CHAPTER 2

WATCHSTANDERS' EQUIPMENT

Whether you are a Seaman or an officer aboard a ship, you will be assigned certain duty periods. Watchstanding is a necessary and an important part of Navy life. And the equipment used in watchstanding helps to keep the Navy operating efficiently.

The following instruments or apparatus are found on the bridge:

- steering
- sounding
- indicating ship's heading and rudder angle
- measuring speed
- communicating speed orders to the engineroom
- taking bearings and ranges
- controlling running lights and speed lights
- indicating revolutions made by the engines, and communicating with other departments in the ship and with other ships

COMPASSES

LEARNING OBJECTIVE: Explain the operation of the gyrocompass and the magnetic compass.

A compass is an instrument that tells you the direction you are heading. It also tells you where north is so you can measure all other directions from that one fixed point or direction.

There are two main types of compasses. They are gyrocompasses and magnetic compasses. The gyrocompass works on the gyro principle of a spinning wheel. The magnetic compass is affected by Earth's magnetic field. In each instance the objective is to produce a compass card (fig. 2-1) that points toward the north. From the compass card, the directions can be taken in degrees or in terms such as north, south, southwest. The Navy expresses direction in degrees, saying the direction or course is 000°, 180° or 225°, instead of north, south, or southwest.

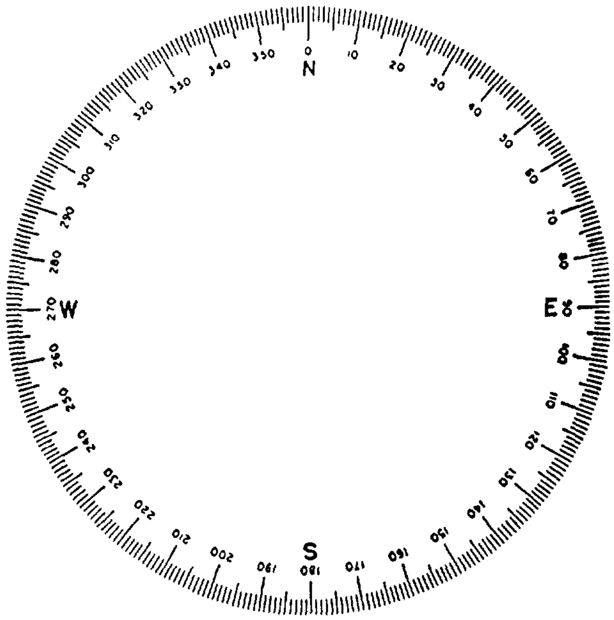

Figure 2-1.— Compass card.

GYROCOMPASS

The gyrocompass is unaffected by magnetic influence. When in proper running order, the gyrocompass points constantly to true north, rather than magnetic north. It may have a slight mechanical error of 1° or 2°, but the error is computed easily and remains constant for any heading; the error does not interfere in any way with the instrument's practical value.

A typical shipboard installation consists of master gyros whose indications are sent electrically to repeaters located at the conning stations, on the bridge wings, and at other necessary points. One advantage of the gyro is that its repeaters may be set up at any angle-nearly vertical for the convenience of helmsmen, or horizontal for taking bearings.

Despite the excellence of the gyro mechanism, the magnetic compass is still standard equipment used aboard ship. Because the gyrocompass is powered by electricity, it would be useless in a power failure. It is an extremely complicated and delicate instrument, and it is subject to mechanical failure. For instance, some gyros become erratic after the ship makes a series of sharp turns at high speed. This does not mean, however, that great confidence cannot be placed in the gyro. When the gyro is running properly, it can be depended upon to point faithfully and steadily to true north. But the magnetic compass remains the reliable standby, constantly checking the gyro's performance, and ready always to take over if it fails.

MAGNETIC COMPASS

The magnetic compass operates through the attraction exerted by Earth itself. Because Earth is certain to continue to function as a magnet, the magnetic compass has an unfailing power source.

The magnetic compass (fig. 2-2) is located in the pilothouse. It consists of a magnetized compass needle attached to a circular compass card, usually 7 1/2 inches in diameter. The card and the needle are supported on a pivot that is set in a cast bronze bowl filled with a petroleum distillate fluid similar to Varsol. This liquid buoys up the card and the magnet. The buoyancy will take some of the load off the pivot, thereby reducing the friction and letting the card turn more easily on the pivot. At the same time, the liquid slows the swing of the card and brings it to rest more quickly. Marked on the compass bowl is a line, called the lubber's line, which agrees with the fore-and-aft line of the ship or boat. By reading the compass card's direction lined up with the lubber's line, you can tell the direction the ship is heading.

The card remains stationary, pointing at the magnetic pole which is a north-south line lined up with the north-south (magnetic) directions on Earth. When you are steering, always remember that the ship turns under the card.

The compass bowl is mounted in a system of double rings on bearings, known as gimbals, permitting the compass card to ride flat and steady no matter how the ship may roll. In turn, the gimbal rings are mounted in a stand called the binnacle (fig. 2-3). The Navy uses a compensating binnacle, on which two spheres of soft iron are mounted on arms, one on either side of the compass. The spheres are adjusted to counteract some of the deviation (covered later in this chapter). To correct for other local magnetic forces that make up the deviation, small magnets are located within the binnacle, directly below the compass. The binnacle is positioned forward of the wheel, where it can best be seen by the helmsman.

The compass card is divided into 360°, numbered all the way around in a clockwise direction.

A true course to be steered can be converted into a magnetic compass course by adding or subtracting variation for the area and deviation for the compass on

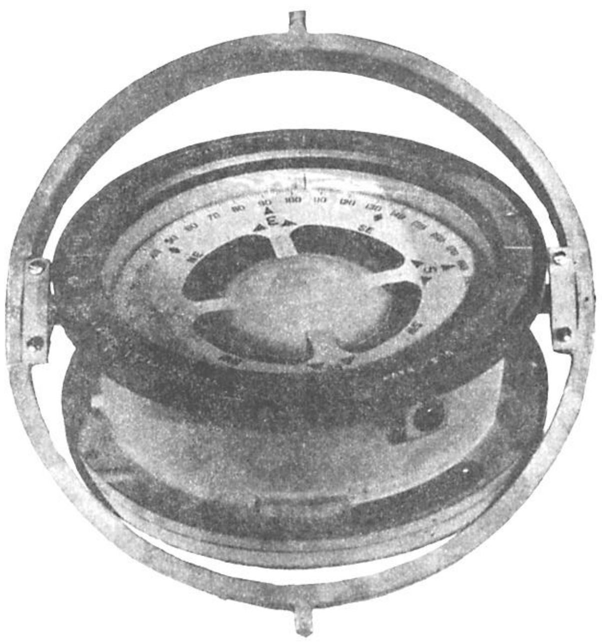

Figure 2-2.— Navy standard 7 1/2-Inch compass.

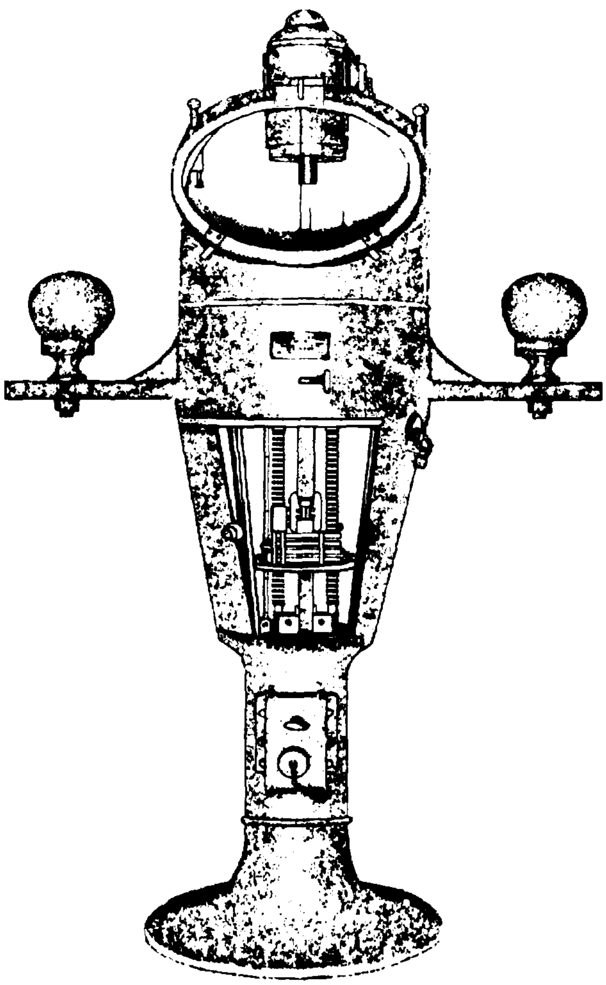

Figure 2-3.— Navy standard magnetic compass binnacle.

that heading. When converting true heading to magnetic, subtract easterly errors and add westerly errors.

CIRCULAR MEASUREMENT

Before we go any further, you must know how distances are measured along the circumference of a circle. Measurement along a meridian, a perfect circle, is expressed in degrees of arc. These degrees of arc may be transformed into linear measurement. The compass card is the best example of circular measurement in degrees of arc.

Whatever the size of the card, its circumference always contains 360°. Each degree contains 60 minutes ('), and each minute contains 60 seconds (").

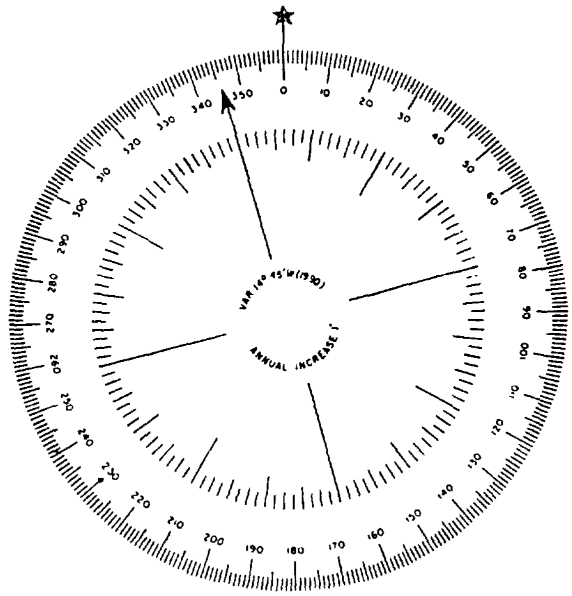

Figure 2-4— Compass rose.

MAGNETIC COMPASS ERROR

LEARNING OBJECTIVE: Explain magnetic compass error, including variations and deviations.

Most of the time the magnetic compass does not point directly north. Usually, there is a difference of several degrees. This difference, known as compass error, is made up of variation and deviation.

