

C. S. BISSELL.
SUN TIME CARD.

APPLICATION FILED OCT. 4, 1905.

Fig. 1.

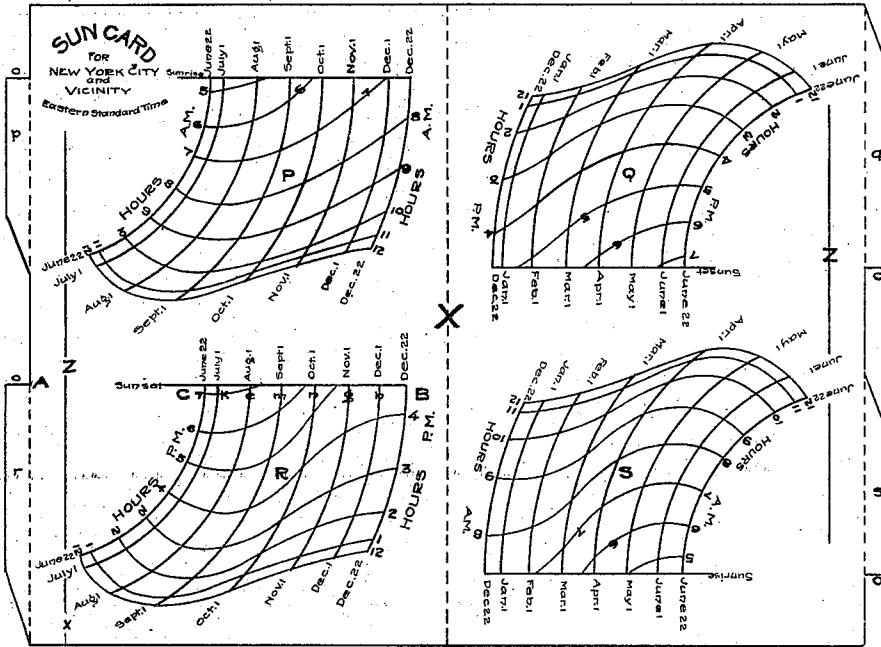


Fig. 2.

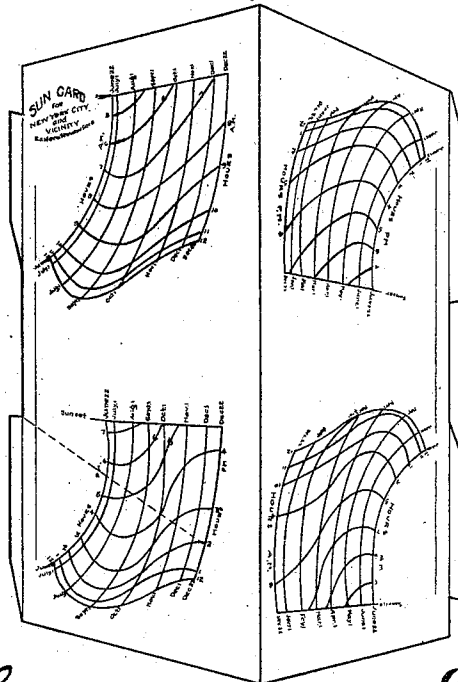
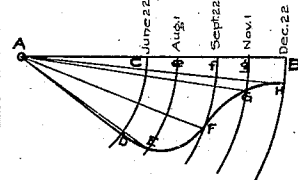


Fig. 3.



WITNESSES:

F. W. Wright.
Beatrice Davis.

INVENTOR.

Clinton S. Bissell

BY *Edward R. Swell*

ATTORNEY.

UNITED STATES PATENT OFFICE.

CLINTON S. BISSELL, OF FLUSHING, NEW YORK.

SUN TIME-CARD.

No. 853,338.

Specification of Letters Patent.

Patented May 14, 1907.

Application filed October 4, 1905. Serial No. 281,259.

To all whom it may concern:

Be it known that I, CLINTON S. BISSELL, a citizen of the United States, residing at 96 Main street, Flushing, New York, have invented certain new and useful Improvements in Sun Time-Cards, of which the following is a clear, full, and exact description.

The object of this invention is to provide a simple, accurate, cheap, portable and readily operated means for telling the time of day by the sun's rays. This object may be attained by the use of an entirely plane surface which may be a sheet of card board, paper or the like, and upon which is mapped preferably a plurality of sets of lines representing different days of the year, each set of date lines being crossed by intersecting lines which I will speak of hereafter as hour lines. Said hour lines are so calculated and located that their points of intersection with the date lines will be such that a line drawn from any such intersection to a given point from which a shadow is cast, will produce an angle to the horizontal which will measure the altitude of the sun for that given day and hour. Thus the hour is readable directly from the altitude without calculation or other regulation. The hour lines may be lines calculated for solar time, but I prefer that they be so calculated that their curves will represent standard time.

