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NOVEMBER 1945

BUSHIPS Electron

NavShips 900,100

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BUSHIPS Electron

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BUREAU OF SHIPS • NAVY DEPARTMENT

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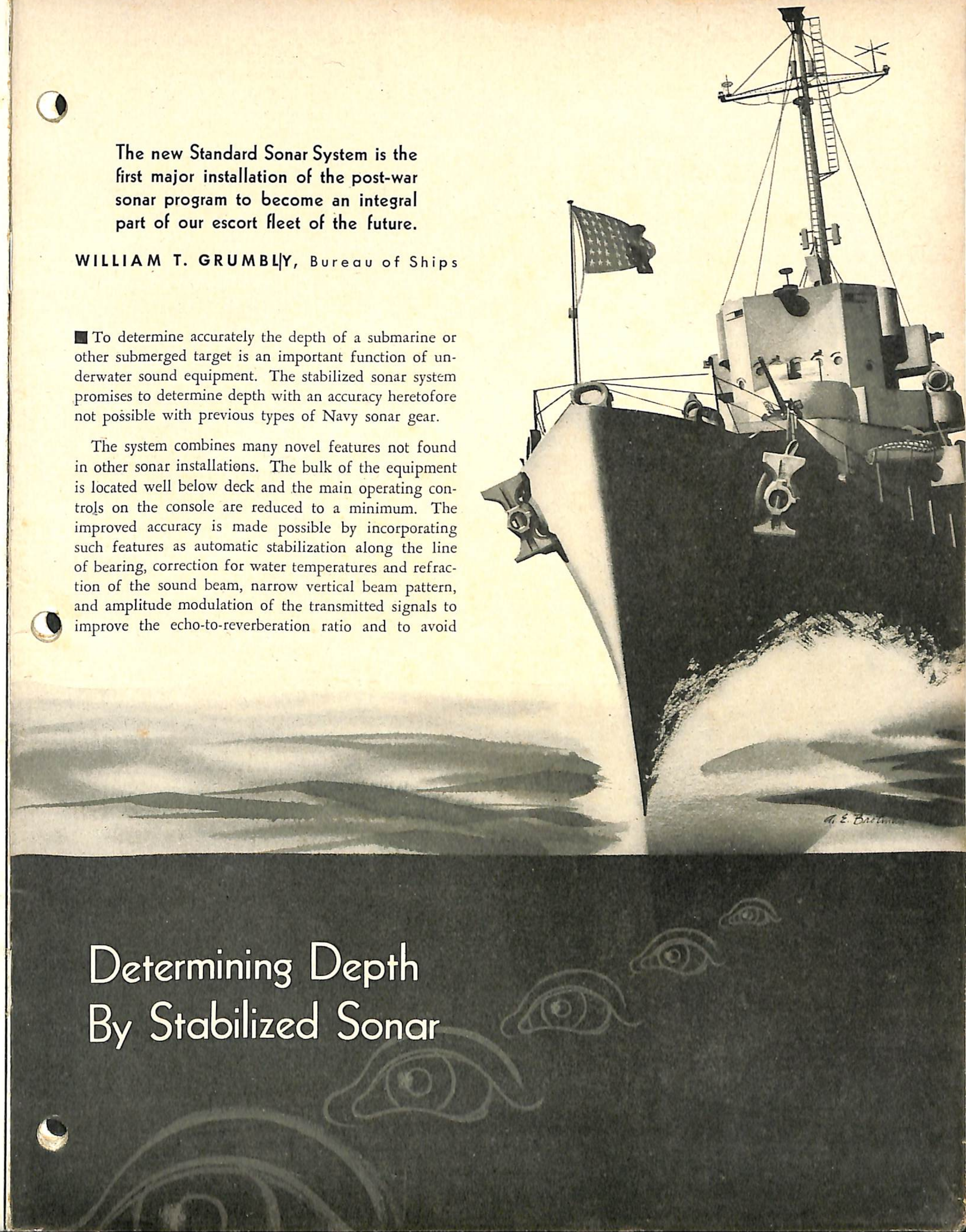


Determining Depth By Stabilized Sonar

The new Standard Sonar System is the first major installation of the post-war sonar program to become an integral part of our escort fleet of the future.

WILLIAM T. GRUMBLY, Bureau of Ships

■ To determine accurately the depth of a submarine or other submerged target is an important function of underwater sound equipment. The stabilized sonar system promises to determine depth with an accuracy heretofore not possible with previous types of Navy sonar gear.

The system combines many novel features not found in other sonar installations. The bulk of the equipment is located well below deck and the main operating controls on the console are reduced to a minimum. The improved accuracy is made possible by incorporating such features as automatic stabilization along the line of bearing, correction for water temperatures and refraction of the sound beam, narrow vertical beam pattern, and amplitude modulation of the transmitted signals to improve the echo-to-reverberation ratio and to avoid large doppler shifts in carrier due to the high frequencies involved. Depth recording to 1500 feet (250 fathoms) with an accuracy of 25 feet or better is achieved by the system. The recorded ranges and depths are repeated to remote stations throughout the ship. Hull-mounted monitoring equipment is provided to check performance. While primarily designed for submarine detection, short pulse lengths are possible to enable the determination of the depth of smaller submerged targets. As an offensive weapon, time to fire is indicated, and provision has been made for automatic fire control guided by an attack director.

The stabilized sonar system is an extension of the principles incorporated in the British 147-B depth determining system. This equipment was installed on several escort vessels and provided a depth indication uncorrected for changing water conditions and without the stable platform to compensate for the rolling and pitching of the ship.

ELEMENTS OF THE SYSTEM

The system is designed for use in conjunction with conventional types of echo-ranging equipment. At the present time it is installed with Model QGB equipment provided with the maintenance of close contact (MCC) feature. The system consists of a Model QDA Depth Determining Equipment designed by the Bell Telephone Laboratories and manufactured by the Western Electric Company, a Model OKA Recording-Resolving Equipment produced by the Sangamo Electric Company, a Mark 6 or 7 Stable Element manufactured by the General Electric Company and a Mark 23 Computer manufactured by the Arma Corporation. The last two items are supplied by the Bureau of Ordnance.

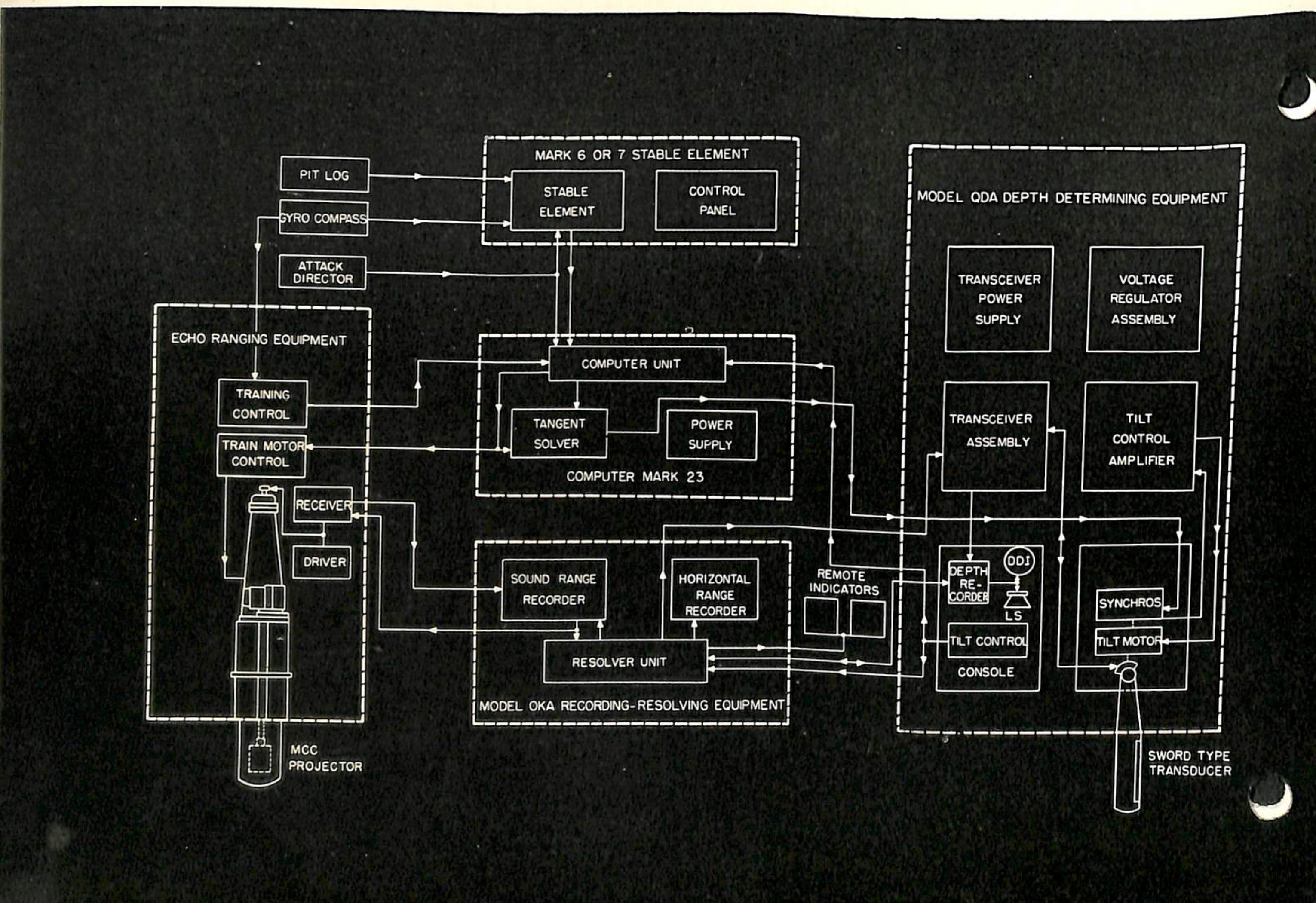
QDA DEPTH DETERMINING EQUIPMENT

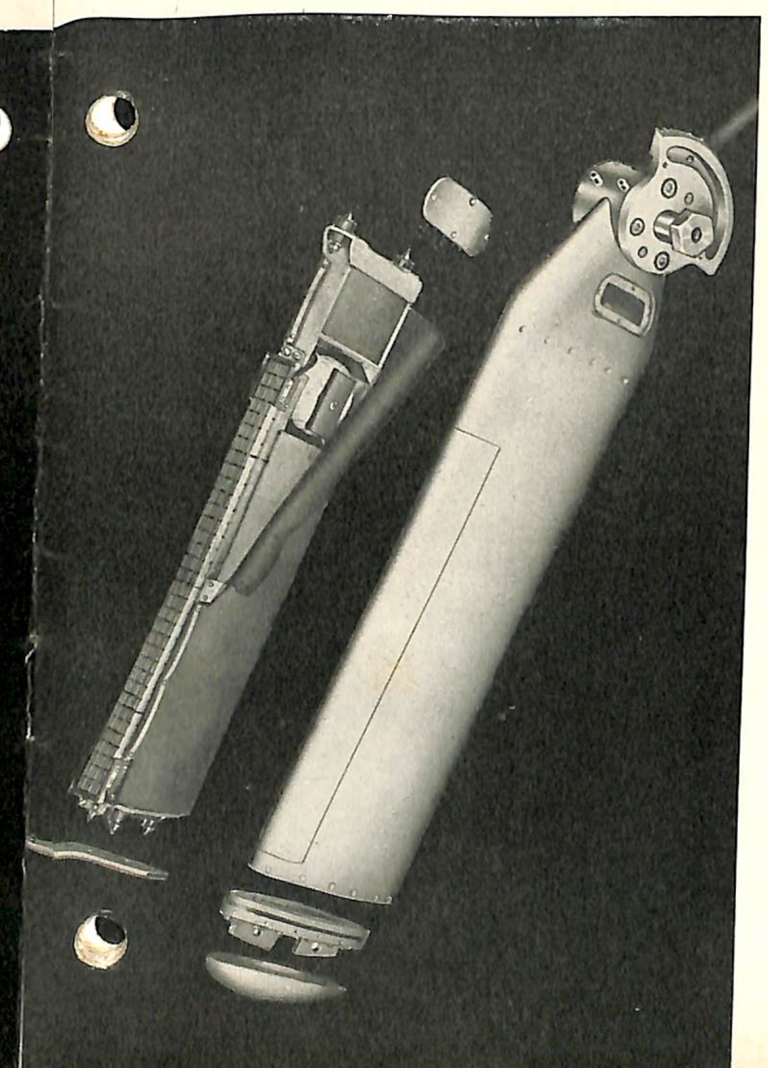
The Model QDA Equipment consists of a transducer, electronic and mechanical control equipment for operating the transducer, and an indicator for presenting depth information. The transducer is a sword-type ADP crystal projector having a horizontal beam width of 90 degrees at —10 db and a vertical pattern about 7 degrees wide at the same intensity. Power output is 150 watts, and the operating frequency is 50 to 60 kilocycles. The narrow fan-shaped beam and variable pulse length make possible a wide range of operating characteristics not heretofore available.

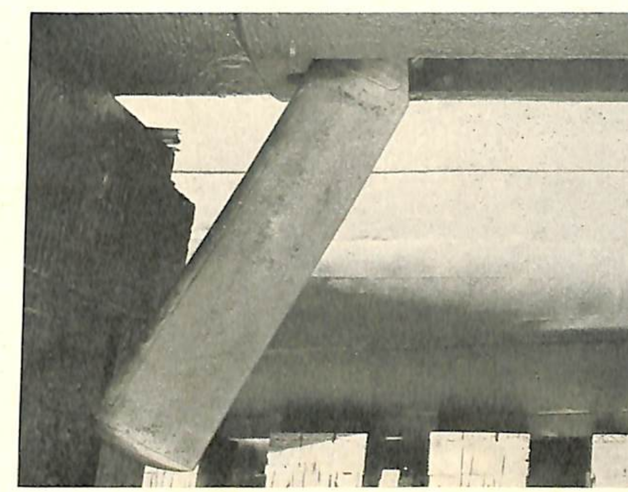
Accurate and precise control of the transducer depression is achieved by the Tilt Control Amplifier and Hoist Tilt Mechanism. Tilting is accomplished by precise gearing which operates in sea water to tilt the sound type transducer through 25 degrees forward and 90 degrees aft of the vertical. The forward tilt is used in stabilizing the equipment under heavy sea conditions and in making alignment tests with a test monitor. A 4 rpm follow-up rate is provided by a thyratron controlled motor of the low inertia type. A 2- and 36-speed synchro system is used for precision control. By the use of vernier scales the transducer is aligned mechanically and acoustically after it has been checked and standardized in dry dock in the course of initial installation. The mechanism tilts the transducer into a 5 inch well where it is then secured against vibration. Removal of the transducer is possible while the ship is water borne by retracting it through a 10 inch gate valve by means of a half-ton chain hoist. After the valve is closed, the cylinder drained and case unbolted, the transducer may be disconnected and removed. A Regulated Power Supply unit of the d-c saturable-reactor type supplies the regulated power for the equipment.

A Transceiver unit supplies 50 to 60 kc energy for the depth determining equipment. An amplitude-modulated signal is transmitted to overcome the undesirable effects due to the large doppler shift. A fixed frequency of 190 kc is modulated with a frequency adjustable from 240 to 250 kc and the difference frequency of 50 to 60 kc is then selected and applied to a second modulator. Here it is modulated with 800 cycles by a third oscillator in such a way that alternate cycles are blocked. The transmitted frequency consists of the carrier interrupted 800 times per second. The driver amplifier is conventional and produces about 150 watts peak power at 60 kc.

The receiver circuit has certain novel features. It is a twin-channel superhetrodyne designed to deliver audio output and depth recorder signals as well as a rectifier signal for the Depression Deviation Indication (DDI). DDI is the same as bearing deviation indication (BDI) but in the vertical instead of the horizontal plane. Input from the two halves of the projector are joined in a hybrid coil, the sum and difference being used for separate amplifying channels. Part of the output of the sum channel, after amplification, furnishes the signal to the loud speaker and depth recorder. It is also used to produce the 800-cycle audio tone from the interrupted signal. By mixing the sum and difference outputs, a d-c







(Above) The QDA sword-type projector retracts jack-knife fashion into the hull.

(Far Left) Block diagram of stabilized sonar system.

(Left) Exploded view of the novel projector used with the stabilized sonar system.

error voltage proportional to the amount of tilting is made available for operating the DDI oscilloscope.

The Console, usually located in the upper sound room, contains the principal operating controls and all of the necessary indicating devices. The three main console features are the Depth Recorder, the Depression Deviation Indication (DDI), and the Tilt Control.

The Depth Recorder has an 0-1500 foot scale with layer-depth contacts adjustable by hand to send a signal to the Model OKA resolving equipment. The layer-depth contact information is used in the solution of the refraction correction. Information for setting the layer-depth contacts is obtained from the bathythermograph (BT). An optical cursor is aligned with the depth traces by means of a thumbwheel and the position of the cursor is transmitted to the Model OKA and thence to the remote depth indicators.

The Depression Deviation Indicator is a three-inch magnetic deflection and focusing type oscilloscope with a non-linear scale approximately calibrated from 0 to 1500 yards, slant range. It is provided with a threshold control to aid in identifying the target signal. DDI response is designed to give an accuracy in angular indication of less than 5 minutes. This can be utilized only when the transducer is properly stabilized.

The Tilt Control is operated by a thumbwheel at speeds of 2 and 36 rpm. Generated depression angle is supplied to the dual-speed differential synchros so that as the range closes on a target at constant depth no thumbwheel operation is required. The thumbwheel is geared so that one revolution gives a 15° projector movement.

Testing facilities are provided as an integral part of the depth determining equipment for making various tests of the system in connection with a keel-mounted test transducer located in a small sea-chest about eight feet forward of the sword. A voltmeter is supplied so that transmitting and receiving response and the angular position of the transducer can be measured. Also a measured output from the oscillator can be applied to the test transducer so that the receiving system can be checked.

OKA RECORDING-RESOLVING EQUIPMENT

The primary function of the Model OKA equipment is to furnish the correct variable-speed supply to the clutch motor in the Depth Indicator located in the console of the Model QDA equipment. Upon this the accuracy of the depth determination depends and all of the variables encountered under different water conditions are resolved and computed in the Resolver of this equipment. The complete equipment consists of the Resolver, the Sound Range Recorder and the Horizontal Range Recorder.

The resolver receives the depression information from the Model QDA Tilt Control synchros. From the sine of this angle in the form of a phase-displaced voltage displacement, corrected for refraction and for the effect of surface reflections on the sound beam, is resolved the proper speed output to the clutch motor of the Model QDA. The returning echo marks a trace on the Depth Recorder. The clutch motor speed is corrected for speed in such a manner that the echo trace indicates the actual depth rather than the apparent depth. Refraction corrections are made for the velocity of sound in the isothermal layer and the thermocline.

The resolver also transmits depth indications to the remote indicator, computes the horizontal range and transmits this to the horizontal range recorder and the remote horizontal range indicators. In addition, the resolver transmits the generated depression angle to the QDA console, where it is combined by means of differential synchros with the handwheel output.

The Sound Range Recorder bears little resemblance to the conventional tactical range recorder, although its input and keying circuits are basically similar. No external "time-to-fire" computing mechanism has been used since this function is now preformed by the Horizontal Range Recorder.

The novel features of the sound range recorder include the transmission of the sound range at 1- and 36-speed to the resolver and later to the attack director. A relay is provided to transmit this information to either the attack director or to a range keeper in the Model OKA. The recorder also provides automatic generation of range in proportion to range rate (range keeper). By aligning an optical cursor with the slope of the recorder traces, the range keeper functions are indicated. A motor drives the lead screw to which the range transmitting synchros are connected at a speed proportional to the range rate. Two manual adjustments, one for range rate and one for the velocity of sound in water due to temperature, are provided. The range as recorded by chart traces is followed by an optical (line of light) cursor which is lined up with the recorder traces by means of a thumbwheel. This insures accuracy of the transmitted slant range information. Stylus and chart (paper) speed is automatically varied in proportion to range rate and sound velocity corresponding to sea water temperature.

The Horizontal Range Recorder closely resembles the conventional tactical recorder. However, the signal is recorded continuously on a strip chart. The conventional time-to-fire computing mechanism is also present. For a deep target the horizontal range as indicated by this recorder is more significant than the range shown on the sound range recorder.

STABLE ELEMENT MARK 7

The Mark 7 Stable Element receives director train and own ship's course information and provides level and cross level. To accomplish this, the stabilizer unit contains a balanced gyroscope driven by a high-frequency motor. It is fitted with an erecting system in the form of a pendulous element. The frame which supports the gyroscope gimbal system may be rotated about an axis perpendicular to the deck in accordance with Director Train Input. A sensitive pickup and amplifiers maintain the proper relationship between the follow-up positioning gimbals and the gyroscope. Thyratron amplifiers are used and synchro signal outputs are provided. Compensation for errors in turning or maneuvering the ship is provided. The stabilizer is designed to follow a roll of 30 degrees in 6 seconds and pitch of 10 degrees in 4 seconds with an error of less than 10 minutes of arc in the measurement of level and cross-level angles.

The stable element control panel contains the amplifiers for train, level, and cross-level follow-up systems, protective devices, switching equipment, and motor generator. The operating voltage is three phase, 115 volts, 60 cycles.

MARK 23 COMPUTER

The Mark 23 Computer consists of the computer, a tangent solver, and a power unit. The Computer receives data electrically from the Stable Element, the conventional horizontal echo ranging equipment and the depth determining equipment. From the stable element, the computer obtains the level, cross level, and bearing and resolves them into roll angle and pitch angle. From the conventional horizontal sonar equipment, the computer obtains the target bearing. From the depth determining equipment, the depression is secured. These quantities are resolved into two-axis system components. The tangent solver resolves these components into a single depression angle which controls the depth transducer. Through these mechanisms both the sword and the MCC projector are maintained on target.