VARIATION

The true North Pole and the magnetic north pole are not located at the same spot. This variation causes a magnetic compass needle to point more or less away from true north. The amount the needle is offset is called variation because the amount varies at different points on Earth's surface. Even in the same locality variation usually does not remain constant, but increases or decreases at a certain known rate annually.

The variation for any given locality, together with the amount of annual increase or decrease, is shown on the compass rose of the chart for that particular locality. The compass rose shown in figure 2-4 indicates that in 1990 there was a 14°45' westerly variation in that area, increasing 1' annually.

To find the amount of variation in this locality in 1995, count the number of years since 1990 (in this case 5); multiply that by the amount of annual increase; (which here gives you 5 X 1', or 5); add that to the variation in 1990 and you have a 1995 variation of 14°50' W.

Remember: If the annual variation is an increase, you add; if it is a decrease, you subtract.

Variation remains the same for any heading of the ship at a given locality. No matter which way the ship is heading, the magnetic compass, if affected only by variation, points steadily in the general direction of the magnetic north pole.

DEVIATION

The amount a magnetic compass needle is deflected by magnetic material in the ship is called deviation.

Although deviation remains a constant for any given compass heading, it is not the same on all headings. Deviation gradually increases, decreases, increases, and decreases again as the ship goes through an entire 360° of swing.

The magnetic steering compass is located in the pilothouse, where it is affected considerably by deviation. Usually the standard compass is topside, where the magnetic forces producing deviation are not as strong. Courses and bearings by these compasses must be carefully differentiated by the abbreviations psc (per standard compass), pstgc (per steering compass), and pgc (per gyrocompass). The standard compass provides a means for checking the steering compass and the gyrocompass.

Some ships may have another magnetic compass, also known as the emergency steering compass, located at the after steering station, when that station is topside.

GYROCOMPASS REPEATERS AND PELORUS

Gyro repeaters mounted on the bridge wings are located in stands somewhat similar to the binnacle. These instruments display directional information on the basis of electrical signals received from the ship's master gyrocompass.

Gyro repeaters on the bridge wings are used in taking bearings on objects outside the ship. Movable sighting vanes on the face of the gyro repeaters are aimed at the object in the same manner in which rifle sights are lined up. True bearings are read directly by observing the degree on the compass card with which the crossbar of the sighting vane lines up. Relative bearings may be read from an outer dumb compass ring on the repeater stand.

True bearing is the direction of an object from the observer, measured clockwise from true north.

Compass bearing is the direction of an object as indicated by the magnetic compass. It must be converted into true hearing by applying the corrections for variation and deviation.

Relative bearing is the direction of an object from the observer, measured clockwise from the ship's heading as indicated by the lubber's line in the binnacle or the gyro repeater. When a bearing is recorded, it is assumed to be a true bearing unless it is followed by the capital letter R, which would mean that the bearing is relative. Figure 2-5 shows true and relative bearings of a lighthouse from a ship.

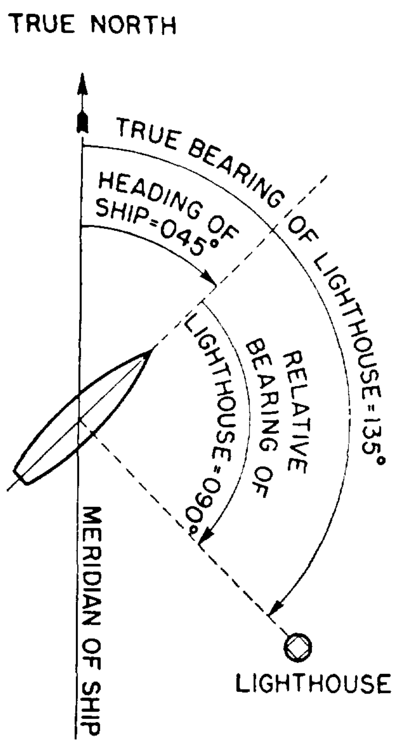

Figure 2-5.— True and relative bearings.

As you learned in *Basic Military Requirements*, lookouts report objects they see in relative bearings by degrees (usually to the nearest 10 degrees) based on the fore-and-aft line of the ship, starting with dead ahead as 000°, on the starboard beam as 090°, dead astern as 180°, on the port beam as 270°, and through to dead ahead as 000°. Another look at the compass card in figure 2-1 will show you the positions of the relative bearings (in 10-degree increments) normally used by lookouts.

Relative bearings by points of the compass are sometimes used in certain problems connected with fixing position in piloting. Each point of the compass is equivalent to 011 1/4°, for a total of 32 points, as opposed to the 36 relative reporting positions. Table 2-1 is included for familiarization purposes.

Without the need of your knowing exact terminology, positions go on thusly around the ship in the 1-2-3-4-3-2-1 pattern, punctuated by “dead astern” and “on the port beam” to “dead ahead.” The relative degree indications continue around the ship in 011 1/4° steps, terminating at 000°.

Table 2-1— Relative Bearings by Points and Degrees

COMPASS POINTS	DEGREES
Dead Ahead	000
1 point on starboard bow	011 1/4
2 points on starboard bow	022 1/2
3 points on starboard bow	033 3/4
4 points (broad) on starboard bow	045
3 points forward of starboard beam	056 1/4
2 points forward of starboard beam	067 1/2
1 point forward of starboard beam	078 3/4
On the starboard beam	090

The reciprocal of any bearing is its opposite, meaning that the point or degree is on the opposite side of the compass card from the bearing. For example, the reciprocal of 180° is 000°, and vice versa. When you obtain a bearing on some object, the bearing from the object to you is the reciprocal of the bearing from you to it.

To find the reciprocal of any bearing expressed in degrees, simply add 180° to the bearing. If the bearing is 050°, for instance, its reciprocal is 050° plus 180°, or 230°. If your bearing is greater than 180°, subtract 180° to find the reciprocal.

SHIP'S STEERING AND SPEED CONTROL EQUIPMENT

LEARNING OBJECTIVE: Identify and explain the operation and usage of the ship's steering and control equipment.

The ship's steering and speed control equipment includes many parts and types of equipment. The parts and types of equipment may change from one ship class to another, so in the following pages we will discuss the ones most commonly used in the Navy today.

STEERING ENGINES

When ships began using steam as a means of propulsion, many problems were created. Foremost was inadequate hand-powered steering gear. The rapid increase in the size and speed of steamships resulted in a correspondingly greater turning effort required at rudder stocks. Consequently, a natural sequence of events led to the introduction of steam-powered steering gear.

Today, there are two types of steering engines. They are electromechanical and electrohydraulic. Electromechanical steering gear is found on some small ships. Most vessels of recent design are equipped with the electrohydraulic mechanism. A brief discussion of the types of steering gear follows.

Electromechanical steering gear applies power to the rudder by means of electromotive machinery. Because electromechanical gear requires large motors and considerable maintenance, it has been replaced, to a great extent, by electrohydraulic gear.

Naval vessels are equipped with electrohydraulic steering gear. Most destroyers use the single-ram steering gear, shown in figure 2-6. Aircraft carriers and some other large ships use a double-ram system.

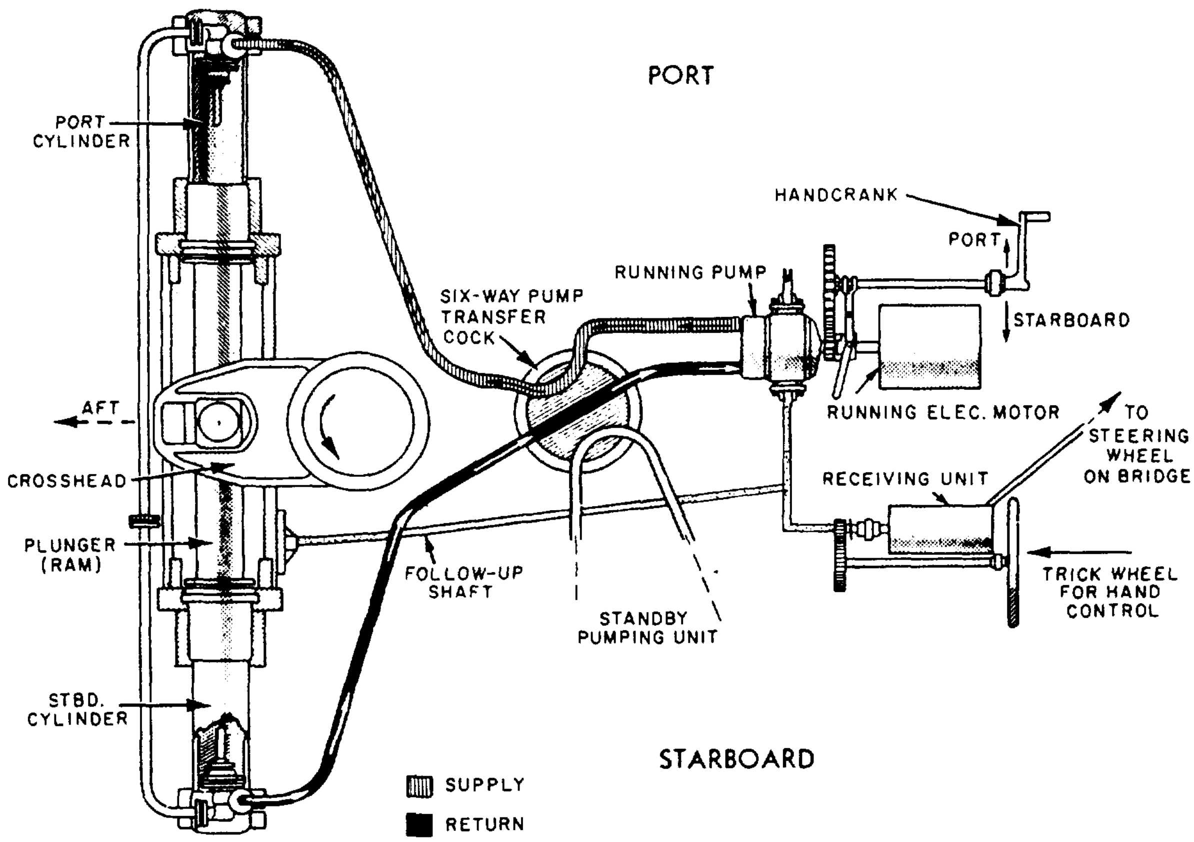

Figure 2-6— Single-ram electrohydraulic steering gear system.

For an idea of how the single-ram system works, refer to figure 2-6 and note what happens during a starboard turn. From the helm on the bridge, movement is transferred electrically to the receiving unit in after steering, where the electrical signal is converted to a mechanical signal. The receiving unit sends the mechanical signal to the running pump, and the pump proceeds to pump oil to the port cylinder. Oil, at the same time, is taken from the starboard cylinder by the pump's suction. As oil is pumped into the port cylinder, the ram is moved toward the starboard side, turning the rudder as it moves. The ram is forced toward the starboard side until the correct rudder position is obtained, at which time the follow-up shaft causes the pumping to cease.

