No. 703,139.

Patented June 24, 1902.

R. T. LAWLESS.

STELLAR COMPASS AND GREAT CIRCLE COURSE PROJECTOR.

(Application filed Feb. 24, 1902.)

(No Model.)

2 Sheets—Sheet 1.

Fig. 1.

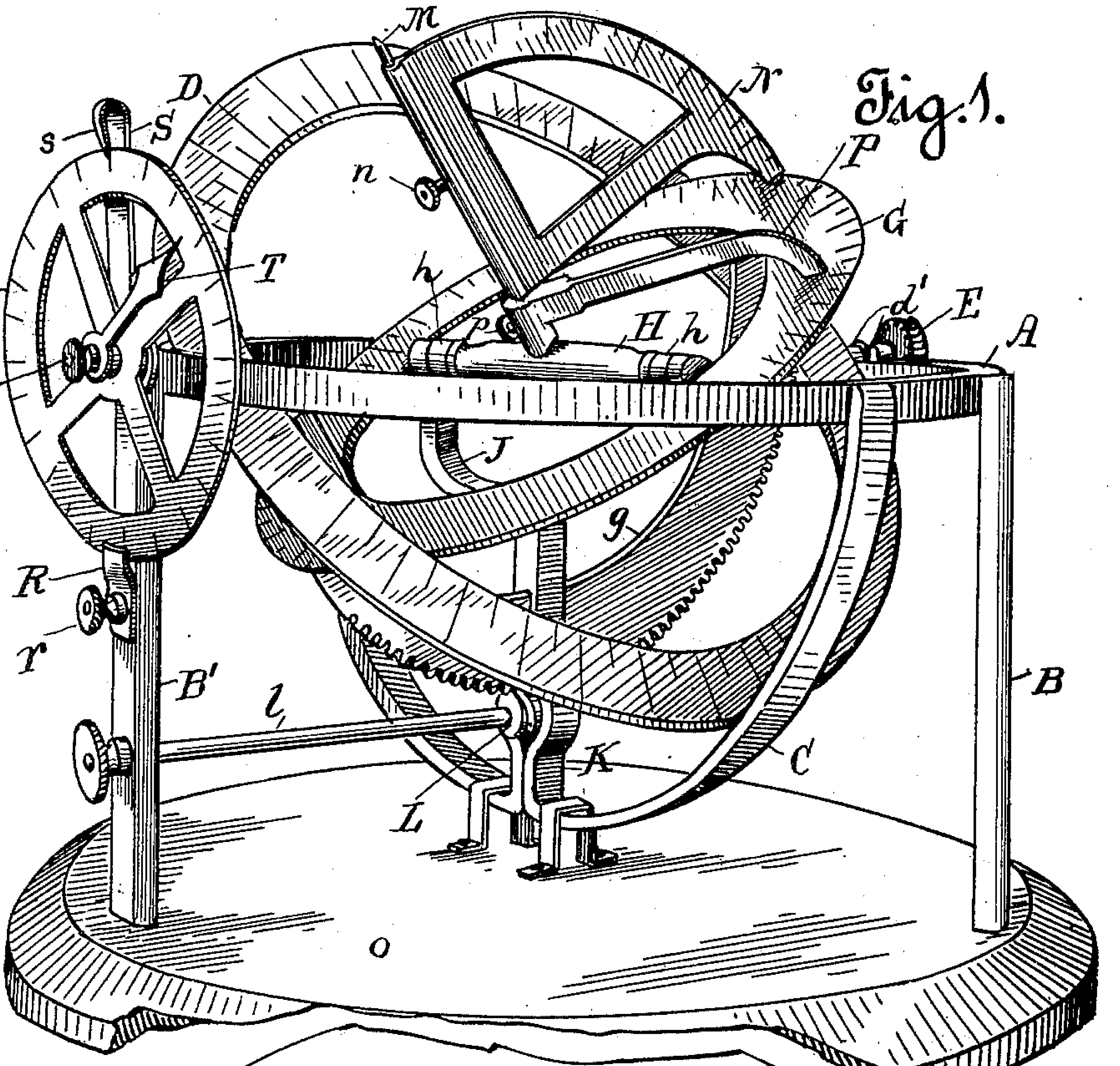
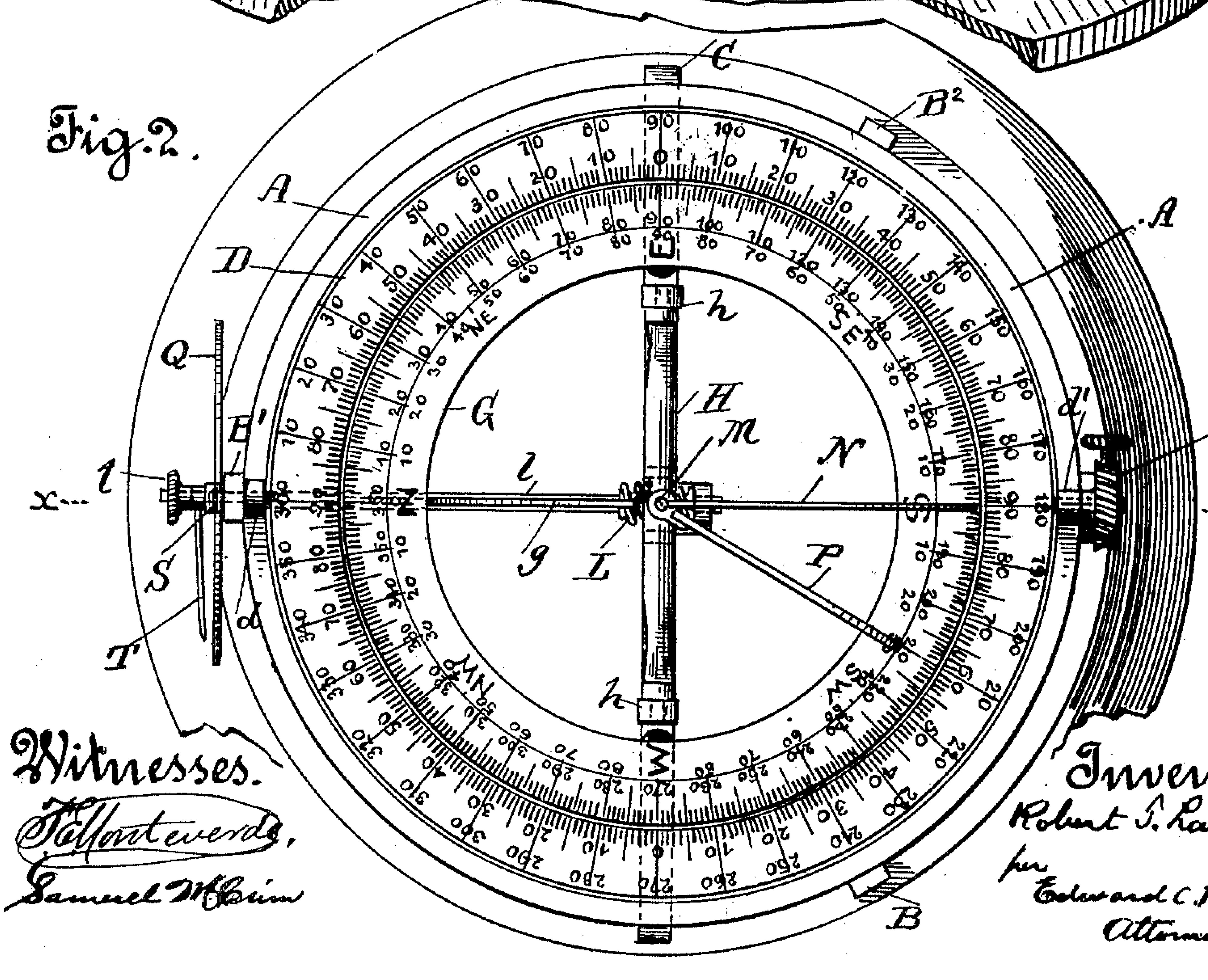


Fig. 2.



