fixed step near the center of the trace. This step coincides in time with the leading edge of the pedestal on the *A* sweep. Since the *R* trace presents 1000-yards on a base line approximately equal in length to that on which the *A* sweep presents 30,000 yards, it is effectively a greatly expanded version of a section of the *A* sweep.

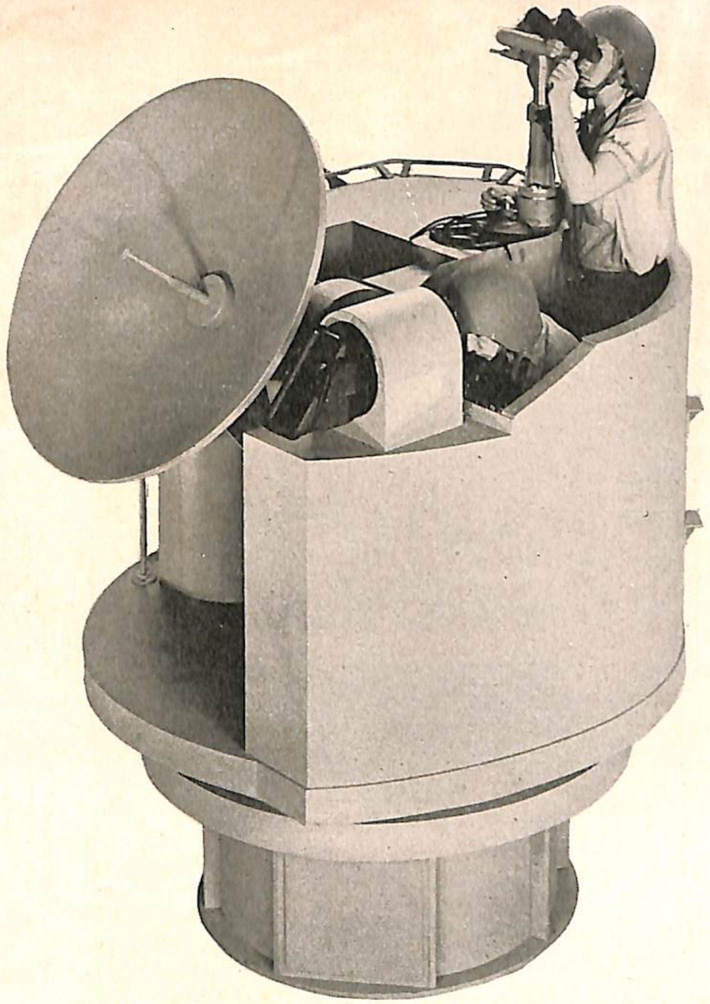
Range marks are 0.1 microsecond in duration and spaced at 1000-yard intervals. Due to this short time duration they will not be readily apparent on the *A* sweep since it encompasses 30,000 yards or approximately 183 microseconds in a space of about 4 inches. Due to the very rapid rise and fall in amplitude of the range mark the vertical portion of the trace will not be seen. These range marks therefore appear as small breaks in the base line of the *R* trace since it only encompasses 1000 yards or approximately 6.1 microseconds in the same physical length as the *A* sweep on the cathode ray tube. Since the *R* trace is 1000 yards in length a mark will appear at one end just as the previous mark is disappearing from the other end. If the range marks move from left to right across the *R* trace, the range is decreasing; if from right to left the range is increasing.

Automatic ranging on the *A* and *R* scopes is dependent upon the action of twin range gates which occur in succession as shown in figure 1, delayed an adjustable time after the modulator trigger. The *R* step and leading edge of the *A* pedestal occur just ahead of the range gates so that when the leading edge of the signal is at the bottom of the step and at the leading edge of the pedestal the signal is within the two range gates. When a signal is thus gated and switched to automatic tracking, the radar will continue to track automatically. When the system is set for automatic tracking, the signal will remain stationary in the *R* step and also in the *A* pedestal, if the pedestal has been set on the signal.

The *E* indicator, which is used primarily for search, presents range horizontally from 0 to 30,000 yards, and true elevation angles vertically from —10° to +90°. Under conditions of search, the system is set for spiral scan. As the antenna feed nutates about the line of sight, the angle by which the beam is off center will vary from 0.5 to 6 degrees at a rate of 2 cycles per second, so that the elevation angle will also vary at the rate of 2 cps. At any instant the sweep trace appears on the *E* indicator at the position corresponding to the true elevation of the antenna. As the antenna goes through a complete spiral-scan cycle, the trace moves up and down on the indicator screen and covers a 12-degree band which is centered on the angle corresponding to the true elevation of the director line of sight. Targets such as aircraft appear as narrow vertical bars with a length equal to about 3 degrees of elevation. Surface targets appear at 0 degrees while aircraft more than 1.5 degrees above the surface appear as an elevated signal on the indicator. In addition to the normal *E* presentation, provisions are made for an expanded presentation in which the trace covers the whole cathode ray tube screen. The center of the screen then corresponds to the line of sight, and only the solid angle in space covered by the spiral scan motion of the beam is presented on the screen. A range mark in the form of a bright vertical line is used to assist in positioning the indicator in range.

FIGURE 1—*Ideal operating conditions are illustrated here, where the signal "midpoint" occurs at the finish of the first and the beginning of the second gate.*





Gun Director Mark 56 with director officer and pointer-trainer in position.

For target acquisition purposes, the *B* indicator is used and employs spiral scan to present range ±500 yards vertically and traverse angles ±10° horizontally. The traverse angle is presented as an angle relative to the line of sight with the line of sight at the center of the cathode ray tube screen. The signal appears on the tube screen at a certain distance from the electronic marker in the center of the tube. This distance is proportional to the traverse angle between the radar beam and the line of sight. A tracking range mark is made to appear at the center of the range sweep. This mark coincides in range with the step in the *R* sweep of the *A/R* indicator, so that signals will lie slightly above the *B* range mark when they appear slightly to the right of the step in the *R* sweep.

The synchronizer-and-timer contains the marker circuits, part of the synchronizing circuits, and the crystal-controlled oscillator which provides the timing for the entire radar system. The marker circuits provide the 1000-yard reference marks which put the range marks on the *R* sweep of the *A/R* indicator. The 1000-yard shifted marks, also generated in this circuit, are used together with the reference marks in the synchronizing circuits. The portion of the synchronizing circuits located in this unit furnishes the trigger to the modulator, the *A* trigger to the *A/R* and *E* indicators, and the screen gate to the range-error detector.

The remainder of the synchronizing circuits plus the range-error detector circuit and the AGC and angle-error circuit are contained in the synchronizer-and-demodulator unit. The various controls for anti-jamming purposes are located on the panel of this unit. The internal repetition-rate oscillator is enclosed in the synchronizer-and-demodulator. In addition to its other functions, the synchronizer-and-timer unit furnishes the *B* trigger to the indicator, the *R* trigger and the *R* step trigger to the *A/R* indicator, and the *B* and *E* range mark to the *B* and *E* indicators respectively. The track gate for the range error detector circuit is also furnished by this unit.

The AGC and angle-error circuit performs three functions—automatic gain control to keep the signal in the receiver at constant amplitude, gain varying with time (sensitivity time control) so that, with no AGC, a moving target is viewed at constant amplitude regardless of range, and an angle-error output to the director system power drives.

Components have been mounted in units with the intention of affording the greatest accessibility possible, consistent with space and component requirements, to the technicians while servicing these equipments. Certain critical trigger voltages have been brought out to the front panel and marked to facilitate ease of checking waveform, amplitude, and duration. In addition to these few critical waveforms, there are numerous test points throughout the equipment for checking input and output waveforms for various stages. The *A* scope can be used as a test scope by merely making a few simple connections and patch-overs.

Splicing RG-84/U and RG-85/U Cables

■ This method of splicing was developed by the Naval Gun Factory, Washington, D. C. The necessary new items for making the splice are incorporated into a cable splicing kit bearing Navy Type No. RW-10646, which is used in conjunction with the previously issued kit RW-10351.

Type RG-84/U is a 70-ohm, lead-covered, r-f cable. Type RG-85/U is identical except for the addition of steel wire armor, both cables having been designed for underground shore installation. It is important to note that before any splices are attempted, or before any rolls of these cables are cut, Bureau of Ships letter R-976D-1021 dated 7 August 1946 should first be consulted. The information presented here is released as advance information concerning this new method of splicing these cables.

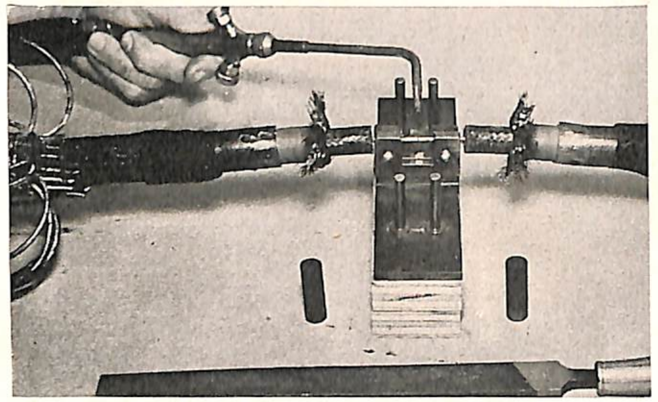


FIGURE 1—*Splice holder in position ready for silver-soldering the inner conductor. Note that the jig is also used to file a square surface on the ends of the conductor.*

In order to understand just what constitutes a satisfactory splice, let us consider the various processes that must be carried out before a splice is completed.

1. Prepare the ends of the cable.
2. Join the inner conductor.
3. Apply polyethylene dielectric over the inner joint and insure the continuity of the cable core.
4. Splice the outer braid.
5. Mold the vinylite jacket.
6. Wipe or solder the joint in the lead sheath.
7. Fit and seal the protector shield.

These steps for RG-85/U cable only:

8. Seize the armor to a smoothly rounded contour.
9. Secure the jute cover so that it cannot fray or work loose.

PREPARING CABLE ENDS

On RG-85/U cable, remove the jute and tar covering from the armor for a distance of 36 inches from the end of the cable. Unwrap the armor wire and bend it back radially for approximately 30 inches. Cut a 15-inch section off the cable. This is necessary since the armor strands must extend past each end of the splice shield for seizing. Next split and remove the inner jute covering for a distance of 7 inches from the cable end.

On either RG-84/U or RG-85/U continue by splitting and cutting off a 3-inch section of the lead sheath. Care must be taken to make the cut around the cable square in shape. This exposes the jacket, which is now cut back 2⅜ inches. The inner conductor is now exposed by pushing back the outer braid and removing one inch of the polyethylene dielectric.

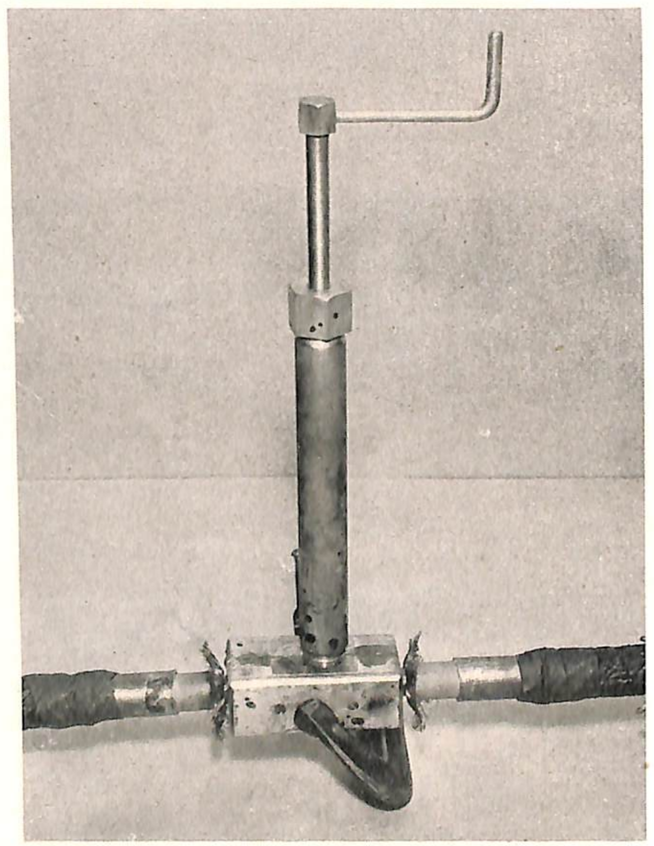


FIGURE 2—*Molding of the polyethylene dielectric over the inner conductor, using the injection gun and mold from the kit.*

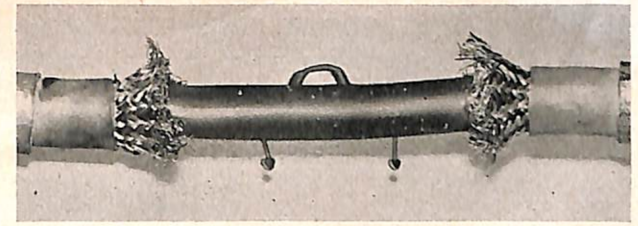


FIGURE 3—*Polyethylene dielectric after the mold is removed.*

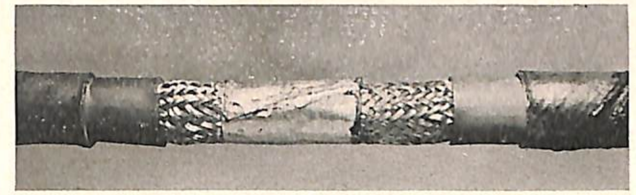


FIGURE 4—*Copper sheet formed and soldered to the copper braid.*

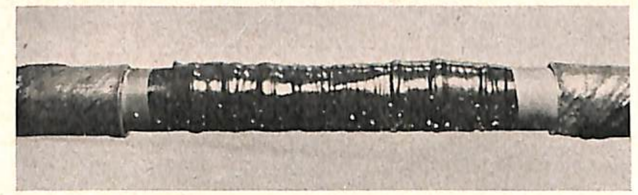


FIGURE 5—*Cable ready for molding of the vinylite jacket. Note the vinylite tape wound in layers over the copper braid.*

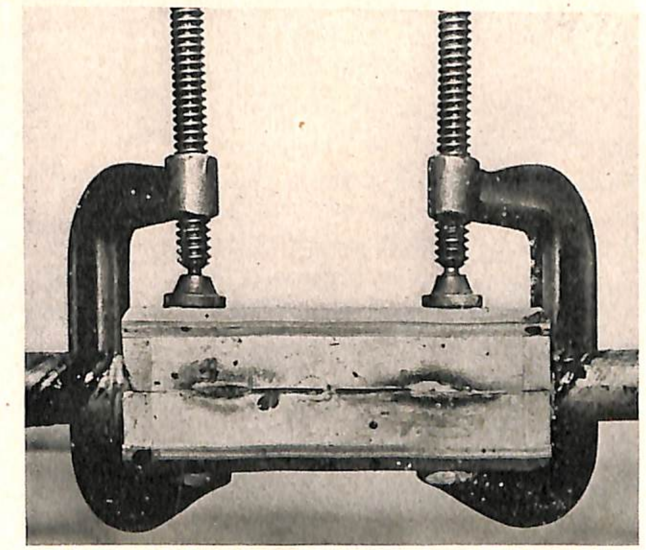


FIGURE 6—*Molding the jacket, using the mold supplied in the kit.*

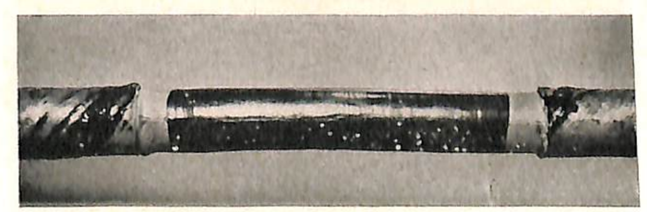


FIGURE 7—*Completed mold of the vinylite jacket of the cable*

JOINING THE INNER CONDUCTOR

By using the jig shown in figure 1, which is contained in the kit, a perfect silver-soldered joint can be made. Removable bakelite rollers are used to align the surface of a file with the ends of the bare inner conductor, to permit filing a perfectly square surface on the ends of the conductor.

