CHAPTER 8

SONAR EQUIPMENT

The future success of the Navy in maintaining control of the seas will depend to a considerable extent on her ability to cope with the high-speed nuclear submarines.

Immediate and compelling, then, is the need for submarine detection capabilities at significantly increased ranges, with reliable performance independent of the water characteristics of any particular operating area.

Sonar sets are used for detecting, tracking, displaying underwater targets, and navigation. This is accomplished by echo ranging and passive listening. Target presentation is provided visually on indicator scopes and audibly by loudspeakers or headphones.

Passive (listening) sonars are used more aboard submarines and at harbor defense activities than aboard ships. Therefore, they are not covered in as much detail in this chapter as are the active sonars.

SURFACE SHIP EQUIPMENTS

Sonar equipment installed on board surface ships include hull-mounted equipments, variable depth equipments, mine hunting equipments, fathometers and sonar accessories. Representative types of these equipments follow.

SONAR SET AN/SQS-4( )

The AN/SQS-4( ) search sonar is an old set which is found on a few ships of the active fleet. It operates on the azimuth scanning principle. Like other scanning sonars, it is an omnidirectional echo ranging and passive listening equipment. It provides a continuous video display of acoustic reception in all directions, and an audio response from any desired single direction.

The AN/SQS-4 also has a built-in test set and control unit. The test set and its control provide facilities for testing and calibrating the sonar system, and for training sonar operators in the use of the system.

Most of the AN/SQS-4 equipments have been modified. The modifications (identified as MODS 1 through 4) can operate in the RDT mode and have received new designations as shown in table 8-1.

Table 8-1

OPERATING FREQUENCY	NEW DESIGNATION	OLD DESIGNATION
8 kHz	AN/SQS-29 ( )	AN/SQS-4 Mod 1
10 kHz	AN/SQS-30 ( )	AN/SQS-4 Mod 2
12 kHz	AN/SQS-31 ( )	AN/SQS-4 Mod 3
14 kHz	AN/SQS-32 ( )	AN/SQS-4 Mod 4

SONAR SETS AN/SQS-29( ) TO -32( )

The AN/SQS-29( ) to -32 sonar sets are identical except for frequency determining components. Because of this similarity, only the AN/SQS-31 (fig. 8-1) is shown as representative of all of these equipments. The frequency bands are spaced so that interference between sets is held to a minimum. The nominal operating frequency of each is listed in table 8-1.

These sonar sets offer a choice of pulse lengths, namely 2, 7, 30, or 120 milliseconds. The pulse length controls the amount of energy leaving the transducer. The power output can vary between 4 KW in handkey modes to 50 KW in normal echo ranging modes.

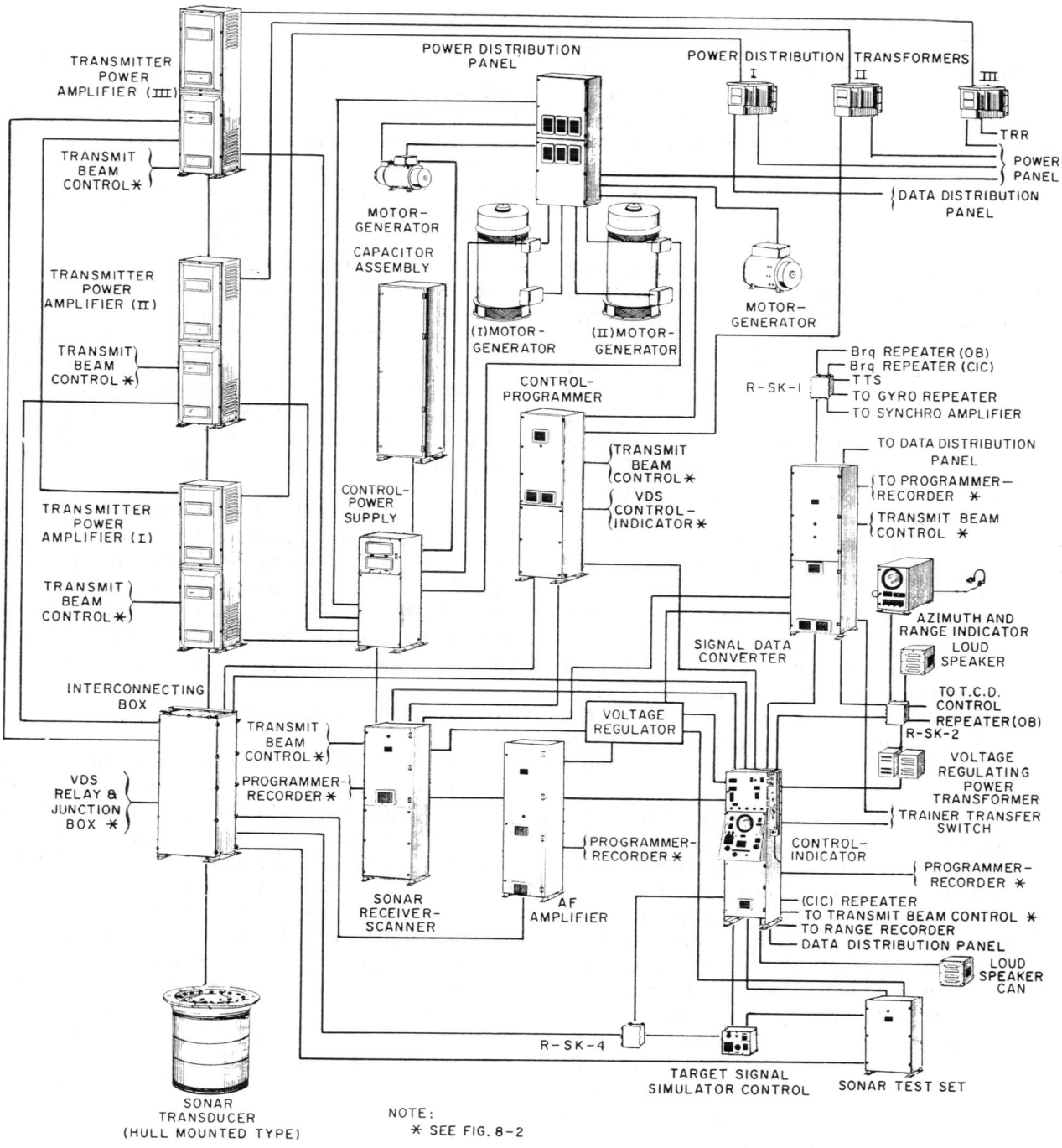

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Figure 8-1.—Sonar Set AN/SQS-31 system.

Available modes of operation are (1) listening for echoes without transmitting (passive listening), (2) echo ranging at 1000, 2500, 5000, 10,000, 15,000 and 30,000 yards, (3) omnidirectional transmission and (4) rotating directional transmission (RDT).

When the equipment is set for passive listening, the scope picture is a continuously expanding circular sweep using the outer two-thirds of the PPI. The sweep recycles at the same rate as the 5,000 yard scale. Signals from an underwater noise source appear on the screen as a narrow radial line or a wedge of light. Bisecting the wedge with the cursor gives the bearing of the noise source. Range cannot be determined because the noise source is not returning an echo.

In the echo ranging mode of operation, the cycle commences with the cursor appearing on the PPI scope at the instant a transmitted pulse is leaving the transducer. After the pulse is transmitted, the cursor disappears from the scope, and an electron beam spirals out from the center of the screen in an ever enlarging circle at a rate proportional to one-half the speed of sound in sea water. Sweep of the electron beam is synchronized with the rotation of the video scanning switch in such a way that a returning echo brightens the scope at a spot corresponding to the range and bearing of the object that produced the echo. Because the system is alert in all directions and echo indications remain for a short time on the screen, the scope becomes a map of all echo-producing objects in the vicinity of the ship. After each scan period, the circular sweep fades out (or blanks), the transmitter is energized with a new pulse of energy, the cursor reappears, and a new cycle begins.

