2 Sheets—Sheet 1.

T. HILL.

INSTRUMENTS FOR SOLVING PROBLEMS IN NAVIGATION.

No. 173,724. Patented Feb. 22, 1876.

Fig. 1.

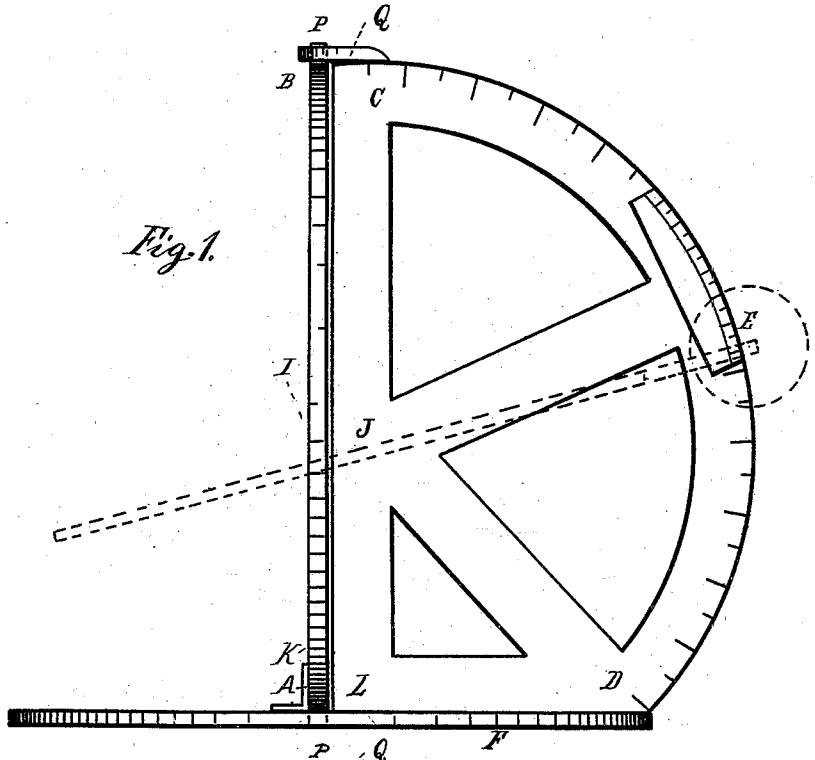

Fig. 2.

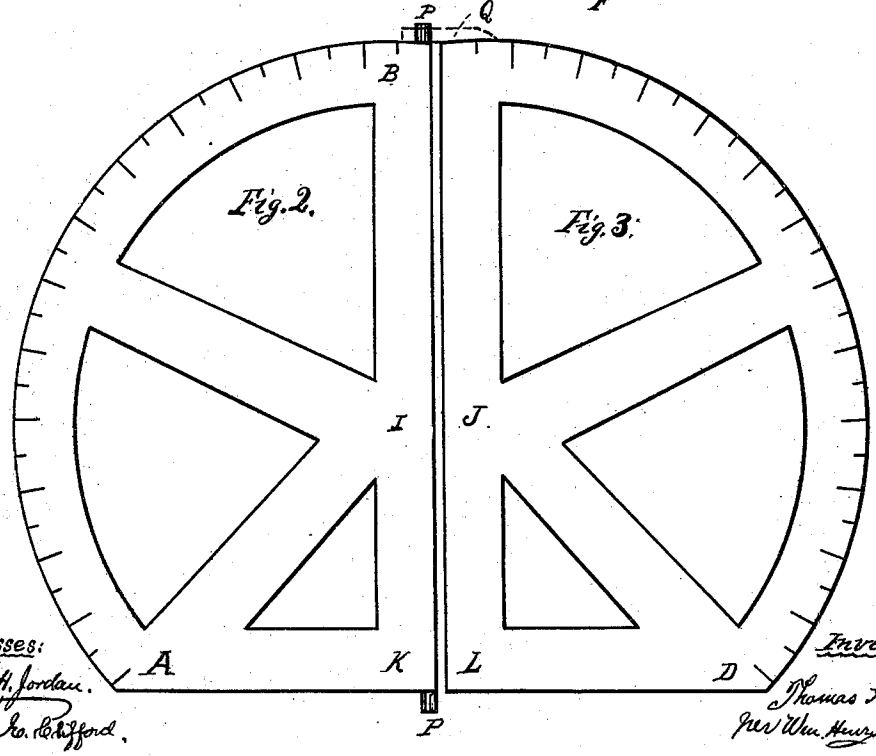

Fig. 3.

Witnesses:
Frank H. Jordan.
Charles Ro. Clifford.

Inventor:
Thomas Hill
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atty.

2 Sheets—Sheet 2.

T. HILL.

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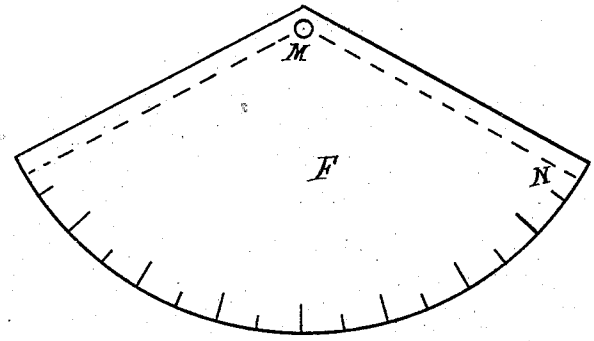

Fig. 4.

