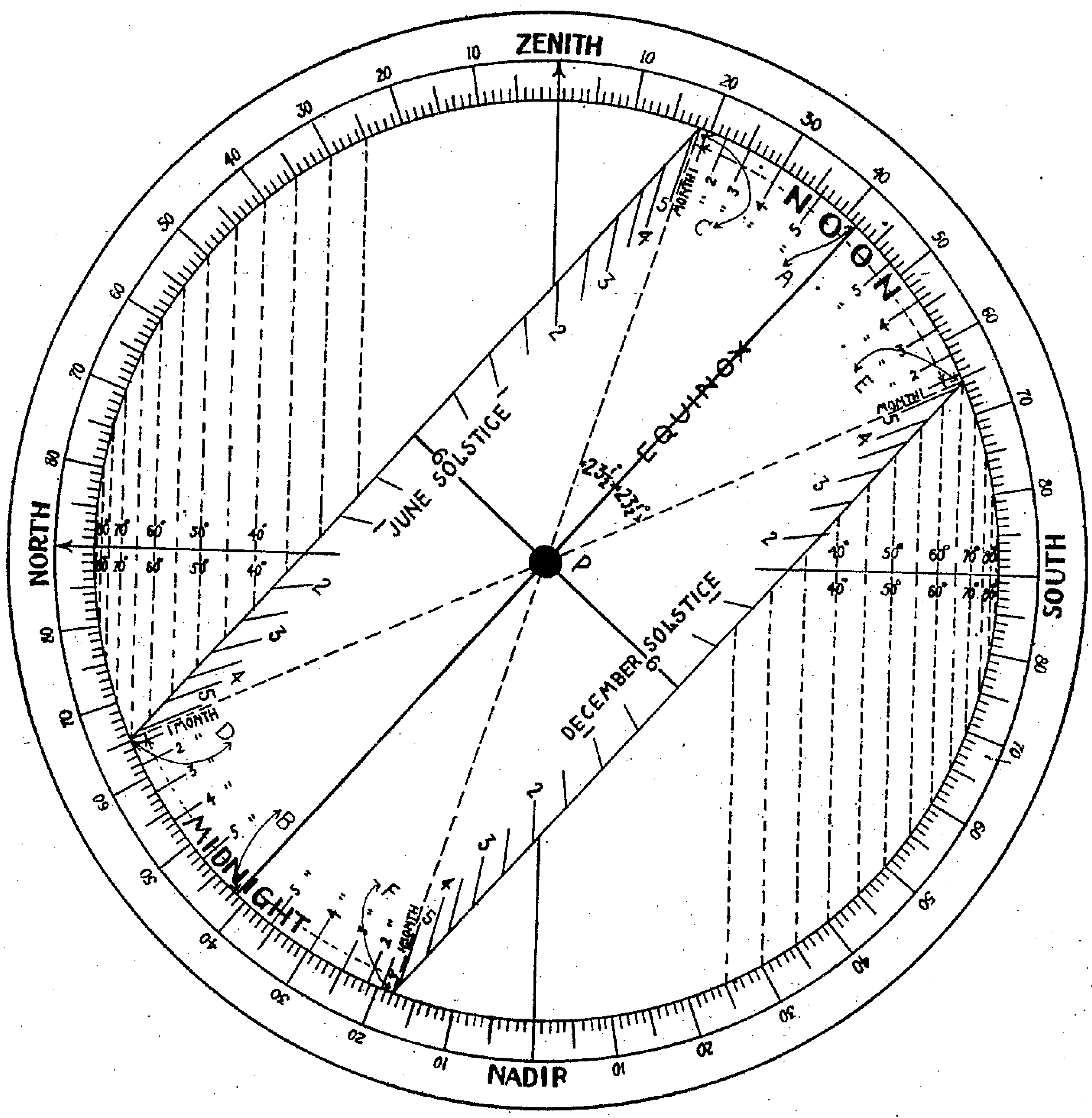
J. F. MORSE.
SUN PATH DIAL.
APPLICATION FILED MAY 17, 1909.