When operating in the rotating directional transmission (RDT) mode of operation, the total power available for omnidirectional transmission will be concentrated into a directional transmission beam that covers a narrow sector at any given instant. This beam is then caused to rotate a maximum of 360° in azimuth around the ship. Coverage is limited to a maximum of 300° and a minimum of 30°, selectable by the operator. In normal operation for search, the transmit sector width is 300° oriented about the ship's bow. The benefits attained from RDT are greater power of transmission and improved ranges.

The AN/SQS-29 to -32 series have a test set and control unit as a part of the system. The test set and its control unit provide facilities for testing and calibrating the sonar receiving system.

These sonar sets, along with later sonars, may utilize Acoustic Short Pulse Echo Classification Technique (ASPECT) equipment, giving a short burst of transmissions in a steered beam for greater accuracy in classifying sonar contacts.

When ASPECT equipment is installed (fig. 8-2) a transmit-beam control and a programmer-recorder are added to the sonar equipment. The transmit-beam control has a steered beam transmit scanner for short pulse operation. The programmer-recorder controls transmission and reception periods and receives the returning short pulse-echoes, printing them on a recorder chart. Programming eliminates the necessity of continual changes as the range increases or decreases. Since the sonar scope is blanked during ASPECT operation, this gives the highest information rate while minimizing the probability of losing the target echo due to changes in range.

A few of the AN/SQS-29 to -32 series are further modified to permit use of the AN/SQS-10 variable depth sonar (discussed later in this chapter).

When the AN/SQS-29 to -32 series receives the MARK (Maintainability And Reliability Kit) modification, the sets will become the AN/SQS-39, -40, -41, and -42 series sonars. The MARK program is a combined effort to extend the usable life of the sonar sets and improve their operation and maintainability.

SONAR SET AN/SQS-23( )

The AN/SQS-23( ) sonar detecting-ranging set is a scanning type of search and attack sonar equipment which uses some of the desirable features of the AN/SQS-29 to -32 series of sonars. Besides passive listening, as with all sonars, it will echo range at any one of six range scales; 1000, 2500, 5000, 10,000, 20,000 and 40,000 yards with a 5 kHz operating frequency and pulse lengths of 2 (later models 5), 30, or 120 milliseconds.

A directional sonic beam rotates around the transducer to form the echo ranging transmissions. The transducer is designed so that it can be excited without damage at moderately high-power levels. The transmission frequency of the equipment, combined with rotating directional transmission (RDT), makes this set effective for longer range target detection than previous sonars.

Features incorporated into the AN/SQS-23( ) include: (1) a means of lowering or raising the normal operating frequency a slight amount to minimize interference during multiship

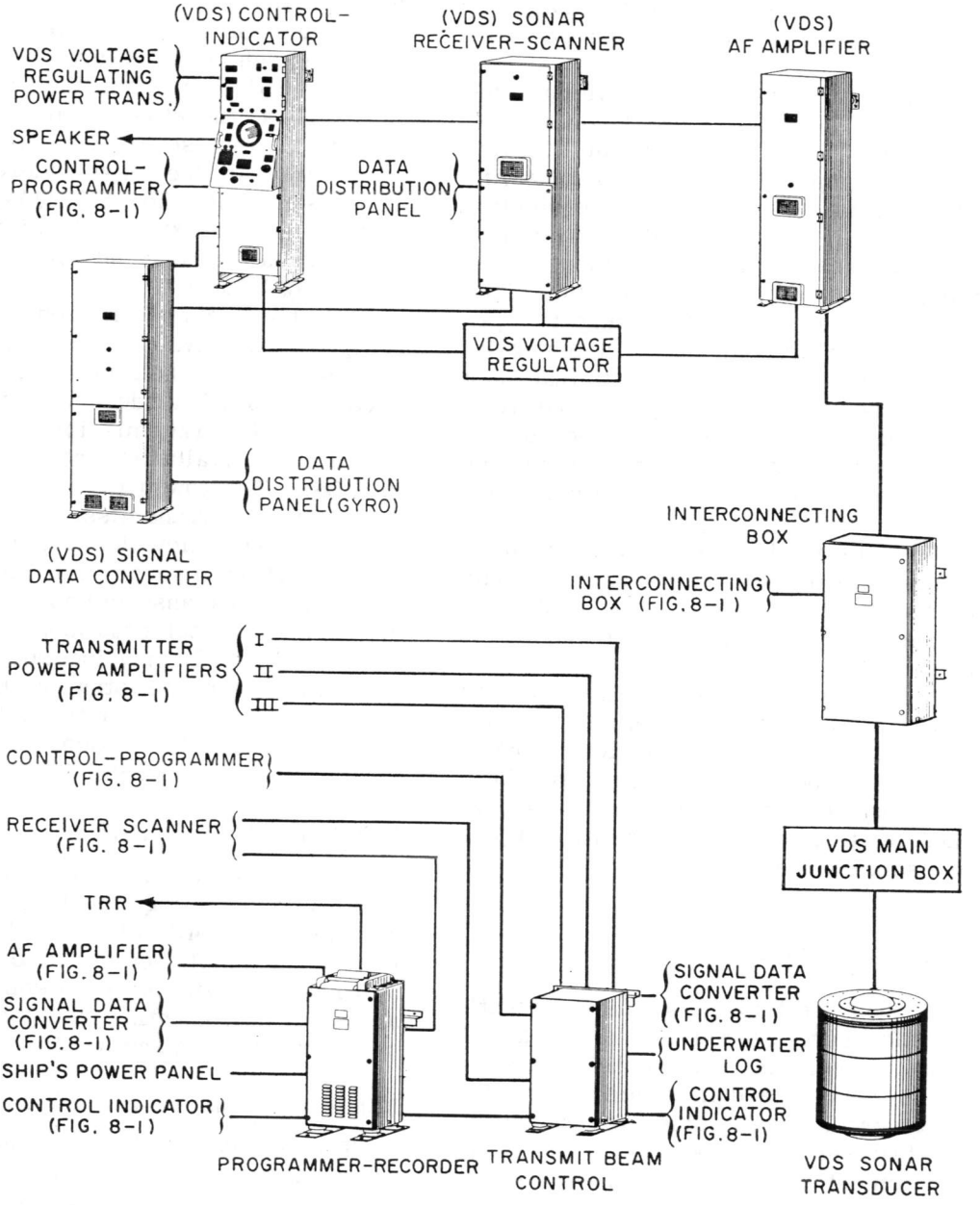

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Figure 8-2.—ASPECT system and variable depth sonar AN/SQA-10.

operations; (2) a beam depression control that permits a downward tilt of the transmitting and receiving beams for use in maintaining contact with close targets; (3) a built-in test set for use in evaluating the overall performance of the system; and (4) a unit for inserting synthetic and maneuverable target signals into the receiving circuits to provide for operator training.

Special programs have been developed for later models of the AN/SQS-23( ) sonar sets. These include TRAM (Test Reliability And Maintainability), and PAIR (Performance And Integration Retrofit). When the equipment has either the TRAM or PAIR modification, the Performance Monitoring Equipment (PME) is an integral part of the sonar system. This eliminates the necessity of having to open various receiving units to obtain a test point for metering and monitoring circuits that must be checked and adjusted for peak operation. The PME may also be used to record and reproduce taped signals for the indicator scope and loudspeakers for training in tactical situations.