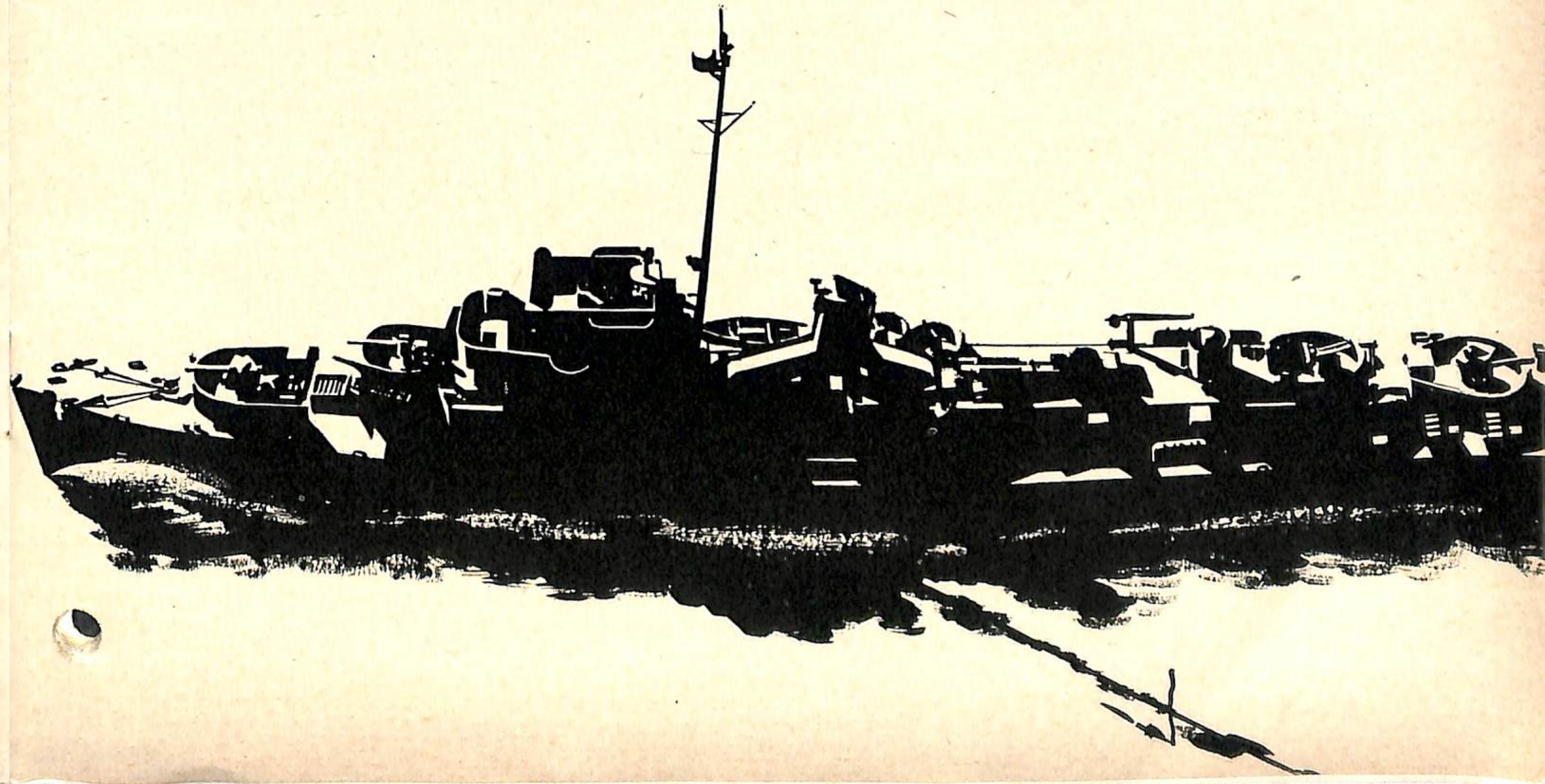
ADDITIONAL FEATURES

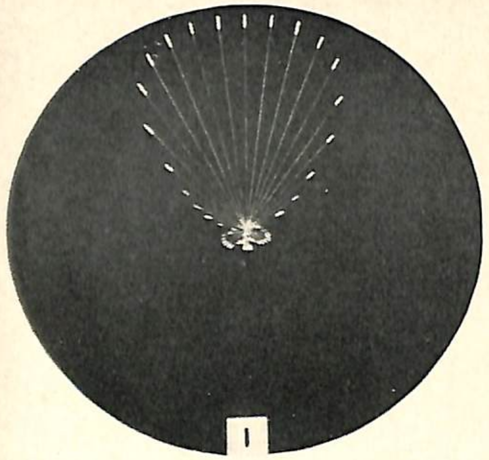
While the main operating controls of the stabilized sonar system are actually few in number, great flexibility of operation is provided in the system.

It is possible to operate the QDA portion independently without the stabilization afforded by the Computer Mark 23, simply by operating a Navy-supplied by-pass switch, which is provided for emergency operation of the QDA equipment in the event of failure of the stabilization system.

Keying of all circuits, recorders, etc., in the complete system is controlled by the transmitting contacts on the Sound Range Recorder (part of the OKA). When the Sound Range Recorder is in the OFF or STANDBY condition, it is possible to operate a switch on the QDA Console to obtain either a long or short pulse length. With the short pulse length the QDA equipment can be used in the location of small submerged targets such as mines.

Although designed primarily for DE's, the system can be adapted to other escort vessels. Now that more time is available for trials to test such an installation, the improvements and novel features incorporated in this system should not only occupy an important place in depth determining equipment but also find wider application in other types of sonar installations.





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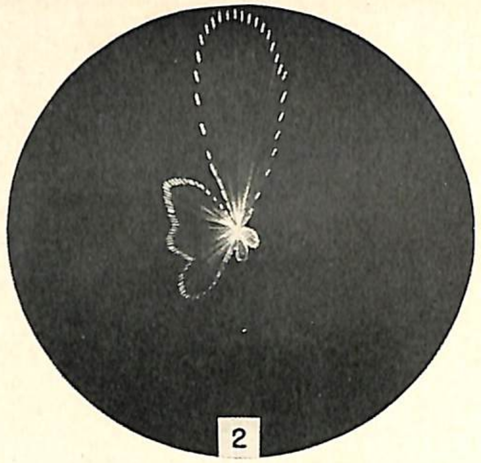

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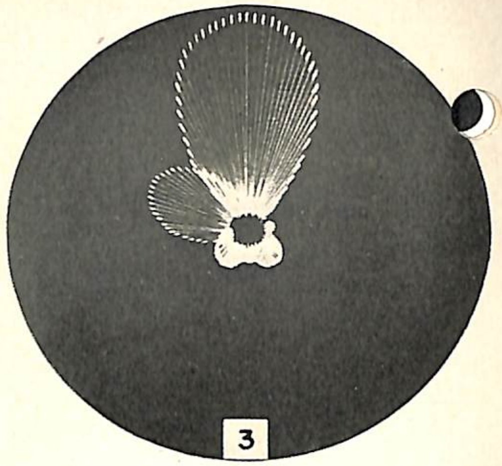

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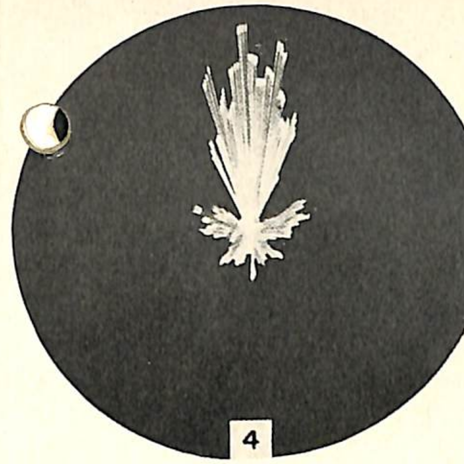

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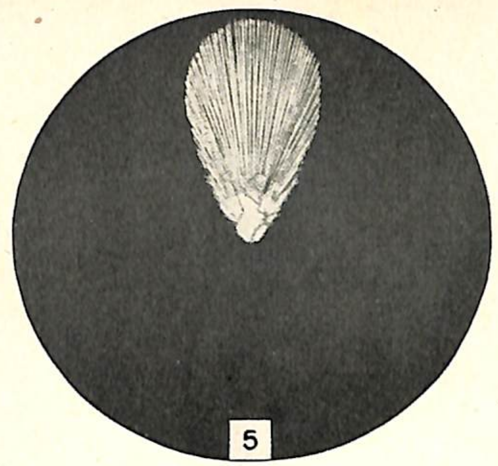

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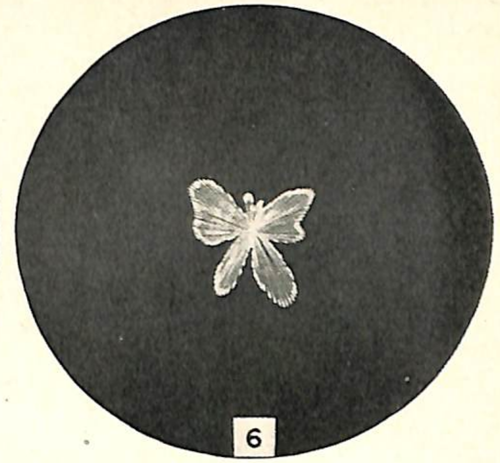

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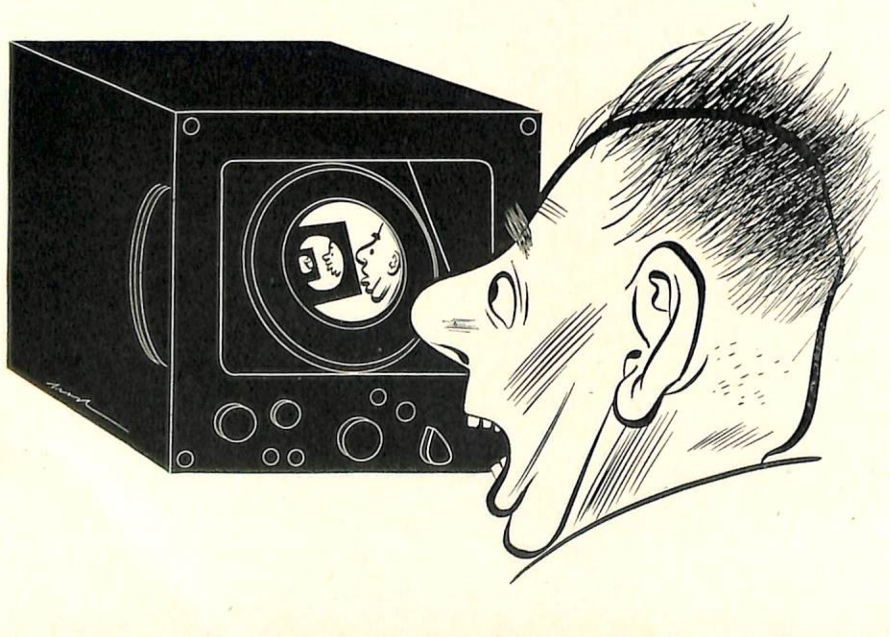
The DBM-1 Radar Direction Finder Equipment

By Jesse O. Richardson, *Submarine Signal Company*

■ The DBM Radar Direction Finder is essentially a radar and radio direction finding equipment designed to operate in the frequency range of 90-5000 megacycles. It presents on a cathode ray tube screen an indication of the direction of the transmitter which is sending out the signals received by the DBM-1 system. By observation of the cathode ray tube screen, the operator may determine certain characteristics of the signal, such as the approximate pulse width and repetition rate, and the polarization (whether horizontal or vertical) of the transmitting antenna. Whether the signal is a pulsed radar, continuous wave, or phone modulated may be determined. The approximate frequency of the received signal may be found by reference to the dial reading of the receiver in use.

The over-all sensitivity of the system is such that the DBM-1 equipment may detect the presence of enemy radars before the enemy radar can detect the vessel on which the DBM-1 is installed, thus providing a great tactical advantage.

The DBM system consists of two antennas (one low frequency and one high frequency), two receivers (one RDO operating with the low-frequency antenna, and one AN/SPR-2 for the high-frequency antenna), and the DBM-1 indicator unit.



The two antennas are specially designed for uniform response over a broad band of frequencies. Each one consists of a horizontal and a vertical antenna, in separate reflectors. Either the horizontal or vertical antenna may be selected at will by the operator, so that the polarization of the receiving antenna may be the same as that of the transmitted signal being received on the DBM-1 equipment. The low frequency antenna covers a range of 90-1200 megacycles, and the high frequency antenna covers a range of 1000-5000 megacycles. The antennas are rotated at speeds up to 250 rpm. The trace on the cathode ray tube screen is rotated at the same rate as the antennas and is synchronized with the bearing of the antennas by a synchro system which drives a scanning capacitor in the indicator.

The output of the receivers is a video pulse which corresponds with the type of modulation present on the received signal, whether it is a pulsed radar, continuous wave or phone modulation. This video signal is fed into a four stage video amplifier. The amplified video output is then applied to the rotors of the scanning capacitor. Circular scanning is accomplished by driving the rotors of the scanning capacitor by a syncro motor, which is in turn driven by a syncro generator geared to the antenna. The rotors of the scanning capacitor are fixed 90° out of phase with each other. The stators of the scanning capacitor are connected to the deflection plates of the cathode ray tube. Video pulses are applied to the plates of the cathode ray tube by coupling from the rotors to the stators of the scanning capacitor. In this manner the video pulses are divided into voltages in quadrature, which deflect the beam of the cathode ray tube in such a manner that a trace is produced which indicates the bearing of the receiving antenna at any instant of time when signals are received from a transmitter.

Figure 1—*By habitual analysis of patterns in terms of the conditions which form them, the operator may derive information about transmitters which are on the air for too brief a time to be studied by any other means. For example, the wide spacing between the pulses in this pattern suggests the low PRF normally employed by air-search radars.*

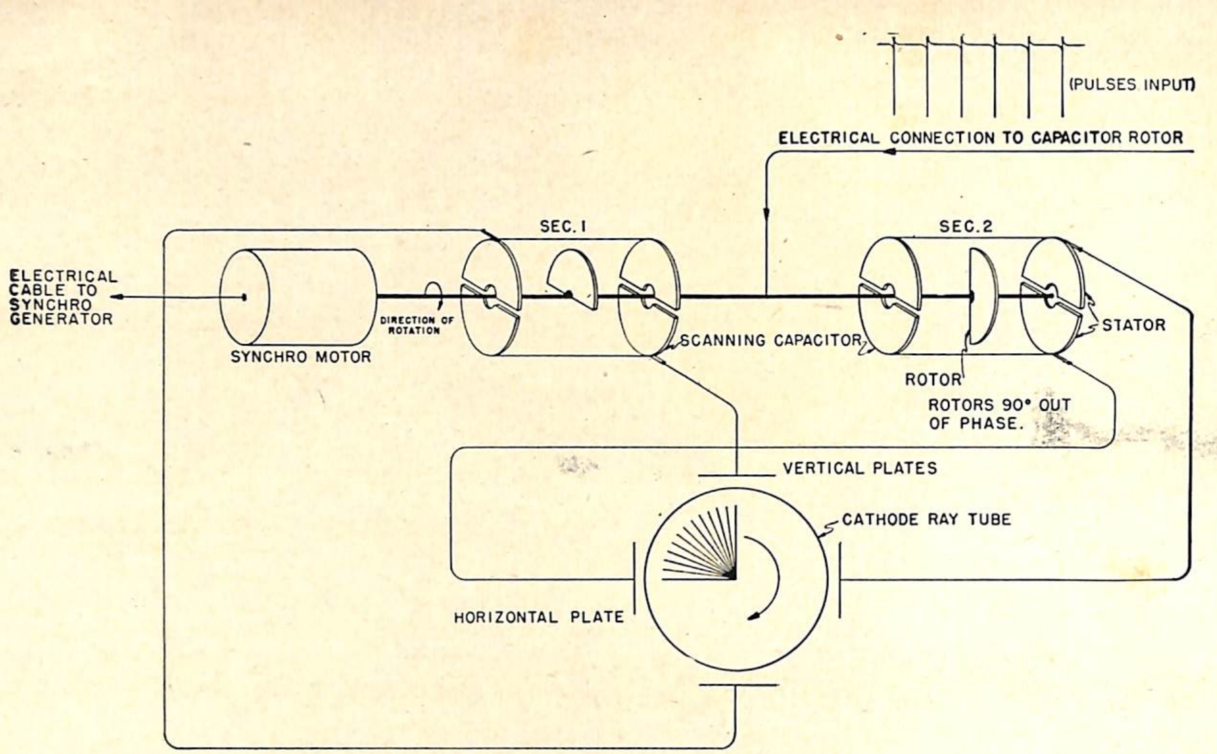
Figure 2—*The minor lobes in this pattern are not symmetrical. This may be due to reflection from some nearby object to the left of the true signal direction. Such a pattern is also characteristc of transmitters whose antennas are polarized at 45 degrees.*

Figure 3—*This pattern is distinguished from that shown in figure 2 due to simultaneous reception from two separate transmitters. Here the greater and smaller lobes have the same shape, are fairly well defined where they overlap, and may, as in this case, have a detectably different PRF.*

Figure 4—*Pulses grouped in sets suggest a lobe-switching radar, possible in a fire control system. When the tips of all pulse groups form a smooth pattern his guns may be trained on you. The shape of the complete pattern, in any case, is the graphic representation of your own DBM antenna's radiation pattern at the carrier frequency tuned in. Thus this pattern is characteristic of a 4-lobe radar whose PRF is about 500 and whose carrier is about 900 Mc, horizontally polarized.*

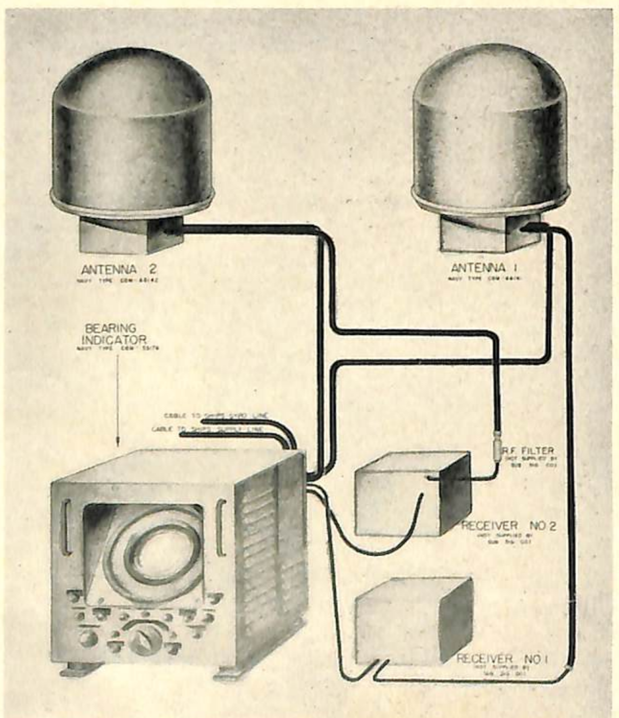
Figure 5—*When sine wave modulation is used, the rate at which the cathode ray spot moves out and back along a single radial line to the screen center is more uniform than with pulse modulation. Therefore the radial lines do not have bright tips. A phone modulated communication signal will show variations in the sine frequencies, and the complete pattern will have irregular boundaries.*

Figure 6—*When no definite major lobe is present, and the minors are symmetrical, the polarization of the DBM antenna is possibly 90 degrees different from that of the transmitter. The switch marked "horizontal-vertical" should therefore be thrown to the opposite polarization.*



▲ *Simplified diagram of the DBM-1 scanning capacitor.*

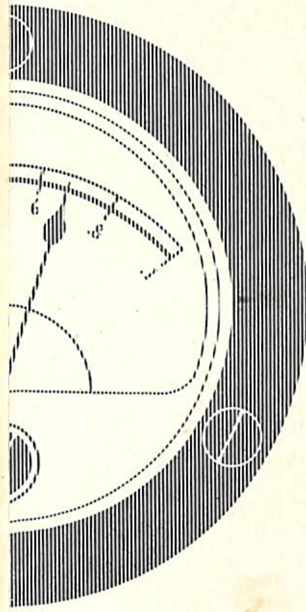
▼ *Principal elements of the DBM-1 system.*



Types of patterns produced by various types of received signals are shown in figures 1 to 6. Determination of the approximate pulse width is made by estimation of the length of the bright tips on the pulse traces in the cathode ray pattern. A 100 microsecond pulse will have a scarcely discernible bright tip. A 10 microsecond pulse will show a bright tip approximately ten percent of the length of the trace. Therefore, the percentage that the bright tip is of the whole trace is the approximate pulse width.

It will be noted that the width of the patterns is not the same in all the figures. This is due to the fact that the directivity of the antennas becomes sharper as the frequency goes higher. For instance, at 90 megacycles the pattern of the low frequency antenna is quite broad, where at 1000 megacycles it is quite sharp. The same is true of the high frequency antenna.

In order to produce the best results, the antenna should be mounted as high up and as much in the clear as possible. The presence of any nearby metal objects will distort the pattern of the antennas and make the picture on the cathode ray tube difficult to interpret. The low frequency antenna should not be mounted any closer than four feet. It is important to note that the low frequency antenna is more susceptible to pattern distortions due to nearby objects, and should be given the best of the two antenna sites if any choice is to be had. Because of the losses in the r-f cables from the antennas to the receivers, these cable lengths should be kept as short as possible, and in general should not exceed 200 feet.



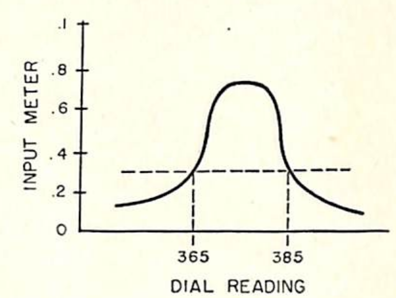
RCK TUNING SYSTEM

■ A simple system has been devised by the Naval Research Laboratory for setting the tuning dial of the Model RCK receiver exactly on the required frequency for each crystal without the use of a signal generator. The system is additionally useful in indicating normal functioning of the multiplier tubes and circuits up to the final multiplier. Only slight alterations to the present preselector are required. The system operates by using a portion of the negative grid-bias voltage developed across the final multiplier grid-leak resistor to bias the AVC bus in the receiver, thereby (when the selector switch is set to "AVC On") causing the input meter on the IF/AF unit panel to indicate. This bias is developed only when the multiplier circuits are tuned to the crystal oscillator, and reaches maximum in the optimum resonance region.

The changes in the Model RCK preselector unit required to provide the alignment facilities are as follows: Replace resistor R-110 (10,000 ohms) with a new one of 47,000 ohms. Connect the contact arm of a high quality, single-pole, double-throw switch to the junction of resistors R-109 and R-110. Connect one contact of the switch to ground and the other to the AVC bus at terminal 14 on terminal board E-104. The connection to the AVC bus can probably be more easily made to terminal 14 on terminal board E-204 in the IF/AF unit, with the lead to the above switch fed through the slot between terminal boards E-104 and E-204. Connection to the junction of R-109 and R-110 will probably require slotting the right-hand edge of the forward wall of the compartment on the top side of the preselector chassis (possibly by filing), in order to allow clearance for the lead.

