CONFIDENTIAL

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BUSHIPS Electron

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BuShips Electron

A monthly magazine for radio technicians

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BUREAU OF SHIPS • NAVY DEPARTMENT

Radar Picket Ships

Lt. (j.g.) Frank S. Andress, USNR, BuShips

With the advent of task forces spread out over hundreds of square miles of ocean, the need for picket ships with highly efficient C.I.C.'s to patrol outpost stations and furnish early warning and interception of prowling enemy units became urgent. The first vessels to receive these lonesome and hazardous assignments were destroyers and destroyer escorts without the addition of any special equipment. Four or more combat air patrol planes were under VHF control of the picket's C.I.C. and were vectored out to intercept bogey contacts. Picket ships were responsible for splashing a high percentage of attacking planes. This is evidenced by the high priority they held on the Kamikaze's list of important targets. In recent operations pickets have been accompanied by two or more small landing craft to increase anti-aircraft fire power and to bolster morale.

The DD picket ships were developed to further tighten the screen around our task forces by equipping already formidable 692-class destroyers with the ultimate in radar and communication equipment. The backbone of C.I.C. in these ships is the SP radar. Existing SC or SR air search radars were retained as was Model SG-1 equipment. Electronic equipment overflowed existing C.I.C. spaces to the former chart room and coding room. The three radar indicators and two type VC radar repeaters, plotting facilities, and radiophone remotes occupy fighter director's C.I.C. The VF precision radar repeater, the DRT equipment, and facilities for maintaining a summary plot are included in the evaluator's C.I.C. Increased reliability of the radar repeaters is afforded by the use of a bearing cutout panel to cut off gyro information to the various repeaters in case of a short circuit in one of them.

The SP radar offers a number of features which make it valuable for fighter direction. One of the most important is the altitude determining system. The antenna may be elevated to point directly at high flying planes and is maintained on constant level and cross level despite ship's roll and pitch by a Mk 8 Mod 2 stable element. A cathode ray scope in the console with *G*-type presentation indicates when the antenna is on the target. When the spot is lined up with the cross hairs on the center of the tube, a switch is operated and the height meter indicates the altitude of the plane. A conventional 7-inch PPI scope permits a choice of five ranges, the longest range being 200 miles. In addition, two 5-inch tubes give *A*- and *R*-presentation. Only one range (100 miles) is available on the *A*-scope, but the *R*-scope will expand any desired 5-mile section of the sweep for closer examination. A "strobe" brightens the five-mile section on the *A*-scope which is being displayed on the *R*-scope. The IFF coordinator controls the associated Model BO-1 and BM-1 interrogator responsors and gives divided-trace presentation. Directional *G*-band elements in the

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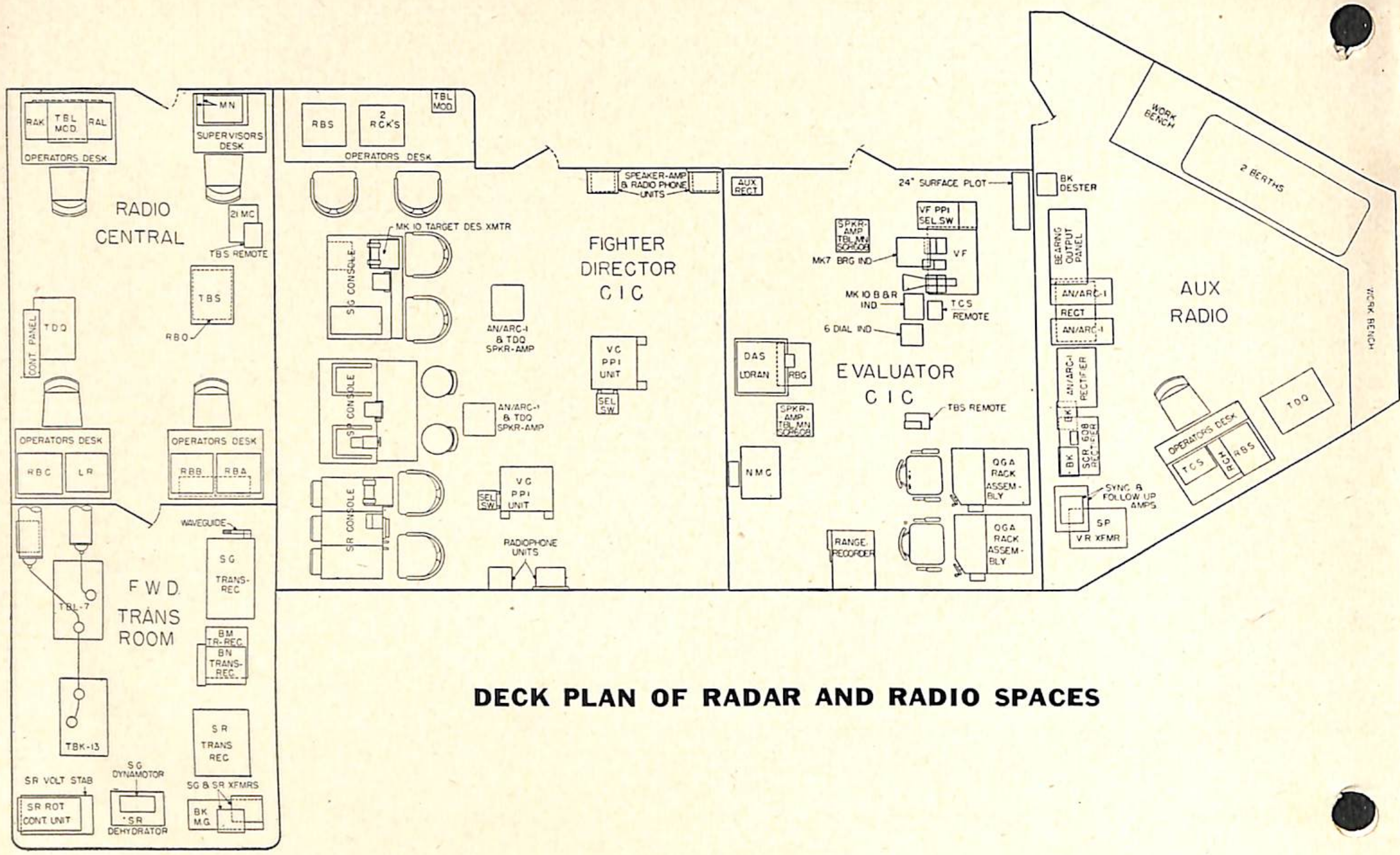


DECK PLAN OF RADAR AND RADIO SPACES

the SP antenna are fed by the BO-1. The BM-1 is operated on the *A*-band into an omni-directional "life saver" antenna.

Model YG homing beacon, Model SP transmitter, and associated equipment are installed in the after radar transmitter room located on the main deck amidships. On the starboard side of this compartment is the RCM room containing complete intercept and jamming equipment. Model RCO and SPR-2 receivers cover the presently used radar frequency spectrum and either may be used in conjunction with RDJ pulse analyzer, RDP panoramic adaptor, or DBM-1 D/F system. Model DBM-1 direction finding system furnishes bearing of enemy radar signals which enables TDY-1 to be beamed most effectively when the tactical situation makes jamming desirable.

DD pickets retain the Mk-12/Mk-22 fire control radar combination and have been given high priority to receive two Mk-63 gun fire control systems. These systems are associated with the after 40mm quad mounts and are capable of firing blind with deadly accuracy. The heart of the Mk-63 system is the Mk-34 Mod-2 radar equipment and gives an additional sting to hostile aircraft. DD picket ships were among the first to receive Mk-32 IFF equipment. This equipment consists of three antenna elements mounted on the Mk-12 antenna, a lober, a Model BN interrogator-responsor, and a special compact indicator displaying IFF returns only. The entire system is mounted in the rotating structure of the Mk-37 gun director and affords IFF interrogation for the heavy AA battery. The indicator displays IFF replies with a back-to-back trace on a 2-inch scope. Lobe switching provides fairly good bearing accuracy; however, range discrimination is most effective. The identification indicator sweep is triggered by the Mk-12 range mark and has a duration of only 30 to 50 micro-seconds. In this way, no IFF returns are seen except those with range equal to the target ranged on by the Mk-12 equipment.

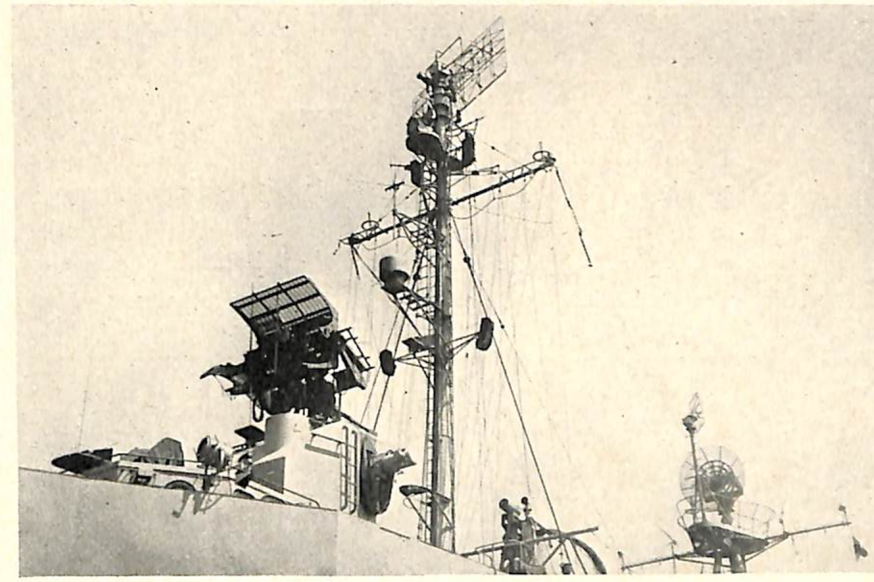
Hand in hand with the detection of enemy activity goes the necessity for instant, positive transmission of the information obtained. To accomplish this, the radio communications equipment usually installed in the DD 692-class destroyer is supplemented by the additional radio equipment required to provide communication with planes and additional channels for surface vessels.

The division commander's cabin was converted into an auxiliary radio room to accommodate some of the equipment.

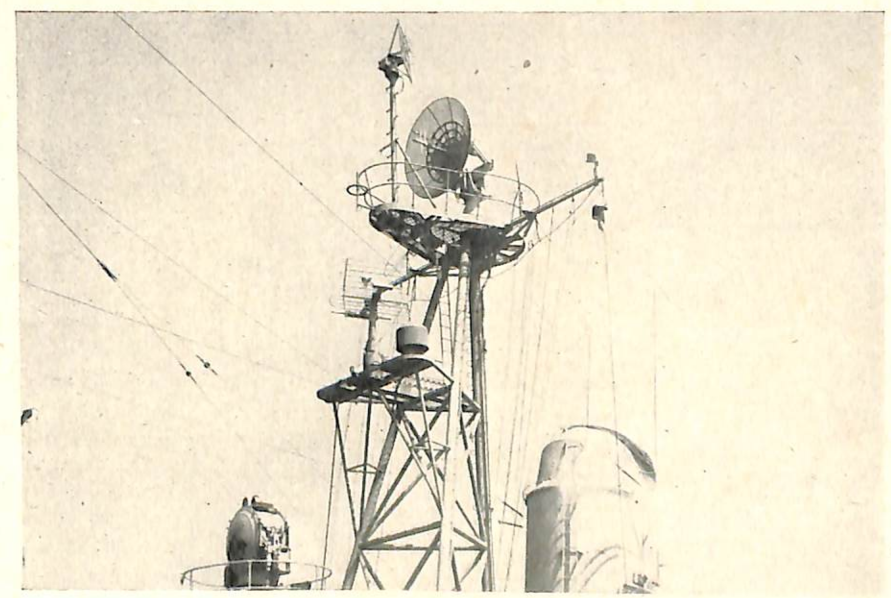
The additional radio equipment in these vessels is comprised almost entirely of the latest type of Navy-designed short-range VHF voice equipment supplemented with shore-type equipment, the latter modified to meet the requirements of shipboard installation. The vessel's entire communication facilities are so interconnected that any combination of transmitters and receivers is available to the personnel in C.I.C. as well as in the radio spaces in which the equipments are installed.

In addition to the increased communication equipment, another important piece of radio gear installed in pickets is the Model YG homing beacon. This equipment has been instrumental in bringing in many of our fliers, and a few of the enemy which, we hope, were successfully splashed.

In order to accommodate the myriad antennas necessary for these equipments, a tripod mast was erected forward of the after stack. The tripod mast gives the DD picket ship a distinctive appearance as compared with the usual 692-class destroyer. Similarity to the silhouette of certain cruisers may cause some recognition difficulties. The SP antenna is mounted on a platform on top of the mast and the YG homing beacon is bracketed above and forward of it with a "cruiser" type arrangement. On an outrigger forward of the tripod mast and below the SP is mounted the TDY-1 antenna. The high frequency DBM-1 spinner is rigged to port of the TDY-1. Cone and scabbard antennas for RCM intercept are spaced along a yardarm immediately below the SP platform.



The SR and SG-1b antennas are mounted above the yardarms. The Mark 12 and Mark 22 antennas are shown mounted on #2 turret.

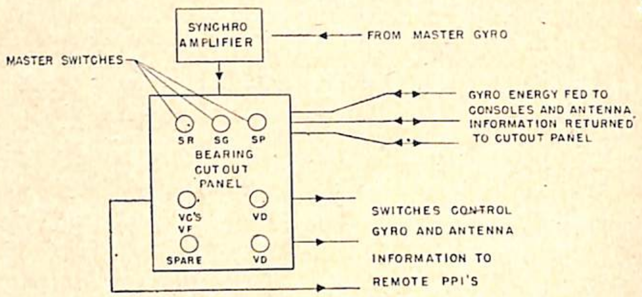


A tripod mast is added to support the SP and YG antennas on the top platform. The lower platform mounts the DBM and TDY antennas.

The usual radio and radar antennas have been retained on the foremast. Additional VHF antennas bristle from the yardarm and all around the mast giving a Christmas-tree effect. TBS and low-frequency DBM-1 spinners are stacked one above the other, outrigged forward of the mast. Antenna trunks and whips sprout from every deck house.

Like other 692-class destroyers, the DD picket ships are equipped with the QCA sonar ranging equipment for underwater detection of enemy craft. The upper sound room contains the two control units installed side by side and each stack controls a projector. These two projectors are mounted one above the other with the upper projector capable of being tilted 45° as well as being trained through azimuth while the lower is only capable of being trained. These projectors extend through the hull at the centerline and are enclosed by a welded-on 100-inch dome, allowing the use of the QGA equipment at high speeds. When the QGA equipment is not needed, or while docking, the projectors are re-

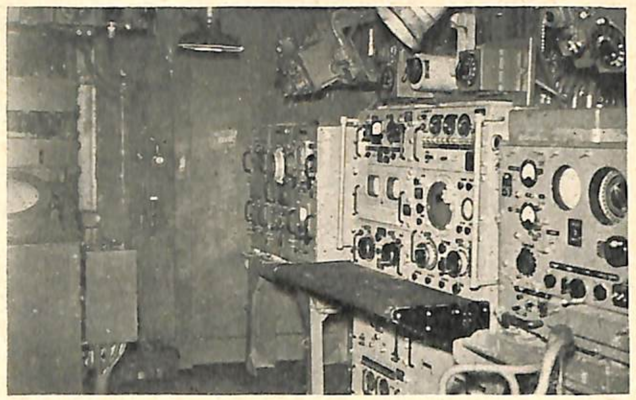
Functional diagram of the bearing cutout panel. Switches in the top row have a third position marked RELATIVE.



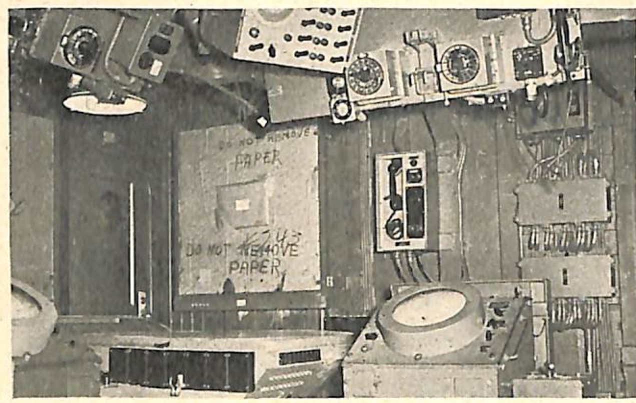
tracted into the vessel by a retracting mechanism located in the lower sound room.

Associated with the QGA equipment is the tactical range recorder which determines, from information received from either control stack, the instant when depth charges should be released. This instrument may be switched from one control stack to the other depending on which has control.

After starboard corner of the Fighter Director CIC showing the SR, SP, and SG-1b radar consoles. A VC remote PPI is shown at the left.



Forward starboard corner of the fighter director CIC showing 2 VC's, an air plotting board, a 21MC, and various telephone circuit control switches.



SILICA GEL

Silica Gel may be reactivated an indefinite number of times without an appreciable loss in efficiency. The following is the procedure for reactivation in the field where no special reactivation equipment is available:

Place the bags of gel in an oven at 250 to 275° F for approximately 15 hours. If available, a fan should be used to circulate the air in the oven. The bags should be hung or laid on shelves in such a manner that the hot air can pass by them. The shelves should not be hotter than the air so that the bags will not be charred. In other words, do not lay the bags on a metal shelf directly above the source of the heat. Remove the reactivated gel from the oven and quickly put in sealed air-tight cans to cool so that they will not pick up moisture. The gel should be stowed in these cans until ready for use. If the gel is contained in metalic containers the temperature should be 325 to 350° F for approximately 4 hours.

If the silica gel has been contaminated with paint, oil, or grease it should be discarded.

The above supercedes the article on salvage of silica gel in Radio and Sound Bulletin of April 1945.

Receiver Sensitivity

By Lt. Comdr. I. L. McNally, USN, BuShips.

The sensitivity of a receiver is defined as the value of minimum signal capable of causing the desired output. In general, the value of input microvolts to give a specified value of output voltage is stated. In addition the conditions of measurement, resistance, voltage, noise level, and band width should be known if a comparison of sensitivity merit is to be made. As the limit of sensitivity is determined by the set noise level the ideal receiver would have no other noise than that set up by the input thermal agitation voltage. Other sources of noise are shot effect, microphonics, local oscillator, and ac hum. Radar receivers are now rated with noise as a reference.

Thermal agitation is caused by difference in temperature of input terminals and ambient temperature of input resistance. Depending on the temperature, the free electrons have a random motion which results in a fluctuating voltage at the terminals. For a given band width of frequency the RMS value of noise voltage is independent of frequency. Noise is also contributed by the random motion of electrons in the grid circuit of the first IF amplifier, the crystal converter, and local oscillator.

If the value of input resistance remains substantially constant over the band width considered, the value of input noise voltage is expressed by the formula:

(1) $e_N = \sqrt{4KTR\Delta f}$ rms noise volts

where: $K = 1.37 \times 10^{-23}$ *joules/°K*

$T =$ absolute temperature in °K

$R =$ resistance in ohms

$\Delta f =$ band width in cps

The theoretical minimum noise power, which is used as the reference, may be expressed as follows:

$$P_{min} = KT\Delta f$$
$$= 4.17 \times 10^{-15} \; watt/Mc$$
$$= 10^{-20.38} \; watt/cycle$$
$$= 203.8 \text{ db below 1 watt}$$

The "noise figure" is a figure of merit for sensitivity and is expressed by the following formula:

(2) $(NF)_{db} = 10 \log_{10} \frac{P_{in}}{P_{min}} = 10 \log_{10} \frac{P_{in}}{4.17 \times 10^{-21} \Delta f}$

where P_{in} is the input power required to obtain an output power equal to twice the noise power.

(3) $(NF)_{db} = 10 \log_{10} \frac{e_N^2}{4KTR\Delta f}$

Signal generators are calibrated in terms of voltage across a matched load rather than total induced voltage. Thus

$e_N = 2e$

$e =$ signal generator voltage

(4) $(NF)_{db} = 10 \log_{10} \frac{e^2}{4.17 \times 10^{-21} R\Delta f}$

The equivalent noise voltage of a receiver (e_N) is the voltage at signal frequency which must be induced into the set in order to obtain an output power equal to *twice* the noise power.

A matched receiver with no internal noise has a theoretical maximum performance, *NF*, of 3 db. Practical radar receivers have *NF*'s running from 7 db to 15 db above theoretical noise.

Converter crystals generate more noise than an equivalent resistance at the same temperature. The conversion loss in a crystal results in a weaker signal at the first IF amplifier.

Conversion loss, $L = 10 \log \frac{P_i}{P_o}$

where: $P_i =$ RF power input to converter

$P_o =$ IF power output.

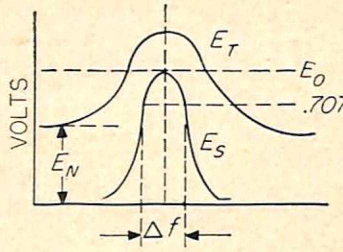
The following table shows the value of conversion loss and receiver noise factor (assuming an IF amplifier with $NF = 5$ db):

Crystal	L	NF
1N21	8.5 db	16.4 db
1N21A	7.5	14.6
1N21B	6.5	12.7
1N28	7.0	13.2
1N23	10.0	17.1
1N23A	8.0	14.9
1N23B	6.5	13.4

The conversion loss L and the NF of the receiver are functions of the rectified crystal current which in turn is a function of the local oscillator voltage level. It is therefore important that the optimum value of crystal current be maintained.