Emergency Steering Gear

On ships equipped with electromechanical steering gear, the old-fashioned, hand-operated steering wheel is about the only recourse if the primary mechanism fails. On some small ships, a yoke can be fitted over the rudder head, and the rudder can be turned with a block and tackle.

Electrohydraulic steering gear usually is provided with a standby pumping unit for emergency use. It is composed of a pump and an electric motor, identical to those shown in figure 2-6. If the steering engine being employed has a casualty, the six-way pump transfer cock is adjusted to align the ram with the standby pumping unit; the power is turned on in the standby unit; and steering is transferred over to the standby unit.

Emergency steering for destroyers also uses the trick wheel, shown in figure 2-6. If a steering signal failure occurs between the steering wheel on the bridge and the receiving unit, the helmsman standing watch in after steering operates the trick wheel and receives steering orders on the sound-powered telephone. Should a power failure occur in steering aft, the rudder is moved by disengaging the running electric motor, and hand-pumping oil to the ram by means of a handcrank. This procedure is very slow. The rudder turns only a small amount for every revolution of the crank.

Steering Engine Cutout

A safety device is installed on every steering engine. This safety device stops rudder movement when the rudder is brought against the stops. The limit most rudders can be turned is 35° to either side of center. Full rudder on most ships is 30° right or left; the extra 5° is applied only in emergencies. Unless you are ordered to do so, never put the rudder hard over. It is possible for the rudder to jam against the stops, causing you to make circles in the ocean.

Rudder

Every ship is provided with a rudder located aft. When the rudder is set at an angle on a moving ship, a high-pressure area builds on the leading surface, and a low-pressure area forms on the trailing surface. Thus the water, through this difference in pressure areas, exerts a force against the leading surface of the rudder, which in turn forces the stem in the direction opposite that which the rudder is set.

When the helm on an oldtime ship was moved athwartships across the deck, the rudder motion was in the opposite direction. The result was that the ship's head would go in the direction opposite that in which the helm was moved, and this still is true of any small craft steered with a tiller. On all ships equipped with steering wheels, however, the wheel, rudder, and ship's head all move in the same direction. That is, when you turn the wheel to port, the rudder goes to port, and the ship makes its turn to port. Remember, though, that the ship begins its port turn by sending its stem to starboard.

The more headway a ship has, the more water piles up against the rudder under the counter, and the quicker the stem is pushed off. Consequently, a ship always turns faster and answers its rudder sooner at high speeds than at low speeds. Also, a greater angle on the rudder is required to turn a ship moving slow than one moving fast.

STEERING STATIONS

When a ship goes into action, no one knows where it might be hit. If a ship has only a single steering station, a hit there would put it out of the fight. For this reason, a combat ship has more than one steering station so that control can be shifted almost instantaneously to any station.

A destroyer, for instance, may be steered from the bridge, after steering, or the steering engineroom. Some ships have fewer steering stations, but every ship has at least two.

RUDDER ANGLE INDICATOR

The instrument above and forward of the wheel angle indicator is the rudder angle order indicator-transmitter (fig. 2-7). This instrument has a dual purpose. During normal steering situations, it shows the actual angle of the rudder, which usually lags the wheel angle indicator by about 2° because of the time required for the steering mechanism to operate. For emergency steering, this instrument becomes useful in transmitting visual orders to the helmsman in after steering. By operation of the control knob, the rudder order is displayed on the instrument when the pointer

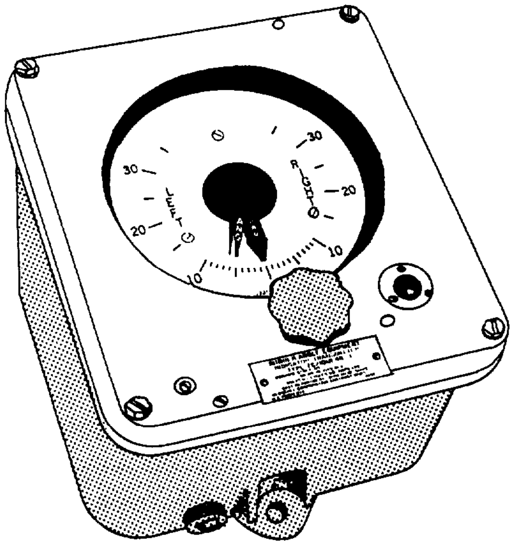

Figure 2-7.— Rudder angle order indicator-transmitter.

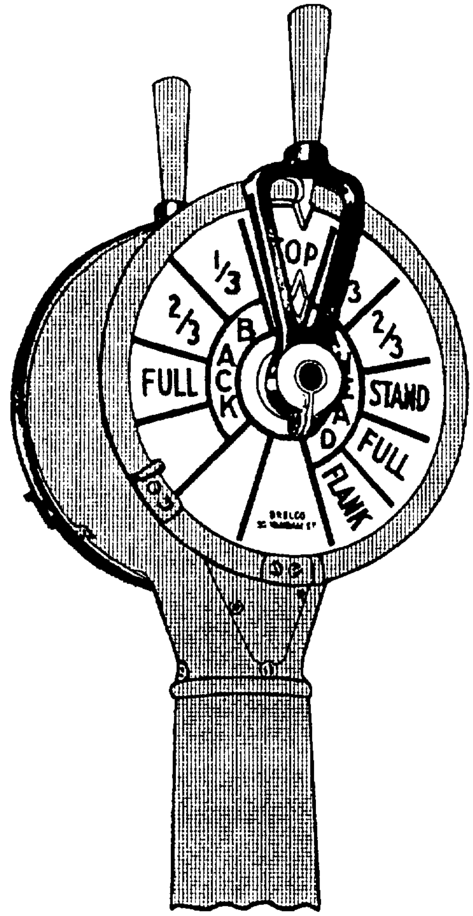

Figure 2-8.— Engine order telegraph.

marked "ORD" is moved to the desired rudder angle. The order is displayed in after steering on another rudder angle order indicator-transmitter, from which the after helmsman receives orders. A push switch next to the rudder angle order indicator-transmitter on the bridge operates a bell in after steering to call the helmsman's attention to a change in rudder angle.

ENGINE ORDER TELEGRAPH

On the conning platform, an instrument called the engine order telegraph (fig. 2-8) communicates speed orders to the engineroom. The engine order telegraph is circular, with duplicate dials divided into sectors for flank, full, standard, 2/3, and 1/3 speed ahead; 1/3, 2/3, and full speed back. A hand lever fitted with an indicator travels over the circumference of the circular face of the instrument. When the handle is moved to the required speed sector, the engineroom complies with the order immediately and notifies the bridge by operating an answering pointer that follows into the same sector.

A ship with one engine has a telegraph with a single handle. Two-engine ships usually have a handle on the port side and another on the starboard side of the telegraph, controlling the engines on the corresponding sides, (The engine order telegraph shown in figure 2-8 is equipped with separate handles for port and starboard engines.) Be sure you have grasped the handle for the correct engine before you operate it. If the answering pointer moves to the wrong sector, does not move at all, or moves to a line between two sectors so that you are in doubt about the speed set on the engine, repeat your operation on the lever. If the pointer does not move to clear up the riddle, report the situation immediately to the officer of the deck.

If a casualty occurs in the engineroom, the speed may be changed by the engineroom without orders from the officer of the deck. In such an event, the answering pointer moves to the speed set in the engineroom. Report any change in the engine order telegraph to the officer of the deck at once. Also report to the OOD immediately if you fail to receive an answer on the pointer when you indicate a speed. The safety of your own ship and others may depend on the immediate and correct transmission of orders to the engines.

Before getting underway, the telegraph is always tested by moving the handle to each sector, and checking the response on the answering pointer. In the event of casualty to the telegraph, the engineroom receives orders over the sound-powered phones.

ENGINE REVOLUTION TELEGRAPH

On or near the engine order telegraph, you normally will find another device, the propeller order

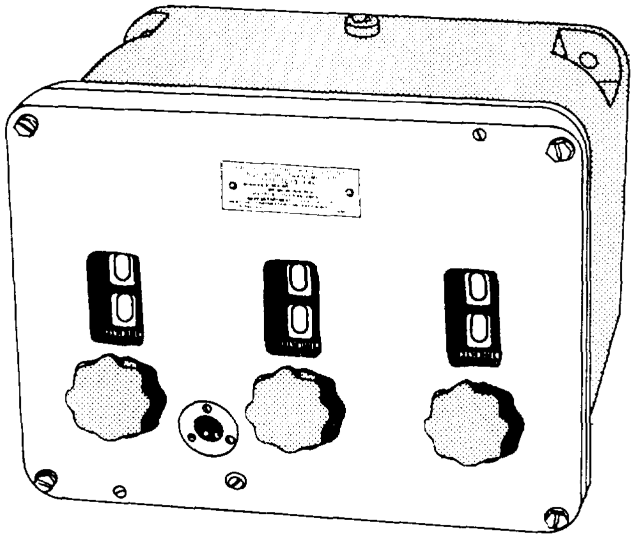

Figure 2-9.— Propeller order indicator-transmitter.

indicator-transmitter. See figure 2-9. It is commonly called the engine revolution telegraph. This instrument enables the lee helmsman to make minor changes in speed by stepping up or lowering the rpm. On the face of the instrument are three small windows, in each of which appear two rows of numbers. The lower row of numbers is set individually by the three hand knobs located directly below the windows. These lower numbers give a visual indication of shaft revolution ordered by the conning officer to the engineroom. Corresponding numbers appear on a similar instrument in the engineroom(s) by means of electrical transmission. In the engineroom(s), these orders are received and acknowledged when the engineroom instrument is set on the same settings. Once again, this indication is transmitted back to the bridge electrically and is shown as the upper row of numbers. Thus, the operator at the conning station is able to report to the conning officer the receipt of the order for engine speed and that it is being carried out.

During the many different conditions of steaming, individual commands usually establish orders regarding when and in what manner the engine order telegraph and engine revolution telegraph are used together or separately. Usually it is found that the engine order telegraph is used alone during periods of piloting, whereas during periods of normal steaming, the engine revolution telegraph may be the primary means of transmitting speed changes. In general, however, both means are used when steaming under normal conditions. Be sure you know the exact orders relating to their use before taking over a watch on the bridge.

The number of revolutions per minute required to travel at the various speeds (full, standard, 2/3, and so on) are calculated in advance and are posted on a table nearby.