The new switch may be of the toggle type, provided that it is of a high quality, low leakage construction, with good, positive, silver contacts. This switch should be protected against the effects of humidity. The switch should be mounted in a suitable manner on a bracket fastened to the side-brace or "wrap-around" at the left, and behind the front panel. It should be plainly marked to identify the "setting-up" and "operating" positions. The receiver is substantially inoperative in the "setting-up" position.

Since the final multiplier grid is tuned by two coupled tuned circuits, the indication at resonance will be similar to the flat-topped resonance curve usually obtained with such circuits. By taking the "chart" dial (lower dial window) readings corresponding to the two flanks of the curve at, say, one third the maximum input meter readings as obtained with the above switch in "setting-up" position, and setting the tuning dial to the mean or mid-point of the two readings, tuning of the circuits within one or two chart dial divisions of optimum as obtained with a signal generator have been observed at the laboratory. The diagram illustrates by means of a graph the indications obtained on the input meter.



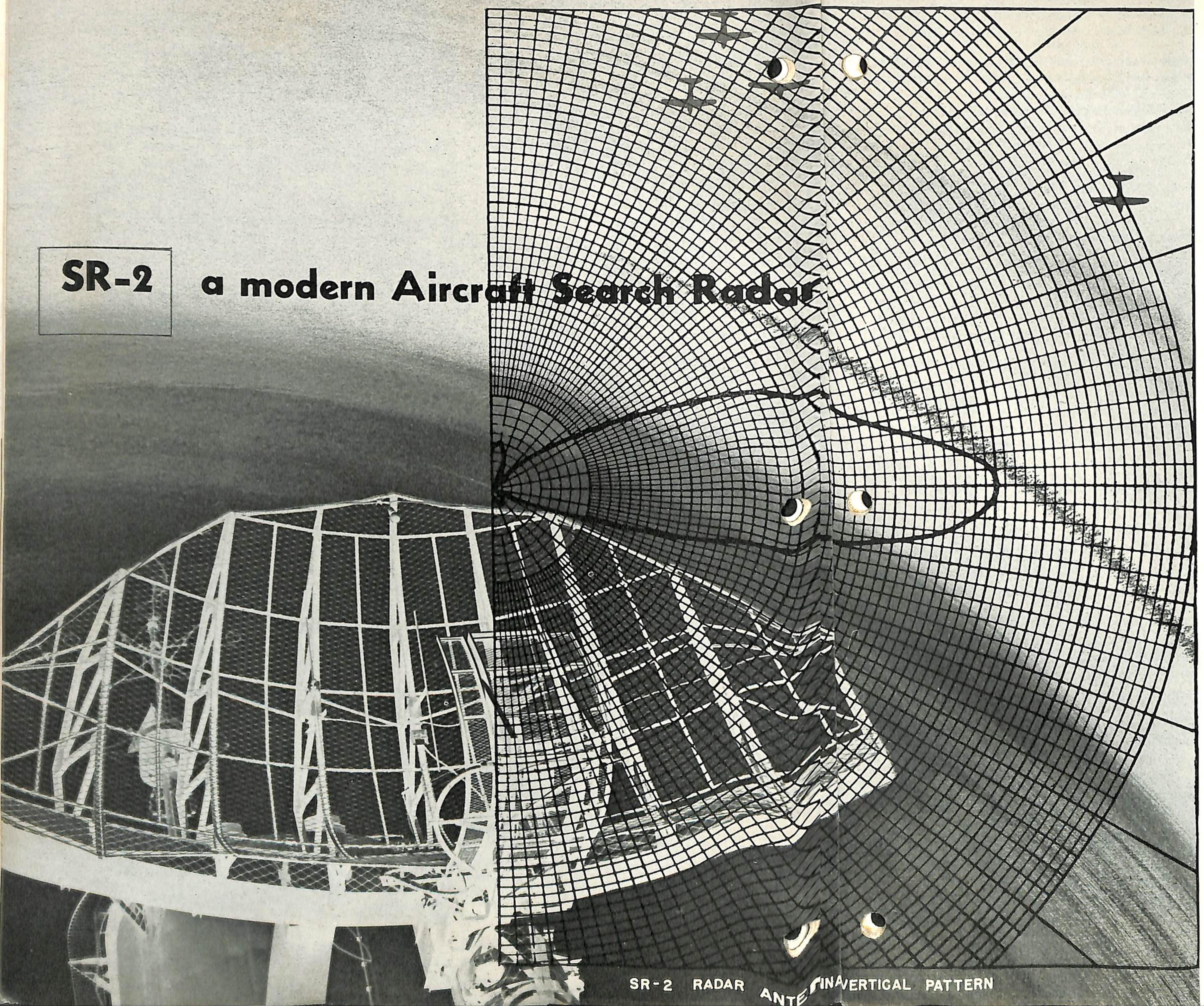
For instance, if dial readings for the one-third input points are 365 and 385, respectfully, the detent should be set at $\frac{385 + 365}{2} = 375$.

Throwing the "setting-up" switch to operating position grounds the junction of R-109 and R-110 and consequently grounds pin-jack J-103. This prevents undesired biasing of the AVC system by possible leakage across the switch terminals in the "operating" position. Since the input meter on the receiver can be used to indicate grid-voltage conditions in the final multiplier, it is believed that disabling of J-103 will not be objectionable.

This modification will be known as RCK Field Change Number One, entitled "Additional tuning set-up system". No field change kits will be supplied. Material for this change should be procured locally.

After the above modification has been accomplished, the instruction book should be corrected accordingly.

SR-2 a modern Aircraft Search Radar



SR-2 RADAR ANTENNA VERTICAL PATTERN

■ The SR-2 is now making its appearance in the fleet as the first air search radar to operate in the 550-660 Mc range. The set is authorized for BB's, CL's, CLA's, CVB's, and CVL's, two installations having been completed on CVB's 40 and 41.

Development of an air search radar in this band was made with the idea of overcoming such conditions as interference, congestion, pronounced nulls, lack of sufficient low-angle coverage, and other undesired features characteristic of the 200 Mc band equipments. Before this development was possible, however, there were several problems to be solved. First, new oscillator tubes and circuits had to be designed to give high-power output over a wide frequency range. A receiver which would cover this band and have a sensitivity comparable to those in the lower frequency range was necessary. Finally, the equipment required an antenna with narrow horizontal beam characteristics and a vertical beam which would afford high-angle coverage. A fulfillment of these specifications required time and effort, but resulted, according to initial tests, in a radar superior to previous air search radars.

GENERAL CHARACTERISTICS

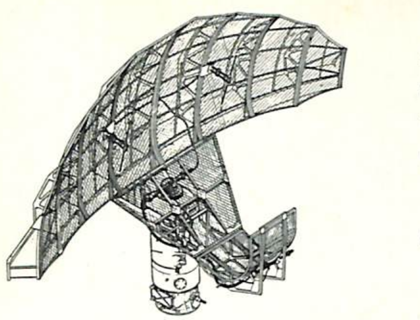
The most important feature of this equipment other than the higher frequency used to give more solid coverage and better range and bearing discrimination, is the wide frequency band over which the gear is capable of operating. The equipment may be set up on any given frequency on the operating band and adjusted for optimum operation within two minutes. This is made possible by front panel controls, a "reflectometer" and an echo box. The latter two units are built in as an integral part of the radar.

The reflectometer is a new piece of test equipment which enables the operator, by use of a meter located on the front panel, to determine when the transmitter is delivering maximum power. As a secondary function, it serves as a rapid means of determining the efficiency of the transmission line and antenna.

The echo box, through the use of a directional coupler instead of a dipole pickup, is no longer frequency sensitive.

The servo system is of the a-c type, and from the performance data is equal to, if not better than, former systems used in air search radars. This type of servo has certain marked advantages such as freedom from brush failures in the training motor, and the ability to by-pass the servo and operate the a-c training motor directly from the the line. These advantages serve to make the equipment more reliable.

Special features of the SR-2 antenna are its wide-band and high-gain characteristics. The complete structure is



fabricated from stainless steel to prevent deterioration due to corrosion as was experienced by former search arrays.

The indicator console represents an effort to standardize the units common to air and surface search equipments. As a result the video amplifier unit, IFF coordination unit, range indicator, and PPI unit are directly interchangeable electrically and mechanically with those in the SG-3 and other standardized search radars. The monitor scope unit located in the transmitter-receiver is likewise interchangeable.

For the first time, a synchro amplifier is used in the synchro system. The new synchro system will be standard for future standardized search equipments.

Such features as delayed PPI, expanded *A*-scope, shipshead marker, sensitivity time control, fast time constant, high video pass, and IAVC, have been provided in the SR-2 with complete control available to the operator at the indicator console.

DESCRIPTION

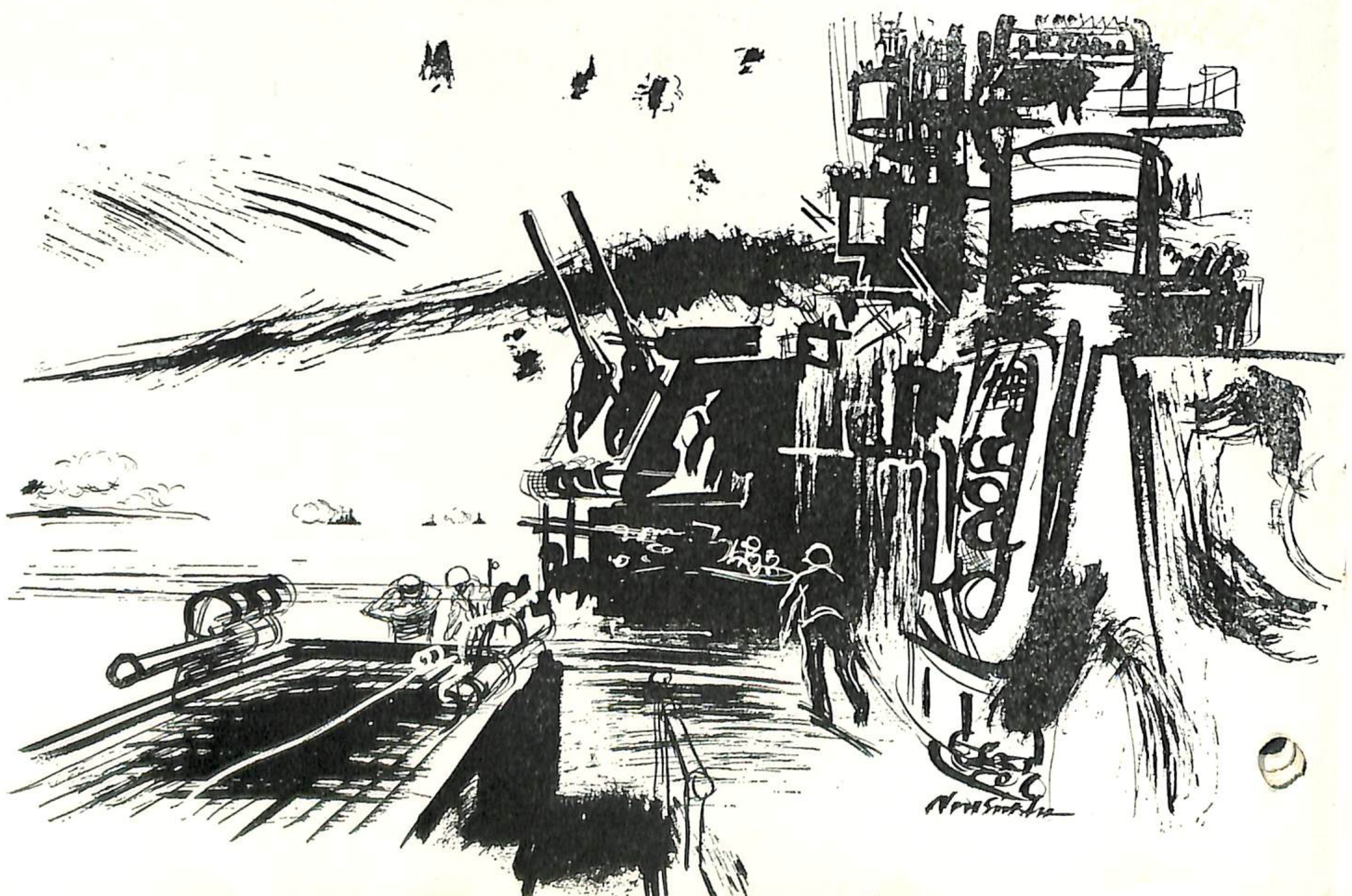
The component parts of the transmitter-receiver assembly are the trigger unit, pulse synchronizing unit, transmitter, receiver, and the monitor scope unit. Operation of these units is normally controlled from the indicator console; however, each may be controlled locally.

The trigger unit contains a blocking oscillator stabilized by an RC oscillator, and functions to control the pulse repetition rate at about either 180 or 600 pulses per second, and to generate 2000-volt trigger pulses for the modulator. A screw driver adjustment serves to vary the pulse repetition rate in seven 5% steps.

The transmitter consists primarily of a two-tube oscillator, a transmission line with two load stubs, and a duplexer. The reflectometer is also located in this unit. The peak power to the oscillator from the pulse transformer is in the order of 800 kw.

The monitor scope is a self-contained unit which is primarily intended to be used for peaking the transmitter and receiver. It may be removed from the cabinet and used as an oscilloscope for general servicing of the equipment.

The radar receiver is shock mounted in a frame which is located on the right hand side of the transmitter-receiver cabinet. It is provided with a gasketed window which protects the dials, controls and switches. A "Press-to-Tune" push button is provided on the receiver panel to mechanically disconnect the tuning gears and clutch, and allow easy operation of the r-f tuning control. Video signals from the receiver are supplied to the video amplifier in the indicator console cabinet.



MODULATOR:—The modulator, containing its own power supply, is capable of modulating an r-f peak power of 375 kw. All components of this unit are mounted on a retractable chassis. The upper doors swing outward and the lower door swings down to form a shelf upon which this chassis may be rolled out for servicing. The modulator furnishes energy to the transmitter oscillator through a pulse transformer.

THE INDICATOR CONSOLE:—The cabinet of the indicator console contains the video unit, general control panel, IFF coordinator, plan position indicator, range indicator, and bearing indicator.

In addition to the several video amplification channels contained in the video unit, a number of switching controls are provided, mainly for remote control of the receiver. One feature of the SR-2 is the automatic receiver tuning. For remote tuning, a three-position lever-type switch on the front panel of the video unit operates a tuning motor in the radar receiver.

The PPI unit located in the center section of the console, contains a five-inch scope with cursor dial and the necessary operating controls and switches.

The IFF coordinator, located on the lower left side of the indicator console, serves to accomplish the following functions:

(1) To trigger and provide either momentary or continuous keying of the IFF transmitter.

(2) To alternately trigger and blank the radar video channel and the IFF video channel in the range indicator unit.

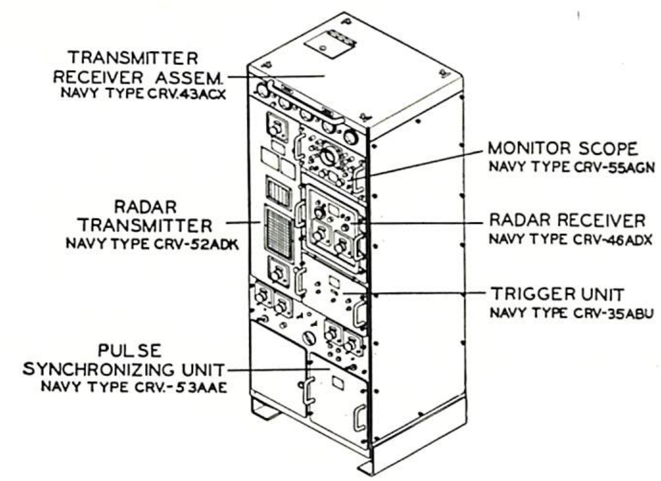
(3) To synchronize and trigger the sweep circuits of the range indicator in order that the received recognition signal and radar echo shall appear one below the other along the two separate base lines on the *A*-scope of the range indicator unit.

The general control unit, located in the lower left corner of the indicator console, controls operations of the radar power system. On the back shelf of this unit is mounted a set of spare tubes for the console. To facilitate tube socket voltage measurements, an analyzer adapter is included.

The bearing indicator unit is located in the lower right hand side of the indicator console. It contains the antenna pedestal drive controls and the indicator of antenna orientation. The speed of direct training is 5 rpm, servo slewing 1.25 rpm, and manual servo up to 5 rpm.

The range indicator unit, located in the upper right section of the console, contains the necessary synchronizing, gate-forming, and sweep circuits to produce a conventional range step on the *A*-scope, a movable range ring on the PPI, and a trigger for the delayed PPI. Calibration circuits are also housed in this unit, and the accuracy of calibration may be checked by a crystal range calibrating unit. This unit is standard navy test equipment.

ANTENNA ASSEMBLY:—The antenna assembly consists of a main parabolic reflector of aircraft construction approximately 15 feet wide by 5½ feet high on which the Mark III array is mounted. A small feed reflector mounts the wide-band radar dipole as well as the Mark V dipoles when used. This reflector is connected to the main parabolic by a flat apron. The antenna and pedestal weigh approximately 800 pounds.



Characteristics of the SR-2 Radar:

Frequency	550-660 Mc
Peak power	350 kw
Pulse length	1 or 4 μs
Pulse repetition rate	180 or 600 PPS
Antenna gain	22 db
Horizontal beam width	7½°
Vertical beam	CSc^2 coverage
Minimum range	600 yards
Receiver sensitivity	9 db above theoretical noise

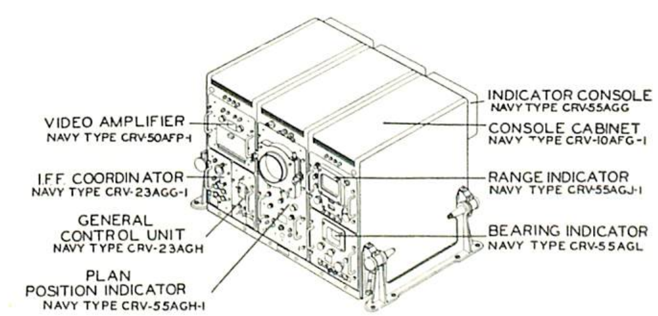


FIGURE 1—*Crystal stock is kept in a temperature-controlled room. The boxes shown above contain full bars, end bars, seed-plate material and crystal plates. All material in one cabinet will be approximately the same size in cross section.*

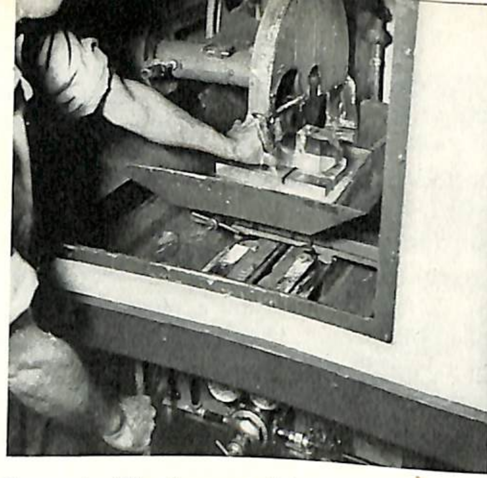


FIGURE 2—*The clear growth is cut from each end of the bar. The time required for cutting a bar such as that shown is about one minute for each end. Pressure of the cutting disc is hydraulically regulated.*

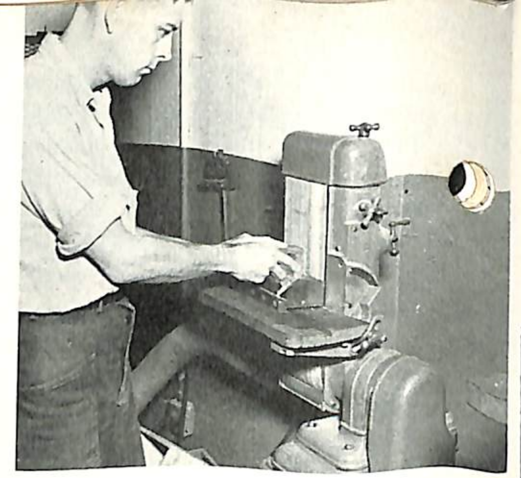
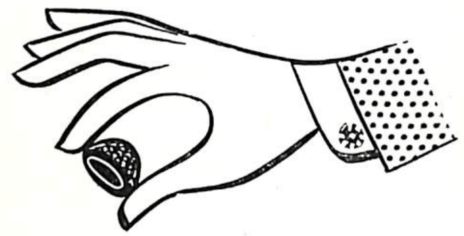


FIGURE 3—*Bar ends must be ground to create an index for correct orientation. This is done on a belt sander using a v-block jig fitting two faces of the pyramid-shaped crown.*

HOW IT'S DONE



The July issue of ELECTRON carried an article on ADP crystals, but crystal cutting was not covered in detail. The actual process of converting a full ADP bar into many crystals of exact dimensions and properties is quite interesting. Starting with the full grown bar, let us follow this process as it is carried on in the crystal cutting section of the Sound Division, Naval Research Laboratory, Washington, D. C.

First, the ends are cut from the full bar by means of an abrasive cutoff wheel as shown in figure 1. This machine is equipped with a hydraulic feed which can be regulated to the desired pressure. The 12-inch wheel is made from a thin piece of 120-grit carborundum. It revolves at 3450 r.p.m. and is cooled by a 1-to-3 mixture of propylene glycol and water, which prevents the crystal from heating and cracking.

The two ends of the crystal bar are the clear growth from which crystals are cut. The center section is cut into seed plates from which more crystal bars are grown.

When an order for crystals comes in, end bars of the required size are taken from stock shelves in a temperature-controlled room. These bars are then held in a jig and sanded for correct orientation. A relatively inexpensive belt sander is used as one-eighth inch tolerance is allowed at this stage. The piece resulting from this sanding is rectangular in cross section and three or four inches long. It is returned to the saw where slices are cut about .035 inch thicker than required for the finished product. These blanks then need only to be ground to the correct size, a process known as wet lapping.

The disc used for wet lapping is similar to a sanding disc, the only differences being the precision carborundum surface and the water-propylene glycol mixture used for cooling. This machine is also equipped with a hydraulic feed designed at the Laboratory. A micrometer head fitted on the jig provides accuracy to about .0005 inch. When the crystal has been squared and the faces paralleled it is ready for the plating process.