It will be obvious that such a card must be designed, so far as its mapped lines are concerned, for use in a given vicinity in order to secure accuracy. For instance a card for San Francisco, one for Denver, one for Chicago, one for Buffalo and one for New York would all differ from each other, but each will be constructed upon the same principle which will be set forth in detail hereinafter.

That point from which the sun's shadow will be thrown I preferably make at the edge of my card, thus enabling me to form a gnomon or fiducial edge out of the paper itself by merely cutting it and bending it at right angles to the plane of the mapped sheet.

My improved time card is adapted to be placed in a vertical position with its plane in line with the sun's rays, by which I mean that no shadow will be cast upon the card by its own edge, and it is in this position that the card is operative. The shadow is cast by a projecting gnomon at the edge of the card.

The sheet is preferably folded to form two surfaces so that it may be stood upon end like a book, with the sunset and sunrise lines

of the mapped surfaces horizontal, and each one of the sheets thus formed is preferably divided into a morning and evening map, each map provided with its own separate fiducial edge or gnomon. Upon one of the vertical sheets the maps will represent in date lines preferably the days of summer and autumn, *i. e.*, June 22nd to December 22nd, while the two mapped surfaces of the other vertical sheet will represent the remaining half of the year or winter and spring. It will be seen that the date lines are drawn upon radii from the point (the fiducial edge) at which the shadow is cast upon the sheet. While I have shown them as divided up into monthly divisions, it will be obvious that any other unit of division may be used. The hour lines as before stated are drawn after accurate calculation.

In use the device is held in a vertical plane, the gnomon being turned directly toward the sun that its fiducial edge may cast a shadow upon the sheet. The shadow will then cross that line of the then present date at a point upon or adjacent to one of the hour lines. The distance away from the hour line can be readily estimated and the time approximated within a few minutes. No great care need be taken when using this instrument. Thus it need only be pointed so that the sun will cast a shadow of the fiducial edge upon the map when said mapped surface is truly vertical. One does not have to consider any cardinal points of the compass.

In the accompanying drawings, Figure 1 is a plan of one of my improved time cards; Fig. 2 is a perspective view of the same time card in use; and Fig. 3 is a diagram illustrating the calculation of one of the hour lines.

In the drawings X represents the sheet upon which the mapped surfaces P, Q, R, S are printed, while *p, q, r, s* represent the gnomons having the fiducial edges *o*, for use one with each map. The line Z indicates a vertical line to act as a guide for the user, while *x* indicates a plummet string which may be used to aid in vertical adjustment of the card. Upon one corner of the card is placed the designation of that part of the country for which the card is to be used. For instance in this modification it reads for N. Y. city and vicinity.

As shown on mapped surface R, which is for P. M. summer and autumn, the point A is the point from which the fiducial edge *o* will cast the shadow represented by the

dotted line in Fig. 2. Upon the card are drawn portions of concentric circles starting at C, K, e, m, n, g, h, B, C being the date line for June 22nd, K for July 1st, e for August 1st, m for September 1st, n for October 1st, g for November 1st, h for December 1st and B for December 22nd. The sunset line is drawn from the point A across the paper as a horizontal line and parallel with its lower edge and acts as one terminus for each of the date lines. Across the datelines I construct with mathematical accuracy according to proper calculation, in this case eight other curved lines, the one adjacent to the sunset line being the seven o'clock p. m. line, as seen in the drawing it merges with the sunset line shortly after August 1st. The line 6 for six o'clock merges with the sunset line about September 22nd, line 5 merges with the sunset line about the middle of October, while line 4, which I will hereinafter use as a model for calculation, intersects every one of the date lines. Lines 3, 2, 1 and 12 each differing slightly in its curve from 4, complete the set. In order to calculate any line of any one of these mapped surfaces I proceed upon the same plan as I do for the hour line for 4 p. m. of summer and autumn as hereafter described and as shown in Fig. 3 of the drawings.

To develop the hour lines.—To show the method of constructing the hour lines the following example is given, in which the hour line of 4 p. m. Eastern standard time at New York (Long. 74 deg. N, Lat. 40 deg. 43 min. N) is developed on the diagram or dial for use from June 22d through July, August, September, October and November to December 22nd. The hour line is drawn by locating upon the diagram or dial five or more points and drawing through them a fair curve.

The points selected for the following example are: June 22nd, August 1st, September 22nd, November 1st and December 22nd, Fig. 3, and upon each of these dates the altitude of the sun at 4 p. m. must be known.

Example—To find the altitude of the sun at longitude 74 degrees W., latitude 40 degrees, 43 minutes, N. at 4 p. m. Eastern standard time on June 22nd.