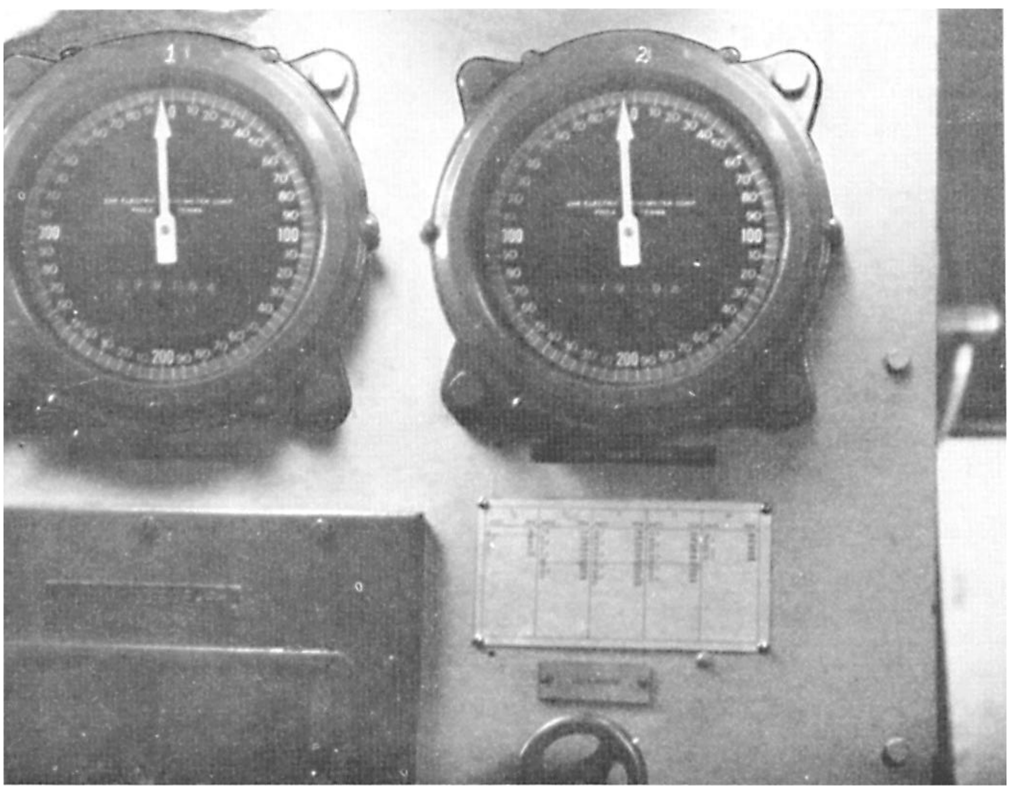

Figure 2-10.— Engine revolution indicator.

When standard speed is ordered, the number of revolutions per minute required to produce that speed must be set on the engine revolution telegraph if the revolution counter is being used.

When not in use, the telegraph on the bridge may be set to 999 or (on some telegraphs) to M (for maneuvering). This setting indicates to the engineroom that the ship is on maneuvering bells.

Although control of the engine order telegraph usually can be shifted from the bridge to an after conning station by a selector switch, control of the engine revolution telegraph cannot be shifted in this manner in most installations.

An engine revolution indicator (or tachometer) on the bridge shows the number of revolutions per minute actually being made by each shaft. This device is only an indicator and is incapable of transmitting orders. See figure 2-10.

CONSOLES

Many ships are equipped with ship control and steering control consoles.

Ship control and steering control consoles normally are installed in the pilothouse and serve as a direct method of controlling the ship. These consoles concentrate in one location many of the interior communication units formerly scattered in several places about the bridge. The units are combined in two consoles, which usually weigh less and require less space than if the same units were installed separately. Components of the consoles are mounted so that they are easily visible and accessible to the personnel concerned with the control of the ship.

Ship Control Console

The ship control console contains equipment for controlling the movements of a ship. Figures 2-11, 2-12, and 2-13 show three types of ship control consoles in

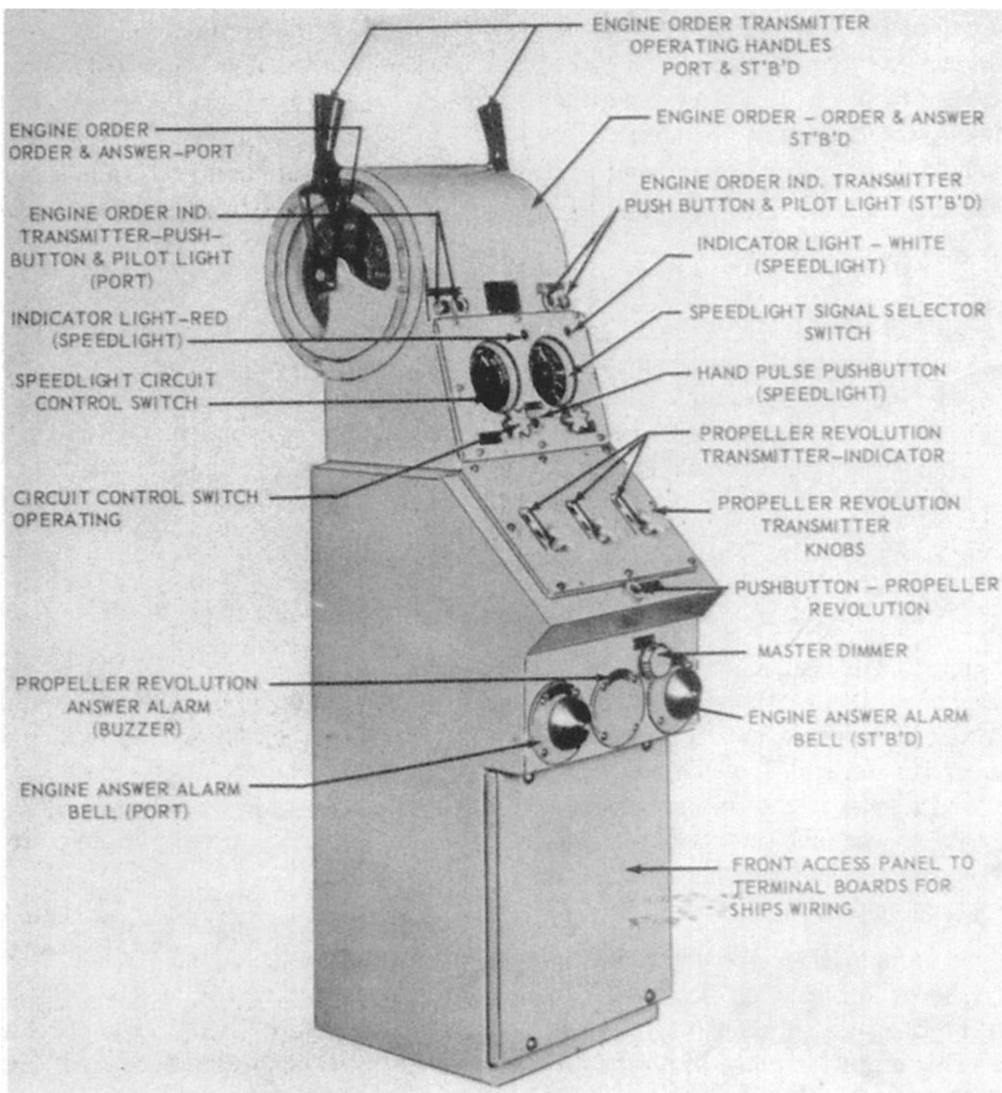

Figure 2-11.— Ship control console.

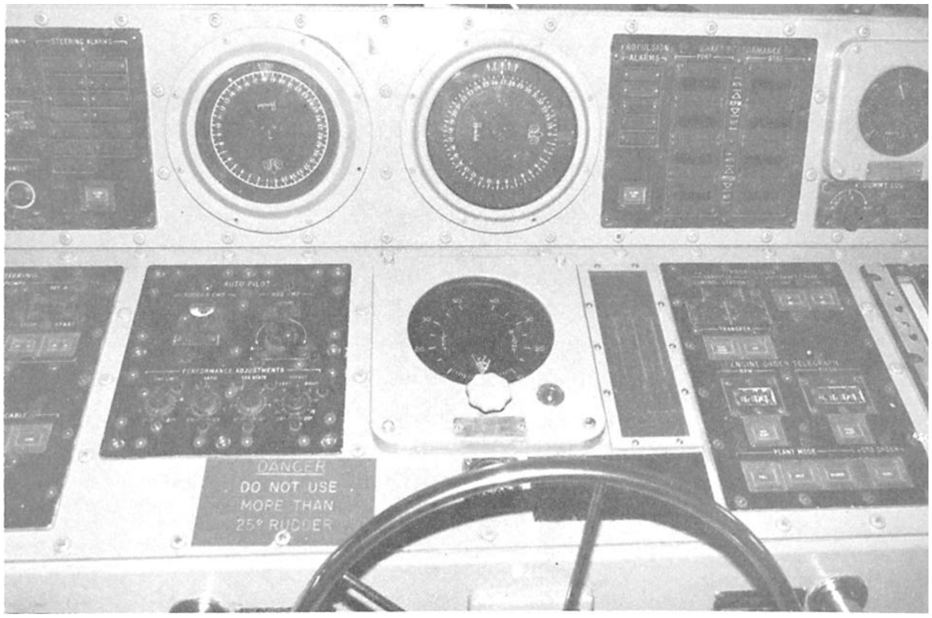

Figure 2-12.— DD-963 ship control console.

use aboard ships today. As you can see from these illustrations, the physical appearance may differ from ship type to ship type.

Steering Control Console

The steering control console (fig. 2-14) is used in conjunction with the ship control console. It includes the rudder angle order indicator-transmitter, helm angle indicator, ship's course indicator, course-to-steer indicator, magnetic compass repeater, and emergency steering switch.

FATHOMETER

Ships are equipped with a sonic fathometer, whose principle of operation is based upon the fact that sound travels through water at about 4,800 feet per second. The fathometer sends out a signal, which bounces off the ocean floor and returns to the ship much like an echo. Obviously, half of the time (in seconds) required for the sound to make the round trip, times 4,800 is the distance to the bottom, in feet.

The set includes a compact receiver-transmitter unit in the charthouse, and a transducer on the bottom of the ship. In spite of its small size, the fathometer gives a very accurate reading at a wide range of depths, from about 5 feet to 6,000 fathoms. It is designed for use on both submarines and surface vessels.

NAVIGATIONAL LIGHTS

LEARNING OBJECTIVE: List and explain the purpose of the navigation lights aboard ship.

The navigational lights installed on naval vessels must be in accordance with *Navigation Rules, International-Inland*, COMDTINST M16672.2B, or as allowed by an existing waiver or a waiver to be issued covering a vessel being built. These lights consist of (1) running lights, (2) signal lights, and (3) anchor lights. Figure 2-15 shows navigational lights onboard a vessel underway.