Plating both faces of the crystal to render them conductive is accomplished by either spraying or gold sputtering. In either case the crystal is first cleaned and slightly roughened by sand-blasting, and must be handled thereafter with tweezers. Touching the crystals would leave a thin layer of oil from the fingers which would prevent adhesion of the plating. If the crystals are to be sprayed, a very quick-drying silver solution is used. The gun used is an ordinary spray gun with a fine-spray nozzle. The gold-sputtering process involves the use of a vacuum chamber. The crystals are placed on a tray, above which is suspended a tungsten coil through which a gold wire is run. When air is extracted from the chamber and a current is passed through the coil, the gold is bombarded and volatilized and becomes deposited on the crystal face. This process must be done in two steps, as only one side of the crystals can be plated at a time. The polarity is marked in one corner of each crystal and it is then ready for packaging and shipment.

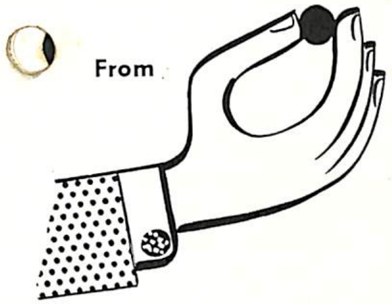
From  material furnished by Stewart I. Slawson, SP(X)1/c, USNR, NRL, Washington, D. C.

FIGURE 4—*The square bar of correct orientation is returned to the cut-off saw where it is sliced into rough blanks slightly thicker than the finished crystal. A coolant is used, as heating will crack the bar and make it useless.*

FIGURE 5—*The finishing operation is known as wet lapping. The coolant used here is a mixture of equal parts of water and propylene glycol. Crystals must be lapped to a tolerance at little as 0.0005 inch.*

FIGURE 6—*Here the accuracy of orientation is being checked by an X-ray machine. Where extreme accuracy is desired, every crystal is tested. For orders requiring less precision, only one crystal out of five or ten is checked.*

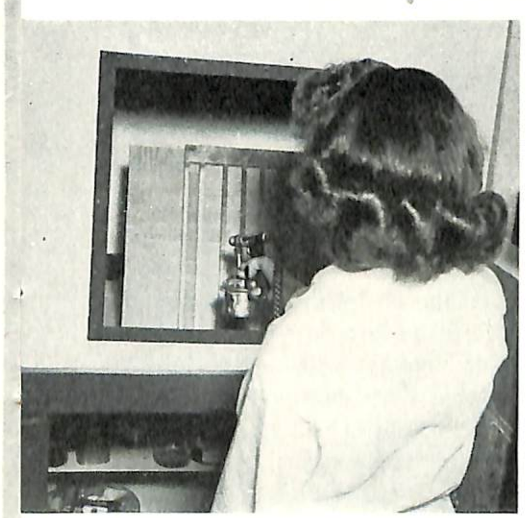


FIGURE 7—*When crystals have been cut and lapped, they are placed in a holder as shown. The faces are cleaned by sand blasting before a silver solution is sprayed on.*

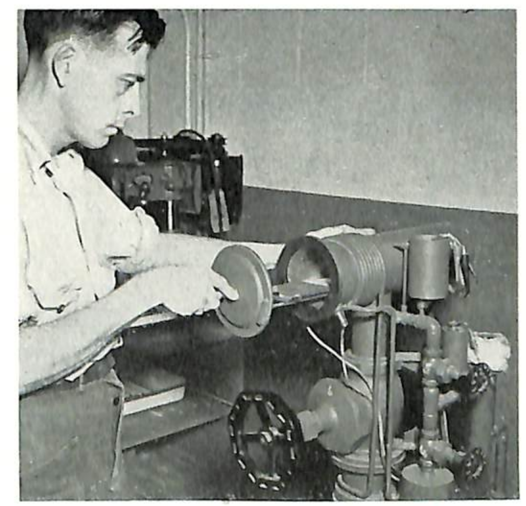


FIGURE 8—*Vacuum chamber for gold-sputtering of ADP crystals. Here pure gold is caused to volatilize and condense upon the exposed upper surface of the crystals.*

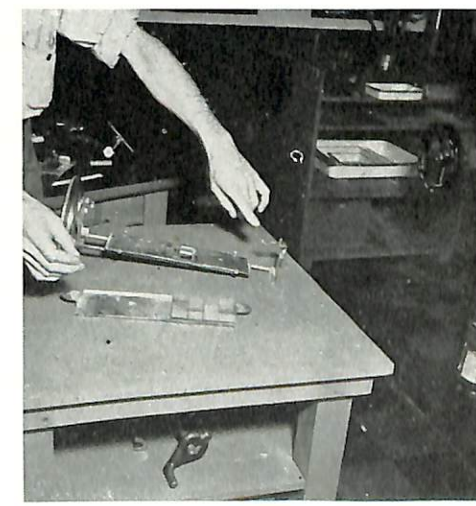


FIGURE 9—*Rack for holding crystals in the sputtering chamber. Note clips for attaching the heating coil and gold wire.*

XTEJ Radio Transmitting Equipment

■ Recently the Navy awarded a contract for the development of an all-purpose transmitting equipment for shipboard installation. The equipment will be constructed for use on both surface and under-surface vessels and will include the best design features established in recent years to cover all present requirements for low-power communication transmission in the frequency range 175-26000 kc, and medium-power transmission in the range 2000-26000 kc. Special emphasis has been placed on compact, light-weight construction and simplicity of operation, maintenance, and installation. In general the design of the TEJ is intended to make it a feasible standard replacement for many diverse types of equipment now in use by the Navy.

The proposed basic equipment in its entirety will consist of two identical 50-watt transmitters and a 500-watt power amplifier which may be excited by either of the 50 watt units. The two 50 watt transmitters may be used for simultaneous operation as each will be a completely self-contained and entirely independent unit. Design provisions have been incorporated for optional operation of the equipment from either a-c or d-c power line sources. Each 50-watt transmitter and the 500-watt power amplifier will operate at all times into a 50-ohm solid-dielectric transmission line and will be capable of utilizing either a 35-foot whip or broad-band antenna. Transmission line to antenna coupling will be provided at the location of the antenna. Circuits for CW, MCW, voice, and frequency-shift keying are included in the design of the model, and operation on any one of these emissions will not require the use of auxiliary equipment. Vacuum tube keying will be employed to provide keying speeds up to 500 words per minute for A1 type emission and up to 100 words per minute for A2 emission. The equipment will be continuously variable throughout the frequency range, and will incorporate ganged controls to facilitate manual tuning. In addition to the manual tuning, telephone-dial rapid selection of ten preset channels will be provided for each 50-watt transmitter and the 500-watt power amplifier. The equipment will be capable of operation from the front panel position and up to 10 remote stations for each 50-watt transmitter and the 500-watt amplifier. Each remote position will provide selection of 10 quick-shift preset frequency channels, type of emission (A1, A2, A3, and F), and indication of transmitter operation. The equipment will also be capable of complete remote operation when connected into present ships control systems and a proposed master ships control system now under development.

An entirely new type of unit construction will be used for the equipment which will permit a variety of arrangements at installation. Light-weight drawer sections will be employed and will stack, one above another, in the manner of a sectional book case, to form a single compact assembly. Each of the two 50-watt transmitters and the 500-watt power amplifier will be contained in separate sections which may be rapidly positioned in or removed from the final assembly. This type of construction permits optional installations made up from the standard units. No external wiring during installation will be necessary and with all sections assembled the equipment will not exceed the dimensions of 72″ high, 32″ wide and 24″ deep. The various chassis will be designed to slide into the front of the sections on runners and will be guided and positioned by stops and pins. Electrical connections will be made automatically by plugs and jacks when the chassis are positioned in the sections. Complete accessibility to the components will be available when the chassis are removed from the sections. Under this condition electrical connections for test purposes will be completed by cables furnished with the equipment.

The proposed basic equipment consists of two 50-watt transmitters and one 500-watt power amplifier. The design of the TEJ radio communication transmitting equipment, however, permits the installation of the necessary number of units to meet the full type allowance of practically all classes of navy vessels. Various possible installation arrangements are as follows:

(a) One 50-watt transmitter.
(b) Two 50-watt transmitters capable of simultaneous operation.
(c) Three 50-watt transmitters capable of simultaneous operation.
(d) One 50-watt and one 500-watt transmitter capable of simultaneous operation.
(e) Two 50-watt transmitters and one 500-watt transmitter capable of simultaneous operation.
(f) One 500-watt transmitter.
(g) Two 500-watt transmitters capable of simultaneous operation.
(h) Two 50-watt transmitters and two 500-watt transmitters capable of simultaneous operation and requiring deck space of two transmitters.
(i) Three 50-watt transmitters and three 500-watt transmitters capable of simultaneous operation and requiring deck space of three transmitters.

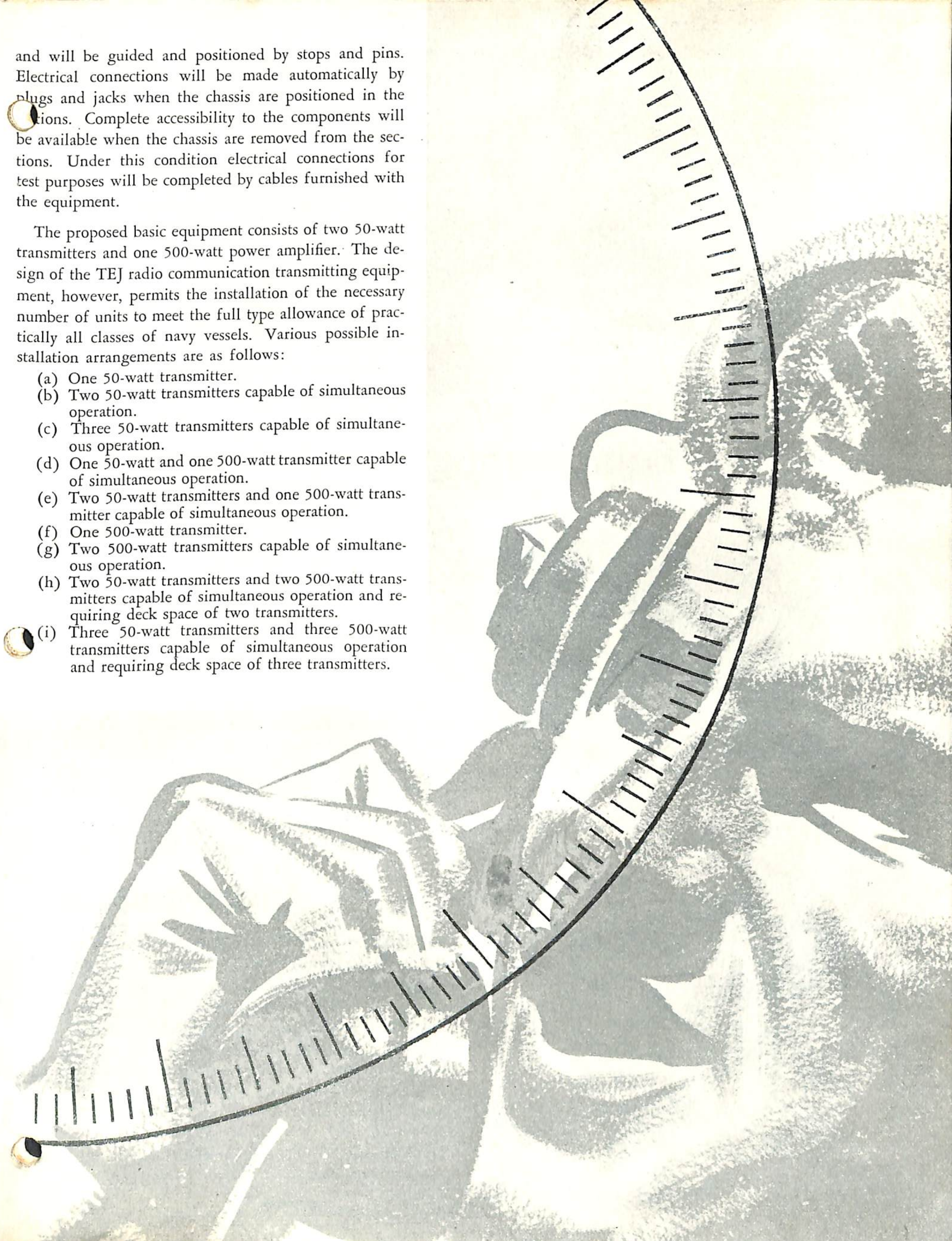


FIGURE 1—*Model OCL Tube Analyzer also provides voltage and resistance measurement facilities.*

Know Your Test Equipment

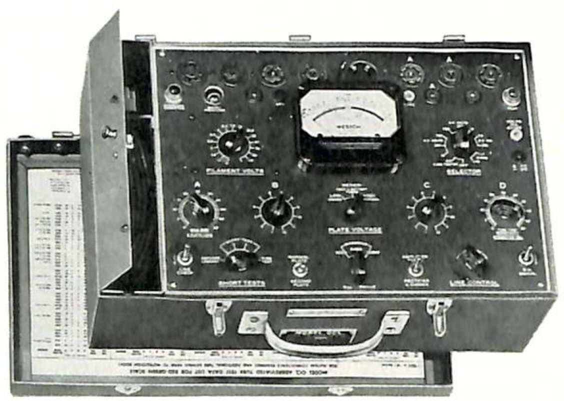


FIGURE 2—*Model OAW Tube Tester. Safety compartment on right houses tube under test.*

■ As an aid to the technician in acquiring information on various test instruments, the BuShips ELECTRON will carry a series of articles dealing with the various types of test equipment having prominent usage throughout the Navy.

Discussed in this issue are the merits and applications of four types of vacuum tube analyzers, the OZ, OCL, OQ, and OAW. It should be remembered at all times that no test equipment obtained through navy supply sources for general use can be expected to give the accuracy of expensive laboratory instruments nor is such extreme accuracy required in routine service work.

Since mutual conductance is the factor which is generally considered as the criterion of value for most types of vacuum tubes, the principal function of any tube analyzer should be to provide a means of checking this mutual conductance. In addition to this function, some vacuum tube analyzers provide for checking certain types of vacuum tubes whose mark of merit is not determined by their mutual conductance but by cathode emission or other characteristic.

OZ SERIES

The OZ Vacuum Tube Analyzer is the navy designation given to the familiar Hickok model 550X. It has several decided advantages in that it is a portable equipment, very simple in operation, and has numerous features which other types of analyzers do not possess. In short it is a combination vacuum tube analyzer and multitester with the following facilities: 1—Complete vacuum tube analyzer, including mutual conductance indication in ranges of 3000, 6000, and 15000 micromhos, gas test, diode test, rectifier test, and facilities for testing for shorts between elements. 2—A voltmeter capable of reading a.c. or d.c. from 0 to 20, 200, 500, and 1000 volts at a sensitivity of 1000 ohms per volt. 3—Resistance measurements from 0 to 5 megohms in 3 ranges. Provisions are also made for measuring high resistance up to 25 megohms. 4—Check leakage of electrolytic capacitors. 5—Capacity measurements (limited range). 6—Inductance measurements (limited range). 7—Current measurements 0 to 20 and 200 milliamperes. 8—Useful as an output indicator when aligning receivers. Table is furnished for conversion to db. 9—Measure hum voltage in filter systems.

OCL SERIES

The newer Navy Model OCL is similar to the OZ with the following exceptions: 1—No facilities for checking capacitor leakage. 2—No facilities for measuring capacity. 3—No facilities for measuring inductance. 4—A-c or d-c voltage measurements to 750 volts in 3 ranges. 5—Current measurements from 0 to 150 milliamperes in 2 ranges. 6—Resistance measurements from 0 to 1 megohm in 2 ranges using internal batteries, which precludes the necessity of an a-c source.

OQ SERIES

The OQ is a portable instrument designed solely for making conventional checks such as mutual conductance, gas test, rectifier test, and inter-element tests for shorts. No provisions are made for measuring voltage, current, resistance, capacity or inductance.

OAW SERIES

In many electronic applications, two or more tubes of the same type are used in a circuit in such a manner that failure of one will cause overloading and consequent failure of the other, which may be a good tube. In such applications it is desirable to use tubes which are matched as nearly as possible. The term "matched tubes" can be defined as two or more tubes which have approximately the same cut-off characteristics, peak emission and current limitations. In small receiving types this matching is not so important insofar as tube conservation is concerned. The OZ, OCL and OQ series analyzers can be used to check the characteristics of these conventional types, but provide no facilities for checking the non-conventional, higher-priced tubes. Due to numerous failures of certain tubes used in such circuits it was deemed necessary to provide a tester for checking these tubes to facilitate matching.

The OAW is a portable equipment designed for the purpose of checking such types as the 15E, 227, 327, and 8011. The 327A types can be checked on this tester using the curves for the 227-327 types. It can be used to determine peak emission and cut-off characteristics. Since some of these types normally require plate voltage in the order of thousands, all checks must be made on a comparative basis. It is neither necessary nor feasible to include a power supply capable of providing such high voltages due to excessive size and weight, and possible damage to the tube when pushing it to peak emission. With these limitations in mind a power supply capable of furnishing 250 and 1000 volts was designed for the equipment. A 150-volt source is also furnished for supplying negative grid bias.

To use the OAW with reduced plate voltage on the tube under test, curves are provided for different types of tubes. When these curves are used correctly the peak emission may be estimated very easily. In like manner, the cut-off point can be determined by setting the filament voltage at the rated value of the tube, and by adjusting the grid bias voltage control for plate current cut-off. The cut-off voltage may be read directly on the grid voltage meter. When matching tubes, the cut-off voltage difference should never exceed 10 volts, and preferably should be 6 volts or less.

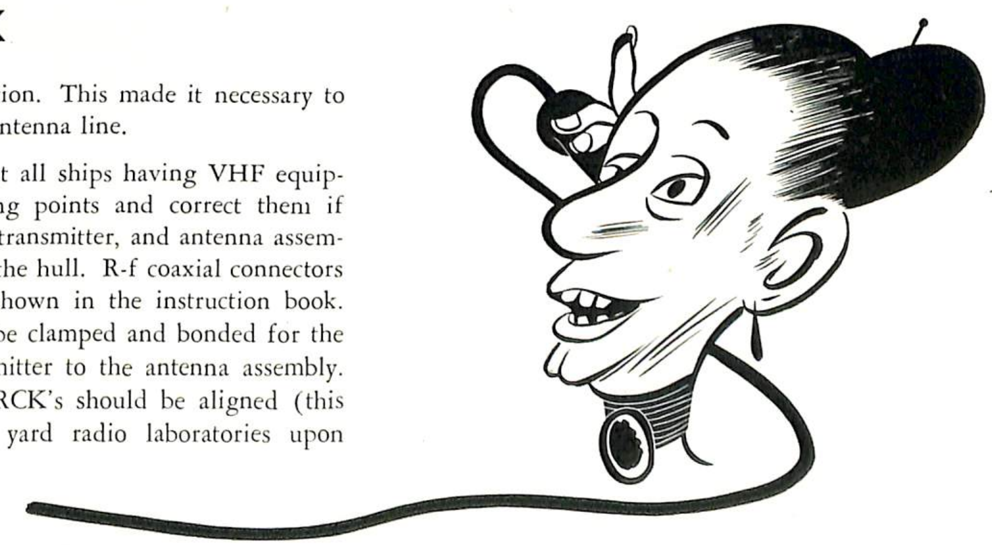
The importance of this tester is evidenced by the fact that matched tubes consistently have many more life hours than unmatched tubes of the same type.

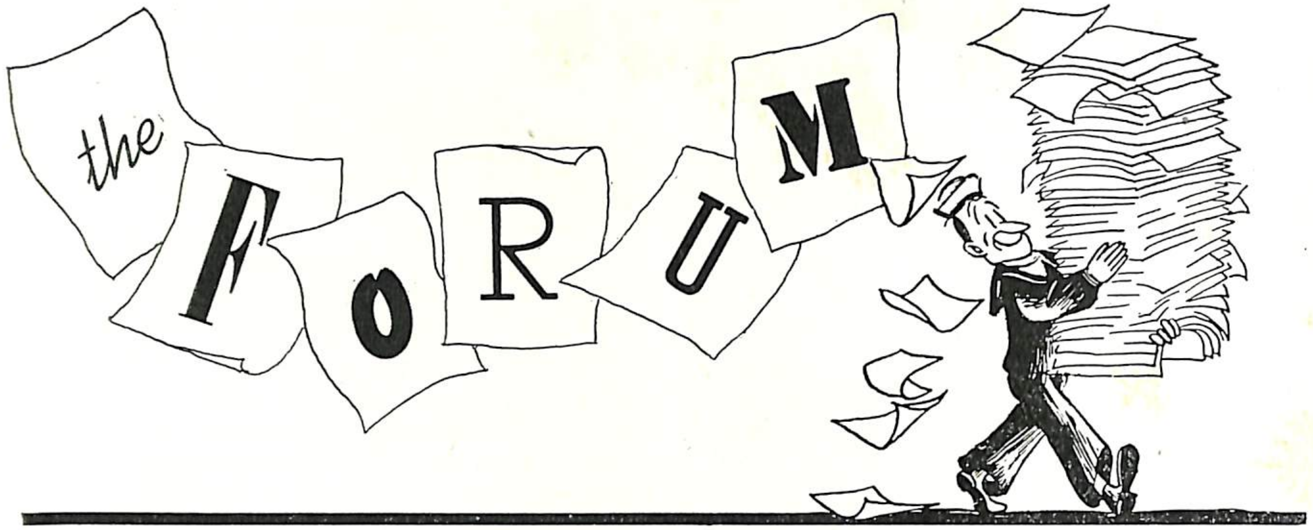
CORRECTING VHF CROSS-TALK

■ On vessels inspected for cross talk on VHF equipments it was found that where antennas were widely separated no crosstalk was present, providing the equipment was in good shape. Cross talk was at a minimum when the antennas were spaced six feet apart, opposite each other, and the channels were separated by at least 1 Mc. In some cases the r-f and i-f stages of the RCK were not properly aligned, and correction of this condition improved the overall performance.

A Megger reading on the antennas indicated low resistance, and disassembly showed the presence of moisture in the matching section. This made it necessary to remove and dry out the antenna line.

It is recommended that all ships having VHF equipment check the following points and correct them if necessary: The receiver, transmitter, and antenna assembly should be bonded to the hull. R-f coaxial connectors should be made up as shown in the instruction book. The coaxial line should be clamped and bonded for the full run from the transmitter to the antenna assembly. R-f and i-f sections of RCK's should be aligned (this will be done by navy yard radio laboratories upon request).

