(No Model.)

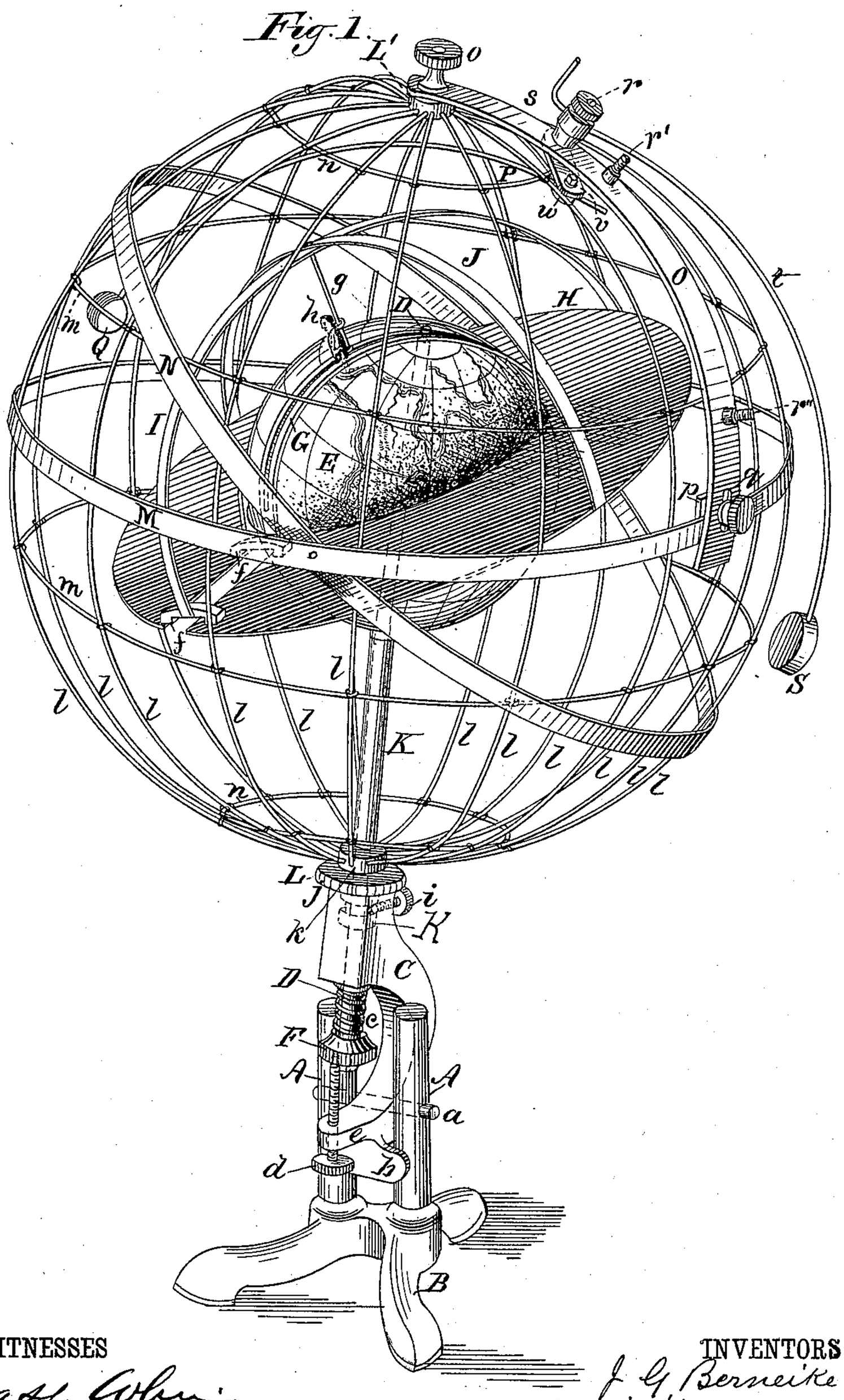
2 Sheets—Sheet 1.

J. G. & M. L. BERNEIKE.

TERRESTRO SIDEREAL SPHERE.

No. 320,999. Patented June 30, 1885.

Fig. 1.



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(No Model.) 2 Sheets—Sheet 2.

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TERRESTRO SIDEREAL SPHERE.

No. 320,999. Patented June 30, 1885.

Fig. 2.