The Test Reliability And Maintainability (TRAM) improves the test, reliability, and ease of maintenance of the sonar sets. This is accomplished by modifying the transmitting system.

The Performance And Integration Retrofit (PAIR) will improve total system performance by replacing the entire receiver indicator group.

When these special programs have been completely installed in the present AN/SQS-23 it is scheduled to be designated the AN/SQQ-23 integrated sonar system.

SONAR SET AN/SQS-26( )

The AN/SQS-26( ) sonar is a more recently developed advanced search track and attack sonar that represents a radically improved approach in concept and in application to the present-day problems of submarine detection. Detection features and operational flexibility of this equipment permit long-range coverage independent of the depth and speed of the target.

The 5 basic modes of operation for the AN/SQS-26( ) are: (1) omnidirectional transmission (ODT); (2) rotating directional transmission (RDT); (3) convergence zone (CZ), (4) bottom bounce, and passive detection.

VARIABLE DEPTH SONAR SET AN/SQA-10

Essentially, the variable depth sonar (VDS) is a conventional sonar that is modified to transmit and receive signals through a transducer contained in a towed vehicle (fig. 8-3). By means of a crane type hoist and a tow cable, the vehicle is lowered below the interferring thermal layers and then towed behind the ship. Thus, the effect of the surface thermal layers on the sonar signals is minimized.

At present, the most widely used variable depth sonar is the AN/SQA-10 Sonar Set. This set is used extensively with the AN/SQS-29 to -32 sonar series and sometimes with Sonar Set AN/SQS-23( ).

With the VDS modification, transmission and reception are available through either of two transducers, one hull mounted and the other a variable depth transducer. Either omnidirectional or RDT transmission, as selected by the operator, is available through each transducer in VDS. The towed or variable depth transducer permits transmission and reception at a selected depth below the surface of the water to achieve optimum sonar performance, and repositioning of the transducer as oceanographic conditions and tactical situations change. The VDS system (fig. 8-2) may incorporate its own receiving and display system, or use the normally installed equipment. In the latter case the operator selects the transducer to be used by means of a selector (Hull/VDS) switch.

MINE-HUNTING SONAR

Mine hunting includes all measures of accurately detecting, locating, identifying, and clearing mines INDIVIDUALLY. The clearance may be accomplished by explosive destruction, by rendering safe, or by sweeping. The following are two mine-hunting equipments which are used for detecting and locating mines.

Mine-Detection Set AN/SQQ-14

The AN/SQQ-14 (fig. 8-4) is a dual-purpose sonar, which can be installed either as a hull-mounted sonar or operated as a variable-depth sonar. When operating as a VDS system, a towed body is used to house the transducers making it possible to operate at various depths. The high detection probability of the set is accomplished by a wide scanned field of view and a high resolution in both range and azimuth.

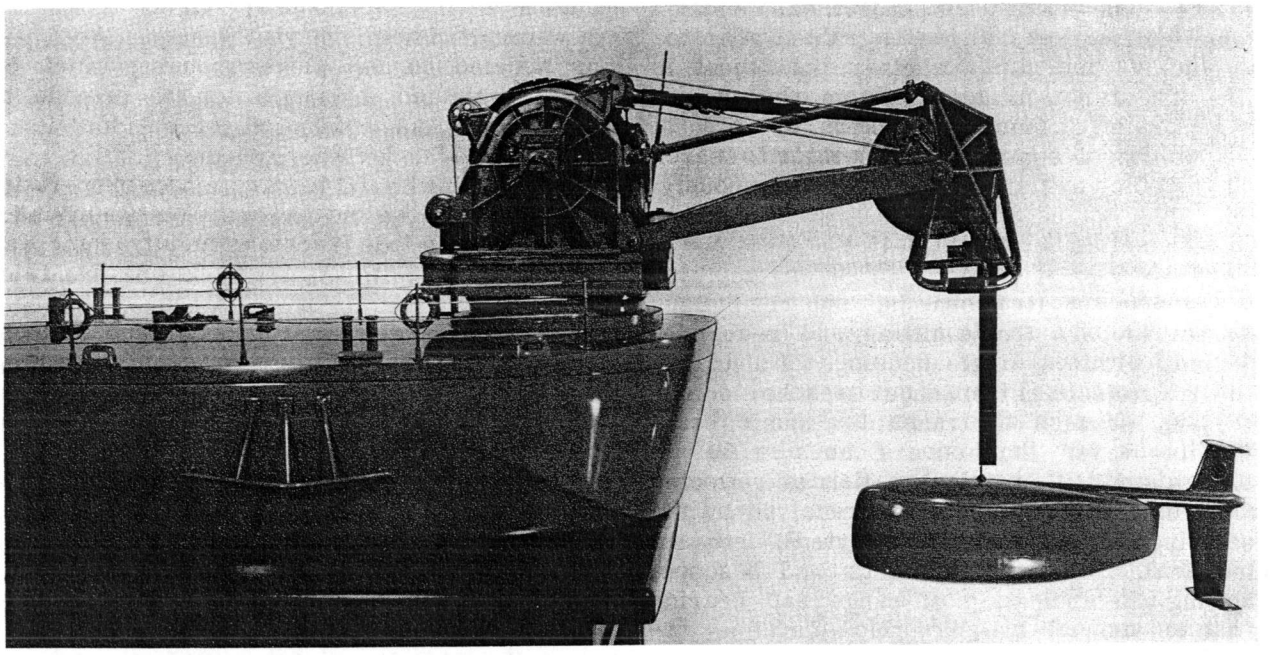

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Figure 8-3.—Towed vehicle for VDS (in suspension).

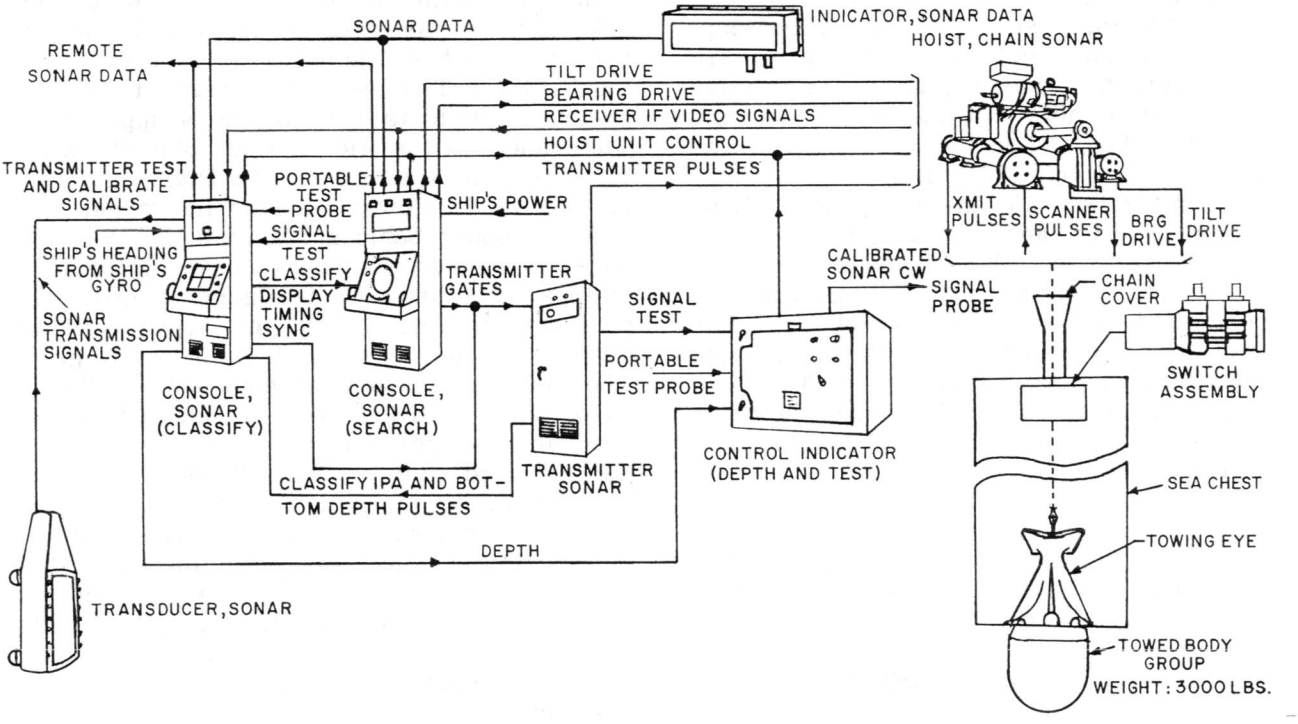

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Figure 8-4.—Mine-Detection Set AN/SQQ-14 system.