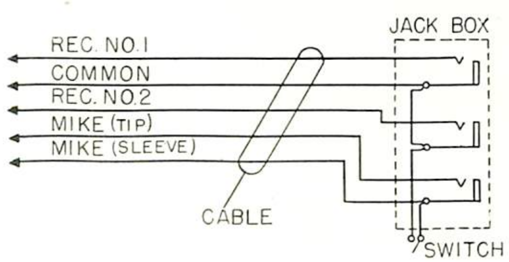




Remote Control Box for SCR-508

By J. T. MacKnight RT 2/c, and W. M. Pace RM 2/c, USS *LST 73*

■ A remote control box for SCR 508/608 is easily made from a type CN-49029 jack box. In our case, we did not have the 3-circuit mike plug, so we used a single-pole-single-throw switch and phone jack as shown in the schematic.



Short out the mike button in SCR Mic and replace the plug with a headphone plug. To transmit, throw toggle switch, but be sure to throw it back when the transmission is completed. The best way to install the box is in a vertical position, with the jacks underneath and the switch mounted in the holes at the top. A five-conductor cable may be used, or a three and a two run to the desired location of the remote box. A volume control might be mounted in the remaining holes, but in our case we found that this was not necessary.

Bureau Comment: Inasmuch as this system is not standard, it is not recommended by the Bureau. The ease of push-to-talk operation is lost. Standard 3-circuit mike jacks are recommended, and should be procured whenever possible. Proper material for standard installations should be more readily available in the future.

Dual-Purpose Dehydrator

W. M. Freismuth, CRM, and F. J. Schmidt, RT 1/c, USS *Dujk* (DE-666)

■ Due to the loss of nitrogen from the TBS gas-filled coaxial antenna line and the limited amount of bottled nitrogen aboard, it became necessary to use a substitute method for keeping moisture out of the transmission line. It was decided to parallel the TBS and the SA-2 transmission line gas supply at the dehydrating unit. Approximately twenty feet of 1/4 inch copper tubing and appropriate couplings were required. The tubing was run from the discharge side of the dehydrator through a "T" connector to the antenna junction box of the TBS-5. The SA-2 gas supply line was connected to the other side of the "T" at the dehydrator.

After one week's observation it was found that the dehydrator was not overloaded, and no difficulty was encountered in maintaining gas pressure in both lines. The TBS-5 and the SA-2 appear to be operating normally and satisfactorily.

Bureau Comment: This procedure is permitted as a temporary measure until the leak can be located and repaired.

■

SG Blower Motor

A solution for many of the r-f interference problems occasioned by auxiliary blower motors is indicated in correspondence received from Mr. M. B. Gilbert. Pertinent comments are quoted herein for the information and guidance of all concerned.

"This modification consists of a very simple but effective change in the B-102 filter only. In the existing filter, two short wires are used to ground the common terminals of condensers C-128, C-129, C-130 and C-131. It has been definitely proven that these two ground wires, having a length of approximately 1/4 wave, will actually radiate interference from the motor. By removing these two wires and turning the common condenser lugs back and soldering them directly to the condenser can, this radiation is completely stopped.

"In many cases ground straps described in Bulletin #61 had previously been added but the interference still persisted".

It is suggested that the above quoted paragraphs should be inserted in your copy of SG Field Change 40.

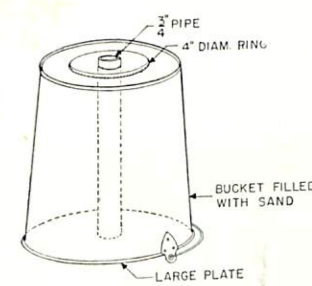
The author is to be particularly commended for his efforts and diligence in pursuing this interference to its source and coming up with the solution.

—*Raytheon*

■

Improved TBX Antenna Mount

By CRE Joseph Edward Riplinger, USN, USS *Rigel* (AR-11)



■ Due to difficulties experienced in erecting the antenna furnished with the TBX portable radio, I planned and constructed a portable antenna mount, the details of which are shown in the sketch. An ordinary general-purpose bucket, Type II, stock catalog number 42-B-24760, was used as a means of anchoring the antenna stake (CFM-66024).

Referring to the sketch, a length of three-quarter inch pipe is welded in the center of a large plate of the same diameter as the top of the bucket. A hole 1½ inches in diameter is burned in the center of the bottom of the bucket. The plate and pipe combination is then fitted in the bucket with the pipe protruding at least 3/8 of an inch through the bottom of the bucket. The edge of the large plate is welded to the top of the bucket with a continuous bead of weld. The bucket is then inverted, filled with sand and the small ring slipped over the pipe. The operation is completed by welding this ring to the pipe and bucket so that no sand can escape.

Bureau Comment: The bureau authorizes construction of this mounting if the additional weight caused by the sand is not a limiting factor in your particular installation.

DAQ Counterpoise Rods

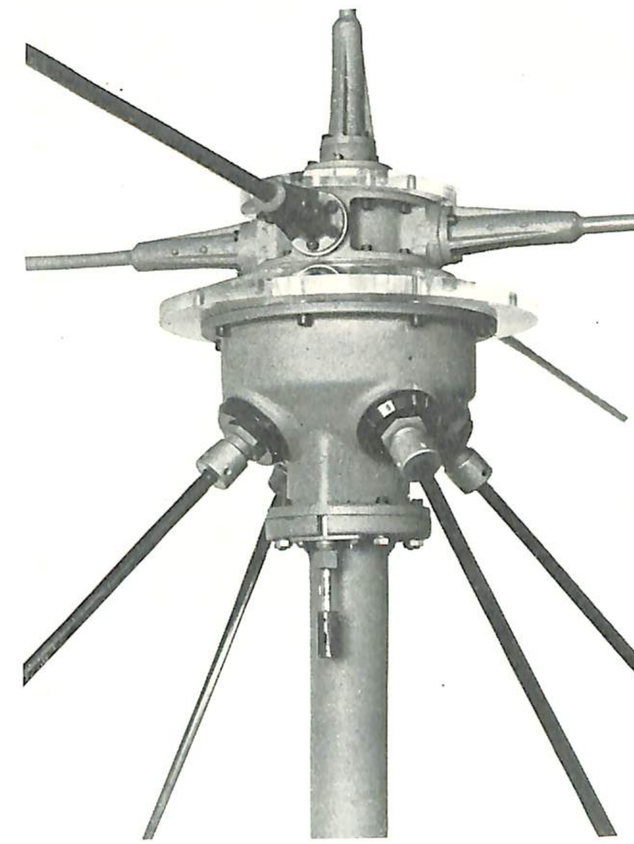
By W. C. Rogers, CRE, USNR, USS Marblehead

■ Due to the height and construction of the DAQ antenna mast on this type ship excessive vibration takes place causing the counterpoise ground rods to snap off at the butt.

The excessive height of the DAQ antenna above the open bridge and open decks makes it very dangerous to life when these counterpoise ground rods snap off and drop to the deck below.

It is recommended that these rods be made of a different metal or that they be made solid one third of the length.

Bureau Comment: The Bureau is procuring a quantity of new loops for use with DAQ and DAU equipment. New loops are designated as CFT-69083B. The photograph shows design detail. It is hoped that the deficiency mentioned, as well as the poor sense performance of some loops, will be remedied by the new loops.



CORRECTIONS

September ELECTRON, p. 6: Figures 1 and 3 represent the International Morse character F instead of the letter S as stated in the text.

September ELECTRON, p. 12: The SU serial number is located on the Control Range and Indicator Unit instead of on the Transmitter Unit.

OBU ADAPTED FOR MK 26

Dipole clamp (left) made from a piece of sheet metal. The right-angle bend is approximately one and one-half inches long.

■ One of the instructors at the Fleet Training Center, with the assistance and advice of Dr. J. M. Wolf of USAF MidPac, has devised a method of adapting the OBU-2 and OBU-3 echo box test sets to the Mark 26 radar for performance checking.

The only additional equipment required for the adaptation is a dipole mounting bracket, which can be constructed with little difficulty. Metal straps used to bind crates, or any sheet metal about .020 inches thick and 9/16 inch wide is suitable. The strap may be formed around a piece of pipe or tubing slightly smaller than the metal body of the dipole, and the extending portion bent and bolted to form the finished product as shown in the figure.

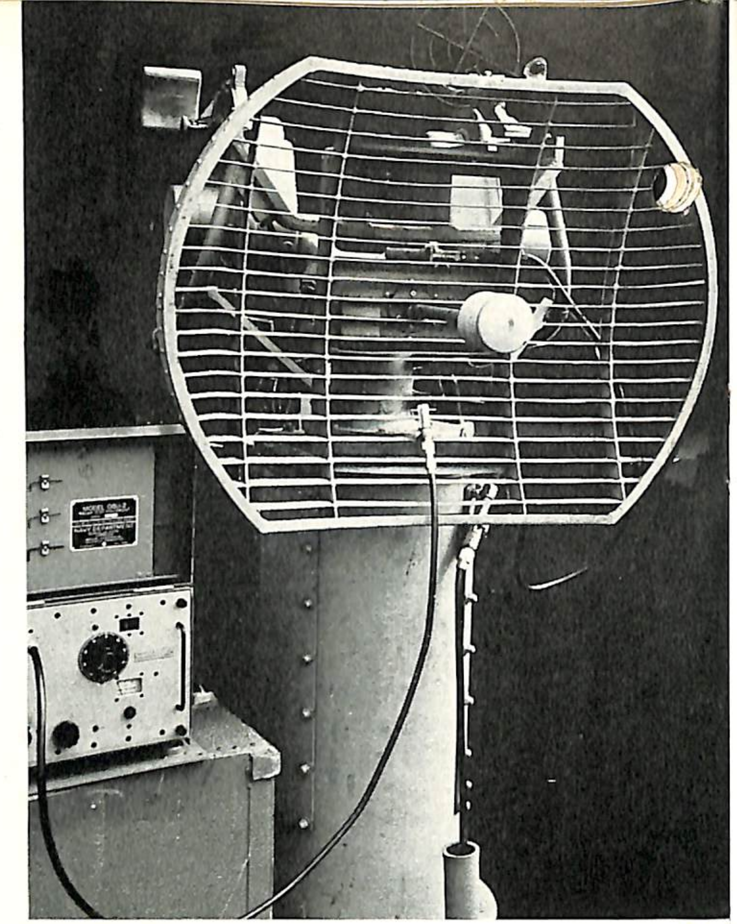
INSTALLATION

OBU-2: A small clamp, or even a paper clip, may be used to hold the dipole clamp in place. The important conditions are that the dipole be centered 1″ forward of the sixth slat of the antenna, as shown in the figure. The cable from the echo box to the dipole should not be shorter than five feet, and should extend vertically downward from the antenna.

OBU-3: The "soap-cake" dipole supplied with the OBU-3 echo box is pressed flat against the back of the dish, raised until it touches the antenna feed coax, and mounted in this position.

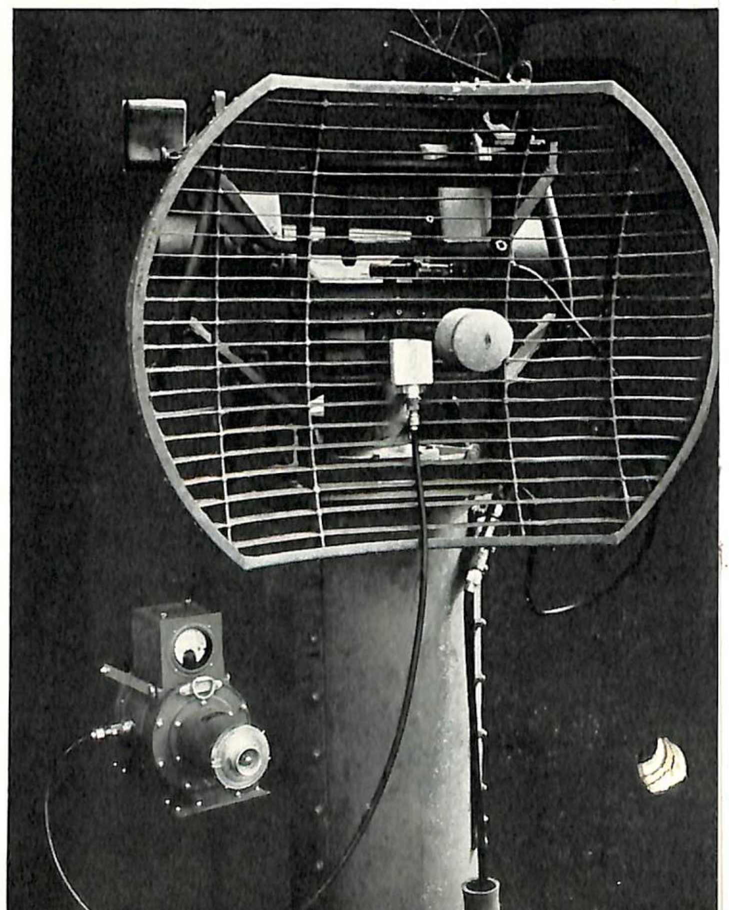
TESTING

Procedure for testing is the same when using either test set. The dish must be elevated to avoid surface echoes when testing. The ringing time obtained is compared with the expected ringing time as calculated from the OBU-2 manual. A decrease in ringing time of 250 yards or more below the expected value indicates serious trouble which must be located and corrected.



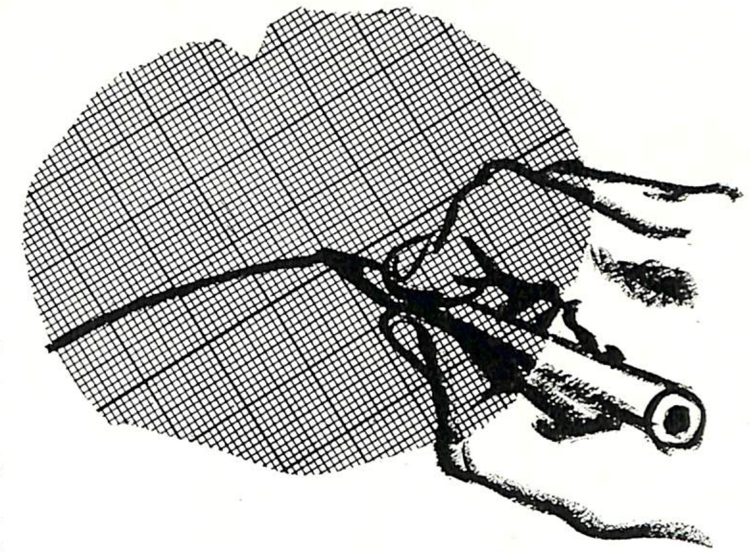
The OBU-2 dipole is mounted one inch in front of the center of the sixth slat of the Mark 26 antenna.

The OBU-3 "soap-cake" is mounted directly under the antenna feed coax. The dipole coax should leave the antenna at right angles to the lower slat.



DBM Calibration Station

■ The Electronics Field Service Group announces a temporary DBM calibration station available for service in the 11th Naval District. This station is located at the end of the San Pedro breakwater next to the Los Angeles harbor light station. The station has two target transmitters: OCY covering 150 to 1400 Mc with AS-71, AS-145 and 66AKL antennas; NRL target transmitter covering 2000 to 4000 Mc with MBE and M1407 antennas. For communications an SCR-624 is used. Main channel (TARE) 141.12 Mc. Standby channel (QUEEN) 143.83 Mc. A spare SCR-624 is available if the ship does not have TDQ, RCK, or ARC-4 equipment.



Calibration usually requires one day and ships desiring calibration should arrange schedule accordingly. Requests for service should be addressed to Electronics Officer, 11th Naval District, Naval Drydocks, Terminal Island, specifying date desired. Requests will be confirmed if they do not conflict with scheduled calibrations. An officer will board ship to make all arrangements on the day of calibration. The ship's force is expected to assist in operation of communications, pelorus, and DF equipment.

OE Adapter Kit

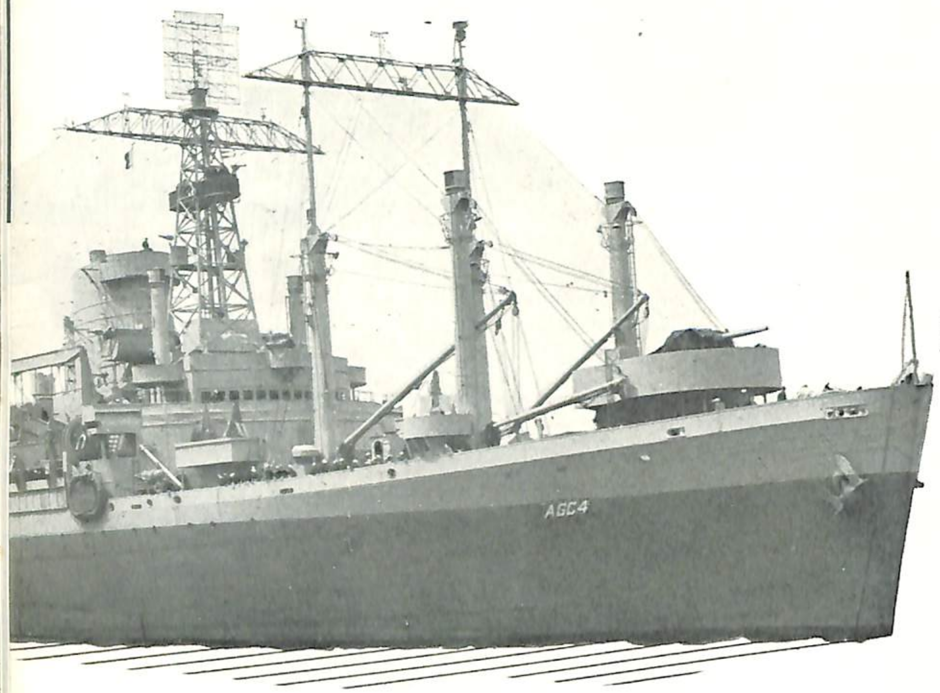
■ The OE radio pin test adapter kit (Navy type CV-49992) has been developed to enable simple point-to-point voltage analysis with a minimum amount of circuit upset. They preclude the necessity of digging into the under side of the chassis to take readings while the tube is in an operating condition.

Small metal tabs are brought out radially from each pin as shown in the photograph. These tabs are easily accessible to the test probes of measuring equipment.

The very latest kits have been equipped with a slightly modified octal adapter. The base of this adapter has been lengthened in order to permit its insertion in all sockets equipped with two clamps.

Ships which have this kit appearing on their allowance list may obtain them from their nearest Electronics Supply Officer.

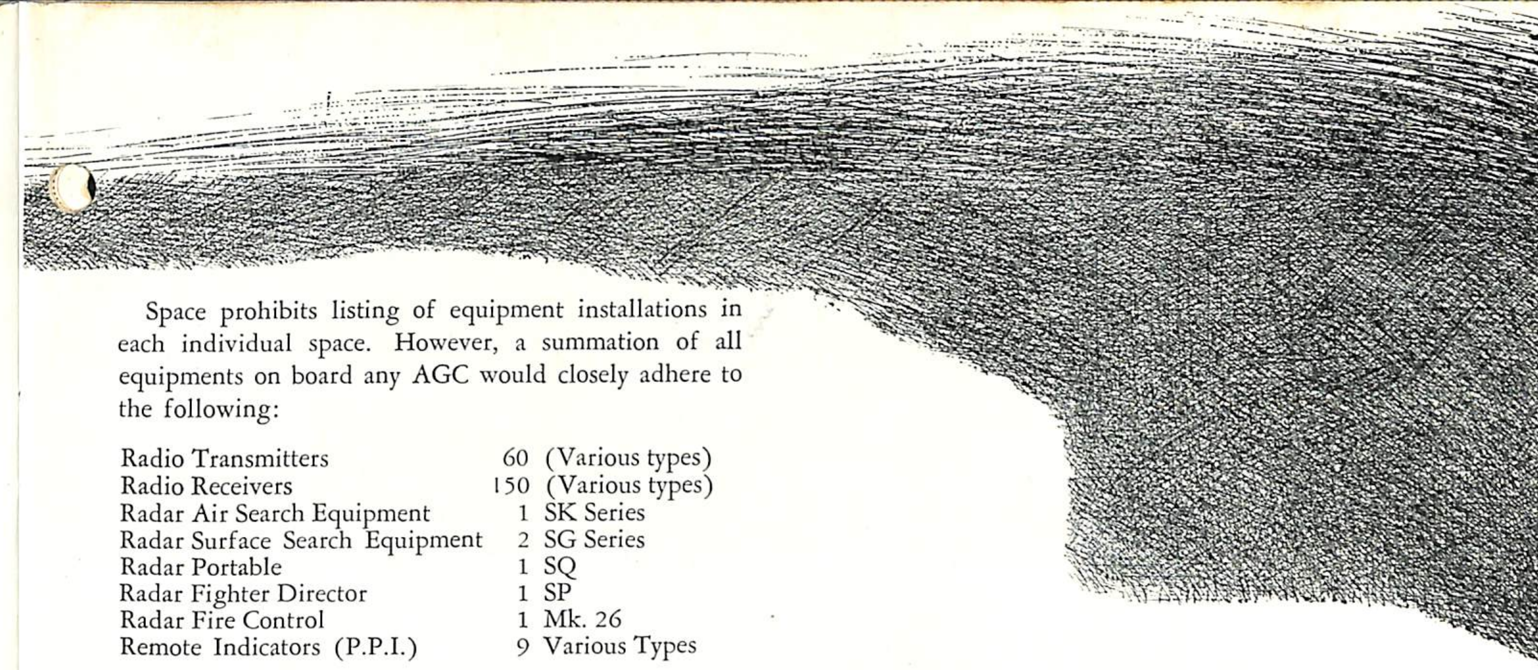
AGC



■ Communication ships (designated AGC's), usually Amphibious Force Flagships, were developed to meet the requirements of a shipboard general command headquarters to direct assault and landing operations. Due to the large number of amphibious operations contemplated, these ships were first requested for use in the very early part of 1943. The project was assigned a high priority and procurement of hulls was started immediately. The first AGC's were converted from hulls already available but designed as passenger ships and as naval and coast guard vessels for other service. To make these hulls suitable as AGC's required extensive changes in design, but work was rushed to complete them. The Navy first used the AGC type of ship in the Mediterranean theatre and the results were extremely satisfactory. The later AGC's, maritime commission C-2 hulls converted while building, were fitted out and manned for the sole purpose of facilitating coordination and control of assault and landing forces prior to and during an amphibious operation.

