FORUM

Some Navigational Techniques for Use with Marine Radar

from Lieutenant-Commander I. S. S. Mackay, R.N.

1. THE PARALLEL CURSOR AND DISC. In the Royal Navy manœuvring problems are normally worked out on the Battenburg Course Indicator which gives a mechanical solution of the speed/distance triangle (Fig. 1). A similar device for direct use on the PPI face can be made by engraving parallel lines on the rotatable PPI mask and attaching two perspex vector arms to the centre. Although developed primarily for manœuvring purposes this idea can be put to several purely navigational uses and from it have sprung two valuable adjuncts to the PPI: the parallel cursor and the fixed plotting surface (or disc).

The use of the parallel cursor as a safety-distance line is obvious and is particularly valuable in such circumstances as working near a coast with strong and

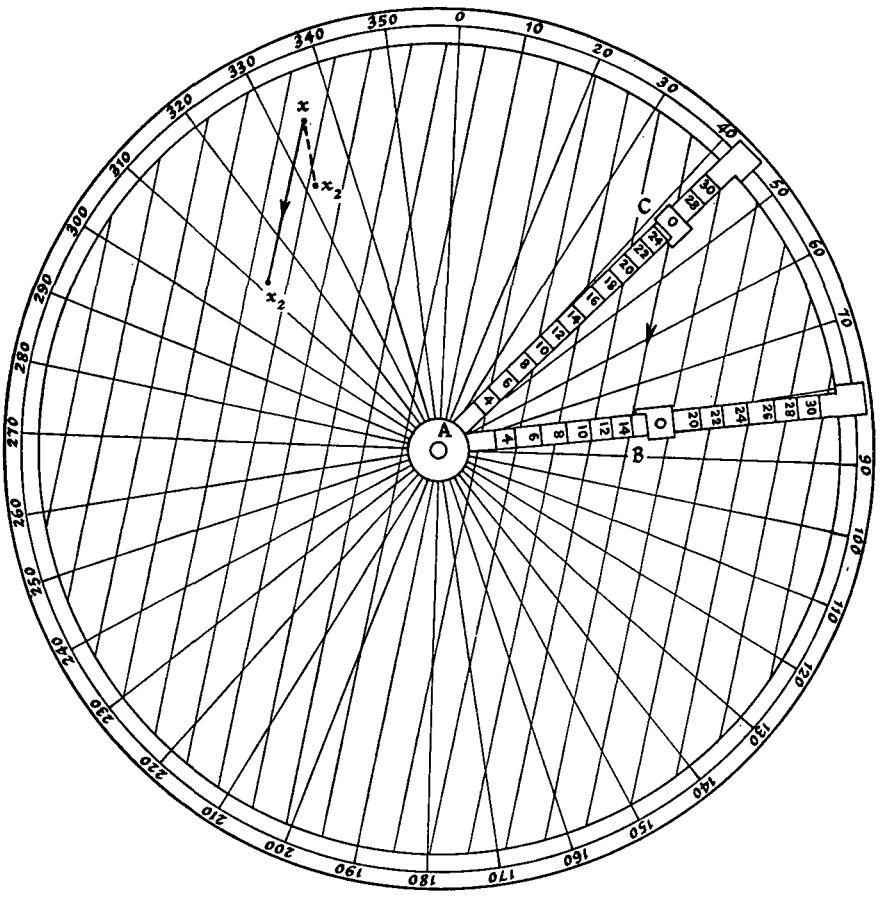

Fig. 1. The Battenburg Course Indicator.

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variable currents and poor fixing aids. The ship is simply conned to keep the land moving along the appropriate line on the cursor.