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2 Sheets—Sheet 2.

Fig. 3.

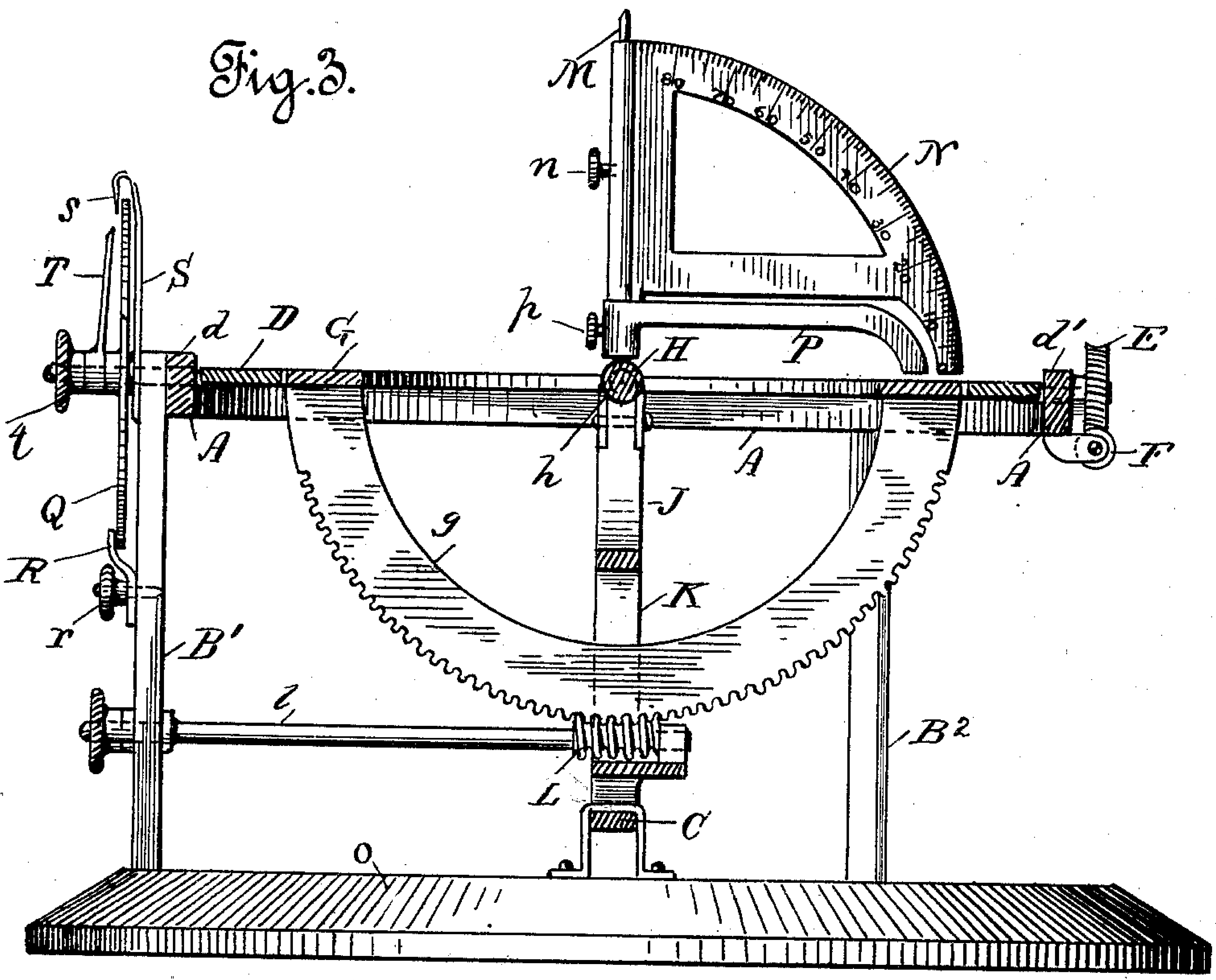
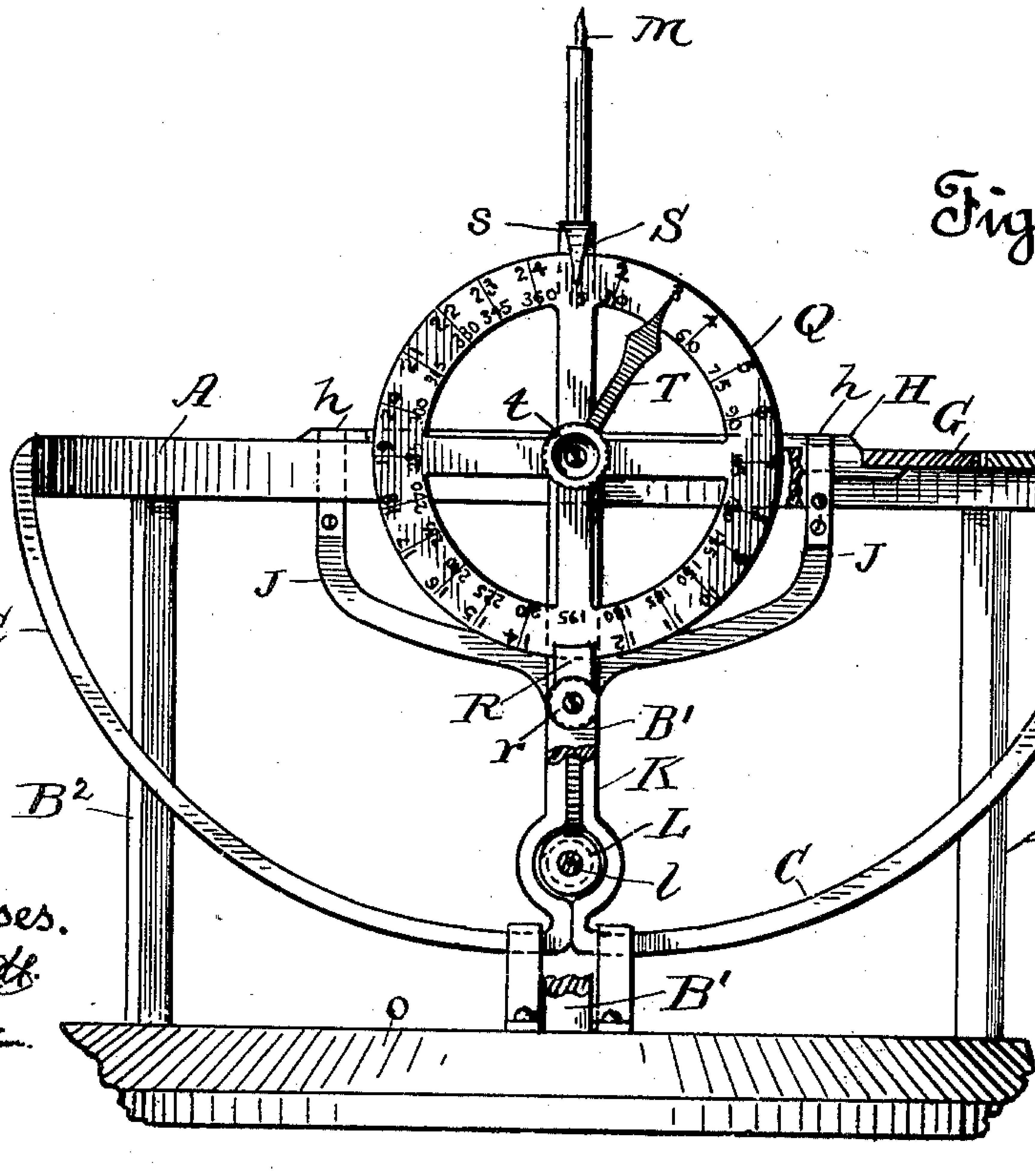


Fig. 4.