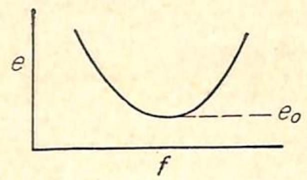
The effective band width, Δf, is the width of the equivalent rectangular filter which will pass, at the same transfer ratio, the same amount of random energy. Two methods of determining Δf will be described.

First Method: Maintain constant input signal generator voltage. Vary the signal generator frequency. Record output voltage. Plot output voltage, E_T, against frequency, f.



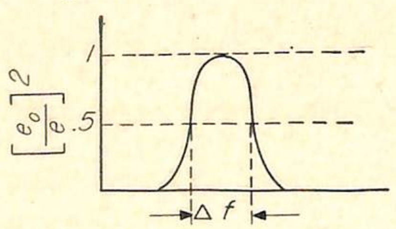
E_T = total output voltage
E_s = signal output voltage = $\sqrt{E_T^2 - E_N^2}$
E_N = noise output voltage
E_o = maximum value of E_s
Δf = band width at .707 E_o

Second Method: (preferred) Maintain constant output voltage. Vary signal generator frequency and input voltage. Plot input signal generator voltage against frequency.



e = signal generator voltage
e_o = minimum signal generator voltage at resonance

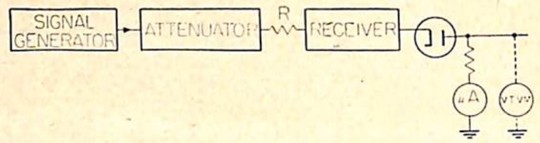
Plot $\left[\frac{e_o}{e}\right]^2$ against frequency:



Δf = band width at $\left[\frac{e_o}{e}\right]^2 = .5$

Practical measurements and connections.

1. Connect a signal generator of negligible internal impedance to the receiver input terminals in series with a resistance equal to the input resistance of the receiver.
2. Connect a vacuum tube voltmeter across detector load or microammeter in series with load resistance.
3. Adjust signal generator attenuator for zero output.
4. Adjust receiver gain (about 75%) to give low noise reading and record value of output current or voltage.
5. Adjust signal generator attenuator to give reading of output current or voltage 1.41 times initial reading recorded in (4). This doubles the power output.
6. The signal generator voltage, e, and the band width, Δf, are now used to calculate the NF.
7. Example:



Let $e = 3\ \mu$ volts,
$\Delta f = 2$ Mc,
$R = 50$ ohms.

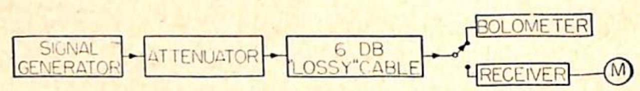
Substituting these values in the formula (4),

$$NF = 10\, log_{10} \frac{e^2}{4.17 \times 10^{-21}\, R\, \Delta f}$$

$$NF = 10\, log \frac{3 \times 10^{-6})^2 \times 10^{21}}{4.17 \times 50 \times 2 \times 10^6} = 10\, log_{10}\, 21.6 = 13.3 \text{ db}$$

Due to the difficulty of measuring the exact value of signal generator voltage due to standing waves, a slightly different method is employed with microwave equipment:

1. Connect the output VTVM or microammeter in the detector output load.
2. Connect the signal generator as shown in the diagram.



The lossy coaxial cable minimizes the SWR, and the bolometer measures input power.

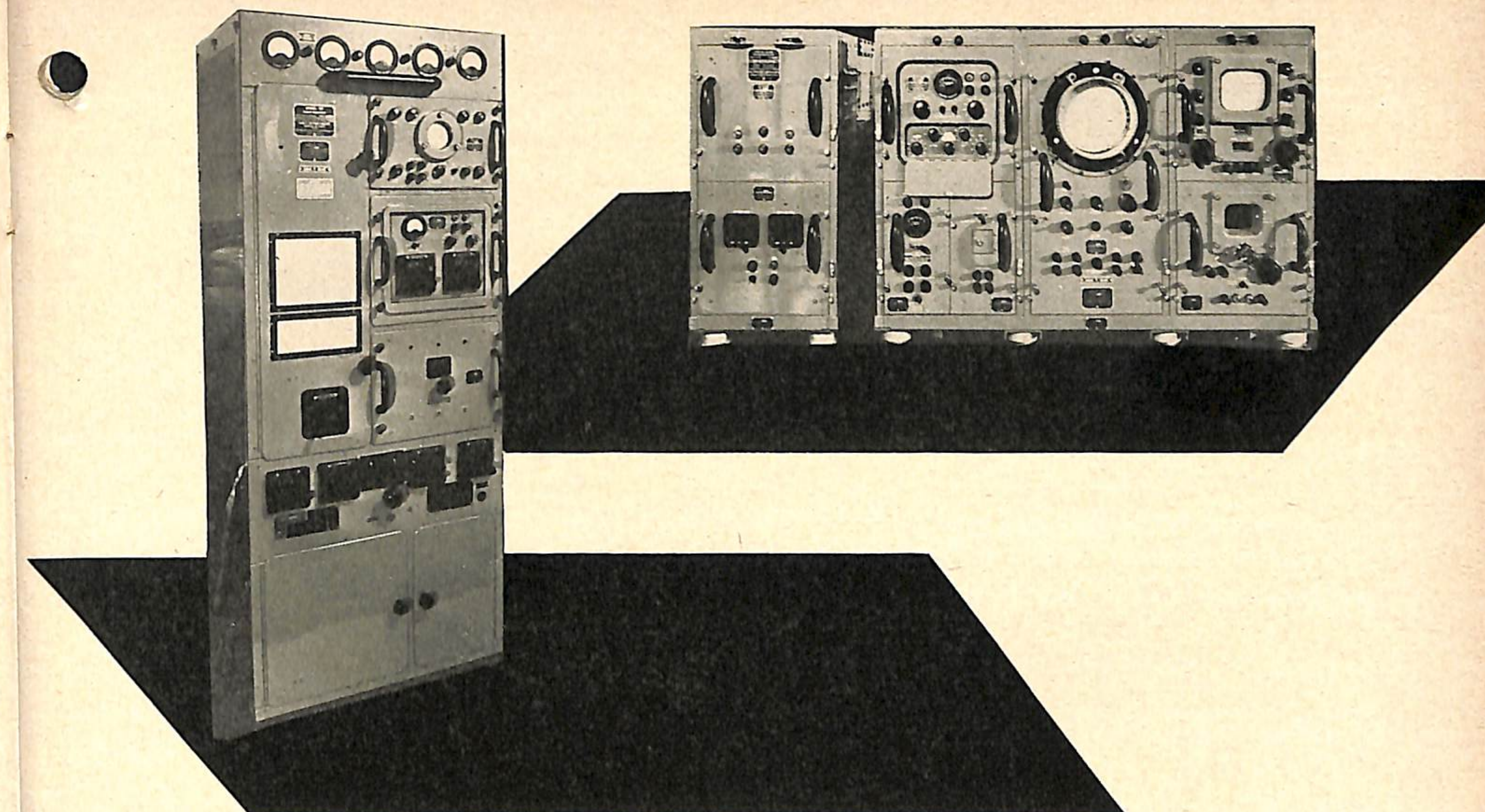
3. Adjust attenuator for zero output.
4. Adjust receiver gain (about 75%) to give low noise reading and record value of output current or voltage.
5. Adjust attenuator to give reading of output current or voltage 1.41 times initial reading. This doubles the power output.
6. Measure the input power with the bolometer and calculate the NF.
7. Example:

When $P_{in} = .21$ micro-micro-watts,
and $\Delta f = 1$ Mc.

These values may be substituted in formula (2),

$$NF = 10\, log_{10} \frac{P_{in}}{4.17 \times 10^{-21} \times \Delta f}$$

$$= 10\, log_{10} \frac{.21 \times 10^{12} \times 10^{21}}{4.17 \times 1 \times 10^6} = 10\, log_{10}\, 50.3 = 17 \text{ db.}$$



SR MODERNIZATION PROGRAM

By M. A. Shultz, Westinghouse Electric Corp.

Left to right are the Transmitter-Receiver, the Rotation Control Unit, and the Indicator console. An outlet for a soldering iron, meter, or oscilloscope is brought out to the front of the console just above and to the right of the PPI.

■ A number of changes and modifications have been made in the SR radar equipment since it was issued to the fleet in August 1944. Some of the changes have been necessitated by fleet operating considerations; others because service usage disclosed design weaknesses. A third group of changes has been brought about as part of the Navy's modernization policy. Since the SR is authorized for all 30% complement ships, the modernization program for the SR is of current interest.

Table 1 summarizes the official Navy field changes to date. Changes #1 to #23 have been issued to the fleet and are available at most major supply depots. No kits were required for field changes 9, 17, 22 and 27. Changes #24 to #28 have been completed on a selected number of vessels and tests have proven their worth. Kits and instructions for making this latter group of changes will shortly be available to all fleet units which desire them.

TABLE I

SUMMARY OF SR NAVY FIELD CHANGES

NAVY FIELD CHANGE NO.	TITLE	DESCRIPTION OF CHANGE	SERIAL NUMBERS OF EQUIPMENTS AFFECTED INCL.
1	INCORPORATING CHANGES IN THE MONITOR RECEIVER, RANGE SCOPE, TRANSMITTER, KEYER, DUPLEXER, AND PEDESTAL	IMPROVES OVERALL OPERATION BY INCREASING SENSITIVITY OF RANGE SCOPE, REPLACES PRE-AMP ASSEMBLY, ELIMINATES PARASITICS, ADDS SHOCK-EXCITED BIAS IN OSCILLATOR, STABILIZES 60 CYCLE REPETITION RATE IN KEYER, REDUCES LOSSES IN DUPLEXER, AND DECREASES THE BINDING OF THE PEDESTAL.	1-13
2	INSTALLATION OF SHIP'S HEAD MARKER.	ORIENTS PPI PRESENTATION WITH RESPECT TO SHIP'S HEADING. LINE APPEARS ON PPI SCOPE	1-30
3	REPLACING CAPACITORS C-719 AND C-724	PREVENTS MOMENTARY BLOCKING OF THE CONSOLE RECEIVER BY STRONG LOCAL SIGNALS.	1-14
4	HAND-CRANK BEARING CURSOR.	REPLACES PPI CURSOR WITH A GEARED CURSOR THAT CAN BE ROTATED BY A HANDCRANK.	1-200
5	REPLACEMENT OF LEAD CABLE IN TRANSMITTER OSCILLATOR D.C. GRID RETURN WITH CABLE OF HIGHER VOLTAGE RATING.	INCREASES SAFETY MARGIN FOR HIGH VOLTAGE BREAKDOWN.	1-35, EXCEPT 24 AND 34
6	INSTALLING GRID BIAS RESISTOR	LIMITS PLATE CURRENT IN TRANSMITTER OSCILLATOR TUBES BY ADDING RESISTOR IN CATHODE CIRCUIT.	1-24
7	CHANGE MONITOR RECEIVER PLATE VOLTAGE AND INCREASE PEDESTAL SPARES.	IMPROVES SIGNAL-TO-NOISE RATIO BY REDUCING PLATE VOLTAGE TO MIXER TUBE OF PRE-AMP. MORE ADEQUATE SUPPLY OF SPRINGS, BRUSHES, AND BEARINGS OF PEDESTAL.	1-30
8	INSTALLING TRANSMITTER GRID PULSE JACK.	ADDS A VOLTAGE DIVIDER IN GRID CIRCUIT OF OSCILLATOR, PROVIDING MEANS FOR VIEWING OSCILLATOR PULSE WAVE FORM.	1-69
9	WIRING CHANGE OF INTERLOCK SYSTEM.	REVERSES AC LEADS TO ECHO BOX RELAY IN MONITOR RECEIVER TO ELIMINATE BACK DOOR CIRCUITS.	1-50
10	CHANGE ANTI-HUNT CIRCUIT.	INCREASES SERVO AMPLIFIER LOW FREQUENCY RESPONSE BY SHUNTING ANTI-HUNT CONTROL AND ADDING A CAPACITOR.	1-49
11	ANTENNA PEDESTAL HEATER	INSTALLS HEATERS AND THERMOSTAT IN PEDESTAL FOR DEW POINT PROTECTION.	1-200
12	ADDING RESISTORS TO PREVENT OSCILLATION.	PLACES RESISTORS IN TIME CONSTANT CIRCUIT OF CONSOLE RECEIVER TO PREVENT OSCILLATION.	1-53, 55-65, 67, 70, 72, 74
13	ADDING DECOUPLER TO VIDEO CATHODE FOLLOWERS.	DECOUPLES THE B+ SUPPLY TO THE CATHODE FOLLOWERS IN THE CONSOLE RECEIVER.	1-74, EXCEPT 54, 66, 68, 69, 71, 72
14	LOCAL OSCILLATOR STABILIZATION.	INCREASES STABILITY OF LOCAL OSCILLATOR IN MONITOR RECEIVER BY DECREASING DROPPING RESISTOR IN PLATE SUPPLY.	31-74
15	REPLACING BLUE ANTENNA MAIN CONCENTRIC LINE.	REDUCES LOSSES IN MAIN CONCENTRIC LINE OF BLUE ANTENNA BY CHANGING MICALEX INSULATORS TO CERAMIC INSULATORS.	2, 3, 6, 8, 9, 10, 12, 15, 17
16	CHANGE PEDESTAL INPUT INNER ELBOW.	STRENGTHENS MECHANICAL CONNECTION OF ELBOW TO "T" SECTION IN BASE OF PEDESTAL DECREASING LOSSES DUE TO POOR CONNECTIONS.	1-60
17	REDUCING SLEWING MOTOR SPEED AND INSTALLING 6SL7GT TUBE.	REPLACES 6SN7GT TUBE WITH A 6SL7GT TUBE IN THE SERVO AMPLIFIER AND REDUCES SLEWING MOTOR SPEED IN BEARING INDICATOR.	(1-103, 105, 107 FOR MOTOR 1- 81, 83, 85 FOR TUBE)
18	INSTALLING A PROTECTIVE SPARK GAP FOR C-151, C-152, C-153.	PROTECTS KEYER CAPACITORS AGAINST GRID TO PLATE 527 TUBE SHORTS.	CANCELLED
19	INCREASING MONITOR RECEIVER SENSITIVITY.	INCREASES THE SENSITIVITY AND THE SIGNAL-TO-NOISE RATIO OF THE MONITOR RECEIVER BY ADDING CHOKES IN GRID AND PLATE CIRCUITS OF MIXER TUBE.	1-91
20	CONVERSION OF SR TO SRA EQUIPMENT.	INCREASES 527 TUBE LIFE BY CONVERTING FROM GRID KEYING TO PLATE MODULATION.	1-300
21	INSTALLATION OF MECHANICAL INTERLOCK.	PREVENTS SIMULTANEOUS CONTACT OF RELAYS WHICH CONTROL PRIMARY AC AND GYRO-COMPASS AC.	1-195
22	CHANGES TO: BEARING INDICATOR; RANGE SCOPE; MONITOR SCOPE.	REMOVES POWER FACTOR CORRECTION CAPACITOR FOR 5D IN BEARING INDICATOR. CHANGES RANGE SCOPE CR TUBE TO BE 5CP1. CHANGES MONITOR SCOPE HIGH VOLTAGE FUSE TO BE 1/4 AMP. INCREASES LENGTH OF RANGE SCOPE MARKERS BY REDUCING CAPACITANCE OF BLOCKING OSCILLATOR TRANSFORMER.	1-234
23	ELIMINATION OF JUMPY RANGE SCOPE SWEEP.	STABILIZES PRESENTATION ON RANGE SCOPE BY CONVERTING ONE SECTION OF THE VIDEO AMPLIFIER IN CONSOLE RECEIVER TO A CATHODE FOLLOWER.	1-214
24	INSTALLATION OF 80 MILE RANGE STEP.	ADDS POTENTIOMETER AND CAPACITOR FOR 80 MILE PHANTASTRON STE	1-235
25	CHANGE FROM 400 MILE TO 200 MILE SWEEP ON RANGE SCOPE	CHANGES RANGE SCOPE RANGE GIVING BETTER IFF OPERATION	1-300
26	STC AND FTC CIRCUITS.	ADDS NEW CONSOLE RECEIVER VIDEO CIRCUITS FOR SIDE LOBE EFFECT REDUCTION AND TO ELIMINATE SEA RETURN.	ADDITION OF FTC AND STC
27	REVERSING PULSE FORMING LINE	INCREASES 5C22 TUBE LIFE BY REVERSING PULSE FORMING LINE IN THE MODULATOR FROM CAPACITY TO CHOKE INPUT.	SRa WITH MODULATOR SERIAL NUMBERS 1-50
28	ELIMINATION OF ANTENNA HUNT.	ELIMINATES ANTENNA HUNTING BY OPERATING ANTENNA TRAINING SYSTEM FROM RECTOX SUPPLY.	1-300

A brief description of field changes #24 to #28 follows. A short discussion of further modernization that may be expected in the SR system is also included.

> The *USS WASP* reports good ranges exceeding 100 miles on aircraft, narrow and infrequent fade areas, steady, clear *A*-scope presentation, sensitive PPI, and stable operation.
>
> "The performance of the SRa on targets at high altitude in test runs was particularly remarkable. On runs made at 20, 25, and 30 thousand feet, on which F6F's were used, the echoes were readily discernible and clearly defined. The much discussed "angles 30" runs seem to have been easy for this set. The largest fade on the incoming run was one of eight miles from 54 to 46 miles range; thereafter there was only a three-mile fade, from 36 to 33 miles range. An interesting point is that the target was tracked in to eight miles with an E2 echo. There were plots at five miles on the runs at 20,000 and 25,000 feet, indicating fair high-angle coverage. The *WASP's* intercept officers conduct all interceptions on a 12-inch VC remote PPI, using SRa input in preference to the SK."

Navy field change #24 involves the installation of an 80-mile range step for the range scope. Earlier model SR equipments have the range step only on the 4- and 20-mile ranges. An 80-mile step has been found to be highly desirable. This step is installed in the following manner (see figure 1 for schematic diagram). A new slope potentiometer (R-6037) is installed in the phantastron circuit, connected to the third switch position of S-600D. A new capacitor C-650 is installed in a similar manner in the cathode circuit of V-603A. Thus a third slope-charging circuit is installed in the phantastron section of the range scope. Zero setting is accomplished by jumpering position 2 to position 3 on S-600E and S-600G. The same zero set controls which are used on the 20-mile range are used on the 80-mile range. It is also necessary to reconnect pilot lights I-602 and I-603 on switch S-600I so that the top counter lights up in the 80-mile switch position. The top counter is then calibrated to read directly in miles instead of yards.

Field change #25 changes the 400-mile range on the range scope to a 200-mile range. This is desirable for several reasons. The early SR equipments were equipped with a 20 μs pulse with a repetition rate of 60 cycles. Using this repetition rate, there was sufficient time between sweeps to permit IFF operation over the entire

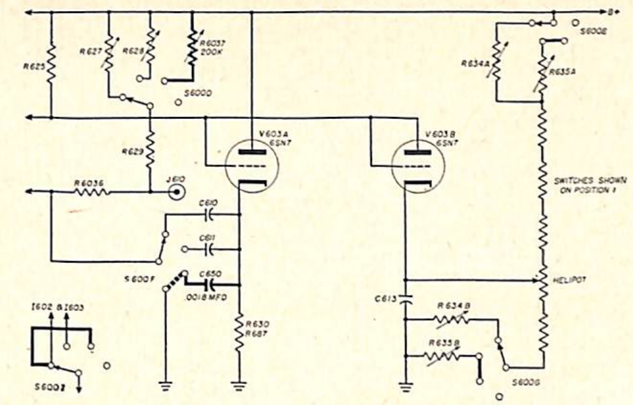


FIGURE 1—*Circuit showing 80-mile range step. Heavy lines indicate new wiring, and the dotted line indicates a connection removed.*

400-mile range. With the advent of the SRa system and the CAY-50AGU plate modulator (Navy field change #20), the pulse width was narrowed and repetition rate increased. The modulator provides a 4 μs pulse at a repetition rate between 100 and 150 cycles. Usual operating practice is to synchronize the repetition rate of the modulator at 120 cycles to prevent jitter in the VC remote indicators operating with the installation. At the 120-cycle repetition rate, insufficient fly-back time exists in the particular circuit used in the range scope to enable the IFF responses to be exhibited over a full 400-mile range.

Tactically, a 200-mile operating range is sufficient. Consequently, the range-scope sweep circuits have been altered to provide a 200-mile presentation, and this improves the IFF operation when the equipment is used with the plate modulator.

Navy field change #25 can be made quite simply. R-611 is replaced with a one-megohm resistor, and C-635, C-644 and C-645 are rewired, C-645 being connected in parallel with the combination of C-635 and C-644 in series. Series-parallel connection produces a sweep capacitor with an effective value of .015 μf. This new value for the 200-mile range is of course 1/2 of the old value of .03 μf formerly used for the 400-mile range. To complete the field change it is necessary to change the plastic indicator on the front of the range scope from the one marked 0, 20, 80, and 400 to one identical to the indicator used on the PPI scope, which is marked 0, 20, 80, and 200. In order that four markers may be obtained on the 200-mile sweep range it is necessary to replace the .82 kc marker coil which may be obtained from the PPI spares as L-505. R-680, mounted on the coil terminals, must be moved to the new coil.