RUNNING LIGHTS

Running lights of naval ships are similar to those used on merchant ships. They include the (1) masthead light, (2) second masthead light (range light), (3) port and starboard side lights, and (4) stem light (white). Some of these running lights are illustrated in figure 2-16.

The masthead light is a white light (fig. 2-16, view A) located on the foremast or in the forward part of the ship, between 6 and 12 meters above the deck. It has a spraytight fixture and is equipped with an inboard shield to show an unbroken light over an arc of the horizon of 225°; that is, from right ahead to 22.5° abaft the beam on either side.

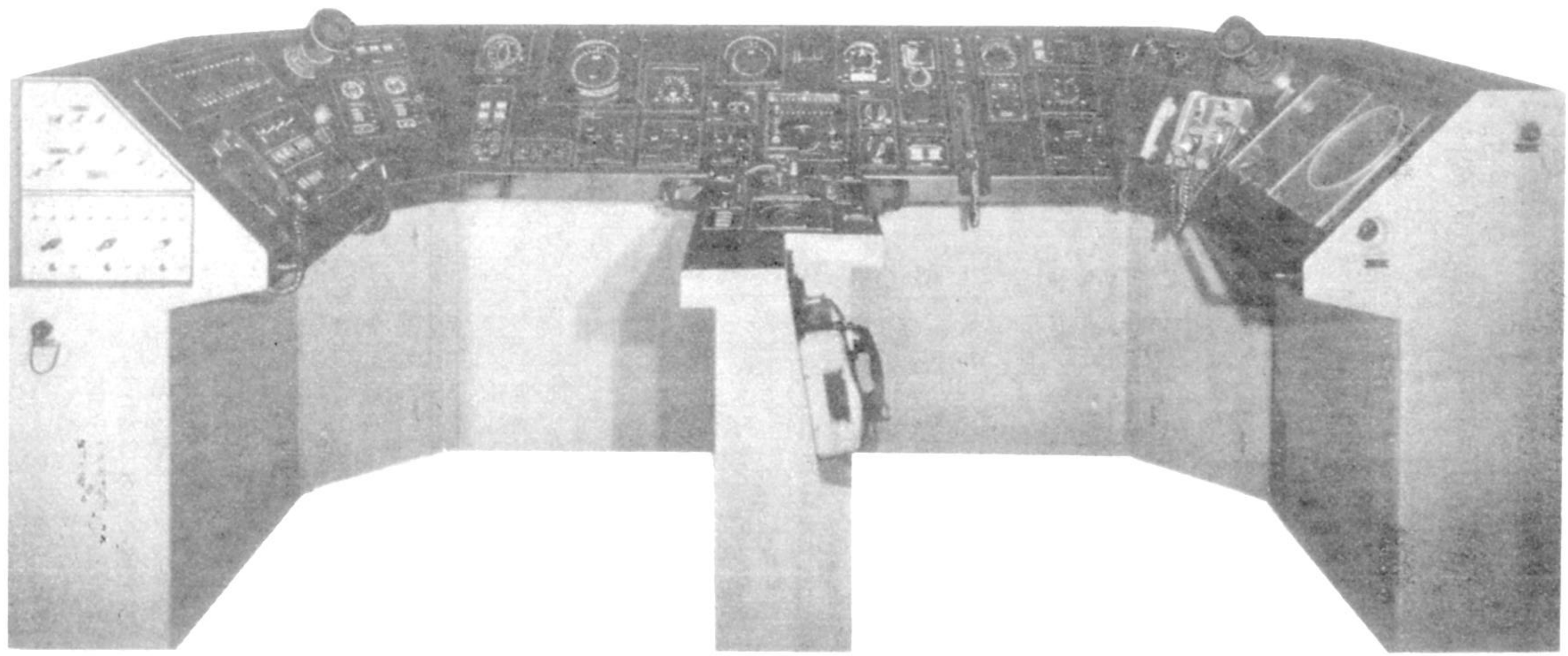

Figure 2-13.–FFG-7 class ship control console.

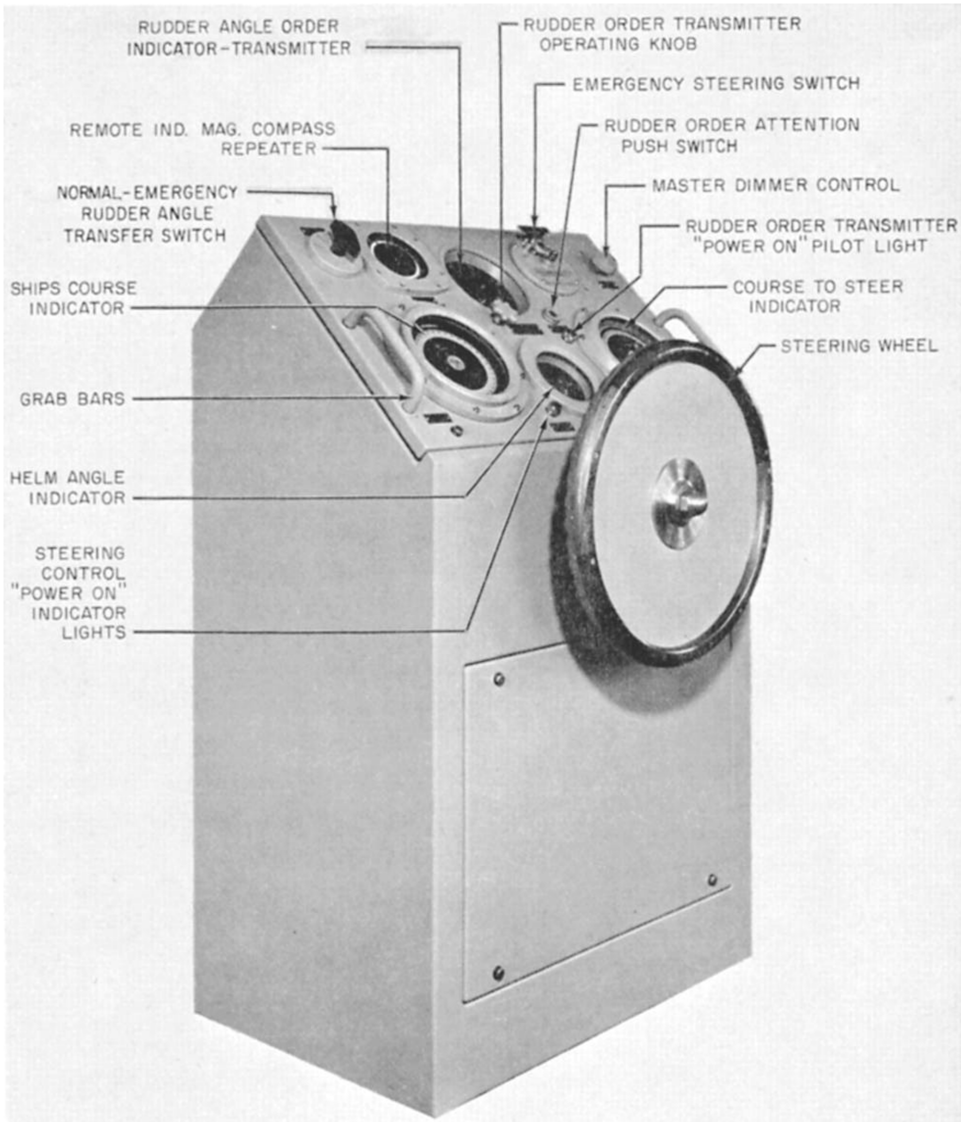

Figure 2-14.— Steering control console.

The second masthead light, also a 225° white light, is mounted on the mainmast or the forepart of any ship 50 meters in length or longer, but at least 4.5 meters higher than the masthead light.

Port and starboard side lights are 112 1/2° lights (fig. 2-16, view B) on the respective sides of the ship. They show red to port, green to starboard, and are invisible across the bow. The fixtures are spraytight, and each is equipped with an inboard screen arranged to throw the light from right ahead to 22.5° abaft the beam, port and starboard.

The stern light is a 135° white light (view C) located on the stem of the vessel. It is a watertight fixture and is equipped with an inboard screen to show an unbroken light over an arc of the horizon of 135°, that is, from dead astern to 67.5° on each side of the ship.

The supply, control, and telltale panel for the running lights is a non-watertight, sheet steel cabinet designed for bulkhead mounting (fig. 2-17). This panel is located in the pilothouse. It affords an audible and visible signal when the primary filament burns out in any one of the five running lights. At the same time, the panel switches automatically to the secondary filament so that the defective light remains in service. A master control switch with an indicator light is also located on the running light supply, control, and telltale panel.

SIGNAL LIGHTS

Signal lights installed on combatant ships usually include (1) aircraft warning lights, (2) blinker lights, (3) breakdown and man-overboard lights, (4) steering light, (5) stem light (blue), (6) wake light, and (7) speed

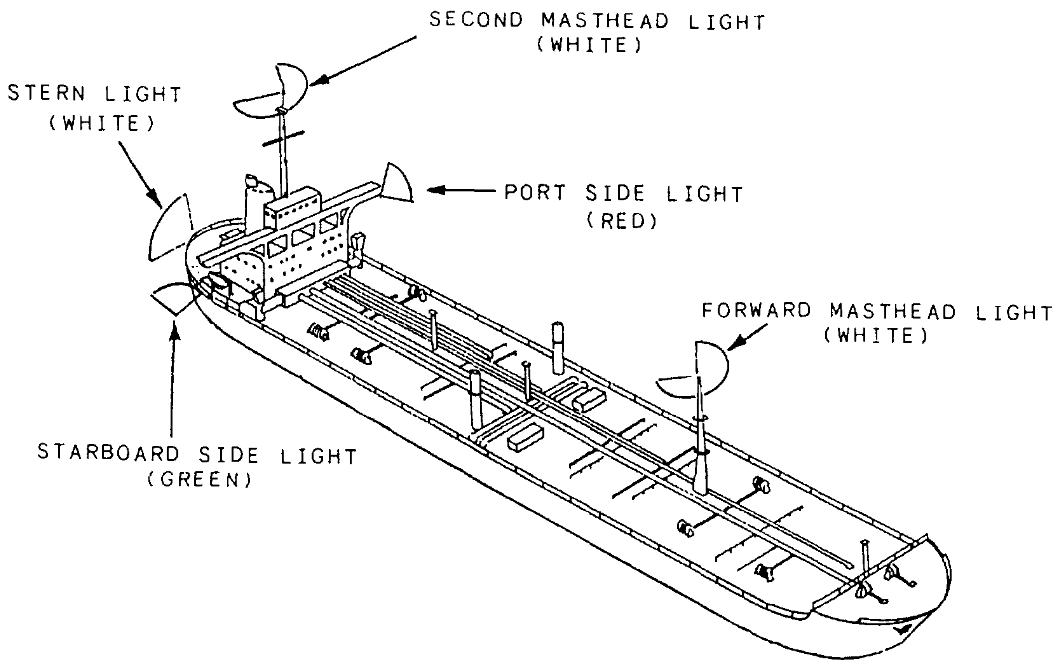

Figure 2-15.— Navigational lights on a power-driven vessel 50 meters or greater, underway.

