No. 794,787. PATENTED JULY 18, 1905.

A. C. CREHORE.

SUN DIAL.

APPLICATION FILED OCT. 21, 1903.

Fig. 1

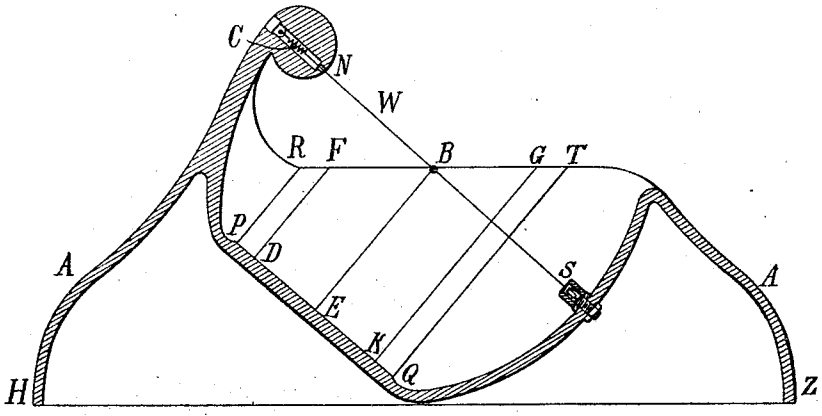
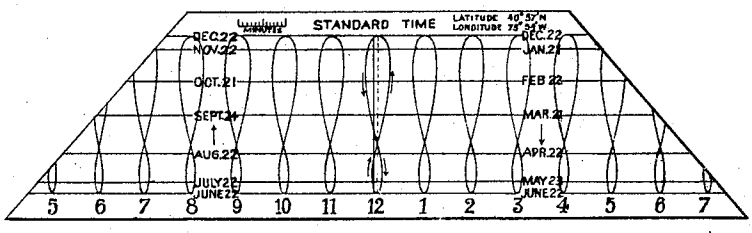


Fig. 2



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No. 794,787. Patented July 18, 1905.

UNITED STATES PATENT OFFICE.

ALBERT C. CREHORE, OF YONKERS, NEW YORK.

SUN-DIAL.

SPECIFICATION forming part of Letters Patent No. 794,787, dated July 18, 1905.

Application filed October 21, 1903. Serial No. 177,856.

To all whom it may concern:

Be it known that I, ALBERT C. CREHORE, a citizen of the United States, residing at Yonkers, county of Westchester, State of New York, have invented certain new and useful Improvements in Sun-Dials; and in pursuance of the statute I have set forth in the accompanying drawings and specification, as an illustration of the invention, that form thereof which I now regard as the best one of the various forms in which the principle of the invention may be embodied.

In the drawings, Figure 1 is a vertical cross-section of a dial constructed according to my invention, and Fig. 2 is a plan of the indicator-plate.

One of the objects of this invention is to provide a sun-dial which is an accurate timepiece at all times when the sun is shining, indicating the correct standard or mean time directly without resorting to tables of correction or other artificial and troublesome devices sometimes attached to dials.

Another object of the invention is to provide an instrument of instruction, for when the dial is understood in all its features the observer has presented to him in concise form the whole story of the sun's apparent motion in the heavens during one year.

While any surface of revolution about a line parallel with the earth's axis may be used for the face of the dial without departing from this invention, the cylindrical surface is preferred to a sphere or spheroid for several reasons. There is less difficulty in turning a cylindrical surface from the casting than almost any other shape, and the distance which the shadow travels during one hour remains the same on the cylinder for every hour of the day and for every day in the year, which makes it possible to apply a fixed scale to the dial in reading the time with exactness when interpolating between the nearest hour-marks. The variation in the distance of the shadow from the bead is unimportant, provided the distance does not exceed the limits of distinctness for the shadow.

Referring to the drawings, Figure 1 represents a section through the dial on the plane of the meridian, and Fig. 2 represents the face of the dial.

