CHAPTER 9

DEAD-RECKONING SYSTEMS

LEARNING OBJECTIVES

After you finish this chapter , you should be able to do the following:

1. Identify the equipment associated with the ship's dead reckoning systems and state the purpose of each piece of equipment.
2. Discuss how to operate the DRT, under both normal and casualty condition
3. Describe geographic plotting procedures including direct plot, indirect plot, determining contact course and speed and man overboard procedures.

INTRODUCTION

Dead reckoning (DR) is probably the oldest form of navigation. This method of determining a ship's position considers only the ship's course and speed over a specified period of time, ignoring the effects of wind and current. Although certainly not an exact or precise form of navigation, dead reckoning provides valuable data from which to establish a true position. It is also useful in planning and executing tactical maneuvers.

In this chapter, we will discuss the basic equipment and procedures used to perform DR navigation.

DEAD-RECKONING EQUIPMENT

The primary equipment used for DR navigation consists of the dead reckoning analyzer indicator (DRAI), the gyrocompass, the underwater log, and the dead-reckoning tracer (DRT).

DEAD RECKONING ANALYZER INDICATOR

One dead-reckoning system is the Dead Reckoning Analyzer Indicator (DRAI), figure 9-1. The DRAI is an electrical-mechanical computer that receives inputs of own ship's speed from the underwater log (pitometer log) (fig. 9-2) and own ship's course from the master gyrocompass (fig. 9-3). The DRAI uses these two inputs to compute the ship's position (latitude and longitude) and distance traveled. The computed position and distance traveled are displayed on counters on the DRAI's front panel. The ship's course and speed inputs also are transmitted to the plotting system.

GYROCOMPASS

The basic navigation compass is the *magnetic* compass. While the magnetic compass is accurate, it has two important drawbacks for use in long-distance navigation. First, the magnetic North Pole is located some distance from the true North Pole. In general, because the true and magnetic North Poles are not located at the same geographic spot, a magnetic compass needle points away from true north. Since navigation charts are based on true north, magnetic directions are slightly different from true directions. The amount the needle is offset from true north by the Earth's magnetic field is called variation.

The second drawback of a magnetic compass is that its needle is deflected by magnetic materials in the ship and by magnetic materials brought near the compass. The amount a magnetic compass needle is deflected by magnetic materials in the ship around it is called deviation.

To eliminate the directional problems associated with magnetic compasses, ships use a *gyrocompass* for primary navigation. The gyrocompass, unaffected by either variation or deviation, points constantly to true north. For DR purposes, the gyrocompass sends course information to the DRAI, where it is combined with data from the pitlog and is broken down into

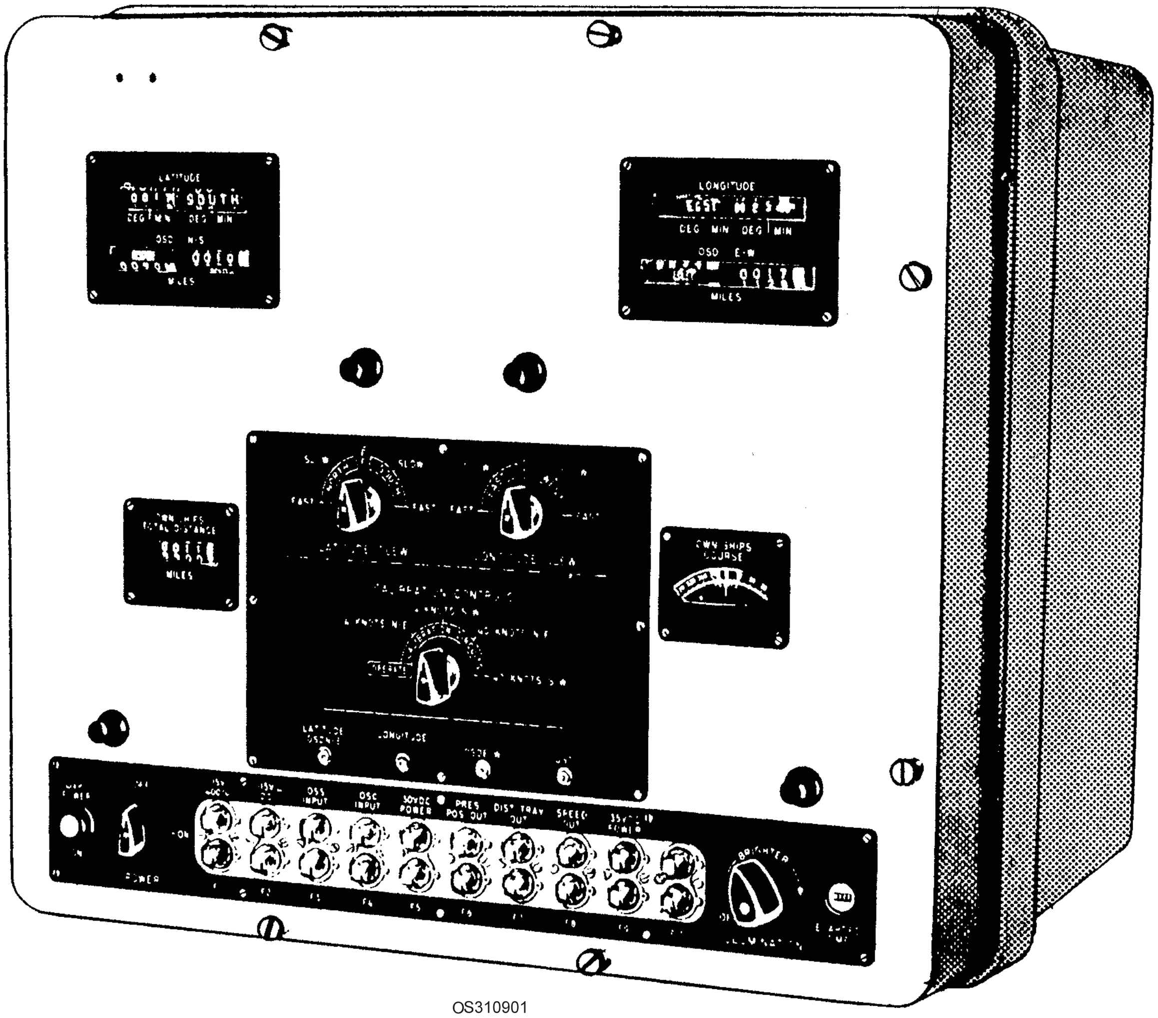

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Figure 9-1.—DRAI Mark 9 Mod 0.