Both ends are then placed in the clamp, with a .003-inch gap between them to allow for a good bond of silver solder. The joint is silver soldered with a torch and then carefully dressed down to the outside-diameter size of the conductor This is done to avoid impedance discontinuities at the point of the splice. The use of the clamp also prevents the heat of the soldering operation from causing the core material to melt.

POLYETHYLENE DIELECTRIC

In making the polyethylene splice using the Navy Type 10351 splicing kit, the polyethylene dielectric is provided by molding new insulation around the joint and blending it into the existing insulation of the cables by the application of heat.

Center the splicing point in the mold. Clamp both halves of the mold together securely with the two "C" clamps provided, load the gun with a polyethylene stick, and secure the gun to the mold, as shown in figure 2. Apply heat to the gun by means of a gasoline or prestolite torch or a pair of 10-ampere soldering tongs. The heat should be applied to the barrel of the gun from the junction point with the mold to the end of the polyethylene charge within the gun. The point of greatest heat will be very near to the mold so that, by conduction, the mold will heat to the correct temperature. The mold should reach a temperature of 225 to 235° F.

To gauge the correct temperature of the mold, a heat-indicating crayon such as Tempil Stik (225° F.) or equivalent should be used. The crayon is rubbed along the mold in the proximity of the vent gates. When the mold is sufficiently heated, the crayon will melt. When this temperature has been reached, stop applying heat. The handle of the gun is now screwed slowly down, forcing the new dielectric into the mold. This is continued until polyethylene flows out the gates, indicating that the mold is full. Allow the mold to cool for about 20 minutes. Do not apply water to the mold, but permit it to cool naturally in order to prevent the dielectric from crystalizing.

A slight pressure should always exist in the mold during the cooling process to insure a good bond of the dielectric. This is applied by taking up on the screw of the gun one half turn every ten seconds, thus keeping the dielectric tightly compressed in the mold during the contracting which is occurring at this time.

If polyethylene is forced into the mold too quickly after it begins to flow out the gates, it may be forced out the ends of the mold along the cable. If this occurs, it is likely that the splice will have to be done over since this indicates a loss of pressure within the mold. A good bond on both ends of the cable depends upon equalized pressure within the mold.

When the mold has cooled sufficiently, disconnect the injector gun, unclamp the mold, remove the splice, and inspect it for air bubbles (see figure 3). Should air bubbles appear, they indicate that the pressure was not applied evenly during the cooling-off period, or that the mold has not been tightly clamped. Since air bubbles form an easy path for corona discharge and usually result in cable breakdown, the entire splice should be remade.

Next trim off any excess dielectric around the splice so that it is equal in diameter to the original cable.

SPLICING OUTER BRAID

The copper shields of the two cable ends must now be spliced together. Form a sleeve around the spliced dielectric, using the copper sheet provided in the kit. Roll back the copper braid from both sides of the splice over the sleeve, cutting the braid to the proper length so that the pieces butt against each other. Wrap a few turns of bare soft-drawn copper wire over the butted ends of the copper braid. Solder the copper braid to the sleeve underneath, as shown in figure 4. When applying the solder use care to prevent too much heat from reaching the dielectric and causing it to become distorted. Trim and clean away any excess solder that may have accumulated on the copper braid.

Soldering the braid to the sleeve without damaging the dielectric is probably the most difficult operation of the entire splice, and great care must be taken to accomplish it satisfactorily.

MOLDING THE JACKET

Cover the copper braid with ¾-inch wide strips of polyvinyl chloride tape (35% filler) with sufficient lapping of the turns to make the splice slightly larger than the original vinyl jacket as shown in figure 5, then check it in the mold. It should fit tightly.

Place the two halves of the vinyl mold over the vinyl tape and clamp them securely with "C" clamps, as shown in figure 6. Make certain that the mold overlaps the joint and does not touch the lead covering. Rest the mold on a piece of asbestos or firebrick to keep the weight off the cable. Apply heat to the mold with the torch until the temperature reaches approximately 350°F. This temperature can be determined by the use of the proper Tempil Stik. Allow the mold to cool and then remove it from the splice. The completed splice is shown in figure 7.

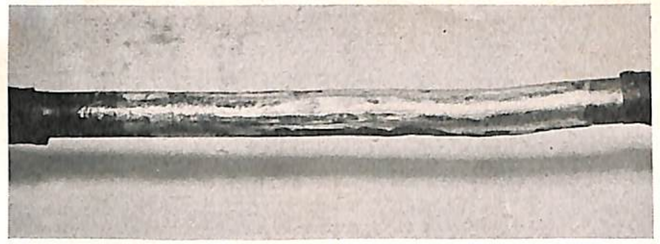


FIGURE 8—*First lead sleeve soldered in place over the jacket*

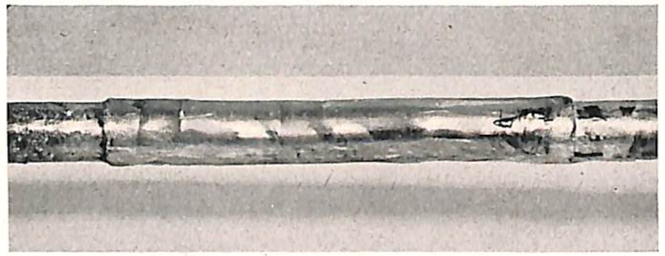


FIGURE 9—*Second lead sleeve soldered in position over the first lead sleeve.*

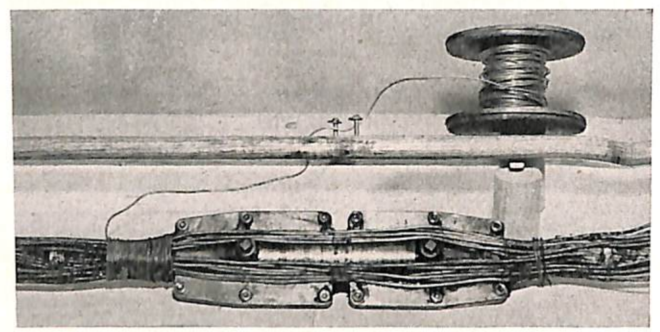


FIGURE 10—*Protector shield in place. Note method of seizing the armor wire with serving stick.*

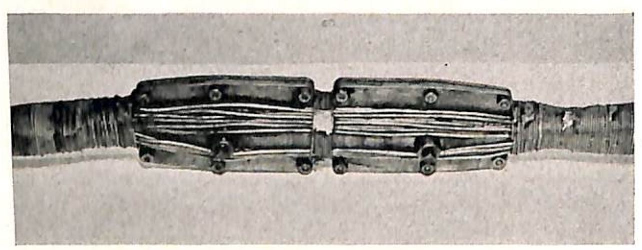


FIGURE 11—*Splice complete with armor wire seized.*

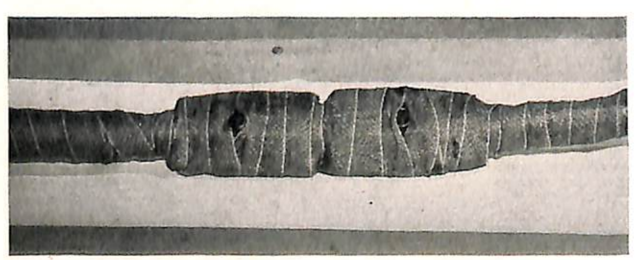


FIGURE 12—*Completed splice wrapped in jute tape and ready for the application of the Okonite compound.*

Alternate method: Another very satisfactory vinylite covering can be made by utilizing the original vinylite jackets. Since this insulation has greater resiliency than the tape, the method is actually more desirable for this operation.

Save the two pieces of vinylite initially cut from the cable, and place them over the copper braid with a strip of black vinylite tape under each seam. Now try on the bottom section the mold and check the gap on the longitudinal cut. If it does not exceed 1/16 inch, the two edges will adhere together again when heated. However, if the gap is greater it will be necessary to wrap the covering around the opposite way, that is, so the longitudinal seams are perpendicular to the cable. Cut off the excess to give the specified gap; also trim so that the end seams butt lightly. Place one layer of the tape over each seam and at the same time recheck the position of the bottom layer. Install the mold in position as previously described and heat, maintaining the same temperature limit with a 350° Tempil Stik. Remove the mold when cool.

JOINING THE LEAD SHEATH

Take one of the small lead sleeves from the kit and form it around the molded vinylite. It may be necessary to trim this sleeve to get a smooth fit. It is extremely important that all seams butt tightly. Cut three small lengths of the seizing wire furnished in the kit and make a tight loop around the center and each end of the sleeve. Heat the lead sparingly and wipe the seams with a stick of flux like tallow, or the stearine furnished with the kit.

Now use the smallest tip available on the acetylene torch and melt solder over each seam. Use just enough heat to allow the solder to run in front of the tip of the torch. Too much heat will burn through the lead sheath and cause the vinylite to oxidize, thus making it very difficult to resolder the joint. Check all seams at completion of the soldering and smooth them down with a file. At this stage the splice is as shown in figure 8. It is advisable to practice making this joint on the section of cable cut off at the start of the splice. Additional lead sleeves have been included in the kit for this purpose.

The larger 8-inch sleeve is now placed over the completed inside sleeve, and soldered in place. The same procedure should be followed as previously for the inner sleeve. When completed, the outer sleeve appears as in figure 9. It should be noted that extra lead sleeves can be obtained by stripping pieces of scrap cable, should the supply in the kit become exhausted.

PROTECTOR SHIELD

There are two halves to each protector shield assembly. One of the castings has a tongue along the inner edge, and the other has a corresponding groove so that the two halves fit together with the tongue fitted into the groove.

Rubber tape must be wrapped around the cable at the points where the ends of the shield will fit. This will insure a good seal when filling the jacket with hot Rubberseal Compound. Fit the rubber tape along the grooved edge of the shield casting, so as to seal the two halves of the shield along the edges. Place the shield over the lead sheath of the cable and fasten it securely, tightly and evenly, using the screws and nuts provided. Bring the shield to 225°F, using the torch for heating. You can tell when the heating should be terminated by marking the surface of the shield with the proper Tempil Stik. Do not overheat. It is very important, however, to maintain this 225°F temperature while pouring the compound into the shield, so as to insure perfect flow around the splice. This will in turn properly seal off the interior of the shield without causing air pockets or bubbles to form.

It is advisable to start heating the compound before heating the shield. Heat the compound to 400°F. Utmost care must be exercised in heating the compound to the required temperature. It is highly inflammable and its flash point is 470°F. A 400°F temperature is sufficient to bring the compound to the proper viscosity for the pouring operation.

With the pipe plugs removed, place the cable splice and shield in position on a splice block. Tilt the shield slightly so that the sealing compound will flow to one end of the shield. Place a funnel in the pipe plug vent on the lower end and carefully pour in the compound. One volume of the compound will most likely seep through the shield, in which case it is considered a normal part of the operation. Pour in one more volume of the compound and permit it to harden with the pipe plugs still removed and the cable splice held in an exactly horizontal position. There will be a slight shrinkage during the cooling off of the compound. Leave the vent plugs removed at this time, to permit observation of the filling operation. After the compound has cooled off screw the two pipe plugs into the threaded vents provided.

SEIZING THE ARMOR

Adjust the cable in the splicing rack so that it lies perfectly horizontal and free from kinks. Remove the temporary wire servings at either end of the splice. Cut off every other armor wire on both ends of the splice, and overlap the remaining wires. This overlap of armor wire should be exactly eight inches in both directions from either side of the shield. Lay the armor wires one at a time and alternately from left to right across the outer shield and parallel with it. The armor wires should be evenly divided between the four quarters around the shield. When all the armor wires have been placed, lash them down temporarily into position around the shield, adding new lashings as necessary.

Wrap approximately 25 feet of No. 12 galvanized seizing wire on a serving stick pool. Thread the wire through the hole in the serving stick and between the studs, allowing the end of the wire to project through approximately 15 inches. Slip the serving wire under one of the armor wires at the end of the shield, make a U-bend with the end of the wire parallel to the armor wire, and continue winding the seizing wire around the cable for a distance of approximately 8 inches. The start of this operation is shown in figure 10. Solder the seized joint securely using the special soldering acid mixture provided in the kit. Wash the seizing off with carbon tetrachloride when completed. Serve the center of the shield in the space provided, after first removing any temporary lashings. Then solder the seizing. The completed seizing is shown in figure 11.

PROTECTING THE JUTE COVERING

Wrap the whole joint with the jute tape provided in the splicing kit. Wind three layers of this tape over the joint, being careful to see that each turn of the tape overlaps the preceding turn, as shown in figure 12. Apply Okonite Compound heated to a temperature of 300°F to the jute surface with a brush. After the first coat has cooled apply a second and third coat as required. Be sure to secure the ends of the joint to the original outer jute covering of the cable. Do not overheat the compound, as its flash point is in the neighborhood of 470°F.

Great care should be exercised in making these splices. The instructions should be studied thoroughly before attempting to complete a splice. It has been estimated that approximately eight hours will be required for experienced personnel to complete one splice.