Referring to Fig. 1, A A represent the section through the casting in the plane of the meridian through the bead B, and it shows the dial to be one solid piece of bronze, except for the face, which consists of an engraved bronze sheet bent to fit the cylindrical surface of which P Q represent an element parallel to the axis N S. This axis is inclined to the horizontal plane H Z at an angle equal to the latitude of the place where the dial is erected and the whole casting oriented until the axis comes into the plane of the meridian, when the axis N S and the line P Q will each be parallel with the earth's axis of rotation. The small bead or "gnomon" B, which casts the shadow, is held in position by a bronze wire W, extended in an axial line constituting the focus of the cylinder, at the upper end of which is a spiral spring C to take up the motion that may result from unequal contraction and expansion by heat or from accidental causes. If the wire were held rigidly at both ends it would be likely to receive a permanent set and fail to keep the bead in the true center. The line P R represents the upper boundary of the turned cylindrical surface, and Q T the lower boundary. The line E B represents the equatorial line, and D F the uppermost limit of the shadow's motion on December 22, and K G the lower limit of the shadow on June 22. The line R T represents the top of the casting, which is cut off as by a horizontal plane passing through the bead B. By this arrangement the shadow of the bead must fall at some point on the plate if the sun is above the horizon, and, in fact, the shadow will during the year cover every part of the area included between the lines D K, K G, G F, F D. This intersection of the surface of revolution with the horizontal plane passing through the bead affords indication of the hour of sunrise and sunset for any time of the year. It is evident that the portion of the circumference K G is the largest, and D F the smallest, of any during the year. In other words, the longest day must be when the shadow falls on line K G, which occurs June 22, and the short-

est when it falls on D F on December 22, the amount of difference depending entirely upon the degree of inclination of the axis to the horizontal plane.

Fig. 2 shows the face of the dial cut so that it may be wound around to fit the cylindrical surface P Q T R, Fig. 1, the equatorial line (marked "Sept. 24" and "March 21") coinciding with the line E B of Fig. 1, and the heavy transverse line through the figure **8** (marked "12") coinciding with the element of the cylinder P Q, Fig. 1. When the dial is so adjusted, it is set to indicate standard time at a place a little to the east of the prime meridian or meridian of reference.

It is not necessary to explain here the causes for the shape of the figure **8** curves or analemmæ, which mark the hours, more than to note that they are due to the elliptic shape of the earth's orbit, the earth moving faster when nearest the sun in January and slower when farthest away in July, and thus correspond to the variations in the sun's position at different times of the year. This irregular action gives rise to the well-known "equation of time," which means the difference between the mean or average time of all the days in the year and the apparent time as indicated by the sun each day. The larger loop of the figure **8** occurs on the upper, or December, side of the dial, because the earth's motion is more rapid at this season than in June. The figure **8** curves therefore serve to show the equation of time, indicating the variation from the mean time which would be represented by a line coincident with the axis of the figure **8**. The arrows are placed on the figure **8** (marked "12") to show on which side of the curve the shadow falls at noon. A corresponding arrow near each column of dates shows that if the date lies after December 22 and before June 22, where the arrow points downward, the hour-mark falls on that side of the figure **8** where the arrows point downward and after June 22 and before December 22 on that side where the arrows point upward. This avoids marking the dates on each analemma or figure **8**.

The use of any other form of indicator, such as a beam of light from a lens, is permissible without departing from this invention; but the preferred form of indicator is a small bead or sphere supported in some manner at the proper point in the center of the axis of the cylinder. The preferred method of support is upon a wire parallel with the axis of the earth, though it may take other directions or not be supported by a wire at all.

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

A sun-dial comprising a surface of revolution having marked thereon a series of complete analemmæ corresponding to the hours of the day, one or more of which has pointers marked on its respective sides and pointing in opposite directions, two groups of dates marked on the dial for the two halves of the year corresponding to the two sides of the analemmæ, each group having a pointer corresponding to one of the pointers on the sides of the analemmæ, and a gnomon or indicator coöperating with said surface.

In witness whereof I have hereunto set my hand, before two subscribing witnesses, this 16th day of October, 1903.

ALBERT C. CREHORE.

Witnesses:
ROGER A. MILLAR,
SARA B. CREHORE.