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UNITED STATES PATENT OFFICE.

ROBERT T. LAWLESS, OF ALAMEDA, CALIFORNIA.

STELLAR COMPASS AND GREAT-CIRCLE-COURSE PROJECTOR.

SPECIFICATION forming part of Letters Patent No. 703,139, dated June 24, 1902.

Application filed February 24, 1902. Serial No. 95,463. (No model.)

To all whom it may concern:

Be it known that I, ROBERT T. LAWLESS, a citizen of the United States, residing at Alameda, in the county of Alameda and State of California, have invented a new and useful machine, which I have designated the Stellar Compass and Great-Circle-Course Projector, of which the following is a specification.

My invention relates to navigation, and is designed to enable the mariner to steer a true course at any time of the day or night without a compass and also to lay a direct great-circle-course between any two points.

The construction of the machine is illustrated in the accompanying drawings, in which—

Figure 1 represents my invention in perspective with its various dials and parts so set for an observation as to exhibit them in detail. Fig. 2 is a top plan of the same with the base partly broken, showing all its parts at a point of rest. Fig. 3 is a side elevation of Fig. 2, partly in section, as through the line *x x* on Fig. 2. Fig. 4 is a front elevation of the same, partly broken, showing the time-circle and its divisions.

The circular stand A, with its three legs B B′ B″ and semicircular support C, all resting on a circular flat wooden base O, constitutes the framework of the machine. Within this circular stand A and resting in its plane are two circles of brass or other suitable metal, the outer one of which, D, moves on pivots *d d′*, set in stand A at points corresponding with the poles or north and south points as designated and marked on the inner circle G. This outer circle D is graduated and marked in degrees, beginning at the pivot *d*, designated as "North," and rising in the direction of the point designated as "East" and ending with "360°" at north. This same circle D has also a second graduation or marking indicated on its inner margin, beginning with "0°" at the east and west ends of the equatorial axis and rising in both directions to "90°" at the poles. It has also a blank space on its outer margin upon which may be designated the names and locations of such stars as may be desired. Attached to the pivot *d′* at the south pole is a cog E, operated by a worm F, by means of which the circle D is moved with nicety and secured in any position. This circle D is designated by me as the "latitude" and "declination" circle. The inner circle G is also graduated and marked in degrees with two sets of figures, one of which, as on D, commences with "0°" at the north pole and rising in the direction of east terminates at north again with "360°," and the other set begins with "0°" at both north and south and rises in both directions to "90°" at the equator. It has indicated upon it also the usual points of the compass. This circle G moves or revolves upon an axis at right angles with the axis of the circle D. This is accomplished by means of a rod H, connecting its east and west points, which has bearings *h h* upon two arms J J, branching from a single upright support K in the center of the machine, resting in turn upon the semicircular support C. The circle G is moved and secured in any position by means of a spiral screw L, set in the support K in such manner as to move in the cogged edge of a semicircular frame *g*, affixed to the bottom of the circle G at right angles to its axis. The rod *l*, passing through the leg B′ and there ending in a milled head, furnishes the means by which the screw L is operated. This circle G is designated by me as the "observer's horizontal plane and compass."

From the center of H rises a rod M, upon which revolves a quadrant or circular arc N, which is graduated and marked in degrees upon both its sides, beginning with "0°" at the bottom and rising to "90°" at the top. This is secured in any desired position by a set-screw *n*.

Upon the rod M and beneath the framework of the quadrant N is a pointer P, which revolves on rod M and is secured in any desired position by a set-screw *p*.

The pivot *d* is made to extend a little beyond the framework of the machine, so as to sustain what I designate as the "time-circle" Q. This circle is graduated and marked on its outer edge as a sidereal clock and upon an inner line with degrees. It is secured in any desired position by means of a clamp R upon the leg B′, which is tightened against it by means of a thumb-screw *r*.