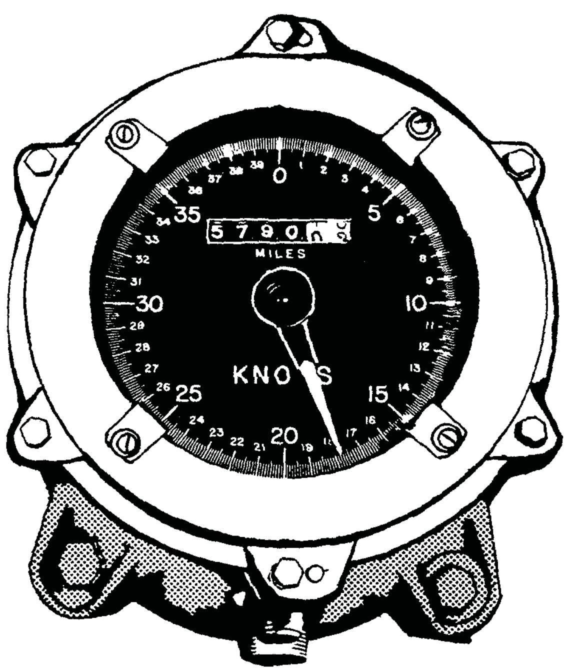

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Figure 9-2.—Pitlog Indicator.

components of travel in north-south and east-west directions.

Despite the proven dependability and reliability of the gyro mechanism, however, the magnetic compass is the standard compass found aboard ship. This is because the gyrocompass is powered by electricity. If the electrical supply is lost, the gyro becomes useless. Also, because the gyrocompass is a complicated and delicate instrument, it is also subject to mechanical failure. Because the DRAI receives its input from the gyrocompass, any casualty to the gyrocompass affects the DRAI outputs to plotting equipment.

UNDERWATER LOG SYSTEM

The underwater log system (called pitlog or electromagnetic log) measures the ship's speed and the distance traveled. It transmits these indications to the speed and distance indicators and to the weapons and navigational systems.

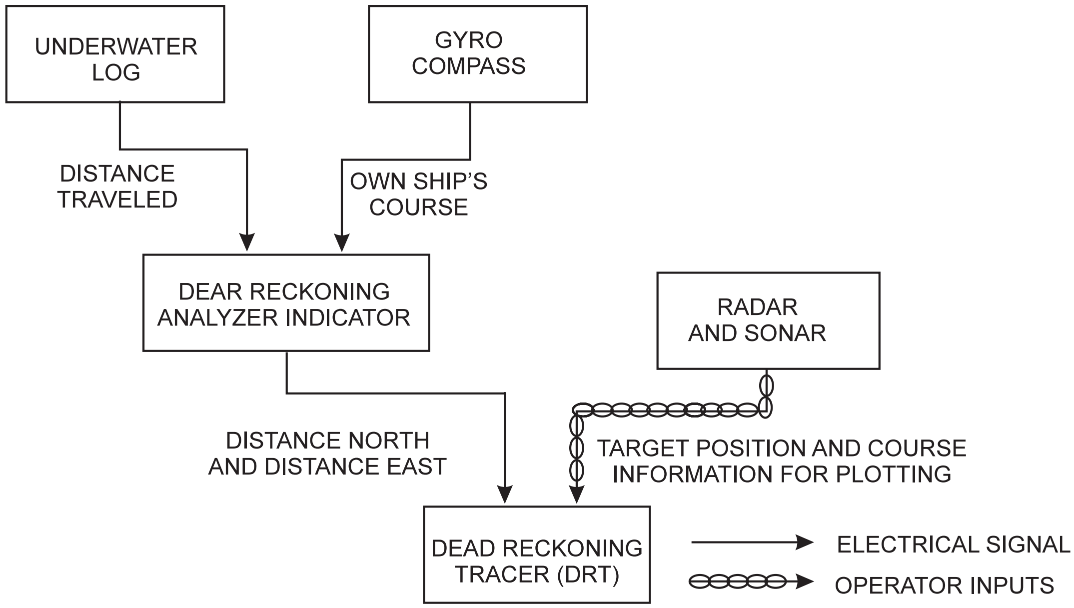

Figure 9-3.—Dead-reckoning system, simplified block diagram.

Sometimes, simulated speed and distance signals are needed for the various DR systems. In these instances, the *dummy log system* supplies such inputs. This system serves two purposes: (1) to simulate ship's movement through the water (for training personnel and aligning equipment) and (2) to serve as a backup for the underwater log system.The majority of all current underwater log systems use the electromagnetic principle to sense the ship's speed. Several different configurations using this principle of operation have been produced by various manufacturers for the Navy.

The electromagnetic principle is the same basic principle by which a generator produces a voltage. If a conductor is moved through a magnetic field, a voltage will be induced in the conductor. The magnitude of the induced voltage will vary with the number of active conductors moving through the magnetic field, the strength of the magnetic field, and the speed at which the conductor is moved through the magnetic field. An increase in the number of conductors, the strength of the magnetic field, or the speed of the conductor through the field will result in an increase in induced voltage.

The electromagnetic underwater log functions by placing a magnetic field in seawater. Seawater conducts electricity very well and is used as the conductor. When the ship is not moving through the water, there is no relative motion between the magnetic field and the conductor; therefore, no voltage is induced in the conductor (seawater). As the ship begins to move, relative motion takes place and a voltage is induced in the seawater. An increase in the ship's speed increases the induced voltage at a rate directly proportional to the increase in speed. By comparing the induced voltage to a known voltage, the system makes an accurate determination of the ship's speed.

DEAD RECKONING TRACER (DRT)

The dead reckoning tracer (DRT) (fig. 9-4) is basically a small table with a glass top, on which the ship's true course is plotted. The DRT operator places a piece of tracing paper on top of the glass and periodically marks lighted ship positions projected onto the paper from beneath the glass.

The DRT operates automatically from input signals from the DRAI. The east and north components, after setting the proper scale, drive the lead (E-W) and cross (N-S) screws to move the bug across the plotting surface. Figure 9-4 shows the location of the lead screw and the cross screw. A switch is provided for rotating the tracking axis 90°. Latitude and longitude are continuously computed from the two inputs and displayed on counters in the control compartment.

Figure 9-5 illustrates the operating controls and indicators of the Mk 6 Mod 4B DRT. Refer to the figure as you review the following list of controls and their functions.

Lamp (1): Provides illumination for the control compartment.