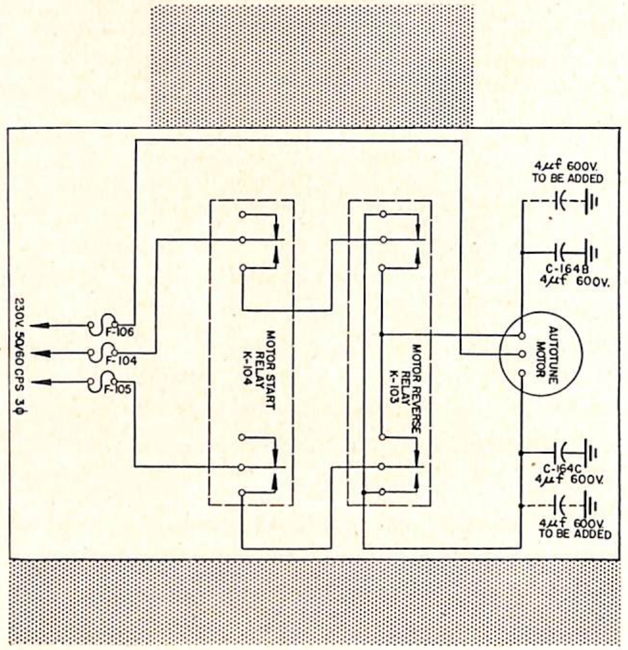
The Bureau of Ships has developed several accessories to be used with the types RG-84/U and RG-85/U cables. The attention of personnel concerned with the maintenance and installation of these cables is invited to the existence of these accessories:

NAVY TYPE NO.	DESCRIPTION	NO. REQUIRED
RW 471138	Antenna coupling	1 per rhombic ant.
RW 491566	End seal for terminating RG-84/U cable in transformer.	1 per run of RG-84/U cable.
RW 491567	End seal for terminating RG-85/U cable in transformer.	1 per run of RG-85/U cable.
RW 491652	Connector adaptor for RG-84/U or RG-85/U to RG-12/U cables.	1 per cable run.
RW 10646	Cable splicing kit for RG-85/U cables. (used in conjunction with kit 10351)	1 per each 5 splices of RG-85/U; 1 per activity installing RG-84/U.

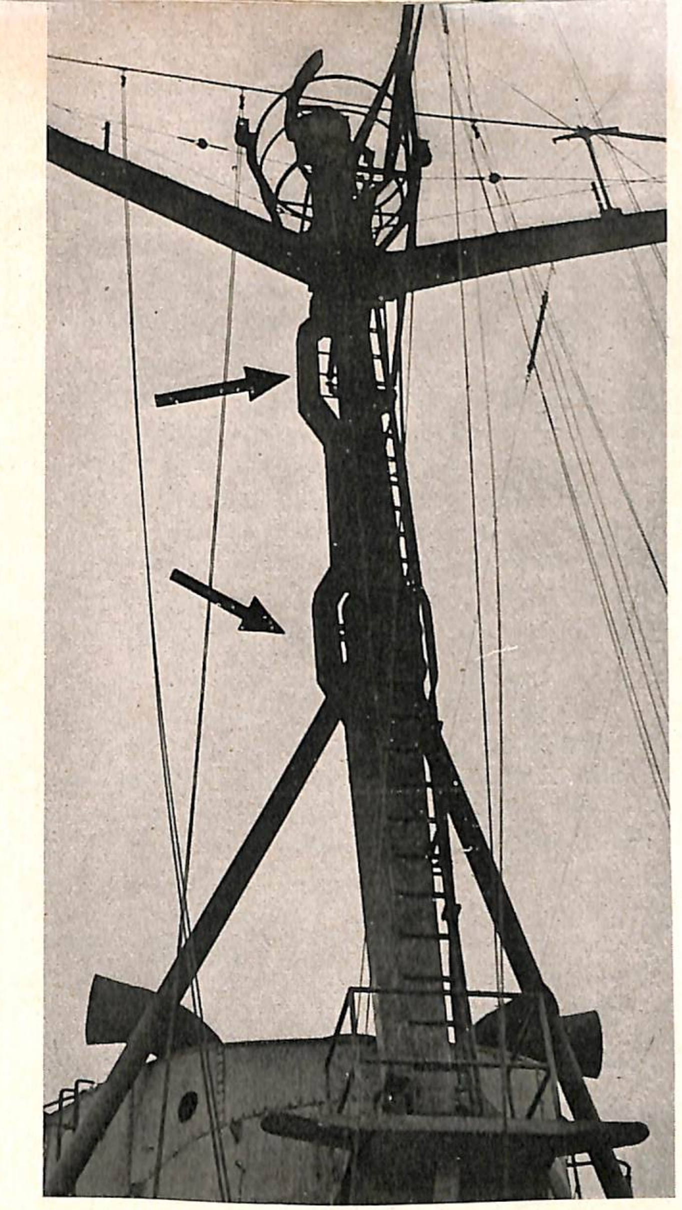
TROUBLE IN COLLINS AUTOTUNE SYSTEMS

■ The U. S. Naval Air Facility in Bermuda reports that erratic operation of the Collins *Autotune* system has occurred at several locations. The Autotune motor fuses blow when the phase is shifted to reverse the direction of rotation of the motor. The failure is infrequent at first but, as time passes, increases in frequency until the equipment becomes useless for remote control or multi-channel work.

It is most prevalent with the TDH-3 transmitter. The contacts on K-103 were found burned badly and when changed the trouble cleared only to reappear a few months later. Capacitor C-164 in each case was found



to be in good condition but nevertheless was replaced. When a closer study of the trouble was made it was noted that excessive sparking occurred at the contacts of K-103 when less than 5μf was used from the contacts of this relay to ground. This sparking caused an eventual breakdown of the insulation between circuits on the movable arm of K103, allowing the a-c supply to break across and short the two phases together, thereby blowing the fuses. Capacitor C-164 was paralleled with 4μf on each side and the relay K-103 replaced. This completely eliminated the trouble. The accompanying drawing shows the equivalent circuit of the autotune system and indicates the addition of the new capacitors. This modification was made on a new installation a few months ago and K103 has given good service and has remained in good condition.



Insulated-duct installation on the USS Wisconsin

Closeup of the Wisconsin's *insulated-duct installation. Note the blower motor at the lower end of the duct.*

Topside Coaxial Cable Protection

■ Many failure reports received by the Bureau of Ships describe the deleterious effects of heat and stack gases upon radar cables, antennas and pedestals. It is worthy of note that during a full-power run of the USS *Lexington,* temperatures along the mainmast exceeded 465° F as indicated by the melting point of fusible alloys used to estimate the temperature. These temperatures existed along a 25-foot length from the smokepipe exit level up to the radar antenna service platform.

Other reports state that failures of soldered joints have occurred on radar equipment installed on the mainmast. From the various failure reports received, and from investigations conducted by the Bureau, it is reasonable to expect that unprotected cables will attain temperatures in the neighborhood of 400 to 500° under the most severe conditions, when installed on the mainmasts of such ship classes as BB-55, -57, -61, CA-68, CL-49, -53, -55, and -95.

Various protective duct designs have been studied by the Bureau, and their relative merits summarized:

1—*Single-shield duct without fan venilation:* This type depends on "chimney-effect" only, and will not provide adequate protection for severe conditions.

2—*Single-shield duct with a Navy standard A-½ axial-flow fan:* This design will barely provide sufficient protection. Since this protection is only marginal, the method is not recommended.

3—*Double-shield duct without fan ventilation:* This design will not provide the necessary protection.

4—*Double-shield duct with a Navy standard A-1/4 axial-flow fan:* This design will provide ample protection.

5—*Insulated duct without fan ventilation:* This design will provide almost sufficient protection on the basis of the design assumptions. However, since this protection is only marginal, its use is not recommended.

6—*Insulated duct with a Navy standard A-1/4 or -1/2 axial-flow fan:* This design will provide ample protection—even more than is offered by type 4 above. It should be noted that while protection of type 4 is ample with the fan in operation, in case of a fan failure the insulated duct will afford protection for a longer period. This is due partly to the relatively low thermal conductivity of the insulation and partly to the fact that the low ventilating air velocity requirement can be met to a greater degree by the free convection circulation (chimney effect) of the insulated duct than by that of the double-shield duct.

Since the insulated duct (type 6) provides better protection than the double-shield duct (type 4) and is only slightly more difficult to construct, it has been adopted by the Bureau as the Type LMM method (BuShips standard drawing 9S-3980-L Alt. 25) of protecting cables in the direct path of stack gases. By this method the cables are protected by an insulated duct through which is forced a current of air from an integrally installed blower. This blower provides air flow sufficient to effectively cool the radar pedestal and antenna array elements in the immediate vicinity.

The insulated duct is designed to maintain a cable temperature not exceeding 150° F with an ambient air temperature of 100° and a maximum gas temperature where it leaves the stack of 550°. The 150° maximum limitation is necessitated by the relatively low melting point of the dielectric material employed in the present types of solid-dielectric r-f coaxial cables as compared with HFA-type cables.

In general, solid-dielectric coaxial cables employ a polyethylene insulation which flows under pressure at 225°. The present average power ratings assigned to solid dielectric cables for each frequency are therefore such that, under continuous load at assigned power in a closed space at 105°, the dielectric at the inner conductor will not exceed 180°. This compares with a maximum permissible operating temperature of 212° for HFA-type cables installed on mast structures.

It should be noted that it will be necessary for installing activities to develop their own plans, tailoring each job to suit the particular conditions existing on the ship. No provisions need be made for running wave-guides within the duct area, however. In planning topside installations in cruisers and larger type vessels, the use of insulated ducts is authorized (strength of mast permitting) in the event that exposure of cables to unreasonable temperatures and attack by stack gases cannot otherwise be avoided. Mainmasts located within 20 feet of the smokepipe enclosure are considered as requiring such protection.

For a cruiser installation, the weight of the insulated duct required is estimated to be about 400 pounds, with its center of gravity located approximately 110 feet above the baseline (these figures are based on the CA-72 trial installation). It is considered that such protection is not required in destroyers and small type vessels. Furthermore, the additional weight and space required by an insulated duct in these vessels is prohibitive.

Naval shipyards have been requested to investigate all cases of excessive heating of coaxial cables and radar antenna pedestals at the first availability of the vessel reporting such trouble, and to take corrective measures as indicated herein. Specific authorization (Shipalt or letter) from the Bureau is required before undertaking any protective duct installations on cruisers in commission and on CV-3, -6, and -9 class carriers due to the critical weight situation existing in these vessels. Naval shipyards contemplating such installations have been requested to submit studies for approval indicating what weight and moment compensation are under consideration. Present mast installations on other class carriers are such that no special protective ducts are required.

In spite of the protection afforded by the installation of insulated ducts, operational reports recently received by the Bureau of Ships provide renewed evidence of the necessity for further action to prevent the failure of solid-dielectric coaxial cables exposed to the effects of hot stack gases.

Installation of insulated cable ducts on the mainmast, in accordance with Bureau of Ships standard methods Plan 9S-3980-L Alt. 25 sheets 58, 59, and 60, as outlined above, has proven effective for the cables within the duct enclosure. However, those cables that come out of the duct at or near the top and run along the yardarms to their respective antenna lead connections are still failing. To prevent these failures, the cables are piped through oversize flexible tubing which is connected into the insulated duct system so as to allow forced air to circulate and cool the cables. This in effect is an extension of the present duct system along the yardarms. The disadvantages of this method are that it involves an increase in the top-side weight, is difficult to maintain, and is unsightly.

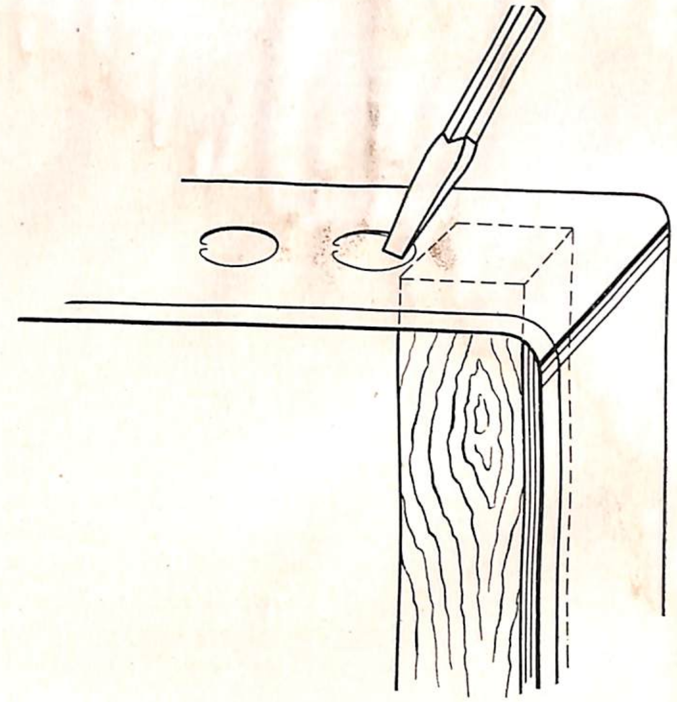
It should be noted here that the size of the fan required by the insulated duct system will depend on the particular conditions existing aboard each ship. The need for forced-air cooling has not yet been definitely established by test. With natural ventilation up the insulated duct the cables may be sufficiently protected. Calculations indicate this possibility, but with no margin of safety.

However, viewing the problem of thermal protection of the radar installation as a whole, it is necessary to provide forced-air cooling in order to assure protection for the antenna pedestal and the cables on the yardarm runs. Accordingly, until a better system is developed, it is believed that the best method of accomplishing this aim is to use fan ventilation up the duct, directing the cold air discharge around the pedestal, and directing some of the flow through a flexible tube surrounding (and supporting) the cable running out the yardarms.

In order to provide a more serviceable and lighter installation, the Bureau of Ships is investigating the use of Pyrotenax cable or its equivalent (Teflon dielectric and silicon-impregnated glass braid) high-temperature-resistant r-f coaxial cable in that portion of the cable run which is outside the protective insulated duct and therefore exposed to the effects of stack gases.

Sample Pyrotenax cables have been procured for this purpose which are fifty feet long and are equipped with fittings (connectors Type UG-21/U and Type 62119 end seal assemblies) attached to each end of the cables. These fittings will permit connection of one end of the cable to the antenna and the other end to the polyethylene coaxial cable somewhere inside the main insulated duct.

Installations employing these cables will be made in the near future for test and evaluation purposes. The results of these tests will serve as a basis for further procurement and the determination of general shipboard applications.



KNOCKING OUT KNOCKOUTS

The CQC-23497 selector control unit and the CQC-20409 power supply unit are used with the MAR and RDZ. The Bureau's attention has been invited to difficulty encountered in the removal of knockouts from some of the 800 of these units which have already been shipped to the field. It was found that because of metal variations the knockouts could not be removed without causing severe distortion to the cases. Corrective measures have been adopted by the manufacturer, so that this condition will not occur in units delivered in the future.

It is recommended that whenever this condition is encountered, a piece of wood be cut and placed inside the case near the knockout to be removed. This adds support to the case and thereby minimizes distortion. The piece of wood should be 2″ × 2″ × 7¹¹⁄₁₆″. Insert it between the top and bottom of the case, keeping it as close as possible to the knockout to be removed. Take a cold chisel and place it on the edge of the knockout nearest the block of wood. With a hammer or mallet, hit the chisel a firm blow. This will cause one side of the knockout to shear loose. The knockout slug can now be removed with a pair of pliers.