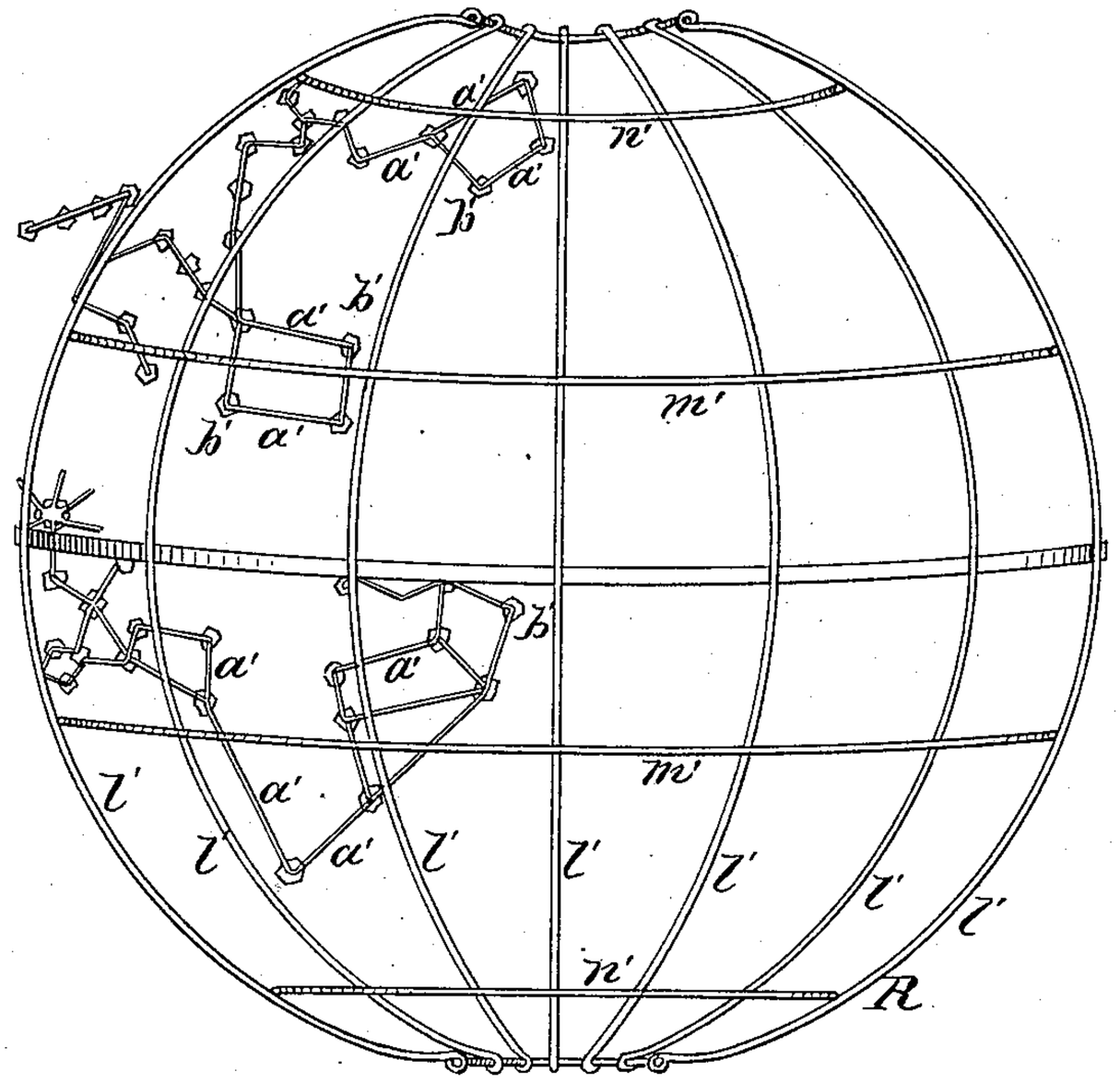
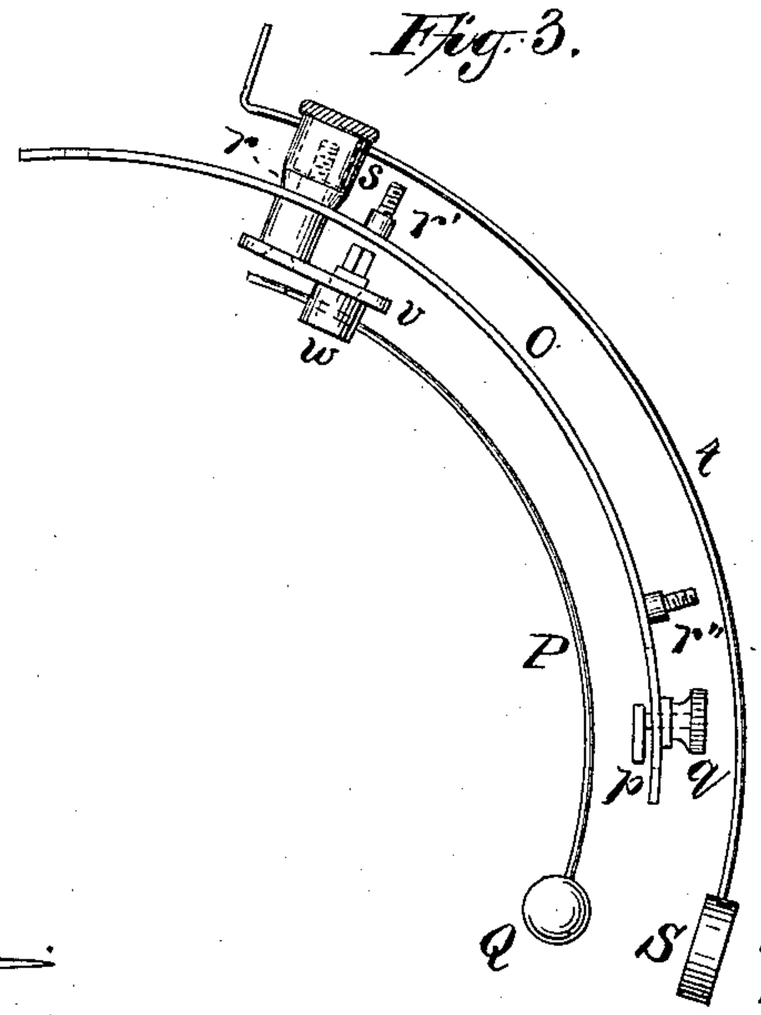