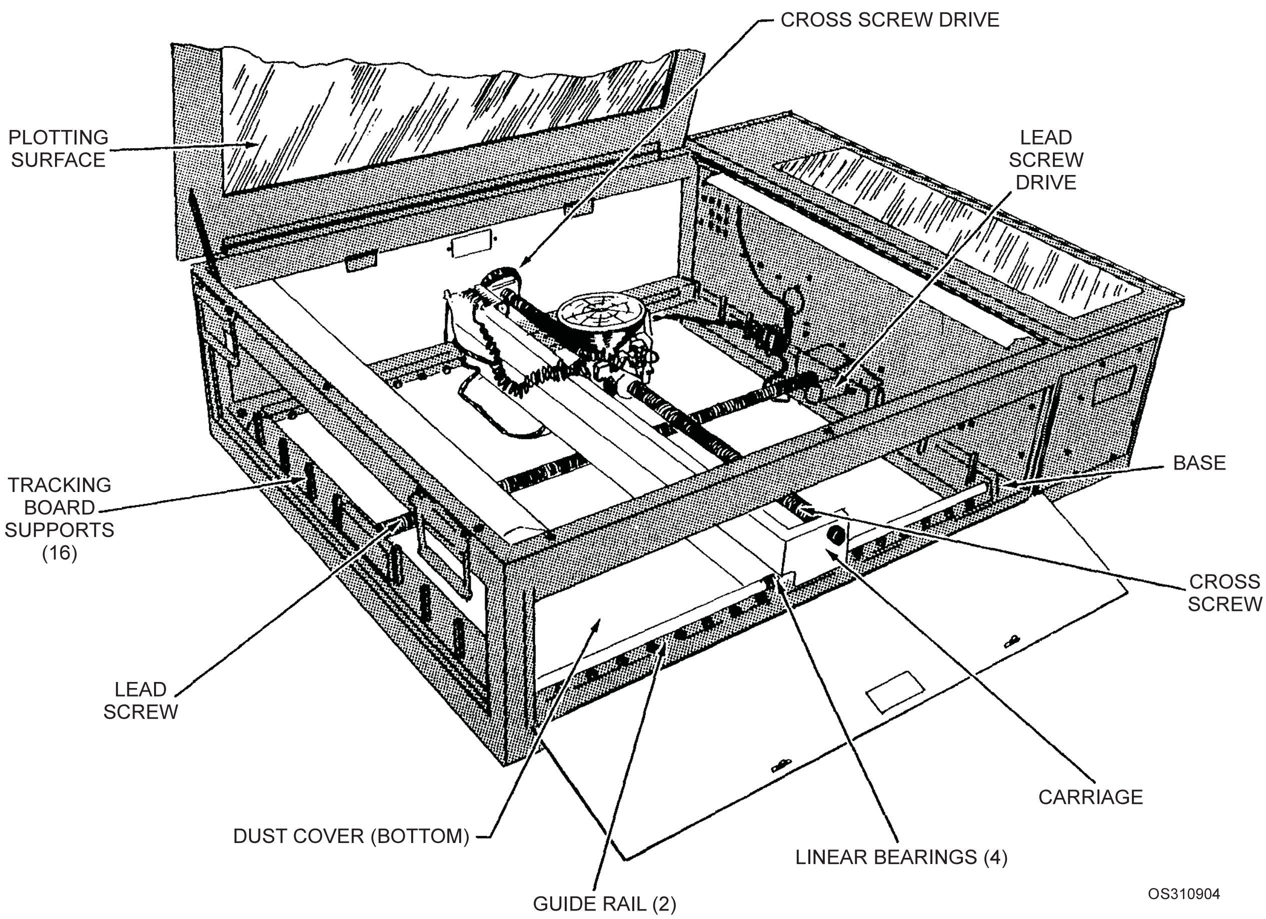

Figure 9-4.—DRT, opened.

Illumination (2): Controls the intensity of the lamps in the tracing and control compartments.

Set latitude (3): Used to set initial and corrected positions manually.

Set longitude (4): Used to set initial and corrected positions manually.

Set trace (5): Used to position the bug manually in the tracing compartment before beginning a plot. The cross screw moves the bug front to back or back to front; the lead screw permits moves the bug left to right or right to left.

Chart orientation (6): Selects desired orientation for chart alignment by switching the coordinate functions of the lead screw and the cross screw.

Trace timer (7): OFF/ON control for the pencil assembly solenoid actuating circuit, which is controlled by the clock. See figure 9-6.

Projection lamp OFF/ON (8): Provides power to the projection lamp (bug).

Trace motors (9): Provides power to the lead screw and the cross screw.

Slew rate FAST/SLOW (10): Used to select fast or slow slewing rate for the bug.

Operation (11): Used to select either normal operating or test signals for longitude and latitude coordinate inputs to the DRT. The NORMAL position selects normal operating input signals from DRAI. The OFF position has no inputs from any source.

Scale (12): Used to select either normal operation or 200-yards-to-the-inch emergency operation.

Chart scale nautical miles/inch (13): Used to set the DRT scale to the desired tracking scale, variable from 0.1 to 99.99 nautical miles per inch.

Longitude (14): Indicates ship's present longitude.

Latitude (15): Indicates ship's present latitude.

Q1. What piece of the dead reckoning system receives inputs of own ship's speed from the underwater log (pitometer log) and own ship's course from the master gyrocompass?

Q2. What is the purpose of the dummy log?

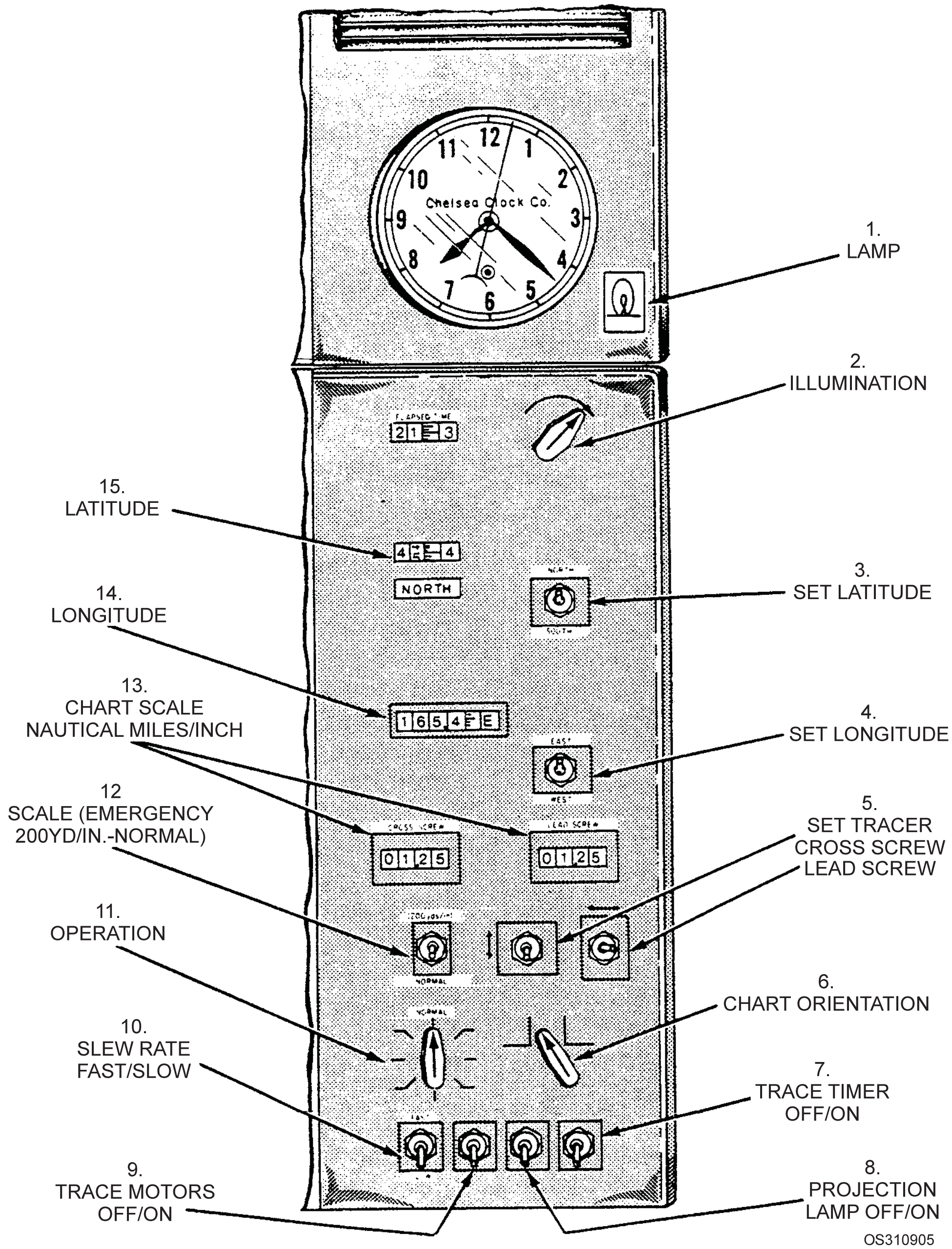

Figure 9-5.—DRT operating controls.

