Dec. 6, 1927. 1,651,621

ST. JOHN O'SULLIVAN

SUNDIAL

Filed Dec. 16, 1925 2 Sheets-Sheet 1

Fig. 1.

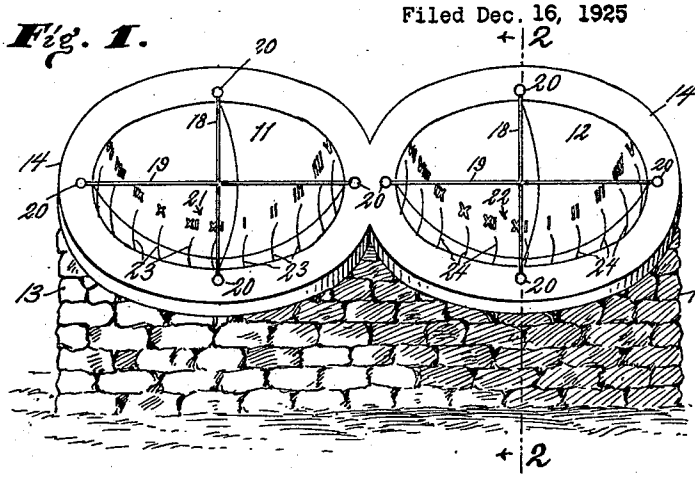


Fig. 2.

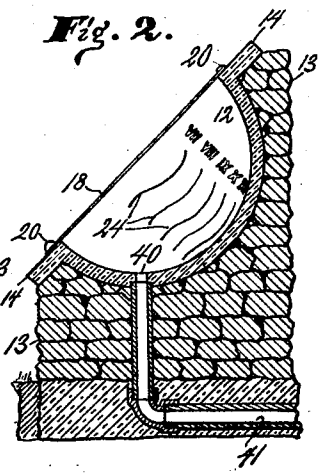


Fig. 3.

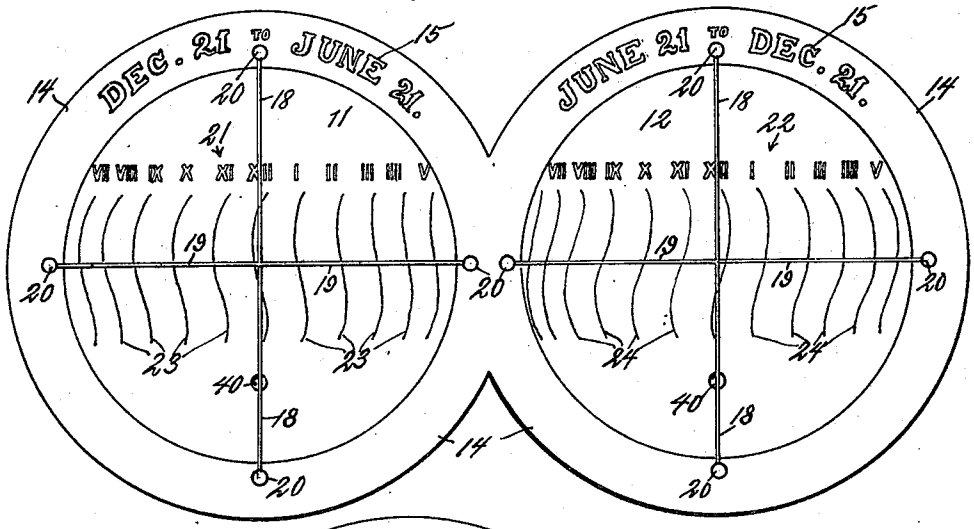
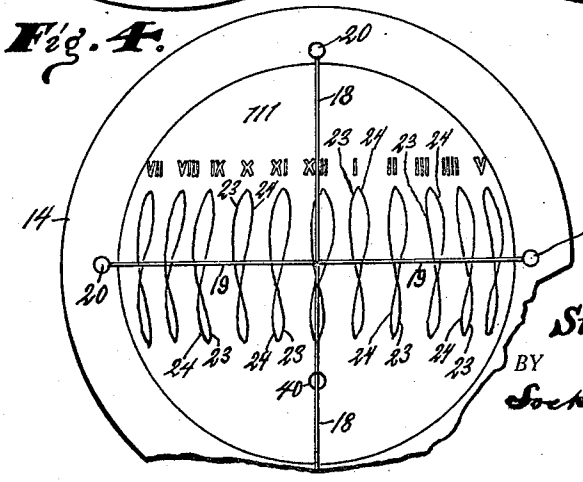


Fig. 4.