Fig. 3.



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TERRESTRO-SIDEREAL SPHERE.

SPECIFICATION forming part of Letters Patent No. 320,999, dated June 30, 1885.

Application filed March 31, 1884. (No model.)

To all whom it may concern:

Be it known that we, JOHANNES G. BERNEIKE and M. LOUISE BERNEIKE, residing in Brooklyn, in the county of Kings and State of New York, have invented a new and Improved Terrestro-Sidereal Sphere, of which the following is a specification, reference being had to the annexed drawings, forming a part thereof.

The object of our invention is to provide a simple and convenient apparatus for demonstrating certain facts and principles of astronomy, to present to the eye of the student illustrations of various celestial and terrestrial phenomena, and to show the relation between the observer and the portion of the heavens visible to him, also to represent certain imaginary lines drawn in the heavens.

Figure 1 is a perspective view of our terrestro-sidereal sphere. Fig. 2 represents one of the hemispherical frames supporting the stars, representing the constellations; and Fig. 3 is a detail view of the axes of the ecliptic and of the moon's orbit.

Similar letters of reference indicate like parts in the different figures of the drawings.

Between two standards, A, erected on the tripod B, is pivoted a curved arm, C, on a pin, *a*, passing through the said standards and arm. The arm C is provided with a stop, *b*, which limits the movement of the said arm in one direction to a vertical position.

A spindle, D, journaled in the arm C at right angles to its pivotal pin *a*, carries upon its upper end a terrestrial globe, E, and is provided at its lower end with a milled head, F, by which it may be turned, and between which and the curved arm C is placed a spiral spring, *c*, for giving to the spindle D a small amount of friction and to hold the globe in place. A set-screw, *d*, passing through an ear, *e*, projecting from the arm C, is capable of being brought into contact with the milled head F to bind it in any desired position. The spindle D is prolonged beyond the globe E, and is grooved circumferentially to receive a slotted meridian-bar, G, which both turns and slides upon the end of the spindle.

An annular horizon-plate, H, is secured to opposite ends of the meridian-bar G in a plane bisecting the globe E. One side of the horizon-plate H is slotted, and the adjacent edges are connected by bridge-pieces *f*, to enable the horizon-plate to be placed in the plane of the axes of the globe, the said slot receiving the sleeve K, while the bridge-pieces *f f*, reaching over the slot, hold the adjacent edges of the horizon-plate in proper relation to each other, and serve also to support the curved meridian-bars G and I.

A curved bar, I, representing the celestial meridian, is arranged parallel with the terrestrial meridian-bar G, and secured by its ends to the horizon-plate H. A curved bar, J, representing the prime vertical, intersects the curved bar I at right angles, and is attached to the movable horizon-plate H at diametrically-opposite points.