DRT OPERATION

If you are assigned to operate the DRT, follow the procedures listed below to prepare the DRT for use and to secure it.

1. Ensure that the plotting surface glass is clean on both sides. Place tracing paper on the tracking surface and secure its corners with tape. Draw any diagrams or reference lines required.
2. Position the bug at the desired starting point; use the set tracer switches to slew the bug. Arrows next to the switches indicate the direction of drive. Slew may be fast or slow; use "slow" for fine positioning.
3. Set the "chart orientation" switch to the desired position. North normally is at the top of the tracer.
4. Set in own ship's present latitude position by pressing the "set latitude" switch in the proper direction.
5. Set in own ship's present longitude by pressing the "set longitude" switch in the proper direction.

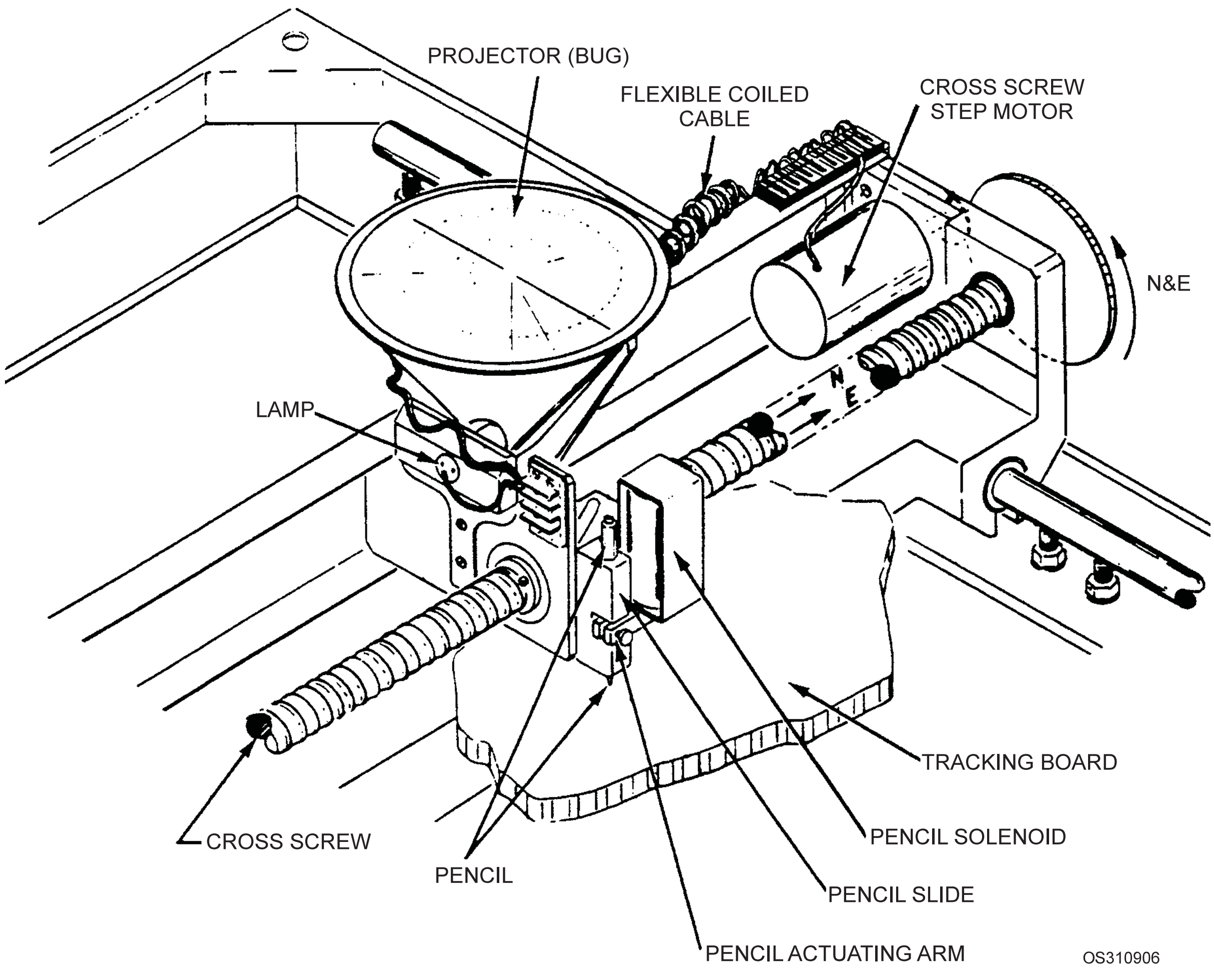

Figure 9-6.—Pencil and projector assemblies.

6. Set the tracking scale by positioning the cross-screw and lead-screw digital switches to read directly the scale you desire for tracking. In emergencies, such as man overboard, you may position the "scale" switch to EMERGENCY, which sets the scale to 200 yards per inch.
7. Adjust the illumination desired.
8. Secure the DRT by turning the "operation" switch to the OFF position. If the DRT is to be secured for an indefinite period of time, it should also be secured at the IC switchboard.

NOTE

The DRT should never be left with the operation switch in any of the test positions except when actual tests are being made.

PARALLEL MOTION PROTRACTOR

Plotting course lines requires the use of some type of straightedge. On the DRT, the straightedge is part of the Parallel Motion Protractor (PMP) (fig.9-7). The PMP is a device that allows a straightedge, positioned in any desired direction, to be moved anywhere on the plotting surface, at all times maintaining the same direction. One end of the PMP is fastened rigidly to the framework of the DRT. The other end of the

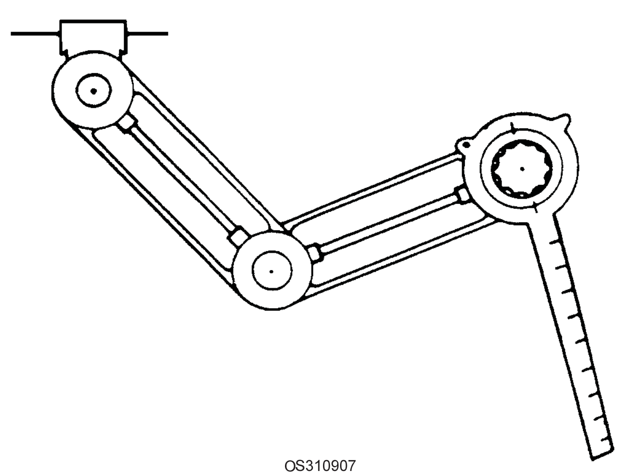

Figure 9-7.—Parallel motion protractor (PMP).

two-section pivoted arm has a bearing circle. A circular plate with four index marks spaced 90° apart, to which a plastic range ruler is attached, rotates within the bearing circle, thus providing the means for measuring exact directions and ranges. Figure 9-7 illustrates a parallel motion protractor with ruler attached.

