STAR IDENTIFIER

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As standard equipment for French naval vessels, the Committee for the Revision of Armament Regulations has adopted a star finder.

This instrument is designed as a substitute, to be supplied at the user's request, for the Perrin and Lecocq star globes, previously the only regulation equipment.

Star globes have been criticized for their bulk and clumsiness, in addition to their difficult adjustment. The Perrin globe moreover requires a complete resetting of the instrument whenever a change in sidereal time occurs, and construction of the Lecocq globe is complex and costly.

Such disadvantages must be overcome in designing a star identifier, and an effort was made to comply with the following specifications :

(1) The instrument must be flat, take up little room, and readily fit in a chart case;
(2) It must neither be too heavy nor so light as to blow away in windy weather on the bridge;
(3) It must be easy to adjust, and when set for latitude, variations in sidereal time must be convenient to follow;
(4) The instrument must be easy to read, notwithstanding the subdued orange light on the bridge;
(5) The most direct possible use of nautical almanac data must be ensured, and the instrument must include all the stars listed in such tables.

A prototype has been constructed according to these specifications and tried out on several ships on cruise. Results were considered sufficiently adequate for the authorized committee to make it a regulation instrument.

PRINCIPLE OF THE STAR IDENTIFIER

The specifications listed above necessitate the use of a projection system to represent the sky.

If a meridian projection is used, adjustment for sidereal time can only be accomplished by translation, and in this case the construction of a robust, compact instrument is difficult.

Recourse must hence be had to a central polar projection enabling adjustment for sidereal time simply by rotation.

The instrument should therefore be based on the following principle :

A disk revolving about its centre carries a representation of the sky, the pole (north or south) coinciding with the centre. The edge of the disk is graduated in sidereal time.

A transparent representation of the local sphere, by altitude and vertical circles, is placed over the disk. This representation follows the same system of projection as that used for the sky, in terms of the observer's latitude.

When the meridian of the observer is made to coincide with the sidereal time corresponding to the time of observation and the observer's zenith is properly adjusted according to his latitude, the instrument should represent the sky's appearance, due allowance being made for the type of projection used.

This principle involves representation of the sky on two disks, one centred on the north pole and the other on the south, and the use of an extensive set of local sphere models for latitudes between 0° and 90°.

The final problem consisted in selecting the projection system to be used in constructing the instrument.

Orthographic and gnomonic projections were rejected, as neither permitted representation of the equatorial zone (scale zero in one case and infinite in the other).

Stereographic projection, although conformal, was likewise rejected, as this would have meant a considerable increase in the diameter of the disks owing to a continuous increase in scale from the pole.

The use of equidistant or equivalent central polar projections, which present similar advantages, was then considered. The former projection was finally selected.

This projection enables the representation, within a circle of acceptable diameter and of adequate radial scale, not only of one hemisphere from the pole to the equator, but of part of the other hemisphere up to latitude 65°. By adequate scale, the condition implied is that circles of latitude may be plotted every ten degrees, with their numbers, and all the stars (in the nautical almanac list), with their legends.

Computation is carried out by means of formulas of spherical trigonometry, and projections of the local spheres are thus readily plotted point by point, using vertical and altitude circles.

For convenience and in order that the observer may have the impression that he is looking at the sky « from the outside » (with azimuths of stars increasing clockwise from north to east, on the local sphere projections), stars must be positioned with respect to the sidereal time ring (clockwise) by their sidereal hour angle (*ascension verse*), which is directly supplied by the nautical almanac.

DESCRIPTION OF THE STAR IDENTIFIER

The identifier consists of a 27 × 19-cm blackened cast aluminium plate, of 1-cm thickness, with the corners rounded off.

Each side of the plate is hollowed out circularly to a depth of 2 mm, the centre of the circle lying 123 mm along the major axis away from the lower edge. The diameter of the circle is 21 cm.

Set screws are arranged symmetrically on each side, near the edges.

The major axis is indicated on either side by short white lines above and below the hollows.

In each of the hollows is set an opaque plexiglass disk 2 mm thick and 210 mm in diameter. Both disks are mounted on the same axis and revolve freely.

The sky is shown on each disk in azimuthal projection. The concentric circles of declination are shown every ten degrees, and are spaced 6.3 mm apart from 0° to 90°.

The centre of one of the disks corresponds to the north pole and the other to the south pole.

The edge of each disk is graduated from 0° to 360°.

The stars are plotted against the circles and the graduated ring. Their representation varies in accordance with their importance, in order that stars of different magnitudes may be distinguished at a glance : each is identified by name. They are coloured green to avoid fading in the orange light used on the bridge.

A set of grids accompanies the instrument. Each grid is plotted in black lines on 5/10-mm transparent plastic, and represents the local sphere for a given latitude, i.e. consists of projections of vertical circles at 5-degree intervals in azimuth from north to east, and projections of altitude circles every 5 degrees (from 15° to 85°).