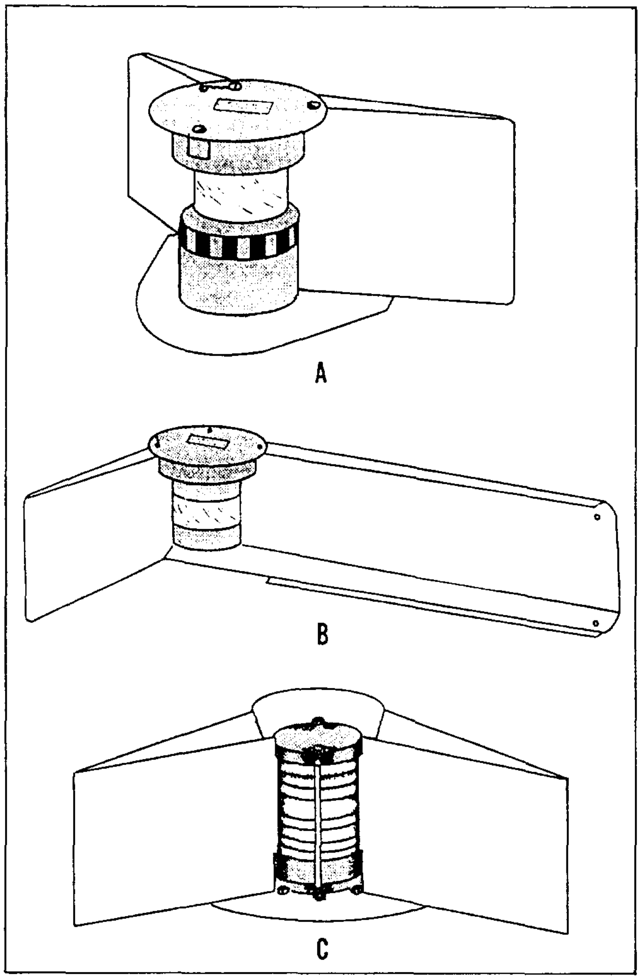

Figure 2-16.— Running lights.

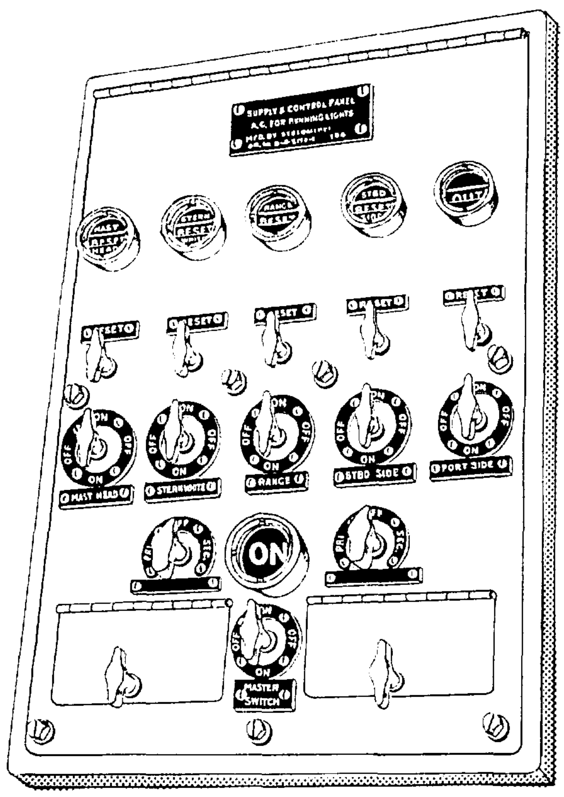

Figure 2-17.— Supply, control, and telltale panel.

lights. Supply switches for these lights are located on the signal and anchor light supply and control panel (in the pilothouse). The switches are individual on-off rotary snap switches.

The aircraft warning lights (red) for ships are 32-point (360°) lights installed at the truck of each mast that extends more than 25 feet above the highest point in the superstructure. Two aircraft warning lights are installed if the light cannot be located so that it is visible from any location throughout 360° of azimuth. The fixtures are spraytight and are equipped with multiple sockets provided with 15-watt, 1-filament lamps.

Blinker lights for ships are located on the yardarms. They are used in sending flashing light messages.

The breakdown and man-overboard lights (red) for ships are 32-point (360°) lights located 6 feet apart (vertically) and mounted on brackets that extend abaft the mast or structure and to port. This arrangement permits visibility, as far as practicable, throughout 360° of azimuth. The fixtures are spraytight and are equipped with 15-watt, 1-filament lamps. When these lights are used as a man-overboard signal, they are pulsed by a rotary snap switch (fitted with a crank handle) on the signal and anchor light supply and control panel.

The steering light (white) for ships is installed on the jackstaff or other spar or structure and must be visible to the helmsman in the pilothouse. The light is installed on the centerline if the pilothouse is on the centerline. If the pilothouse is not on the centerline, a vertical plane through the light and the helmsman's station in the pilothouse must be parallel to the keel line. The fixture is spraytight and includes a disk screen with a 3/64- by 1-inch slot (opening) through which light is emitted from a 2-candlepower lamp. A suitable bracket is provided with which the light is mounted on a jackstaff (1/2 inch in diameter).

The stem light (blue) for ships is a 12-point (135”) light similar to the white stern light (fig. 2-16, view C) described previously. The light is installed near the stem on a ship that is engaged in convoy operations. It is mounted to show an unbroken arc of light from dead astern to 6 points on each side of the ship.

The wake light (white) for ships is installed on the flagstaff or after part of the ship to illuminate the wake. It is so mounted that no part of the ship is illuminated. The fixture is tubular and spraytight. One end of the fixture has an internal screen with a l-inch-diameter hole and a 2 5/16-inch-diameter by 3/8-inch-thick lens, through which light is emitted from a 100-watt, 2-filament lamp. A suitable mounting bracket is included, with which the position of the light can be adjusted. Thus, the wake light puts a “target” in the ship's wake.

Speed lights for the ships are combination red (top) and white (bottom), 32-point (360°) lights. They are at the truck (top) of the mainmast unless height of the foremast interferes with their visibility; in that case, they are located at the truck of the foremast. Two speed lights are installed if their light cannot be located so that they are visible throughout 360° of azimuth.

Speed lights are provided to indicate, by means of a coded signal (as in table 2-2), the speed of the vessel to other ships in formation. In other words, they indicate the order transmitted over the engine order system. The white light indicates ahead speeds. The red light signifies stopping and backing.

The speed light is used as an aircraft warning light to provide a steady red light when the signal selector switch is placed in the stop position and the circuit control switch in the aircraft warning position.

ANCHOR LIGHTS

The forward and after anchor lights (white) for ships are 32-point (360°) lights. The forward anchor light is located at the top of the jackstaff or the forepart of the vessel; the after anchor light is at the top of the flagstaff. Each of the splashproof fixtures is provided with a 50-watt, 1-filament lamp. Anchor lights are energized through individual on-off rotary snap switches on the signal and anchor light supply and control panel in the pilothouse.

STANDING LIGHTS

Standing lights are dim, red lights installed throughout the interior of the ship or white lights installed on exterior deck passageways. The general purpose of standing lights is to provide the following:

1. In berthing spaces, the red lights provide just enough light to permit safe movement of personnel within the space when the regular lighting is extinguished.

2. On the limited number of established routes between the berthing spaces and the weather stations, with reduced light contrast between the interior of the vessel and the dark outside deck. The purpose of the reduced light contrast is to reduce to a minimum the period of blindness experienced by ship's personnel going to stations on the outside deck.

Table 2-2.— Speed Light Signals

SIGNAL SELECTOR SWITCH DIAL MARKINGS	PULSATIONS
Standard speed ahead	Steady white light (motor off)
One-third speed ahead	One white flash in 6 seconds
Two-thirds speed ahead	Two white flashes in 6 seconds
Full speed ahead	Four white flashes in 6 seconds
Flank speed ahead	Five white flashes in 6 seconds
Hand pulse key ahead	Manually controlled (code same as above)
Stop	Steady red light (motor off)
Slow speed back	One flash in 6 seconds
Full speed back	Two flashes in 6 seconds
Hand pulse key back	Manually controlled (code same as above)

3. White standing lights are used on exterior passageways to provide light so the ship's crew may move around the exterior of the ship with out danger of injury. These white standing lights are normally only turned on when the ship is in port or at anchor.

INTERIOR COMMUNICATIONS

LEARNING OBJECTIVE: Define the purpose and use of the various interior communications systems.

Interior communications deal with those forms of communication between a sender and a receiver aboard the same ship. Interior communications are carried out via sound and some visual methods. Communications by messenger, probably the most ancient of all methods, remains the most reliable system.

SHIP'S SERVICE TELEPHONE SYSTEM

The ship's service telephone system is similar to a dial telephone ashore. It is electrically powered and has a dial apparatus and central switchboard. By means of this system, you can communicate with any part of the ship merely by dialing a number. When the ship is alongside, the ship's service system can be connected with the beach to permit outside calls; but the switchboard, which functions automatically for interior communications, must be manned by an operator for outside calls. Ship's service phones normally are equipped with light handsets, which are easy to manage, and you do not have to talk any louder or more distinctly than you would on a telephone ashore.

An ordinary ship's service phone, like any telephone ashore, sends back a busy signal if it already is in use when dialed. However, if there should be an emergency call, some phones (such as those on the bridge or quarterdeck) have an executive right-of-way feature, by which it is possible to break into a conversation in progress.

The ship's service phone has one disadvantage: The number of talkers it can reach on a single circuit is small compared to the number that can be reached by the sound-powered battle phones.

SOUND-POWERED-TELEPHONE SYSTEM

The battle telephones are sound-powered; that is, instead of a battery or generator, your voice provides the power for the circuit. Failure of the electrical power system has no effect upon the sound-powered phones, although one or more stations can be knocked out by a direct hit. You should remember that every sound-powered receiver is also a transmitter, and vice versa. In other words, if all but one earpiece on a sound-powered headset is knocked out, you normally can continue to both talk and receive through the earpiece.

The primary battle telephone circuits provide means for communication between selected battle stations grouped on established circuits. No dialing is necessary; when you plug in to one of these circuits, you can communicate immediately with anyone who is plugged in on the same circuit. Additional stations not on the circuit may be cut in by a switchboard, which also can cut out stations on the circuit if desired.

Since as many as 30 stations may be on the same circuit, strict compliance with standard telephone talker's procedure and terminology is important. Everything a talker should know may be found in *Basic Military Requirements.* As a watchstander, you must be thoroughly familiar with it.