Behind the time-circle Q and between it and the stand A is an upright extension of the leg B′, (indicated by S,) the end of which

is turned over in a sharp point *s* upon the face of time-circle Q to serve as a fixed indicator.

Upon the pivot *d* and outside the time-circle Q is a hand or pointer T, which may revolve independently on pivot *d* or may by means of a set-screw *t* be secured in any position, so that it can only revolve in accord with the circle D.

Similar letters refer to similar parts throughout the several views.

The objects attained by this invention and for which the machine is designed are, first, the ascertainment of a true course at any time of the day or night without the aid of a magnetic compass; second the ascertainment of a direct course on a great circle of the earth between any two points on the earth's surface.

The machine can be used also to work problems of latitude and longitude and the solution of spherical triangles and to ascertain local apparent time and the right ascension of heavenly bodies; but its most valuable uses and those for which it is especially designed are the two hereinbefore specified.

To lay any desired true course with this machine, proceed as follows: First, make the pointer P indicate on the compass G the course which it is desired to lay and steer—say, for instance, west. Then set the observer's horizontal plane (circle G) at your latitude, which let us assume for purposes of illustration to be "38° north," the latitude of Point Reyes on the Pacific coast. This is done by turning the circle G upon its axis to a position where its north point is depressed thirty-eight degrees below the level of the outer circle D. This measurement of thirty-eight degrees is made by the quadrant N, which for the purpose is set upon the compass G in an exact northerly direction. Then ascertain by means of an ordinary mariner's quadrant the altitude of the star or other heavenly body which is being used for the purpose of the problem. The declination of this star is ascertained by reference to the nautical almanac, or it may be one of the stars which the observer has already by reference to the nautical almanac, indicated upon the circle D in its true position. Assume, for illustration, that the observer is using the star Vega, whose declination is thirty-eight degrees forty-one and one-half minutes north and that its ascertained altitude at the time of the observation is twenty degrees. Now swing the quadrant N in the direction of the figures on the latitude and declination circle D, indicating the location of the Vega, and at the same time raise the latitude and declination circle D so that the figures "38° 41½'", indicating the star's declination, will coincide with the altitude "20°" upon the quadrant N. Secure the quadrant in that position and its lower point will then indicate upon the compass G the true bearing of the star Vega from the observer. The difference in degrees between this point and the direction indicated by the pointer P will show the difference which must be found to exist between the star's bearing and the ship's course in order that the ship may be steering the desired true west course.

In high northern and southern altitudes when circumpolar stars are too near the upper or lower transit there will not be sufficient change in the altitude to make the foregoing process reliable as ascertaining the true bearing of the star. In such cases the time-circle Q should be used in the following manner: First, set the observer's horizontal plane G for your latitude as before. Then, the time-circle Q being set with the mark indicating twenty-four hours under the fixed indicator *s*, turn the hand of the pointer T independently, so that it indicates upon the face of Q ninety degrees, or six hours. It will then be parallel with the plane of the latitude or declination circle at rest. Secure it in that position. Then ascertain the right ascension of your own meridian and turn the time-circle Q so that figures indicating this right ascension shall rest under the fixed indicator *s*. Clamp the time-circle in this position, and then turn the latitude and declination circle D (and with it the hand of pointer T) until the hand of pointer T points to the figure on Q, indicating the right ascension of the star under observation. Then swing the quadrant N until it intersects the latitude and declination circle D at the figure indicating the declination of the star under observation. Secured in this position the lower hand of the quadrant N will indicate upon the compass G the true bearing of the star, and between it and the pointer T, indicating as before the true course desired, will be found the angle which the course of the ship must make with the star's bearing in order to follow the desired course. In using the time-circle in this manner it may be necessary for convenience to make the hand or pointer T parallel with the latitude and declination circle, pointing in the direction of the mark indicating eighteen hours, or two hundred and seventy degrees; but the result in either case will be the same.