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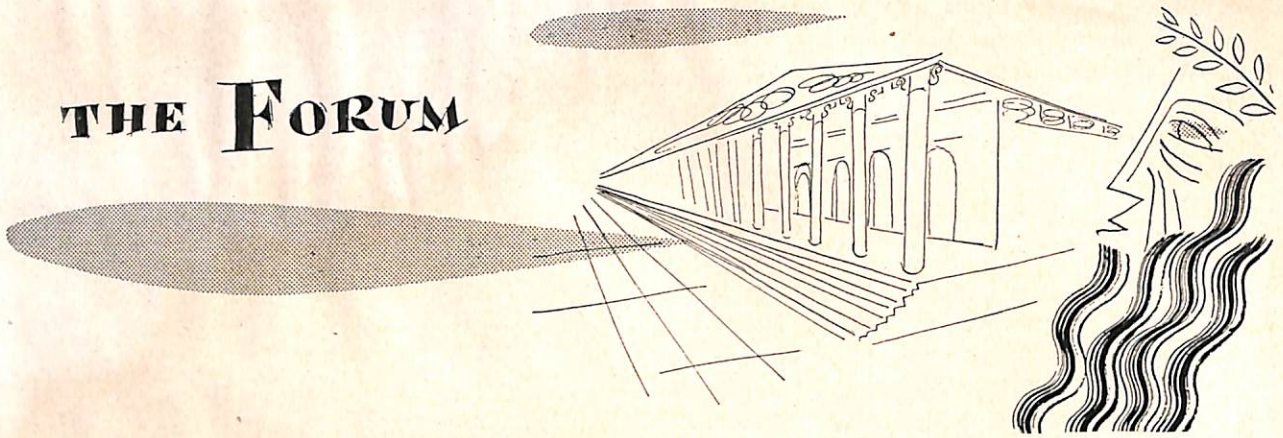
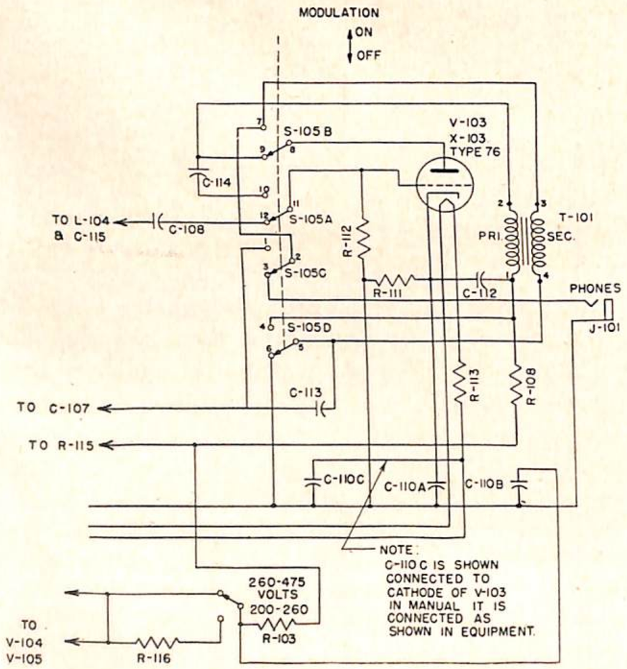
FRA INSTRUCTION BOOK

Figure 3-1 on page 3-2 of the Model FRA frequency-shift converter instruction book (NavShips 900,613) is incorrect in that it shows the r-f input cable connection and the audio output cable connection in the back of the FRA interchanged. Figure 3-1 should be corrected accordingly.

THE FORUM





LM-18 INSTRUCTION BOOK

By W. D. McMurray, S2/c, *USS Devastator*

A trouble-shooting job on our LM-18 frequency meter let to the discovery of two errors in the instruction book (NavShips 900,002). The first one appears on page 17, section V (2d), under the column "V-103". This column contains pin numbers and associated voltages for tube V-103. The pin numbers for the filaments are incorrect; filament 1 should read 6.8AC (5) and filament 2 should read 0.0 (1). The second error appears on the schematic wiring diagram, figure 20. Capacitor C110C is shown connected in parallel with C110A when it should be connected as shown on the accompanying corrected diagram.

Bureau Comment: All activities having NavShips 900,002 instruction books should correct these errors as soon as possible. The wiring error on the schematic diagram also appears in the LM-19/20 instruction book (NavShips 900,217). This type of information is appreciated by the Bureau as it proves very helpful to the fleet. ITEM No. 422

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ELECTRICAL FEEDBACK IN THE TBS

U. S. Naval Shipyard, Brooklyn, N. Y.

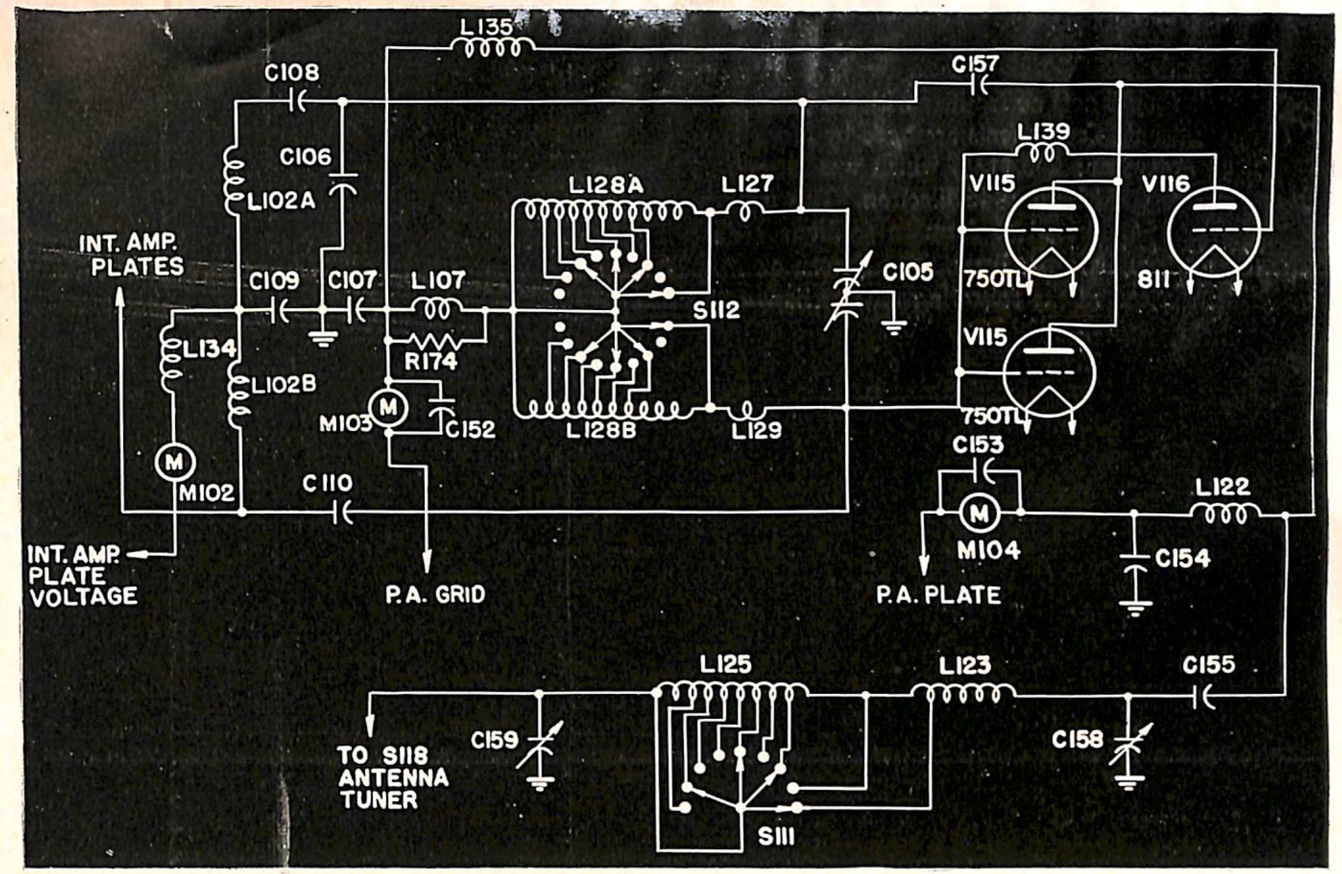
TBS installations where remote control units are located at a considerable distance from the transmitter-receiver unit are subject to electrical feedback. In cases where the cable runs are not over 200 feet, it is recommended that proper leads be chosen in the MHFA-14 interconnecting cable to insure minimum coupling between microphone and audio output leads. The color coding shown in the instruction book is usually satisfactory in this case.

Installations where remote control units are located 200 feet or more from the TBS transmitter-receiver require a separate audio cable between the receiver output terminals and the remote control unit to properly eliminate feedback difficulties.

Bureau Comment: The Bureau has found that the careful choice of leads in these cables has eliminated electrical feedback in practically every instance, regardless of the length of the cable run.

Correction, page 5, September, 1946, Electron: The sentence which commences with the seventh line from the top of the first column should be changed to read:

The XTEJ is being constructed for use on both surface and under-surface vessels for low-power operation in the frequency range of 300-26,000 kc. and medium-power operation in the frequency range of 2000-26,000 kc.



FAULTY TDH-4 TRANSMITTERS

The Naval Radio Station, Summit, C.Z., has reported that trouble was experienced in model TDH-4 transmitters, serials 176 and 196.

During the initial testing of these transmitters it was observed that the plate blocking condenser, symbol C-155, would arc over upon application of higher plate voltage for A-1, and on peaks when A-3 operation was used. These arc-overs were apparently due to parasitic oscillations causing C-155 to produce a corona discharge and to short the plate supply to ground through coils L-123, L-125 and L-126.

Circuit investigation indicated discrepancies between figures 81 and 82 in the Model TDH-4 instruction book: 1—Parasitic damping resistor, symbol R-174, shunted across L-101, was shown in figure 81 but not in figure 82. Further investigation disclosed that this resistor was omitted in the transmitter. 2—Choke L-139 is shown between the plate of the power-amplifier stabilizing tube V-116 and the power amplifier grids in figure 82, while in figure 81 the plate of the stabilizing tube and the grids of the power amplifier tubes are directly connected. The transmitters were wired according to figure 81, which is incorrect.

It is requested that all activities receiving Model TDH-4 transmitters check the equipment for the above discrepancies. The spare parasitic damping resistor R-174, contained in spare parts, should be installed, and the power-amplifier grid parasitic suppressor check L-139 should be rewired and connected as shown in figure 82. A corrected diagram of the final amplifier showing the proper placement of components is given here for reference.

The Bureau has no information relative to the number of equipments shipped which contain the above errors. It is probable, however, that all instruction books contain these errors. Figure 81 should be corrected according to the accompanying diagram.

REPLACEMENTS FOR JONES CONNECTORS

Many difficulties have been experienced in the use of certain types of Howard B. Jones coaxial connectors. These types will no longer be stocked by electronic pools. They include Navy types 49163, 49164, 49458, 49459, 49460, 49461A, 49462, 49463, 49464 and others which carry no Navy type number.

When it becomes necessary to replace a defective Jones-type plug and the replacement is not available in either equipment or stock spares, it is recommended that a "UHF" connector be used. It is not always possible to effect type-for-type replacements because, due to plug irregularities and panel arrangements, certain UHF-type plugs will not always replace a similar plug of the Jones type. Replacements may be selected from the following: Navy types 49190, 49191, 49192, 49193, 49194, 49195, 49199, and 49483 or "BN" AN types UG-85/U, UG-86/U, UG-87/U, UG-114/U and UG-115/U.

LIST OF ELECTRONIC COMPONENTS

All hands should now be familiar with the publication "List of Electronic Components arranged by Navy Type Numbers" (NavShips 900,113), which was introduced on page 26 of the March 1946 Electron. This publication was made in loose-leaf form to facilitate adding pages or sections at future dates. The Bureau of Ships has so far distributed the following nine sections to be placed in the binder:

Part I	Low Travel Limit Switches
Part II	Dry Batteries
Part III	Fuses
Part IV	Electrolytic Capacitors
Part V	Mica Capacitors—Section I—Button Types
Part V	Mica Capacitors—Section II—Cased Types
Part V	Molded Mica Capacitors—Section III—Lug and Pigtail Types
Part VI	Vacuum Tube Sockets
Part VIII	Ceramic Capacitors

It is pointed out that the various sections are not necessarily prepared or distributed in proper numerical sequence, as illustrated above where Part VIII followed Part VI. The following sections are now being printed and should be available for distribution shortly:

Part VII	Paper Capacitors
Part IX	Fixed Wire-Wound Resistors
Part X	Ceramic Insulators
Part XI	Fixed Composition Resistors
Part XII	Relays
Part XIII	Wire-Wound Potentiometers
Part XIV	Composition Potentiometers
Part XV	Variable Capacitors
Part XVI	Toggle Switches
Part XVII	Lever and Turn Switches

Sections on Connectors, Meters, and Transformers are also being prepared for inclusion in NavShips 900,113 and will be distributed as soon as they become available.

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BLOWER MOTOR FAILURES IN THE SO

The 115-volt d-c blower motors used in the Models SO-1 and SO-8 radar transmitter-receivers have been found to require frequent maintenance and replacement. These motors are equipped with small sealed bearings which become dry after a few hundred hours of operation and then rapidly wear out. The brushes employed also require frequent inspection and replacement.

To alleviate the maintenance problem of this blower motor, a 400-cycle a-c type blower has been adapted for replacement use in these equipments. This blower combines the impeller and motor in a single housing and requires only a modified bracket to replace directly the existing type.

The a-c type blower is designed to give one year's continuous operation without attention. The motor is a capacitor-start induction type having no brushes, and is equipped with large open-race bearings packed with high-temperature lubricant. It will obtain its power from the 400-cycle primary supply to the filament transformer in the transmitter-receiver. The fuse in this circuit will also serve the blower.

This change will be known as "SO Radar System—Field Change No. 107—Installation of 400-cycle Blower Motor". The necessary items to make this conversion, together with instructions, are contained in a kit.

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DISTRIBUTION OF INSTRUCTION BOOKS

Electronic equipment instruction books prepared by manufacturers and which were formerly stocked by the registered publications system are now stocked by District Publications and Printing Offices (see p. 14, ELECTRON for July 1946). Stocks now held by Electronics Officers will also be stocked by District Publications and Printing Offices as soon as facilities become available. District Publications and Printing Offices will issue instruction books pertaining to electronic equipment only when such requests are approved by an Electronics Officer or his authorized representative.

Electronics Officers have been instructed to approve requests for electronic publications from holders of basic equipment, personnel concerned with the installation and maintenance of the equipment, and other personnel, who, in the judgment of the Electronics Officer, have need for the publication in the performance of an assigned duty. Technical personnel should be advised as to the above restrictions and regulations to avoid unnecessary requests for books for which they obviously have no need.

