L. I. TRUEG.

Sun Dial.

No. 100,691. Patented March 8, 1870.

Fig 1

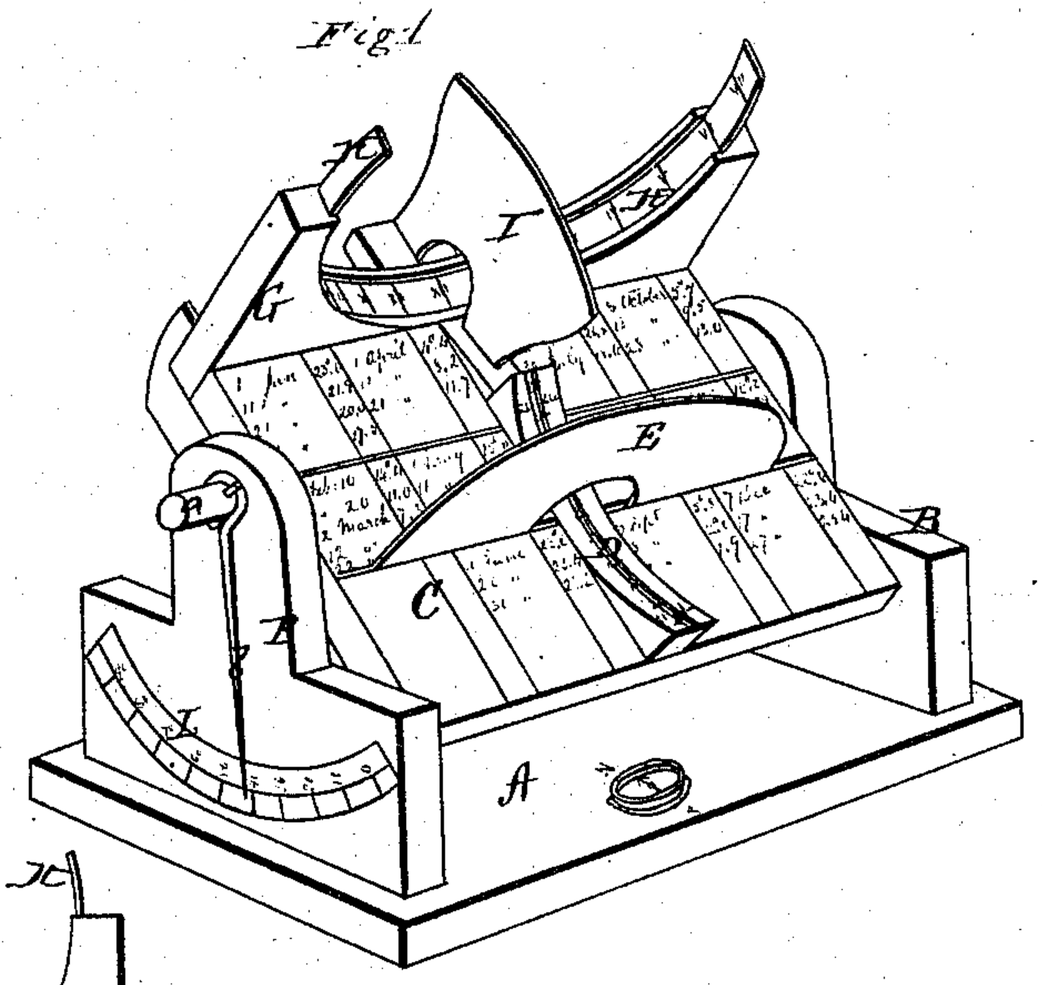



Fig 2

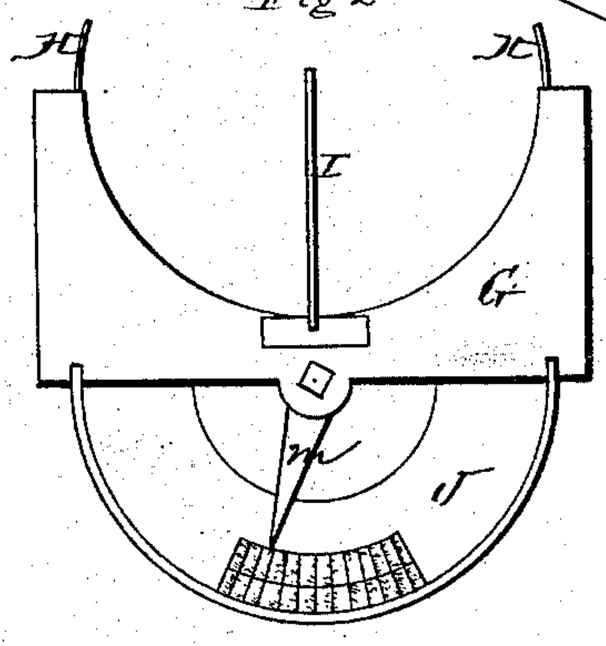



Fig 3

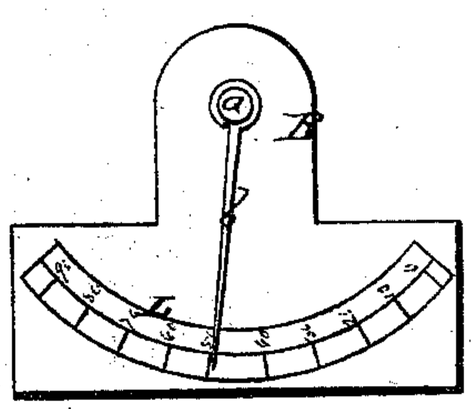



Fig 4

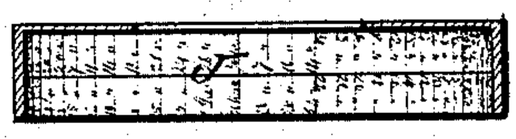
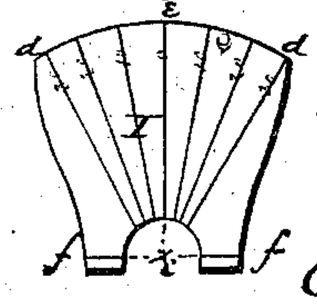



Fig 5

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# UNITED STATES PATENT OFFICE.

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## IMPROVEMENT IN SUN-DIALS.

Specification forming part of Letters Patent No. **100,691**, dated March 8, 1870.

*To all whom it may concern:*

Be it known that I, L. IGNATIUS TRUEG, of St. Vincents, in the county of Westmoreland and State of Pennsylvania, have invented certain new and useful Improvements in Heliorama; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon, making a part of this specification.

The nature of my invention consists in the construction and arrangement of an instrument by which the degrees of latitude and the sun time and clock time is measured, and which instrument I call the "heliorama."

In order to enable others skilled in the art to which my invention appertains to make and use the same, I will now proceed to describe its construction and operation, referring to the annexed drawings, in which—

Figure 1 is a perspective view of my entire instrument. Fig. 2 is a rear view. Fig. 3 is an end view. Fig. 4 is a plan view of the rear portion of the instrument, and Fig. 5 is a side view of the plate whose shadow measures the sun time.

