F. J. DICK.

SUN DIAL GNOMON.

APPLICATION FILED JULY 16, 1908.

978,859.

Patented Dec. 20, 1910.

2 SHEETS—SHEET 1.

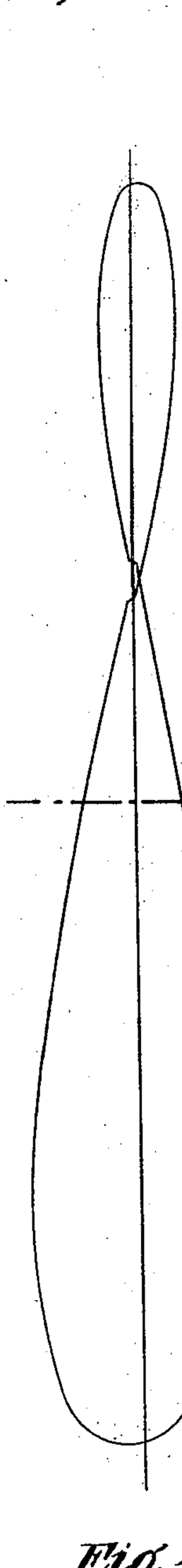

Fig. 4

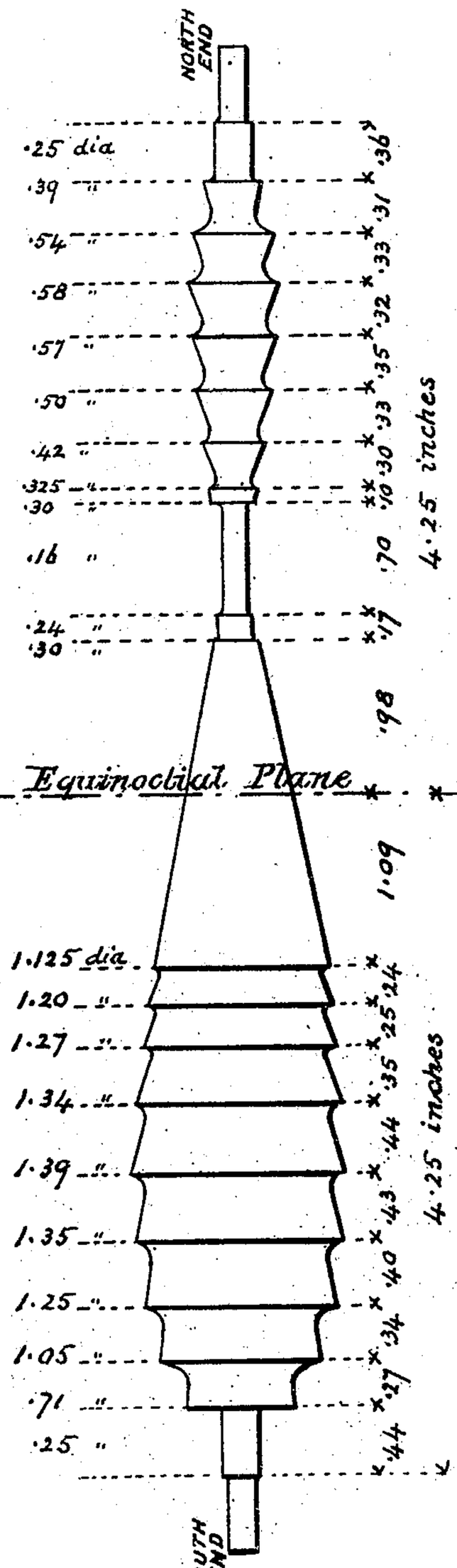

FIG. 1.