A wire, *g*, secured to the middle of the meridian-bar G, is connected with the curved bars I J at their point of intersection, and represents a radius of the earth extended to the observer's zenith. A figure, *h*, representing the observer, is connected by a swivel-joint to the wire *g*, around which it may be turned. The horizon-plate H may be turned in any direction upon the globe E, and always represents the horizon of the observer *h*.

On the spindle D, between the globe E and arm C, is placed a sleeve, K, which extends downward into an enlargement of the bearing of the spindle D in the arm C, and is grooved circumferentially to receive the end of a screw, *i*, which is received in the arm C, and retains the sleeve K in its bearing. A hub, L, attached to the sleeve K is provided with a milled flange, *j*, by which it may be turned, and with a boss, *k*, for receiving the lower ends of the meridian-wires *l*. The upper ends of the wires *l* are secured to a hub, L′, and the said wires, in connection with the horizontal wires *m* and *n*, representing tropic and arctic and antarctic circles, form a skeleton sphere, which envelopes the globe E and the horizon-plate H and parts attached thereto. The wires *l* are separated by spaces corresponding to two hours of time. A band, M, representing the celestial equator, is secured to the wires *l* in a plane at right angles to the axis of rotation of the hollow sphere, and a band, N, pivoted to the band M at diametrically-opposite points, represents the ecliptic.

A curved bar, O, of sufficient length to reach

from the hub L′ to the equatorial band M, is removably secured at one end to the hub L′ by means of a milled screw, *o*, and the opposite end is secured to the equatorial band M by a bolt, *p*, passing through a slot, *q*, in the bar O, and capable of clamping the said bar to the equatorial band M. Upon the curved bar O, twenty-three and one-half degrees from the celestial pole, is placed a pivot, *r*, coinciding with the pole of the ecliptic, and upon which is placed a sleeve, *s*. To the sleeve *s* is secured an arm, *t*, which extends ninety degrees from the pole of the ecliptic, and carries at its extremity a disk, S, representing the sun. The arm *t* and the sun S are capable of making a complete revolution around the hollow sphere. The pivot *r* is prolonged within the hollow sphere and forms the pivot of an arm, *v*, carrying at its outer end a stud, *w*, which is removed from the ecliptic pole five and one-seventh degrees, and coincides with the pole of the moon's orbit. An arm, P, secured to the stud *w*, extends through an arc of ninety degrees, and carries at its extremity a ball, Q, representing the moon. The stud *w* is squared on its outer end to receive a key, by which it may be turned so as to bring the moon into any desired position within the hollow sphere. The rotation of the arm *v* carries the stud *w* around the ecliptic pole, and illustrates the variation of the pole of the moon's orbit.

Two pivotal studs, *r′ r″*, removed from the pole of the heavens, respectively, twenty-eight and seventy degrees, serve to show what the effect of an increased inclination of the earth's axis would be, when the arm *t* is made to revolve on one of the said pivots. The stud *r′*, in its relation to the pole of the heavens, corresponds with the ecliptic pole of Mars, and the stud *r″* with the ecliptic pole of Venus, so that by changing the arm *t* to these studs the seasons of these planets may be illustrated.

Two hemispherical wire frames, R, adapted to the exterior of the hollow sphere provided with wires *l′*, separated by a distance representing two hours of time and connected by circumferential wires *m′ n′*, are secured to the hollow sphere, with the wires *l′* alternating with the wires *l*, so that the divisions of the celestial equator made by the wires *l* and *l′* correspond to hours of time. To the hemispherical frames R are secured wires *a′*, which outline the star figures of the constellations and carry metallic stars *b′*, which form the constellations. The frames R may be used independently of the hollow sphere, as celestial maps and charts, which may be viewed from the interior as a miniature copy of the celestial vault.

Our terrestro-sidereal sphere demonstrates:

First. The equinoctial, circles of declination, diurnal circles, the ecliptic, the tropics, the horizon, the celestial meridian, the prime vertical.

Second. Right ascension, declination, polar distance, longitude, latitude, altitude, zenith distance, azimuth, amplitude.

Third. Celestial poles, ecliptic poles, the equinoxes, the solstices, zenith, nadir.

Fourth. Apparent motions of heavenly bodies, daily westward motion of all, annual eastward motion of sun, revolution of circumpolar stars around the pole-star.

Fifth. The moon's revolution around the earth from west to east, its aspects, its phases, (increasing and decreasing,) its nodes, change of position of its nodes, cause of variation in its declination, why the full moon of winter reaches a high meridian altitude while the full moon of summer does not, why the polar regions have moonlight for each alternate two weeks in winter, what phases of the moon take place above the horizon at any time of the year for the polar regions, why we see the increasing crescent-moon in the west and the decreasing crescent in the east, that the pole of the moon's orbit moves around the ecliptic pole, inclination of the moon's orbit to the ecliptic, variation in its meridian altitude during its changes of phase, why the moon rises later each successive day, cause of the "harvest-moon," sidereal period of the moon, synodical period of the moon, terminator of the moon, "wet" and "dry" moon, why the full moon rises as the sun sets.

