No. 855,226. PATENTED MAY 28, 1907.

F. L. BRYANT.

ARMILLARY SPHERE.

APPLICATION FILED SEPT. 27, 1906.

2 SHEETS—SHEET 1.

Fig. 1.

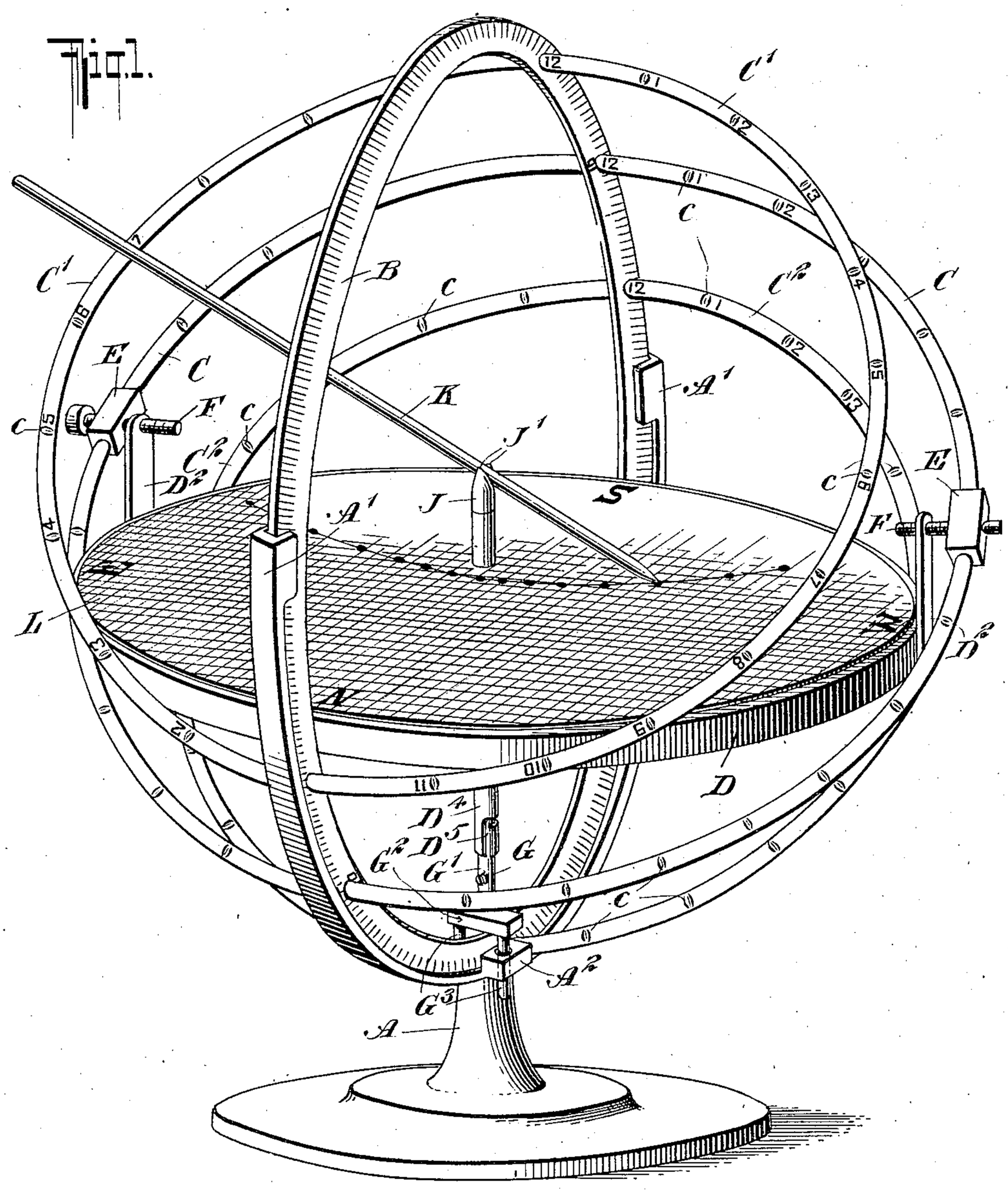
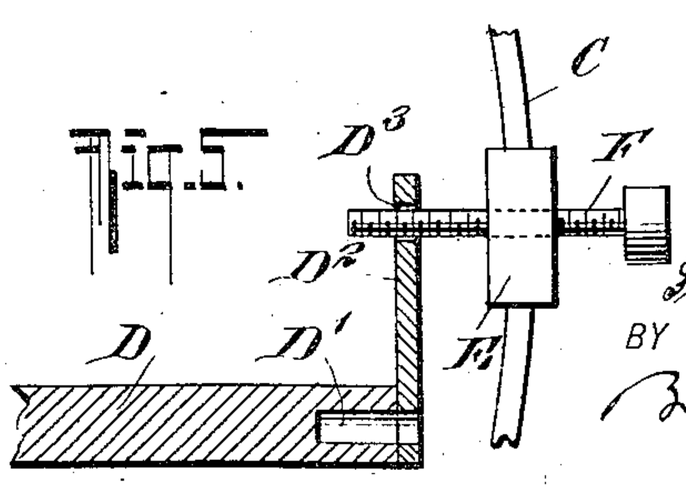