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SU GYRO CONTROL BOX

Page 6-12 paragraph (b) of the SU Radar Instruction Book (Ships 313) states that the SU radar antenna stabilizer gyro control box must be replaced as a unit, and that the cover must never be removed. This paragraph should be changed to read "The SU radar antenna stabilizer gyro control box must be replaced as a unit, and the cover should never be removed except in a dehydrated, dust-filtered and air-conditioned room in accordance with the method outlined in Supplement #1 to Ships 313".

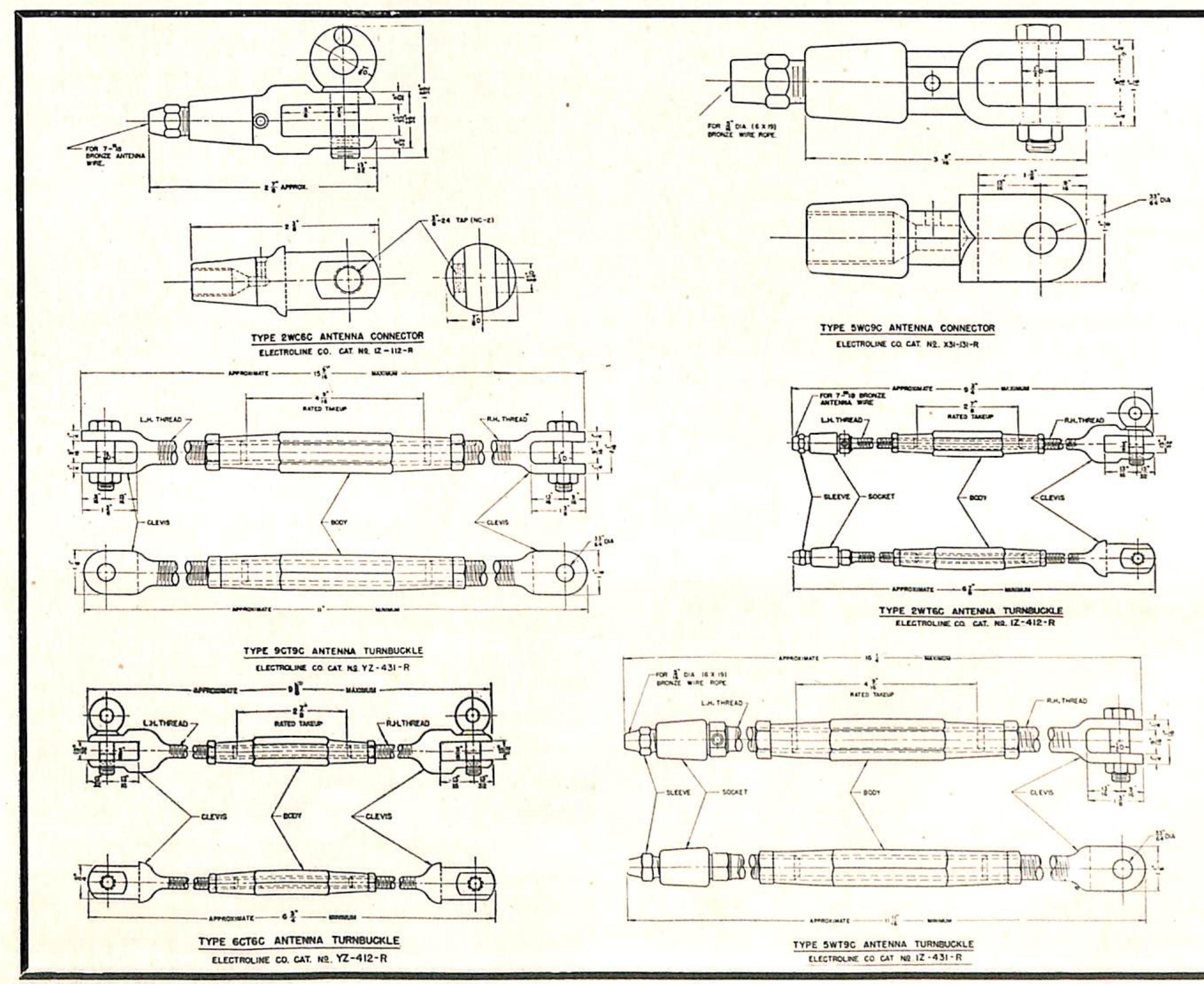
Procurement of Wire Antenna Fittings

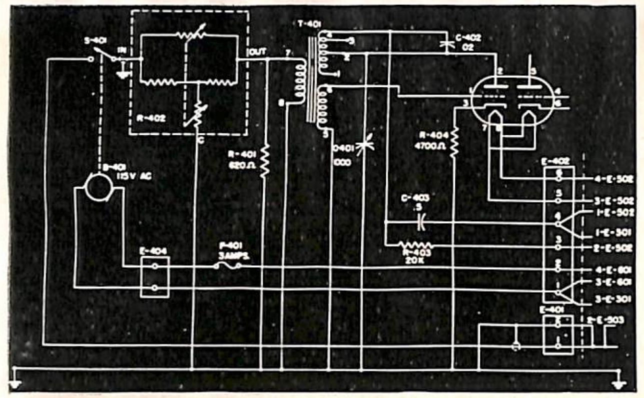
In June 1945 a coordinated system of wire antenna fittings was announced. It included shackles, clamps, connectors and turnbuckles. Also various manufacturers were listed who were prepared to supply these fittings to any naval activity ordering them.

Individual naval activities are having some difficulty in procuring their requirements directly from these manufacturers due to the small quantities involved. Consequently, each major activity was requested to submit requirement figures covering a period of twelve months for each item involved, i.e. shackles, clamps, connectors and turnbuckles, so that the requirements of the major activities could be combined and the resulting attractively larger quantities procured from two or more manufacturers by BuShips. These figures were received and correlated, and procurement negotiations were started. A contract covering the clamps and shackles has been placed, and deliveries are scheduled to begin in the near future. However, difficulties have arisen in connection with group procurement of the connectors and turnbuckles by the Bureau, and it has become necessary to let the procurement of these particular items revert back to the individual activities as originally planned. All activities, both naval and commercial, are therefore advised that their requirements for connectors and turnbuckles, until further notice, should be procured direct from a manufacturer in the usual manner.

To ensure that the connectors and turnbuckles procured by the various activities are suitable in all respects for use with the associated standard clamps, shackles, and insulators, they should be procured in accordance with Bureau Drawing RE 66F 562. The applicable parts of this drawing are reproduced here for information and reference. The navy identification and the catalogue number of one manufacturer are shown with each sketch. When additional manufacturers are located and their products approved, they will be added to the listing.

Attention is again invited to the fact that the original quantities of clamps and shackles requested by the various activities are being procured by the Bureau and should not be duplicated.





Schematic wiring diagram of the keyer-audio oscillator unit of the Model YR Radio Telephone Beacon.

YR BEACON TRANSFORMER FAILURE

Several failures of audio transformer T-401 used in the Model YR Radio Telephone Beacon have been reported by the field. Nearly all of these failures have been replaced under an emergency arrangement in which new replacement transformers were shipped directly from the factory. Failure of the transformer has been attributed to insulation breakdown between the core and the inner primary winding, usually opening up the winding between terminals 3 and 4. Upon investigation, it was found that the core liner, on which the wire is wound, had been partially cut through by the center leg of the E-core lamination during assembly.

The component manufacturer has accepted responsibility for this fault, and the contractor has taken steps to procure a quantity of transformers for replacement of the defective units. In an emergency, a new transformer will be shipped immediately to any activity upon receipt of a telephone or telegraph request addressed to the Naval Inspector-In-Charge, c/o Washington Institute of Technology, College Park, Maryland.

UHF INSTALLATION PROGRAM

Due to conditions beyond Bureau of Ships control, the delivery program for the Model TDZ UHF transmitting equipment has been very erratic. Now that TDZ deliveries are about to be resumed, UHF installations will be made on a limited basis at first and, later, as more equipments become available, on an allowance basis.

The U. S. Army, the CAA, the Bureau of Ships, the Bureau of Aeronautics, and the Chief of Naval Operations are all vitally interested in this program. In order to keep a check on the development of the program, it has been decided that the Bureau of Ships will compile monthly progress reports showing the percentage of completion of the UHF conversion program.

In order to compile these reports properly, it is essential that every UHF installation be reported to BuShips (Code 980) immediately upon completion, giving the location and model letters of the equipments (as TDZ, MAR, RDZ, etc.) and their serial numbers. This accurate and up-to-date information must be available to the Bureau of Ships at all times if the highly important UHF conversion program is to be completed and coordinated satisfactorily with other agencies.

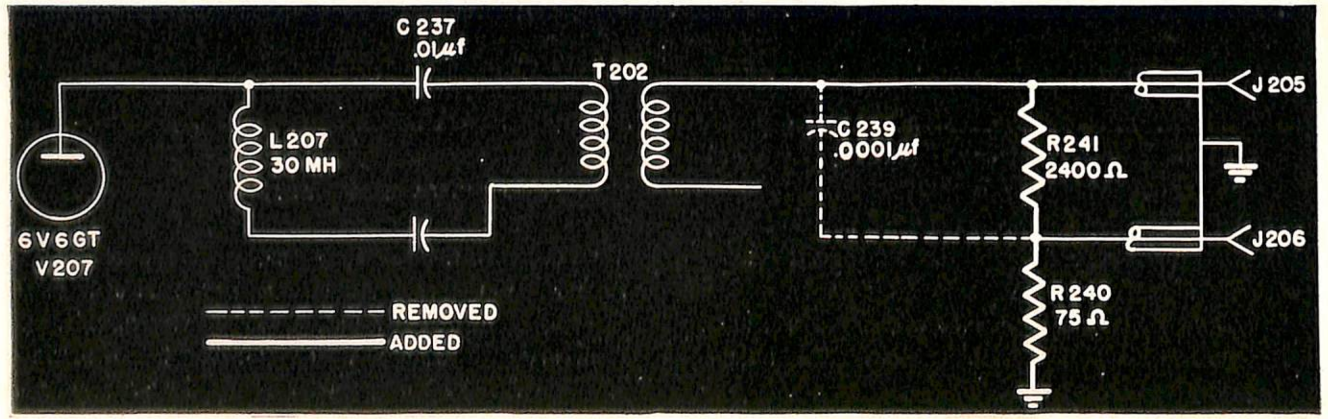
•

MODEL FSH FREQUENCY-SHIFT KEYER

In order to provide the proper resistance termination for the frequency meter r-f output jack of the Model FSH shore-type frequency-shift keyer, certain changes must be made to the equipment.

These changes include the substitution of a 2400-ohm resistor designated R-241 in place of capacitor C-239, and the insertion of a 75-ohm resistor designated R-240 between the ungrounded side of jack J-206 and ground. These changes are known as Field Change No. 1 and are shown schematically in the accompanying figure.

Changes necessary to accomplish Field Change No. 1 on Model FSH Frequency-Shift Keyer Equipment.



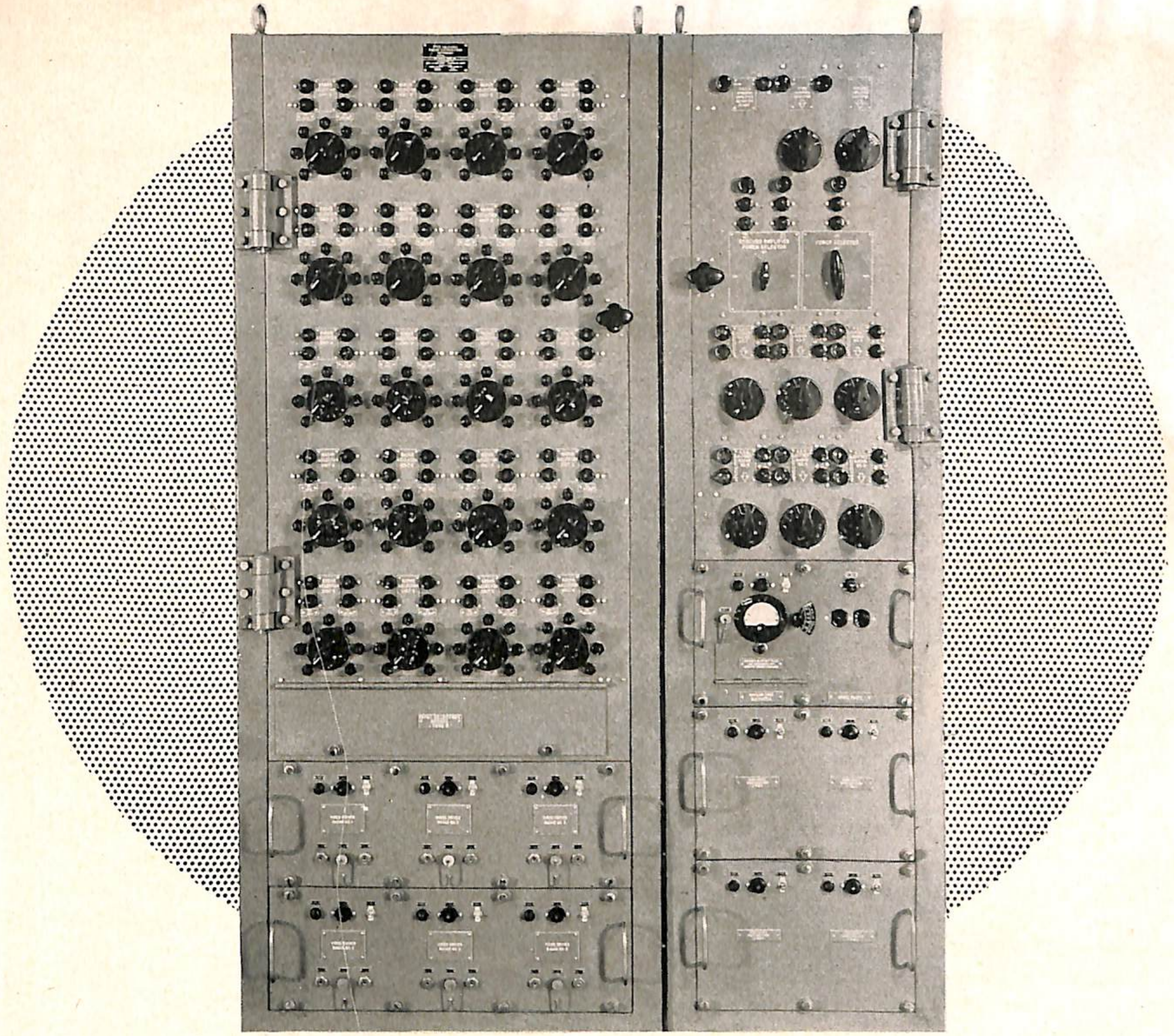


FIGURE 1—*Front view of the model 23AGU RDS. Note that the upper-right and -left sections are hinged, while the remaining units are of the sliding-drawer type.*

The 23AGU Radar Distribution Switchboard

By R. D. CHIPP, Facilities Engineer,
American Broadcasting Co.
(Formerly of BuShips)

■ The development and operational features of Radar Distribution Switchboard Model 23AFL were described in the August issue of ELECTRON. A later model of RDS, the 23AGU, was mentioned, and is shown here in figure 1. The purpose of the following discussion is to list the differences between the two models and to point out briefly the reasons for certain changes which have been incorporated into the later model. The points in question are listed in table I.