Battle telephone circuits vary in number according to the size and mission of the ship. Circuits are designated by standard symbols, each symbol consisting of two or possibly three letters. The first letter is always *J,* indicating a circuit that is part of the primary sound-powered-battle-phone system. The other letter or letters designate a subdivision circuit of the main system, as shown in the list given in the next topic.

Any subdivision of the system may be subdivided even further. In that event, each separate circuit is identified by a number before the symbol- *1JS,* for example. Some circuits used exclusively for operations in a single department may have no outlets on the bridge or may have outlets that are used only in special circumstances.

THE J CIRCUITS

It is possible that not all of the circuits listed here may be installed in the ship you are serving on, but you never know when you may be transferred. For this reason, you should learn them now.

JA	Captain's battle circuit
JC	Ordnance Control
JF	Flag officer
1JG	Aircraft control
JL	Battle lookouts
2JC	Dual-purpose battery control
1JS	Sonar control
1JV	Maneuvering, docking, and catapult control
JW	Ship control rangefinders
JX	Radio and signals
JZ	Damage control

Every one of the circuits listed, if it is in the ship at all, has an outlet on the bridge. Some of them are manned all the time; most of them are manned during general quarters. You must know where the outlet for each circuit is; when the circuit should be manned; and the type of traffic it handles.

The following explanation gives the standard purpose of each *J* circuit:

The *JA* circuit is used by the commanding officer to communicate with his department heads and their assistants.

The *JC* is the weapons officer's command circuit on ships having a single-purpose main battery. The circuit is controlled by the weapons officer, but has a bridge outlet for use by the commanding officer and the OOD.

The *JF* is the flag officer's circuit, controlled by the flag. When no flag is embarked, it may be used as an auxiliary circuit.

The *1JG* is the air officer's command circuit on an aircraft carrier. The captain also uses it to transmit orders that concern only the air department.

The *JL* is the circuit over which the lookouts report. It is a most important channel of vital information to the bridge, CIC, and weapons control. In wartime, the *JL* circuit is manned under all cruising conditions. In peacetime, it is manned when circumstances require extra lookout precautions, but it may then be combined with other circuits. The controlling JL station is on the bridge, and the bridge talker is often designated as lookout supervisor.

On a ship like a destroyer having a dual-purpose main battery, the *2JC* circuit serves the same purpose as the JC on a ship having a single-purpose main battery and a separate secondary battery. Ships having both circuits use the 2JC as the air defense officer's circuit.

The *1JS* is used as an ASW command circuit and also as a CIC dissemination circuit. When the 1JS is used as an ASW command circuit, communication links are usually found in sonar control, CIC, UB plot, and on the bridge. This circuit enables stations on the communication link to exchange information without interrupting the constant flow of information on other circuits. On some ships the 1JS is used to disseminate CIC information to the conning, gunnery, and aircraft control stations. The 1JS is usually controlled by the CIC evaluator.

The *1JV*, called the primary maneuvering circuit, is the one with which the Quartermasters are chiefly concerned. It connects the bridge and other conning stations with main engine control, steering aft, and other emergency steering stations. It has outlets on the main deck for control of the anchor detail and line-handling parties fore and aft. This circuit is always manned by CIC, and may be manned by other control stations when advisable. The conning officer controls the 1JV, and the circuit is always manned-or at least is ready for instant use-whenever the ship is underway.

The *JW* is the navigator's circuit by which Quartermasters stationed at peloruses may report directly to the navigator at the chart table. During piloting, the JW is connected with communication spaces.

The *JZ* circuit is the damage control circuit by which damage control parties can communicate with DC Central.

Some of the foregoing circuits may vary slightly on different ships. As soon as you report aboard a new ship for duty, you must learn the details of any possible variance.

AUXILIARY BATTLE CIRCUITS

The auxiliary battle circuits form a secondary system, consisting of sound-powered lines that are not routed through a switchboard. Most of the important circuits described previously have substitutes in the auxiliary system.

An auxiliary circuit is designated by the letter *X*, followed by the symbol of the circuit for which it is a substitute. Many circuits are equipped with call buzzers so that communication can be maintained with stations on the circuit without the circuits having to be manned continuously. A typical example is the *X1JV*, which permits the OOD to exchange communications directly with the engineering officer of the watch.

VOICE TUBE

On most mine craft, patrol boats, and the like, the voice tube still is the primary means of interior communications, although some small craft have sound-powered-phone circuits. A voice tube requires neither electrical nor sound power, but its effectiveness decreases, of course, in direct ratio to the length of the tube and number of bends it contains. On large ships, communication by voice tube is for short distances only, as between open conning stations and the pilothouse.

SHIPBOARD ANNOUNCING SYSTEMS

In the old Navy, before the days of loudspeaker systems, an all-hands order was passed by word of mouth by the Boatswain's Mates fore and aft. The boatswain or BM of the watch sounded “CALL MATES” on his pipe to get the BMs together, and they answered repeatedly with the same call from various parts of the ship as they converged on the bridge or quarterdeck. When they heard the word, they dispersed fore and aft to sing it out at every hatch.

This procedure was very colorful, but it took a lot of time. Now, a single Boatswain's Mate can pass the word over the *MC* circuit in short order, while the others stay where they are, keeping the gang heaving around. The basic MC circuit is the *1MC*, the general announcing system, over which word can be passed to every space in the ship. The general alarm system is tied into it as well. Transmitters are located on the bridge, quarterdeck, and central station; and additional transmitters may be at other points. See figure 2-18.

The OOD is in charge of the 1MC. Except for possibly an emergency call by the damage control officer, no call may be passed over the 1MC unless authorized by the OOD, the executive officer, or the captain.

Normally, the 1MC is equipped with switches that make it possible for certain spaces to be cut off from announcements of no concern to them. The captain, for

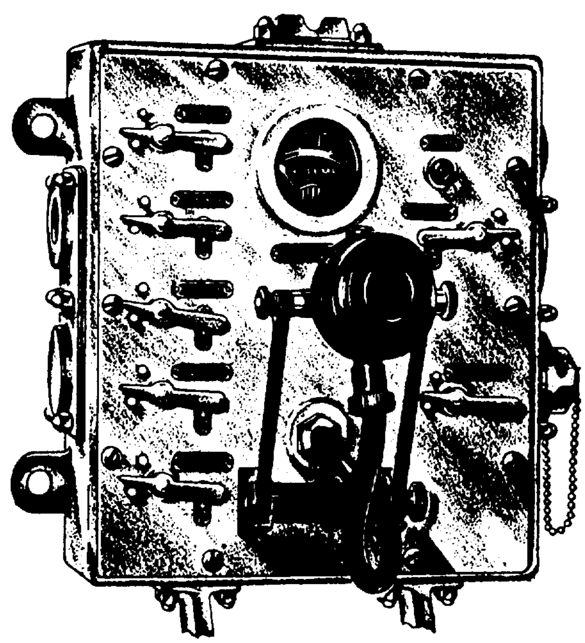

Figure 2-18.— loudspeaker transmitter.

instance, does not want the cabin blasted with calls for individuals to lay down to the spud locker. The BM of the watch is responsible for passing the word; but if he or she is absent and you are required to pass the word by yourself, be sure you know which circuits should be left open, Some parts of the ship have independent MC circuits of their own, such as the engineers' announcing system *(2MC)* and the hangar deck announcing system *(3MC)*.

The bull horn *(6MC)* is the intership announcing system, but it seldom is used for actual communication between vessels. It is, however, a convenient means for passing orders to boats and tugs alongside or to line-handling parties beyond the range of the speaking trumpet. If the transmitter switch is located on the 1MC control panel, you must be careful to avoid accidentally cutting in the bull horn when you are passing a routine word. The 1MC, 2MC, 3MC, and 6MC are all one-way systems.

Such MC circuits as the *21MC,* familiarly known as squawk boxes, differ from the preceding PA systems in that they provide means for two-way communications. Each unit has a number of selector switches. To talk to one or more stations, you need only throw the proper switches and operate the press-to-talk button. A red signal light mounted above each selector switch shows whether the station called is busy. If it is busy, the light flashes; if it burns with a steady light, you know that the station is ready to receive.

Following is an example of how to operate the intercom. You are on the signal bridge, at the 24MC transmitter (fig. 2-19), and you want to call conn. First you push the selector button marked CONN. We will assume the line is clear for your message, which means that a steady red light appears over the SIGNAL BRIDGE selector switch at the conn transmitter. When the operator at conn pushes on the SIGNAL BRIDGE button, the signal lights at both stations begin to flash. Now you can operate the PRESS-TO-TALK button and start your message. Any other station attempting to cut in gets the flashing busy signal.

The chief disadvantage of the intercom is that it raises the noise level in any space in which it is used. For this reason, it seldom is used when telephones are manned. Intercom circuits that may be located on the bridge are identified briefly as follows:

The *20MC,* combat information announcing system, connecting the same stations as the 1JS

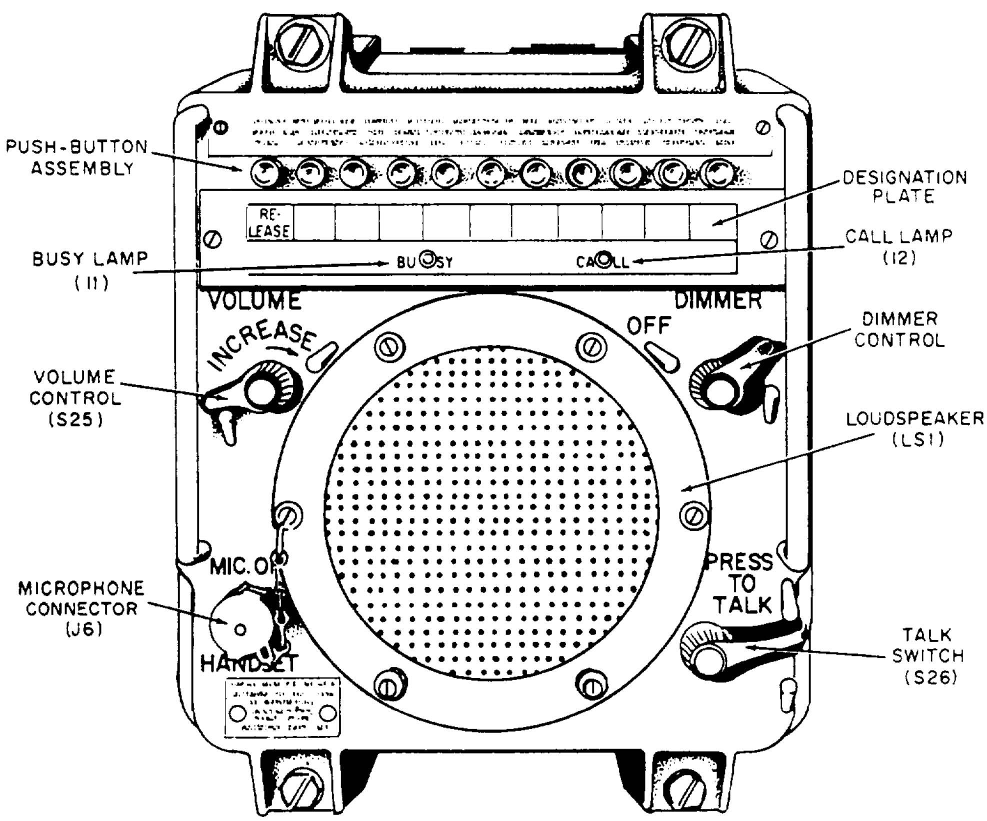

Figure 2-19.— Typical MC unit.