To shape a great-circle course by the use of this machine, set the observer's horizontal plane G for your latitude—that is, the latitude of the point of departure. Then set the latitude or declination circle D so that it indicates the difference, east or west, as the case may be, between the longitude of the point of departure and the longitude of the point of destination—that is to say, if the difference in longitude is forty degrees then the circle D should be turned so that it shall be upon the proper side that many degrees above the level, measured upon the quadrant N, set in a line at right angles to the axis of D. Now turn the quadrant N around until it cuts upon the latitude and declination circle D the latitude of the point of destination, and it

will indicate upon the compass the direct great-circle course desired.

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

1. In the machine of the character described, the combination of a suitable support, a latitude and declination circle mounted to swing in said support, a horizontal plane and compass circle mounted to swing in said support at an angle to the plane of movement of the latitude and declination circle, and means to determine the angular disposition of said two circles with respect to each other.

2. In a machine of the character described, the combination of a suitable support, a latitude and declination circle mounted to swing in said support, a horizontal plane and compass circle mounted to swing in said support and in a plane at substantially right angles to the plane of movement of the latitude and declination circle, and a circular arc to determine the angular disposition of the said two circles with respect to each other.

3. In a machine of the character described, the combination of a suitable support, a latitude and declination circle, a horizontal plane and compass circle, pivotal supports for said circles disposed substantially at right angles to each other, and a quadrant or circular arc mounted on the supports of one of said circles to determine the angular disposition of said circles with respect to each other.

4. In a machine of the character described, the combination of a suitable support, a latitude and declination circle, a horizontal plane and compass circle, pivotal supports for said circles disposed substantially at right angles to each other, means for moving said circles upon their pivotal supports, and a quadrant or circular arc mounted on the supports of one of said circles to determine the angular disposition of said circles with respect to each other.

5. In a machine of the character described, the combination of a suitable support, a latitude and declination circle, a horizontal plane and compass circle, each of said circles being provided with suitable graduations, pivoted supports for said circles disposed substantially at right angles to each other and a quadrant or circular arc to determine the angular disposition of any portions of the said circles with respect to each other.

6. In a machine of the character described, the combination of a suitable support, a latitude and declination circle, a horizontal plane and compass circle, pivotal supports for said circles disposed substantially at right angles to each other, and a quadrant mounted to swing upon the support of one of said circles.

7. In a machine of the character described, the combination of a suitable support, a latitude and declination circle, a horizontal plane and compass circle, pivotal supports for said circles disposed substantially at right angles to each other, and a pointer and a quadrant mounted to swing upon the support of one of said circles.

8. In a machine of the character described, the combination of a suitable support, a latitude and declination circle, a horizontal plane and compass circle, each of said circles being provided with suitable graduations or scales, pivotal supports for each of said circles arranged at right angles to each other whereby the circles may be swung in planes at right angles, a rod centrally disposed with relation to said circles and movable with one of them, and a quadrant having suitable graduations and mounted to swing on said rod.

9. In a machine of the character described, the combination of a suitable support, a latitude and declination circle, a horizontal plane and compass circle, pivotal supports for said circles arranged substantially at right angles to each other, a time-circle mounted on the supports of one of the first-named circles, and a quadrant mounted upon the support of the other of said circles.

10. In a machine of the character described, the combination of a suitable support, a latitude and declination circle, a horizontal plane and compass circle, pivotal supports for said circles, arranged substantially at right angles to each other, a time-circle and pointer mounted on the supports of one of the first-named circles, and a quadrant mounted upon the support of the other of said circles, and means to clamp the pointer to its support.

11. In a machine of the character described, the combination of a suitable support, a latitude and declination circle, a horizontal plane and compass circle, pivotal supports for said circles arranged substantially at right angles to each other, a time-circle and pointer mounted upon the pivotal support of the latitude and declination circle, means to clamp said pointer and time-circle in desired position, a quadrant mounted to swing upon the support of the horizontal plane and compass circle, all of said circles being provided with suitable graduations.

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