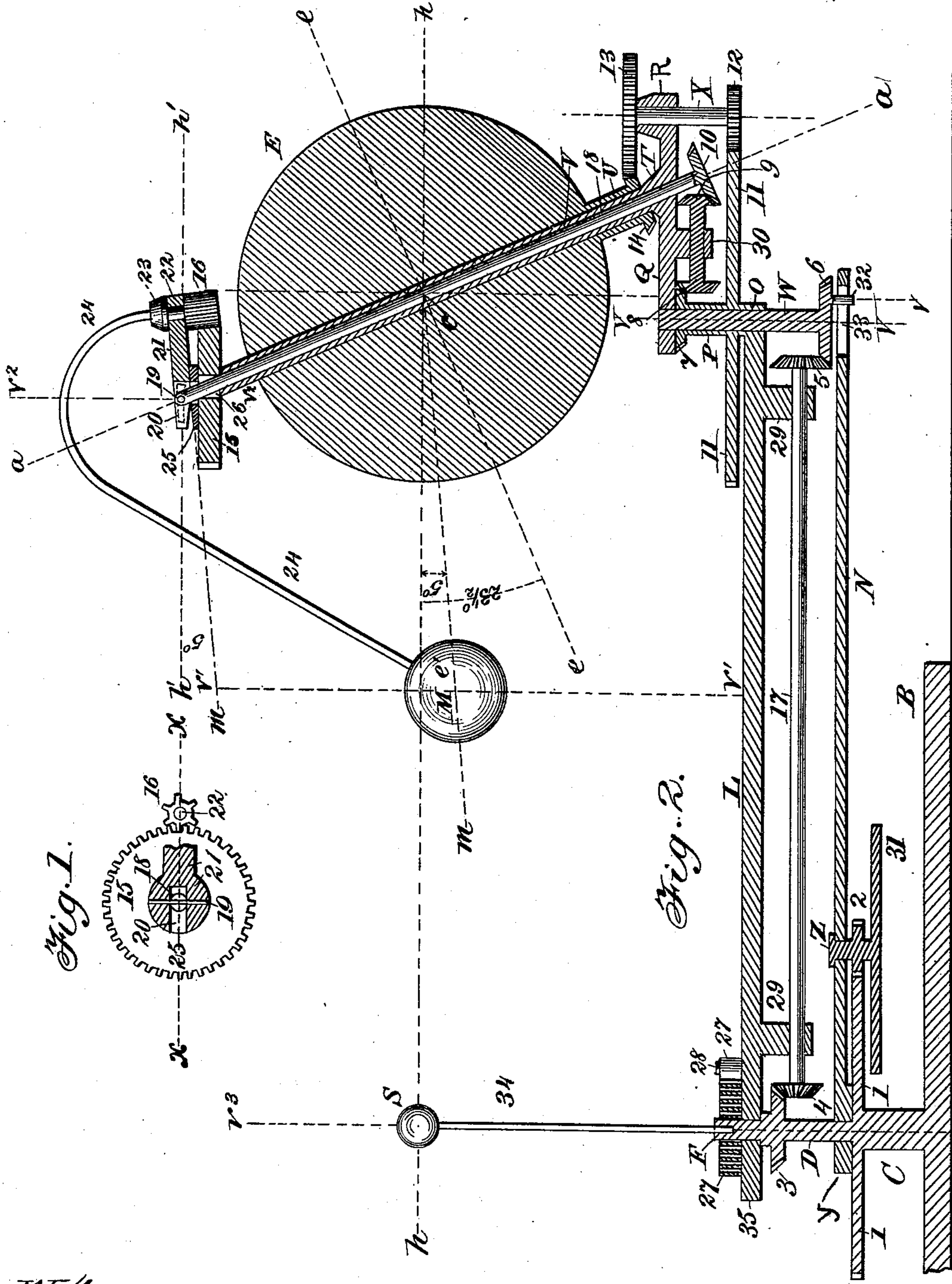
(No Model.) 3 Sheets—Sheet 1.

S. M. REAVIS.

TELLURIAN.

No. 469,719. Patented Mar. 1, 1892.



Witnesses:
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Hugo E. Carstens.

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(No Model.)