After detecting an object, the sonar's classification mode allows a trained operator to quickly distinguish whether the object is minelike, or non-minelike bottom clutter such as sunken oil drums, foot lockers, or anchors. The two consoles permit one operator to search and the other to classify mines simultaneously.

Mine-Detection Set AN/UQS-1( )

The AN/UQS-1( ) sonar (not shown) employs two transducers (transmitting and receiving) enclosed within a single housing. The transmitting (projecting) transducer uses the electrostrictive process to transmit a sonic beam into the water that covers an arc 60° in azimuth and 10° vertical. Echoes reflected from underwater objects are received by the receiving transducer, converted into an electrical signal, and applied to the PPI scope, showing an indication of range and bearing of the object.

Either manual or automatic searching is available. In manual operation, the transducers are caused to rotate as a bearing handwheel is rotated, searching through 360° in azimuth at selectable ranges of 200, 500, and 1000 yards. When operating automatically, the transducers may be caused to rotate through 360° in azimuth, to search all around the ship, or to rotate back and forth through an arc 90° in azimuth, searching from 315 relative to 045 relative ahead of the ship. (A field change to the equipment provides for an automatic sweep of 180° ahead of the ship.) For automatic search, the equipment can be set to search in ranges of 200, 500, or 1000 yards. Whether searching manually or automatically, the operating angle of the transducers is controlled manually by a handwheel. The transducers may be tilted to cover from plus 5° to minus 50° in depression. The angle of tilt can be observed on a depression indicator dial, which shows the angle of depression of the sound beam.

The scan pattern appears on the face of the scope as a 20° triangular sector with the vertex of the sector at the center. Targets are indicated on the scope as a bright spot at the correct range and bearing of each target.

Mine Detection Range Set AN/PQS-1C

The AN/PQS-1C (fig. 8-5) is a portable hand-held sonar set used by SCUBA divers during diving operations. It is incased in a waterproof hemispherical housing. A compass is located on top of the housing which can be illuminated by a switch to provide the diver with an indication of the location of the detected underwater objects.

The AN/PQS-1C has two modes of operation. The search mode and the passive-listening mode. The search mode transmits an ultrasonic wave which sweeps through a 30 kHz bandwidth within the limits of a 50 to 90 kilohertz frequency range. A transducer and reflector directs the transmitted ultrasonic waves into a narrow beam to provide precise angular sensing of the target location. The returning ultrasonic echo is combined with a sample of the transmitted signal, producing a difference in frequency proportional to the distance from the target. The lower the tone of this audiofrequency, the closer the operator is to the reflecting object. Three angle scales (20, 60, and 120 yards) are provided. The receiver compensates for variations in echo signal strength and delivers 100 milliwatts of power to the head set within the audiofrequency range of 250 to 2500 hertz.

During search operations, SCUBA divers will set the range switch to a range commensurate with the depth of the water and submerge to the desired depth while holding the equipment so an echo is received from the bottom. The tone thus produced becomes lower in pitch as the bottom is approached. The range switch (fig. 8-5) enables the diver to search in a circular area having a radius of 120 yards slowly scanning the target area with the sonar beam and listening for a short-duration echo tone in the headset as the beam sweeps past an echo producing object. He continues moving toward the object until the audio tone in the headset is at a low pitch. The selector switch is then set on the 60 yard range position, and the audio tone will immediately increase to twice the pitch on the 120 yard range. This allows the operator to continue to close-in on the target, while listening for change in pitch. He continues moving toward the target until the audio tone is again at low pitch. The same procedure is continued at the 20 yard range until the exact object is located. If the target is a mine, procedures can be initiated for its destruction.

In the passive-listening mode, the equipment can be used to locate marker beacons

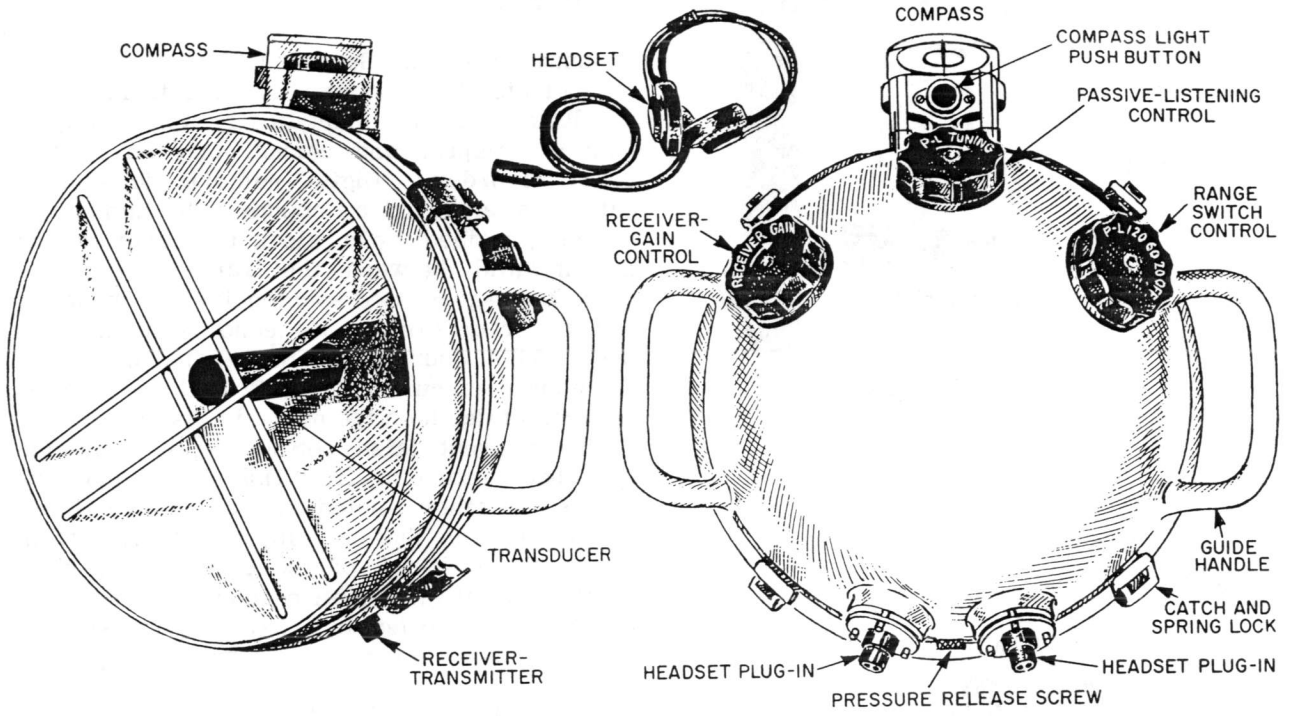

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Figure 8-5.—Mine-Detection Range Set AN/PQS-IC.

operating in the 30 kHz to 40 kHz frequency range.