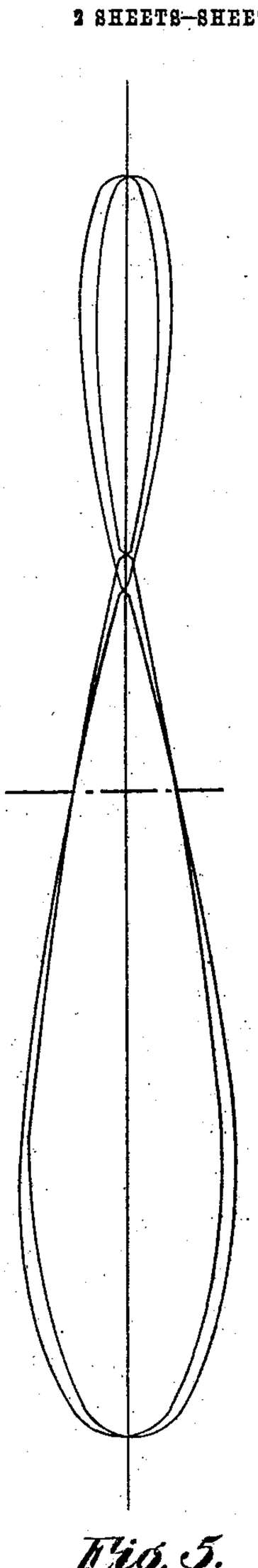

Fig. 5.

WITNESSES:

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2 SHEETS—SHEET 2.