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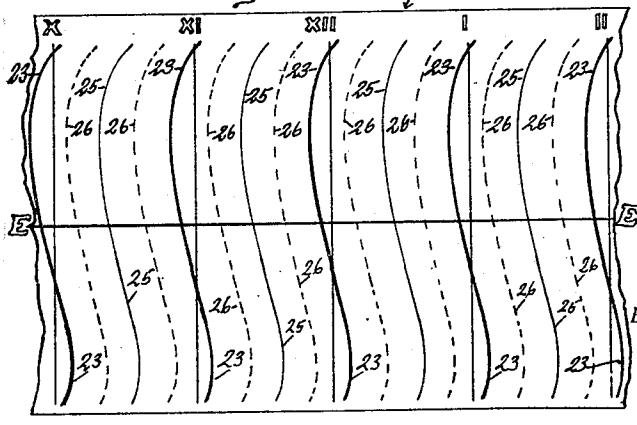
Fig. 5.

DATE.	A	B
Dec. 26-'25	23°-26'-30"	-1m-43s
Jan. 3-'26	22°-55'-5"	+4m-8s
" -17- "	20°-55'-52"	+9m-54s
" -23- "	19°-40'-6"	+11m-44s
" -31- "	17°-38'-55"	+13m-26s
Feb. 16.- "	12°-39'-48"	+14m-17s
" -28- "	8°-19'-43"	+12m-52s
Mar-8- "	5°-15'-53"	+11m-10s
" -11- "	4°-5'-36"	+10m-25s
" -20- "	0°-32'-38"	+7m-54s
" -31- "	3°-46'-33"	+4m-34s
Apr-12- "	8°-19'-23"	+1m-6s
May-10- "	17°-21'-40"	-3m-6s
June 15- "	23°-16'-13"	-0m-2s
June 22"	23°-26'-53"	-1m-32s

Fig. 6.

B	A	DATE.
-1m-27s	23°-26'-51"	Dec. 23-'26.
-15m-29s	18°-14'-25"	Nov. 15- "
-16m-21s	14°-45'-35"	" -3- "
-14m-57s	9°-59'-19"	Oct.-20- "
-13m-55s	8°-9'-12"	" -15- "
-11m-31s	4°-44'-14"	" -6- "
-9m-38s	2°-24'-43"	Sep. 30- "
-4m-24s	3°-24'-47"	" -15- "
+1m-38s	6°-26'-45"	" -7- "
+0m-1s	8°-17'-12"	" -2- "
+4m-35s	14°-22'-16"	Aug.-15- "
+6m-20s	18°-59'-42"	July.-29- "
+1m-32s	43°-26'-53"	June 22- "

Fig. 7.



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Patented Dec. 6, 1927. 1,651,621

UNITED STATES PATENT OFFICE.

ST. JOHN O'SULLIVAN, OF SAN JUAN CAPISTRANO, CALIFORNIA.

SUNDIAL.

Application filed December 16, 1925. Serial No. 75,711.

This invention is a sundial that is so constructed and arranged as to indicate with approximate accuracy mean solar time or standard time instead of sundial time. This is accomplished by providing a sundial having a concave spherically disposed surface, or preferably a hemispherical bowl, that faces the celestial equator, and a gnomon at the geometric center of the spherical surface or bowl so as to cast a shadow spot on a chart arranged on the concave surface or bowl. The chart has curved lines thereon, each of which indicates the path of the shadow of the gnomon a certain time in every day of the year or part of a year. By having such curved line for every hour of the day or part thereof mean solar time will be indicated instead of sundial time.

Another feature of the invention is a sundial having two bowls arranged so that each functions during an approximate half year so that combined they indicate approximate mean solar time during a complete year. Two bowls are used in order to avoid confusion of the reversely curved lines in the charts. However in large sundials, where the charts can be combined without confusion, one bowl is sufficient.

Another feature of the invention is a gnomon that will cast a shadow with great accuracy on the lines of the chart in the bowl. To the end I employ cross wires that preferably are united at their intersection so that the intersection point is the same radial distance from all points on the concaved surface of the chart, whereby the shadow cast will be accurately and easily determined.