FATHOMETERS

Fathometer equipments transmit accoustical pulses vertically downward and echo pulses are reflected back to the fathometer from ocean floor or from intervening objects. The interval of time required between transmission and reception is converted into a depth indication on a recorder chart or cathode ray tube (CRT) indicator. The fathometer is used primarily for navigation purposes. It also serves as an aid in gathering depth information for oceanographic topography, and is occasionally used as a sonar contact classification aid. The two fathometers used chiefly by the fleet in depth sounding for navigational purposes are the AN/UQN-1( ) and AN/UQN-4.

Depth-Sounding Sonar AN/UQN-1( )

The AN/UQN-1( ) fathometer and its transducer are shown figure 8-6. This fathometer is a compact unit, capable of giving reasonably accurate readings at a wide range of depth--from about 5 feet to 6000 fathoms. It uses the electrical stylus and sensitized paper method of recording depths. For shallow depths, it has a visual scope presentation.

Three recorder chart ranges are provided on the AN/UQN-1( ). They are 0 to 600 feet, 0 to 600 fathoms, and 0 to 6000 fathoms. In addition to recorder chart indications, two visual indicator ranges are available: 0 to 100 feet; and 0 to 100 fathoms. The equipment may be keyed manually or automatically.

When the fathometer is operating in any of the three recorder chart scales, a stylus starts down the recorder chart simultaneously with the transmission pulse. The stylus moves at a constant velocity and marks the paper twice—once at the top of the chart when the pulse is transmitted, and again on the depth indication when the echo returns. A depth recording made by a fathometer of this type is seen in figure 8-7. The recording illustrated was made from a ship sailing over a sea

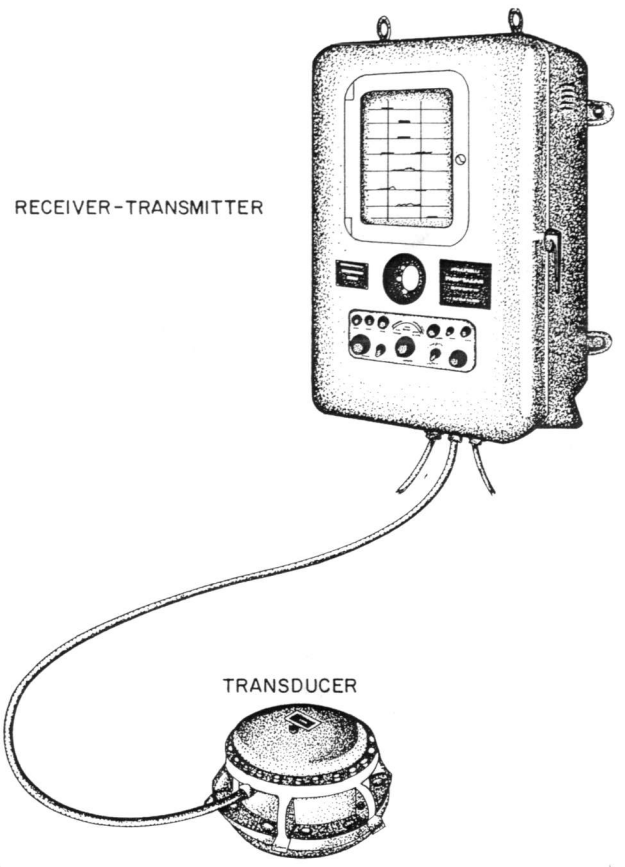

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Figure 8-6.—Depth-sounding Sonar AN/UQN-1( ).

whose depth was decreasing steadily. The first part of the trace was recorded on the 6000-fathom scale. Inasmuch as the paper moves from right to left, you can see, in the section of the paper shown, that the depth decreased from 4000 to 600 fathoms. (Later depth information is to the right of the paper.) When depth was about 600 fathoms, the scale was shifted to the 600-fathom setting. Because the depth decreased still further, the scale was shifted to the 600-foot setting when a depth of about 100 fathoms was recorded.

Visual indication is supplied by a circular sweep on the face of a cathode ray tube. Transmitted pulse and returning echo deflect the sweep trace radially. The visual indicator, pointing to a depth of 82 (feet or fathoms, depending upon the scale setting), is shown in figure 8-8.

Depth-Sounding Sonar AN/UQN-4

Sonar Sounding Set AN/UQN-4 is designed to indicate water depths ranging from 4 feet to 6000 fathoms, transitorily on a digital numeric display and permanently on a strip chart recorder. Digital numeric depth indication is achieved by counting the number of pulses provided by a clock frequency during the interval between the transmission of a transducer-generated sound pulse into the water and the reception of its echo from the sea bed. This count, after processing by digital countdown circuits, is indicated as feet or fathoms of depth on the numeric display.

To prevent false bottom depth indication by echoes returning from fish shoals, plankton layers or other anomalies, a "Range Gate" circuit insures that only signals received from within the confines of the gated range shall be effective at the digital readout. A permanent record is recorded on chart paper (similar to that shown in fig. 8-7) by a strip chart recorder.

The AN/UQN-4 has the capability of transmitting numeric depth information to remote indicators or sonar computers which can be located up to 1000 feet from the fathometer.

SONAR ACCESSORIES

Supplementing the basic sonar system are a number of equipments that either extend the capability of the system or facilitate its use. Some of this supplementary or accessory equipment forms an integral part of the overall sonar system, whereas other equipment in this category is completely isolated from the system.

AZIMUTH-RANGE INDICATORS

A complete azimuth search sonar installation includes one or two remote units called azimuth-range indicators. These units are remote video repeaters of the scope presentation at the sonar control indicator. They provide an indication of target bearing and range, and they have provisions for monitoring the audio response from targets.

The PPI (scope) display modes of operation (echo ranging or listening) may be presented in either of two ways: the ship center display