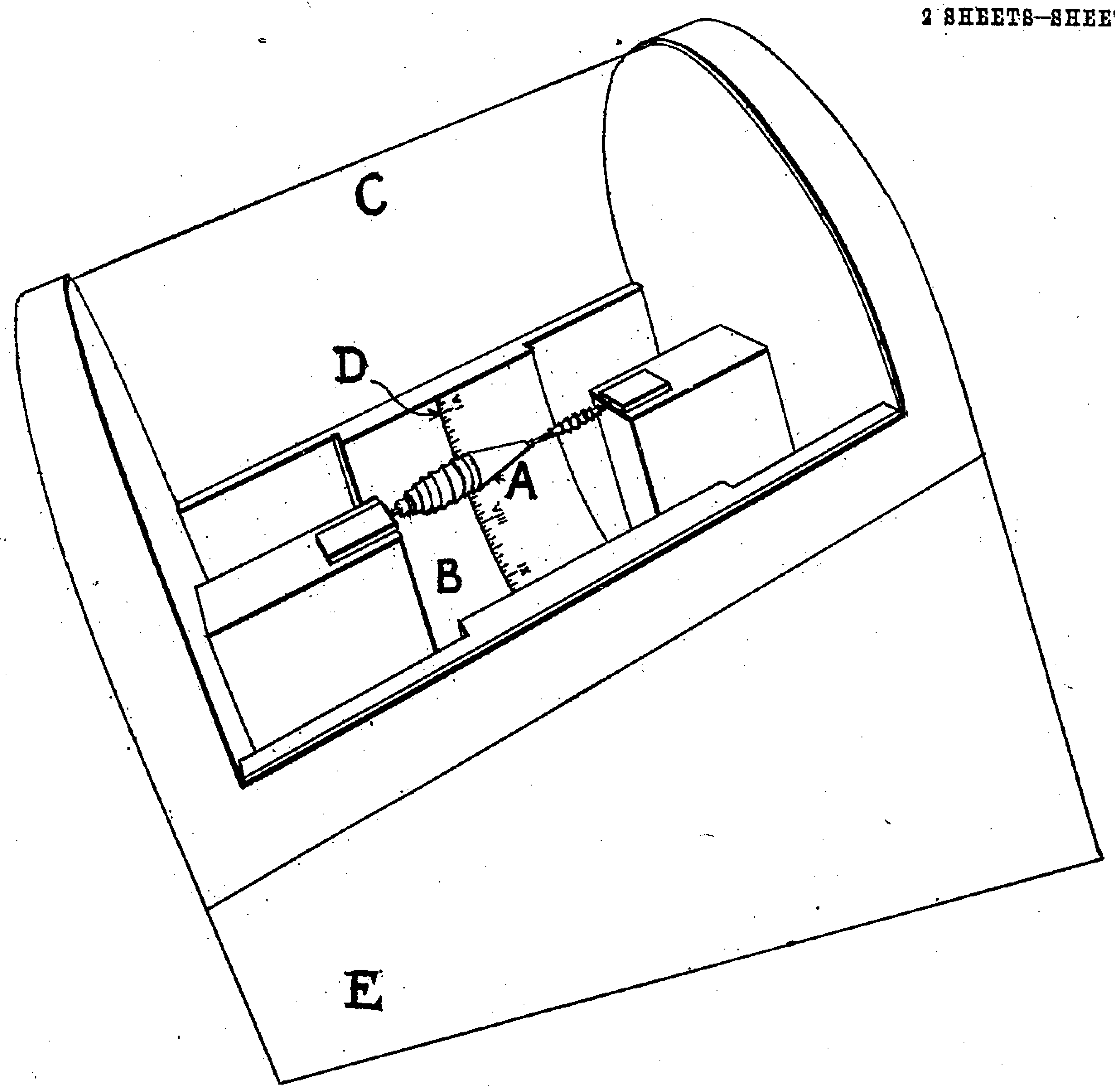

FIG. 2

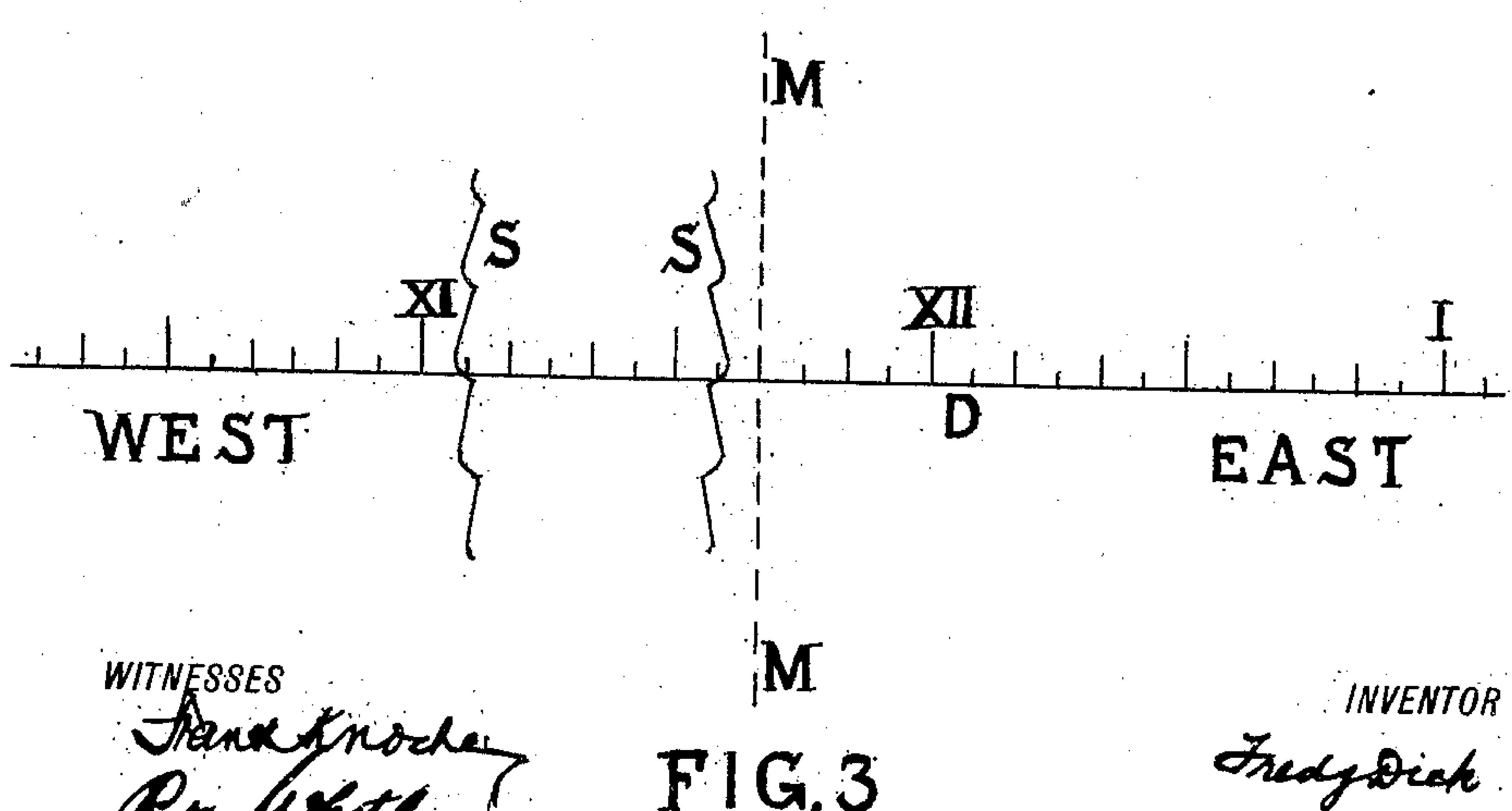

FIG. 3

WITNESSES

[illegible signature]

[illegible signature]

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UNITED STATES PATENT OFFICE.

FREDERICK J. DICK, OF POINT LOMA, CALIFORNIA, ASSIGNOR TO KATHERINE TINGLEY, OF POINT LOMA, CALIFORNIA.

SUN-DIAL GNOMON.

978,859. Specification of Letters Patent. **Patented Dec. 20, 1910.**

Application filed July 16, 1908. Serial No. 443,920.

To all whom it may concern:

Be it known that I, FREDERICK JOHN DICK, a subject of His Majesty the King of Great Britain, residing at Point Loma, in the county of San Diego and State of California, have invented certain new and useful Improvements in Sun-Dial Gnomons, of which the following is a specification.

The object of my invention is to provide a means of ascertaining the correct clock time in use at any station, by mere inspection of the shadow of my improved gnomon cast by the sun, without at any time touching or manipulating the sundial, and without having recourse to corrections or calculations. I attain this improvement by the general arrangements illustrated in the accompanying drawings, in which—

Figure 1 is a side view of my improved gnomon, which is throughout circular in cross section. Fig. 2 is a perspective view of this gnomon, mounted in a suitable frame containing a cylindrically-shaped surface whose axis is that of the gnomon, on which