The sundial is neat and pleasing in appearance and effective and durable in use; and automatically makes corrections between apparent solar time and mean solar time for every hour, half and quarter hours that the sun shines on it. It needs no regulation to make its time approximately agree to or correspond to mean solar time; and also does not require calculations such as were formerly necessary to determine mean solar time from sundial time.

The accompanying drawings illustrate the invention.

Fig. 1 is a front view of the sundial showing it provided with two bowls; Fig. 2 is a vertical cross section on line 2—2, Fig. 1; Fig. 3 is an enlarged diagrammatic view of the sundial shown in Fig. 1; Fig. 4 is a plan view of the sundial when constructed with one bowl, part of the rim broken away; Fig. 5 is a diagrammatic plan view of one of the charts used when the sundial is constructed with two bowls; showing one of the developed lines associated with other data utilized for indicating mean solar time; Fig. 6 is a diagrammatic plan view of the chart in the other bowl that is used when the sundial is constructed with two bowls; also showing but one of the developed lines utilized with other data to indicate mean solar time; Fig. 7 is a diagrammatic plan view of a chart, with lines for hours, half hours and quarter hours indicated thereon.

The sundial shown herein to illustrate the principles of the invention comprises a body that is preferably formed of plastic material such as cement that will harden after it is shaped to form and dry; and it is preferably formed with two hemispherical bowls 11 and 12 that are substantially of the same dimensions and arranged side by side and faced toward the celestial equator.

The sundial can be provided with one bowl and be formed in any way of any suitable material, and it need not be a bowl, but a spherically concave surface is all that is required. The bowl has a support 13 preferably formed of brick and provided with a rim 14 of considerable width on which data 15 can be inscribed, as shown in Fig. 3; or, if desired the rim can be left plain as shown in the other figures. The face of the rim 14 corresponds to a plane cut centrally through a sphere; and the concave inner surfaces of the bowls correspond to hemispheres.

A gnomon is formed of intersecting cross wires 18, 19 secured by anchors 20 to the rim 14; and the intersection thereof is arranged at a point that is an exact radial distance from all points on the concave surface of its respective bowl that is in the geometric center thereof; and preferably these wires 18 and 19 are united at their point of intersections so as to form a gnomon with a point adapted to cast a distinct shadow which can be seen with accuracy.

Charts 21 and 22 are arranged in the bowls 11 and 12 in position to be in registry with the shadows of the gnomon at certain predetermined times. Chart 21 is provided with developed curved lines 23 that are spaced one hour apart and are indicated by the Roman hour numerals VII to XII and I to V, the hour VI at the beginning and

close of the day not being shown. Also half-hour and quarter hour lines 25 and 26 of the same curvature can be shown in the chart, if so desired, as indicated in Fig. 7.

The chart in Fig. 5 and bowl 11 in Fig. 3, indicates approximate mean solar time between December 21 of one year and June 21 of the next year. The other chart 22 in Fig. 6 and bowl 12 in Fig. 3 is provided with developed curved lines 24 that are spaced one hour apart and also indicated by the Roman hour numerals VII to XII and I to V as is shown in the other chart and it also can have intermediate lines 25, 26 if desired, as in Fig. 7, but for the sake of clearness in the drawings and brevity they are not shown in the other figures. This chart completes the year cycle by indicating the time from December 21 in one year to December 21 of the next year.

When the sundial is to be constructed on a scale sufficiently large to avoid a confusion of lines, the charts 21 and 22 can be combined as shown in Fig. 4, and when thus combined are adapted to indicate time for a complete year.

Some lines of the charts 21 and 22 are diagrammatically illustrated in Figs. 5, 6 and 7. In Figs. 5 and 6 the development of the lines is explained by dates and astronomical data beside the lines. The data, beside the dates, is the declination of the sun at noon on the given dates in column A, and in column B the equation of time, or the minutes and seconds difference between sundial time and mean solar time; and adjacent to the minute and second spaces is the developed line 23 relative to the meridian line C—C.

The line E—E indicates the equator; the line C—C, as stated, indicates the meridian or line on which the shadow of point of the gnomon will fall at the noon hour of sundial time, and the curved line 23 indicates a developed line that is adapted to indicate approximate mean solar time when the gnomon shadow registers with it.