Pertinent comments on the items given in the table may present a clearer picture of why and how various changes were made in the design of the 23AGU.

Figure 2 shows one basic change in design, made to permit complete servicing of the switchboard from the front. In the early model 23AFL, the quantity and complexity of cabling in the rear of the switchboard required approximately two feet of clearance between

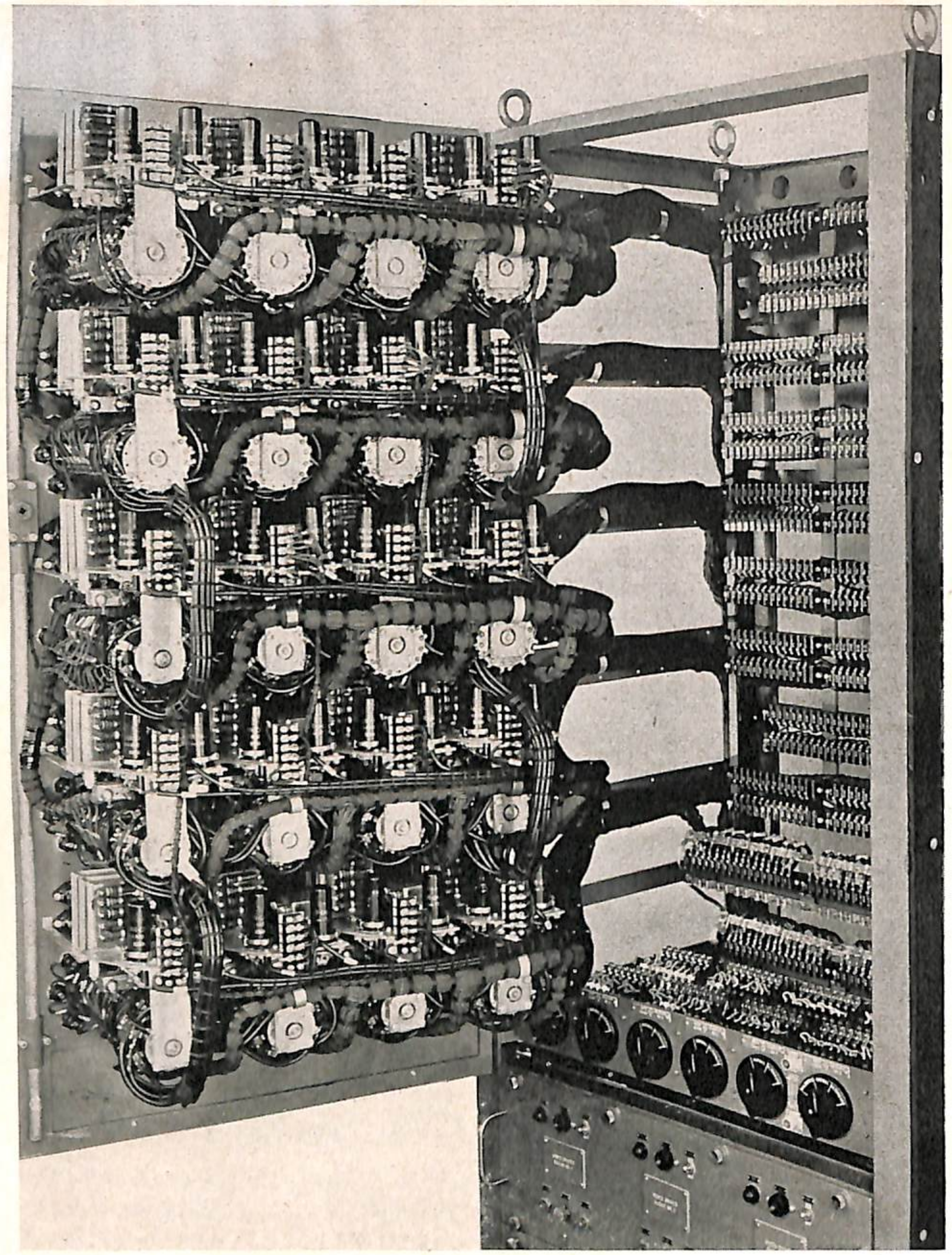


FIGURE 2—*Upper-left section of 23AGU RDS opened to reveal components and cables accessible for servicing.*

unit and bulkhead for servicing. Even with this amount of clearance servicing was very difficult. In the 23AGU design the rear of the switchboard is completely enclosed, units and sub-assemblies being mounted either on hinged doors which swing outward, or on drawer slides which pull out from the front as shown in figures 3 and 4. By employing this type of design the entire switchboard can be mounted with the back flush with the bulkhead and still provide complete access to all components and cabling from the front.

It will be recalled that in the 23AFL there were provisions for only 5 radar systems, while in the 23AGU this number has been increased to 6 as shown in figures 5 and 6. The change from 5 to 6 inputs is the result of a trend toward increasing the number of sources of radar information. Present plans indicate that future shipboard systems will make use of all 6 channels. In addition to this change, the order-switch circuit has been modified to use 6-volt incandescent lamps in lieu of 115-volt neon lamps. There are two basic reasons for this change; it increases the intensity of the order lights, and precludes the possibility of erratic operation of the order lights when grounds and other irregularities are present in the ship's power circuits. Such irregularities in the power circuits on some ships caused the order lights to glow even when the order switch was off.

Inasmuch as 36-speed OSC and 36-speed antenna-train information are required only for the VF repeater, this information has been made available at only ten of the output circuits. Relays are used to supply the OSC for these ten outputs, although relays have hitherto been frowned upon for shipboard use because shock will often cause them to open. However, these OSC relays are so arranged in the circuit that there can be only a

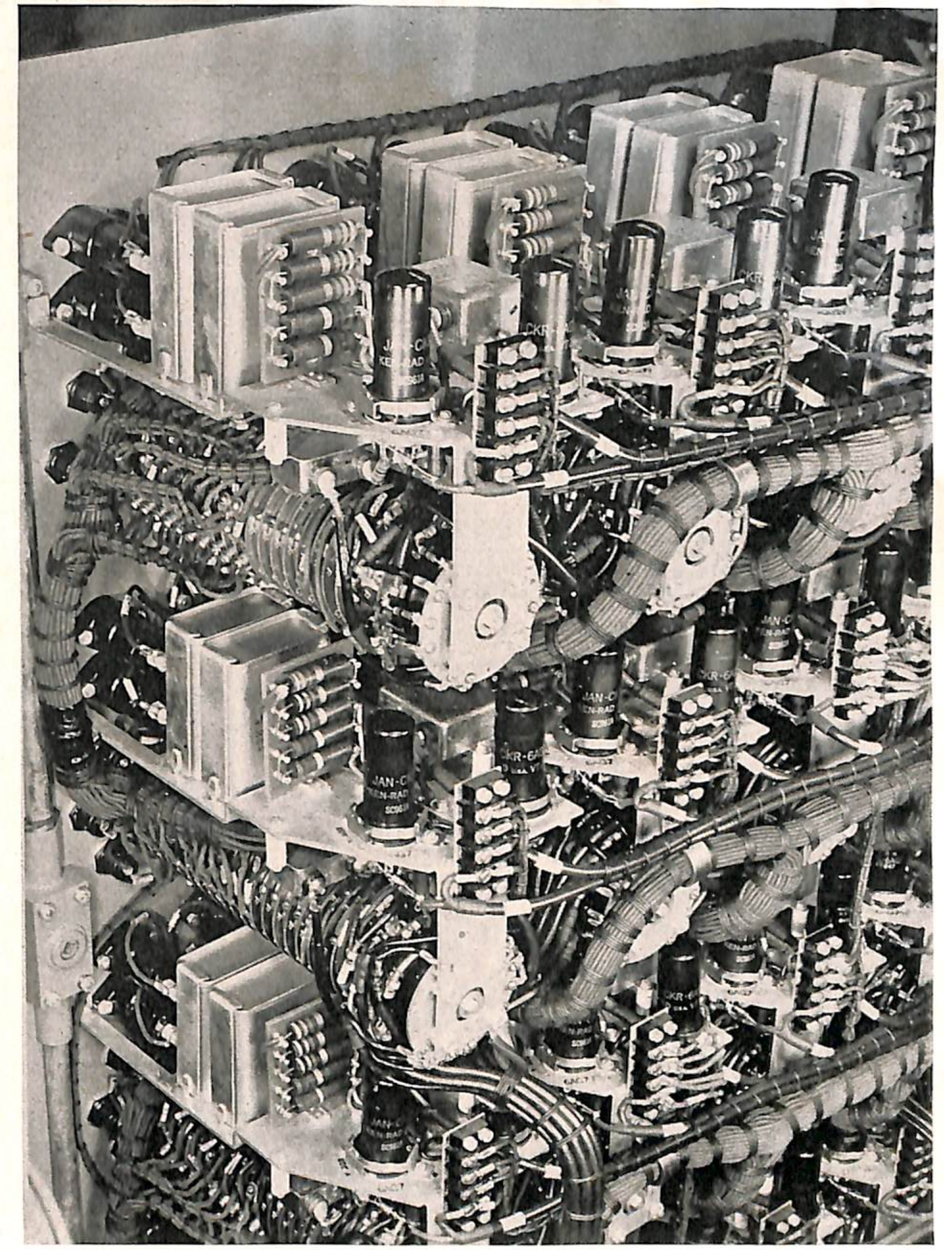


FIGURE 3—*Close-up view of a section of the panel shown in figure 2. Despite the large amount of wiring and cables on this panel, replacement of electronic components is not difficult.*

momentary interruption to the OSC circuits during shock. The use of the relays permitted considerable saving in space and also permitted the radar selector switches to be shortened so that they could be front-panel-mounted without additional support at the rear.

In the early model (23AFL) RDS there was no provision for interconnecting any IFF equipment. However in the 23AGU it was decided to add an extra deck to ten of the radar selectors to further correlate IFF and search information. An examination of the wiring diagram (figure 5) shows that the leads from this extra switch deck are brought out to terminal boards and thus can be used to switch IFF indicator consoles simultaneously with repeaters either by means of motor driven selectors or by relays. With this arrangement the design of the RDS should not become obsolete by possible future changes in IFF requirements.

Figure 6 shows an additional input to channel 6 from a crystal calibrator. The intention of this feature is that a standard Model TS-358/UP Crystal Range Calibrator may be patched into the coaxial jacks appearing in the front panel (shown in figure 7) and the trigger and range marks from the calibrator can be transferred to the entire repeater system. By utilizing this feature the range-mark circuits of every repeater can be adjusted to match a standard range mark so that all repeaters will be in agreement on the correct range.

Another improvement in the 23AGU is the provision for switching rapidly, in case of trouble, from regular

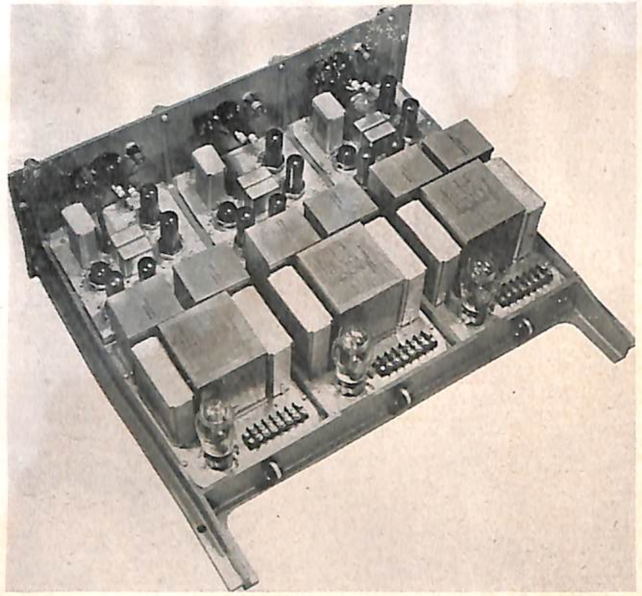


FIGURE 4—*One of two sliding drawers, containing three video amplifiers, removed from the main frame. Note the neat and compact assembly of components.*

video and trigger lines to alternate video and trigger by means of the front panel switches, as shown in figure 7. The circuit setup to provide for these switches is shown in the wiring diagram, figure 5.

In connection with the built-in vacuum-tube voltmeter, the 23AGU has a probe on the input cable and both 50-volt and 5-volt scales to allow measurement of trigger voltages as well as video voltages. It is anticipated that a retroactive field change to the 23AFL vacuum-tube-voltmeter circuit will add the same features to that equipment. (See ELECTRON, April 1946, page 6.) The use of the probe permits easier checking of incoming and outgoing pulses, both video and trigger, as well as signal tracing within the equipment itself.

In the original model (23AFL), the synchro-amplifier power switch and the synchro-amplifier selector switch were two separate units. This was done because one standard switch had a 45-degree throw whereas the other standard switch had a 90-degree throw, and there was insufficient time available to design a practical method of coupling the two. Operationally, the power and signal circuits should be switched simultaneously; therefore, in the new RDS, a single switch was designed for this use.

The 23AGU employs type EL fuse holders and standard cartridge fuses throughout, whereas in the 23AFL there are three types of fuses and fuse holders. This is not an improvement electrically, but the standardization has simplified the stocking of spare parts. From the standpoint of installation and servicing, the cable entrances provided in the 23AGU (figure 8) permit greater flexibility than was possible with the 23AFL, which restricted these entrances to the bottom of the unit. The standard terminal designations, which are used in the 23AGU and which are based on the Dictionary of Standard Terminal Designations, also aid in servicing.

While the 23AFL did not include a gyro compass-synchro amplifier output deviation alarm, it contained provisions for energizing the alarm circuit from a relay in the synchro amplifiers. The alarm circuit was energized only when the 115-volt gyro reference bus to the synchro amplifier failed or was cut off. The 23AGU is provided with a built-in deviation alarm which will energize the alarm system whenever an error of approximately 3 degrees or more exists between the gyro compass signals and the output of the synchro amplifier, or when there is a failure of either the 115-volt gyro compass reference bus or the amplified OSC reference bus.

The preceding paragraphs constitute a summary of the major improvements incorporated in the 23AGU Radar Distribution Switchboard. It should be noted that from the standpoint of performance both models are comparable, as shown by typical video response curves, figure 9. However, these changes are refinements which should make installation, operation, and maintenance easier.