surface is delineated an hour-line suitably subdivided. Fig. 3 illustrates the shadow of my improved gnomon crossing the hour-line. Fig. 4, on the same scale as Fig. 1, shows the curve of the equation of time, corrected for the sun's semi-diameter. Fig. 5 is a longitudinal section of the two surfaces of revolution generated by the rotation of the curve in Fig. 4 upon its line of abscissæ, or polar axial line.

The dimensions marked in Fig. 1 are such as would be used in connection with an hour-line having a radius of nine and one-sixth units. This gives two-fifths of a unit for every ten minutes on the hour-line. The unit employed in the actual drawings, Figs. 1, 3, 4 and 5, is one inch. The dimensions in Fig. 1 are determined as hereinafter explained.

In Fig. 2, A is the improved gnomon which is mounted so that its axis lies in the plane of the meridian; with its north or small end elevated if in the northern hemisphere, or depressed if in the southern, at an angle equal to the latitude of the station. B is the cylindrical surface, inclosed within the framework E, on which surface is marked the hour-line D in a plane centrally at right angles to the axis of the gnomon, or in other words in the plane of the equinoctial. C is a strong semi-cylinder of glass inclosing and protecting the dial both from atmospheric influences and from being tampered with; for once erected, a sundial furnished with this improved gnomon need never be touched.