A further example of its usefulness occurred in a ship working amongst numerous icebergs in the Bransfield Strait; by plotting their relative tracks on the disc, it was a simple matter to see which bergs were drifting and which were aground and therefore stationary. As the echoes on the (10 cm.) set disappeared into the ground wave at half a mile, it was possible to get the ship steadied on the correct heading, allowing for drift, to make good the required course before this point of no return was reached. Asdics were used to make sure that the bergs had no dangerous underwater ledges. Fig. 2 shows a typical plot of this type of situation. A and B are bergs drifting at nearly the same rate as the ship while C is a grounded berg. By lining up the parallel cursor to C's relative track and extending it to C1 the closest distance of approach of C can be found by use of the range strobe. This type of relative plot is of course commonly used for anti-collision purposes. Fig. 3 shows a column of four warships and a ship which, when seen from the leading vessel, appears forward of the starboard beam but drawing aft. A relative plot on the PPI, on the other hand, shows that she will eventually pass through the column unless course or speed are altered. Having found her course and speed between A and A1 the parallel cursor can be lined up to the desired closest distance of the other ship from the last ship in the line and the speed triangle completed by using the two vector arms. Once on the new course the movement of the other ship's echo down A1A2 will confirm the correctness of the new course.

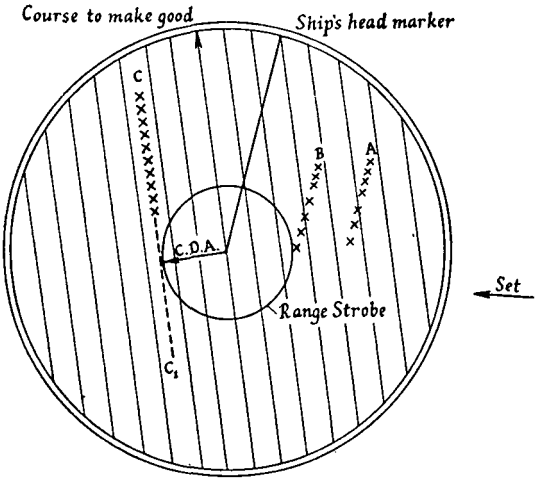

Fig. 2

The disc may also be used as a station pointer when the coastline is hard to identify. The trace is expanded to the scale of the chart in use and the PPI picture drawn on the disc, which is then placed on the chart and aligned to the north/south line, thus producing a cheap and simple form

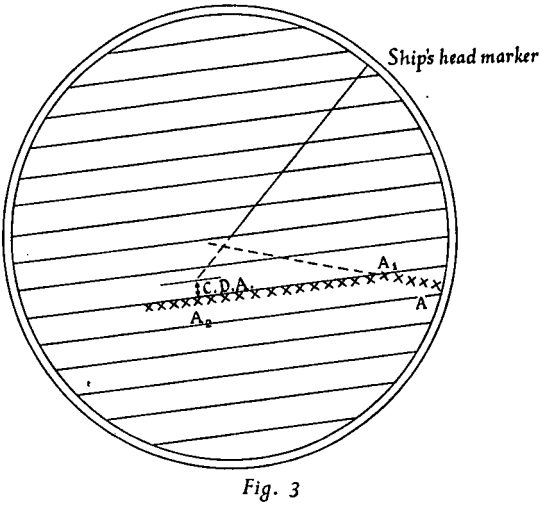

Fig. 3

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of chart comparison unit. With this method the trace must be linear throughout or distortion of the plotted picture will occur.

As the error in azimuth in radar is far greater than that of range, by using the parallel cursor (which is dependent on range) the possible error in azimuth is greatly reduced. In addition, by preparing the chart or manœuvre beforehand and conning from the PPI, an up-to-date position is always available, whereas the conventional method of plotting the fix results in a stale plot, as well as being an added distraction.

The lines on the parallel cursor should be engraved about half an inch apart on the back of the rotatable PPI mask, one cross index line being engraved through the centre at right angles to the parallel lines. If the lines are further apart than half an inch, the tram-line effect is greatly reduced and the relative course is less easily and less accurately obtained. The lines do not in fact clutter up the scan, but if they did it would be a simple matter to reduce the dial lamp illumination and fade them out.

The plotting surface or disc is conveniently used for plotting when it is required to rotate the cursor for any reason. As there is no edge illumination as yet for the disc, black or dark blue chinagraph can be used for plotting. However, when the situation does not require a great deal of use of the cursor, the plotting is best done directly on to the mask, using red or yellow chinagraph which stands out well with edge lighting.