Navy field change #27 is a simple one involving the plate modulator. The life of the 5C22 hydrogen thyratron tube is dependent upon the rate of rise of the current through it during the pulse. It will be recalled that the pulse-forming network Z-2001 is connected to the plate of the hydrogen thyratron V-2006. The pulse-forming line as originally installed had the capacitor section of the line connected to the tube plate and a choke section was used as the output. Under these conditions, the discharge current through the 5C22 rose at a rate of approximately 2000 amperes per microsecond. If this line is reversed, that is, if the input becomes the output and the output becomes the input, the section of the network closest to the plate of the tube contains the choke rather than the capacitor. Using this connection the rate of discharge current through the 5C22 is reduced to only 600 amperes per microsecond. With the choke input to the line connected to the thyratron plate, sparking in the tube is considerably reduced or eliminated, and the life expectancy of the 5C22 tube is much longer. Navy field change #27 is accomplished in the field by merely unbolting the network Z-2001, picking it up and turning it 180°, then reconnecting it into the circuit.

Navy field change #26 adds a sensitivity time control and a fast time constant circuit to the console receiver. Operational conditions have indicated that, for air search, radar equipments of the SR type have several deficiencies. Because of the heavy sea return on the scope when the receiver gain is on full, eye fatigue soon causes the operator to loose small targets. The sensitivity time control incorporated in field change #26 causes the gain of the receiver to vary during each sweep cycle. The gain of the receiver is made low at zero range and then caused to rise exponentially to full gain at any desired time up to 20 miles. In this manner, large echos near the main bang are greatly reduced in amplitude. Adjustments are provided so that these echos may be eliminated entirely if desired. The sensitivity time control also causes side lobes to be less annoying because the echos from the side lobes are discriminated against more than the echos from the main beam.

The fast time constant circuit also assists in side lobe reduction. This circuit is so arranged that large blocks of targets are reduced to mere spikes, representing the front edge of each target. Figure 2 shows a schematic diagram of the portion of the console receiver containing these new circuits. Figure 3 shows a photograph of the range scope with the sensitivity time control in operation. Figure 4 shows the range scope blocked and then unblocked by the action of the fast time constant circuit. These circuits are installed in the console receiver in such a manner as to eliminate the previous balanced video circuit and the time-constant circuit. The same number of tubes are employed in the new circuit as were used in the old one.

Navy field change #28 changes the training system of the SR antenna so that all traces of hunting are removed. The SR training system using the servo generator in conjunction with the servo amplifier has always been a difficult one to adjust. The original system has been sensitive to climatic variations. Once the system is adjusted, a change in temperature often requires a different adjustment to prevent violent antenna hunting. The new training control system introduced by field change #28 eliminates this hunting by providing for train control from the Rectox supply located in the rectifier power chassis of the rotation control unit.

Two Rectox speeds of train are provided, 2½ rpm and 6 rpm, both clockwise and counter-clockwise. Under these conditions the servo generator is disconnected and the antenna drive motor is fed directly from the ac

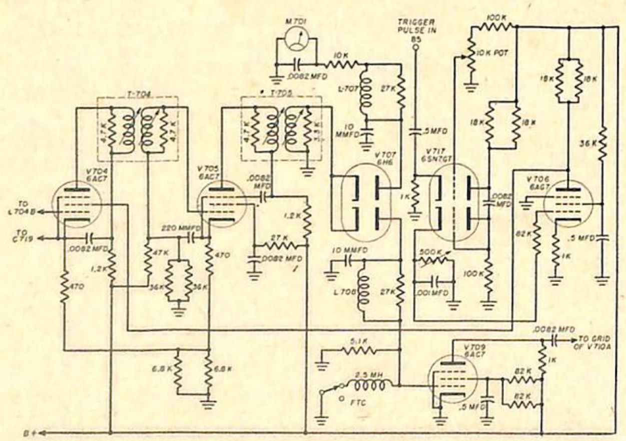


FIGURE 2—*Revised console circuits showing connections for FTC and STC.*

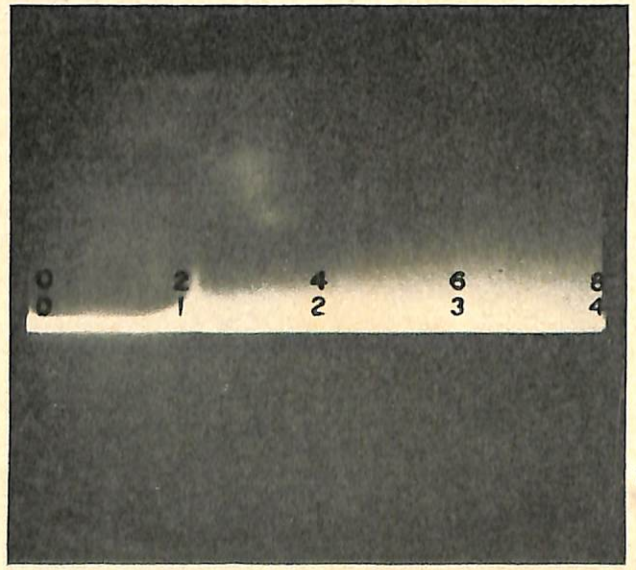


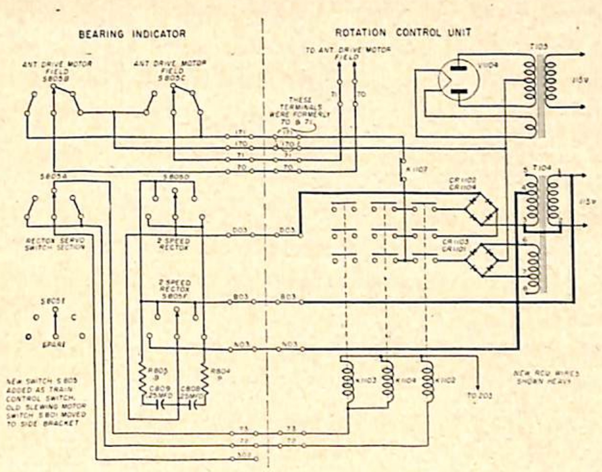
FIGURE 3—*SR range scope showing effect of STC action.*

line through the Rectox dc conversion unit. This drive is identical with the previous "PPI or Emergency" position which existed as a control on the bearing indicator. The servo generator and servo amplifier are turned on only when the train control switch of the bearing indicator is in the center (off) position. This permits hand slewing via the servo generator as before. Power for continuous rotation speeds in either direction is furnished by the Rectox unit.

To make this change, a new training control switch is installed on the front panel of the bearing indicator. The old switch is unbolted and swung around to a new bracket on the left hand side of the range scope. This switch is then available for continuous slewing on emergencies, employing the servo amplifier and servo generator as before in the case of Rectox failure. This switch, however, is normally in the off position and its functions are totally replaced by the new switch (S-805) which controls the Rectox supply. Figure 5 shows the new interconnections between the bearing indicator and rotation control unit necessary with this field change.

Navy field change #28 is the last field change to date. Several interesting modifications, however, have been planned for the improvement and modernization of the SR equipments. The first of these proposed changes involves the transmitter control circuits. The variac drive motor, cam and microswitch system for obtaining plate voltage for the high-voltage rectifier tubes has been complicated, and in many cases troublesome. When the SRa modulator is employed, the need for a continuously variable voltage for the plates of the 527 tubes is eliminated. It is therefore possible to eliminate the variac

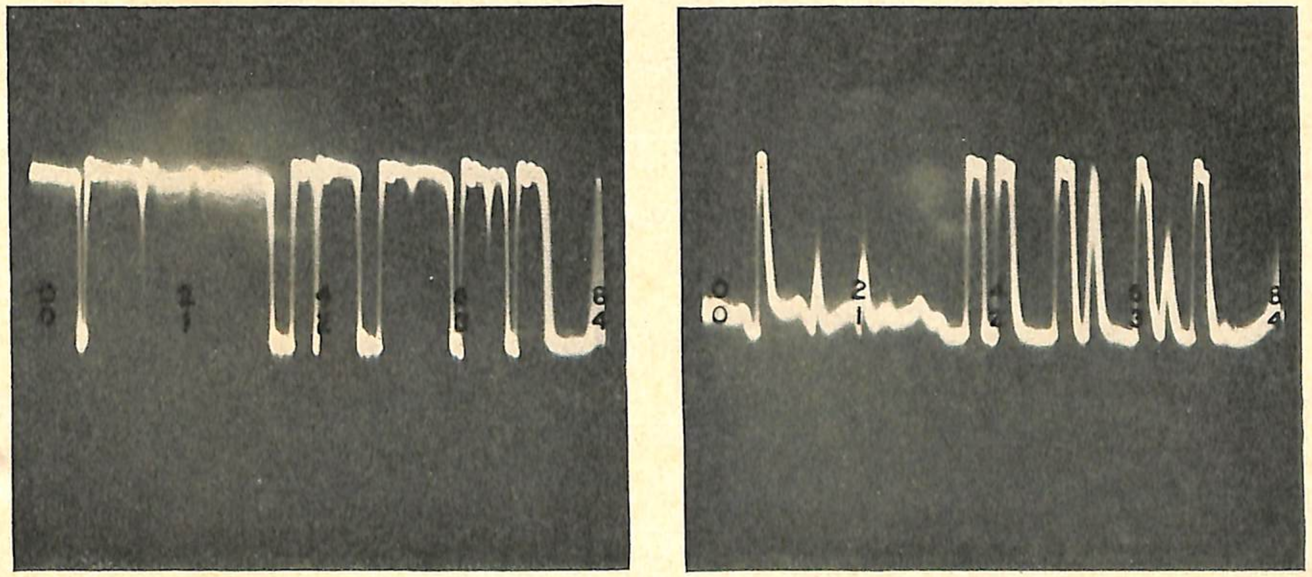
FIGURE 5—*New training control system for SR equipment, showing new wiring in heavy lines.*



drive motor with its associated cams and micro-switches and replace this complicated control system with one simple contactor. The raise and lower push buttons become high and low push buttons with two fixed voltage steps being available. Two output voltages consequently will be derived from the high-voltage rectifier. These voltages will be approximately 1500 volts and 5000 volts dc. The 5000 volt position will be adjustable manually by means of a knob on the variac.

Another proposed modification to the SR system is an echo box change. At present the echo box is quite inefficient due to its low Q. Its main use is as a frequency meter. The proposed change consists of connecting the echo box antenna input to the grid of V-209 instead of into the tuned line. In this manner the echo box system

FIGURE 4—*SR range scope under normal operation (left) showing loss of nearby echos. FTC action (right) discloses presence of these echos.*



becomes a relative power output meter in conjunction with an absorption type wave meter. If the echo box is detuned from the main radar frequency it will indicate an output directly proportional to the transmitter output, and as the echo box is brought into frequency a dip will result in this output. As yet, the echo box circuits for use as a relative power indicator are subject to resonance effects as a function of frequency. This condition is being worked on in the Westinghouse laboratory and it is hoped that it will soon be mastered to the extent that the output read on the meter will be utterly independent of the frequency of the transmitter. In this manner the transmitter output may always be kept tuned for maximum output. Transmitter tuning will consist merely of maximizing the meter reading.

MARK 22 IF AMPLIFIER

■ The maximum gain of the D-151709 IF Amplifier may drop below an acceptable figure when using 6AC7W tubes currently being produced by RCA. As a rule Kenrad 6AC7's are satisfactory. The gain tends to diminish over a period of a few hours, primarily due to low grid bias on the final IF stage. Any available 6AC7 or 6AC7W will be satisfactory when the following circuit changes are made:

(1) The 30-ohm resistor R401-6 is replaced by a 100-ohm ±5%, ½-watt resistor.

(2) A 470 $\mu\mu$f, 500-volt capacitor is connected between terminals 2 and 5 of X401-6.

(3) Break the connection between terminals 2 and 1 of socket X401-6 and connect terminal 2 to the adjacent socket ground.

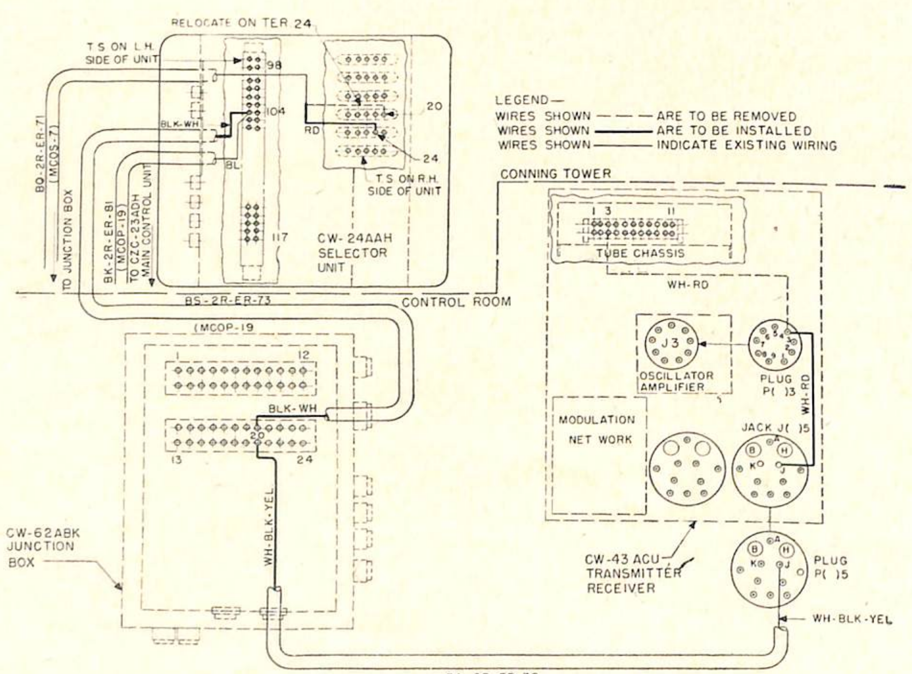
(4) Change the ground connection of X401-6 from terminal 3 of X401-6 to the ground adjacent to this terminal.

This increases the negative bias on the last amplifier stage, decreasing the plate dissipation and increasing the grid overload point. It also increases the gain of this stage by bypassing the cathode resistor, thus eliminating the negative feedback present in the original circuit.

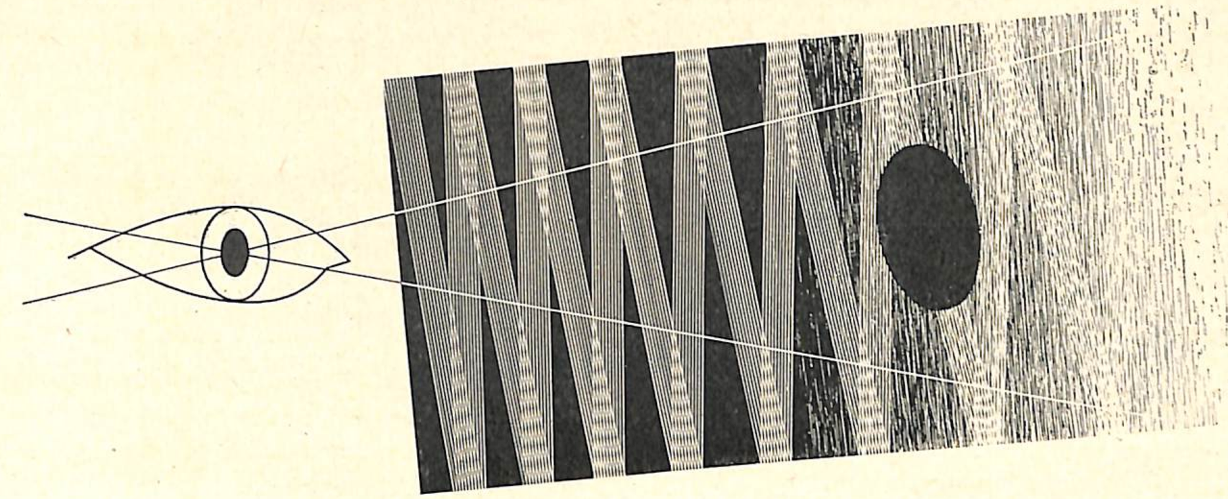
ST FIELD CHANGE No. 9

■ When operation is switched from the SJ to the ST system, there is an initial frequency drift in the beating oscillator of the ST radar. Elimination of this drift is accomplished by the illustrated circuit change which functions to continuously energize the resonator circuit of the 723A/B oscillator tube. This field change applies to ST radar equipments bearing system serial numbers 1 to 354 inclusive.

Upon completion of the change revise the Cable Interconnection drawing, the Transmitter-Receiver Schematic and Wiring Diagram, and the Selector Unit Schematic in the ST instruction book to show the changes. Enter the field change on equipment record cards and in radar log book.



REDUCING GLARE FROM RADAR INDICATORS



A Polaroid filter for APS-6 and 6a aircraft radar indicators makes the radar screen easier on the eyes.

■ Every radar or cathode-ray scope operator has looked up on numerous occasions and realized that several seconds are required to accustom his eyes to the surroundings. It is much the same sensation which one experiences when walking into a theatre or a dark room. Now, on many occasions this temporary blindness is not too important, but to the pilot of a night fighter this time interval could easily mean the difference between an enemy flag stenciled on his cowling and a lot of actual practice in using a parachute or life raft. Moreover, not only does the radar screen impair night vision by reducing the pilot's state of dark adaptation, but some scopes are often a source of constant glare in his normal field of view.

To remedy these situations, the Physical-Optics Division of NRL set about to design some type of filter which could be fitted over the screens of the more common airborne radars. Ingenious RT's formerly had attempted to solve this problem by using a makeshift hinged sheet-metal cover which could be used as a shutter for the radar screen when visual contact was made.

Two ways of reducing these undesirable effects on night vision were considered. The screen could be dimmed without change in color, or the screen could be made redder at the same time by using a filter to cut out the more harmful yellow and green colors. This second method is to be preferred, since red has less effect on night vision.

VARIABLE DENSITY FILTER

To accomplish the first result, a variable-density polarizing filter was designed. This was made from a pair of Polaroid neutral polarizing discs arranged so that one disc could be rotated easily through 90° relative to the other by means of a knurled ring or handle. In one position the screen would be nearly as bright as with the device removed, and in the other position it would be blacked out. In between these limiting positions, adjustment to any intermediate brightness could be made. Thus, the pilot could dim the scope as much as he considered necessary during the search for a target. After radar contact was made he could then adjust the screen for best results. Finally, just before going to visual contact, the control on the Polaroid screens could be flipped to completely extinguish the image. The principal disadvantage of this variable-density filter is that the screen is dimmed without change in color.

VARIABLE-RED FILTERS

An adjustable filter which does permit change to a red image in addition to dimming was then developed. This device consists of two polarizing discs with a wave retardation plate between them. The retardation plate and the second polarizing disc are arranged to rotate separately relative to the first disc. When the retardation plate is set parallel to the first disc and the second disc rotated, the screen brightness is changed without alteration of the color. However, when the second polarizing disc is set parallel to the first and the retardation plate rotated, the screen becomes redder as it gets dimmer, reaching maximum redness and dimness at the 45° relative position. For ease of operation, a single adjustment for this variable filter is provided. When turned clockwise the wave retardation plate (but not the polarizing discs) will rotate, and the field becomes redder. When turned counter-clockwise only the second disc rotates, and the field becomes dimmer. Thus, the pilot may set the control as red as possible during search and approach, and when visual contact is secured he can then rotate the control all the way counter-clockwise to black out the screen.

While full-scale production of these filters was not accomplished before the surrender of Japan, several experimental units were distributed to night fighter groups. These proved to be very helpful, and their development represents another step in making electronic equipment not only more efficient in operation but better adapted to the comfort of the operator.

NEW GLARE REDUCING COATING

■ There have been several glare-reducing materials developed, but their use has been limited due to the difficulties encountered in application or to undesirable characteristics such as diffusion or instability.

The American Optical Company has recently developed a coating, AO-131, which has in general greater transmission and less reflection over the entire visible spectrum, and is very easy to apply. However, the coating is less resistant to abrasion, handling, etc., than the hardest coating presently used.

The Bureau of Ships is preparing a manual and kit for coating with AO-131. The manual will contain full instructions for application of the coating to electronic components such as cathode ray tube faces, plastic filters, safety glass, etc. The coating will be furnished in liquid form and may be applied by single-stroke wiping, spraying, dipping, or spinning. This permits on-the-spot application to transparent objects of any size or shape. The operation is completed in about 45 seconds, the approximate drying time of the solution. At room temperature the coating attains full hardness in a few hours. The hardening process may, however, be accelerated by baking, the temperature limited only by the material being coated.

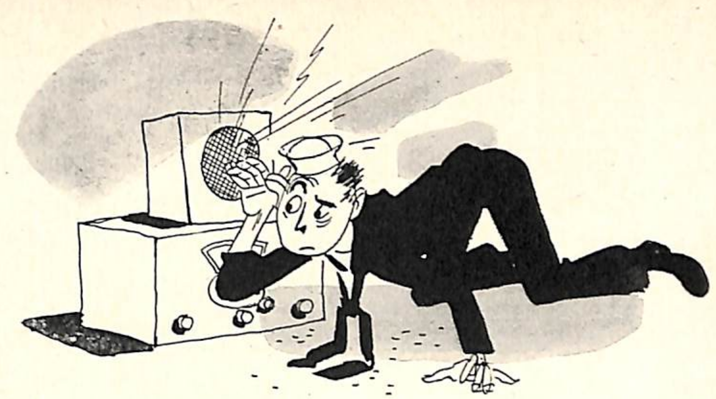
A surface coated with AO-131 should be cleaned with soap and water, never using a dry cloth or any abrasive material which will scratch the coating and impair its efficiency.