The abscissæ measured from the central transverse line, or equinoctial plane, in Fig. 4, are equal to the tangents of the various sun-declinations multiplied by the radius of the hour-line. The ordinates to the curve are practically those of the equation of time, on the scale of measurement of the hour-line, plus a distance equal to one minute of time measured on the hour-line. This is because the defined edge of the shadow is always one minute nearer the center of the shadow than it would be if the sun were only a point, instead of occupying, as it does 0° 32′ of arc. The curve, thus obtained, of Fig. 4 being rotated upon the line of abscissæ as an axis, the double curves of Fig. 5 result, representing the longitudinal section of two surfaces of revolution. The problem now is, to construct a solid which will produce a shadow, when at the varying angles due to the sun's northernly or southernly declinations, such that, in the immediate vicinity of the hour line, it will clearly indicate two sets of curves, and in such manner that the definite edge of one or other of them shall intersect the hour-line at the proper point to give the correct time. The principle by which this is attained may be expressed by imagining a series of thin flat circular disks strung at intervals on a central wire, the disks being also pierced centrally by a couple of spindles end to end of smaller sectional area. The outer curves of Fig. 5 would envelop the disks, and the inner curves the two solid spindles. The shadow thrown by such an object would obviously reproduce the general outlines of both sets of curves in Fig. 5. Reference to Fig. 1 shows that, practically, the supposed thin disks are united to the supposed inner spindles by sloping surfaces, without interfering with the designed effect, as regards the shadow. Thus the outline of the curve inclosing the supposed disks is indicated by a series of ridges on the shadow, and that of the supposed inner spindles by a series of depressions or hollows on the shadow.

Having due regard to the fact that the shadow of any circular cross section of the gnomon, when the sun has a declination

other than zero, will always be an ellipse, the dimensions shown in Fig. 1 result, for an hour-line radius of nine and one-sixth units. For any other radius, all the dimensions, whether longitudinal or transverse, change in the same proportion, so that the instrument can readily be constructed of any convenient size. The dimensions given in Fig. 1 are thus a necessary guide to the practical construction of a gnomon which will fulfil the conditions above indicated. In Fig. 3 is shown the actual definite edges of the shadow outline, in the vicinity of the hour-line, produced by a gnomon constructed in accordance with these dimensions, whenever the sun's declination happens to be about 14° south. The wavy lines S S in Fig. 3 show the appearance of this improved gnomon's definite shadow relatively to the hour-line D, at a certain moment on February 9th, or at a certain moment on November 3rd. The plane of the meridian is shown by the dotted line M M. For the purpose of clearly explaining how it is that the correct clock time is shown, it is purposely assumed in Fig. 3 that the sundial is situated at a place whose longitude is five degrees to the eastward of some standard time meridian, and where standard time is used. Hence the XII, or noon-point, is here shown twenty minutes to the east of the meridian line M M. In other words, the hours and their subdivisions are here shown, relatively to the meridian plane, as suited for places having longitudes, for example of 70°, 85°, 100°, or 115° west of Greenwich, and which use eastern, central, mountain, or Pacific time, respectively. For places using local mean time the XII-point would coincide with the meridian; and for places having other longitudes than those of standard time meridians, and using standard time, the XII-point would be situated east or west of the meridian line M M, according to the same rule as is illustrated in Fig. 3.

The method of using a sundial furnished with my improved gnomon is indicated by the following directions, which are intended to be marked on the surface B, Fig. 2, or other convenient part of the sundial:—

Dec. 27 to Mar. 21 read profile of easterly indentations of shadow.

Mar. 22 to Apr. 13 read profile of easterly protuberances of shadow.

Apr. 19 to Jun. 12 read profile of westerly indentations of shadow.

Jun. 18 to Aug. 30 read profile of easterly protuberances of shadow.

Sep. 4 to Sep. 23 read profile of westerly indentations of shadow.

Sep. 24 to Dec. 23 read profile of westerly protuberances of shadow.

"Read profile" means: read, on the hour-line, the point where an imaginary curve drawn through the easterly (or westerly) indentations (or protuberances, as the case may be) of the gnomon-shadow would cut the hour line.

In Fig. 3, assuming it to be the month of February, we read the "profile of easterly indentations of shadow," and the time shown is therefore 11.34 a. m., standard time. Assuming it to be the month of November, we read the "profile of westerly protuberances of shadow," and the time shown is therefore 11.03½ a. m., standard time.

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

A sundial-gnomon permanently fixed and formed with a series of transverse flutings so designed that the sun throws across the hour-line of the sundial a shadow indicating the profiles or outlines of two independent sets of curves of such a nature that the correct clock time can be read on the hour-line, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

FREDERICK J. DICK. [L. S.]

Witnesses:

C. THURSTON,

J. FRANK KNOCKE.