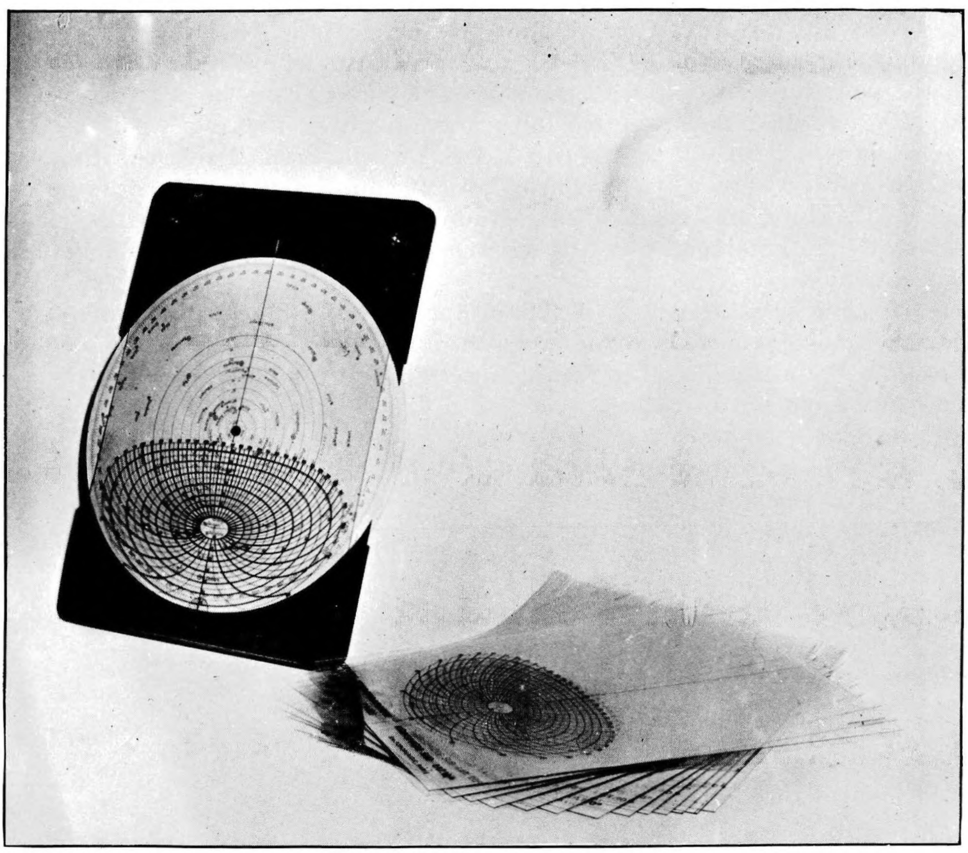

FIGURE 1

As latitudes are given every 10 degrees, a complete set of grids consists of 20 transparencies (10 for the northern hemisphere and 10 for the southern hemisphere, hence 2 for latitude zero).

USE OF THE IDENTIFIER

The nautical almanac supplies, for each hour of each day, the sidereal time reckoned in degrees at the meridian of origin.

In theory the observer knows his dead reckoning position with largely sufficient accuracy to make use of the instrument. Two main cases for identifier use may be considered to exist.

CASE 1. — An observer desires to know the sky arrangement to be used at a predetermined time. Knowing his estimated latitude at the desired time, he selects the corresponding grid (to within 5 degrees).

He places the grid over the instrument so that :

(*a*) the midline of the grid exactly coincides with the two white lines defining the axis of the plate;

(*b*) the small cross marking the position of the zenith on the grid is positioned as accurately as possible in latitude in relation to the disk circles.

He then fixes the grid by two screws.

Knowing the local time of the intended fix, the observer can easily compute the corresponding Greenwich time, and by entering into the tables at the page for that day, read the sidereal time of origin in degrees.

He need only then add or subtract the longitude (adding if east of the meridian of origin, and subtracting if west) to obtain local sidereal time.

The observer then orients the disk for the applicable hemisphere (under the grid), lining up the disk ring graduation, corresponding to the local sidereal time obtained, with the reference mark at the lower end of the instrument.

He then sees the sky as it should appear at the preselected time. The image is of course distorted, but he is able to read, interpolating by inspection, the altitude and azimuth of each star through the transparency, reckoned from north to east.

He may then readily select the stars he should observe to obtain good position line intersection, and ascertain the direction and altitude enabling him to find them.

CASE 2. — An observer has taken the altitude of a star surrounded by clouds and desires to identify the star.

From the Greenwich mean time (obtained by the chronometer used in the observation, due allowance being made for its condition) of observation, he obtains from the almanac the sidereal time of origin, and from the estimated longitude, the local sidereal time.

By means of the estimated latitude, the appropriate grid is placed in position (as described in case 1), and the disk is oriented by referencing the local sidereal time.

CONCLUSION

The above account shows the simplicity of the instrument's method of use. As long as the observer's latitude does not appreciably vary, the identifier is available for immediate use, subject to the resetting of the sidereal time. This may easily be calculated mentally by referring to the almanac data.

The accuracy of the results supplied by the identifier is of the same order as those given by the star globe. Provided the grid zenith is properly set and the sidereal time correctly referenced, the azimuth and altitude of a star at a given time may reliably be obtained to within two degrees, which for ordinary purposes largely suffices.

Greater accuracy, involving a larger number of stars, would require increasing the size of the instrument and doubling the number of grids (one for every 5 degrees).

As designed, the instrument is convenient and reliable, retains its adjustment, is easily stored in a chart case, is unaffected by wind and roll, and may be read under orange bridge lights.

It has so far been favourably received by its users.

FIGURE 2