My instrument—the heliorama—is composed of two instruments—the helioclisis, to measure the declination of the sun from the equator, and consequently the degrees of latitude; and the hemerophora, by which the shadow of the sun time is measured.

A represents the basement—a plate of wood or any other suitable material, having a recess in its upper side for the insertion of a compass wherewith the instrument is adjusted. The needle of the compass has to coincide with the line N S on the bed A, so that the north pole of it shows toward N, thus bringing the sides of the bed due north and south and the ends east and west. It is self-evident that the basement or bed A has to be put level when the instrument is set up for use.

At each end of the bed A is placed a side piece, B, perpendicular with the bed. The lower parts of these side pieces have nearly the width of the bed or basement. The higher are narrower, having a hole wherein the pins or axles *a a* of the middle piece, C, are revolving.

On the outside of the side pieces, B B, are arcs L L, with degrees marked thereon, one for the latitude and the other for the height of the celestial equator, the arms *a a* being each provided with a finger, *b*, for indicating the same.

C is the middle piece or plate, revolving upon the pins *a a* in the side pieces, B B. Crosswise on the plate C is placed a graduated arc, D, called the "cliseologet." It is graduated so that degree 0 is in the middle, and from this degrees are counted on both sides up to 25. Strictly required, however, are only $23\frac{1}{2}$, because the declination of the sun on the solstices does not exceed said number of degrees.