Referring to the nautical almanac the average value of the equation of time, for eight or more years, is found to be two minutes, subtractive from mean time. Also the average value of the declination of the sun, for eight or more years, is found to be 23 degrees, 27 minutes. Since this declination is north, the same in name as the latitude, the polar distance of the sun is 90 degrees less 23 degrees 27 minutes, or 66 degrees 33 minutes: Eastern standard time being that of the 75th meridian of longitude west from Greenwich it is noted that the difference of longitude from 74 degrees W., is one degree, or 4 minutes of time. Hence it follows that in longitude 74 degrees W. at 4 p. m. East-

ern standard time, the hour angle of the sun is 4 hours less 2 minutes plus 4 minutes, or 4 hours and 2 minutes; the equivalent of this is 60 degrees, 30 minutes of angle, which is the hour angle of the sun at the given time and place. This data is sufficient to solve the two following equations, which result in the proper value for the required altitude of the sun:—

- (1) Tan. X=cot. latitude cos. hour angle.
- (2) Sin. of altitude=sin. latitude sec. X cos. (polar distance-X).

in which latitude is 40 degrees 43 minutes, hour angle is 60 degrees 30 minutes, polar distance is 66 deg. 33 minutes, and the figures for the solution are:—

Log. cot. 40 degrees 43 minutes.....	10, 0652
Log. cos. 60 degrees 30 minutes.....	9, 6923
Log. tan. X.....	9, 7575
X.....	29 degrees, 47 min. eq. (1)
Log. sin. 40 degrees 43 minutes.....	9, 8145
Log. sec. 29 degrees 47 minutes.....	10, 0615
Polar distance.....	66 degrees 33 minutes
X.....	29 degrees 47 minutes
Difference; log. cos. 36 degrees 46 minutes...	9, 9037
Log. sin. altitude is.....	9, 7797

Therefore at 4 p. m. on June 22nd the sun's altitude is 37 degrees 2 minutes, eq. (2).

By a process entirely similar the altitude of the sun is found for the remaining dates to be as follows:

Sun's altitude at 4 p. m. Aug. 1st....	34 deg. 40 min.
" " " " Sept. 22nd..	20 deg. 19 min.
" " " " Nov. 1st....	8 deg. 34 min.
" " " " Dec. 22nd..	4 deg. 18 min.

To locate these five points upon the diagram or dial any convenient distance, A C, is laid off on the horizontal line A B, see Fig. 3.

From C toward B, using one unit of distance for one month of time, the points marked August 1st, September 22nd, etc. to December 22nd are laid down, making the distance from C to August 1st equal to one and one third units; the distance from C to September 22nd equal to three units, as being 1½ months and three months respectively; and in like manner fixing the points for November 1st and December 22nd.

With A as a center an arc is described downward from each of these points.

To locate point D the angle B A D is made 37 degrees, 2 minutes, as calculated in the above example for June 22nd, and in like manner angles B A E, B A F, B A G and B A H are made 34 degrees 40 minutes, 20 degrees 19 minutes, 8 degrees 34 minutes, and 4 degrees 18 minutes respectively, and the curve D E F G H joining these points represents the hour line of 4 hours p. m. between the dates given.

It is apparent from the above development that at point A is the fiducial edge of the dia-

gram or dial, and that the sun's shadow lies across the diagram or dial in the direction A D or A G, etc. at any particular time when the diagram or dial may be in use; and that angle B A D or B A G, etc. is the angle of the altitude of the sun when the line A B is horizontal.

It is also obvious that a similar development of hour lines may be formed so as to give solar time, mean local time or standard time for any meridian of longitude—in any particular latitude.

I claim as my invention:

1. A sun dial comprising a card and a gnomon, said card having hour measuring lines and intersecting date lines, so mapped that for a given place correct time may be directly read from the position of the shadow of the gnomon on the card at any hour of the day by arranging the card vertically and with its surface substantially in the plane of the sun's rays while being so read.

2. A sun dial comprising a card having a portion of its surface mapped with date lines and intersecting hour measuring lines, and another portion of said card bent at an angle to the map portion to form a gnomon.

3. A portable sun time-card readable when in a vertical plane, comprising a fiducial edge, a mapped surface upon which a shadow from said edge may be cast, said mapped surface comprising date lines and intersecting hour measuring lines represented as determined from the altitude of the sun at any given hour, said fiducial edge being formed of a wing bent up from the body of the card.

4. A portable time card comprising a plurality of mapped surfaces, a plurality of fiducial edges adapted each to cast a shadow upon its adjacent mapped surface, each map surface comprised of date lines and intersecting hour measuring lines represented as determined from the altitude of the sun at any given hour, a line of fold between said mapped surfaces whereby the surfaces may be turned at an angle to each other bookwise to make the surfaces self-supporting.

Signed at New York city, N. Y. this 29th day of September 1905.

CLINTON S. BISSELL.

Witnesses:

EMERSON R. NEWELL,
F. WARREN WRIGHT.