TABLE I—*A Comparison of certain features of the Models 23AFL and 23AGU Radar Distribution Switchboards.*

ITEM	23AFL	23AGU
Access for servicing	Front and rear	Front only
Radar inputs	5	6
Order lights	Neon, 115-volt	Incandescent, 6-8 volts
36-speed own-ship's course	To all repeaters	To 10 repeaters
36-speed antenna train	To all repeaters	To 10 repeaters
IFF switching provisions	None	For 10 repeaters
Calibration provisions	None	Input on channel 6
Regular/Emergency switching	Video only	Video and trigger
Vacuum-tube voltmeter	Checks video only	Checks video and trigger
Size	72″ high, 48″ wide, 26″ deep	70″ high, 48″ wide, 22″ deep
Weight	2160 pounds	1545 pounds
Synchro amplifier power and signal selection	2 separate switches	1 switch
Fusing	Type 3AG and 2 types of cartridges	Standard cartridge throughout
Deviation alarm	Relay in synchro amplifier	Separate unit, made part of switchboard
Coaxial cable entrances	Bottom only	Bottom or either side
Multi-conductor cable entrances	Bottom only	Top or either side

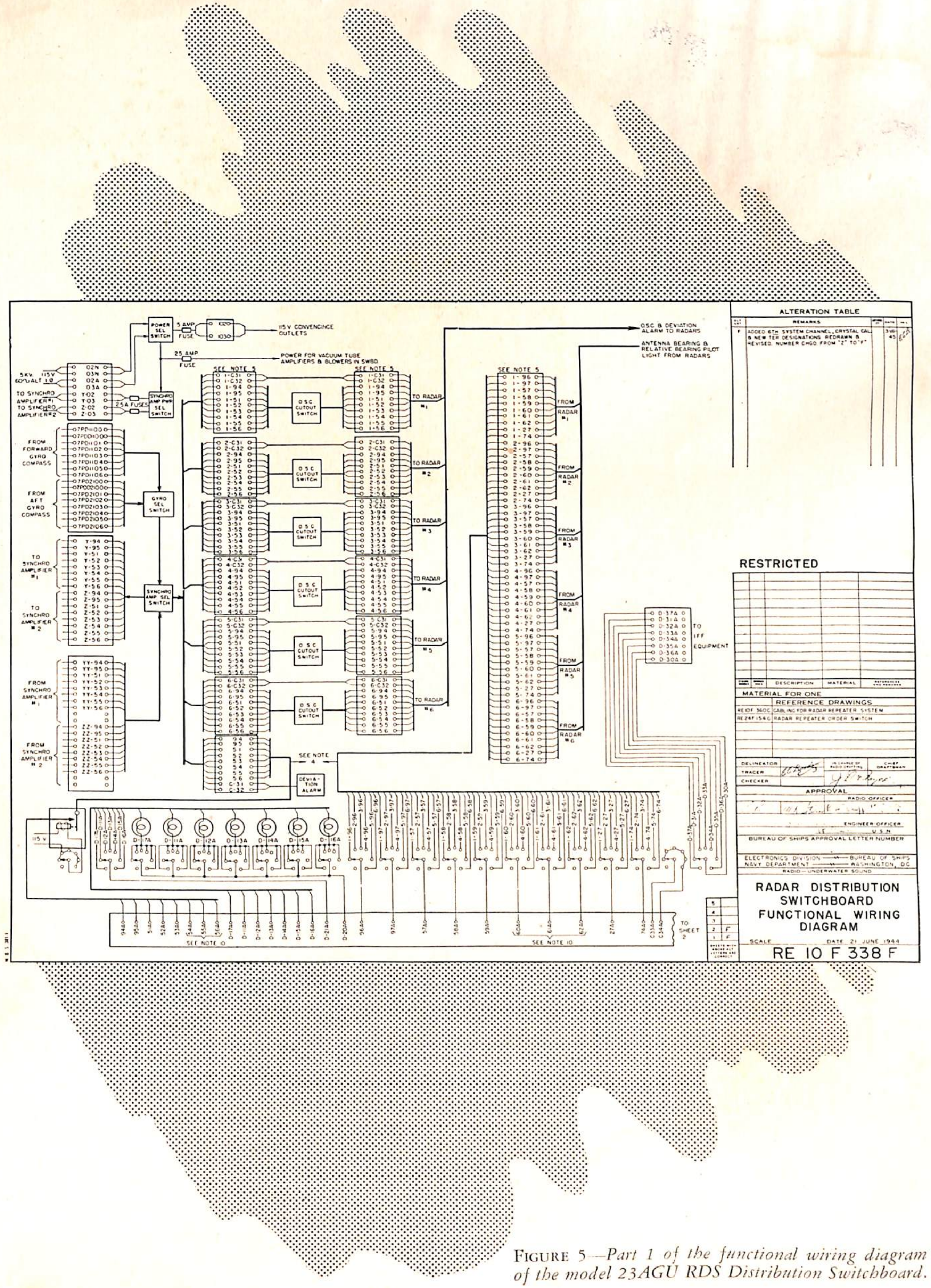


FIGURE 5—*Part 1 of the functional wiring diagram of the model 23AGU RDS Distribution Switchboard.*

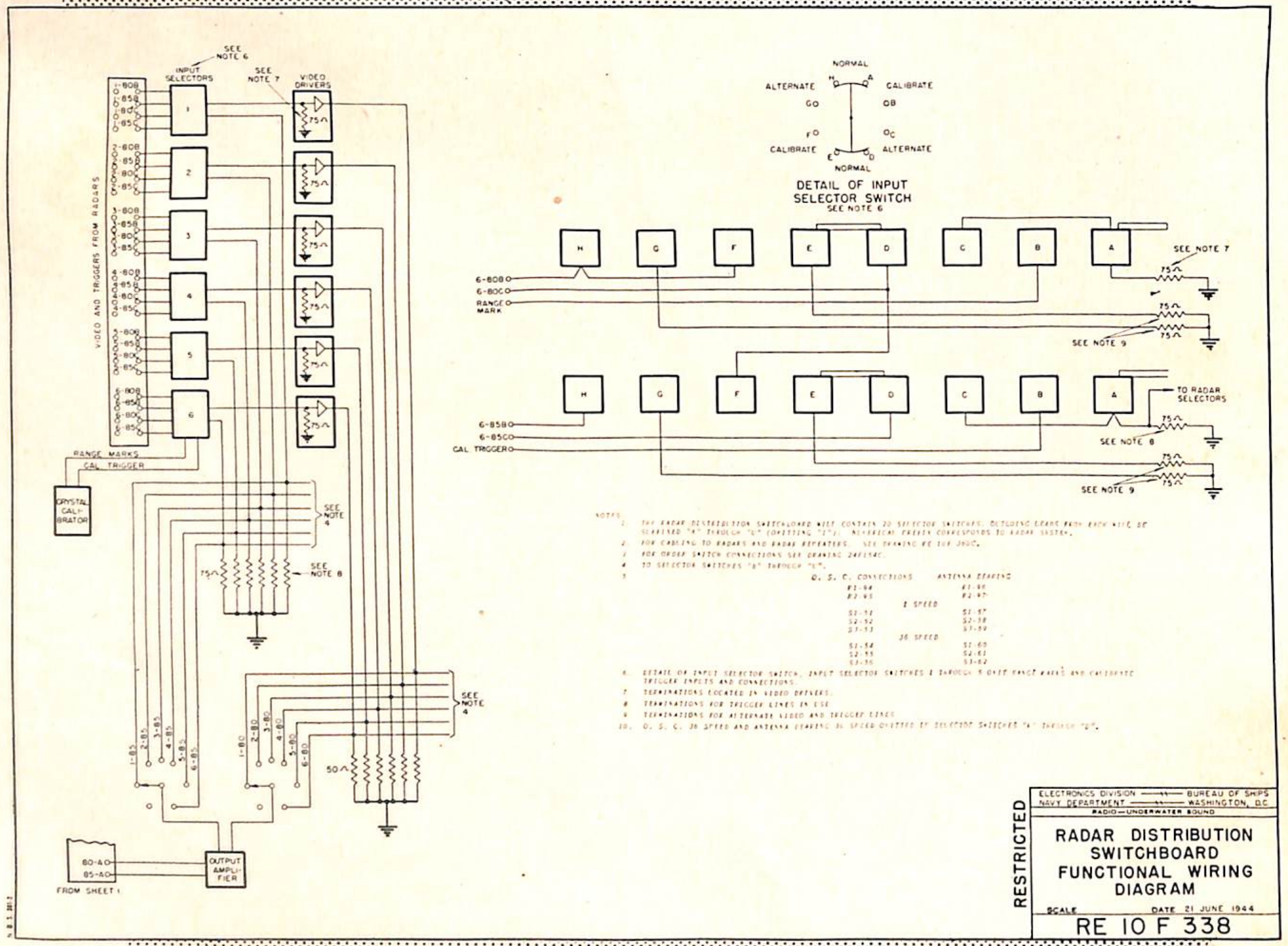


FIGURE 6—*Part 2 of the functional wiring diagram of the model 23AGU Radar Distribution Switchboard.*

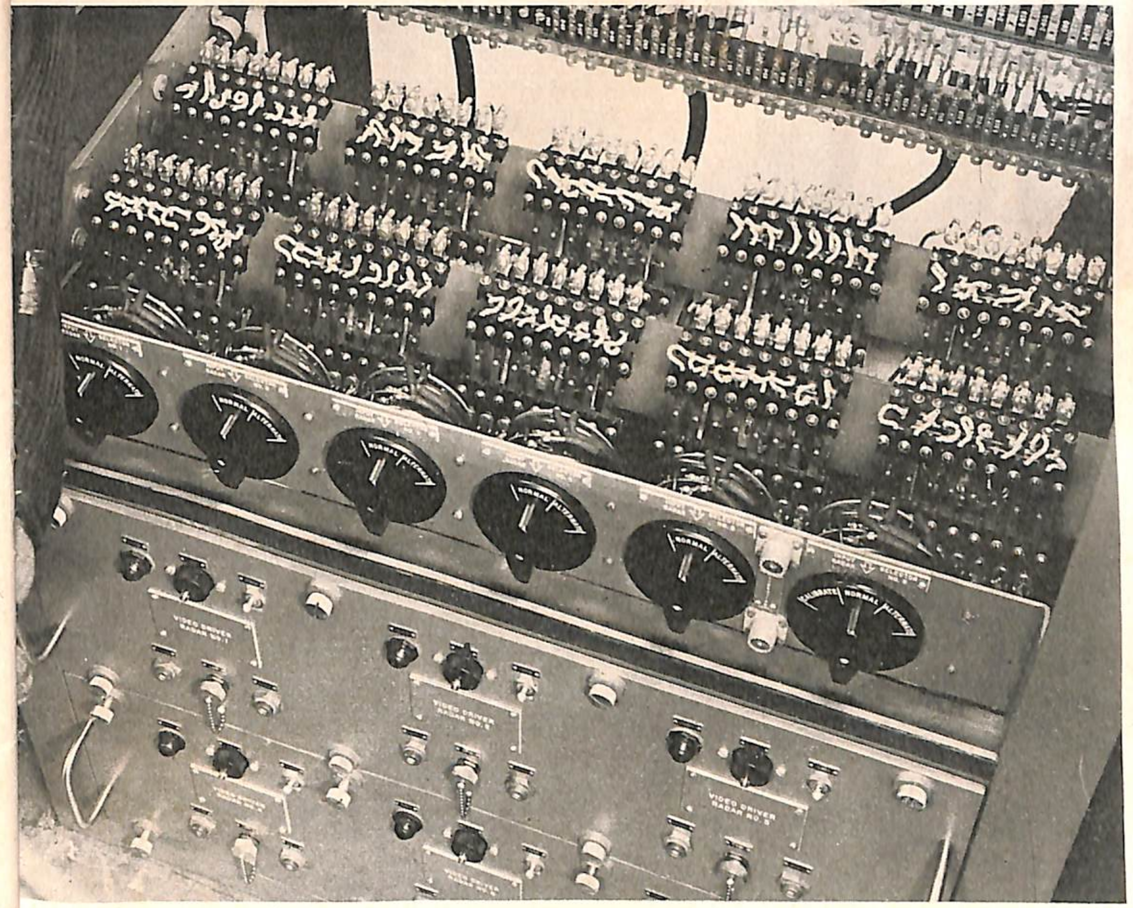


FIGURE 7—*Input Selector Switch Panel in the model 23AGU RDS. These are the video and trigger selector switches used for normal or alternate inputs. Note that switch No. 6 has a third position, "Calibrate", which is used to obtain calibration range marks and trigger voltages from a standard crystal calibrator.*

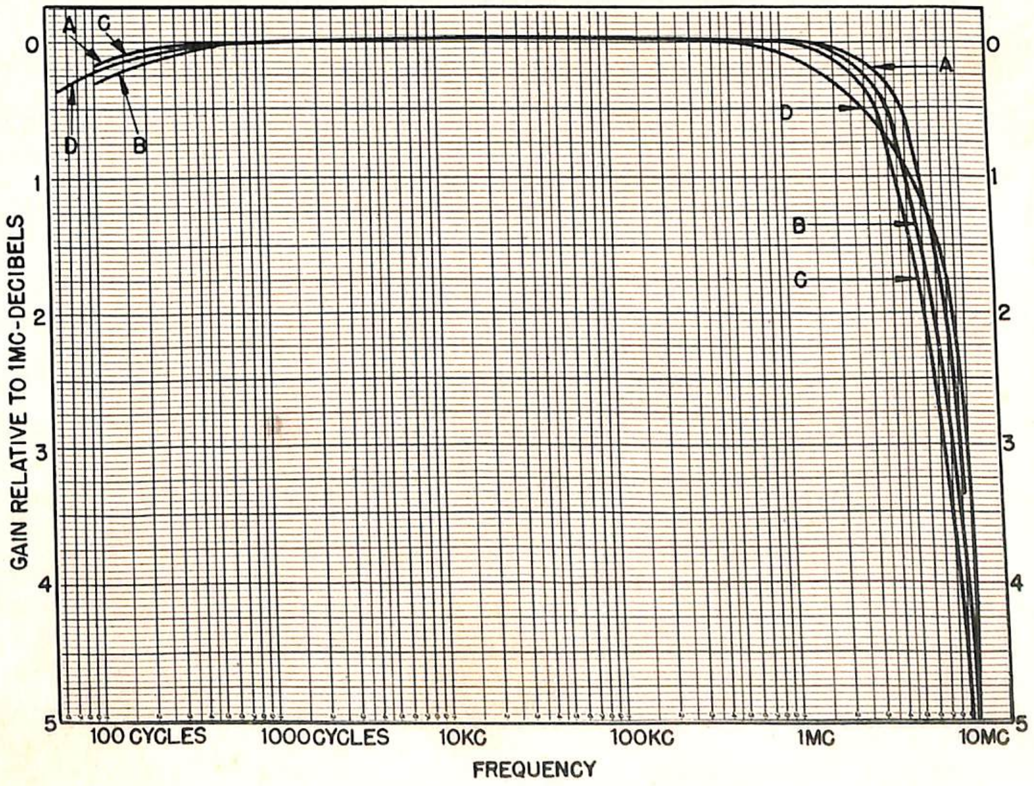


FIGURE 9—*Chart showing comparison of video response curves of the model 23AGU and the model 23AFL Radar Distribution Switchboards. Curves A, B and C are minimum, full, and mid-gain respectively on the 23AGU. Curve D is the response of the 23AFL.*

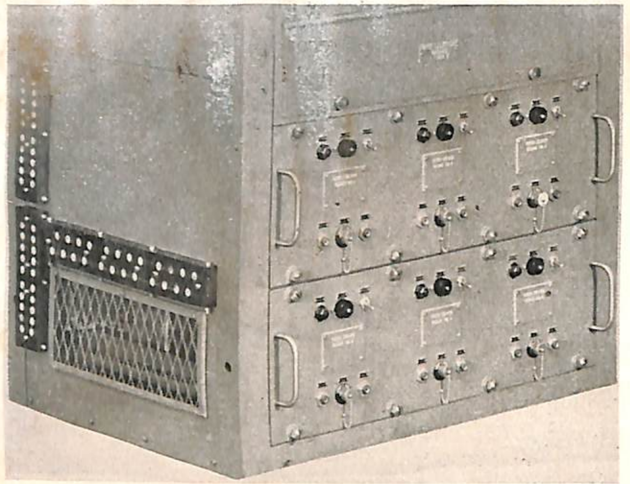


FIGURE 8—*Left-front view of model 23AGU RDS showing coaxial cable entrances on left side. Similar entrances are available on the right side of the cabinet.*

CAUTION NAMEPLATES FOR TDQ

The Bureau has received numerous reports of damaged antenna cables or connectors as a result of removing the r-f unit from the TDQ transmitter without first disconnecting the antenna. To warn technicians of this situation new nameplates have been procured which carry the words "Caution—Remove antenna connection before withdrawing this r-f unit". These are put on the panel in place of the ANTENNA COUPLING (G) and PA TUNING (F) nameplates.