It requires from two to three aerial rotations before the range strobe can be placed on the echo. In order to measure distances between two echoes or points of land, linear scales for the three most convenient ranges can be fixed on the front of the PPI casing.

When busily engaged on the PPI, which is invariably under cover, one tends to forget the drift from wind and current. Red and blue arrows can be used to indicate the true direction of wind and current; these can be fixed by means of a suction base on the PPI casing in the required position, facing the centre of the PPI.

It is a good idea to use rubber-tipped dividers, and they should always be made of brass so that they do not distort the trace. Some practical examples of the use of these techniques for blind pilotage follow.

2. BLIND PILOTAGE. In order to have a ready check on the picture for error in azimuth, a course is best chosen parallel to two well-defined points of land where the radar response will be little affected by the height of the tide. The distance off of the nearest points of land or of fixed objects are noted for each course and, if there is no convenient line on the mask at this range, one can be drawn in chinagraph pencil. It is advisable to plot the wheel-over position, using the distance-to-new-course or advance from the turning data so that the ship may steady up on her new track.

To identify buoys the centre line of the cursor can be lined up to whatever the bearing ought to be and with the dividers and linear scales the distance from the known object can be laid off. This is especially useful when there is a lot of small-boat traffic near a buoy, and the reverse sequence can of course be used when it is required to find out if another ship is fouling your berth. When the ship is required to anchor in a position where there is no ahead ranging mark, preparations can be made as shown in Fig. 4. The distance-off can be laid off on a well-defined point and perpendiculars from the let-go position and the required distance to go will indicate the distance to go along the distance-off line

measured from the cross-index line. The technique using the parallel cursor would be to set the range strobe to the distance-off (D.O.) and the cursor to the course to make good; the ship can then be conned so that the required point of land travels down the D.O. line. At about half to one mile from the new course (depending on speed), the cursor can be set to the new course to make good and the strobe to the new D.O. Dividers set to either the wheel-over distance off or the parallel distance to new course, can then be used to lay off the wheel-over position on the mask. For an anchorage with no ahead bearings, it is advisable to draw the distances to go along the D.O. line on the mask measured from the cross index line. As the ranging point travels down the line the distance to go can be seen at a glance.

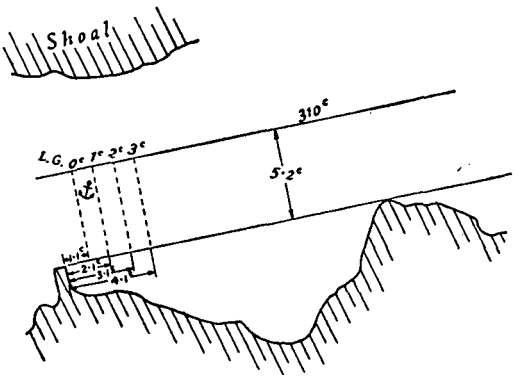

Fig. 4

Similar techniques can be used to great advantage when manœuvring in darkness or poor visibility. For manœuvring it is convenient to have a relative-speed scale, graduated for 3 or 6 minutes on the 10- and 3-mile range scales, fixed to the PPI. The 3 min. scale will give an approximate plot and the 6 min. scale an accurate one. A relative turning data diagram will be valuable for warships who require to use turning data when working in close company.

These notes refer only to the use of a gyro-stabilized PPI; the techniques described should not be used with an unstabilized picture.

The Region of Collision

from W. T. Slater

CAPTAIN WYLIE's paper on 'The Region of Collision'* raises some interesting points but if one accepts the view that graphing of some sort is not wholly 'academic' the writer feels that there is an alternative graph which Captain Wylie has not mentioned and is worth considering.

As Captain Wylie has shown, the time-distance plot gives very little useful information except that it does keep prominently in mind the distance between the two vessels. The time-bearing plot is much more informative as to the element of danger present in the situation but if the time-bearing is the only plot kept then the fact that it shows no distance between the vessels is a serious disadvantage. The writer suggests that it might be worthwhile considering the advantages of plotting change of bearing against distance between the vessels, especially if this is done on a graph having precomputed curves for various

* Wylie, F. J. (1956). The region of collision. This *Journal*, 9, 161.