It is recommended that this coating be used on all front and back surfaces of plastic or glass where an increase of light transmission is desired. The use of this coating is especially recommended for use on cathode ray viewing surfaces, plastic scales and filters, and safety glasses in which the transmission of the information appearing on the tube is impaired by high external surface light reflections. It is not recommended that this coating be applied to any precision optical parts, such as range finders or to optical parts upon which the use of a magnesium fluoride coating has previously been required.

SUPREME COMFORT

■ Reports from an EFSG field engineer indicate that a Navy barber's chair with arms and a foot rest has been installed in front of the SU-4 indicator in the *USS CATOCTIN* (AGC-5). The seat may be raised or lowered to satisfy various sized operators.

OPERATION OF RAL RECEIVER ON VOICE CHANNELS



■ Operation of the Model RAL series equipments on voice circuits, particularly with those equipments aboard navy submarines, has been necessary due to the occasional non-availability of satisfactory modern equipment. The RAK and RAL were designed primarily for code reception and the characteristics necessary for voice reception were compromised to effect this end. As a consequence, the RAK is definitely unsuited for voice reception. However, the RAL, owing to its higher frequency range and corresponding reduction in RF selectivity, may, under certain conditions of adjustment, be utilized for voice reception as an interim proposition pending the development and procurement of more satisfactory equipment. The character of performance that will be obtained, while not wholly satisfactory, will at least be usable.

On CW reception, both sensitivity and selectivity are improved by adjustment of the regeneration control. To an experienced operator, this control is a means to accomplish reception of weak signals through interference, when its adjustment is properly coordinated with adjustment of the RF gain control. To both experienced and inexperienced operators, operation of the regeneration control may sometimes be confused as being synonymous with the effects obtained from operation of the RF gain control.

The effect of the regeneration control is to increase both selectivity and sensitivity. However, the improvement in selectivity is considerably greater, relatively speaking, than the improvement in sensitivity under conditions of constant RF gain. When selectivity is increased by regeneration, fidelity is sacrificed. Therefore, to achieve reasonable performance on voice circuits, it is essential that the regeneration control be retarded well below the point at which oscillation begins. This will result in the attainment of the normal selectivity of the receiver without regeneration. By the proper use of the RF gain control, the signal-to-noise ratio may be adjusted to a point where reception of weak voice signals can be assured for the majority of such cases that may be encountered. The loss in sensitivity by this adjustment of the regeneration control will be approximately 6 db and this reduction should not be too serious under most conditions. Certainly, it would be less serious than the loss of intelligibility that would result by increasing regeneration merely for the sake of realizing an improvement in sensitivity, which is largely psychological.

The fidelity of the audio amplifier of RAL equipments, with both the low-pass and adjustable AF filter switched out, is such as to yield reasonable intelligibility from voice-modulated signals. Reduction in fidelity and consequent loss of intelligibility can result from too much selectivity in the RF circuits preceding the autodyne detector. Below 500 kc there will be a reduction in fidelity due to the circuit constants which result in greater inherent selectivity. Therefore, while intelligibility of speech may be obtained below 500 kc, its reliability will be compromised. Above 500 kc the inherent selectivity of the tuned circuits is reduced so that sideband cutting will be less, and usable voice reception may be obtained by employing little or no regeneration, when the audio system without filters, and RF gain are adjusted as required.

Action is already underway for the development of new equipment to replace the Model RAL series equipments aboard naval combatant vessels. A program of this nature requires time for development, tooling, manufacture, and distribution. During the interim period, it is hoped that the foregoing will be helpful in effecting voice reception from present installations of RAL equipments.

CARRIER CONTROL APPROACH

Early in 1942 a group of scientists at the ... Laboratory conceived the idea that if radar could detect the exact position of an airplane at any given moment, this information could be used to guide the airplane to a safe landing through fog, darkness, or other conditions which previously had made landings impossible or extremely hazardous. This idea came to be known as GCA (Ground-Controlled Approach).

The Navy took immediate interest, and the Bureau of Ships engaged in a development program and the procurement of a number of GCA equipments for advanced base operation.

The concept of radar as a means of landing carrier planes had suggested itself early in the program, but the emphasis on radio silence, and the many complexities encountered in early development confined the system to land planes. Equipments were built, crews trained, and systems put into operation by the Army, Navy, and the British, in the European Theatre, Africa, and the Pacific. GCA saved many lives and valuable planes in all kinds of adverse flying weather and ...cies.

Late in 1944, Navy interest revived in landing carrier planes by means of radar. GCA was then a well-established and successful system, and it seemed that the problem of guiding a fast fighter plane down to a relatively small, pitching, rolling, flight deck in darkness or bad weather could now be undertaken. Accordingly the Bureau of Ships undertook a study of all radar equipments then in production which might be adapted to a solution of the problem, and began to develop a system for a speedy trial installation on a carrier. On the basis of numerous technical considerations, it was finally decided that the AN/APQ-7, commonly called "Eagle," a precision airborne radar bombing equipment used largely by the Army Air Forces, most nearly met the basic requirements for a CCA system (Carrier-Controlled Approach).

The indicator, however, designed to show a map-picture of the target to a bombardier flying at twenty to thirty thousand feet, did not present the kind of picture needed by a landing signal officer on a carrier to direct a fighter plane to a safe landing. So a new indicator had to be designed. The problem was assigned to the Naval Research Laboratory on an urgent basis. For ten days engineers and technicians worked on a "round the clock" schedule. In that brief time they designed, built, and tested a new and radically different indicator for use with the "Eagle" which would show an expanded view of the sector astern of the carrier as scanned by the radar beam. It would clearly show the approaching plane as it turned into the proper flight path, and give the control officer the data required to keep the plane "in the groove" and tell him in how many seconds the plane would be over the end of the flight deck for the "cut" signal which would drop the plane precisely on the carrier's arresting gear.

ComAirLant cooperated in every way possible with development and tests of the system.

NRL's indicator was completed and flown to Special Project Unit "Baker" at NAS Banana River, Florida, where an APQ-7 radar had been installed simulating as closely as possible the conditions encountered in carrier operation.

The system was assembled and operational tests were carried out showing effects of sea-return, maximum and minimum range, appearance of planes on the scope as approaches were made, and numerous other items of technical information. It is interesting to note that pelicans could be seen on the indicator scope and, according to the operators, even *counted* as they flew in formation along the beach a few hundred feet in front of the equipment.

The tests at Banana River were completed in a very few days, and the indicator was sent by air to the *USS Solomons* (CVE-67), where another APQ-7 radar was in process of installation. In this installation the antenna was installed on the after edge and slightly below the top of the flight deck, scanning astern of the carrier from 10° starboard to 50° port of the centerline. Modifications to the APQ-7 and its antenna, found necessary at Banana River, were quickly made and the indicator installed in a compartment near the landing signal officer's position.

The operation of the equipment exceeded the most optimistic expectations. As procedures became well defined, increasingly difficult conditions were imposed, finally resulting in several landings being successfully made with the ship and her escorts in complete darkness.

The AN/APQ-7 is an X-band radar system. The antenna system consists of 250 stacked co-linear dipoles, fed by a "leaky-waveguide" scanner system. This is a section of waveguide alternately squeezed and extended in the *b*-dimension by mechanical means at a rate of 1.5 cycles per second. Changing the guide width causes phase shifts in dipole feed, which in turn changes the direction of propagation of energy from the dipole array. Thus the beam sweeps through a sector in space at a scanning rate corresponding to the mechanical drive of the "squeeze-box". The radiated beam is very narrow in azimuth (in the order of 0.4°) and is confined to about 45° in elevation by means of flaps extending out from the waveguide. No reflector is used.

The indicator developed by NRL is a special type of *B*-scope which presents a partially-expanded picture of the scanned area astern of the carrier. The indicator is designed for a five-mile maximum range.

The operating procedure worked out aboard the *USS Solomons* consists of a cooperative system between CIC, Communications, the APQ-7 operator, the landing signal officer, flight officer, and the pilot of the approaching plane. The airplane is first picked up on the SG or other search radar, identified by CIC, and the pilot then guided by voice communication into the sector scanned by the APQ-7 at a point about 1.5 miles astern. The APQ-7 *B*-scope operator then takes over the communication channel, directing the pilot along a line approximately 10° to port of the flight-deck centerline. At a point 100 yards astern, the pilot is in a position to see the landing signal officer with the help of the usual aids to visibility already worked out for carriers, such as contrasting colors, fluorescent illumination, etc., and from this point the plane is landed "contact" in the usual way.

The success or failure of any approach system depends largely upon the opinion of the pilots who are to use the system. One pilot who flew during the initial tests of CCA reported: "I believe the CCA system is the answer to low visibility and night approaches under difficult weather conditions. I flew the pattern entirely on instruments, looking out of the cockpit only after receiving *contact* or *wave-off*. I never felt uncomfortable or uneasy at any time during approaches. This was due to confidence in instruments and controllers. This system obviates the necessity of repeatedly going from instruments to *contact* as is done in a standard night or low-visibility approach. . . . I believe this system will work effectively if the pilot has confidence in his instruments and controllers, and if he flies in entirely on instruments up to *contact*. If these conditions are met, the pilot will always get aboard."

It is expected that further installations of this system will be made, and further development work is still under way to provide better over-all operation. Such matters as a *rate-of-closure* indicator to show the exact air speed of the airplane, and independent "traffic control" type of search radar having high-speed scan and positive means of identification, and similar problems are under investigation.

Failure Reports

their use and importance

■ Many radio technicians are prone to regard failure reports as so much red tape with little or no practical value. Such is by no means the case. Failure reports constitute one of the most important links between those who design and manufacture electronic equipment and the men who use this equipment to make our fleet a more efficient and powerful striking force. Their importance cannot be over-emphasized.

Although many persons have been conscious of the value of failure reports, the filling out of the old forms, making seven copies, and the effort involved to get them properly signed once they were made out—well, it just seemed too much. Consequently, with war-time conditions leaving very little time for any sort of paper work, particularly in the electronic field where new installations and maintenance problems were first and foremost in the minds of all concerned, failure reports have often been neglected.

In order to simplify the filling out and submission of electronic failure reports, the new NavShips 383 Failure Report—Electronic Equipment card was developed. Millions of these forms have been distributed with the sole purpose of giving the fleet a single failure report card which can be filled out quickly and completely by any radio technician, electronic officer, or field engineer—in fact, by any user of the equipment—and mailed in the accompanying self-addressed envelope directly to the Bureau of Ships. This single card replaces the two long forms, NavShips 383 and 304, and contains most of the information required on every type of failure. Proper filling out is a simple matter. No copies or additional signatures are necessary.

DISPOSITION OF REPORTS

In order to make clear the route which an individual failure report follows after it reaches the Bureau of Ships, let us consider one isolated example.

A compressor diaphragm failed in a Model 22 Dehydrator for the SR Radar aboard a cruiser in the South Pacific. The failure report was submitted to the Electronics Division of BuShips. It was then routed to the Radar Maintenance Section, where those in charge of the SR program recorded the failure and classified the information on the report. The original card was then forwarded to the resident INM (Inspector of Naval Matériel) at the factory where the equipment was produced.

The inspector used the information on the failure report as one of the reasons for replacement of the defective part and as a basis for cost adjustment on the part of the manufacturer.

The data on the cards became part of the monthly failure report summaries sent to the electronics officers at all navy yards, to supply officers of radar equipment, and to various cognizant sections of the Bureau. These summaries serve as a source of trouble-shooting notes and are used as the basis for the procurement of stocks and spare parts. Field activities find additional value in the data as instruction material for probable failures.

The submission of similar failure reports resulted in three field changes being supplied to the fleet for both Models 22 and 2200 Dehydrators as used on SA/SC/-SK/SR Radar. Moreover, failure reports on the earlier dehydrators played an important role in the design of the later Model 22 equipments.

BENEFITS OF PROMPT SUBMISSION

In every branch of electronics, numerous examples of the direct results of the prompt submission of all failure reports may be cited.

The gears, bearings, and other parts of the CR tube assembly of the SL/SL-a/SL-1 Radar equipments began wearing out, freezing, stripping, and binding. Reports began pouring in on these failures. Investigation showed that the original lubrication instructions given in the SL instruction books were inadequate. Immediately new lubrication instructions were prepared and distributed to all activities. The worn parts were replaced and additional quantities of spares were made available to take care of the losses. Thus, failure reports were directly responsible for these corrective measures.

In the BN type IFF equipment the high-voltage transformer T-251 began failing at an abnormally high rate. Failure reports revealed this information, and prompt action caused a new oil-filled transformer to be distributed as Field Change No. 1 on the BN equipment. Eventually this newer type transformer will replace all of the original transformers.

Temperatures as high as 160°F were reported in the indicator console of the SL/SL/-a/SL-1 Radar. Reports indicated that the failure of components in this unit could be traced to inadequate ventilation. As a direct result, extensive tests were made by the manufacturer which resulted in Field Change No. 49, referred to as "Addition of Console Ventilation". This kit consisted of a blower motor, glass filters, and canvas air ducts. Improvement in operation and a definite decline in component failures resulted from this action.

The average life of 8014 oscillator tubes in the SA and SD radars was less than 50 hours. As an outgrowth of the failure reports, a series of changes in design was made. A different type filament, grid seals, and copper anode were incorporated into a new tube designated the 8014-A, and this was distributed to replace the 8014's. The average life of these new tubes has been greater than 400 hours, with an occasional life greater than 1000 hours.

Antenna dipole assemblies on the SA, SC, and SK series radars were deteriorating rapidly due to rust and corrosion. As a result, detailed information on painting and repairing antennas has been distributed. Manufacturer's drawings of the SA/SC/SK series antenna dipole assemblies have been sent to all maintenance bases and repair activities, enabling the machine shops to turn out replacements and make immediate repairs to the damaged parts.

Failure reports indicated very unsatisfactory performance of the indicator units of Model QCQ-2 sonar gear. These facts were brought to the attention of the contractor and completely new indicator units were designed. Not only were the indicator units replaced and the Navy reimbursed for the initial units, but an entirely new principle of operation was used in the design of the replacements. QCQ-2 Field Change No. 11 "Replacement of Belt-Type Indicators with Lite-Lane Indicator" has been supplied to effect this change.

On the TCS radio transmitters, failure reports of the bleeder resistor in the TCS-12 power supply were responsible for 100% replacement of this component by the contractor.

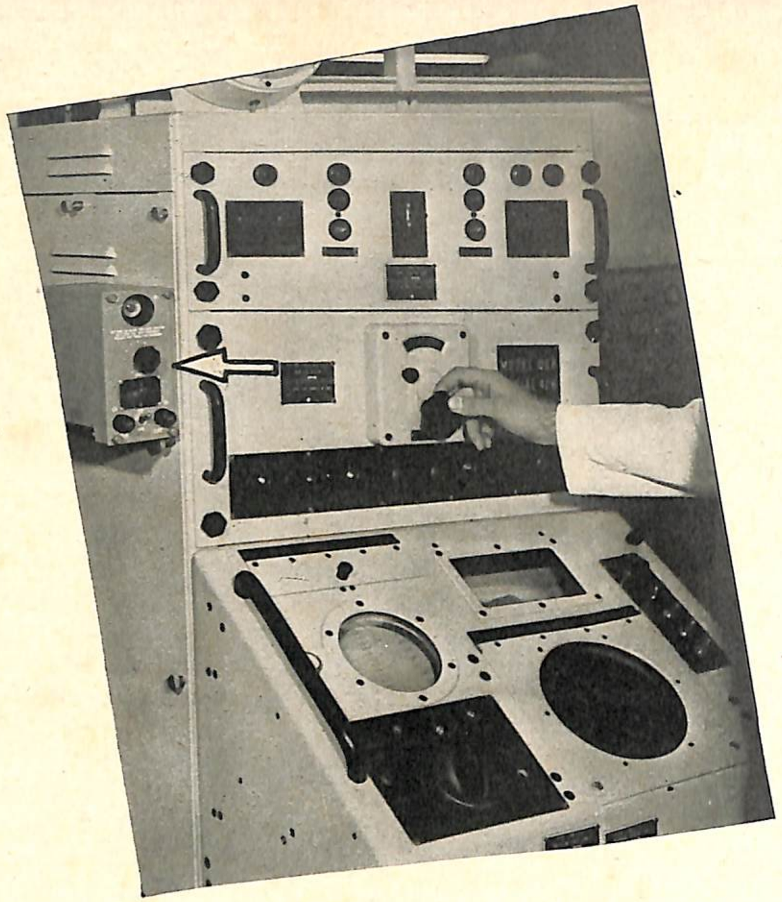
As a result of the failure reports on the squelch circuit, ON-OFF switch, and other parts of the Model MBF, several modifications have been made which have resulted in improved intelligibility and performance of this equipment.

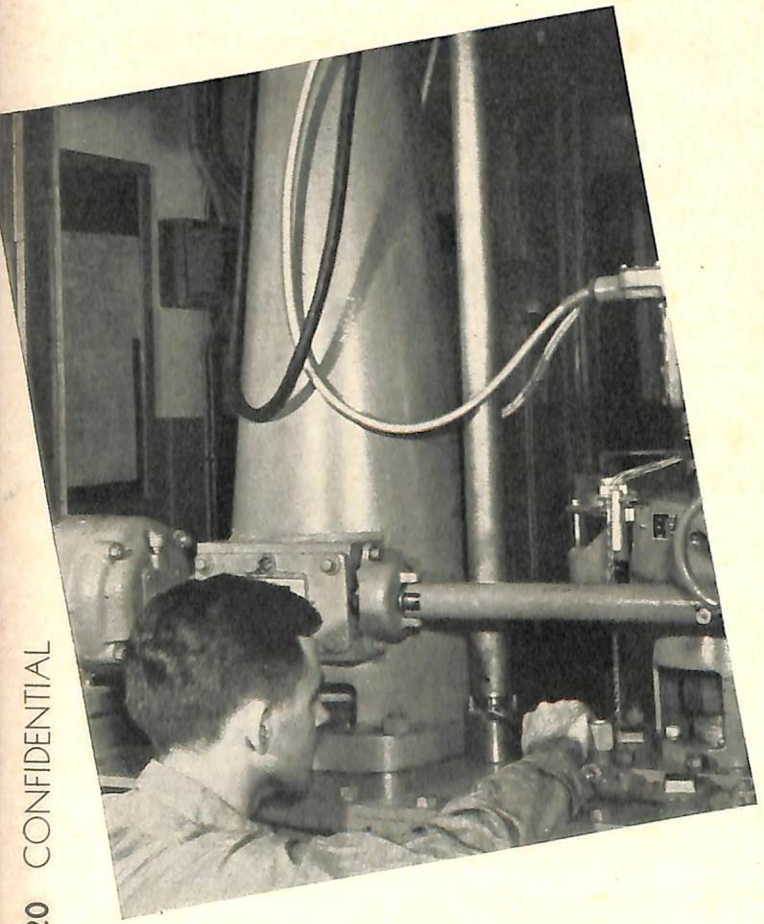
REPORT ALL FAILURES

Hundreds of specific instances might be cited to show the importance of prompt submission of all failure reports. The information on these forms is concise but significant. Always fill out to the best of your knowledge the requested information and forward the cards promptly to the Bureau. The value of individual reports increases tremendously as the number increases. All failures should be reported.

Through the cooperation of all radio technicians in the fleet many improvements in design and maintenance can be made which lead to better performance and more trouble-free electronic equipment aboard your ship. Now that Japan has surrendered, let's catch up on the paper work so that some of the failures of the past will not appear in the equipment of the future.

KEEPING THE SONAR DRIVER TUNED





■ With the new Retractable Dome Tuning Indicator equipment now in production, most sonar gear having a streamlined dome will be magic-eye tuned. This new tuning indicator is designed for use with echo-ranging equipment installed with either the 50-inch or 54-inch retractable domes.

The retractable dome type of tuning indicator is similar both in design and in principle of operation to the Sound Monitoring Equipment for Fixed Domes, described on page 33 of the August issue of the ELECTRON. The installation consists of a type CAED-51095 magnetostriction hydrophone mounted in a horizontal position in the forward part of the dome, a stainless-steel push-rod assembly to take up the cable slack and prevent fouling of the hydrophone connection when the dome is retracted, and a type CDI-55180 Indicator Unit mounted near the driver or sound stack and containing a type 1629 magic-eye indicator tube. Sonar equipments having a separate oscillator control for driver and receiver are provided with two type CDI-55180 Indicator Units.

This equipment offers a simple and accurate method of tuning the sonar driver for maximum output, regardless of whether the ship is underway or alongside the dock. No longer will the rather hit-and-miss "dip-peak", "sizzle", "reverberation", and "plate current" methods of driver tuning be necessary. Once properly calibrated, these magic-eye tuning indicators can also be used to check the projector-bearing error, check for changes in power output, and to tune the BDI equipment.