Alignment Procedure

In normal use, the bearing circle is aligned with the DRT bug, locked, and then not disturbed until there is evidence of slippage or the ruler needs to be realigned. To align the DRT, turn on the light in the bug and turn off the drive motors. Mark the position of the bug, then move the bug manually a foot or more in one of the four cardinal directions and mark its position again. Use these two marks to line up the plastic ruler. Then lock the bearing circle so that the cardinal headings match the four indices.

Locking Range Rule

When you have aligned the protractor properly, it is ready for use. Two methods are permissible for holding the range rule on a desired bearing. In one method, you may move the PMP to the preferred position after adjusting the range rule to the proper setting and locking the rule lock firmly.

In the other method, you may hold the bearing circle and the index circle tightly with your thumb and forefinger while sliding it across the plot. This method is faster and, therefore, generally preferable to the method described above. However, you must be careful to not let the bearing circle slip. Slightly different models of the PMP are in use; some models have controls and locks not available on others. The locks described in this chapter are common to all models.

DRT CASUALTIES

Like any other mechanical and electrical device, the DRT is not infallible. Always be prepared for a casualty. Should a casualty occur, inform your supervisor immediately because the assistance of an Interior Communications Electrician may be required. Immediately extend your present course line from the last position plot. For example, should own ship be on course 260° when the DRT fails, set this course on the PMP arm, and draw a light line in this direction from the last position of the ship's DR track. A light line does not interfere with the remainder of the plot when the ship changes course. Dead reckon own ship's position along this line.

To determine the distance the ship travels each minute, apply the 3-minute rule, based on own ship's speed. From this new dead-reckoned course, continue the plot on all contacts.

Place the time along the track only when the ship *should* reach that point. In this manner, the ship's location is always indicated. Do not DR more than a few minutes ahead, because there is a possibility that the ship may change course and speed. Draw the DR line lightly so that if the ship changes course, you will be able to overlook the unneeded portion of the line, thus avoiding confusion while keeping the plot neat and clean.

A casualty to the ship's gyro presents a serious problem. If the gyro fails, movement of the bug becomes unpredictable. In some ships, such a casualty can be corrected either by shifting to another gyro or by shifting to "manual" and manually inputting courses into the DRAI. In some ships, the Own Ship's Motion Simulator (OSMOS) can be used for course inputs.

Blacking out of the bug light is another casualty the DRT could suffer. Although a simple casualty, it can make tracking as impossible as a major DRT failure. Always keep a supply of spare bulbs on hand.

Conversion of Bearings

If the gyro fails, you must use relative bearings and convert them to true bearings in order to continue the plot. You can simplify the conversion by using the following formula:

"True course (corrected true course if magnetic or compass headings are used) plus relative bearing equals true bearing." The following are some examples of the conversion of bearings.

True course	Relative bearing	True bearing
135	080	215
075	035	110
245	200	085

Notice in the last line of the above example that 245° added to 200° equals 445°, which of course is greater than 360°. Subtract 360 from 445 (because a circle contains only 360°); 445 minus 360 equals 085, which is the true bearing. In every instance where the sum of the true course and the relative bearing exceeds 360, subtract 360 from the sum to obtain the true bearing.

NOTE

To convert true bearings to relative bearings, use the following formula: "True bearing minus true course equals relative bearing." Set the PMP bearing dial on the ship's course; relative bearings are automatically converted to true bearings.

Halifax Plot

Dead reckoning during a DRT casualty is a relatively simple procedure when own ship is steaming on one course at a constant speed. However, if own ship is maneuvering, dead reckoning is not reliable, and you must use a Halifax plot.

The Halifax plot (fig. 9-8) is a homemade plotting board. It is usually made from a maneuvering board and constructed with cardboard backing for rigidity. You should draw your ship's turning circle for various predetermined speeds on the plot or have several plots already made up, one for each speed.

Three Operations Specialists are required whenever the Halifax plot is used. One OS (the regular DRT operator) continues to mark own ship (the center of the plot) and all surface contacts designated. Another OS positions the plot, under the DRT paper, and moves it according to the ship's movement. By the use of dead reckoning and the 3-minute-rule principles, the plot is moved from one position to the next. The third OS calls out the "mark" at 30-second intervals and gives the ship's course and speed. Because of maintaining a plot through numerous course and speed changes, it is recommended that the ship come to a steady speed before the plot is used.

The person manipulating the plot must have a working knowledge of the ship's tactical and maneuvering characteristics.

Using the plot properly requires practice. Each watch section should practice with a team until it achieves proficiency.

Q3. What is the proper procedure for aligning the ruler on the PMP arm?

Q4. What is the proper casualty procedure to use if the DRT fails while your ship is conducting maneuvers?

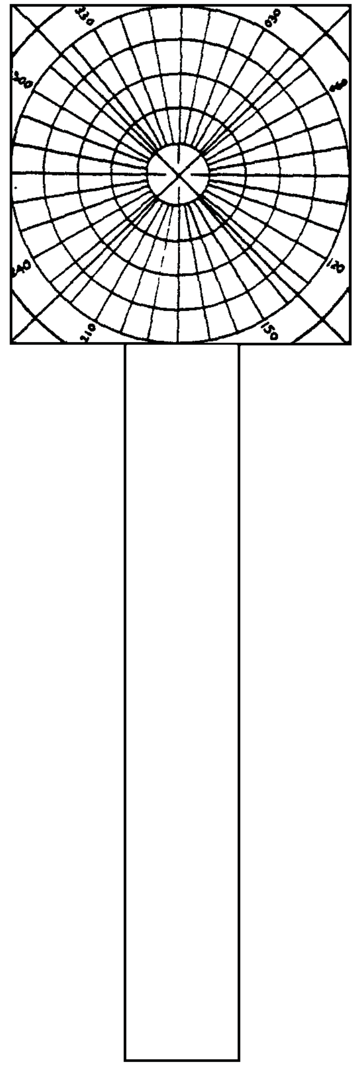

Figure 9-8.—Halifax plot.

GEOGRAPHIC PLOT

As we mentioned earlier, the DRT is capable of producing a graphic record (dead-reckoning track) of the ship's path. Tracking can be done automatically, by means of the pencil carried across a paper fastened to the table surface immediately below the bug. However, the automatic method is rarely used because of the inaccessibility of the plot for making additional or explanatory notations. Normally an operator will mark the center of the bug on tracing paper (DRT paper) fastened on top of the glass-plotting surface. In rare cases, you may wish to use both plotting methods simultaneously and later superimpose one plot over another.