990,764. Patented Apr. 25, 1911.



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JOSEPH FAIRBANKS MORSE, OF CHICAGO, ILLINOIS.

SUN-PATH DIAL.

990,764. Specification of Letters Patent. **Patented Apr. 25, 1911.**

Application filed May 17, 1909. Serial No. 496,637.

To all whom it may concern:

Be it known that I, JOSEPH FAIRBANKS MORSE, a citizen of the United States, residing at 7327 Stewart avenue, Chicago, in the county of Cook and State of Illinois, have invented a new and useful Educational Device, to be known as the "Sun-Path Dial," of which the following is a specification.

My invention is designed to demonstrate the apparent diurnal path of the sun at the equinox and solstice dates with reference to the horizon and zenith of an observer at any latitude. I attain this object by means of the adjustable device shown in the accompanying drawing, which is a plan view.

The portion of the drawing included within the boundary C E F D C represents the portion of a circle cut from any suitable flat material along the two chords, C D and E F, parallel to the same diameter, A B, on opposite sides, each at a distance of 23½° from said diameter. Said portion of a circle is pivotally secured, at its central point, namely, the middle point of its diameter, to the center of a complete circle (see drawing) of an internal diameter equal to the diameter of said portion of a circle. Said pivot at the common center of said portion of a circle and said complete circle is shown in the drawing at P. The circumference of said complete circle is graduated in degrees, as shown in drawing. Said complete circle is crossed by two diameters at right angles to each other. One of said diameters is taken as fixing the vertical direction, zenith to nadir, as represented with reference to the center of the circle. The diameter at right angles to said vertical direction is taken as representing the north-to-south direction with reference to the center of the circle. Said complete circle thus fixes the meridian plane as represented with reference to the center of the circle. The two ends of said north-to-south diameter of complete circle are divided into parts, representing equal degree spaces, by chords of complete circle drawn parallel to its zenith-nadir diameter. In the drawing said degree spaces are 5° wide, and begin at 25° from said zenith-nadir diameter, on either side.

A device constructed in the manner described can be used in the following way as an adjustable diagram to demonstrate for any latitude the apparent diurnal path of the sun at the equinox and solstice dates:

Observer of sun is represented as being at the center of complete circle. The north-to-south diameter of complete circle represents said observer's horizon, as it would appear projected upon his meridian plane and viewed from the west. The diameter of the rotating portion of a circle, and the two edges parallel with the diameter represent observer's diurnal sun-paths at the equinox and solstice dates respectively, as said sun-paths would appear projected upon observer's meridian plane and viewed from the west. The equinox and solstice sun-paths, as thus represented, can be placed at the proper slant to the horizon line by placing the "noon" end of the equinox line of rotating piece as many degrees from the zenith point of complete circle as the observer is supposed to be from the equator, but in the opposite direction, southward for northern latitudes, and vice versa. The drawing shows the "sun-path dial" as adjusted for 42° north latitude, the approximate latitude of Chicago.

In every adjustment, that is, at all latitudes, the equinox sun is shown to rise due east and set due west, and to be twelve hours above the horizon. The noon position of the equinox sun is properly fixed by the adjustment.

In the vertical adjustment for the equator the sun-paths are shown to be perpendicular to the observer's horizon plane. The June solstice sun is seen to cross the horizon, in its rising and setting, 23½° to the north of east and west, and to be 23½° north of the zenith at noon, while the December solstice sun rises and sets 23½° to the south of east and west, and passes 23½° south of the zenith at noon. In the equator adjustment the days and nights are shown to be equal at the solstice dates as well as at equinox, because in this adjustment the horizon line bisects the edges as well as the diameter of the rotating portion of a circle.

In adjusting for increasing latitude northward from the equator the mid-summer days and mid-winter nights are seen to lengthen *pari passu*, the June solstice edge of rotating piece being thrown more and more above the horizon line, and the December solstice edge more and more below it.

Increasing southward adjustment shows lengthening of December solstice days and June solstice nights, at an equal rate, reversing the northern seasons.