Fig. 2.



WITNESSES

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2 SHEETS—SHEET 2.

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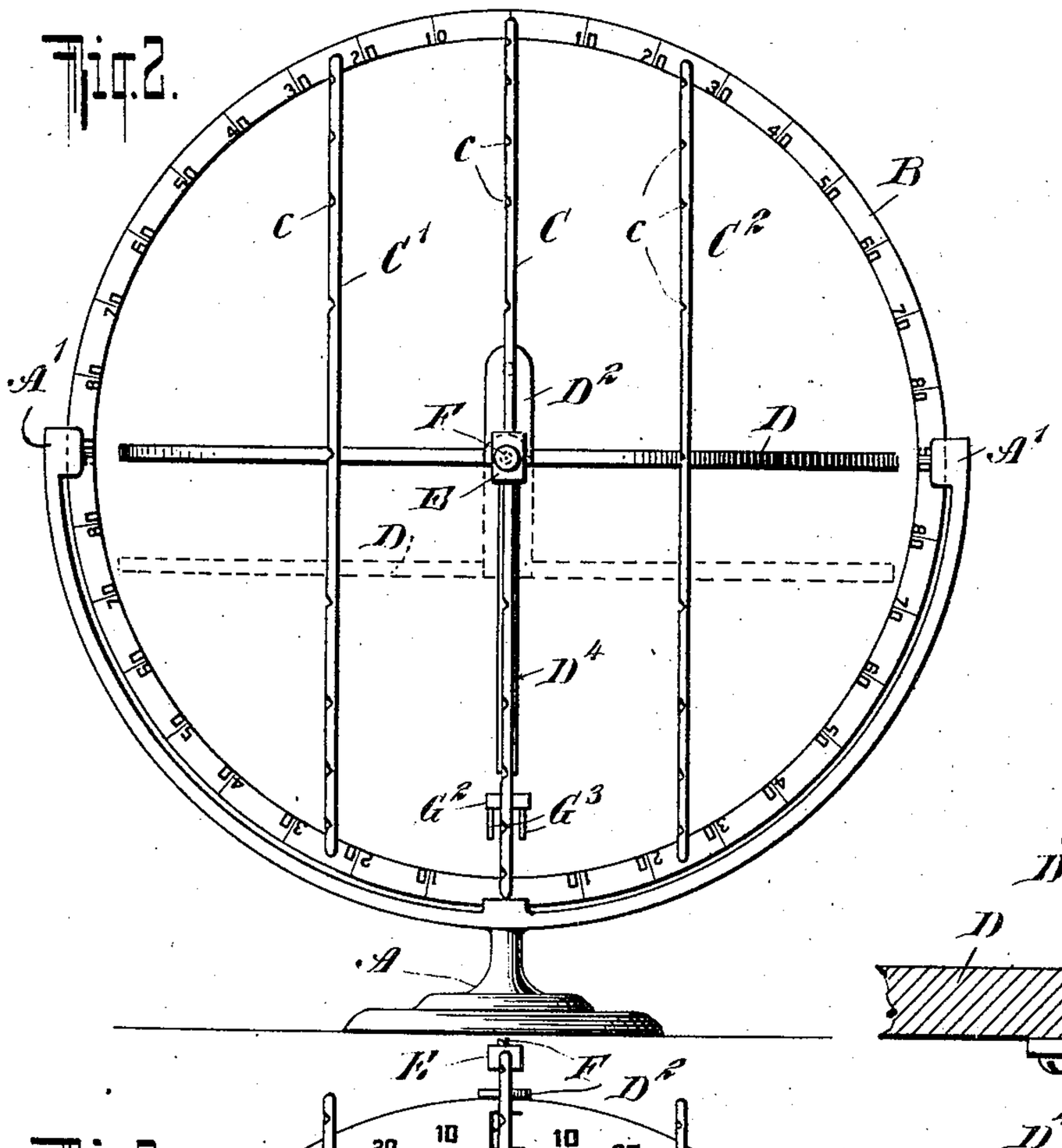