Although the DRT was developed as a navigational tool, it is useful in the field of operations. You can make a geographic plot directly on a chart to show the ship's path in and out of a harbor or around islands. When you prepare to do so, you must set the DRT mechanism to the chart scale. Remember, a chart scale usually is expressed as a ratio. For example, l/20,000 means that 1 inch on the chart corresponds to 20,000 inches on the Earth's surface. You can convert this figure to yards per inch by dividing by 36 or to miles per inch by dividing by 72,000.

The chief value of the DRT is its use in analyzing ship movements. It is also useful in planning and carrying out ship maneuvers. As a geographic plotting device, the DRT uses TRUE courses and speeds. Marking the bug indicates your ship's true position in relation to the topography and other ships in the area in which you are operating. Connecting these plotted positions yields the ship's true track. Plotting ranges and bearings of the contacts, using own ship's position as references, establishes their true positions. Tracks are established by connecting these positions (plots). An experienced DRT operator can maintain up to six contact plots simultaneously while supplying essential data on contacts plotted. The principal navigational function of the DRT, regardless of the position of the bug or alterations to the scale, is carried out by the latitude and longitude dials.

The record provided by the DRT of an action during wartime may be an invaluable aid in conducting a surface engagement or in reconstructing the situation later. In peacetime, a DRT plot may be equally important in evaluating exercises, groundings, or collisions. In grounding and collision situations, the DRT tracings become a legal record. Therefore, they must be kept neatly and accurately. No erasures may be made on the plot. Erroneous information or mistakes must be canceled by drawing a single line through that portion of the plot. The DRT tracings must be stored on board for a period of 6 months, then destroyed, unless otherwise directed. DRT tracings should contain a legend, usually in the lower-right corner, that includes, but is not limited to, the following information: north-south reference line, name of the ship, scale used, date, time the trace was started, ship's position (Lat-Long) at the start of the trace, wind direction, sea state, grid origin, name of plotter(s), type of operation (ASW, AW, SUW, NSFS, etc.), and assisting ships.

When the DRT is used for tracking contacts, the 2000-yards-per-inch scale is the most popular. The 36-inch-square plotting area of the DRT then becomes a 36-mile square. Should a more detailed plot be desired, you may increase the scale as desired. Usually, the 200-yards-per-inch scale is used for man overboard. When a printed chart with its preprinted scales is not used, some other means must be used to enable the operator to measure and plot distances. The most common substitute is the plastic ruler, which attaches to the parallel motion protractor (PMP). Figure 9-9 shows two plastic rulers. One has scales of 2000- and 500-yards-per-inch; the other has scales of 1000- and 200-yards-per-inch. (You may draw a scale along the edge of the tracing paper and then transfer distances with a pair of dividers. You may also draw a scale on a strip of masking tape and fasten the tape to a plastic ruler for use with the DRT.)

In the center of the ruler are speed scales calibrated for various times.

DEVELOPING OWN SHIP'S TRACK

The moving bug indicates the position of own ship at all times. Suppose the ship is steaming on course 090° at 15 knots. Place a pencil mark in the center of the bug at time 1500 and again 3 minutes later. By then the bug would have traveled 1,500 yards in a direction of 090°. To measure distance traveled, lay the PMP ruler in a line from dot to dot in the direction of bug movement. Read the distance, in yards traveled,

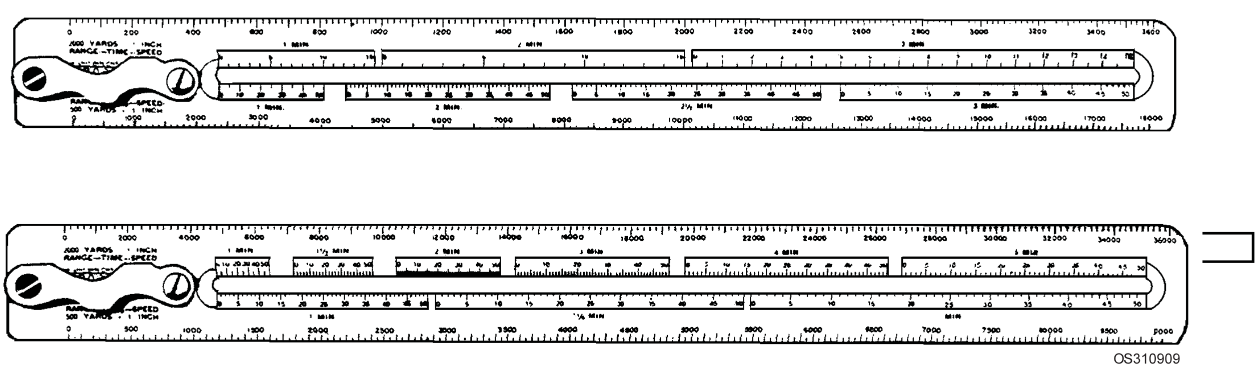

Figure 9-9.—PMP range scales.

directly off the scale. Read the ship's course from the PMP bearing indicator. Develop own ship's track by marking a small dot over the light. When you start a track, record latitude and longitude in the legend (indicated on the latitude and longitude dials).

Indicate time of the mark next to own ship's track. On the first plot show the hour and minute in a four-digit number. For succeeding positions on the same track, use only two-digit numbers, indicating minutes, until the next hour. At the next hour, again record the four digits to show the hour to which the minutes refer. Occasionally, you may need to show quarter-minute time exponents next to the track.

PLOTTING BEARINGS AND RANGES WITH PMP

Two methods of plotting ranges and bearings help eliminate awkward movements of the protractor: direct and indirect. Use the one most convenient for the contact you are plotting. These plotting methods vary according to the contact's range and bearing and the position of the bug in relation to the contact.

Direct Plotting

Figure 9-10 illustrates the direct plotting method. It is summarized as follows:

1. Plot own ship's position at the time the range and bearing are taken.
2. With the range ruler free to rotate, set the bearing indication arrow (that points toward the ruler) on the desired bearing, then lock the PMP. Do not lock it too tightly. Doing so may throw it out of alignment.
3. Place the zero mark on the ruler exactly on own ship's position so that the edge of the ruler extends along the true bearing line from own ship's position.
4. After you hear the range, repeat it mentally while you place the protractor in position. Now read outward from zero to the contact's reported range and mark the point.
5. Immediately after you establish the range, release the rule lock on the PMP, making it ready for use. At the plot of the contact, record the same time that you recorded next to own ship's position that served as a reference point.
6. Move the PMP clear of the plot so the evaluator has an unobstructed view and so you can "dress up" the plot.

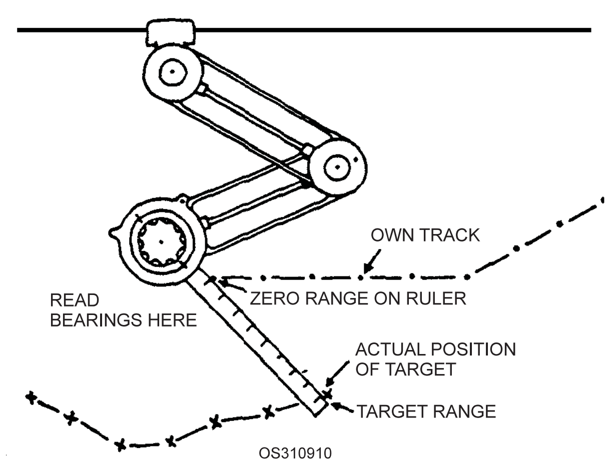

Figure 9-10.—Direct plotting method.