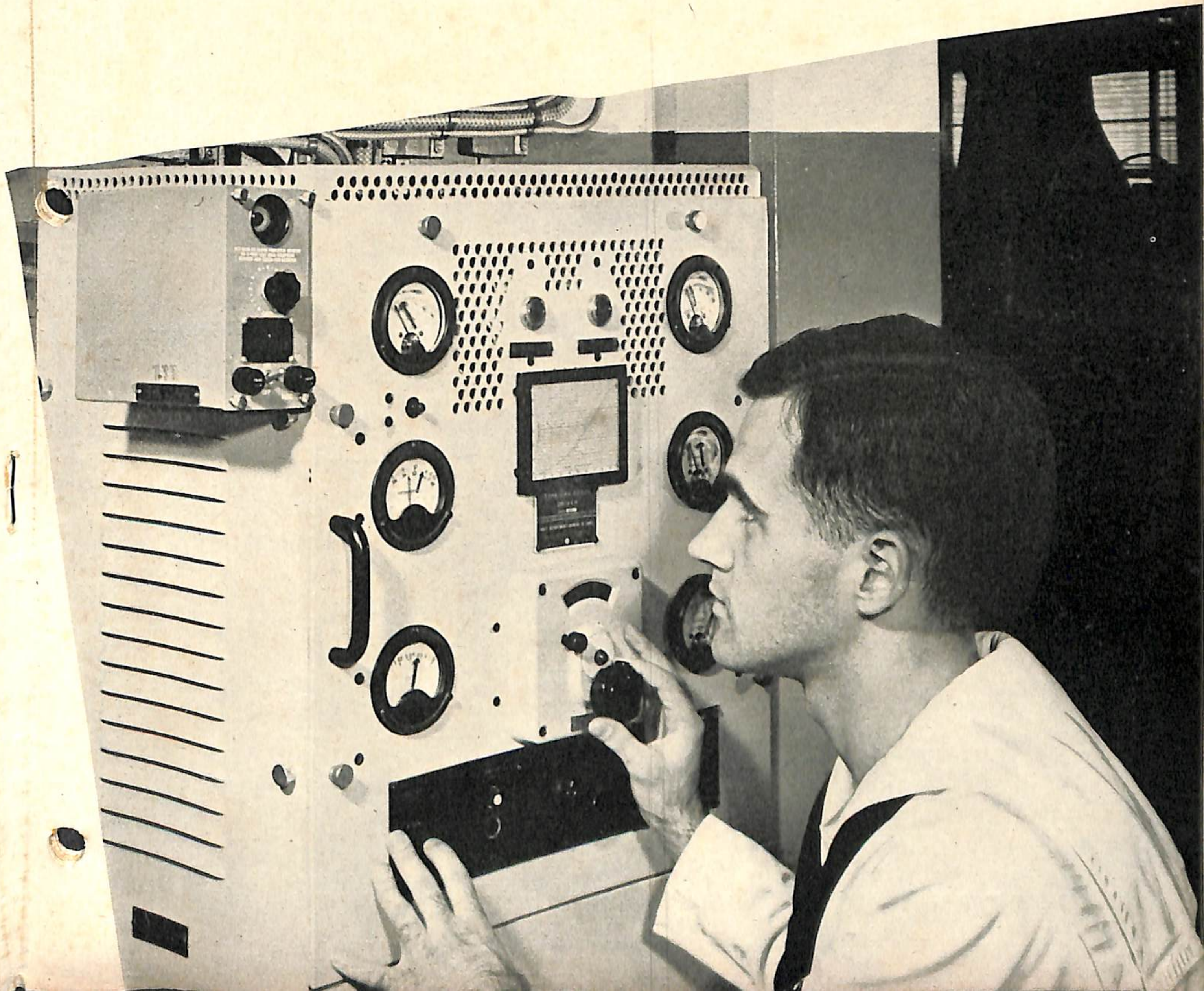
Maintenance of the installation is very simple. The indicator must be recalibrated whenever the magic-eye tubes are replaced. Whenever the BDI equipment is tuned, the signal lead from the indicator must be disconnected and an OAX Sound Monitor or similar equipment used to drive the hydrophone.

During installation of the tuning indicator, every effort must be made to have the push-rod assembly correctly aligned. It is important that the inner movable shaft containing the hydrophone cable should not foul.

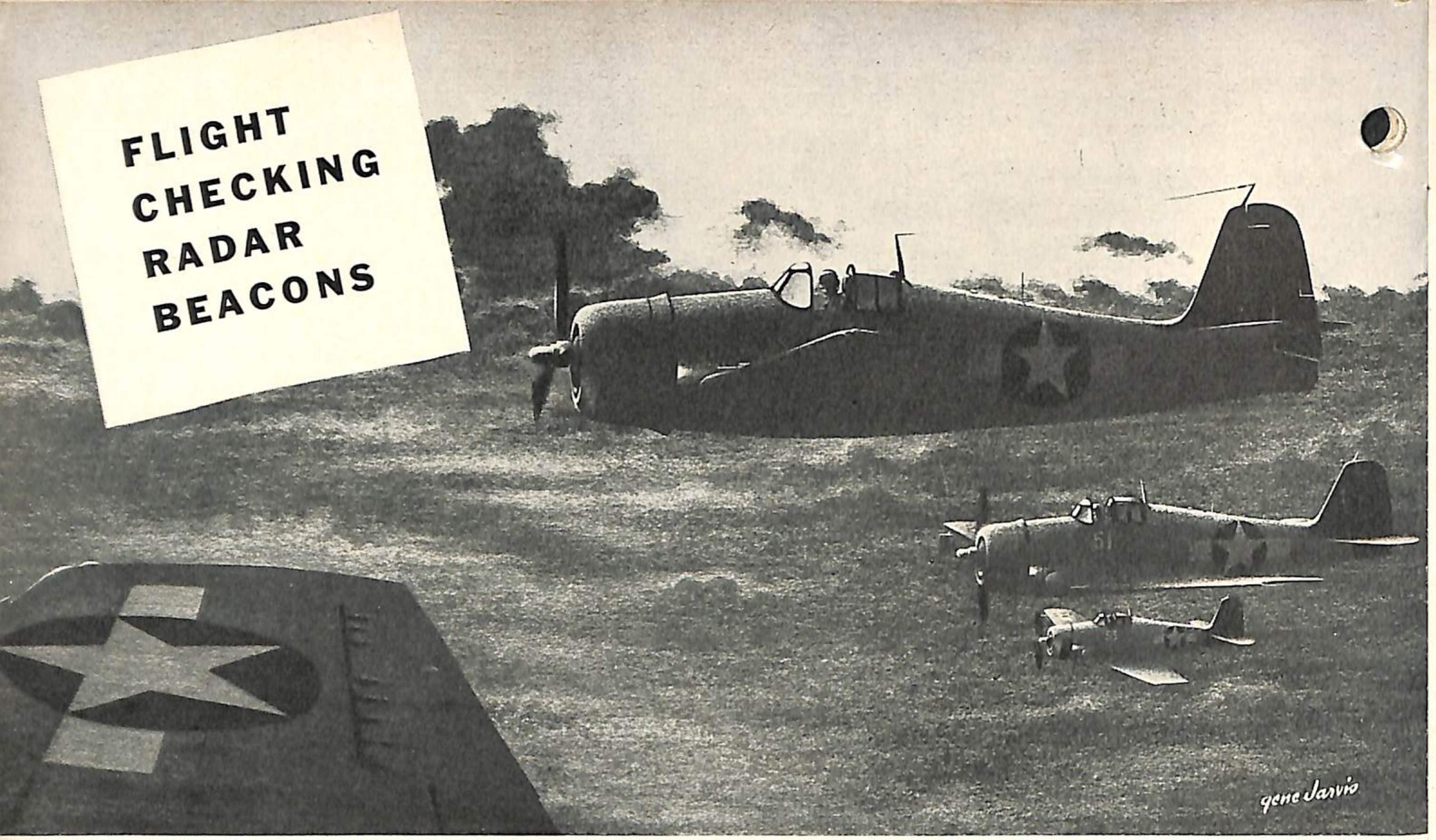
To remove the outer shaft of the push-rod assembly, it is necessary merely to loosen the four screws on the side of the cross brace clamp. The other half of the clamp which is bolted on the cross support should never be disturbed, otherwise a difficult realigning job will be necessary.

When removing the dome from the ship, it is necessary to disconnect the hydrophone cable from the junction box in the lower sound room, slip off the outer shaft of the push-rod assembly, loosen the packing assembly in the inner shaft, and allow the cable to slide through into the dome. This must be done before the dome is removed, otherwise damage to the cable, push-rod assembly and hydrophone will occur.

Ships should contact the nearest source of supplies in regard to the availability and installation of these tuning indicators.



FLIGHT CHECKING RADAR BEACONS



■ Numerous mechanical and electronic devices are being employed, both by the Navy and Army, to assist pilots in locating their carrier or base when visibility conditions make other navigational methods impracticable.

The radar beacon is one of the foremost electronic aids to navigation insofar as aircraft is concerned. As with all electronic equipments, there are conditions which must be satisfied before its services can be employed with dependability. The beacon must be working properly, and the chart for the beacon and its associated coverage must be as accurate as possible.

When a pilot is using radar beacon services in orienting himself while flying under conditions of low visibility, his beacon coverage chart must show hazards at various bearings so that he can adjust his altitude and direction accordingly. Since the safety of pilots and aircraft depends on these charts it is imperative they be accurate and complete.

In general the procedure for making flight checks, as outlined by Bureau of Ships, is as follows: Arrangements should insure continuous communication between plane and beacon, correct initial operation of beacon, frequent monitoring of beacon during flight check for correct operation and frequency, correct frequency and operation of airborne radar transmitter within beacon receiver band width, adjustment of gain of airborne radar receiver as for normal search, setting frequency of airborne radar receiver to that of beacon and maintenance at that frequency during the check. Runs should be made on a number of bearings (usually eight) at altitudes of 10,000, 5000, 2000, 1000, 500, 100 and 50 feet, terrain permitting. When feasible, the check should include the landward as well as the seaward side of the beacon location for investigating "shadows" due to high land. The head of the report should show beacon location in latitude and longitude, model and serial number, plane radar model and serial number and maximum range. The body of the report should provide space for Time, Bearing of Beacon, Altitude in feet, Range in nautical miles, Degree of tilt, S/N ratio, Width of signal in degrees, and Appearance. In the column for appearance it should be noted whether it is solid, weak, skips, well defined, not well defined, or intermittent. Provisions should be made for reporting results on eight bearings at the altitudes specified above.

Detailed instructions for performing radar beacon flight checks are available from ComServPac. These instructions apply to the following equipments:

Radar Beacon Model	Airborne Radar Model	Scan	Max. Range
YJ Series	ASE, ASV, ASVC (low band)	M	90 miles
	ASB (high band)	M	70
BGS, AN/CPN-3, AN/CPN-8, AN/CPN-17 (future)	ASG (AN/APS-2) (and subsequent models)	A, PPI	100
	SCR-720	B, C	100
CXEH, AN/CPN-6	ASD (after serial number 1300)	B	100
	ASD-1 (AN/APS-3)	B	120
	ASH (AN/APS-4)	B	150
	AIA (AN/APS-6)	Spiral	100
	AN/APS-15	A, PPI	220
	AN/APS-19 (future)	B, Spiral	150

The type of antenna with which the plane is equipped dictates the direction of flight while making the check. Planes equipped with *yagi* antennas (ASE, ASV, ASVC, ASB) make runs from outside of range towards beacon with antenna set for "homing". Planes equipped with wing-mounted parabolic reflectors which scan less than 360 degrees (ASD, ASD-1, ASH) make runs toward the beacon. Planes equipped with fuselage-mounted 360-degree-scan parabolic reflectors (ASG, AN/APS-15) make runs toward or away from the beacon, taking advantage of the available backward scan. Parabolic-type reflectors should be adjusted for maximum signal when readings are taken, and the degree of tilt recorded in the proper space on the report form.

In all flight tests the theoretical values in table I should be used as a reference. This table has been found to be quite accurate over areas where no obstruction exists between plane and beacon. Results of test should closely follow this table. It may be necessary to increase or decrease altitude by steps depending on a "no signal" or "too strong signal" at any specified altitude using the table as a reference. Data should be taken as soon as a satisfactory useful signal has been received.

A 2-to-1 signal-to-noise ratio on *A*- or *M*-scan and/or a 5-degree width of signal on *B*- or PPI-scan is considered satisfactory for signal requirements. The *A*-scan will be considered the criterion in preference to the PPI when both are available.

Re-runs should be made when temporary faulty operation is suspected. For example, no signal at some point where shadow in the field pattern due to terrain is improbable or impossible.

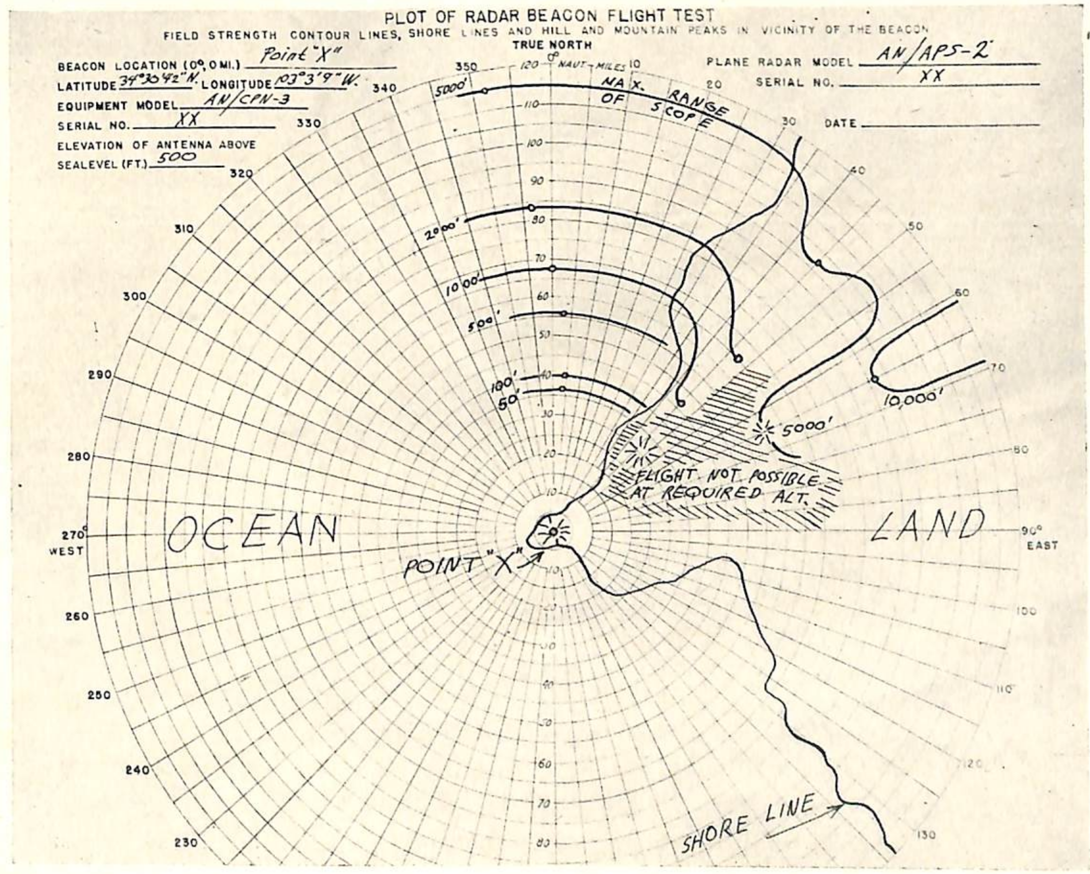
A graph or plot should be prepared on a chart similar to that shown using data obtained during test. Beacon location (point X) should be represented as being at the center. Shore lines, mountain peaks, hills and shadows should be plotted in their proper geographical location.

Forms for recording and reporting data may be obtained at any navy yard printing office.

TABLE I—Theoretical Ranges in Nautical Miles

Line-of-sight corrected for refraction, mainly over water

Aircraft Altitude	Beacon antenna altitude above sea level—ft.					
	20	30	100	200	500	1000
10,000..........	127	131	135	140	150	161
5,000..........	92	95	99	104	115	126
2,000..........	61	64	67	72	83	94
1,000..........	45	48	52	57	67	78
500..........	33	36	40	46	56	67
100..........	17	20	22	30	40	51
50..........	14	16	19	27	37	48



...PASS...THE...BAD...WORD...ALONG

By Capt. James Leveque, USMCR, BuShips

■ Here was the pay-off.

The condition was "red", your radar was out of action again and the colonel was on the field phone demanding to talk to you.

"He sounds whizzed off," your sergeant said unnecessarily. You knew what the colonel was going to ask. He was going to ask, "Why?"

You had to think of something to say—and fast!

That condenser had been failing for months, ever since your equipment—a new design—had been operated in this steaming jungle country. You had used up your equipment spares during staging, had replenished from Pearl and now with your radar in combat, forced to function continuously for long periods and under peak voltages, you had seen the supply of condensers dwindle at an alarming rate. Sure, you had sent a dispatch requesting urgent shipment of more, but they hadn't arrived and you knew the supply at Pearl was limited; they'd have to get them from San Francisco. That would take time and you needed them now. The last spare had just gone ph-h-h-t. Your radar was out of action and the colonel was on the phone.

What were you going to say?

Blame the technicians? That wasn't the Marine way of doing it. Besides, they were good technicians and the trouble was not one they could correct. They had worked at it and worked hard.

Blame supply channels? Maybe yours is the first equipment of its type being used in combat. On what basis, therefore, would the Quartermaster be justified in stocking ten times as many of this condenser as any other?

Blame Bureau of Ships Design Section? The equipment passed all tests in the United States. How is Design to know this condenser is failing overseas?

Blame the manufacturer? What reason has he to believe the equipment or any of its parts may be defective?

Blame the Bureau of Ships Installation and Maintenance Section? They depend almost entirely on trouble reports from the field. You have sent no such reports.

You had seen them around, pads of Marine Corps Signal Equipment Failure Report forms. They looked like useless paper work to you. And when, recently, the Base Depot began demanding them as a prerequisite for issuance of parts, you had railed at the stupidity of "Shiny-pants Marines" who proposed saddling the overworked men in the field with more red tape and paper work. What were they trying to do, impede the war effort?

If you had reported each failure of this condenser promptly, as it happened, your area depots would have had immediate reason to suspect this part as critical; Bureau of Ships Installation and Maintenance would have received early notice that the part was failing and could begin its analysis of the trouble; as the evidence accumulated, Bureau of Ships Design would have been enabled to contact the manufacturer with concrete evidence of failure and to take the necessary steps to correct the fault in yours and all similar equipments and in others being planned; the Quartermaster General would have had the required proof justifying a sharp increase in stock levels and the Division of Plans and Policies would have been kept currently informed for follow-through action if required.

In short, your problem would have been studied and probably solved long before your equipment had gone into combat. The chances are your radar would not now be out of action and you would not have to explain things to the colonel.

The failure report system makes sense, even the unique twists the Marine Corps gives it.

First, the Marines use a multiple copy form. (One copy remains in the Pacific, Plans and Policies gets the original and forwards the third copy to the Bureau of Ships, Marine Corps Installation and Maintenance).

Second, for approximately a year now, base and field depots have required submission of failure reports whenever replacement of parts if desired. Requisitions are to carry, opposite each part ordered, the serial number of the report covering the failure.

Third, after the Bureau of Ships' analysis, the Signal Corps gets copies of those reports where the Army has cognizance.

Fourth, the form is designed to report failure of all signal equipment—radar, radio, telephone and other types.

Isolated on some Pacific island, you had no way of knowing much about this life history of a Marine Corps failure report:

A part fails. The Signal Equipment Failure Report is written out with the part identified by name, description, Signal Corps stock number, symbol number, manufacturer's item number; contract number, the type equipment, and equipment serial number are listed; the cause of failur with detailed symptoms and suggestions for a remedy are given; the report is signed and forwarded. At Pearl Harbor, the Marine Corps Service Command extracts a copy and forwards the two remaining to the Division of Plans and Policies.

In Washington, the Division of Plans and Policies studies the report, keeps the original, forwards the copy to the cognizant Marine Corps Section of the Bureau of Ships, Installation and Maintenance Branch. Here the report is again analyzed thoroughly, a card index record (used to prepare monthly summaries and to provide a running account of failures on both Army and Navy equipments) is made. Result of the analysis, together with all individual reports on Navy gear, go to the cognizant Marine Corps Design Section in the Bureau of Ships. In the case of Army equipment, a letter calling attention to particular failures plus the individual reports goes to the Signal Corps.