3 Sheets—Sheet 2.

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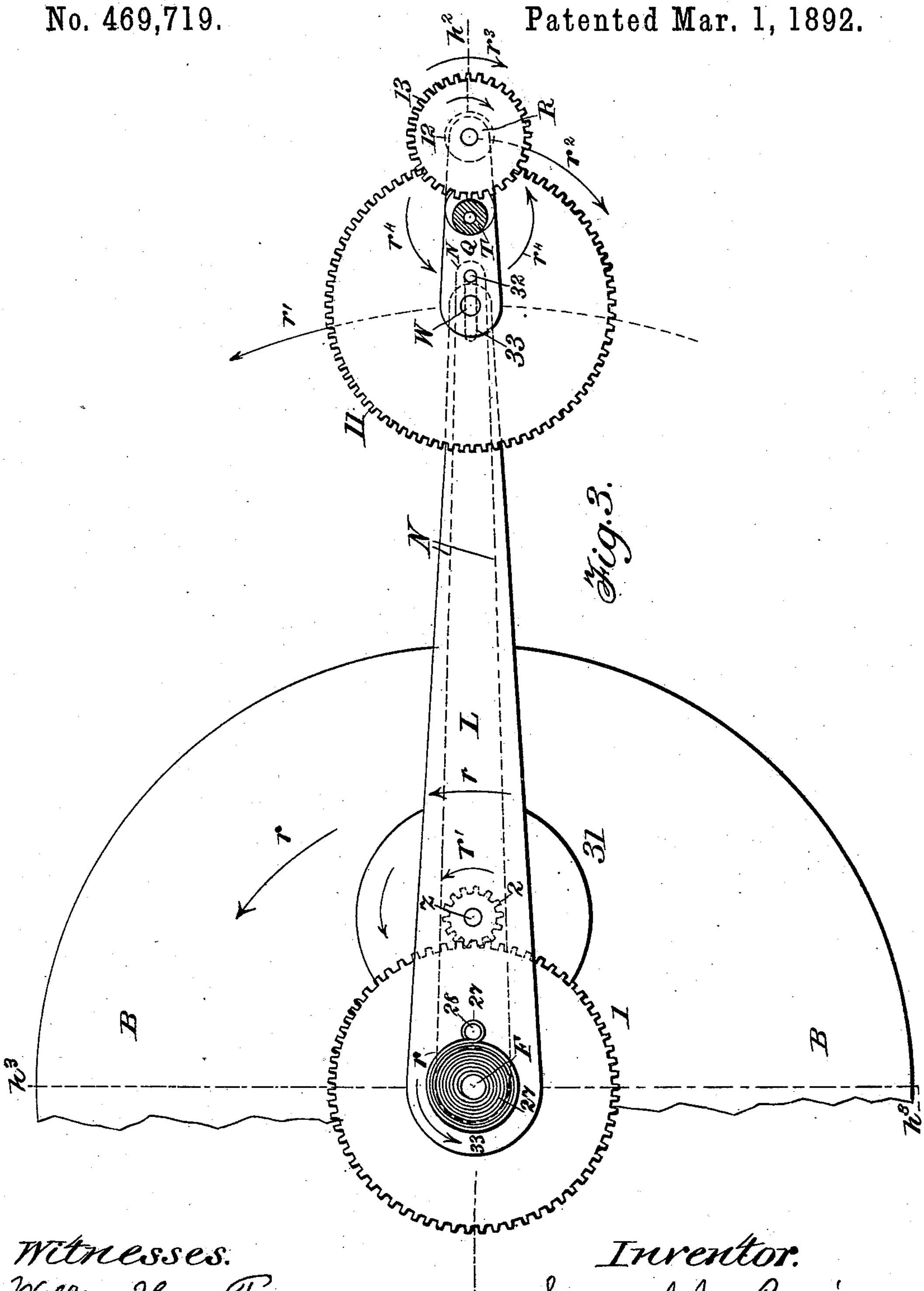

Fig. 3.

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(No Model.) 3 Sheets—Sheet 3.