Indirect Plotting

An example of indirect plotting is illustrated in figure 9-11. Indirect plotting makes use of the reciprocal bearing mark on the PMP. By the use of this method, you can easily plot most targets that are awkward to handle by direct plotting. The basic steps of indirect plotting are listed below:

1. Read the desired bearing beside the arrow that is 180° from the ruler side of the PMP arm.
2. Place the desired range, instead of the zero mark, at the marked position on own ship's track.
3. Plot the target's position at the zero mark on the ruler.

Many times the DRT operator is required to track several contacts. When you are tracking five contacts and plotting only one each minute, the plots of each contact will be 5 minutes apart. Usually this period of time between plots is too great, especially at close

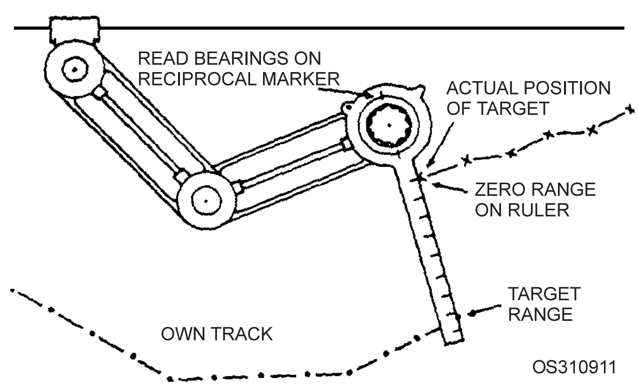

Figure 9-11.—Indirect plotting method.

ranges. An Operations Specialist Third Class should be able to maintain a track of a least three contacts a minute on the DRT. This requirement means that the radar operator will be sending ranges and bearings frequently over the phones. At such times, you must remember many numbers while also determining each contact's course and speed. For a memory aid, most ships have a surface status board.

The person manning this position—called the surface recorder—is usually an alternate operator and is on the same sound-powered phone circuit as the radar operator and plotters. He or she records each range and bearing as it comes over the circuit from the radar operator, together with the time of each report. This record keeps the evaluator informed and serves as a backstop to plotters. If plotters miss the range, bearing, or time of a report, they can refer to the recorder board. As soon as a plotter obtains and disseminates a course and speed solution, as well as the point and time of closest approach of the target, the recorder enters the information on the status board.

When the standby-mark method of plotting is used, the recorder acts as a timer for both the radar operator and plotter. In this instance, he or she watches the clock and calls "Stand by (contact designation)." This expression warns the radar operator to have a bearing and range ready and alerts the plotter to stand by to mark the bug's position on the DRT. On hearing "Mark" from the recorder 10 seconds later, the plotter marks the bug while the operator sends range and bearing information to the plotter. On receiving the range and bearing, the plotter plots the contacts. This method is used when several surface targets are tracked at the same time. Also, it is used for tracking submarines on the DRT when ranges and bearings from the sonar gear are used.

DETERMINING TARGET COURSE

Earlier, we explained how to compute own ship's course by laying the PMP ruler along pencil dots that resulted from marking the bug. You determine a target's course in the same manner. Align the PMP ruler along the target's plots and read the indicator on the PMP in the same direction as the target is moving. A word of caution: plots do not always fall in a smooth track. Although the plotter can cause erratic plotting, the same result can be caused by a radar operator giving ranges and bearings that are slightly erroneous. Figure 9-12 illustrates the correct procedure in such a situation. Lay the PMP ruler along the mean of the plots and read the indicator. If the contact's plots moved from right to left, the course to read is indicated on the left side of the PMP.

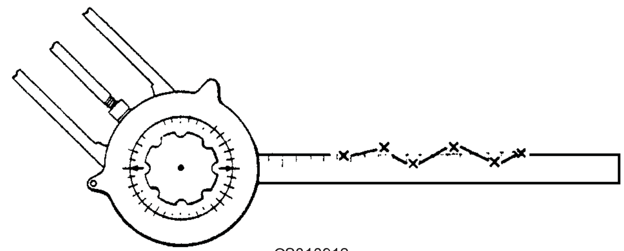

Figure 9-12.—Example of how course is determined.

DETERMINING TARGET SPEED

There are several ways to determine speed. One is the "basic formula". Another, of primary importance to you, is the 3-minute rule.

Basic Formula for Determining Speed

You can determine speed by using the basic formula:

Speed = distance/time.

When you divide distance traveled (in yards) by time (in minutes), you will obtain speed, (expressed in yards per minute). To convert this result to nautical miles per hour (knots), first multiply by 60 minutes (which gives yards per hour), then divide by 2,000.

Assume that a target travels 1,100 yards in 3 minutes. When you apply the basic formula, you will find the speed of the target to be 11 knots.

Although the basic formula will provide you a speed based on distance and time, using it is not nearly as fast nor as satisfactory as using the 3-minute rule. The 3-minute rule is used on the maneuvering board, surface plot, and DRT. It is also used in air plotting, except that the scale is in miles, instead of yards.

3-Minute Rule

The 3-minute rule, simply stated, is: To find a contact's speed, find the number of yards the contact traveled in 3 minutes and point off, or drop, two numbers from the right side of this figure and change "yards" to "knots". For example, if the contact traveled 1,700 yards in 3 minutes, its speed is 17 knots.

As another example, assume that a contact travels 800 yards in 2 minutes. This target would travel 400 yards in the next minute, making a total of 1,200 yards in 3 minutes. Therefore, its speed must be 12 knots. By the same kind of mental arithmetic, you can use the 3-minute rule to convert 1 minute, 1-1/2 minutes, and other times of travel. Thus, if a target covers 800 yards in 1-1/2 minutes, it would travel 1,600 yards in 3 minutes, and its speed is 16 knots. If it traveled 1,100 yards in 1 minute, it would cover 3,300 yards in 3 minutes and must be making 33 knots.

When the required range scale is available, there is an easy method for determining both target course and speed at the same time. Down the center of each range ruler are speed scales calibrated for various time periods (fig. 9-9). To determine speed, select the amount of track time desired and align the appropriate time-speed scale with it; e.g. for 2 minutes of track, use the 2-minute speed scale. At the same time, you may determine the target's course from the PMP bearing dial.

CONTACT DESIGNATION

Surface contacts may be internally designated by letter, assigned in sequence, beginning at 0000 local time. They are referred to by the code words *Skunk* or *Friendly*, as appropriate; for example, Skunk A, Friendly B, and so on. If all the alphabet is used, subsequent contacts are assigned two letters, such as AA, AB, and AC. When a contact is designated, it is identified on the plot by placing the letter designator in a large circle (the size of a quarter) near the origin of the contact's series of plots.