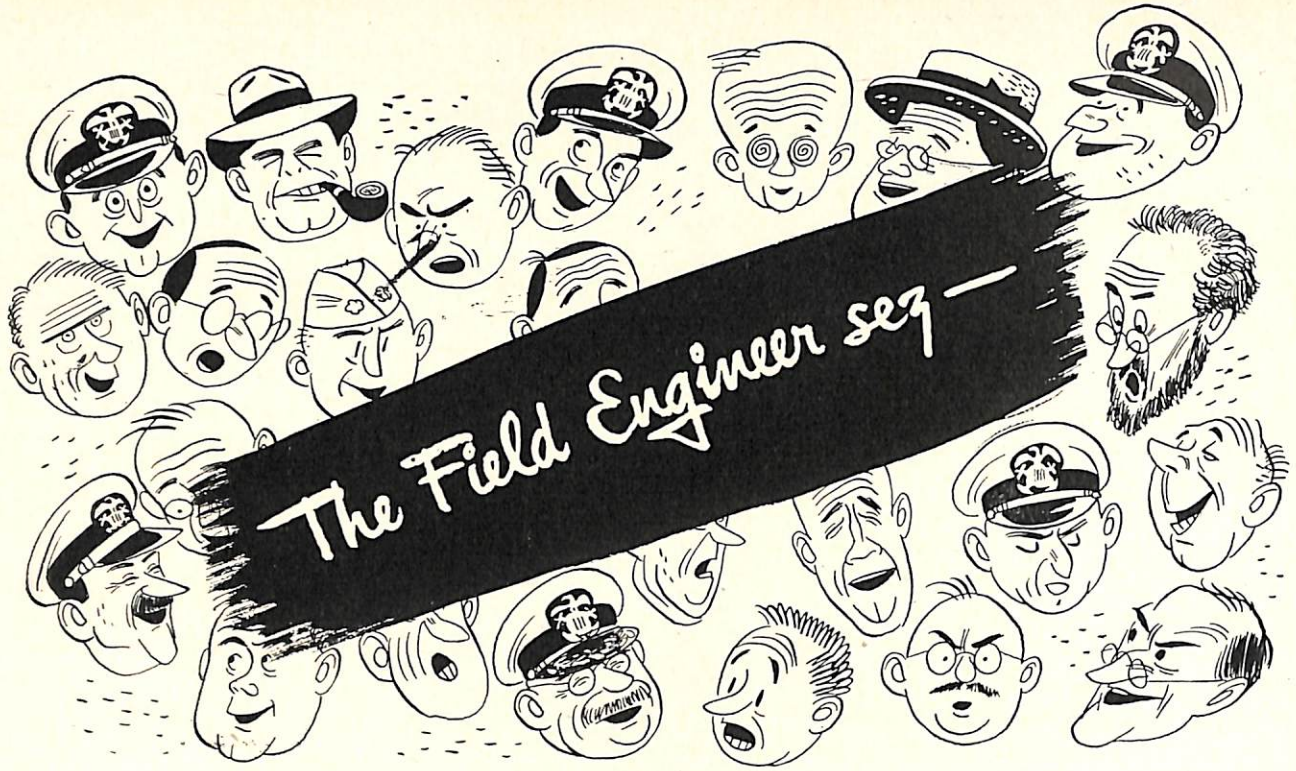
The Bureau of Ships Design Section pursues its own investigation of the failure, confers with the manufacturer, and conducts tests of the part and determines whether a new type part or a circuit change is needed to correct the fault. Perhaps a field change is indicated. Complete replacement of faulty parts without cost to the Navy often is possible. After action has been taken, the report is returned to the proper Installation and Maintenance Branch and filed.

Meanwhile, the Quartermaster General, acting on information obtained from current requisitions and from recommendations of the Division of Plans and Policies and the Bureau of Ships, can adjust stock levels of the part to provide adequate supplies for the field.

The degree to which the above results can be accomplished depends almost wholly upon the user sending in his report promptly, filling out the form with all identification data and his statement of the symptoms of failure and probable cause. As can be readily understood, the value of the reports increases tremendously as their number increases.

These are some of the wheels within wheels that turn when a Signal Equipment Failure Report is sent in. But you turned no wheels, you sent in no report. So the condition is "red", your radar is out of action and your colonel is on the phone.

What are you going to say?



SU/SU-1 ANTENNA MODIFICATION

■ On all type 974A Antenna Assembly Units, serial 100 and up, the flywheel from the antenna training motor must be removed to eliminate an antenna training error. In removing this flywheel it will be necessary to remove the two set screws securing it to the motor shaft. In some instances it may be necessary to employ a small gear puller. Do not remove antenna training motor flywheels from type 974 antennas.

—*Submarine Signal Co.*

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JT BEARING REPEATER

■ Special care should be taken when adjusting the bearing repeater in the JT console in order not to damage the bearing ring. In many JT installations it has been found that the bearing repeater ring "followed" with a jerky motion. This has been caused by the outer ring rubbing against the stationary center portion of the repeater card. A little patience in adjusting the outer ring will usually result in smoother action.

—*EFSG*

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SJ, AND MARKS 8, 16 & 27

■ Oscillations in regulated rectifiers type 20AAQ used in SJ, Mark 8, Mark 16, and Mark 27 Radar Equipments sometimes occur when 6L6 tubes are replaced by 6Y6G tubes. To eliminate this oscillation: (a) Replace the connection between R-8 and the plate (terminal 3) of V-6 with a wire laid along the *outside* of the cable but not carried around the loop toward the front of the rectifier. (b) Do the same with the wire from the screen (terminal 4) of V-7. (c) If oscillation has not stopped, remove R-15 and clip off both ends of the wire to the grid (terminal 5) of V-6. Remove the ground strap from terminal 6 of V-6. Install a 470-ohm carbon resistor between terminals 5 and 6 of V-6. Connect terminal 6 to the outer lug at the previous location of R-15.

—*Western Electric*

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SWEEP JITTERS

■ Several instances of jittery bearing sweeps and signals in the Mark 8, Mod. 3 control indicator caused by 60-cycle modulation have been reported. This trouble has been eliminated by paralleling C26.3 (0.25 μf) with a 2μf (or larger) capacitor.

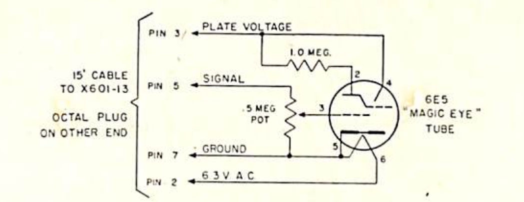
—*Western Electric*

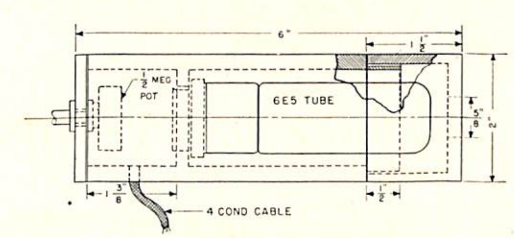
MARK 22 RF TUNING

■ If you have trouble tuning the RF section of your Mark 22, here is a device you might find helpful. It consists of a 6E5 (magic-eye tube) connected to an octal plug as shown in the figure. The device was developed by the engineers at the Boston Navy Yard, and you can make it yourself.

The video signal is applied to the grid of the 6E5 whose sensitivity is controlled by a .5 megohm potentiometer. The success of this type of tuning is dependent upon the portion of the sweep on which signals appear. It is therefore necessary to tune the gear when near land or other objects which afford strong echoes. If an echo box is available, its ringing time is sufficient to make the tuning-eye method feasible.

Place the Probe of the test amplifier in Test 607 to pick up negative video signals. Replace the 6L6 in X-601-13 with the octal plug of the tester. Connect the Test Meter Unit to the Transmiter-Receiver Unit and vary the repeller voltage until signals are received as indicated by the closing of the eye of the tube. With the receiver gain set at a point just before noise overloads the second detector, vary all the tuning adjustments in the RF unit, peaking each one for maximum signal (narrowest shadow) on the 6E5. As tuning is





improved, the shadow overlaps itself and the indicator must have its sensitivity reduced to the point where a narrow shadow is again visible. Slight changes in shadow width are then more apparent.

—*Western Electric*

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NEW PROJECTORS

■ When the CW-78178 rochelle salt projector is replaced by the CW-78207 ADP projector, two circuit changes are advisable. Because the protection afforded by thermistor R-235 is not required, this component may be removed. To compensate for a difference in impedance, the function of the retard coil L-203 should be changed from an impedance matching auto-transformer and tuning inductance to that of simply a tuning inductance. Both changes can be accomplished at the same time in the following manner.

Remove the white-green wire from terminal 6 of output transformer T-202 and the white-orange wire from terminal 2 of L-203. Carefully tape the exposed ends of these wires and secure them in place to prevent their making contact with other parts in the driver amplifier. Then run a new short length of good quality #20 insulated wire directly from terminal 6 of T-202 to terminal 1 of L-203 to complete the change.

—*Western Electric*

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MARK 8, MOD. 3 SCHEMATIC

■ The schematic diagram for the IF amplifier in the Mark 8 Mod 3 instruction book was for the wrong equipment, the D-150412 instead of the D-150889. The correct schematic is in the Western Electric handbook (Drawing 20A, Mark 8, Mod. 3) The differences are as follows:

(a) R-220—eliminated.
(b) R-221—560 ohms instead of 62,000
(c) R-202, 205, 208, 211, 214, and 217—1500 ohms instead of 1000.
(d) R-203, 206, 209, 212, 215, 218—560 ohms instead of 510.
(e) C-222, 223—0.006 μf instead of 0.01 μf.

—*EFSG*

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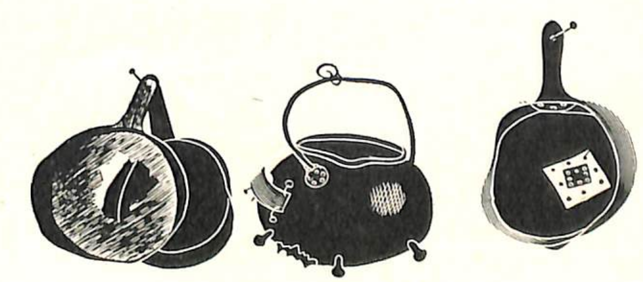
IS YOUR POT WARPED?

■ In a number of radar installations (Mark 29 Mod. 2, Mark 34 Models 3, 4, and 7, etc.), potentiometers driven by the range units are electrically part of the computer. The range information must be nonlinear with respect to range since it must be adjusted to the ballistics of the particular guns with which the circuit is used. This nonlinearity is accomplished by a mechanical arrangement whereby the contact arm changes its position relative to the arm which is fixed to the shaft. A metal *warping plate* is built into the center of the pot (potentiometer) to accomplish this lead or lag. Adjusting this plate for proper output is known as "warping the pot."

—*Western Electric*



NEW APPLICATIONS FOR ULTRASONIC WAVES

High frequency sound waves in water employed to simulate actual radar radiation.

■ It's rather hard to imagine any liquid moving back and forth 15 *million* times per second. Yet that is exactly what happens to the particles of water acted upon by the 15 Mc signal sent out by the quartz crystal of the Ultrasonic Trainer, a radar ground-training device developed by the Special Devices Division of the Office of Research and Inventions.

Most of the more common sonar equipment operates in the frequency range of 14 to 30 kilocycles. Yet, an ultrasonic frequency of 15 Mc can be transmitted in water with a speed of approximately 5000 feet per second and it behaves much as the supersonic waves from service echo ranging equipment. If it strikes a suitable reflecting surface, the returning echo can be picked-up. These properties have been used to very good advantage in the ultrasonic trainer.

PURPOSE OF THE TRAINER

The trainer fills the need for a miniature "radar system" with which to train crews in scope interpretation, search, navigation, in medium- and high-level bombing, and in making actual simulated missions under the control of an instructor. Since the device can closely duplicate the actual radar scope presentations for any given area, range, and altitude, it affords a very good method for briefing crews at advanced bases before a raid on enemy territory.

The ultrasonic trainer is adapted for use with the AN/APS-2, 3, 4, 10, 15 and 30 radars. In special instances cables, junction boxes, and antenna take-off units can be so arranged as to permit switching from one type of gear to another. These standard types of radar gear are directly connected to the training device and are the sources of the pulse which triggers the training equipment.

CIRCUIT DESCRIPTION

The outgoing pulse first passes through a trigger-delay circuit made up of an amplifier, a blocking oscillator, a multivibrator, and a single output stage. This circuit, together with the trigger sweep return, controls the time interval of the outgoing signal generated by the radar gear.

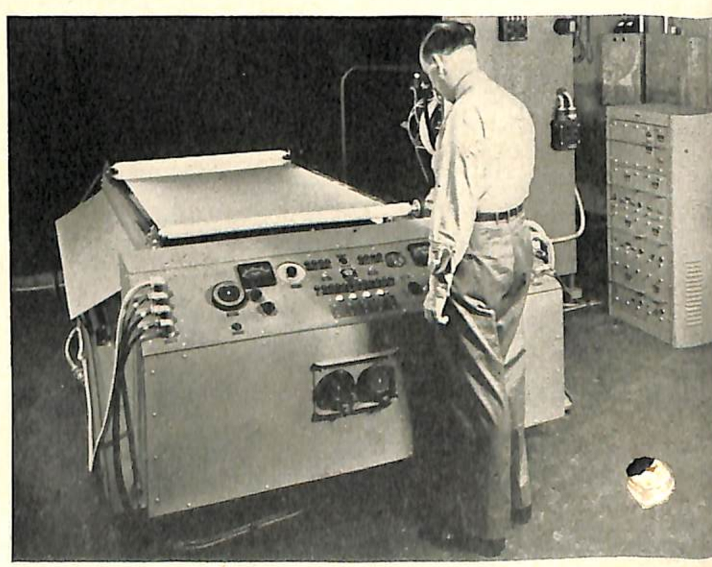
The crystal driver, which causes the quartz crystal to vibrate at 15 Mc for approximately one microsecond, consists of a 6SN7 tube which amplifies the outgoing pulse, a blocking oscillator, a 6AC7 switching tube, and a 15 Mc oscillator tube connected to a 6AC7 driver and an 829 output tube.

A single quartz crystal, which represents the antenna of the radar set and corresponds to the transducer of a sonar installation, is immersed in a tank filled with approximately four inches of ordinary fresh water. This crystal is suspended from a traveling carriage arrangement, whose movement is controlled by an electronic unit which enables training, tilting, and horizontal movement of the entire carriage mechanism. Provision is made to rotate the crystal for sector scaninng as well as for 360° search. Under the crystal is a reflector to direct the outgoing ultrasonic energy in a beam, narrow in azimuth and approximating the actual radar beam pattern of the particular type of gear connected to the equipment.

On the bottom of the tank is placed a large sheet of Vinylite or other suitable material on which is built a relief map to reflect the ultrasonic energy. This 4 x 6 foot map is coated with sand and varnish wherever ground return is desired. Cities are built up by glass beads or carborundum. Since bare spots on the map plate give practically no return, these areas simulate water.

The energy reflected from the sand, carborundum, glass beads, and other reflecting surfaces is picked up by the quartz crystal, and by the piezo-electric effect is reconverted into electrical oscillations. Thus the single crystal operates in the same manner as the transducers of ordinary sonar gear, and performs the functions of the antenna of the radar.

External view of Ultrasonic Trainer showing instructor operating the controls on front panel.



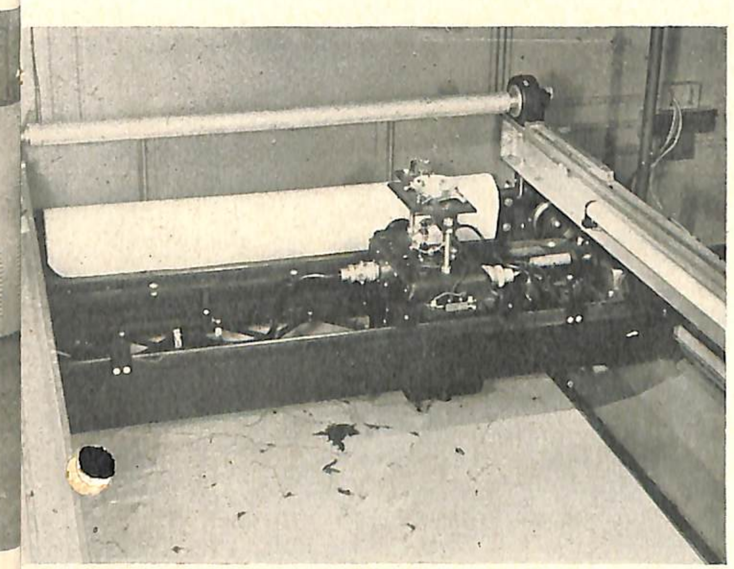
The returning energy or echo is fed into the pre-amp converter. This unit consists of four stages of amplification (6AC7 tubes) and a mixer tube connected to a 45 Mc oscillator. A sum and difference circuit converts this 15 Mc echo into IF's of 30 and 60 Mc, which are amplified and fed to the IF input channels of the standard radar gear.

FEATURES OF THE TRAINER

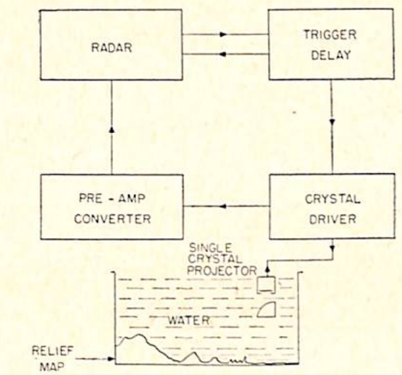
The rate of travel of ultrasonic radiation in water is approximately 5000 feet per second. Inasmuch as the time interval involved in traveling a distance of five feet is a thousand microseconds, this interval would correspond to a distance of 164 nautical miles to the radar. By this ratio, an exact scale of one inch on the ultrasonic map represents 2.78 nautical miles.

A set of maps of the Hawaiian Islands, Tokyo, Nagasaki, Hiroshima, as well as several selected local United States coastal areas are provided by the contractor of the training device. Moreover, techniques have been developed so that relief maps may be made in the field of any area for which a chart showing topographic lines is available. The standard aeronautical charts used by the Army Air Forces and in much of Navy flying are on a scale of 1:500,000. These maps may be enlarged 2½ times and used as a reference in making maps for the ultrasonic trainer. A vertical scale of 1/6″ per 1000 feet is employed in order to secure proper signal strength on the scope. Complete instructions for making the ultrasonic maps are provided with each training unit.

Internal view of Ultrasonic Trainer showing projector scanning relief map of Tokyo area.



Several ingenious techniques have been devised to simulate the distortions and interference phenomena often encountered in actual radar operations. Cotton gauze roughly two inches square with ragged edges is used to simulate a storm front. Small carborundum crystals may be employed to give the effects of convoys, ships, and other small targets. Small metal strips appear as bridges, and metal rings show up as circles. A small carborundum crystal cemented to the end of a small piece of human hair and suspended from a cork float is used to represent aircraft targets. Window "jamming" can be simulated by shaking table salt in the tank at the desired locations. One of the methods of showing "beacons" is by placing wire mesh screens or especially spaced reflectors, in the tank and by using a special crystal reflector, or by tilting upward the standard reflector below the crystal. This eliminates ground return. Interchangeable reflectors for the crystal unit are provided to alter the antenna pattern in simulating various radar equipments. Repeater scopes are used with the radar gear to improve the equipment as a classroom instruction device.



Simplified functional block diagram of Ultrasonic Trainer.

The ultrasonic trainer is only one of the many electronic devices which have been developed to improve the training program for service personnel. However, the ingenious use in the ultrasonic trainer of the more common principles and circuits of radio, radar, and sonar indicates the interrelationship between these three branches of electronics, a relationship too often overlooked by naval personnel.

■ Do not depend on the field engineer to make all authorized field changes to your equipment. When you learn that a field change is available, request it through normal channels.

DOWN GO CLASSIFICATIONS

■ Following is a partial list of the gear effected showing the new classifications. Some of the older equipments aren't included but every model you see in the list has been dropped down at least one grade. So if you have any of these equipments on board, be sure to mark the new classification on the instruction books. In case you would like the original authority for reference, it is CNO letter OP25-3/jeh, Serial 34725 of 18 July 1945.

AN SERIES

AN/SPT–1 to –5	R	AN/UPT–T3	R
AN/UPM–1 to –3	R	AN/URA–T2 and T2A	R
AN/UPT–T1	R		

B SERIES

BE and –1	R	BM and –1	R
BF	R	BN to –2	R
BI	R	BO and –1	R
ABK to –7	R	BQ	R
BK	R	BR and –1	R
BL to –6	R	BT	R

D SERIES

DP to –19	U	DBA and –1	R
DQ to –7	U	DBB and –1	R
DY to –4	U	DBC and –1	R
DAE to –2	U	DBD	R
DAF and –1	U	DBE	R
DAP	U	DBF	R
DAQ	R	DBG	U
DAS to –4	R	DBH	R
DAU and –1	R	DBM and –1	R
DAV to –2	U	DBN	R
DAW to –3	R	DBT	R
DAX	R		
DAY	R	LRN–1 and 1A	R
DAZ	R		

M SERIES

MS	U	MX	U
MU	U	MAA	U
MV	U	MAB	U
MW	U	MAH	U

N SERIES

NJ to –9	U	NAC	C
NK to –7	U	NAD	C
NM to –8	U		

R SERIES

RAA to –4	U	RBR	U
RAB to –5	U	RBT to –2	U
RAC and –1	U	RBU and –1	U
RAE to –2	U	RBV and –1	U
RAN and –1	U	RBW to –2	U
RAO to –9	U	RBX	U
RAR	U	RBY and –1	U
RAS to –5	U	RCB and –1	U
RAU to –2	U	RCC	U
RAW	U	RCD	U
RAZ and –1	U	RCE and –1	U
RBD	U	RCF and –1	U
RBE	U	RCG and –1	U
RBF to –3	U	RCJ	U
RBG to –2	U	RCP	U
RBH to –4	U	RCT	U
RBJ to –5	U	RCU and –1	U
RBK to– 14	U	RCX and –1	U
RBL to –6	U	RDC	U
RBN	U	RDG	U
RBP and –1	U	RDM	U

S SERIES

SA to –3	R	SK to –1	R
SB	R	SL to –1	R
SC to –5	R	SN	R
SD to –5	R	SO to –2	R
SE	R	SO-7M/N	R
SF and –1	R	SO–8 and –9	R
SG to –1e	R	SO–13	R
SG–2S	R	SQ	R
SH	R	SR	R
SJ to –1	R	SW	R

T SERIES

TAB to –7	U	TCQ	U
TAJ to –19	U	TCR	U
TAQ to –11	U	TCS to –14	U
TBA to –13	U	TCT	U
TBC to –5	U	TCU to –2	U
TBK to –20	U	TCV	U
TBL to –13	U	TCX	U
TBM to –11	U	TCY and –1	U
TBU to –4	U	TCZ and –1	U
TBX to –3a	U	TDA	U
TCA and –1	U	TDB to –2	U
TCB to –2	U	TDC and –1	U
TCC to –4	U	TDD to –2	U
TCE to –2	U	TDE to –3	U
TCF	U	TDF	U
TCG to –3	U	TDG and –1	U
TCH and –1	U	TDH to –4	U
TCJ to –2	U	TDJ	U
TCK to –7	U	TDK	U
TCL to –2	U	TDN to –4	U
TCM to –2	U	TDQ	R
TCN and –1	U	TDU	U
TCO to –2	U	TEB	U
TCP to –3	U	TEC	U

SERIES V

VC and –1	R	VG to –3	R
VD to –2	R	VH	
VE and –1	R	VJ	R
VF and –1	R		

SEARCH AND DETECTION FOR THE POST-WAR FLEET

■ We know that you are anxious to get the word on post-war plans. But the complexity of the electronics picture, and incomplete information in regard to the size and needs of tomorrow's Navy makes it impossible at this time to give a clear and concise statement. About the best we can do is to let you know how we are thinking today, at the time this issue goes to bed.