Sixth. The motions of the observer and his horizon as the true cause of the apparent daily motion of the heavenly bodies, that the rotation of the earth causes the observer's zenith to describe a circle every twenty-four hours, that the north and south points of the observer's horizon are fixed if he is at the equator, but revolve around the celestial poles if he is placed elsewhere, the motion of the celestial meridian from one hour-circle to another as the earth turns, the elevation of either pole as the observer travels toward it.

Seventh. Position of the horizon with regard to other circles and points to the heavens, that it is parallel to all diurnal circles if the observer is at either pole and oblique to the diurnal circles if the observer is between the equator and the poles, and perpendicular to the diurnal circles if the observer is at the equator, the variation in the inclination of the ecliptic to the horizon as the earth turns, that the equinoctial and horizon maintain the same angle during the earth's rotation, that the altitude of the visible pole is equal to the latitude of the observer, that the width of the circles of perpetual apparition and perpetual occultation are respectively equal to the observer's latitude, that the declination of an observer's zenith is equal to the latitude of his place.

Eighth. The sun and the rotation of the earth, the cause of day and night, cause of constant day and night near the poles, cause of six months day and six months night at the poles, the approximate length of day and night for any latitude at any time of the year, that the length of day and night vary with the declination of the sun, the sidereal day, the solar day, why the solar day is longer than the sidereal day, the causes of variation

in the length of the solar day, the cause of variation in the declination of the sun, the cause of variation in the meridian altitude of the sun during the year, the cause of the difference in the length of twilight at different latitudes, the day of the astronomical clock, its beginning and end.

Ninth. Position of the ecliptic, the angle which it makes with the equinoctial, cause of the seasons, effect of a change in the position of the ecliptic, seasons for other planets.

Tenth. The elongation of a planet.

Eleventh. Aspects of the planets.

Twelfth. Eclipses of the sun, their greatest and least numbers.

Thirteenth. The sidereal year.

Fourteenth. The zodiac.

Fifteenth. The chief constellations.

We claim—

1. The combination, with the globe E, of a pivot corresponding with the prolongation of the polar axis of the globe, and a slotted meridian-bar, G, carrying a figure representing the observer, the slotted meridian bar being capable of sliding upon the said pivot to allow the figure representing the observer to stand at the pole, as herein specified.

2. The combination, with the horizon-plate H, of the curved bars I J, crossing each other at right angles, the meridian-bar G, and a wire, *g*, extending from the said curved bars to the meridian-bar G, and representing a radius of the earth extended to the observer's zenith.

3. The combination, with the globe E and spindle D, of the sleeve K, and a hollow sphere composed of wires *l l*, *m m*, and *n n*, as described.

4. The combination, with a hollow sphere formed of wires *l m n*, as described, of the equatorial band M and the ecliptic band N, pivoted to the said bar M at diametrically-opposite points.

5. The combination, with a hollow sphere, constructed as herein described, of a curved bar, O, supporting a pivot, *r*, representing the pole of the ecliptic, and a curved arm, *t*, and disk S, turning on the pivot *r*, as herein described.

6. The combination, with a hollow sphere, constructed as herein described, of the arm *v*, the pivot *r*, representing the pole of the ecliptic, and the stud *w*, representing the pole of the moon's orbit and carrying the arm P, and the ball Q, representing the moon, as described.

7. The combination, with the slotted horizon-plate H, of bridge-pieces *f*, and meridian-bars G I, substantially as and for the purpose herein described.

8. The combination, with the spindle D, of the spring *c*, milled head F, and binding-screw *d*, as described.

9. The combination, with a skeleton sphere formed of wires *l m n*, representing meridians and circles, of the hemispherical frame R, formed of wires *l' m'*, representing hour-circles and diurnal-circles, the wires *l'* alternating in position with the wires *l* when the said spherical frame R is placed upon the hollow sphere, as herein specified.

10. The combination, with the hemispherical frames R, constructed substantially as described, of wires *a'*, outlining the constellations, and stars *b'*, representing the constellations, as herein described.

JOHANNES G. BERNEIKE.
M. LOUISE BERNEIKE.

Witnesses:
WILLIAM M. ZIMMERMANN,
FRANK ZIMMERMANN.