Fig. 3.

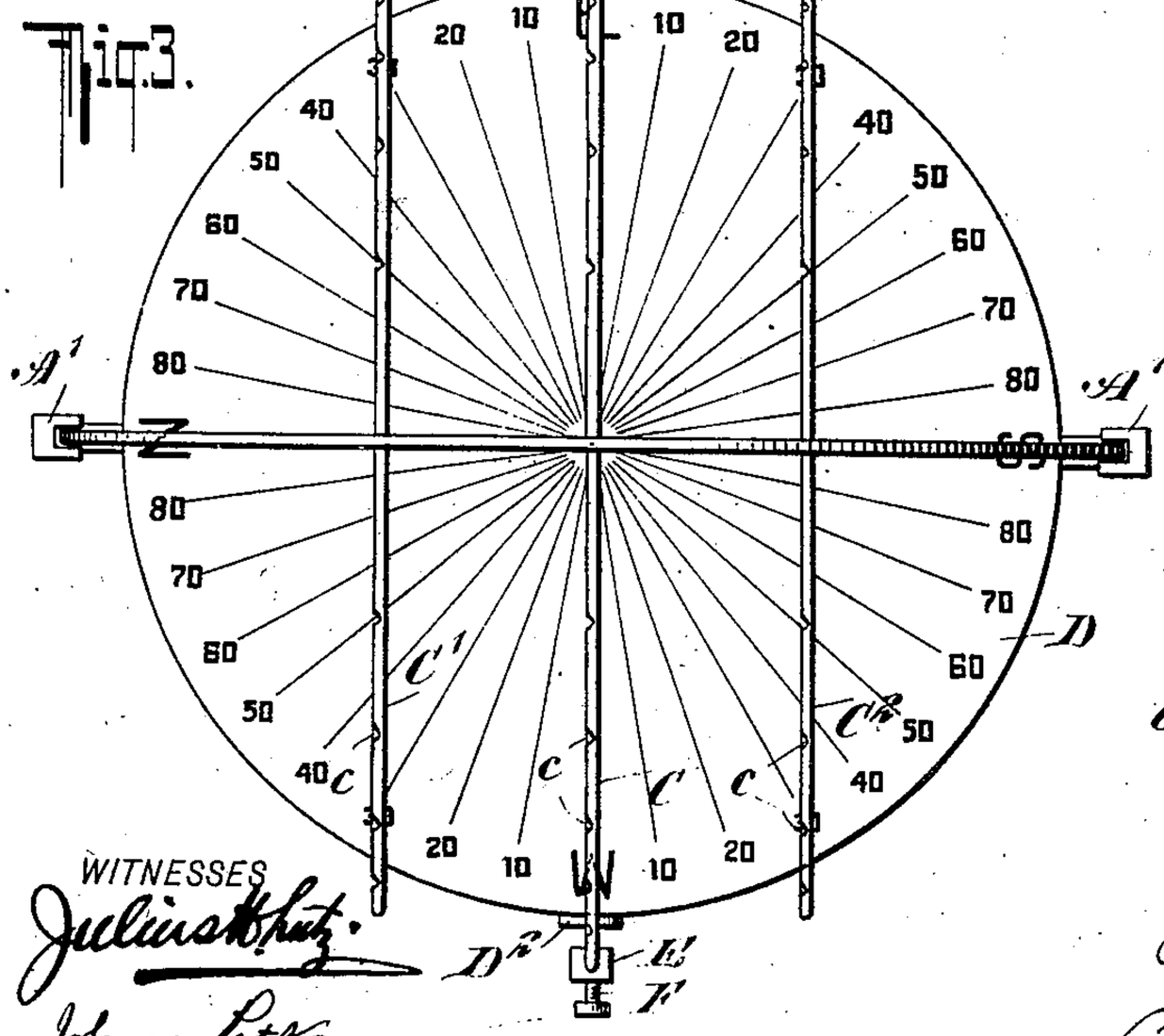
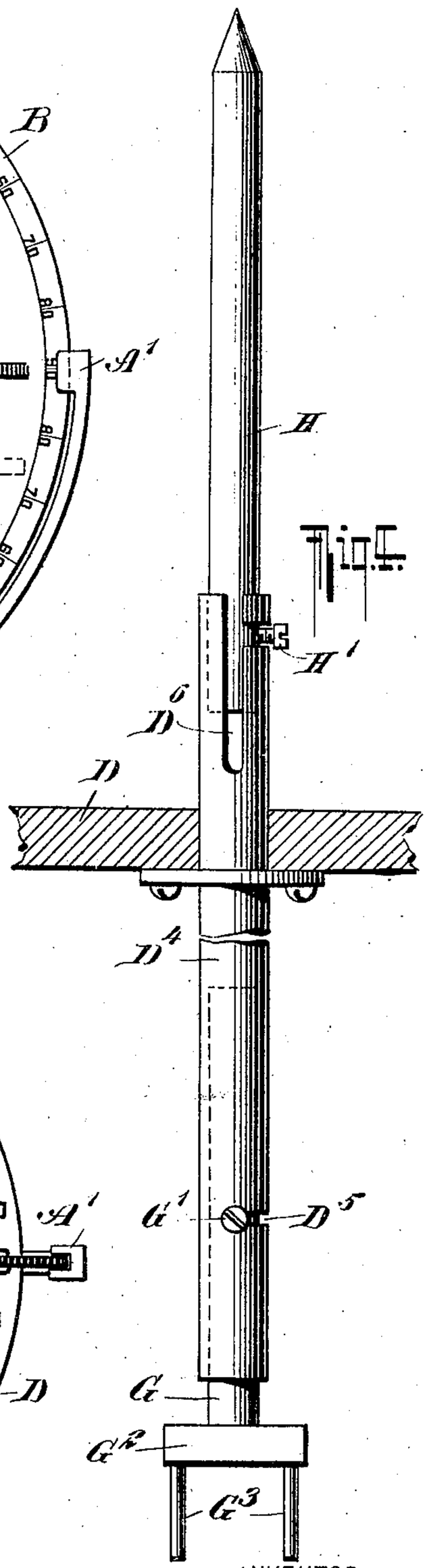


Fig. 4.



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ARMILLARY SPHERE.

No. 855,226. Specification of Letters Patent. Patented May 28, 1907.

Application filed September 27, 1906. Serial No. 336,437.

To all whom it may concern:

Be it known that I, FRANK L. BRYANT, a citizen of the United States, and a resident of the borough of Brooklyn, county of Kings, city and State of New York, have invented certain new and useful Improvements in Armillary Spheres, of which the following is a specification.

My invention relates to the educational appliance known as an armillary sphere, that is, an apparatus for illustrating certain astronomical phenomena, and particularly the relation of sun and earth at different seasons and under different latitudes.