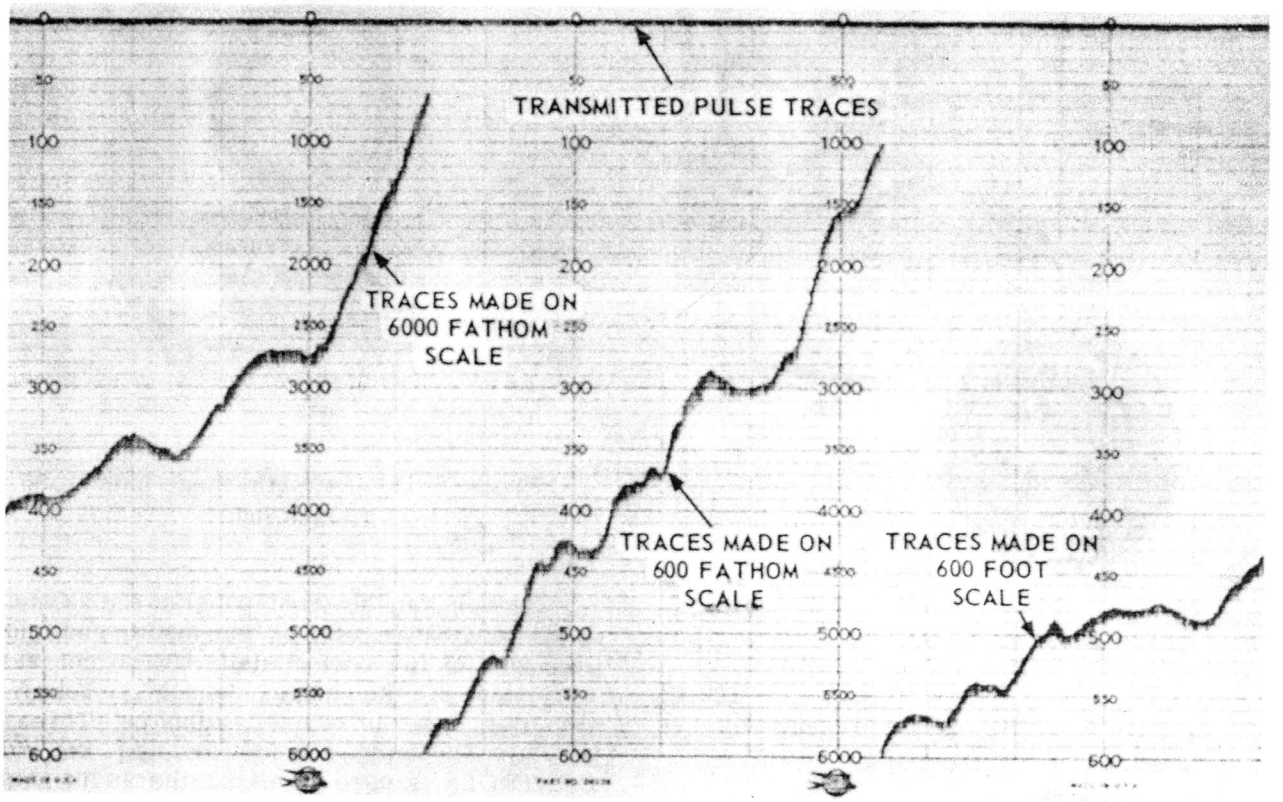

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Figure 8-7.—Fathometer depth recording.

71.57

Figure 8-8.—Visual depth indicator.

(SCD), whereas the ship is depicted in the center of the scope display; or the target center display (TCD) in which the target is represented in the center of the display whenever the end of the bearing cursor is on target.

The SCD (fig. 8-9) utilizes a circular sweep starting at or near the center of the screen which indicates the position of own ship. Various underwater objects are represented by the bright spots (pips) that appear on the screen. The SCD is the normal operating mode because it allows the operator to observe many targets around the ship at one time.

The TCD (fig. 8-10) uses an expanded sweep with the target at the center of the scope. The sweep is enlarged to 2 1/2 times its normal size and is offset from the center on a reciprocal bearing from the cursor. This mode is used only as an aid to classification.

One common type of azimuth-range indicator, the IP-286/SQ, is illustrated in figure 8-11. This particular unit is used with installations

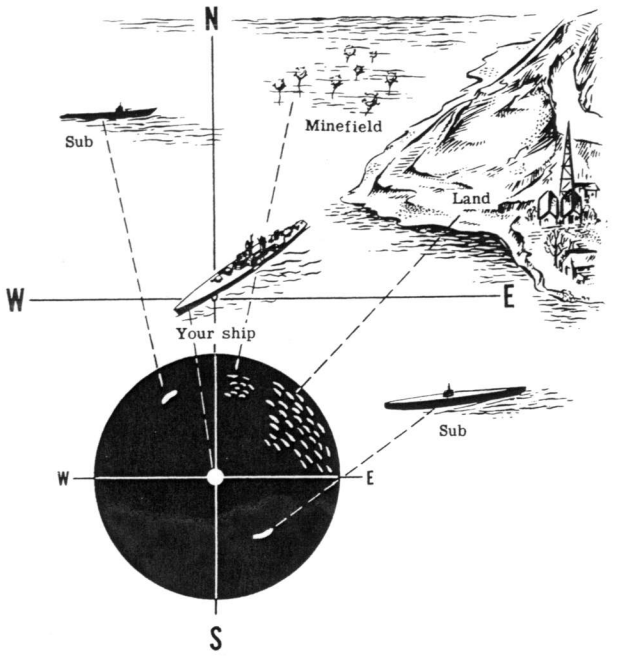

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Figure 8-9.—SCD sonar presentation.

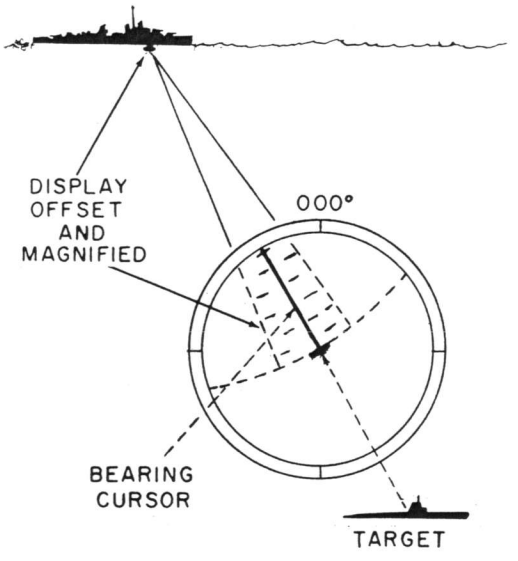

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Figure 8-10.—TCD sonar presentation.

of the AN/SQS-29 to -32 series of sonars (discussed earlier). A similar unit, designated IP-481/SQ (not shown) is used with the AN/SQS-23 sonar equipment.

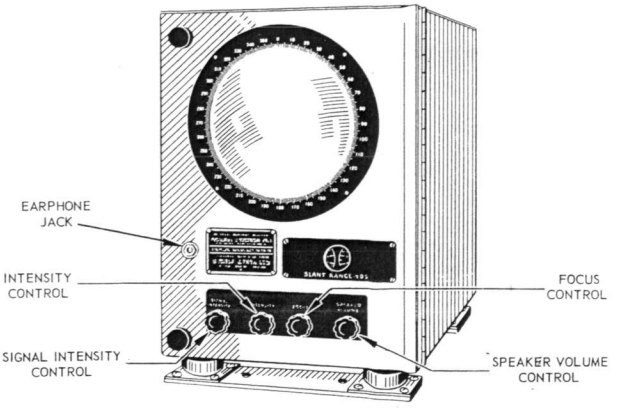

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Figure 8-11.—Azimuth-range indicator IP-286/SQ.

Controls on the front panel of the azimuth-range indicator affect the audio and video response of the remote unit, but do not affect operation of the sonar console. Three of the four controls are for adjusting the video display. The fourth, labeled SPEAKER VOLUME CONTROL, is used to adjust the audio output level.

Target bearing is read from an azimuth ring surrounding the video presentation. Target range is indicated on two dials that are visible through a window opening. Audio response is heard from either an external speaker unit or headphones, as desired.

TARGET COURSE PROJECTOR

The target course projector (fig. 8-12) has a servosystem, transistor amplifier, and optical system. This unit is a sonar accessory which responds to target course orders from fire control, and projects a cursor image in the form of a red line on the screen of the range and azimuth indicator. The unit is located 4 to 5 feet from the CRT screen and mounted in such a position on the overhead that persons viewing the screen do not obstruct the light beam.

RECORDER-REPRODUCER

A tape recorder-reproducer is employed with most sonar installations to record audible sonar information of actual ASW operations.