Search and detection radar equipment has been classified as to suitability for installation in various classes of ships. These classifications are:

(a) *Modern*—equipments which embody the latest developments and those which satisfactorily perform the functional requirements for the ship class.

(b) *Not Obsolescent*—equipments which are not the best available for the function but which are satisfactory for the ship class.

(c) *Obsolescent*—equipments which can be considered satisfactory for inactive ships of the class.

(d) *Obsolete*—equipments which are unsatisfactory for any shipboard installation. The following models are obsolete for all types of ships:

CXAM-1, SA-1, SC-1, SD-Series, SE, SF Series, SH, SM, SN, CXBL, SO-11.

The table below shows the classification of radar equipment for the more important types of ships.

The initial program for equipping the post-war fleet calls for the following:

(1) In 80% complement ships modern equipments are to be installed to complete unfilled allowances and to replace equipments on current allowances which are either obsolete or beyond economical repair.

(2) In 30% complement ships, not obsolescent equipments are to be installed to complete unfilled allowances and to replace equipments on current allowances and to replace equipments on current allowances which are either obsolete or beyond economical repair.

(3) In ships in inactive status, not obsolete equipments are to be installed to complete unfilled allowances, and to replace equipments on current allowances which are either obsolete or beyond economical repair, only as necessary to provide a minimum of usable equipment to perform initial mobilization tasks.

Concurrent with the initial program and through the fiscal year 1946 approximately one-fifth of the equipment of the 80% complement ships is to be replaced with equipment which is now modern for the respective ship classes.

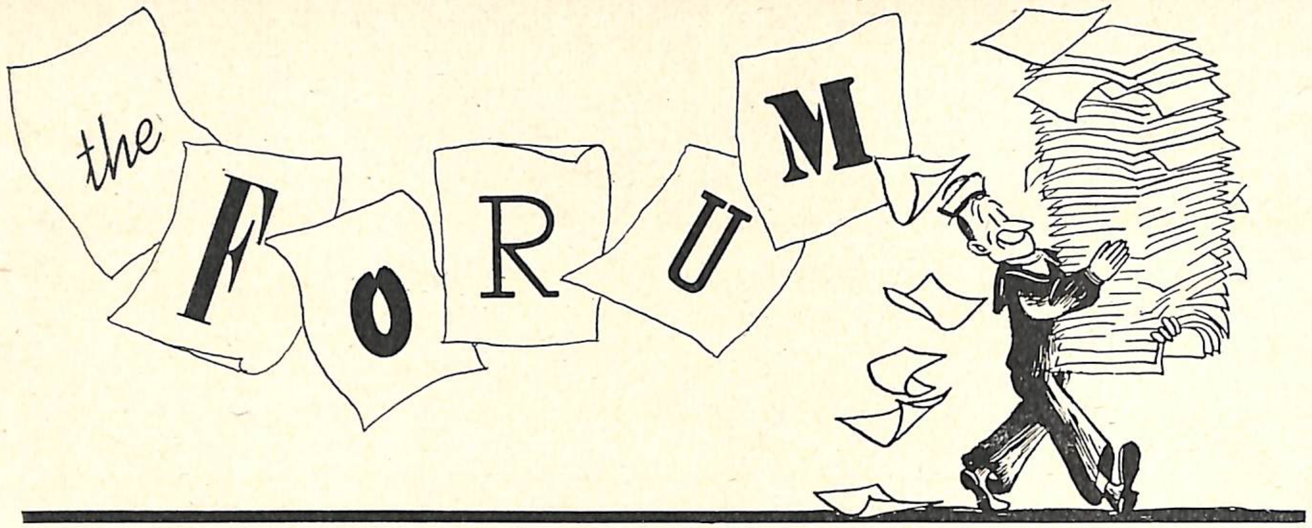
New construction vessels will be provided with a full allowance of modern equipment without regard to the post-war status of the vessels concerned.

During the fiscal year 1947 and annually thereafter, when technical advance dictates, approximately one-fifth of the equipment of the 80% complement ships is to be replaced with equipment which is then most modern for the respective ship classes. In general, improvements will be made in 30% complement ships by installation of equipments made available by the replacement program for 80% complement ships. Such installations should be made only when distinct improvement in functional performance will result therefrom.

Improvements in ships in inactive status will be made only as necessary to provide a minimum of usable non-obsolete equipment required to perform initial mobilization tasks, utilizing equipment made available from the replacement programs of active ships.

Installations are to be made only upon specific instructions for the vessel concerned. This plan is not to be taken as authorization for installation or allowances.

Type of Ship	Modern	Modern But Not the Best (Not Obsolescent)	Obsolescent For Type
BB	SR-2, SR-3, SG-5/6, SG-3, VJ, VH, VF, SP, VG	SR, SU, SG-1, SK-2/3, VD	VC
CB	SR-3, SG-5/6, VJ, VH, VF, SP, VG	SK-2/3, SG-1, SP, VD	VC
CA	SE-3, SG-5/6, VJ, VH, VF, SP, VG	SK-2/3, SG-1, SR, VD	SC Series, VC
CL & CLAA	SR-2, SG-5/6, VJ, VH, VF, SP, VG	SK-2/3, SG-1, SR, VD	SC Series, VC
CVB	SR-3, SR-2, SG-3/4, SX, VJ, VH, VF, VG	VD, SQ	—
CV	SR-3, SU-2, SX, VJ, VH, VF, VG	SK-2/3, SG-1, SR, VD, SQ, SP	SC Series, VC
CVL	SR-2, SG-5/6, VJ, VH, VF, SP, VG	SK-2/3, SG-1, SR, VD, SQ	SC Series, VC
CVE	SR-3, SG-5/6, VJ, VH, VF, SP, VG	SK-2/3, SG-1, SR, VD, SQ	SC Series, VC
DD	SR-6, SG-5/6, VJ, VH, VF	SC-2/3/4/5/ SG-1, SR, VD	VC
SS	SS-1, ST-1, SV-1, VH	—	SJ-1, SD
DE	SR-4/7, SU-2, VJ	SU, VC, SA-2/3, VD	SL-1
AGC	SR-3, SX, SU-4, VJ, VH, VF, VG	SK-2/3, SG-1, SR, SP, VD, SQ	VC
DM	SR-6, SG-5/6, VJ, VH, VF	SC-2/3/4/5, SG-1, VD	VC



SC-4 TUNING

By M. Nemirow, CRT, USCGC *BIBB*

■ When the SC-4 transmitter is located at a point remote from the receiver indicator, transmitter tuning and duplexer adjustment may be facilitated.

The method devised on this vessel makes use of the BM monitor scope, which is essentially a synchro-scope with a sweep duration of 150 microseconds and a repetition rate of 60 cycles. Any synchro-scope of suitable sweep-duration time and repetition rate would be satisfactory. In the event that a unit fulfilling these requirements is not available, an external sweep circuit may be built for use with an ordinary service oscilloscope, converting it to a synchro-scope.

A 70-ohm coaxial cable was connected between J-2003 in the SC-4 indicator video unit and the BM monitor scope video terminals. A 1200-ohm resistor was used to terminate the cable at the BM. A synchronization coax is unnecessary as the BM monitor scope and the SC-4 are synchronized.

SC-3 PPI CENTERING

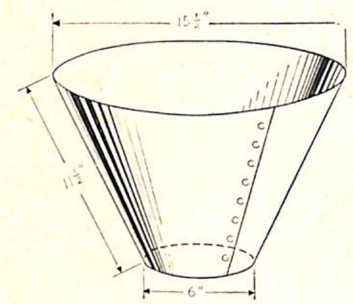
By Commander Destroyer Squadron 57

■ Course changes have affected the centering of the SC-3 PPI on all ships of Destroyer Squadron 57 to such an extent that excessive error in plotting has resulted. Electric coils spaced 90° with respect to each other were installed on two ships with negative results. The centering of the scope wandered so erratically with course changes that some means of stabilizing it became mandatory when operating with fast task forces.

A satisfactory remedy has been achieved in an electromagnetic shield made of ordinary sheet metal to fit outside the tube harness. The dimensions of the shield are shown in the accompanying sketch. The shield was turned out by a tender, and was fitted to the equipment by the ship's force.

A 1½″ square was cut out for the anode connection and a section cut out to allow the deflection coil contacts to be cleared. It is mounted and secured by the two braces running from the cursor to the mounting of the deflection coil in front of the tube.

In installing the shield the tube harness must be removed and the PPI assembly pulled out to allow the shield to pass between the receiver-indicator and PPI assembly. After it is mounted and secured, the PPI assembly is pushed back, and the tube and harness replaced with no difficulty.



There is ample clearance between the tube and shield to absorb gunfire shock without physical contact. This shield with its simplicity and ease of installation has eliminated completely a troublesome situation.

Bureau Comment: Although this is not an official field change, the Bureau of Ships permits this modification to SC-3/4/5 equipment whenever PPI centering becomes troublesome.

LORAN AS A FREQUENCY SOURCE

By Sidney H. Liebsom, Receiver Section, NRL

■ The loran 100 kc crystal oscillator may be used as a secondary standard frequency source by stations and ships that have loran receiving equipment but are unable to utilize either the standard frequency transmission from WWV or their LM or LR frequency meters. The loran transmitting stations are operated at pulse recurrence rates which are maintained to an accuracy of several parts per million with the aid of the standard frequency transmission eminating from WWV.

Although all Loran stations in the Pacific are not yet checking with WWV, even without this checking their accuracy is almost certainly better than 50 parts per million, (.005%). The maximum error involved in the LR is 10 parts per million (or 100 cps, whichever is greater) and the maximum error of the LM is .01% of the frequency.

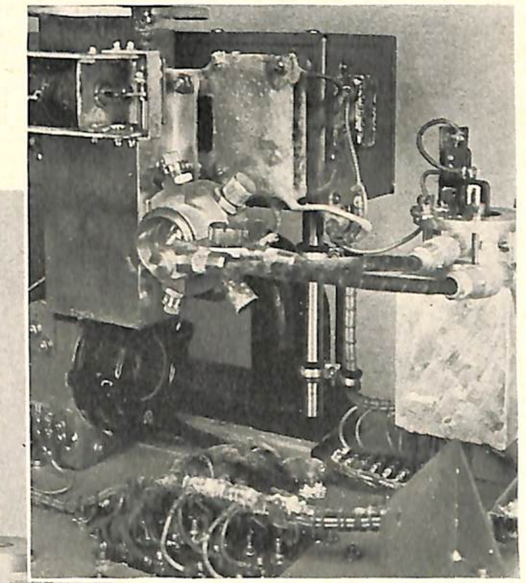
To avoid interference with the normal operational use of the loran receiving equipment, the scheme should be used only as an emergency measure.

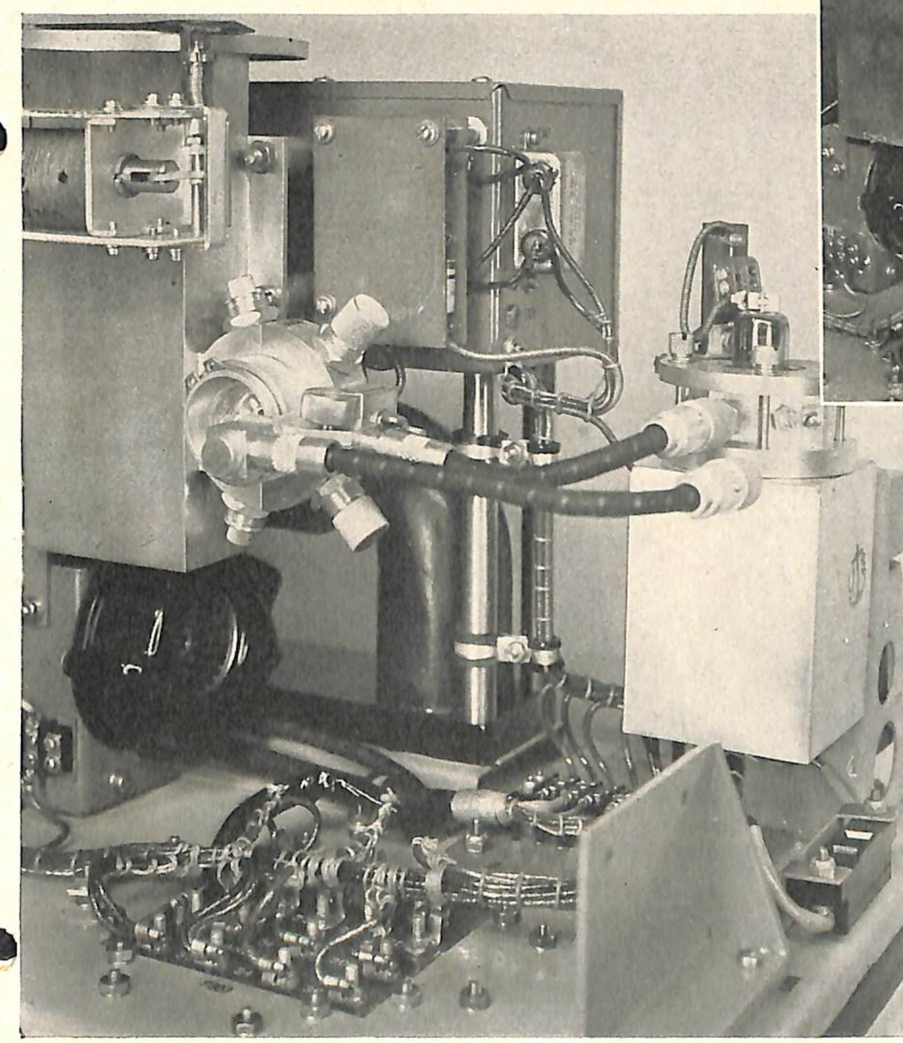
Loran receiver-indicators have several stages, such as the 100 kc squaring amplifier, where harmonics at 100 kc intervals may be obtained, up to more than 5 Mc. Suitable connection points in the various equipments are as follows:

Models	
LRN-1, LRN-1A, DAS-1	—Plate (pin #2) of V-16
DAS-3, DAS-4	—Plate (pin #2) of V-116
DAS, DAS-2	—Terminal marked V10 on indicator interconnecting terminal strip
DBE	—Pin 2 of V-102
AN/APN-4	—Plate (pin #2) of V-303-2
AN/APN-9, DBS	—Plate (pin #2) of V-107

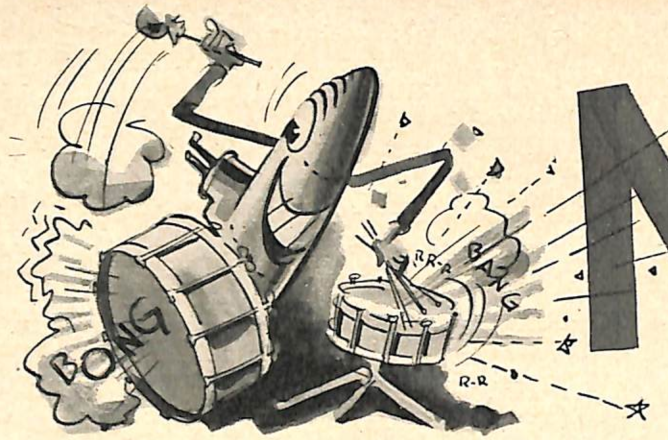
The connection should be made through a small isolating capacitor.

TROPICALIZATION

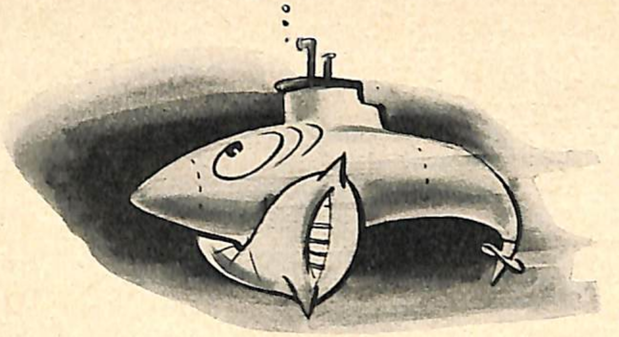




Two new SO-8 transmitter-receiver units, tested and packed by the manufacturer. The equipment on the left has been tropicalized. The unit on the right is awaiting the same treatment. Note the two phenolic boards and the elements contained between them are completely encased with heavy mold growth. (For information on this process, see the August, 1945, ELECTRON)



NLM KEEPS THE SUB QUIET



Noise Level Monitor provides a definite check of the noise being made by the submarine at all times.

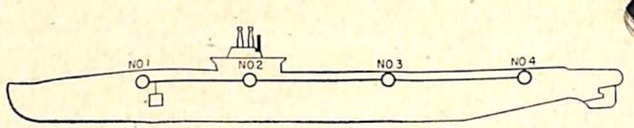
■ Since the surrender of Japan, our fleet subs don't have to be so particular about how much noise they are making. In fact, when you're heading for the States like a bat out of the lower regions, you don't care if you sound like an empty Model T Ford on the rocky road to grandpa's farm in Arkansas. However, every submariner remembers that only a few weeks ago there were times when you could hear a pin drop on any of our fleet subs. Remembering the truth of the old adage that "silence is golden" has been the salvation of many a submarine.

The Noise Level Monitor is a device which enables the submariner to tell whether his ship is getting quieter or noisier. The equipment affords a means of determining which sound can be most easily picked up by an enemy ship, a method of locating the source of these unwanted noises, and a quantitative measurement of the submariner's attempts to eliminate or minimize these undesirable submarine squeaks.

The equipment consists of five hydrophones mounted on the outside of the pressure hull at carefully selected locations. The hydrophones are permanent-magnet magnetostriction units consisting of coils wound on nickel tubes split to contain narrow permanent magnets. They are rubber-covered for mechanical protection and rubber-mounted to reduce transmission of hull vibrations to the units.

Four of these hydrophones are connected to an adapter unit mounted on the front panel of the Model JP-1, -2, or -3 sonar amplifier. A db meter on the adapter is used to measure the output of these hydrophones. A selector switch enables any one of the four hydrophones to be monitored at any time. An additional remote sound level meter is also provided.

The fifth hydrophone is connected through a spare type 755 amplifier unit to two indicator devices known as Cavitation Indicators. This hydrophone picks up the



Diagrammatic sketch showing location of NLM hydrophones on a fleet sub.

noise produced by the submarine's own propellors. This noise, known as cavitation, is produced by the formation of numerous regions of vacuum when the propellors are turning so rapidly that the water cannot maintain contact with the blades as they pass through. The volume of propellor noise naturally increases greatly as soon as cavitation starts. The Cavitation Indicators, generally installed in maneuvering and control rooms, contain three neon lamps. The lamps are set in 5 db steps so that the first one flickers intermittently whenever the sub is underway but there is no cavitation. The second one starts flashing with the onset of cavitation, while the third neon light flashes whenever serious cavitation begins.

The NLM equipment affords a check on the noise produced by the submarine. It does not replace the standard Navy sound-range or overside tests made with the OAY equipment. These standard OAY noise tests provide the reference levels for all comparisons. On patrol it is advisable to use the NLM for a 10-minute check each day to see if the overall noise level has increased. Once each week another check is made at various speeds for a more complete comparison.

The NLM does tell how the noise output compares with the original standard tests, provided the equipment has been calibrated at the time these OAY tests were made. Moreover, if a ship has not yet had the benefit of sound-range or overside tests, the NLM is still valuable to show whether the noise output is increasing.

NEW TUBE BASE MATERIAL

■ A yellow phenolic tube base, identified as BM-16981, has been developed for use on certain types of glass and metal tubes. The new material absorbs less moisture than the black bakelite phenolic base, thereby reducing the number of cases wherein bases become loosened from the tube envelope. High-frequency and dc losses are decreased considerably, and less frequency drift is noticed in constant-frequency oscillator tubes employing the new base. Preliminary tests indicate that these bases are definitely superior to the micanol bases used on such tubes as the 807, 89Y, and the 10Y.

•

DON'T SPREAD IT TOO THICK

■ Spray your radome with a thin coat of *lacquer*. Do not use zinc chromate! Emitted power output is reduced in proportion to the amount of paint used. One coat of zinc chromate has the power loss of fifteen coats of lacquer.