E is the equatorial gnomon, formed of a semicircular brass plate of the same radius as the arc of the cliseologet D. The gnomon E is provided with two feet, which are inserted in the plate C. The two arcs D and E bisect each other at right angles, so that a radius perpendicular with the diameter or base of the gnomon E will stand perpendicular with the arc or cliseologet D at degree 0, and its lower end, being the center of the semicircular gnomon, will touch that arc on which the degrees are marked.

When the instrument is set up for use, the plate must be put level, and the compass has to show north and south, as indicated by the letters N S. From this it appears that the gnomon E, or rather its diameter or base, is in the direction east and west, and since it follows the equator is called the "equatorial gnomon." It must be remarked that the degrees of latitude on the western side piece, B, are laid out thus, that the arc L, on which the degrees are measured, has its center in the center of the pin *a;* and, further, in the distribution of the degrees one-half degree (thirty-three minutes) must be lost, so that on the place where 89° 27′ should come 90° will be marked. The reason for this will appear hereinafter.

For convenience' sake, the surface of the middle piece or plate, C, bears a list of the dates of the year, with the degrees of the declination of the sun marked opposite the respective dates. In case the degree of latitude of the place is known where the device is set up, the middle piece, C, is turned thus till

the indicator *b* shows the degree on the arc L of the western end piece, B. The arc L on the opposite end piece is graduated in precisely in the opposite direction, so that when the indicator shows 0 on the latitude side the indicator on the celestial-equator side will show 90°. The sum of the latitude and the height of the celestial equator is always equal to ninety degrees. The shade of the sun cast by the gnomon E on the cliseologet D indicates the declination of the sun from the equator, north or south. During the season when the sun is actually south of the equator the shade falls north of degree 0 on the cliseologet; but during the season on which the sun is north of the equator the shade falls south; but in case the degrees of latitude of the respective places are not known, then the list on the plate C has to be consulted. Suppose we have the 10th of February. The list shows that on this date the declination of the sun amounts 14.4°. Having adjusted the instrument with regard to north and south, &c., I then turn the middle piece, C, until the shadow of the sun is cast on the said degree north of degree 0. After this I look on the arc L. What degree is indicated thereon by the indicator? The very same is the degree of latitude of the place.

The advantages of this part of my invention are that the helioclisis shows the declination of the sun on the different seasons, and it does this not only on the mid-day hour, but on every hour—forenoon and afternoon. Its greatest advantage, though only a consequence of the first, is this, that it shows the degrees of latitude in case they are not known. The helioclisis will, for this reason, be of great service to mariners. When used on the sea, it has to be kept in its direction (north and south) by means of a great magnet. It might be asked how the effect of the refraction of the sunbeams in our atmosphere is corrected. By the simple means that on the distribution of the degrees on the arc L thirty-three minutes are lost, as described above. The refraction of the sun is, at 10°, 10″; at 20°, 21″; at 30°, 33″, and increasing until at 90° it is 33′. Another point remains to be corrected, if deemed necessary. The sun, when casting a shadow, does so not from its center, but from the outline of its disk. In order, now, to get the shadow, as it were, cast from the center, the radius of the sun-disk, which is sixteen minutes, must be added to the degrees of latitude, which can be effected by subtracting them in the gradature of the arc L. So that, with this second correction, 90° will be marked where 90°—(16′+33′)—that is, 89° and 11′—ought to be.

On the rear side (north side) of the middle piece, C, the hemerophora is attached. This consists of a bearer, G, secured to the side of the plate C, said bearer being provided with a semicircular cut, as shown in Fig. 2. On the inner side of this cut is a groove all around the arc, which admits an arc, H, called the "horologet." This arc is made of brass or other suitable material, and bears upon it the description of the hours of the day, and is for this reason called "horologet." The bearer might also properly be called "equator," for the reason that it has to be set, by means of the revolving middle piece, C, in accordance with the celestial equator, it being exactly perpendicular, or at right angles with the middle piece, C. The division of the arc H regarding the inscription of the hours is simply this: 6 o'clock of the morning and 6 o'clock of the evening are 180° distant from each other, so that a straight line drawn from 6 to 6 passes through the center of the arc. The remaining hours are 15° distant from each other. Thus if we call 6 o'clock of the morning degree 0, 7 o'clock comes on degree 15, 8 on 30, &c., 12 o'clock on degree 90. The horologet is more than a semicircle, in order to gain space for the inscription of at least one hour more for the morning and one for the evening. Thus provision is made for the summer season, when the day is longer than twelve hours. The horologet H can be shifted around its own center. The motion is, however, very small, amounting in all only to the space which half an hour, or, more accurately, thirty-one minutes, on the horologet occupy. The end of this motion is to set the horologet so that it indicates the middle time, or the time of a correct clock, for the sun time differs more or less from the latter, it being sometimes too slow, sometimes too fast.