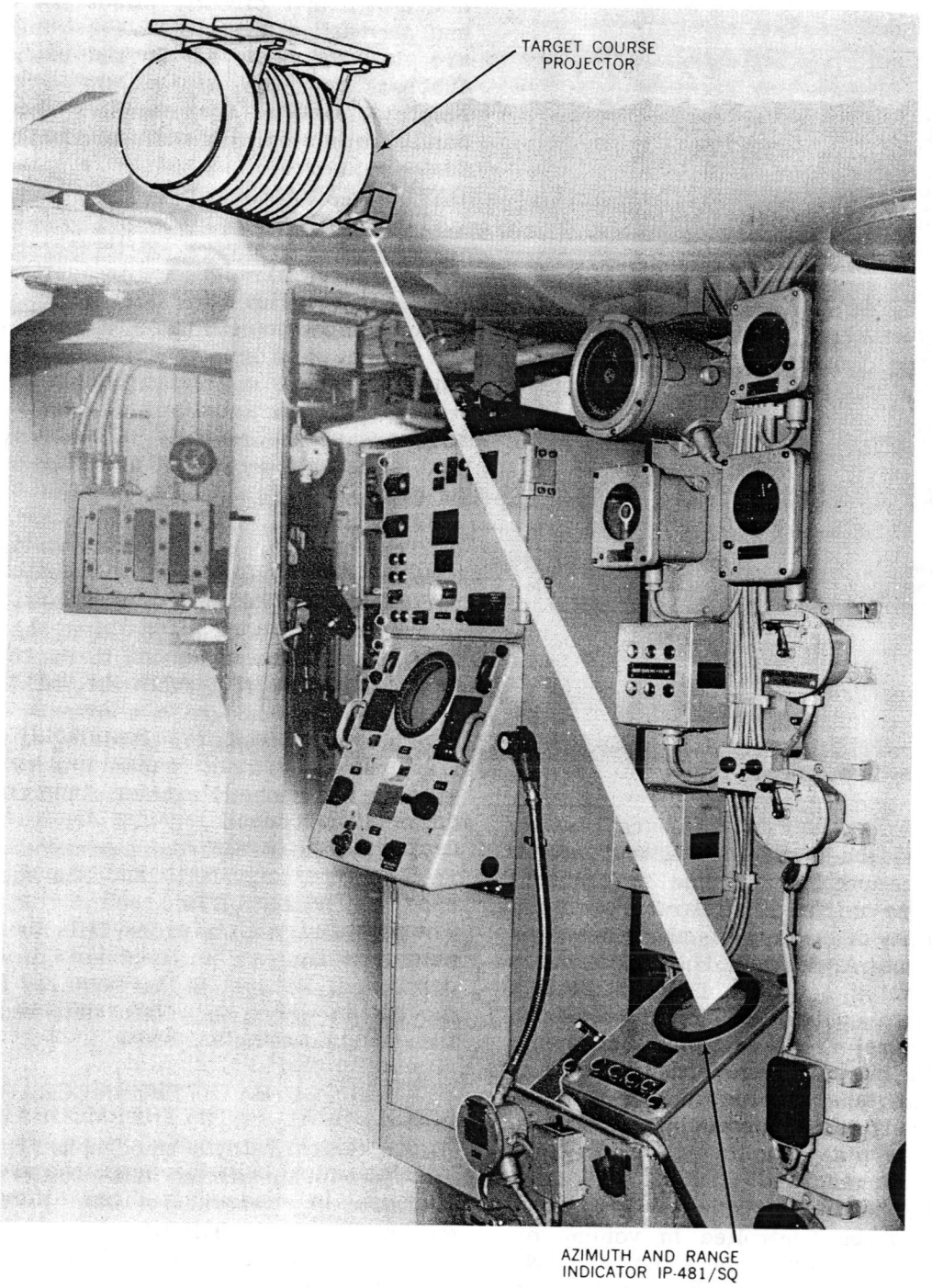

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Figure 8-12.— Target course projector, relationship to range and azimuth indicator.

Information thus obtained is utilized for post-analysis of ASW actions and for the aural training of sonar operators in echo recognition.

The AN/UNQ-7( ) recorder-reproducer set (fig. 8-13) is a two-track recorder and reproducer that uses magnetic tape to record its information. It stores for playback (immediately

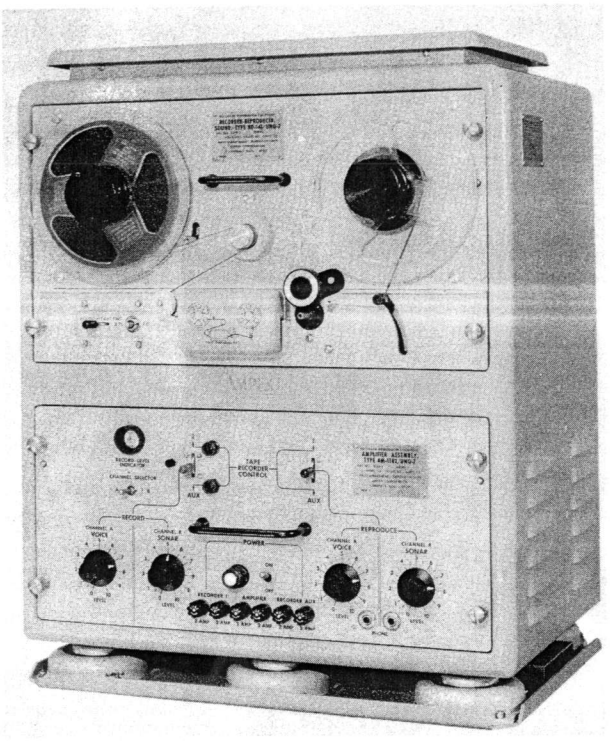

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Figure 8-13.—Tape recorder AN/UNQ-7( )

or indefinitely) the sounds it "hears" within the limits of the audible spectrum. Two channels (A and B) are utilized. Voice information from the vicinity of the sonar operator's station is fed to channel A. Channel B track normally is fed underwater sound information directly from the sonar equipment. Both tracks can be (usually are) recorded simultaneously, although either one may be recorded separately. In addition, the tape recorder allows simultaneous recording and reproducing of sounds. This feature permits monitoring what is being recorded as it is recorded.

When a recording is played back, both tracks can be heard at the same time, and both tracks can be controlled in volume or can be cut out entirely. In short, the AN/UNQ-7( ) tape recorder-reproducer acts as a combination of two tape recorders, coupled together, to allow superimposing upon each other, two audio information sources.

The top half of the tape recorder-reproducer, as seen in figure 8-13, is the actual recorder and reproducer. The lower portion is the amplifier section. It includes controls and indicators that directly affect the recording and playback of tapes. The recording controls are to the left of the amplifier section. Playback controls are at the right of the amplifier section. Both channels have separate controls for recording and reproducing.

BATHYTHERMOGRAPH

Pressure, salinity, and temperature affect sound travel through water. Increases in pressure speed up the velocity of sound, making the speed of sound higher at extreme depths where pressure is greater than on the surface. An increase in salinity also has a tendency to increase the velocity of sound in water. The effects of pressure and salinity are not as great, however, as those caused by changes in temperature.

Temperature, then, is the most important consideration to contend with in calculating variations in the speed of sound in water. Information obtained about the ocean temperature, at a given depth and time, can be used to predict what will happen to the transmitted sound beam as it travels through the water.

The bathythermograph, commonly called the BT, is an instrument for obtaining a permanent, graphical record of water temperature (in degrees Fahrenheit) against depth (feet) as it drops into the ocean.

Two types of bathythermographs are being used. The expendable and the mechanical. The expendable BTs record the readings automatically as the probe falls to the ocean depths. This is in contrast to the older mechanical BT system that requires retrieving the BT in order to obtain data recorded on a metallic coated glass slide.

MECHANICAL BATHYTHERMOGRAPH

Mechanical bathythermographs are designed for use in measuring three different depth ranges. In general, a No. 1 designation means it is a shallow type, No. 2 means it is a medium type, and No. 3 indicates that it is a deep type BT. Table 8-2 lists the various BTs in use and gives their design depth.

The mechanical BT consists of temperature and pressure elements (fig. 8-14). The temperature element consists of about 45 to 50 feet of fine copper tubing filled with xylene.