The object of my invention is to provide a simple apparatus of the above-indicated character, which will quickly and readily illustrate the apparent motion of the sun for any point of the globe and at any time of the year; as a special novel feature, my apparatus includes means for conveniently plotting shadow curves, that is curves such as are described on a horizontal surface by end of the shadow of a pole or like article.

Reference is to be had to the accompanying drawings in which

Figure 1 is a perspective view of my improved armillary sphere; Fig. 2 is a front elevation thereof; Fig. 3 is a top view; and Figs. 4 and 5 are details drawn upon an enlarged scale, with parts in section.

My improved armillary sphere comprises a base A of any suitable construction, provided with guides A′ in which the meridian circle B rests loosely so that it may be slid in either direction to turn about its own axis. This meridian circle is graduated from zero points to 90° on both sides. Secured to the meridian circle, at right angles thereto, are sun-path circles of which I prefer to employ three; one of them, C, the diameter of which is about equal to that of the meridian circle B, is located at the zero points of the meridian circle, the other two, C′, C², are of a smaller diameter and located at the points of the graduation marked $23\frac{1}{2}°$. Each of the sun-path circles C, C′, C² is divided by marks *c* into twenty-four equal parts, corresponding to the hours of the day, and if desired, smaller subdivisions may be provided. The central sun-path circle C has means for pivotally supporting a horizon-disk D. This means may consist of two brackets or bearing blocks E secured to the circle C at diametrically opposite points, half-way between the points at which said circle is connected with the meridian circle B; these blocks receive screws F having their ends fitted loosely (that is, not screwed) into openings D′ of the horizon disk. These openings are practically in the plane of the horizon-disk, and by engaging the screws F with them, said disk may be pivotally supported in a central position within the space inclosed by the several circles.

For a purpose fully explained hereinafter, the horizon-disk D may be dropped from its central position, and to enable this to be done, it is provided with upward brackets D² having holes or sockets D³ adapted to be engaged by the ends of the screws F. Figs. 1 and 5 show the horizon-disk in the dropped position; Fig. 2 shows it in the central position in full lines, and also indicates the dropped position by dotted lines. It will be understood that by screwing the screws F in or out in the bearing blocks E, they may be engaged with, or disengaged from the horizon-disk, which in either of its positions is pivotally supported by said screws, which form pivot points.

In order to hold the horizon-disk D stationary, that is horizontal, I may secure to it a central tube D⁴ into which is fitted at the bottom a sliding rod G having a pin G′ arranged to move in a bayonet-slot D⁵ of the tube D⁴. The lower end of the rod G has a block G² with pins G³ adapted to fit into sockets A² of the base A and thus lock the horizon-disk D against pivotal movement. When it is desired to release said disk, the rod G and the parts secured thereto are raised and locked in their elevated position by turning the rod so that its pin G′ will reach the horizontal member of the bayonet-slot D⁵, as shown in Figs. 2 and 4. Fig. 1 shows the locking device dropped to its active position. It will be understood that the locking device may be dropped to engage the sockets A² whether the horizon-disk is in the central position or in the lowered position.

In order that the meridian circle B and the sun-path circles carried thereby may be adjusted accurately, I may provide a pointer H carried by the horizon-disk D centrally and arranged to indicate the zenith point on the graduation of the meridian circle B. In

order that the end of the pointer may be close to the meridian circle whether the horizon-disk D is in the central or the lowered position, I have made the pointer H extensible by fitting it to slide in the upper portion of the tube D^4 and providing it with a pin H′ adapted to rest either at the lower end or in the lateral member of a bayonet-slot D^6. The vertical distance between said lower end and the lateral branch of the bayonet-slot D^6 is equal or approximately equal, to the vertical distance between the sockets D′ and D^3.