The time of the rising and setting of the solstice sun, from which the length of solstice days and nights can be determined, is read from time marks placed at proper intervals, as calculated for the purpose, along the solstice edges of the rotating piece. The time marks shown in the drawing are one-half hour apart, and the figures, 1, 2, 3, 4, 5, distributed along alternate time marks, indicate the number of hours that six o'clock, morning and evening, is above the horizon at one solstice date and below it at the other.

In every adjustment of the rotating piece, whether for northern or southern latitudes, the June solstice noon sun is shown to be 23½° to the north of the equinox noon sun, and the December solstice noon sun 23½° to the south of it, as measured in each case on the meridian.

As the rotating piece is leaned away from the vertical position (equator adjustment) in either direction, southward or northward, the June solstice edge crosses the horizon line more and more to the north, and the December solstice edge more and more to the south. Increase of latitude, whether northward or southward, is thus seen to throw the rising and setting points of the June solstice sun increasingly northward, and of the December solstice sun more and more southward.

In adjusting the rotating piece for latitudes beyond the polar circles the solstice sun-paths, as represented by the edges of the rotating piece, are thrown clear of the horizon, one above and the other below it, their distance from the horizon increasing with latitude, until in the polar adjutments they are parallel with the horizon, 23½° above and below it. Polar latitudes are thus shown to have a period of continuous sunshine in summer and of continuous night in winter, the length of the period increasing with latitude, from a few days at the polar circles to six months at the poles.

Every adjustment of the rotating piece shows the position of the midnight sun,—how many degrees it is below or above the horizon, and in what direction.

The length of summer and winter twilight at any latitude can be read from the rotating piece by placing a ruler edge parallel with the horizon line and 18° below it, and counting the half-hour spaced intercepted between the ruler edge and horizon line.

The Chicago adjustment represented in the drawing shows that the June solstice sun, as seen from Chicago, rises 32½° north of east at 4.30,—three half-hours before six,—and sets 32½° north of west at 7.30,—three half-hours after six,—giving a fifteen-hour day, and that the December solstice sun rises and sets 32½° to the south of east and west, with a nine-hour day.

Without further detailed illustration it is evident that a device constructed and adjusted in the manner described in the foregoing specification is capable of demonstrating for every latitude the apparent diurnal course of the sun at the equinox and solstice dates with reference to an observer's horizon and zenith.

What I claim as my invention, and wish to secure by Letters Patent is:

In an adjustable device for demonstrating for any latitude the apparent daily path of the sun above and below the horizon at the equinox and solstice dates, the combination of the portion of a circle cut from any suitable flat material along two chords parallel to the same diameter, on opposite sides, each at a distance of twenty-three and one-half degrees from said diameter, the diameter and parallel edges of said portion of a circle representing the apparent daily path of the sun at the equinox and two solstice dates, respectively, as such apparent sun-paths would appear projected upon an observer's meridian plane, with a complete circle of the same diameter as said portion of a circle, said combination being effected by pivotally securing said portion of a circle at its central point, namely, the middle point of its diameter, to the center of said complete circle, the complete circle representing the circular portion of an observer's meridian plane of the same diameter as his true horizon and drawn about the observer as its center; the parallel edges of said portion of a circle being marked off into time spaces at proper intervals to represent equal time spaces on the apparent daily path of the sun at either solstice as such spaces would appear projected upon an observer's meridian plane; the circumference of said meridian circle being graduated in degrees; points on the circumference of the meridian circle diametrically opposite to each other being taken as fixing the zenith-to-nadir direction with reference to the center of the circle; the diameter of meridian circle at right angles to said zenith-to-nadir direction representing the north-to-south direction with reference to the center of the circle; said north-to-south diameter of meridian circle being marked off into degree spaces at proper intervals to represent corresponding equal degree spaces on an observer's eastern and western horizons as such degree spaces would appear projected upon the observer's meridian plane; substantially as described.

In testimony whereof I have signed my name to the foregoing specification and claims in the presence of two subscribing witnesses.

JOSEPH FAIRBANKS MORSE.

Witnesses:
JOHN STRITESKY,
C. C. BAILEY.