If a surface track splits into two or more parts, each part is assigned a secondary numeral after the primary letter designator. Secondary numeral designators are assigned in order clockwise from true north at the point at which the split occurs; for example, Skunk Al and Skunk A2. The primary letter designator and the secondary numeral designator are placed in a circle near the point of the split. If two parts of the contact are on the same line of bearing, the part nearest the ship is assigned the smaller designator number. Parts of a split may also be redesignated. For example, Skunk A that splits may be redesignated Skunk D and Skunk F. We will discuss external contact designation in a later chapter.

DATA RECORDED ON PLOTS

Each plot provides a graphic, step-by-step account of events by means of symbols and abbreviations in boxes alongside own track and the target track. The picture it presents depends solely on the ability and skill of the plotter. Figure 9-13 illustrates the proper technique of recording data.

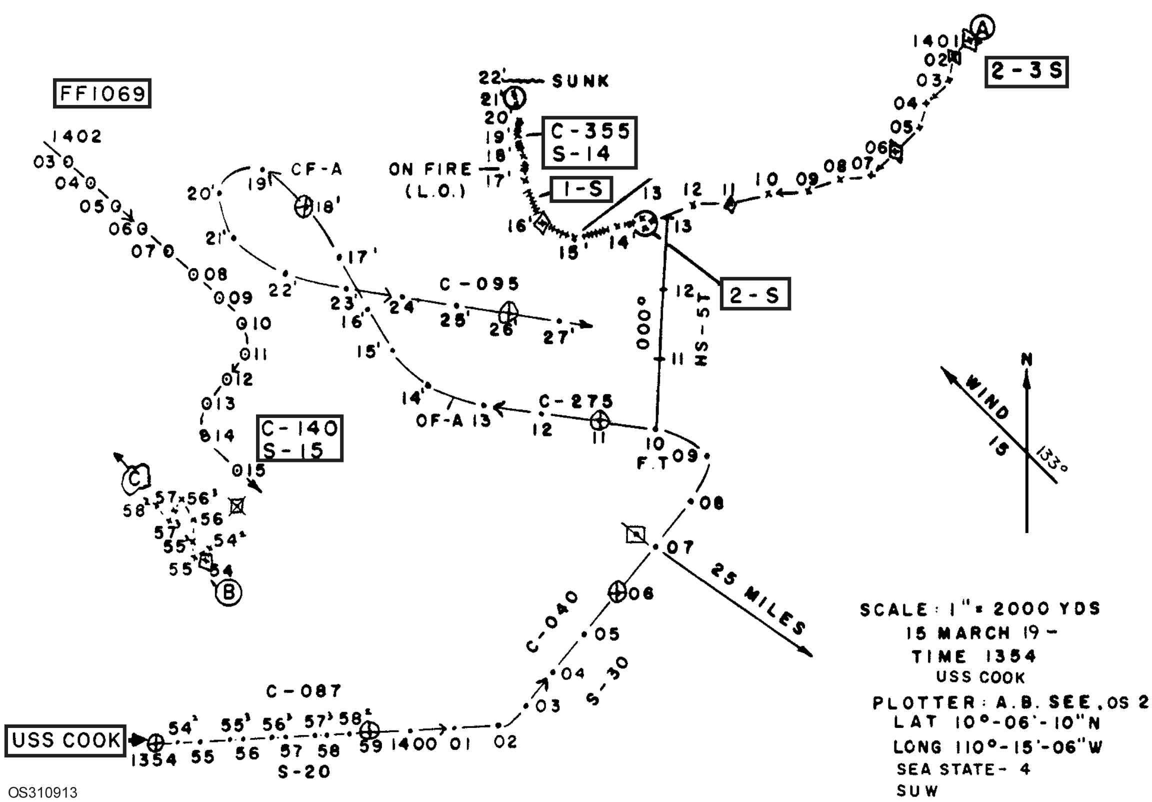

Figure 9-13.—Example of a DRT plot (recording data).

Alongside own ship's track, indicate information such as point of opening fire, point of firing torpedoes and number fired (ASW), with corresponding arrows, base course and speed, point where own ship received shell or torpedo hits, any action performed by own ship or that happens to own ship during the track, and changes in course and speed.

Next to the target's track, indicate its composition by number and type, or the best estimate available. Before number and type are established, the best information usually approximates the number (as one, few, or many); types are classified as large or small. Always box the composition of the contact. Circle the target designation letter at the beginning of the track. Whenever the target's course and speed are determined, placed them in a box at the appropriate track time.

Include amplifying data along the enemy track, such as "slowing", "on fire", or anything that happens to the target. Record the source of information (other than radar or sonar) near the track.

Indicate the mode of IFF shown by a friendly contact beside the track at the point where the operator reports it. Make the symbols a prominent size but do not enclosed them in a box.

Where appropriate, include the following additional data on the plot: reference points, such as Point Romeo, Point Oscar; position of intended movement; and geographic points.

MAN OVERBOARD PROCEDURE

All Operations Specialists must know what to do when someone is reported overboard. Having this knowledge helps the crew consume minimum time in recovering the individual(s). Because of varying factors aboard ship, each ship has its own man overboard procedure. Operations Specialists must, therefore, read the CIC doctrine to ensure that they fully understand all of their man overboard responsibilities.

A DRT plotter is indispensable in a man overboard situation. Although plotting procedures vary, the basic functions a plotter *must* perform are as follows:

1. When a man overboard report is received, a plotter must quickly mark the bug, indicating ship's present position, and change the DRT scale to 200-yards-to-the-inch. (When the bug is near the edge of the plotting surface, the plotter must reposition it to approximately the center of the plotting area.)
2. The ship's position at the point where the individual actually went over the side must be determined. Since a lapse occurs between the time of the incident and receipt of a report in CIC, a correction is required in the initially indicated position. One correction procedure you can use is to locate the person at a point on the reciprocal of the ship's course, at a distance of 100 yards for each 5 knots of speed. Then plot the offset from the initial point and labeled it.
3. Finally, determine the bearing and range to the person every 15 to 30 seconds. Keep sending this information to the conning station and lookouts until the person is sighted.

Q5. What is the purpose of the 3-minute rule? How do you use it?

Q6. When a man overboard is reported, to what scale should the DRT be set?

ANSWERS TO CHAPTER QUESTIONS

A1. The Dead Reckoning Analyzer Indicator (DRAI).

A2. The dummy log serves two purposes: (1) to simulate ship's movement through the water (for training personnel and aligning equipment) and (2) to serve as a backup for the underwater log system.

A3. To align the DRT, turn on the light in the bug and turn off the drive motors. Mark the position of the bug, then move the bug manually a foot or more in one of the four cardinal directions and mark its position again. Use these two marks to line up the plastic ruler. Then lock the bearing circle so that the cardinal headings match the four indices.

A4. Use a Halifax plot.

A5. To find a contact's speed. Find the number of yards the contact traveled in 3 minutes and point off, or drop, two numbers from the right side of this figure and change "yards" to "knots". For example, if the contact traveled 1,000 yards in 3 minutes, its speed is 10 knots.

A6. 200 yards per inch.