For most purposes, the apparatus is used with the horizon-disk D in the central position as shown in Fig. 2. The meridian circle B and the sun-path circles C, C′, C^2 are adjusted for the intended latitude by slipping the meridian circle in its guides A′ until the pointer H indicates such latitude on the graduation of the meridian-circle B. Thus when the apparatus is adjusted to show conditions at a point on the equator (latitude 0°), as shown in Fig. 2, the pointer H indicates 0° on the meridian circle B, and the sun-path circles extend vertically, or perpendicular to the plane of the horizon-disk D. It will be seen that in this case the portion of each sun-path circle above the horizon-disk (that is, the day portion of such circle) is equal to the portion below the horizon-disk, thus indicating that at the equator day and night are of equal length all the year around. The central circle C indicates the path of the sun at the equinox, showing that twice a year the sun will rise to the zenith at the equator. By means of a graduation on the horizon-disk D having its 0° points adjacent to the pivots (east and west points) and running up to 90° on both sides (north and south points), it will be seen at a glance which is the greatest variation north or south from the east and west points that the sun will reach at the equator. The apparatus also shows that only at the equinox the sun will rise due east at the equator, and that this is true of every other latitude. The circle C′ illustrates the path of the sun at the summer solstice, and the circle C^2 shows the path of the sun at the winter solstice. The locking device may be dropped to engage the sockets A^2 so as to hold the horizon-disk stationary. By adjusting the apparatus in the guides A′, the conditions obtaining under various latitudes can be clearly demonstrated. Thus it can be shown that for any point of less than 23½° latitude the sun will reach the zenith twice a year; that for a point under 23½° latitude the sun will reach the zenith only once, at the time of one of the solstices; that at a latitude of 66½° there will be a day of 24 hours at one solstice and a night of 24 hours at the other solstice; that at any point north or south of the equator, day and night are of unequal length except at the equinox; that the farther away a point is from the equator, the farther the sun will rise and set from the east and west points respectively at the time of the solstices; and various other phenomena and conditions can be explained with great ease by the use of my improved apparatus, as will be evident to any teacher of astronomy and of mathematical geography.

One of the exercises which is recommended to students is the plotting of a so-called shadow curve, that is the curve which is described by the end of the shadow of a pole or like article. This exercise, if performed in the field, naturally takes a long time and my apparatus provides means for reproducing these conditions and thus enabling a shadow curve to be plotted in a very short time. For this purpose the horizontal disk D is dropped as shown in Fig. 1, the pointer H is removed from the tube D^4 and a guide J is inserted in the upper end of the tube, D^4; this guide J has a forked upper end J′ which is located exactly at the center of the meridian circle D, that is, in line with the screws F; the guide J which is capable of turning in the tube D^4 forms a support for a shadow tracing rod K. Various points of a shadow are ascertained by resting rod K upon the guide J and at the same time against one of the sun-path circles C, C′ or C^2. As illustrated in Fig. 1, the apparatus has been adjusted for a point of the Northern Hemisphere under about 40° of latitude, and the curve has been plotted for the longest day of the year, that is, at the summer solstice. Each of the black points indicates the position of the shadow's end at a different hour, and the points thus obtained are connected by a line as shown in drawing. The curve might be marked on the horizon disk D itself, but I consider it preferable to employ a sheet of cross section paper having the indications N. E. S. W. so that the sheet will be properly positioned on the horizon disk. The sheet may be held in position by friction or it may be secured by pins, thumb tacks, clamps or other devices.

I claim:

1. An armillary sphere, comprising a base, a meridian circle loosely supported thereon so as to be capable of being rotated about its own center in its own plane, sun-path circles extending at right angles to the meridian circle and connected therewith, an interior horizon member located within said circles, and means for pivotally connecting said horizon member with the largest sun-path circle at points equidistant from the connections of said circle with the meridian circle.

2. An armillary sphere, comprising a base, a meridian circle loosely supported thereon so as to be capable of being rotated about its own center in its own plane, sun-path circles extending at right angles to the meridian circle and connected therewith, an interior horizon member located within said circles, means for pivotally connecting said horizon member with the largest sun-path circle at points equidistant from the connections of said circle with the meridian circle, and a device for locking the horizon member to the base.