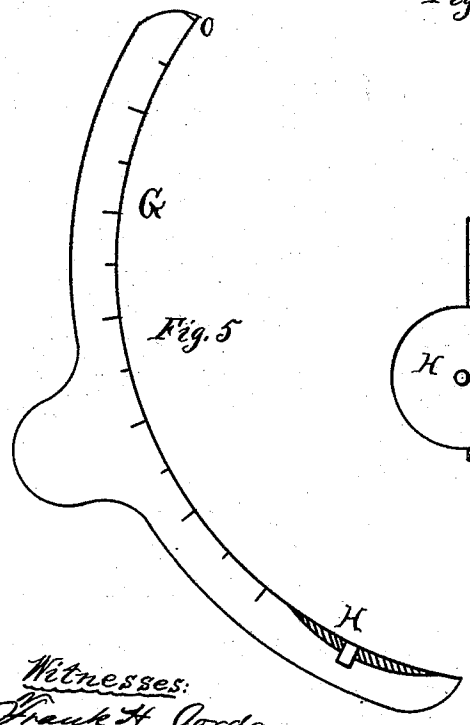

Fig. 5

Fig. 6.

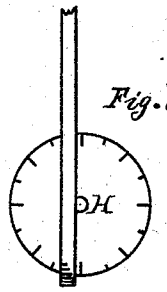

Fig. 7.

Witnesses:
Frank H. Jordan
Charles E. Clifford

Inventor:
Thomas Hill
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UNITED STATES PATENT OFFICE.

THOMAS HILL, OF PORTLAND, MAINE.

IMPROVEMENT IN INSTRUMENTS FOR SOLVING PROBLEMS IN NAVIGATION.

Specification forming part of Letters Patent No. **173,724**, dated February 22, 1876; application filed January 10, 1876.

To all whom it may concern:

Be it known that I, THOMAS HILL, of Portland, in the county of Cumberland and State of Maine, have invented certain new and useful Improvements in Instruments for Solving Problems of Navigation; and I do hereby declare that the following is a full, clear, and exact description thereof, which will enable others skilled in the art to which it pertains to make and use the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

Figure 1 is a front view of the instrument. Fig. 2 is a front view, in detail, of the latitude-circle. Fig. 3 is a front view, in detail, of the declination-circle, bearing a vernier. Fig. 4 is a top view of the hour-angle circle. Fig. 5 is a face view of the altitude-arc. Figs. 6 and 7 are under and upper views, respectively, of the compass-card attached to the altitude-arc.

I will first describe the machine, and then its operation.

A B and C D are two meridians—the one marked latitude, the other marked declination—which are placed together in such a manner that the edges B K and C L are in contact for their whole length; and the two meridians may open and shut upon these edges as a hinge. F is a plate in the form of a sector of a circle, marked hour-angle. To this plate the meridian C D is fastened at right angles, while the latitude-meridian is set at any required angle with C D by the graduated edge of F. On the latitude-meridian are two hinge-thumbs, P P, the lower one of which plays in a hole, M, in the plate F. The upper one plays in a hole in the ear Q, at the top of the declination-meridian C D. The declination-meridian bears a vernier, E, carrying a steel pin at its vernier-point. This vernier is movable upon the arc of C D. Both meridians are of the same radius, and are graduated from the pole Q down to thirty degrees below the equator at A and D. G is an arc of altitude, graduated from two degrees below the horizon at O to the zenith H. It is of precisely the same radius as the meridians, and bears at its zenith-point a compass-card, pierced at the center with a hole to fit the vernier-pin.

The use of the instrument is to solve the spherical triangle, which is formed when the zenith-point H is placed upon the pin of the vernier E, and the altitude-arc laid across the latitude-meridian. The sides of the triangle are known by inspection, because they are graduated arcs. The angle at the pole Q is measured upon the graduated hour-angle arc of F. The angle at E is measured by the compass-card attached to the zenith of the altitude-arc. The third angle, at the intersection of the altitude-arc with the latitude-meridian, remains to be measured, which is done not in the triangle itself, but in a symmetrical triangle formed by moving the vernier-pin to the latitude on the declination-circle, and the altitude-arc to the declination on the latitude-circle. The new triangle thus formed being symmetrical with the old triangle, the compass-card now measures what was the third or unmeasured angle, and thus the triangle is completely solved. In this manner the instrument finds the time from an altitude taken by the sextant. The vernier E is placed at the declination of the heavenly body observed, the zenith-point is put upon the pin, and the hour-angle is altered until the observed altitude on the altitude-arc exactly reaches the latitude of the observer. The hour-angle is then equal to the difference of the right ascension of the body and that of the meridian, which gives at once the apparent time at the place of observation.

By making the altitude equal to zero, this method gives at once the time of sunrise and sunset.

If, in the same problems, the symmetrical triangle is formed as above described, the compass-card gives the azimuth of the heavenly bodies observed. The instrument also solves the problems of great-circle sailing.

The meridians being clamped at an angle equal to the difference between the longitude of the ship and of the desired port, the vernier E is placed on the declination-meridian at the ship's latitude, the zenith of altitude is put upon it, and the altitude-arc laid over the latitude of the desired port. The compass-card now indicates the course, while the co-altitude is the great-circle distance. Thus the navigator, by this machine, can solve all the principal problems of navigation relating

to time, latitude, longitude, azimuth, and great-circle sailing without the labor and the liability to error of numerical or logarithmic computations.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. The combination of three arcs of equal radius—two convex and one concave, or two concave and one convex—so combined as to form a spherical triangle, for the solution of that triangle in problems of navigation or geodesy, as herein set forth.

2. The attachment of a portion of a spherical surface with a graduated limb to one of the arcs, as at H, as and for the purposes herein set forth.

In testimony that I claim the foregoing as my own I affix my signature in presence of two witnesses.

THOMAS HILL.

Witnesses:
FRANCIS FESSENDEN,
C. H. FARLEY.