Only one line 23 is shown in Fig. 5, it being understood that there are other curved lines substantially like it for each day hour as shown in Figs. 1, 3, 4; and there can be additional lines for half hours and quarter hours as indicated in Fig. 7. As seen therein the heavy lines 23 indicate the hours, the fine full lines 25 indicate the half-hours and the intermediate dotted lines 26 indicate the quarter hours, and in actual practice all these lines will appear on the chart 21; but, for the sake of clearness only the hour lines are indicated in Figs. 1 to 4 inclusive.

The declination of the sun and equation of time used in making the charts herein are those for the year 1926, the second year after leap year. Also the lines 23 and 24 are, for the purpose of illustration, here shown as they appear developed on a flat surface, but for absolute accuracy are to be and have in actual practice been developed on the concave spherically disposed surface.

It is understood that in practice there will be eleven of each of the hour lines 23 and 24, and that between them will be arranged the half-hour and quarter hour lines 25, 26 as previously stated and as shown in Fig. 7. For the sake of brevity and clearness only a small number of year dates and time-rectifying figures are given in Figs. 5 and 6 or just sufficient to illustrate how the difference in time is computed and the time rectifying lines developed.

As seen in Fig. 5 sundial noon time and mean solar noon time at the point 27 for December 24 agree; then on January 31 there is a difference of 13 minutes and 25 seconds. In other words the pointer shadow at the noon hour mean solar time falls on line 23 at the point 28 and at noon hour sun dial time the shadow engages the line C—C at the point 29, 13 minutes and 26 seconds later, or the difference in time previously stated. Again on the date of April 15 sundial time and mean solar time agree; then on May 10 there is a difference of three minutes and six seconds, sundial noon time being indicated at the point 30 and mean solar noon time at the point 31. Sundial time and mean solar time again agree on June 15, as indicated at the point 31. It is understood that the difference in time for the other hours of the day are determined in substantially the same way as the noon hours shown in Figs. 5 and 6.

Referring now to Fig. 6 on July 29th there is a difference of six minutes and twenty seconds between mean solar time at the point 32 and sundial time at the point 33. Again September 1 the times agree at the point 34. On November 15th there is a difference of fifteen minutes and twenty-nine seconds between sundial time at the point 35 and mean solar time at the point 36.

In other words the lines 23 and 24 and their associated lines 25, 26 are developed so that when they are engaged by a pointer shadow they indicate mean solar time for the hour or fraction of an hour that the line represents.

The bowls 11, 12 are provided with holes 40 that are connected to drain pipes 41 as best illustrated in Fig. 2, so that rain or snow water can escape from the bowls.

The invention is not limited to the bowl form of body or chart as the essential feature is a spherically disposed surface or chart. Thus the upper and lower parts of the bowl shown, above and below the chart, could be omitted, and the dial be operative. Nor must the gnomon be made of cross wires on the bowl rim, as any shadow casting gnomon located by any means at the geo-

metric center of the concave chart will suffice, although the cross wires on the rim are preferable. Also either one bowl or two may be used to indicate time for the whole year, although the latter is preferable.

Nor is the invention limited to use for indicating mean solar time, as it can be used for standard time by making either of two variations from the mean solar time dial. By making the curved lines of the chart, either to the right or the left of the positions herein shown, according to the difference between the standard and mean solar time of the place where the sundial is located; or by laterally tilting the bowl so the lines of the chart as shown herein will be shifted to provide for standard instead of mean solar time, that is so these lines will mark the path of the shadow of the gnomon according to standard time.

I claim as my invention:

1. A sun dial including a hemispherical bowl arranged to face the celestial equator and having a rim, a concave chart in said bowl, and cross wires extending in an equatorial and meridional direction respectively and secured on the rim of the bowl with their intersection located at the geometric center of the bowl to serve as a gnomon.

2. A sun-dial including two hemispherical bowls located side by side and facing the celestial equator, each of said bowls being provided with a gnomon consisting of a pair of cross wires, one equatorial and the other meridional, with the intersection thereof located at the geometric center of the spherically disposed surface, the equatorial wires of the two bowls being in alignment with each other and the meridional wires thereof being parallel with each other, and a chart in each bowl on which a gnomon may cast a shadow and indicate the time, the chart in one of said bowls being arranged to indicate the time for one-half of a year and the chart in the other bowl arranged to indicate the time for the other half of said year.

In witness whereof, I have hereunto affixed my signature.

ST. JOHN O'SULLIVAN.