3. An armillary sphere, comprising a base, a meridian circle loosely supported thereon so as to be capable of being rotated about its own center in its own plane, sun-path circles extending at right angles to the meridian circle and connected therewith, a horizon member pivotally connected with the largest sun-path circle at points equidistant from the connections of said circle with the meridian circle, and a device for locking the horizon member to the base.

4. An armillary sphere, comprising a base, a meridian circle loosely supported thereon so as to be capable of being rotated about its own center in its own plane, sun-path circles extending at right angles to the meridian circle and connected therewith, a horizon disk located within said circles and means for pivotally connecting said disk with the largest sun-path circle at points equidistant from the connections of said circle with the meridian circle.

5. An armillary sphere, comprising a base, a meridian circle loosely supported thereon so as to be capable of being rotated in its own plane, sun-path circles extending at right angles to the meridian circle and connected therewith, a horizon member, and means for pivotally connecting said member, at different levels, with the largest sun-path circle at points equidistant from the connections of said circle with the meridian circle.

6. An armillary sphere, comprising a base, a meridian circle loosely supported thereon so as to be capable of being rotated in its own plane, sun-path circles extending at right angles to the meridian circle and connected therewith, a horizon disk located within the said circles and provided with superposed sets of sockets, and pivotal supporting means adapted to engage either of said sets of sockets and located on the largest sun-path circle at points equidistant from the connections of said circle with the meridian circle.

7. An armillary sphere, comprising a base, a meridian circle loosely supported thereon so as to be capable of being rotated in its own plane, sun-path circles extending at right angles to the meridian circle and connected therewith, a horizon member provided with superposed sets of sockets, and retractable pivotal supporting means adapted to engage either of said sets of sockets and located on the largest sun-path circle at points equidistant from the connections of said circle with the meridian circle.

8. An armillary sphere, comprising a base, a meridian circle loosely supported thereon so as to be capable of being rotated in its own plane, sun-path circles extending at right angles to the meridian circle and connected therewith, a horizon member having superposed sets of supporting points, and pivotal supporting means adapted to hold said member either in a central or in a lowered position and located on the largest sun-path circle at points equidistant from the connections of said circle with the meridian circle.

9. An armillary sphere, comprising a base, a meridian circle loosely supported thereon so as to be capable of being rotated in its own plane, sun-path circles extending at right angles to the meridian circle and connected therewith, a horizon member having superposed sets of supporting points, pivotal supporting means adapted to hold said member either in a central or in a lowered position and located on the largest sun-path circle at points equidistant from the connections of said circle with the meridian circle, and an extensible pointer projected centrally from the horizon member at a right angle to the plane thereof, to indicate on the meridian circle.

10. An armillary sphere, comprising a base, a meridian circle loosely supported thereon so as to be capable of being rotated in its own plane, sun-path circles extending at right angles to the meridian circle and connected therewith, a horizon disk and means for pivotally supporting said disk at points above its plane, located on the largest sun-path circle at points equidistant from the connections of said circle with the meridian circle.

11. An armillary sphere, comprising a base, a meridian circle loosely supported thereon so as to be capable of being rotated in its own plane, sun-path circles extending at right angles to the meridian circle and connected therewith, a horizon disk, means for pivotally supporting said disk at points above its plane, located on the largest sun-path circle at points equidistant from the connections of said circle with the meridian circle, a guide mounted to turn and projected upwardly at the center of the horizon disk to the center of the meridian circle, and a shadow-tracing rod adapted to rest on said guide.

12. An armillary sphere, comprising a base, a meridian circle loosely supported

thereon so as to be capable of being rotated in its own plane, sun-path circles extending at right angles to the meridian circle and connected therewith, a horizon member pivotally connected with the largest sun-path circle at points equidistant from the connections of said circle with the meridian circle, and a locking device, slidable up and down relatively to said horizon member and arranged to hold the same stationary in relation to the base.

In testimony whereof I have hereunto signed my name in the presence of two subscribing witnesses.

FRANK L. BRYANT.

Witnesses:

JOHN LOTKA,

JOHN A. KEHLENBECK.