Table 8-2.—BT Series Designations.

Series No.	Name	Maximum depth	Maximum Towing Speeds	
			Nose Sleeve	
			Without	With
OC-1S OC-1A/S OC-1B/S OC-1C/S	Shallow	200 feet	15 knots	22 knots
OC-2/S OC-2A/S OC-2B/S OC-2C/S	Medium	450 feet	10 knots	13 knots
OC-3/S OC-3A/S OC-3B/S OC-3C/S	Deep	900 feet	3 knots	6 knots

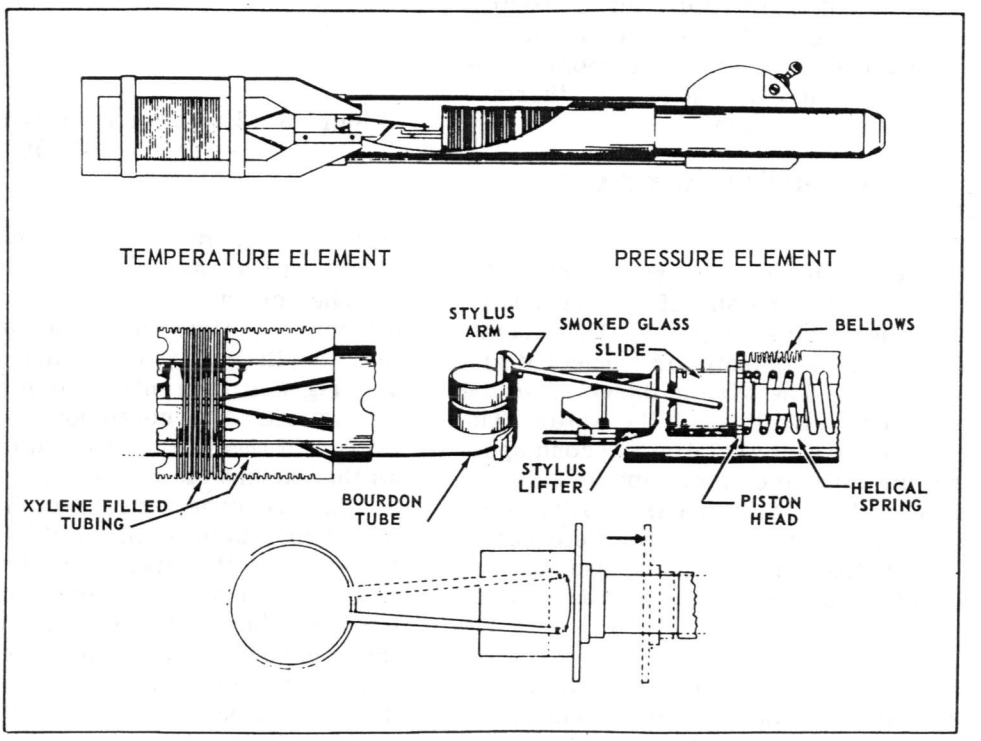

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Figure 8-14.—Mechanical Bathythermograph temperature and pressure elements.

The tubing is wound around inside the tail fins of the BT, and comes into direct contact with the sea water. As the xylene expands or contracts with the changing water temperature, the pressure inside the tubing increases or decreases. This temperature

change is transmitted to a Bourdon tube, a hollow brass coil spring, which carries a stylus at its free end. The movements of the Bourdon, as it expands or contracts with changes of temperature, are recorded by the stylus on a metallic-coated glass slide. The temperature range is from 28° to 90° F.

The slide is held rigidly on the end of a coil spring enclosed in a copper bellows. Water pressure, which increases in proportion to water depth, compresses the bellows as the BT sinks.

The dotted line drawings in the lower portion of figure 8-14 illustrate the action of the stylus moving left on the slide with a decrease in temperature and the bellows being compressed to the right (arrow) as depth increases. Increase in depth pulls the slide toward the nose of the BT, at right angles to the direction in which the stylus moves to record temperature. When the BT is raised toward the surface, the spring expands the bellows to its original shape. Thus, the trace scratched on the plated surface of the slide is a combined record of temperature and pressure, the pressure being proportionate to depth.

The mechanical type bathythermograph is being replaced by the expendable bathythermograph as they become available.

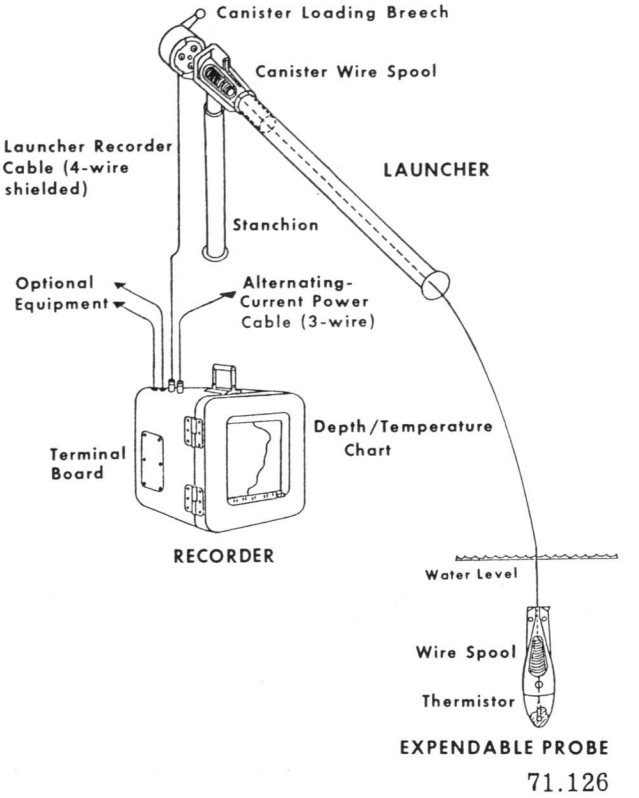

Figure 8-15.—Expendable Bathythermograph Set AN/SSQ-56.

EXPENDABLE BATHYTHERMOGRAPH AN/SSQ-56

The expendable bathythermograph AN/SSQ-56 (fig. 8-15) consists of an expendable probe, a launcher, and a recorder. The expendable probe contains a thermistor connected to a spool of fine wire. The wire is dereeled as the probe drops vertically through the water. The other end of the wire is wound on a second spool mounted within a probe canister aboard ship. As the ship moves ahead, this wire is also dereeled. The dual spooling technique allows the probe to free-fall from the exact point of sea-surface entry without being affected by the moving ship or sea state.

The nose of the probe is weighted and the entire unit is spin-stabilized to assure a known rate of descent upon launching. Changes in resistance of the thermistor due to temperature changes in the water are transmitted by the trailing wire to the shipboard recorder. Since the rate of descent of the probe is known, depth can be read directly from the vertical scale on the recorder. After the probe passes 1500 feet, its full scope of wire will be exhausted and the probe sinks to the bottom of the sea.

The chart type recorder is programmed to convert time and thermistor resistance into depth and temperature in units of feet and degrees Fahrenheit, or meters and degrees Centigrade. A continuous temperature/depth profile is traced on a 6-inch portion of the chart as the expendable probe descends.

The recorder has a completely automatic program, which is initiated by inserting a probe and closing the breech of the probe launching device. This procedure completes a circuit between the probe and the recorder, locking the servo in the center scale position and driving the chart for a few seconds. The chart drive then stops. It starts again when the probe is released and enters the water completing a seawater trigger circuit to begin the measurement cycle. After 90 seconds, the temperature depth profile has been recorded and the chart drive stops, indicating completion of the cycle. The launcher is then ready for reloading.