Great quantities of equipment of numerous types were required due to the different branches of the service represented by the flag officers on board at various times. Each branch had its own tasks to perform in each operation. In addition all branches represented were constantly made aware of the overall situation by having joint operations facilities available. When one considers the number of ships, planes, troops, assault and landing craft employed, the magnitude of the task of directing becomes very apparent. As electronic equipment was the primary means of communication between flag officers and their forces it is evident that a tremendous amount of such equipment was required. The fitting out of these ships presented many problems both as to number and types of equipment required and to allocation of space for installations.

To avoid confusion and to create as little interference as possible during operations it was necessary to provide separate compartments or spaces to accommodate the officers and men of the staffs directly concerned with the prosecution of the operation. These spaces are identified by name, the more important ones being the Combat Information Center, Flag Communications, Joint Operations, Auxiliary Joint Operations, Voice Circuit Filter Room, Flag Bridge & Flag Plot, Staff Gunnery and Air, Aerological Office, Chart House, and War Command Room. Communication between these spaces is provided by various methods including teletype, ships service telephones, sound-powered telephones, pneumatic tubes, and others. In addition to electronic installations, extensive facilities for photographic work were provided.

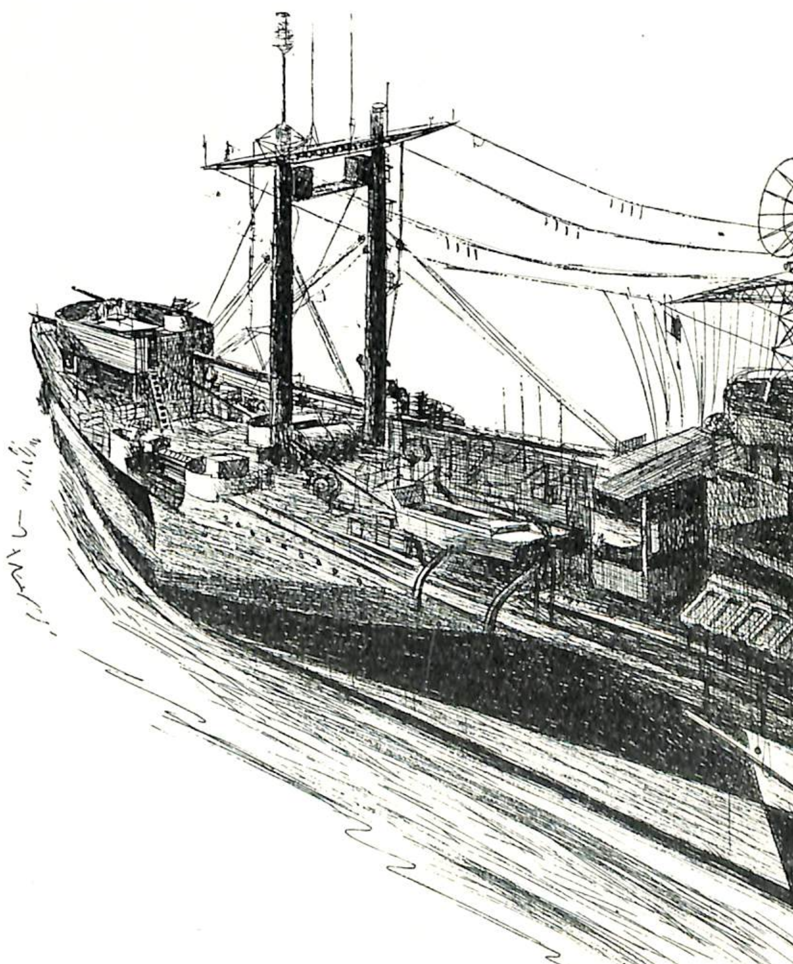


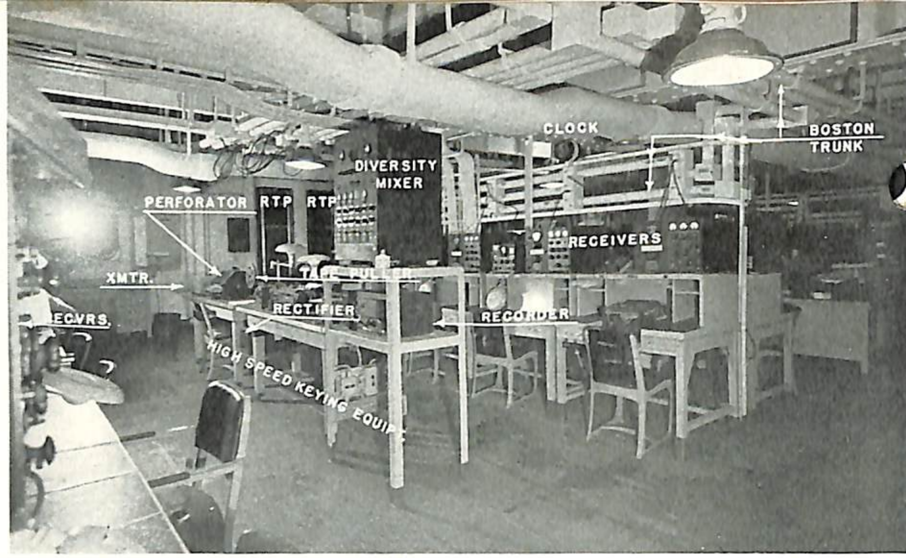
Space prohibits listing of equipment installations in each individual space. However, a summation of all equipments on board any AGC would closely adhere to the following:

Radio Transmitters	60	(Various types)
Radio Receivers	150	(Various types)
Radar Air Search Equipment	1	SK Series
Radar Surface Search Equipment	2	SG Series
Radar Portable	1	SQ
Radar Fighter Director	1	SP
Radar Fire Control	1	Mk. 26
Remote Indicators (P.P.I.)	9	Various Types

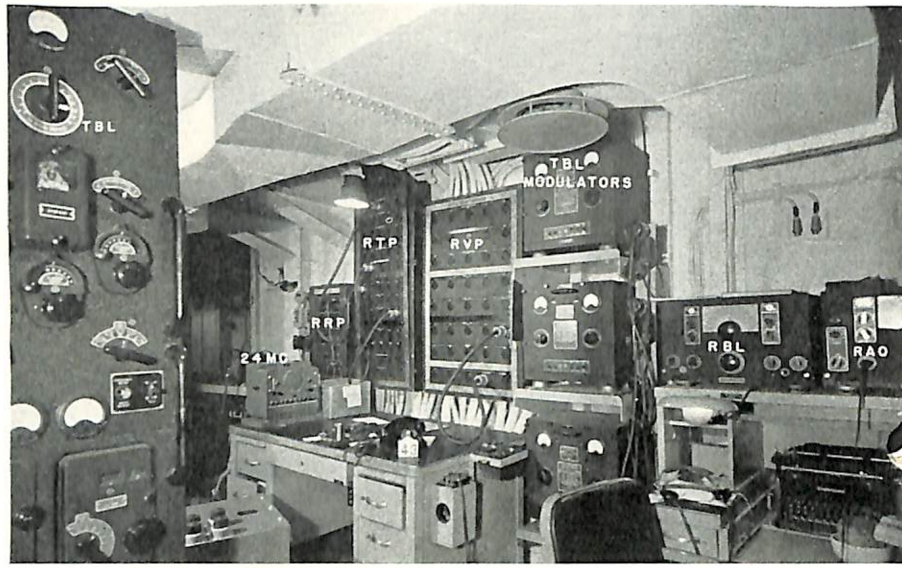
. . A concentration of electronic equipment

Interrogator-Responsors	5	Various Types
Transponders	3	BK
Noise Transmitter	1	TDY-1
Receivers	1	RDO series, and 1 AN/SPR-2
Pulse analyzer	1	RDJ series
Panoramic Adapters	1	RDP series, 1 RCX-1, and 1 RBW-2
Direction-finder system	1	DBM-1
Recorders, Visual	3	PQ
Recorders, Voice and CW	2	VRW-1
Radar Beacon	1	YG
Radio Direction Finder	1	DAK-2
Echo Sounding Equipment	1	NMC
Loran Equipment	1	DAS-1
Remote Control Units	65	Various Types
Teletype Machines	17	Various Types
Receiver-mixer units for RAK/RAL	2	CMX-23073-A





Port side of Radio I, showing high-speed c-w communication and miscellaneous equipment.



After port side of Radio II, showing a small part of the equipment in the main Transmitter Room.

Complete high-speed c-w communication system includes 3 Wheatstone tape perforators, 3 tape transmitters, 3 ink recorders, 4 tape pullers, 2 tape bridges, and 2 typewriters (telegraph keyboard).

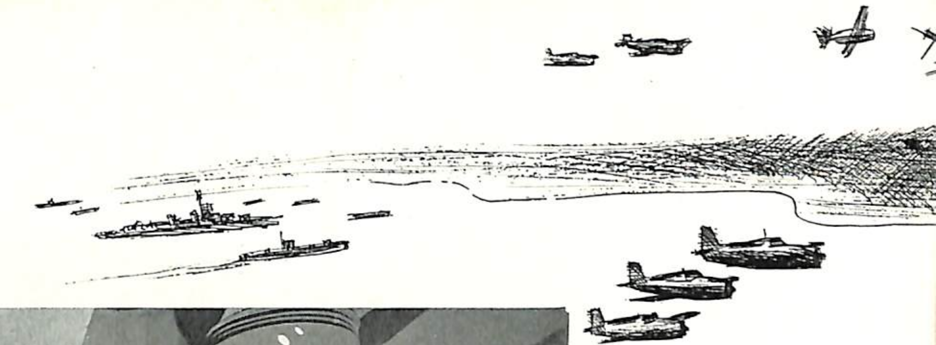
In addition to the major equipments listed above, each space is provided with necessary test equipment, transfer panels, switching panels, switchboards, patch cords, recorder units, power supplies, motor-generators, hand keys, plotting tables and other miscellaneous equipment necessary for operation of the equipments and conduct of operations. A complete electronic repair shop is maintained.

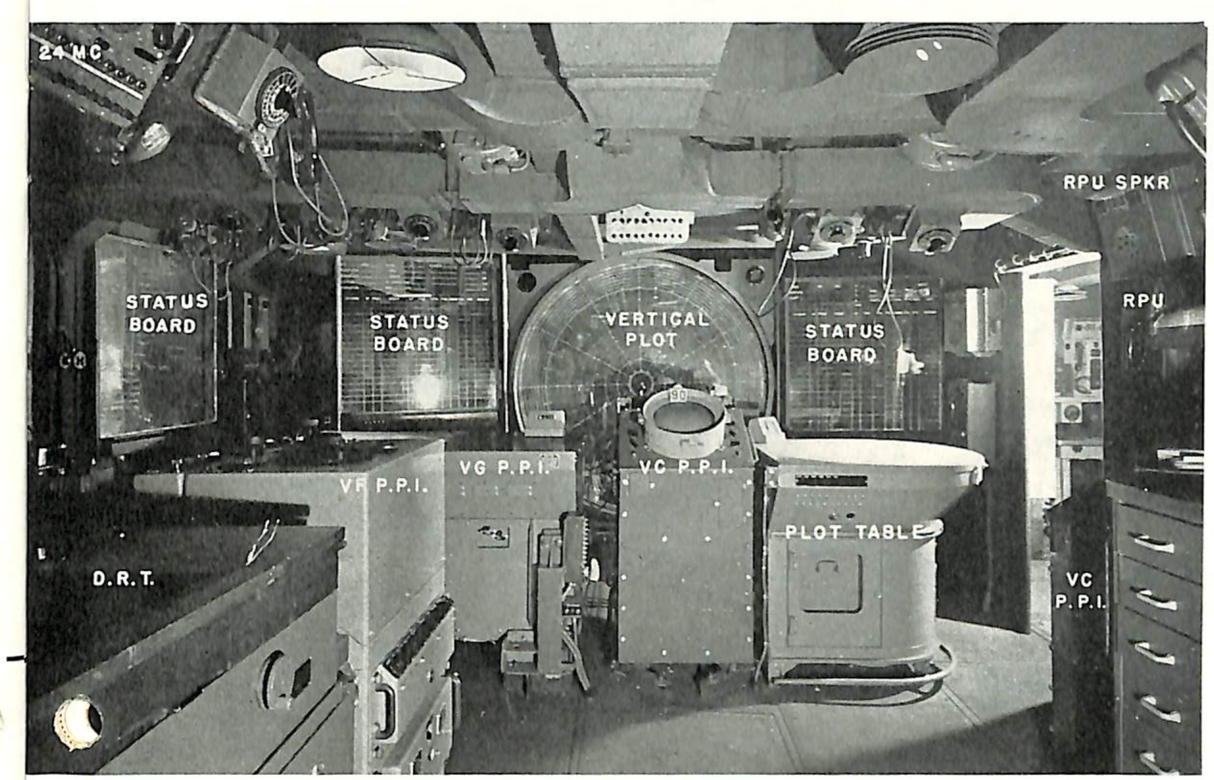
As can be observed from the above list, the amount of electronic equipment is staggering. Efficient operation and maintenance requires a large force of Radiomen, Radio Technicians and Radarmen. The war-time complement of an AGC as directed by the Bureau of Personnel takes into consideration this large demand for personnel as follows:

	2 CRE or RE	
3 CRT	3 CRM	3 CRDM
5 RT1c	6 RM1c	5 RDM1c
7 RT2c	10 RM1c	7 RDM2c
9 RT3c	15 RM3c	10 RDM3c

Each ship will have in training numerous seamen in all three branches which will augment the petty officer complement.

When an Army flag officer is on board his staff usually includes technicians and operators, the number varying with the command. In addition to these technicians and operators there is a complement of army officers (usually four or five) and enlisted personnel, technicians and operators, assigned permanently to the ship.





Starboard side of the Combat Information Center. ▲

▼ *Operating positions, Joint Operations Communication Room.*

MK 28/34 DUTY CYCLE

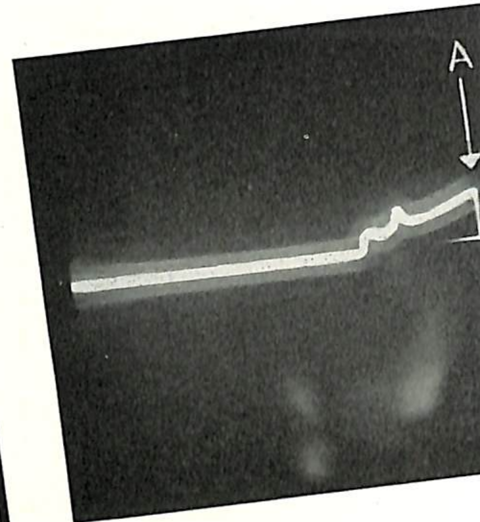


Fig. ~~1~~ 2

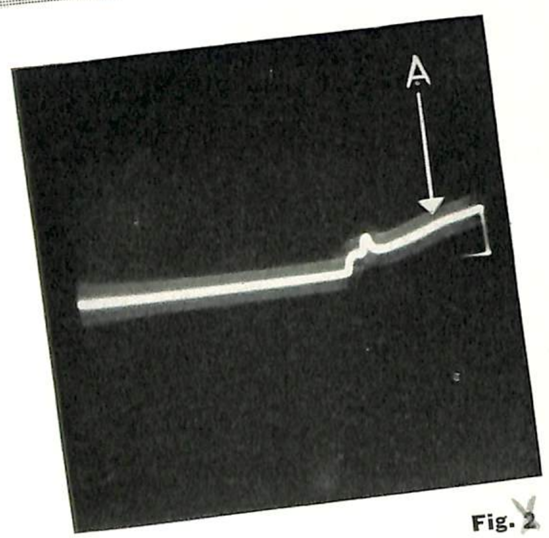


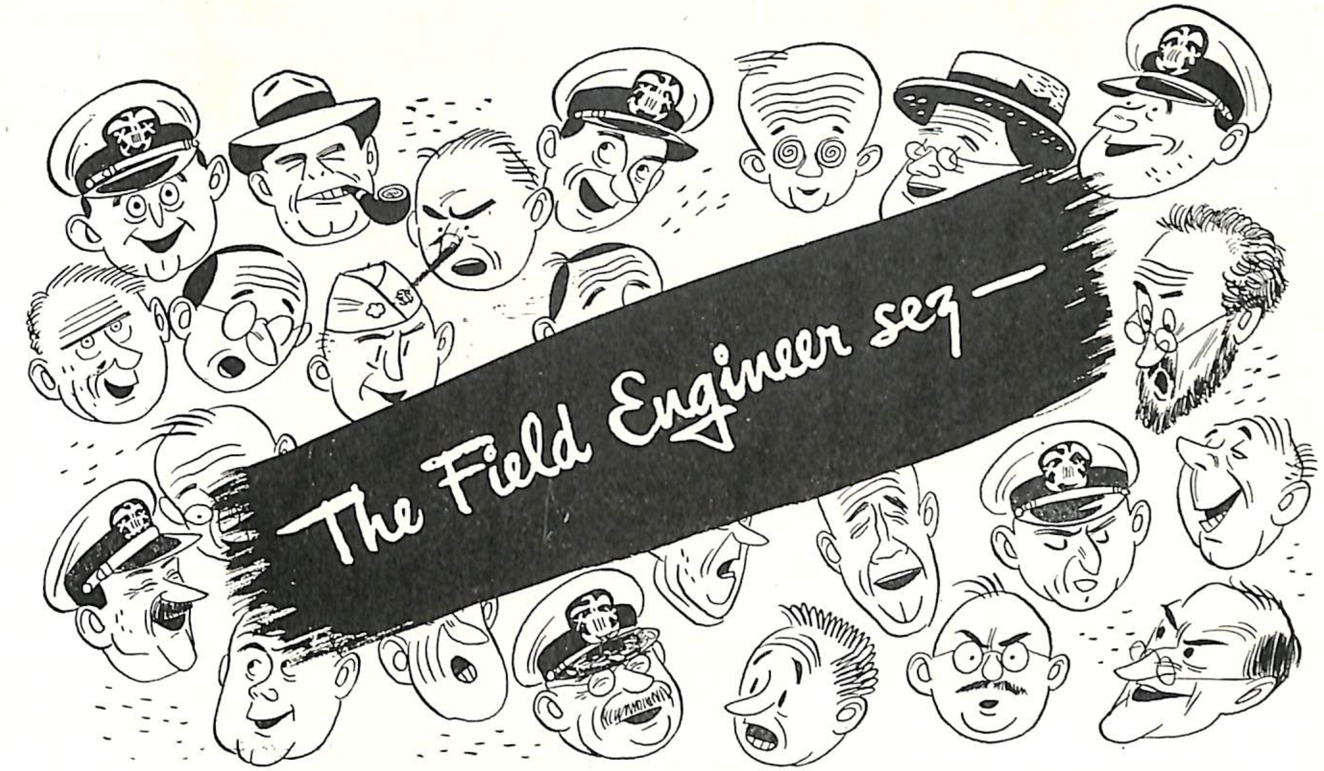
Fig. ~~2~~ 1

■ To compensate for plate voltage variations in the 5D21 modulator tube of Marks 28 and 34 radars, it is necessary to adjust the duty-cycle control on the modulation generator. A field change is contemplated making available a meter for setting the current to 175 milliamperes. To make this adjustment without the use of a meter, the following method is considered suitable.

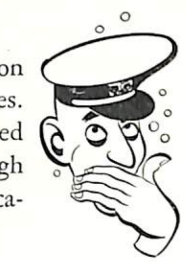
Remove P-304 from the control indicator and connect it through a blocking capacitor to terminal 10 in the modulation generator. Place the equipment in full operation using the main sweep on the control indicator and set the duty cycle control at its mid-position. Vary the horizontal positioning control until the end of the trace can be seen. The pattern on the control indicator scope will be similar to figure 1.

Vary the duty-cycle adjustment on the front panel of the modulation generator until the point where the trace begins to level off (point A in the figures) coincides with the point where retrace occurs. This leveling is very slight, and care must be exercised in making this adjustment. Rock the potentiometer back and forth while watching the pattern in order to achieve as precise a setting as possible. The final adjustment should leave the pattern as shown in figure 2.

It will be noted that the large pip on the trace is approximately midpoint on the trace after the adjustment is made.



SG Repetition Rate



Present SG specifications for position "A" requires a PRR of 800 to 850 cycles. Recently certain 6SN7's in V-401 caused repetition rates up to 925 cycles, though these tubes were within JAN specifications.

It is suggested that the Navy and field representatives be advised that such a condition exists and to switch over to position "B" when trouble is experienced on associated equipment with a 200-mile range.

—*Raytheon*

*

DBM-1 Incorrectly Marked

■ Submarine Signal Co. advises that the DBM-1 true-bearing selsyn G-101 is stamped G-102, and B-102 is stamped B-103. These errors should be noted by maintenance personnel. Future issues of instruction books will point out the error.

*

5J29 Magnetrons

■ Approximately five thousand 5J29 magnetrons manufactured by Federal have been sent to the field. These are not usable until a modification is made in the water-injector tubes. A spare set of water-injector tubes should be obtained (probably from spare parts) and ¾ inch cut off the small end of each tube. The end of the lower tube should then be plugged with a piece of solder and the injector tubes inserted as usual. When 5J29 magnetrons other than Federal are used, the regular injector tubes must be used.

—*E.F.S.G.*

*

Handling Fungus-Proofed Wire

■ There are certain precautions to be observed to avoid skin irritations when handling fungus-proofed Fiberglas-insulated wire.

Insulation skinned from wires should, whenever possible, be placed directly into containers to keep it off the floors, benches or clothing. The dust liberated during the skinning should be picked up by a portable vacuum cleaner at whatever intervals are found necessary in order to keep the benches, equipment and floors clean. Compressed air should not be used for removing dust from benches, equipment or floors. After skinning the wire or handling the skinned wire, wash the hands and arms thoroughly with soap and water.

If an itching sensation on the hands and arms is experienced, refrain from scratching, and wash the hands and arms with water and a good hand cleaner to remove the fine particles of glass. Should skin irritation persist, obtain medical advice for "exposure to Fiberglas treated with fungicide".

—*Western Electric*

Mark 28 Unstable Sweep

■ Some ships have been complaining about a lateral movement of signals on the precision sweep, and a lateral movement of the step and sweep in the main and expanded positions. The amount and frequency of the lateral motion could be controlled by the modulation frequency control in the modulation generator. By using the scope this same lateral motion was traced back to the grid of the multivibrator in the modulation generator, and the trouble was diagnosed as a-c pickup. The appearance of the transmitter pulse and signals on the precision sweep was fuzzy. This trouble was cleared by moving R-583 in the range unit away from the lead between the phasing condenser and the grid of V-506. This resistor was laying against the grid lead giving enough pickup to modulate the grid of V-506.