I represents the meridional gnomon or indicator, consisting of a brass plate, (see Fig. 5,) the upper end, *d e d*, being an arc, the center of which is *i*. As it is represented in the drawings, the arc extends on both sides of *e* a little over thirty degrees. Of strict necessity they are, however, only twenty-three and one-half degrees on both sides, these being the amount of the declination of the sun; but it seems preferable to let the arc extend farther, for the sake of obtaining a full and distinct shade cast on the horologet, especially at the time of the solstices. The radius *i e* has to be obtained thus: Take the radius of the horologet, add to it one thirty-second part of its own length. The sum is the radius of the gnomon I. The reason for this will be hereinafter set forth. The gnomon has to be set thus: The line *i e* has to stand perpendicular on the horologet, passing through its center. The line *f f* bisects the horologet at right angles, and, moreover, touches the surface of the inner side of the horologet, so that the point *i* touches the middle of it, or, more accurately, *i* touches that circular line passing along the middle of the horologet, on which the divisions of the hours are marked.

It may here be observed that the shape of the bearer or equator G is not essential, only so that in all cases it is perpendicular to and

revolves with the middle piece, C; that it bears around in this revolution the horologet H, giving to it the direction described above; that it admits the horologet to be shifted around its own center, and that it carries along, when turned around together with the horologet, also the gnomon I and the apparatus required for shifting the horologet. This apparatus will be hereinafter described.

The advantages of the hemerophora are that it shows at every season of the year, at every time of the day, at every place on the globe the correct time—that is, the time which a correct clock shows. It might be asked whether the refraction of the sunbeams in our atmosphere would not affect the hemerophora, preventing it from showing the correct time. It does not, since provision is made for that. The gnomon I is, as described above, shaped so that the radius of the arc *d e d* is by one thirty-second greater than the radius of the horologet. The effect of this is that on the morning the shadow is cast backward, on the evening forward. If, for instance, on the 21st of March the run rises in fact, not in appearance, at 6 o'clock, (sun time,) the shadow of the rising sun is cast backward by a few minutes, showing 5.53. As the apparent sun, so to speak, rises over the horizon, little by little the shadow falls on 6 o'clock at the very point of time when the real sun rises.

Under the bearer G is a box, J, of semicircular shape, having upon the inside of its rim and on its bottom the days in the year, so arranged that the days, when there is no variation between the sun and clock-time, will be immediately below the center of the gnomon I, and the names or dates will come in regular rotation on each side of the center—that is, one side for the sun time becoming slower and the other side for it becoming faster, only such dates, however, being put in where the difference is not less than one minute from the preceding date.

In the bearer G is hung a finger, *m*, pointing toward the names in the box J. This finger is, by suitable mechanical devices, connected with the horologet H in such a manner that, moving it (the finger) one space, the horologet will be turned around its own center the distance of one minute. By this means I am enabled at any time so to set the horologet that it will show the exact time.

Having thus fully described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. The equatorial gnomon E, in combination with the cliseologet D and revolving plate C, all constructed and arranged substantially as and for the purposes herein set forth.

2. The end pieces, B B, provided with graduated arcs L L, and used in combination with the equatorial gnomon E, cliseologet D, and revolving plate C, substantially as and for the purposes herein set forth.

3. The meridional gnomon I, in combination with the horologet H, revolving or moving around its own center within the grooved bearer G, substantially as and for the purposes herein set forth.

4. The combination of the bed A, end pieces, B B, plate C, pins *a a*, fingers *b b*, arcs L L, cliseologet D, gnomon E, bearer G, horologet H, and gnomon I, all constructed and arranged as described, substantially as and for the purposes herein set forth.

In testimony that I claim the foregoing I have hereunto set my hand this 1st day of February, 1870.

L. IGNATIUS TRUEG.

Witnesses:
J. M. STOOPS,
C. L. EVERT.