The *21MC,* captain's command announcing system, an approximate parallel to the JA

The *22MC*, radio room announcing system, a substitute for the JX

The *24MC,* flag officer's command announcing system, the intercom equivalent of the JF

LOOKOUTS' EQUIPMENT

LEARNING OBJECTIVE: Explain the proper usage and care of lookout equipment.

You were born with the most important lookout equipment you will ever use-your own two eyes. In lookout work, your eyes are invaluable if you use them right. You have already learned a good deal about proper use of the eyes in night scanning and in day scanning. However, you still have much to learn about scanning and the equipment you are required to operate.

The lookout on the average ship in the Navy will have most of the following equipment:

- binoculars
- binocular filters
- sunglasses
- dark-adaptation goggles
- alidades
- peloruses
- sound-powered phones
- various articles of foul-weather gear

Although this gear may be stamped "U.S. Navy," it is yours while you use it. And it is up to you to know how to use it and how to take care of it properly.

BINOCULARS

The most commonly used optical equipment is the binoculars (fig. 2-20). Although normally only 7 power, the binoculars gives a wide range of vision and is best suited for searching over a wide area or for following a swiftly moving target. The binoculars requires the use of both eyes; but since both eyes do not always have the same vision, it is best to adjust the focus for each lens individually. Proper focus is essential. If the focus is off, things look blurred, eyestrain is greatly increased, and maximum efficiency will not be obtained.

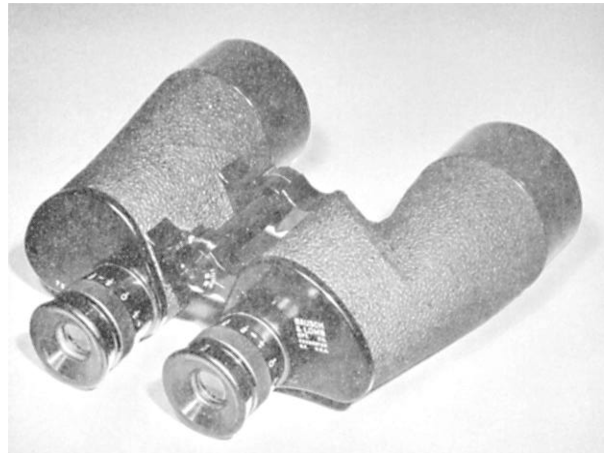

Figure 2-20.-7 x 50 binoculars.

Before focusing the binoculars for each eye, turn both scales to the +4 setting. Hold the binoculars firmly against your eyebrows. To get the focus for the left eye (only one eye can be focused at a time), cup the right hand over the right lens, cutting out all the light to that eye. Be sure to keep both eyes open, however, since closing one eye will give an incorrect focus. Train the binoculars on a small, well-defined object. Slowly turn the eyepiece from its +4 setting until the object stands out in sharp detail.

The reading on the scale will give you the correct focus for your left eye. Now do the same for the right eye. The chances are the setting will be different. You might repeat this focusing process for each eye several times just to make sure the focus is right.

Once you get the glasses properly focused, remember the settings. The best reason for remembering the settings is that it is difficult to focus your binoculars on a very dark night. The correct night focus is usually a -1 setting from your day focus for each eye.

The other adjustment for binoculars is the inter-pupillary distance (IPD) adjustment. All Navy binoculars have the IPD scale on the hinge between the barrels. Find out what your IPD is and remember it. When you set your correct IPD on the scale, you will see a single circle in focus. At night, if you have the wrong IPD setting, light that should be going to your eyes will be cut out.

Take a look through a pair of binoculars that is not adjusted for your eyes and then look through a pair that is properly adjusted. Notice the great difference. Keep this in mind when you see the binoculars that belong to the captain, navigator, or officer of the deck, and never touch them.

Although most binocular glass has been treated to reduce glare, there are times when the direct rays of the sun are so strong that even with treated glass, it is almost impossible to distinguish shapes and colors. To overcome this handicap, binocular glass usually has colored lens filters, which can be inserted over the regular lenses, greatly reducing the glare.

Your efficiency with optical equipment, the same as with anything else, will greatly improve with knowledge and practice.

The care of binoculars: Your binoculars are your most important single piece of equipment. They will do a top-notch job for you if you use them properly; otherwise, they will only hinder you. Here are some suggestions:

- Treat them carefully. They are fragile and will break or get out of adjustment if handled roughly.

- Keep them "short-strapped" around your neck when in use so that they do not dangle and get knocked against ladders or the rail.

- Do not leave them in the sun; and do not expose them to sudden changes in temperature. The cement between the lenses will crack if you do.

- Above all, keep your binoculars clean! You would not drive with a dirty windshield; likewise, you should not scan with dirty binocular lenses. Both situations are dangerous! To get best results in cleaning lenses, (a) blow off the loose dust; (b) breathe on the lenses to moisten them (never breathe on the glass in freezing weather); (c) use lens tissue, or other soft, clean tissue to wipe your lenses (never use your sleeve or your handkerchief or anything that has the slightest amount of grit or grease on it). With a circular motion, gently rub the surface of the lenses until they are dry and clean. To remove grease, moisten the cleaning tissue slightly with alcohol.

- When your binoculars are not in use, see that they are properly stowed.

FOUL WEATHER GEAR

Under the best of conditions, the lookout's job is tough enough. But in rough weather, things can get really rugged. For this reason you have special types of foul weather gear. Navy issue on most ships is a special suit with hood and mask. In addition, you will have a life jacket. But the most important part of all is up to you: Make sure you dress warmly; you cannot perform your duties efficiently if you are cold and wet.

BREAKDOWN AND MAN-OVERBOARD EMERGENCIES

LEARNING OBJECTIVE: List and identify shipboard emergency signals.

Emergencies aboard ship can be dangerous to you and to your shipmates if the emergencies are not discovered and reported immediately and if each person does not know exactly what to do and how to proceed. For this reason, breakdowns and man-overboard situations, although not watches in the strict meaning, could be considered permanent watches to be stood by all hands at all times. It is the responsibility of all hands-including you as a Seaman-to serve at all times as a lookout for either of these emergencies.

The captain of your ship requires that all hands be trained by frequent drills to meet these situations. Do not look lightly on this training; loss of your own life and that of your friends could be the price of inattention.

Breakdown and man-overboard situations require extremely rapid action on the part of the officer of the deck and assistants to the OOD. You should always consider yourself one of these assistants while aboard ship. Saving the life of a person overboard depends on the speed with which rescue action is taken. The captain, executive officer, and OOD must be notified immediately of either emergency.

BREAKDOWN SIGNALS

The breakdown flag is the FIVE flag. It is kept made up for breaking at the foretruck, ready to be broken should any breakdown of equipment vital to the ship's running or steering occur during daylight hours. When broken (flying free), it warns other ships to keep clear of the disabled ship. When a breakdown is discovered during daylight hours, the following procedure is put into effect immediately:

1. The five flag is displayed (Navy use only).

2. Two black balls are hoisted.

3. Six or more short blasts are sounded on the whistle.

Two red lights in a vertical line are displayed to signal a breakdown at night, in lieu of the five flag and the two black balls.

MAN-OVERBOARD SIGNAL

The man-overboard flag is the OSCAR flag displayed at the foretruck or where it can best be seen during daylight hours. When someone goes overboard at night, the peacetime procedure is the display of two blinking red lights arranged vertically. In addition, either by day or night, the ship losing the person sounds six or more short blasts on the whistle.

Man-Overboard Procedure

Only the ship losing a person overboard may make the signals described in the foregoing section. Action taken by other ships in a formation or around the ship losing the person overboard depends on existing conditions. If at all possible, the person overboard is to be rescued, but collisions must be avoided.

The peacetime (standard) practice for a ship losing a person overboard follows:

1. Anyone aboard ship who sees a person fall overboard must shout as loud as possible and without hesitation, "MAN OVERBOARD, STARBOARD (PORT) SIDE." This call must be repeated until the conning officer takes necessary action or indicates in some way that the word was received.
2. Rudder and engines are used, if appropriate, to avoid hitting the person with the screws.
3. A lifebuoy and smoke float are dropped.

   When launching a Mk 6 smoke float, (a) remove the tape from over the pull ring, (b) pull the ring smartly from the device, and (c) immediately throw the smoke float over the side. Do NOT remove the tape from over the pull ring until just before launching. Salt air will rust the pull wire, causing it to break and thereby making the device useless.
4. At least six short blasts are sounded on the whistle.
5. By day the OSCAR flag is hoisted where it can be seen best. By night, two pulsating red lights arranged vertically are displayed. (In peacetime any ship may use searchlights as necessary.)
6. The ship is maneuvered as prescribed by doctrine.
7. In formation, the officer in tactical command (OTC) of all ships present is notified.

Signals to Lifeboat

The following signals are used to direct a lifeboat engaged in picking up a person overboard.

Flag or Blinker	Pyrotechnics	Meaning
8	1 white star	Steer straight away from ship
8 PORT	1 red star	Steer left (or to port)
8 STARBOARD	1 green star	Steer right (or to starboard)
8 SCREEN	2 green stars	Steer straight toward ship
QUEBEC	2 red stars	Return to ship
	2 white stars	Steady on present course

Lifeboat Signal to Ship

When a lifeboat is attempting to pick up a person overboard at night, the following signals are used from the boat to the ship.

Visual Signals	Pyrotechnics	Meaning
Blinker or semaphore	1 green star	Cannot find person
	1 white star	Have recovered person
	1 redstar	Need assistance

SUMMARY

You should have learned in this chapter the various watchstander's equipment used on the ship's bridge. Failure to use proper nomenclature or a lack of basic knowledge of a ship's equipment is unprofessional and may, in an emergency, lead to dangerous confusion.

As an underway watchstander, you will perform, on occasion, routine checks or tests on bridge equipment as either the messenger of the watch or the helmsman.

Know your job and keep your equipment in good working order so you can do an outstanding job!