—Western Electric

*

Due to its very high speed of rotation the SU-1 motor generator servo B-405 must be given special attention to insure long life. Both brushes on the generator end should be replaced after each 1000 hours of operation. After each 2000 hours the machine should be disassembled and cleaned thoroughly with carbon tetrachloride.

—Sub Signal

*

Error in QBE-3 Instruction Book

■ The d-c resistance of the high-voltage secondary of T-106 is listed on the service print and on page 20 of the QBE-3 instruction book as 700 ohms total. This value is also given on schematic 8 (EQ 311), 50.4121, of the Manual for Sonar Field Engineers.

This is incorrect and should be changed to 104 ohms across the entire secondary.

—E.F.S.G.

*

SP Radar Fade Charts

■ Some interesting data was obtained on the SP radar one day when SR fade charts were being made on the DD-832. There seems to have been a very erroneous statement circulated that the SP has no fade areas. On almost any ship that gets an SP, the CIC personnel will tell you something is wrong because when following a plane at 1500 ft. it will disappear at about 35 miles and not reappear again until about 30 miles away.

On these tests the plane used for SR fade charts was followed by the SP also. At 20,000 feet the SP is essentially a fade-proof radar. The plane was followed out to about 65 miles with the expected gradual decrease in echo height until it finally vanished in the grass. At higher elevations the same type of performance might also be expected. As lower altitude runs were made, the fade areas definitely showed themselves. These fade areas, while not so long or pronounced as those of the SR, were nevertheless still there.

The fade areas seemed to show themselves occurring as follows:

20,000 ft.—No noticeable fades.
15,000 ft.—Fade areas at 35 to 40 miles.
10,000 ft.—Fade areas at 30 to 35 miles.
5,000 ft.—Fade areas at 25 to 30 miles.
1,000 ft.—Fade areas at 10 to 15 miles.

These were the results as found in this series of tests for this particular installation. They may vary somewhat between installations, but of all the SP installations observed by the writer, the performance was similar.

—E.F.S.G.

*

Failure of 323-A Tubes

■ A great number of failure reports are being received showing open filaments in W.E. 323-A tubes. Tests show that the trouble is in many cases due to poorly soldered connections to tube-base pins 2 and 4. After a period of time corrosion develops on these pins, causing a high resistance and throwing all or most of the current load on pins 1 and 2. The filament current plus the anode current is too great for the soldered connections inside the tube base, causing the solder to melt. This results in the filament showing an open circuit when checked at the tube pins.

By tilting the tube on its side it is possible to inspect the filament. If it appears in good condition but continuity check indicates an open the following procedure should be employed.

Saw off the bakelite base 1/4 inch above the bottom of the base, being careful not to injure the wires from the tube to the base pins. Using a hot soldering iron on the pins of the tube base, carefully remove the sawed-off section of the base. Check the filament for continuity. If not open, resolder the connections inside the tube base (1 to 2 and 4 to 5). Tin the leads to pins 2 and 4 (copper leads). Clean the solder out of the pins and insert wires in their proper pins. Tape the tube with friction tape and serve with serving twine. Fill the pin holes with solder, allowing some solder to run down on the wires for better connection.

Many "defective" tubes have been reclaimed in this manner.

—E.F.S.G.

SP RADAR

■ Failure of V-107 in the receiver unit can cause burning of the fluorescent coating of the PPI tube screen if the set is not shut off immediately. The tube is normally conducting and places a negative bias of approximately 5v on the PPI grid. Signals cut off the tube and raise the grid to approximately ground potential. Failure of the tube therefore causes the PPI tube to light up brightly. This condition may be rectified by insertion of a .05 μf capacitor in series with the video potentiometer and an increase of the video potentiometer to 1 megohm.

—E.F.S.G.

*

SA, SC AND SK ANTENNAS

■ The increased failure rate of antenna arrays indicates that all antenna framework and dipoles installed directly aft of the stack should be inspected monthly, and all others quarterly.

Stack gasses contain sulphur which forms sulphuric acid when mixed with salt water spray. The atmosphere in the vicinity of the stacks is therefore often permeated with acid particles which greatly accelerate any tendency toward corrosion.

—E.F.S.G.

*

SP B-MODULATOR MODIFICATION

■ As you all know, there must be a major modification to the SP and SP-1M B-modulator before it can be used. Some time ago this modification was made on several equipments and a life test was made to see how the magnetron would stand up with the new circuit. During this life test it was found that the commutator bars of the B-modulator rotary spark gap were burning. The following letter from General Electric Engineer Mr. G. G. Poulsen discusses the trouble and its cure:

"In connection with the burning of the commutator on the Modulator-B Rotary Gap motor we have the following circuit change that should effectively eliminate any burning on the commutator. The burning that occurs at the leading edge of one commutator segment is probably caused by the capacitor inrush current in the PHD relay circuit. This inrush current may be reduced from 730 to 23 mils by placing a 1000-ohm resistor in series with the capacitor. The addition of this resistor eliminates all visual arcing at the commutator. The position of the resistor in the circuit is that found to be most favorable from the standpoint of capacitor inrush current and commutator arcing."

Specifically, the change may be made as follows:

1. Move wire #501 from TB-2306-6 to TB-2306-8. This can be done with very little difficulty. In some cases it may be necessary to move the harness lacing slightly.

2. On the bottom terminal of capacitor C-2302, slip back the insulating tubing and cut off wire #455 at the terminal.

3. Wire #455 may then be brought straight down and forward to TB-2306-8. Measure off the correct length of #455, cut off the excess wire, and attach a terminal to the end of the wire. Connect to TB-2306-8.

4. Take a 1000-ohm, 2-watt resistor (type RC-41) and attach a terminal to each end leaving 5/8" of lead between the end of resistor and the terminal. Bend the leads around so that the terminals span the distance between terminals 6 and 8 on TB-2306.

5. Connect the resistor between terminals 6 and 8 on TB-2306.

As an emergency measure (to help prevent commutator troubles immediately) an equivalent resistor may be used. In this circuit an equivalent resistor is 2 watts and from 700 to 2000 ohms.

—General Electric.

Classifications Reduced

A recent down-grading in the classification of certain equipments has made it possible to reduce the following Bureau of Ships publications from confidential to restricted.

Title	*Short Title*
SA Instructional Diagrams	903-6
SC/SK Instructional Diagrams	903-9
Instructions for the Operation of SO Series Radar	900,014
Instructions for the Operation of SA Radar	900,021
Instructions for the Operation of SF/SF-1 Radar	900,029
Instructions for the Operation of SA-Z-PPI Radar	900,041
SF/SF-1 Instructional Diagrams	900,049
Instructions for the Operation of SA-Z-PPI with JF Receiver	900,050
SG-a/SG-1 Instructional Diagrams	900,056
VF Operation	900,076
SL-a/SL-1 Instructional Diagrams	900,082
Calibration of Shipboard Direction Finders	900,101
Loran Handbook for Shipboard Operators	SHIPS 278
Instructions for the Operation of SC-1 Radar	———
Instructions for the Operation of SG Radar	———

*

DBM-1 Scope Spot Intensity

■ A report has been received that trouble developed in one DBM-1 installation due to intermittent changes in intensity and spot size on the scope.

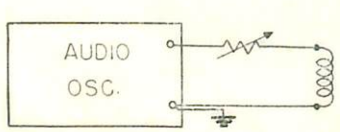
Resistance checks of the high-voltage system indicated normal conditions. A visual check in darkness revealed a breakdown along the entire length of the high-voltage lead between the 2X2 rectifier and the high-voltage transformer. Investigation disclosed that only 500-volt insulation had been used on this lead which was carrying 3600 volts. The wire was replaced with one having 5000-volt insulation and operation returned to normal.

—*E.F.S.G.*

*

Calculating Loudspeaker Impedance

■ Technicians may find it desirable to know the impedance of the voice coil of a loudspeaker. The measurement of this impedance can be made quite easily by using an audio oscillator, a variable resistance, and a high-resistance or vacuum-tube voltmeter.



Connect the resistor and coil to be measured in series across the output of the oscillator as shown in the diagram. With the oscillator output set so as not to overload the speaker, adjust the variable resistor so that the voltage across the resistor and the voltage across coil are equal. The d-c resistance of the resistor is then equal to the a-c impedance of the coil at the frequency supplied by the audio oscillator. Loudspeaker measurements are usually made at 400 cycles.

—*E.F.S.G.*

*

CHECKING TROPICALIZATION

■ All the lacquers used for tropicalizing are colorless in order that the numbers and identification marks on the various components may be plainly seen after coating. The result is that it is not easy, by ordinary visual inspection, to check on the thoroughness and evenness of the spraying.

A simple field check which can be used in the forward areas to discover weak spots in the spraying of suspected parts is to try writing on the lacquered equipment with an ordinary lead pencil. If the pencil goes along smoothly as on glass the spraying is satisfactory. However, if the pencil "starts writing" it has encountered a thin spot. By this method the tropicalization can be checked and touched up in the field.

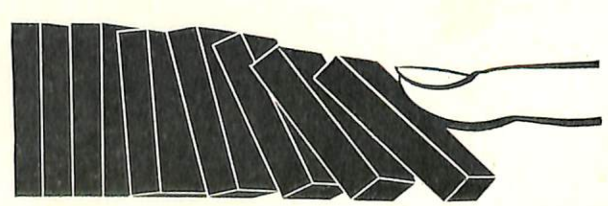
—*E.S.F.G.*

*

CHAIN REACTION

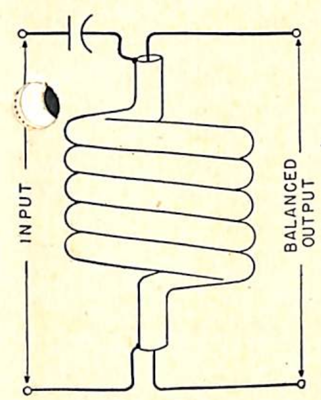
■ To prove that truth is stranger than fiction, we quote a story received from a field engineer. This is what happened in the range indicator unit of an SJ-1 aboard the USS *HOE* (SS-258):

"When the equipment was turned on, no step or precision sweep was present. Inspection showed resistor R76 had rested against grid pin No. 1 of V12 causing an arc to be established, disintegrating R76. The 300 volts from R76 burnt up grid resistor R77. With 300 v d.c. on plate and grid of V12, cathode resistor R80 and R87 burnt out. The excessive 300-v load burnt out supply resistor R74. Plus 300 v on grid of V12 damaged V12. Replaced V12, R74, R76, R77, R80 and R87 and operation was normal."



A Wide-Band Single-End to Push-Pull Transformer

BY LIEUT. CDR. J. C. WALTER, USNR



■ The transformer herein described provides a simple method for converting single-ended transmitters such as TDO and TDH to operate as push-pull or balanced-output devices. No adjustments are necessary over a band from 2 to 26 Mc. Materials required for construction are readily available at most activities.

Electrically, the transformer unit consists of a unity-coupling coaxial winding having the following characteristics: Inductive reactance of primary, secondary, and the mutual reactance between both windings are all equal to 1200 ohms at 2 Mc. A series primary capacitance of 320 $\mu\mu$f is used to reduce the reflected inductive reactance at the lower end of the band, resulting in a substantially constant reflected purely resistive load of 600 ohms when the secondary is loaded with a balanced impedance equivalent of a 600-ohm pure resistance. It can be shown that such a transformer is the equivalent of a shunt inductive reactance equal to the mutual reactance between the windings.

Physically the unit consists of 25 turns of RG-11/U solid-dielectric concentric cable close-wound on a bakelite tube of 8 inches outside diameter. The outer braid is used as the primary (single-end) and the inner conductor as the secondary (push-pull) winding. Unity coupling is provided by this method of winding. The outer sheath of plastic provides sufficient insulation between turns. It is recommended that assemblies of this type be mounted symmetrically with respect to ground, (i.e., horziontal mounting preferred) and that clearance from the winding be not less than 4 inches radially and 8 inches at each end.

Field tests have demonstrated the practicability of such a transformer using a single-end TDH transmitter to excite antennas connected to balanced 600-ohm transmission lines. The elimination of tuned circuits and moving parts has a distinct advantage from both the operational and maintenance points of view, and it is recommended that the system be applied wherever it is desired to use dipoles, rhombics or other balanced antennas remotely located to avoid interaction with other antenna systems.

New Books

RECENT INSTRUCTION BOOK DISTRIBUTION

■ The instruction books listed below have been distributed during the period 15 September to 29 September 1945. These books which have "Ships" short titles are available from Registered Publications Issuing Offices and the others may be obtained from Electronics Officers. Preliminary editions should be replaced with final editions where they are indicated as available.

MODEL	SHORT TITLE	EDITION
AK/SPT-6	Ships 312A	F
AN/SPR-2		P
JT		P
Mark 13	NavShips 900,365	MP
Mark 34, Mod. 2	Ships 358	F
OBH	NavShips 900,472	F
OBU-4	Ships 345(A)	F
QCU/QCU-1 Navy Field Change #5.		
RCH	NavShips 900,339	F
SA/SA-2/SA-3 Field Change #36.		
SF	Ships 314	F
SL, SL-1 and SL-2 Field Change #40, #42 and #45.		
SV	Ships 340	P
TBM-12		P
TBS/TBS-1/2/3/4/5/6/7	NavShips 900,590	F
TDP	NavShips 900,330	F
Teletype Model 14		
TS-295/UP	Ships 311	P
Type CAGQ-24-AAL R/F Changeover Switch.	NavShips 900,665A.	F
Type CAGQ-24-AAP R/F Change-over Switch.	NavShips 900,704	F
Type CAJO-211444 MG Set	NavShips 900,584	F
Type CG-47368 Antenna Coupling Unit.	NavShips 900,571	F
Type CNM-60096 Loop Antenna Assembly.	NavShips 900,505	F
Type CPD-10137 Auto Dryaire Model 2200 Dehydrating Unit.	NavShips 900,517	F
Type CRV-60047, YG and R/F Monitor.	NavShips 900,510	F
Type CUL-49546 Weatherproof and Blast Proof Loudspeaker.	NavShips 900,618	F

■ The instruction books listed below have been distributed during the period 11 August to 8 September 1945.

MODEL	SHORT TITLE	EDITION
AN/UPA-1	Ships 271	P
C-1 Timer Instruction Leaflets.	NavShips 900,221.	
Change #1 to SO-12M/N	Ships 294	F
Change #1 to SR	Ships 235	P
DBB-1	Ships 332A	F
DBM-1	NavShips 900,587.	P
F-19/UPR	NavShips 900,583.	F
Field Engineers Service & Install. Bulletin for SO and SG Series Radar.	NavShips 900,634. NavShips 900,635.	 IB
LAE-2	NavShips 900,518.	F
LAF-1	NavShips 900,585.	P
LAF-3		P
LAH	NavShips 900,550.	F
Mark 3 and 4	Ships 365	F
Mark 8 Mod. 4 Stable Element.		
Mark 34, Mods. 3 and 4	NavShips 900,368.	MP
NMC-2	NavShips 900,595.	P
Navy Field Change #2, #6 for NMC-2.		
Navy Field Change #3 for QGB.		
Navy Field Change #4 for QCQ-2.		
OAO-1	Ships 245	F
PQ/PQ-1	NavShips 900,622.	F
QBD	NavShips 900,270A	F
QBE-1a	NavShips 900,584.	P
RAK-7/RAL-7	NavShips 900,480.	F
RAO-5	NavShips 900,489.	F
RAU-2	NavShips 900,348.	F
RDP	NavShips 900,555.	F
SR-2	NavShips 900,577.	OH
SW	Ships 244A	F
Stable Element and Deck Tilt Corrector for SM Radar.	Ships 337	F
TBK-19	NavShips 900,482.	F
TBW-2/3/4/5	NavShips 900,247.	F
TCJ-2	NavShips 900,529.	P
TCK-7 Change No. 1	NavShips 900,466.	P
TCS-8	NavShips 900,575.	F
Teletype, Instruction Manual No. 22.		
Teletype, Instruction Manual No. 26.		
Trouble Shooting Chart for SO-1/SO-8 Equipment.	NavShips 900,095.	
TS-35A/AP	Ships 339	F
TS-218/UP and TS-62/AP	Ships 366	F
TS-270/UP	Ships 342A	F
Type CAKG-211260, MG Unit.	NavShips 900,286.	F
Type CLG-20206, Power Packs.		
Type CME-50063		
Type CRV-53191	NavShips 900,720.	F
Type CW-50101, Line Amplifier.	NavShips 900,591.	P
TWG	NavShips 900,727.	F
UJ Timer Instruction	NavShips 900,375.	

F—Final
P—Preliminary
MP—Maintenance Print
IB—Installation Bulletin
OH—Operator's Handbook

NEW BOOK

Radar Equipment Log—Restricted—Navships 900,-065. The third of three equipment logs (others cover Radio and Sonar). Distributed to all radar-equipped ships; one book per equipment. 254 pages.

RCU New Service

■ Heretofore the letters RCU have been a descriptive symbol for a radio receiver used by advanced bases. Now they take on a new significance for they also form an abbreviation for the words, "Requisition Control Unit". This new unit, established 1 July, 1945 as a part of Western Sea Frontier, is a centralized control agency for receiving, forwarding, and following requisitions initiated by naval forces in the Pacific for maintenance material other than aircraft.

Ship's requisitions for electronics material are submitted to the appropriate bureau, mainland or forward-area electronics pool. These activities take necessary action with respect to procurement in the case of the bureaus, or to supply material on hand in the case of electronics pools. Any required general supply material not on hand is consolidated into Depot Responsibility Lists and is submitted at regular intervals to the Requisition Control Unit. Proprietary spare parts for BuShips material, including electronics spares, may be obtained by initiating an individual requisition which is forwarded to the Requisition Control Unit, San Francisco, by the supply base. In emergencies, if so desired, material will be delivered direct to the ship requiring it.

The Requisition Control Unit is comprised of four primary groups, Processing, Material, Statistical, and Administrative and Planning. The Processing Group is a service group which receives, sorts, screens, and routes incoming mail and requisitions within the Requisition Control Unit.

The Material Group consists of seven major units, BuShips Spare Parts, Electronics, General Supplies, Submarine, Yards and Docks, Medicine and Surgery, and Ordnance. These units schedule delivery dates, designate ports of trans-shipment, route requisitions to proper supplying activities, follow up requisitions and material to insure compliance with the requested delivery date, and send shipping notices to requisitioning activities and handle inquiries.

The Statistical Group computes estimated shipping space requirements and compiles and analyzes data regarding supply time required by supplying activities. The Administrative and Planning Group is a service group which develops and installs plans for the effective operation of the Requisition Control Unit.

The essential operations performed on the requisitions are as follows:

1. The requisition is recorded and the letter W is added to the requisition number. An additional letter E is added to denote *electronics* material.

2. The requisition is passed to the appropriate supply activity for shipment or procurement of the material required.

3. The requisitioning activity is informed as to the disposition of the requisition involved.

4. Within a specified period the RCU initiates followup to insure that the material requested is either enroute or at the cargo terminal, or that proper steps have been taken to purchase the material.

5. Shipment data is then secured from the trans-shipment point and the requisitioning activity is advised by the Requisition Control Unit.

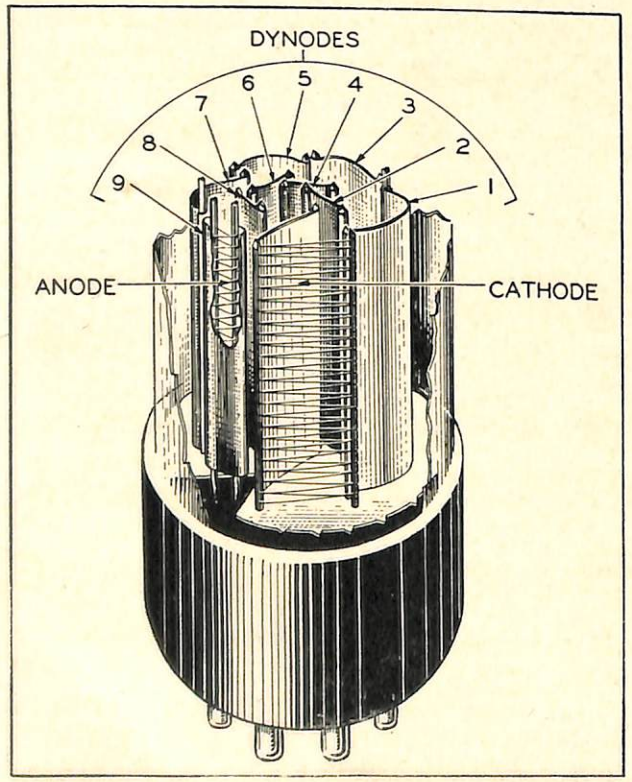
By establishing a centralized control point, the communications load between the Pacific ships and bases and the Continental United States is reduced, methods of requisition processing are standardized, depot work is facilitated, more effective followup is provided, and freight deliveries are coordinated with ship movements and available shipping space.

Electronics officers and supply officers should address all inquiries concerning shipments of material to ComWesSeaFron, Code 3311-E, which is the designation for the Electronics Group within the Requisition Control Unit.

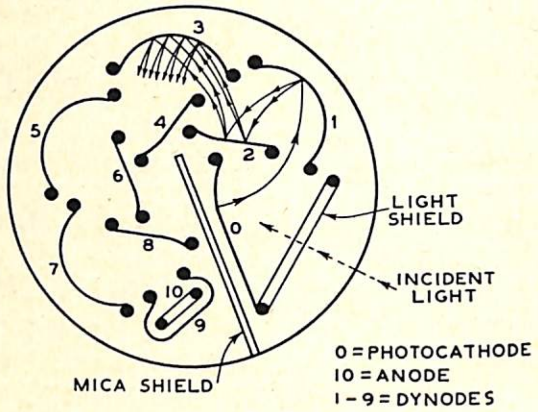
The functions performed by the Requisition Control Unit are in conformance with BuShips and CincPac directives regarding the operations of the CincPac Electronics Pool and comply with the overall procurement and distribution policy concerning major items of Electronics Material now under cognizance of ComServPac.

THE 931-A ELECTRON-MULTIPLIER

■ The type 931 electron tube is a multiplier phototube originally brought out by RCA. The unusual features of this tube are the signal-amplifying elements built within the tube. It employs an S4 photo-surface which is sensitive to blue light such as that obtained from a mercury vapor lamp. The amplification of the 931, that is, the ratio of the anode sensitivity to the cathode sensitivity in microamps per lumen, was first rated at a minimum of 60,000. As more tubes were made and the techniques improved, this factor was raised to a minimum of 75,000 and the tube designation was changed to 931-A. The average amplification value for the 931-A is 200,000. Certain individual tubes have even higher amplification factors, and in order to separate these tubes for very critical applications they are designated 1P21, and have an average amplification value of 300,000, with some tubes going over 1,000,000.