MARK 13

■ A range jitter of the 200-yard bearing line dots can be caused by insufficient coupling between the range pulse amplifier, V-14, and the line oscillator keyer, V-15. This jitter may be remedied by changing C-26 from 47 to 100 $\mu\mu$f. There will probably be no field change for this correction.

—*Western Electric*

DD's CONVERTED TO PICKET SHIPS:

USS FRANK KNOX (DD-742)
USS SOUTHERLAND (DD-743)
USS CHEVALIER (DD-805)
USS HIGBEE (DD-806)
USS BENNER (DD-807)
USS DENNIS J. BUCKLEY (DD-808)
USS MYLES C. FOX (DD-829)
USS EVERETT F. LARSON (DD-830)
USS GOODRICH (DD-831)
USS HARSON (DD-832)
USS HERBERT J. THOMAS (BD-833)
USS TURNER (DD-834)
USS CHARLES P. CECIL (DD-835)
USS HAWKINS (DD-873)
USS DUNCAN (DD-874)
USS HENRY W. TUCKER (DD-875)
USS ROGERS (DD-876)
USS PERKINS (DD-877)
USS VESOLE (DD-878)
USS LEARY (DD-879)
USS DYESS (DD-880)
USS BORDELON (DD-881)
USS FURSE (DD-882)
USS NEWMAN K. PERRY (DD-883)

COLOR CODING

Color coding systems had been developed long before the advent of the war, and had proven their usefulness in aiding the technician in rapid determination of values and connections. With the rapid development of electronics due to the war and the enormous increase in types, quantity, and number of components in all electronic equipments, color coding of components became of inestimable value in rapid and efficient servicing of the various equipments. But color coding can be helpful and valuable to the RT only when it is standardized and universally used.

Color coding systems have been devised to include tube socket pins, transformer leads, frequency bands, battery cables etc., as well as capacitors and resistors. Currently standard Navy codes for marking these items are given below:

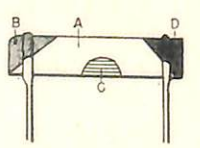
TABLE I—Power Transformer Leads

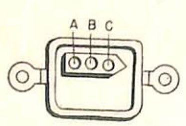
High voltage	Red
High voltage CT	Red-yellow
Rectifier filament	Yellow
Rectifier filament CT	Yellow-blue
Filament #1	Green
Filament #1 CT	Green-yellow
Filament #2	Brown
Filament #2 CT	Brown-yellow
Filament #3	Slate
Filament #3 CT	Slate-yellow
Primary—not tapped	Black
Primary—taps	Black-yellow
Primary—taps	Black-red
Primary—common	Black

TABLE II—The RMA Color Code

Color	A 1st Digit	B 2nd Digit	C Ciphers
Black	—	0	.0
Brown	1	1	0
Red	2	2	00
Orange	3	3	000
Yellow	4	4	0,000
Green	5	5	00,000
Blue	6	6	000,000
Violet	7	7	0,000,000
Gray	8	8	00,000,000
White	9	9	000,000,000

D—Tolerance: Gold = 5% Silver = 10% (Omitted) = 20%





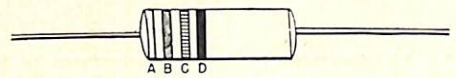
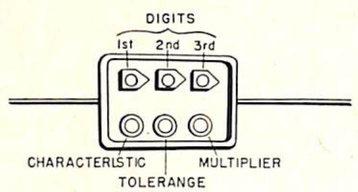


TABLE III—JAN-C-5 Capacitor Color Code

Color	Digits	Multiplier	Tolerance	Characteristic
Black	0	1	20%	A
Brown	1	10	—	B
Red	2	100	2%	C
Orange	3	1000	—	D
Yellow	4	—	—	E
Green	5	—	—	F
Blue	6	—	—	G
Violet	7	—	—	—
Gray	8	—	—	—
White	9	—	—	—
Gold	—	.1	5%	—
Silver	—	.01	10%	—



The tube-socket code, Table IV, provides a means of indicating which terminals connect to the various elements inside the tube. A small spot of the appropriate color is painted on both the top and underside of the chassis adjacent to the openings in the socket. To avoid unnecessary confusion, it is customary to mark only the cathode, control-grid, and plate connections in this manner, although any of the other elements may be color-coded when appropriate.

TABLE IV—Tube Sockets

Plate	Blue
Screen	Yellow
Control Grid	Green
Cathode	Brown
Heaters	Black
Suppressor	White

TABLE V—Battery Cables

A+	Red
A—	Black
B+ #1	Blue
B—	Yellow
B+ #2	White
C+	Brown
C— #1	Orange
C— #2	Green

In some electronic equipment, particularly radar, there are tubes used in circuits to provide functions which are not essential to the basic operation of the system, such as monitoring circuits, etc. All octal base and miniature tubes which are essential to the basic operation are distinguished by a green ring about 1/16″ wide painted on the chassis completely around the socket. This ring appears on the side of the chassis from which the tubes are removed.

In the interest of security, a frequency-spectrum color code combined with letter designations has been developed. Interested personnel will find this color code useful in many ways, the identification of spare parts received as replacements, the use of proper oscillator tubes, echo boxes, etc. These parts are associated with the proper equipment by the color code in Table VI.

TABLE VI—Frequency Spectrum Code

Color	Green	Black	Brown	Red	Orange	Yellow
Band	R	P	L	S	X	K
Black	A	A	P	E	A	P
Brown	B	B	C	F	Q	S
Red	C	C	I	T	Y	E
Orange	D	D	Y	C	D	C
Yellow	E	E	T	Q	B	U
Green	F	F	S	Y	R	T
Blue	G	G	X	G	C	Q
Violet	H	H	K	S	L	R
Gray	I	I	F	A	S	M
White	J	J		W	X	H
Gold	K	K		H	F	I
Silver	L	L		Z	K	
Black-White				D		

Note: The first dot indicates the frequency band, the second dot indicates the frequency sub-band, and the third dot may be used to indicate a specified part of the sub-band.

TABLE VII—Power Cables

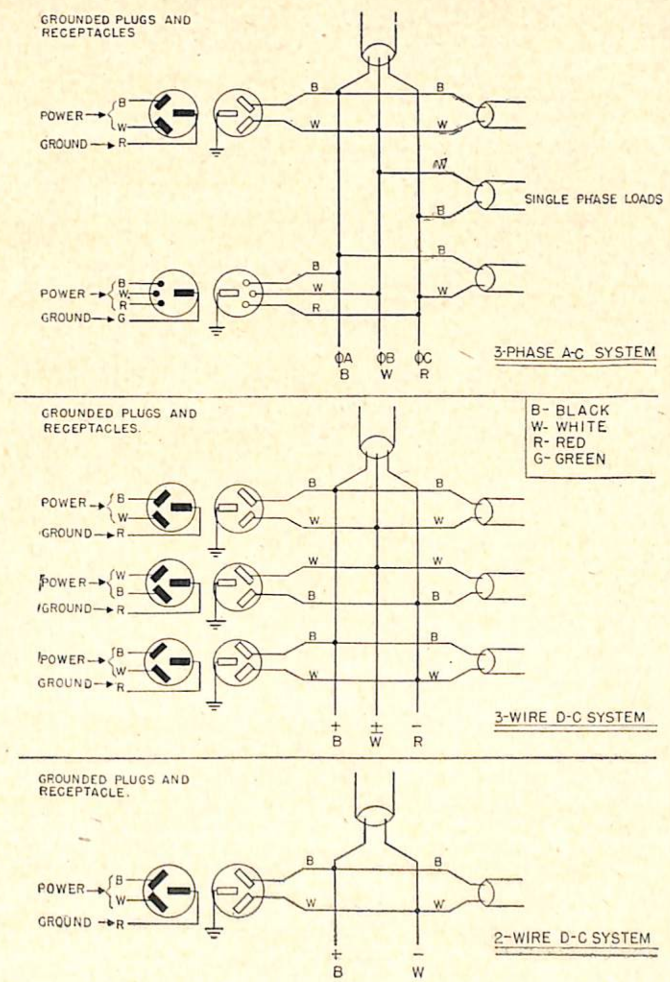
Power System	Cable Type	Phase or Polarity	Color Code
3 ph. A C	3 Cond.	A B C	Black White Red
	2 Cond.	AB	A = Black B = White
		BC	B = White C = Black
		AC	A = Black C = White
3-Wire D C	3 Cond.	+ ± —	Black White Red
	2 Cond.	+ and ±	+ Black ± White
		± and —	± White — Black
		+ and —	+ Black — White
2-Wire D C	2 Cond.	+ —	Black White

For example, all 2J50 magnetrons generate frequencies in the X_L band. The X_L band is 160 Mc wide and most non-coded magnetrons have frequencies near the middle of this band. The color code divides this band into four sections, starting from the low end as follows:

1. Orange-Violet-Yellow — 10 Mc wide
2. Orange-Violet-Green — 50 Mc wide
3. Orange-Violet-Blue — 50 Mc wide
4. Orange-Violet-Violet — 50 Mc wide

To standardize color code identification of power and lighting circuits, Bureau of Ships specifications should be followed. The electronics technician will find Table VII very helpful when working on these circuits. Note that in 3-conductor cables the RED conductor is the ground while in 4-conductor cables the GREEN conductor is used as ground. The ± (or neutral polarity) when it exists, shall always be the WHITE conductor.

Typical power and lighting circuits.



RECTROX FAILURES

■ The Bureau of Ships has received reports of failures of Rectox rectifier units from the Caribbean and Pacific areas. These rectifiers are always used as part of transmitting equipments that are operated on intermittent duty. Under intermittent duty cycles, components heat and cool with each cycle, and under high relative humidity conditions condensate is likely to form on the component during the cooling part of the cycle.

In each case reported, the Rectox unit was found corroded, the corrosion having penetrated to the rectifying surfaces and shorted out the sections, in some cases causing the power transformer to be overloaded and failure to result.

The circumstances causing such failures can be easily combatted. The most desirable means is to keep equipment hot. Install some convenient type of heater unit that will be switched on when the equipment is not operating (it might be left on continuously in some equipments). A lamp is better than nothing but not as desirable as a resistance because of its limited life.

A further defense is to periodically varnish the units with a high grade of varnish (such as Federal stock Cat. No. 52-V-1680). Clean and bake at 140° F for 2 hours before applying the varnish. This treatment must be repeated, depending on humidity conditions and operating temperatures.

TCZ GENERATOR

■ TCZ and TCZ-1 28-volt generator brushes (both positive and negative) stamped with the number 105 have shown rapid wear and should be replaced with a new type marked with the number 113.

New equipment coming out will have the new brushes, but all equipment should be checked to insure this fact.

New brushes for this generator, plus a set for the spare parts box, are available at the nearest supply activity and should be ordered through your supply officer.

ECHO BOX TRAINING FILM

■ A training film explaining the use of the echo box in evaluating radar performance has been prepared by the Bureau of Ships. This film, #MC-5135, is being distributed to naval training activities, field activities, and laboratories. One copy is to go to all cruisers and above.

ALLOWANCES FOR TEST EQUIPMENT

■ Allowances of shipboard test equipment are made up in such a way that duplication of items which are used in common by communication, radar, and sonar personnel is avoided. This policy is based on the assumption that *all* test equipment on a ship is available for servicing *all* equipments.

Reports indicate that maintenance personnel in ships which have radio, radar, and sonar equipments in separate divisions, are not fully aware of the ship's total allowance of test equipment and its whereabouts on the ship. A typical example would involve the Model LX (or LAF, LAG, 804B, etc.) Signal Generator. It would probably be found in the radar repair shop, although it would be the only signal generator on board suitable for servicing the TBS, MBF, RCK, RBK, etc.

If your ship is divided into divisions for maintenance purposes, be sure you know what test equipment is aboard.

MHF RADIO INTERFERENCE

■ The successful elimination of power-line interference and YG key clicks from MHF communications receivers has been reported by Airborne Coordinating Group Technician W. J. Inman from NAS, Holtville, California. This report, first published in the ACG Digest, is reprinted here for the information of other Air Stations which may be having headaches similar to those of Holtville.

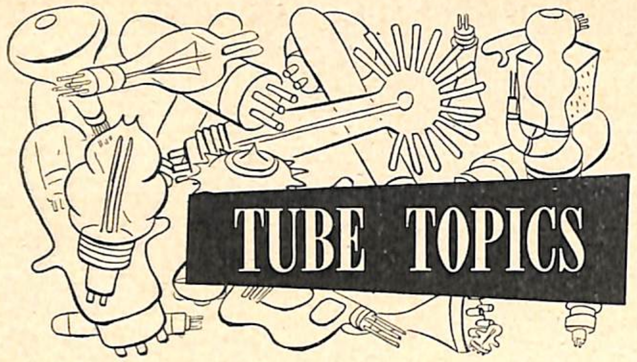
"Since the commissioning of the CASU-53 Base Radio and Communications Station, the writer has made many attempts to find some way of improving the reception on MHF. Various types of antennas were tried in various locations. Comparisons were made with and without shielded lead-ins. Nothing that was done, including raising the rod antenna to thirty-eight feet above the roof, seemed to have the least bearing on the strength of the interference. Using an RAS-5 receiver, the RF gain control could not be increased beyond "4" without driving everyone from the room. A line filter was tried on the receiver but was of no value in this case. When the PT-5 lead-in was disconnected at the antenna, the noise was completely eliminated; hence it was clear that noise was entering the receiver via antenna pick-up only.

"It was therefore decided to solicit the aid of the power and light company and attempt to stop the noise at the source. The official contacted was most cooperative, and the following day sent an engineer equipped with a Sprague Interference Locator. It was the opinion of the engineer, and rightly, that "loose hardware" was causing a great deal of the interference. We drove all over the station with the locator turned on and found various power-carrying poles where the noise seemed worse. Public works electricians were called to remedy the troubles found. Shaking the guy wires of the poles that were so noisy usually resulted in a marked cutting in and out of the noise.

"One of the main difficulties was that there were many spots of trouble on different frequencies together with their harmonics. It was a matter of eliminating each one. The trouble was caused by the fact that some of the cross arms were improperly drilled resulting in such a close proximity of the cross arm brace to the dead-end bolts which support the insulators that, being in the field of the 12,000 volt line, all metal involved became charged. To eliminate this trouble, it was necessary to bond the D. E. bolts to the cross arm braces on both sides. (Double arms are used.) As each pole was bonded, the noise on the broadcast band lowered, but had no effect on the noise on the UHF band. This noise peaked at the pole nearest to the administration building. Finally a hot stick was used and the lightning arrestors were removed from the line. This was the answer. One lightning arrestor was arcing, and its removal stopped the noise. It was then possible to increase the gain control on the receiver to "9" without objectionable noise except for key clicks from the YG beacon. Public Works was notified to replace the arrestor.

"Next our attention (not the power engineers') was turned to the elimination of the YG key clicks. This was accomplished by modifying the YG as described in 10 February issue of ACG Digest (also described on page YG:1 of the revised edition of CEMB or on page C YG-2 of the original printing). The results are more than satisfactory. There are no key clicks audible in the RAS-5. This elimination of noise has made it possible for us to work stations at many times our previous range on 3815 kc.

This information is forwarded in the hope that it will help other field men who are confronted with similar conditions, as it is believed that the same type of high line construction has been used on other stations. If the cross arms are properly drilled, there will be at least an inch space between the cross arm brace and the dead-end bolt, and no bonding is necessary. It was found that ours were properly spaced on one side of the pole, and too close on the other."



6AB7's FOR MULTICOUPLER

■ Instructions for the RCA Multicoupler Model S-8853 indicate the use of specially selected 6AC7 tubes in order to minize spurious responses due to high-level input signals. The use of JAN-6AC7 tubes which have not been specially selected may result in greatly impaired performance of the multicoupler. It has been found that a single 6AC7 of improper characteristics, when used in the first stage of the multicoupler, will produce excessively high spurious responses (due to the intermodulation products of high-level input signals) in all of the multicoupler outputs. It is not feasible to provide a simple test to determine the spurious response qualities of vacuum tubes in the field.

Recent laboratory tests have shown that the spurious response characteristic of unselected JAN-6AB7 tubes is at least as good as that of specially selected 6AC7 tubes. Furthermore, the 6AB7 tubes can be used without modification of the equipment.

These specially-selected 6AC7 tubes supplied with the equipment should be used until replacements become necessary, at which time the entire set of tubes should be changed to type JAN-6AB7. All tubes should be of one type or the other. Future procurement will be equipped with JAN-6AB7 tubes exclusively.

NEW ELECTRON GUN

■ A new "zero-first-anode-current" electron gun has been developed for new cathode ray tubes, identified by the suffix "A" to the type designation.

Earlier cathode-ray guns employing a long first-anode structure with masking apertures drew currents which were often larger than those taken by the second anode. The large flow of current to the apertures not only necessitated the use of heavy bleeder currents and expensive power supplies but also caused interaction between intensity and focusing controls.

In the new z.f.a.c. gun the accelerating electrode has been lengthened to carry the masking aperture and the first anode has been shortened and is used only for focusing. With this construction, the first anode no longer masks the electron stream and, consequently, draws practically zero current from the focusing tap on the power-supply bleeder. This feature provides better focusing characteristics, and may permit appreciable economies in the power-supply design.

A tube with the new z.f.a.c. gun can be operated with a beam current anywhere between zero bias and cutoff without variation in the bleeder current affecting the focusing voltage. This characteristic simplifies operation of an oscilliscope in that it is not necessary to readjust the focusng control for every change in the intensity control.

Along with the gun change, design refinements have been introduced which provide a more nearly round, smaller spot with less increase of spot size with deflection. This, in turn, results in increased range and bearing resolution when used as a radar indicator.

The Bureau has recommended to all equipment design sections the use of the 2AP1A, 3AP1A, 3BP1A, 3DP1A, 3FP7A, 5BP1A, 5CP1A, 5CP7A, 5HP1A, 902A and 905A in place of the corresponding older types. Both types are interchangeable in all except new equipments designed specifically for use with the new tubes.

327-B TUBES

■ In answer to a query received, the following information is published: The type 327-B vacuum tube was an experimental tube developed by the Eimac Tube Company. It proved unsuccessful and was never put into production.

—General Electric

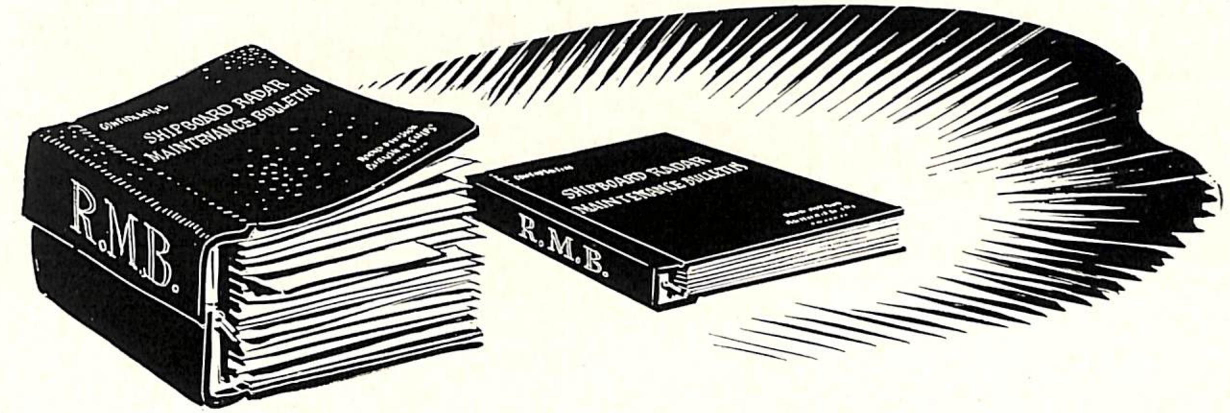
TESTING THE 2C40 AND 446A

■ To facilitate testing of 2C40 and 446A "lighthouse" Tubes, two types of adapters are now available for issue. These adapters can be identified by their Navy designations: Type CV-49415 is to be used with either the OD or QQ Testers. Type CHK-49617 is to be used with Hickok Type 530, 540, 540X (OZ), and 560 Testers.

Ships having need of either of these adapters may requisition them from the nearest Electronics Supply Officer.

TUBE DECLASSIFICATION

■ It is expected that in the near future practically all tubes now classified as confidential will be completely declassified. Special K-band tubes, and tubes which have only military applications, will continue to be classified.



TRYING to add new pages to an already-filled RMB binder reminds us of the old gag about trying to stuff two pounds of shavings into a one-pound sack, or shoveling sand against the tide.

To relieve this condition and to make possible the quick location of desired information, a new and revised RMB has been printed.

Articles of no permanent interest, such as interim modifications, news items, etc., have been extracted along with material which has become obsolete. This deletion has made possible a volume of practical size.

A complete rearrangement of all material was made in order to group together all the information on a particular radar. It is no longer necessary to look through five or six sections to find the dope on your gear. A new system of page numbering speeds up the filing of new supplements.

The basic purpose of the RMB is to aid Radio Technicians in the maintenance of radar equipment. For this reason the new edition and all future supplements must be made available to them immediately.

Distribution of the new RMB should be complete at this time. If additional copies are required they may be obtained by a request to the Bureau of Ships.

read the "Forum"

The public square of Rome during Caesar's time was called the "Forum." There public spirited citizens, thinkers, inventors, and statesmen read to the assembled public the results of their work. The FORUM department of BuShips ELECTRON is your public square, so to speak. It is the place your private gadget or methods can be brought to the attention of your fellow RTs.

contribute to it!