These new nameplates have been shipped to the various electronics pools and all activities that have TDQ's should requisition them from the nearest Electronics Officer. Make this change now and avoid needless damage to your equipment.

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ARMATURE REPLACEMENTS

The attention of the Bureau has been directed to the numerous requests received for replacement armatures for various electronic equipments. Supply depots, in particular, have submitted requisitions for large quantities of armatures.

Existing conditions make it impractical to fill most of these requests. The procurement of armatures or other parts for old models is expensive and usually involves excessive delay due to re-tooling, etc. Also some manufacturers cannot be interested in such production, and others charge excessive prices because of the reorganization of their facilities needed to produce obsolete models.

Tenders and naval shipyards are equipped to repair most types of electronic equipment including motor-generators. Where it is not practical to replace essential equipment with modern types, repair of the failed armature should be effected in the field.

All failed parts that are replaced by new or repaired items should be turned in to repair activities for reconditioning or salvage of parts useful in the repair of other similar units. Thus a limited quantity of replacement parts or units may be available from salvaged equipments or from equipments removed from decommissioned vessels.

Accordingly all activities shall arrange to repair and rewind failed parts, and shall indicate on any requisitions forwarded to supply sources that such repair is impossible and that replacement in kind is essential.

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TRANSDUCERS FOR THE NJ

Models NJ-3, -4, -6, -7 and -9 sonar equipments originally used the type 78138 transmitting transducer and the 78139 receiving transducer. Failure reports received by the Bureau indicate excessive failures of the 78139 transducer as compared to the 78138. Preliminary investigations conducted by the contractors and by the Bureau indicate that the 78138 transmitting transducer could be substituted for the 78139 receiving transducer without serious loss in performance. Accordingly, authorization for the substitution was given in September, 1945. To date all reports received from the field have supported the results determined in the preliminary investigations. Since insufficient time has elapsed to permit final determination of the effectiveness of the substitution, all activities and cognizant ship's personnel are requested to report promptly any instance of unsatisfactory performance to the Bureau of Ships.

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COUNTERMEASURES EQUIPMENT DECLASSIFIED

Torpedo and Sonar Countermeasure equipments have been assigned new classifications as follows:

NAJ Beacon Mark 1	Uncl.
NAJ Beacon Mark 2	Uncl.
NAE Beacon Mark 1	Conf.
NAE Beacon Mark 1 Mod 1	Conf.
NAE Beacon Mark 1 Mod 2	Conf.
NAE Beacon Mark 2	Conf.
NAE Beacon Mark 2 Mod 1	Conf.
FXP	Conf.

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WFA AND NGA TRANSDUCER BOLTS

Current instructions require that 5/8 inch diameter nickel-copper cap screws having a yield point of 20,000 pounds per square inch be used to fasten Model WFA or NGA sounding transducers to the hulls of submarines. These instructions have been changed to require that 5/8 inch diameter studs, lock washers, and nuts made from nickel-copper (specification 46M7) be used instead of cap screws.

MORE ABOUT POOR TUBES

The dome and topside projector of the Model WFA submarine sonar equipment installed aboard the USS *Irex* were replaced. The equipment was checked while the ship was underway, and the performance of the WFA was not all that it should have been. Testing the tubes in the equipment showed that many of them had very low transconductance. Replacing these tubes with good ones improved the performance of the gear immensely.

This condition is similar to that encountered aboard the *Odax* and reported on page 32 of the August ELECTRON under the title "How Good Are Your Tubes?". It is desired at this time to call attention to and emphasize the recommendations made in the earlier article.

—*E.F.S.G.*

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WCA VERSUS WFA

Tests were run to compare the operating ease and relative performance of the Models WCA and WFA submarine sonar equipments. The equipments used in these tests were aboard the USS *Odax* (SS-484), the USS *Requin* (SS-482) and the USS *Clamagore* (SS-347). Each equipment was checked and tuned up to insure that it would perform at its best when the underway tests were made. Only men who were highly trained in the operation of these equipments were used to operate them and evaluate their performance.

It was everyone's opinion that the WFA was definitely easier and simpler to operate. Bearing accuracy with the WFA was at all times within 1/2°, and the operators had this accuracy, as a result of the BDI action, on all bearings taken. The WFA operators suffered no fatigue due to training. On the other hand, the bearing accuracy of the WCA was not better than within 1°, and an operator had to be very good to obtain consistent accuracy in his bearings. Also, the WCA operators were beginning to tire after an hour of constant reporting.

Echo ranging with the WFA was more definite than with the WCA due to the recording action of the chemical recorder. The WCA failed completely to give echo ranges below 400 yards due to the fact that the keying pulse was about 150 yards long, and reverberations masked the target. The WFA had no trouble in giving constant echoes at ranges down to 100 yards. The WCA can also give ranges down to 100 yards, but this requires constant changing of the keying length. The WFA does this automatically, which is advantageous.

The simplification of the switching on the WFA became apparent when the men who were operating the WFA changed over to the WCA. All agreed that the WFA was simpler to operate, especially when keying. When operating the WCA to obtain a one-ping range, it is necessary for the operator to "flail" to get on target and set his switches for a ping. Then he must be careful that only one ping goes out. The WFA has the advantage of having to operate only one switch for pinging. The equipment can be put on target bearing with a minimum of effort, and kept on bearing while ranging. It is no trouble to send out one ping and be certain that *only* one ping will go out.

During echo ranging on far targets (3000 yards) the WFA gave better results. Having a record of the echo on the chemical recorder of the WFA is advantageous. Both the WCA and WFA gave reliable echos on ranges over 3000 yards. However, the WCA gain had to be run very high, with attendant noise causing operator fatigue. The WFA was quieter due to the RCG *(reverberation-controlled-gain)* circuit.

The QC head of the WCA, putting out about 400 watts of energy, showed no apparent advantage over the WFA head which puts out about 100 watts. For the tests the QC head of the WCA and the bottomside head of the WFA were used.

—*E.F.S.G.*

Bureau Comment: This one bouquet among the bunch of brickbats is appreciated by the Bureau. The WFA, being a later model submarine sonar equipment, should certainly outperform the earlier WCA.

PANEL METER 10 107

The scale of the meter which is mounted on the front panel of the Navy type CRV-43067 Transmitter-Receiver is calibrated in arbitrary units. The basic range of all such meters is one milliampere and, although some of the meter scales are marked "DC Milliamperes", this marking should be disregarded. Some scales are marked 0-5-10 and others are marked 0-.5-1.0, but for the deflections referred to in the MAR instruction book (NavShips 900,719) all these meters should be used as though the scale read 0-5-10.

PROHIBITION

Unless you want a good case of "sonar dome," don't drink "NRL #56," a solution containing methanol and used as a filling liquid for certain sonar domes and transducers. In view of the circumstances of a recent fatality caused by drinking NRL #56 it is imperative that existing safety precautions be emphasized.

The story on NRL #56, together with the recommended safety precautions, are contained in Article 14.4 of the Sonar Bulletin. In this connection, the instructions that "all containers containing methanol must bear the stenciled warning: POISONOUS, INFLAMMABLE, DO NOT APPLY TO SKIN" must be construed in the broadest sense. This means that the instructions must be applied to equipment as well as shipping and storage containers containing even highly-diluted solutions of methanol.

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VHF/UHF REMOTE CONTROL UNITS

The Navy type 23445 Remote Channel Selector Unit, the 23497 Selector Control Unit and the 20409 Power Supply Unit have been developed to operate in various combinations. In conjunction with other electronic units they provide standard, although flexible, remote control systems for VHF/UHF communication equipment.

The principal function of any of the various systems employing any or all of these units is to permit rapid selection of pre-set frequency channels at stations remote from the points of installation of the equipment. These units, when operated in conjunction with a type 23496 Control Indicator Unit or type 23500 Radiophone Unit, also provide several additional facilities. One of these is the remote release, where desired, of silencing or squelch circuits in the receiving equipment; another is for remote push-to-talk operation of composite transmitting-receiving equipments.

Remote control indicator systems are generally used with two types of installations. One type of installation involves the control of only a receiver, such as the Model RDZ, RDR or similar. This type utilizes one 23497 Selector Control Unit and from one to four 23445 Remote Channel Selector Units and/or 23496 Control Indicator Units, depending upon the number of remote station units to be controlled. In the second type of installation the equipment serves for control of a transmitter-receiver such as the MAR or similar. The same basic units are required as with the first type, with the addition of a 20409 Power Supply Unit. The power supply unit is used to supply the power required by the change-over relay in the controlled equipment, and also to supply power to the remote stations normally supplied by shipboard transmitters.

It should be noted that the type 23492 Remote Channel Selector Unit was authorized to be used with the first thousand RDZ receivers in lieu of the No. 23497 Selector Control Unit and 23445 Remote Channel Selector Unit until these latter units became available.

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SP ANTENNA COUNTERWEIGHTS

When the six-foot SP radar antennas were first shipped to installation activities, they were not equipped with counterweights. It soon became apparent that, without counterweights, a condition of unbalance existed in the train axis. Installation activities were advised to fabricate counterweights and install them on all six-foot SP antennas. Counterweights have been manufactured recently by the equipment manufacturer and distributed to naval repair activities in quantities as indicated below:

10	Philadelphia Naval Shipyard
10	Boston Naval Shipyard
5	New York Naval Shipyard
10	Mare Island Naval Shipyard
5	Puget Sound Naval Shipyard
5	Naval Supply Depot, Oakland, Calif.
5	Naval Supply Depot, Mechanicsburg, Penna.

Radar personnel of SP-equipped ships experiencing unsatisfactory performance with the present counterweights should contact the Electronics Officer at the nearest of the above-mentioned activities and request that new ones be installed.

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FLOODING OF RADAR ANTENNA ASSEMBLIES

Information received by the Bureau indicates that many ships are experiencing trouble because of the flooding of their Model SS radar antenna assemblies during post-repair dives. To minimize recurrences of this trouble, it is suggested that a general procedure be set up by all submarine repair activities which will insure their conducting air-pressure tests on submarine radar installations prior to post-repair dives.

STOP!

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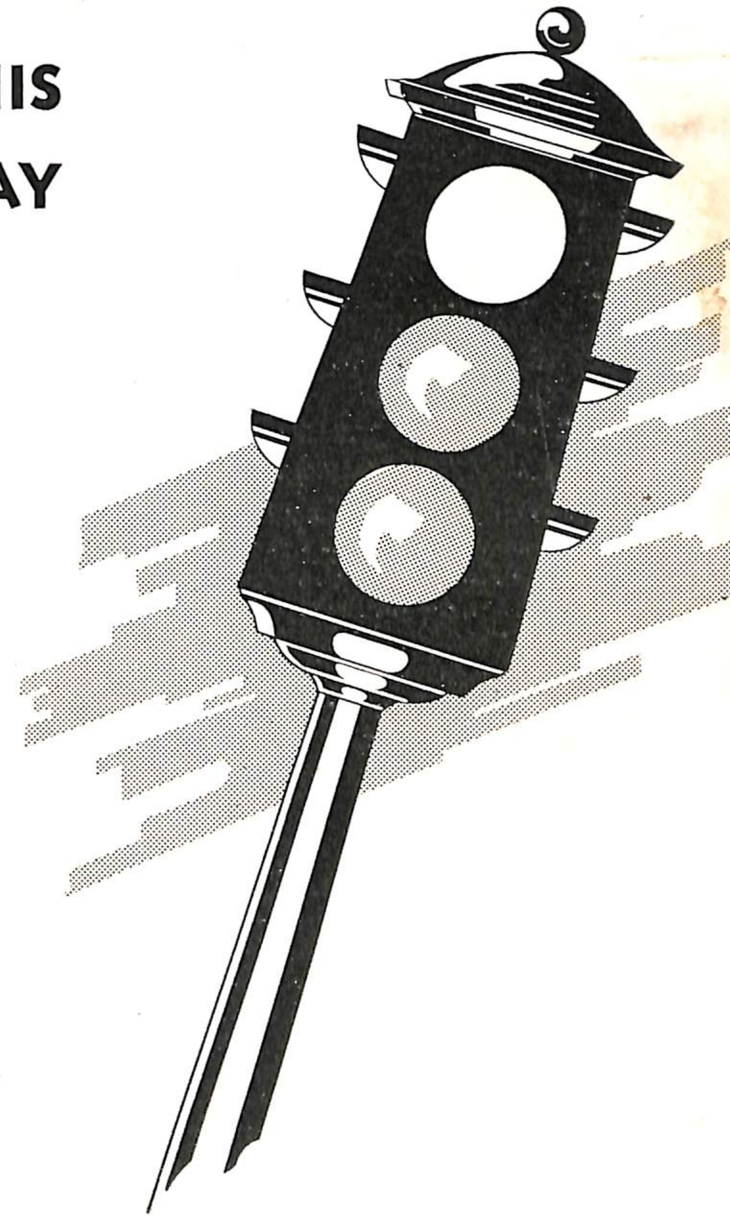

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d us your Problems . . .

LET US JUGGLE THEM FOR A WHILE

ELECTRON magazine is a good place to send your installation and maintenance troubles. We may not know the answer to your problems either, but we are here in the Bureau where we can turn them over to the proper section to have them juggled by experts.

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