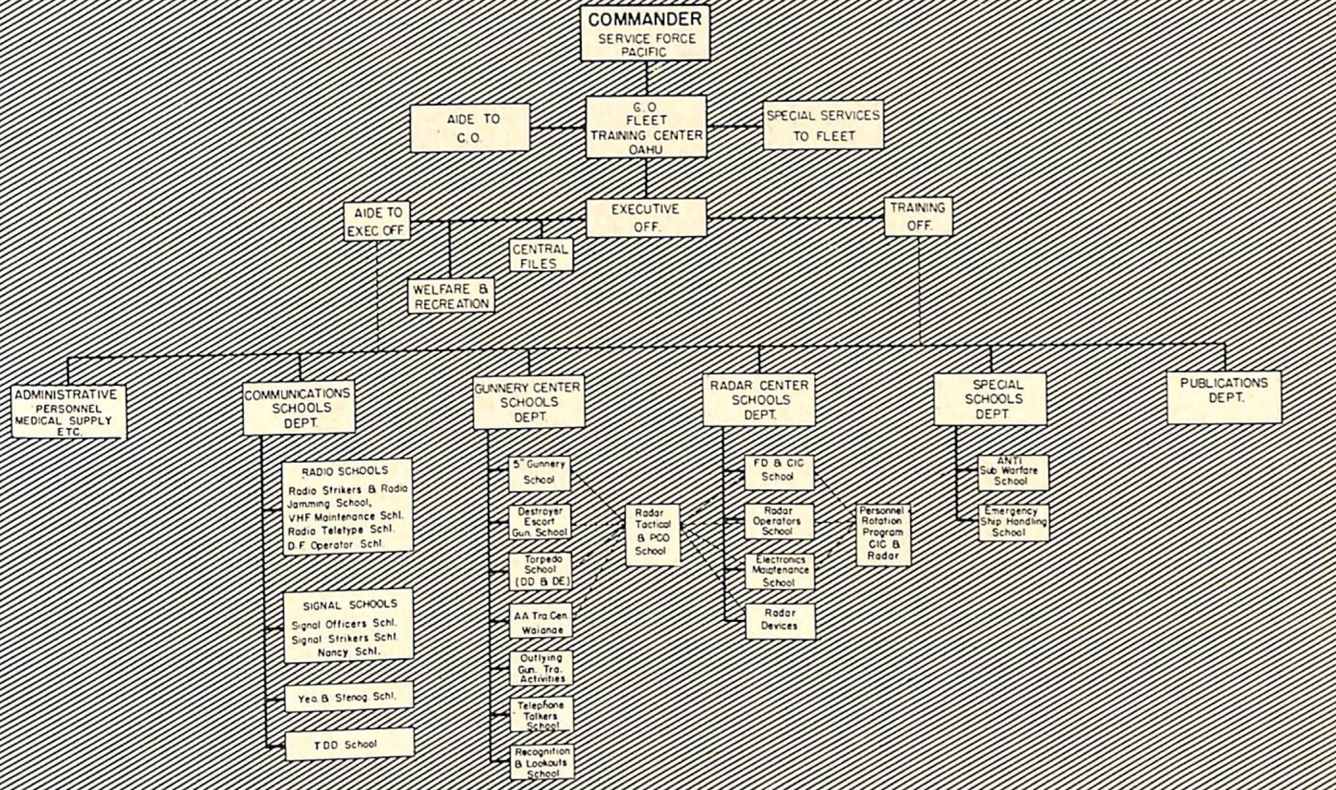
The multiplier phototube utilizes the phenomenon of secondary emission to amplify signals from the cathode. The cathode is coated with a photo-sensitive material and emits electrons when illuminated by an external light, the emission being proportional to the intensity of the light. These electrons are directed along curved paths by fixed electrostatic fields as they are attracted to the first *dynode* (secondary emitter electrode) where they dislodge other electrons, the number depending on the energy of the impinging electrons. These secondary electrons are in turn guided to the second dynode and the process is repeated. The same procedure follows in each successive stage with additional multiplication occurring at each dynode until the electrons emitted by dynode 9 are finally collected by the anode, where they constitute the signal output of the tube.



Another difference between this tube and ordinary phototubes is the shape of the anode. The anode assembly consists of a grid (see part #10 in the figure) which allows electrons from dynode 8 to pass through it to dynode 9. The spacing between the anode and dynode 9 is close, and as a result dynode 9 creates a collecting field such that all of the electrons it emits are collected by the anode. Thus the output current is essentially independent of the instantaneous positive anode voltage over a wide range.

The mica shield which extends between the photocathode and the anode prevents positive-ion feedback. If the ions produced in the high-current regions near the anode were allowed to reach the photo-cathode or the early dynode stages, they would cause the emission of spurious electrons which, after multiplication, would produce undesirable and uncontrollable regeneration.

Convenient control of the amplification of the 931-A or 1P21 can be obtained with a small sacrifice in sensitivity by defocusing the electron paths. This is accomplished by changing the potential applied to one of the dynodes.



Organization of Fleet Training Activities

■ The Fleet Training Center, Oahu, was formally commissioned on 3 August, 1945 for the purpose of coordinating and administering the various individual schools and associated activities formerly operated as the Pacific Fleet Schools and Pacific Fleet Radar Center.

More than a simple change in name results from the commissioning of the Fleet Training Center, Oahu. With its inception the administrative features of the training activities were streamlined to bring them into line with the requirements of the individual schools which, since the original administrative organization was established, have increased in number and size by well over 100 per cent.

The objective of this training command has been to allow staff personnel of the various schools to concentrate solely on training, and to free them from every possible administrative function. This is attained with greater efficiency under the new command, organized as it is to handle effectively all administrative matters relating to operation of the schools it embraces.

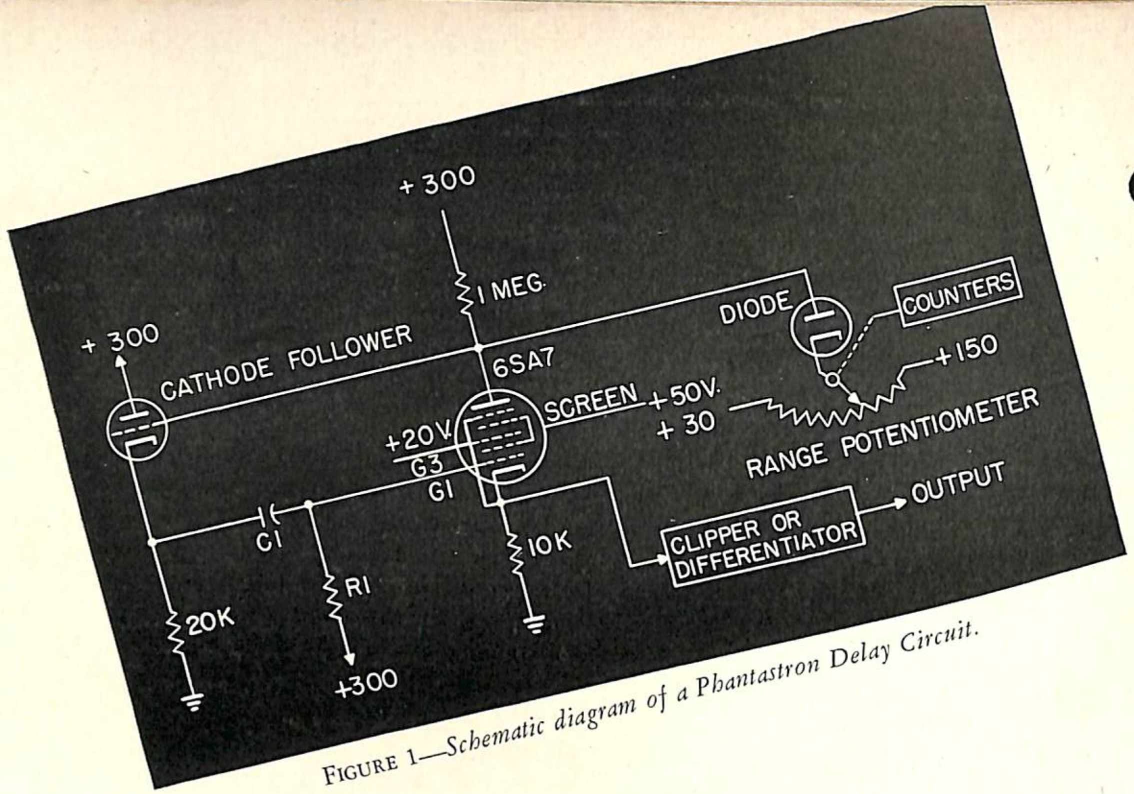


FIGURE 1—*Schematic diagram of a Phantastron Delay Circuit.*

The Phantastron Circuit

By J. J. Stone, Jr., Ensign, USNR, Instructor, Radio Matériel School, Bellevue, D. C.

■ Accurate measurement of range in a radar system is normally accomplished by the movement of a step or spot across the time base. The time interval between the start of the time base and the occurrence of the step is indicated, directly in yards, by counters attached to the ranging system. As the counters are moved, an arm of a potentiometer is likewise rotated so as to change the reading of the counters into a corresponding value of control voltage. The value of the control voltage should directly determine the position of the step or spot on the scope.

This has been accomplished in the past by applying the sweep (time base) voltage to the control grid of a tube whose cathode potential is the control voltage. When the grid voltage rises to a point where the tube will conduct, as determined by the control voltage on the cathode, a waveform will occur at the plate which may be used as a step. As the control voltage is increased the tube will conduct at a later and later point on the rise of voltage applied to its grid, and the step will "move" across the time base.

This system is fundamentally sound, but there are definite disadvantages. The sweep voltage is normally a portion of an exponential. To track the step with the range counter requires the use of an exponentially-tapered potentiometer, which is difficult to construct. Furthermore, if applied voltages or circuit components are changed, the tracking will be adversely affected. Calibration must be checked against some standard frequency. The current of the step-generating tube will flow through the range potentiometer, thus affecting the voltage distribution across it.

The phantastron circuit, figure 1, will remove the step-generating circuits from the sweep channel and furnish a step whose tracking will be simpler and more stable. This circuit is triggered coincident with the starting of the time base and the trailing edge of its output waveform is used as a step. A linear change in the voltage applied to the circuit from the range potentiometer will result in a linear movement of the step along the time base. This will allow the use of a linear potentiometer for control, which may be easily wound and tracked with the range dials. Current from the circuit will not be allowed to flow through the potentiometer so there will be no effect on the voltage distribution along the potentiometer. This will permit the use of smaller wire and more turns per inch, improving the linearity. It does require the use of extra stages and a voltage-regulated power supply, but in some cases the advantages will overshadow the added components.

The circuit consists of a 6SA7 (the phantastron) along with a cathode follower and diode. The control voltage is supplied the circuit by the diode and due to current through the 1-megohm plate load of the 6SA7 the plate will assume the value of applied control voltage. Grid 1 of the phantastron is returned to B+ through R-1, so the tube will be drawing grid current and will be biased close to zero. High space current will hold the cathode potential high and the screen grid and grid 3 of the tube are returned to a low value of voltage. In the neighborhood of the screen grid and grid 3 there will be an electron cloud which repels any electrons attempting to reach the plate.

Triggering is accomplished by applying a positive pulse to grid 3. This will lessen the effect of the electron cloud and some current will get through to the plate, resulting in a drop in plate voltage. The cathode follower applies this negative swing through C-1 to the grid of the phantastron, reducing the grid potential, cathode potential and space current. Since the cathode potential dropped, there will be a greater cathode-screen and cathode-grid-3 voltage which further reduces the electron cloud and increases plate current. The screen current falls off, allowing the plate current to increase. This action continues until the grid has fallen to a slightly negative voltage. Here the control grid will limit the amount of current that can reach the plate, and regenerative action will stop.

The screen will then reduce the electron cloud, allowing the circuit to begin functioning as a simple, high-gain amplifier. C-1 begins to discharge through R-1, allowing the grid to move in a positive direction. The change at the grid is amplified and applied to the left-hand plate of C-1. This action is degenerative, tending to prevent a change of grid 1 voltage and maintaining a constant discharge rate of C-1 (by holding the drop across R-1 constant). C-1 discharges linearly, resulting in a linear fall of plate voltage.

When the plate voltage has fallen to near the cathode voltage, a further increase in the grid potential will fail to increase the plate current. The grid will then begin to rise much faster as C-1 discharges, lifting the cathode potential up and reducing the cathode-screen and cathode-grid-3 voltage. An electron cloud will begin to reform and the plate current will be reduced, resulting in a positive rise at the plate. This will drive the grid further positive, returning the stage quickly to its static condition.

The pulse width, as seen in the above explanation, is the time necessary for the plate voltage of the phantastron to reach the cathode voltage. This is determined by the starting point and the rate of fall (set by the product of R-1 and C-1). Varying the starting point of the fall will then vary the pulse width. The starting point may be controlled by the setting of the range potentiometer, and a linear change in the voltage applied will cause a linear change in the pulse width, since the rate of fall in the plate voltage is constant. The RC product is set during calibration so that the pulse width will track properly with the setting of the range dials.

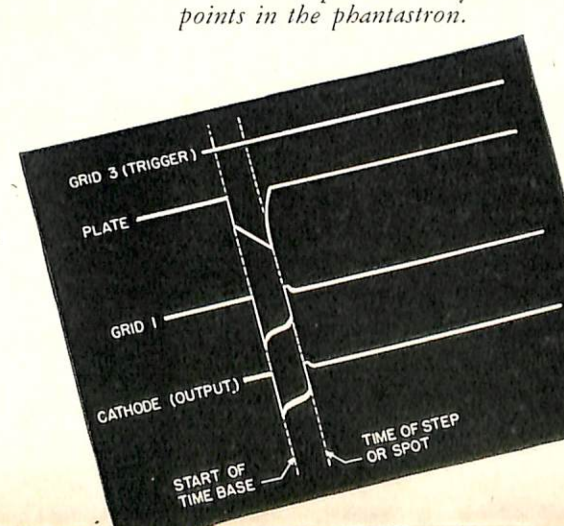
A large value of plate load was used in order that the gain of the phantastron during the cycle may be as high as possible. The higher the gain of the stage, the more linear will be the fall of voltage at the plate. In order to maintain a high plate load and in addition prevent shunting this load with the grid circuit of the phantastron, a cathode follower was used to couple the voltage back to the grid.

When the plate moved negative the diode was cut off. This removed the range potentiometer from the circuit so that the voltage distribution across the potentiometer was not affected. This also allowed a low resistance (wire-wound) potentiometer to be used without danger of shunting the plate load of the phantastron.

The output, the trailing edge of which is used as the step, is normally taken from the cathode of the 6SA7. This is not completely satisfactory since the negative pulse is not square. Squaring is accomplished by placing a clipper stage in series with the output. If used as a spot, the output may be differentiated by a small time constant RC circuit placed across the cathode, using the trailing positive pulse as a spot voltage.

The voltage values in this circuit are critical and once set must be maintained for stable operation. This will require the use of a voltage-regulated power supply for best results where the primary voltage supply may vary widely.

FIGURE 2—*Time relationships and waveforms at several points in the phantastron.*



Using the OBU Echo Box with Mk 27

■ In checking the system performance of the Mark 27 when there is a lack of suitable targets, a tune-up procedure using a tunable *S*-band echo box can be employed.

If the type 47AAP directional coupler supplied with the OBU-4 echo box is not available, the echo box may be patched into the Mark 27 waveguide by means of a short length of flexible coaxial cable plugged into the Holmdel coaxial jack adapter, which is supplied with the CW-60ABM wavemeter, inserted in the standing wave detector receptacle and set at the bottom of its travel. The echo box is then tuned to the magnetron frequency and all r-f adjustments are made to obtain a maximum ringing time as observed on the Mark 27 range indicator. Using this method it is possible to obtain a ringing range of approximately 4500 yards.

Certain inherent limitations must be recognized and allowed for when using a probe pickup with an echo box. The degree of coupling is unknown and not reproduceable, so comparative performance checks are not possible. The coupling is not directional and so both direct and reflected power will be coupled to the echo box. The coupling should be as loose as possible, i.e., minimum insertion of the probe which will give satisfactory measurable ring time should be employed.

■

Standard Patching System

■ The need for standardization of components, methods of installation, and wiring practice in both AF and RF distribution of signal energy has existed for several years. The Bureau of Ships has under engineering development a complete line of audio- and radio-frequency components for Naval shore radio stations.

The plan calls for standardization of signal-distribution methods from all types of antennas—10 kc to 140 Mc — in current use, including r-f distribution to the receivers and a-f distribution to load and signal circuits. Where necessary, modification kits will permit rack mounting of most standard Navy receivers and test equipment. Where replacements or additions are necessary, outside r-f transmission lines will be run in special jute-protected armoured 70-ohm RG-35/4 cable. 70-ohm RG-11/U will be used for inside distribution. A-f distribution will be above ground, balanced, shielded, and be of standard 600 ohms impedance.

A universal cabinet-type relay rack 84" high will be provided for mounting rack panels. Installation of doors in the front or back of the cabinet is optional. The panel-mounting rails are adjustable to permit flush or recess mounting of equipment.

Inclusion of an antenna comparison selector switch, a-f channel selector switch, and instrument panel will facilitate flexibility and rapid operational analysis.

■

Keep 'Em Covered

■ Remember to keep all crystals used in microwave radars stowed in a metal box or wrapped in metal foil. Failure reports continue to come in which tell of the loss of sensitivity of these crystals by exposure to neighboring r-f fields when these simple precautionary steps are not taken. And it ain't easy to get new crystals!

■

LORAN FIELD CHANGES

■ There has been considerable confusion caused by the various models of loran and the field changes for these equipments. At the beginning of the loran program there were only a few modifications to the equipments. However, with the advent of new and non-interchangeable models, and the necessity of fairly extensive modifications, it has become necessary to revise and integrate the whole loran field-change program.

In Supplement #5 (November) to the CEMB will appear an extensive article describing the various loran field changes and assigned field change numbers and titles. These numbers and titles supersede all previous modification data, as it is the Bureau's intent to put the loran field changes on the same system as now used for radar and sonar.

■

FLEET TRAINING CENTER ON MK 28

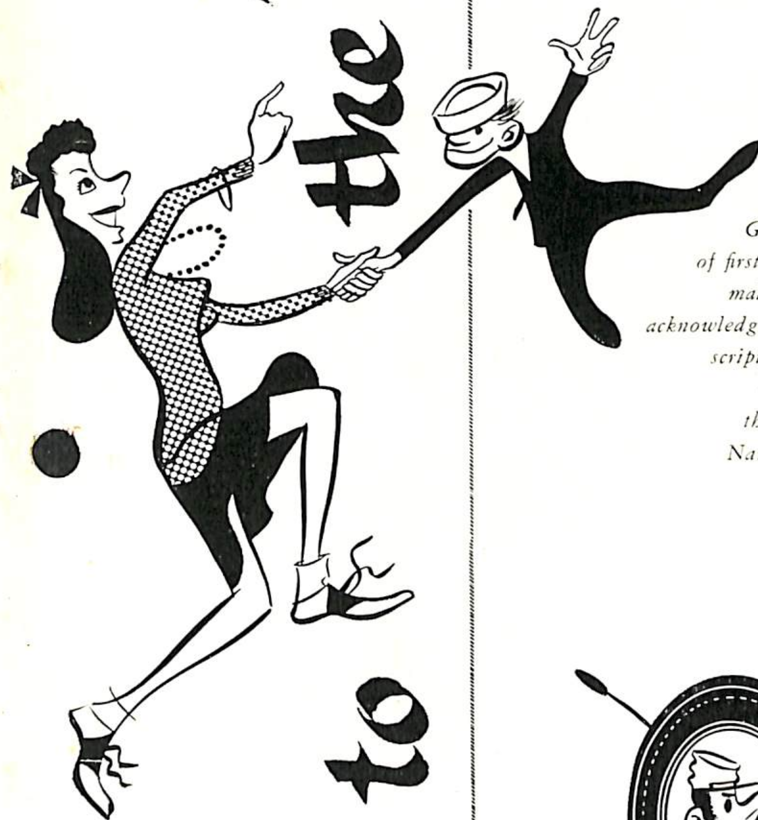
■ The following notes were among Mark 28 material submitted by the Fleet Training Center, Oahu.

Tuning on the transmitter pulse: If no echoes are available and it is desired to peak-tune the r-f system, the following procedure is suggested. Pull out the i-f *IN* plug in the oscillator-amplifier unit, decoupling until the transmitted pulse appears on the scope as an unsaturated echo. Then make r-f adjustments to peak the transmitted pulse. Decouple the i.f. into the first 717-A as is necessary to bring the pulse down from saturation. Never tune on "grass", as it is unreliable.

Tuning with the automatic gain control: It is impossible to tune sharply by a visual echo on the range scope. If an echo is available, gate it; or if none is available, decouple the i.f. and gate the transmitted pulse as described above. Switch to AGC and place a high impedance d-c voltmeter from the cathode of V-301 to ground. As the system is tuned, a dip will occur in the AGC voltage at the point of maximum signal strength. The dip on the meter is a much sharper indication of correct tuning than the visual peaking of an echo.

Send it to the Forum

Pictures of Novel Installations



Improved performance

The FORUM invites contributions from Marine, Coast Guard and Navy technical personnel. Let us have the advantage of first-hand accounts of your personal experiences in installation and maintenance of electronic equipment. All contributions will be acknowledged, and credit will be given to the author of any signed manuscript. Photographs and diagrams should accompany the manuscripts which should be sent, via your Commanding Officer, directly to the Editor, BuShips ELECTRON, *Bureau of Ships, Code 993B, Navy Department, Washington 25, D. C. Individual methods, techniques, gadgets, suggestions for improving performance or the safety of equipment, novel methods of trouble-shooting or of installation, discussions of circuit peculiarities, or any technical subject that might be helpful to your fellow technicians will be proper material for the FORUM.*

Methods and Techniques

THIS magnificent reproduction of one of the great works of Otto Zilch is presented as a special feature for those nontechnical people who handle this magazine between the time it leaves the press and the time it reaches the Radio Technician. The part INSIDE the magazine is prepared especially for maintenance personnel, and contains information needed by fleet and field electronics ratings to keep them posted in their specialty. Won't you help us to make this confidential publication accessible to those who need it most?