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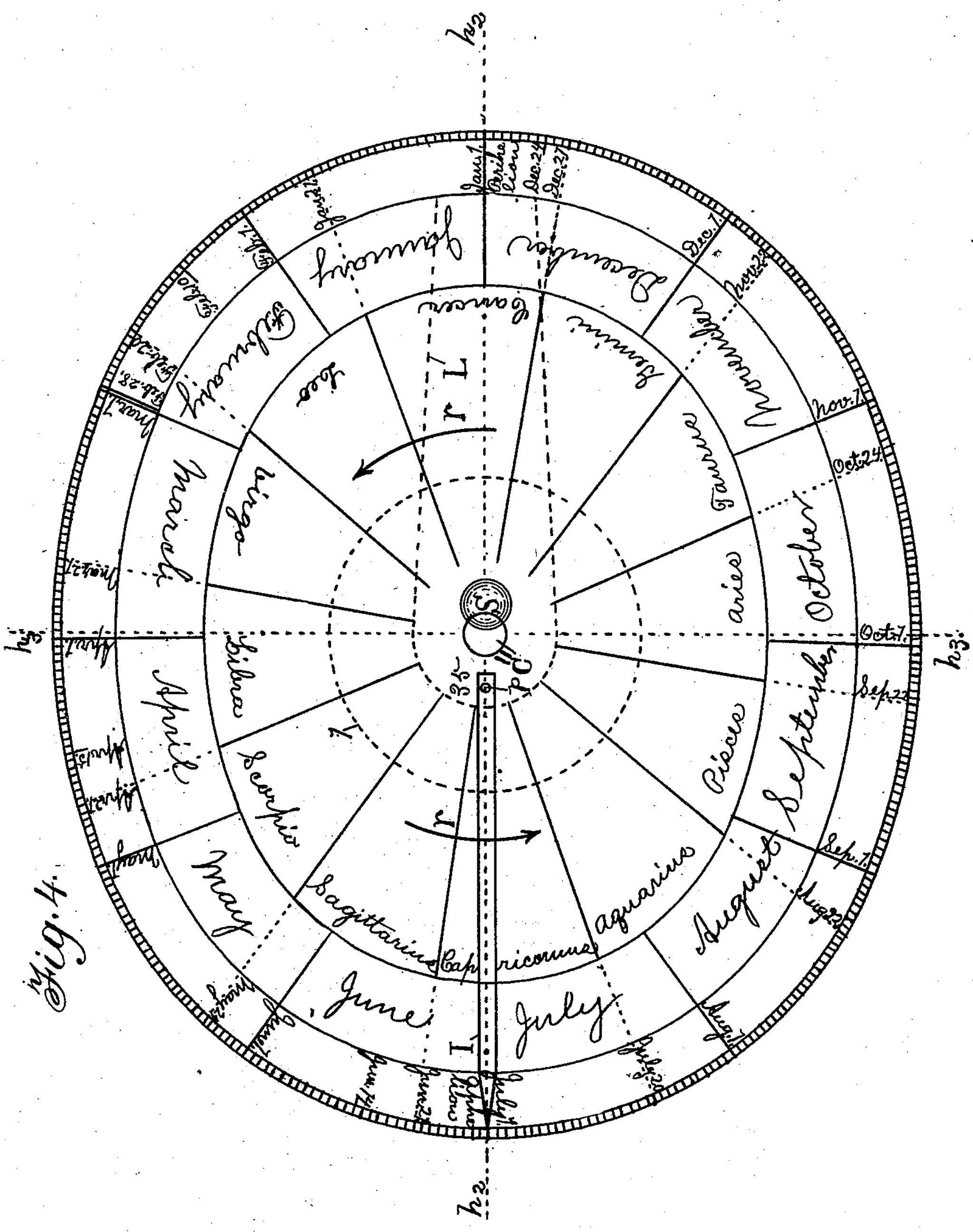

Fig. 4.

Witnesses

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UNITED STATES PATENT OFFICE.

SAMUEL M. REAVIS, OF FRANKFORT, INDIANA.

TELLURIAN.

SPECIFICATION forming part of Letters Patent No. 469,719, dated March 1, 1892.

Application filed July 30, 1890. Serial No. 360,429. (No model.)

To all whom it may concern:

Be it known that I, SAMUEL M. REAVIS, a citizen of the United States, residing at Frankfort, in the county of Clinton and State of Indiana, have invented certain new and useful Improvements in Tellurians; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to improvements in tellurians.

The object of my invention is to produce a tellurian which will be simple and inexpensive of construction, be durable, and which will be adapted to illustrate the greatest possible number of phenomena for the simplicity of its design.

Figure 1 is a plan view of a part of the device. Fig. 2 is a sectional view of the instrument along plane h^2 h^2 of Fig. 3. Fig. 3 is a plan view of the essential portions of the apparatus. Fig. 4 is a plan view of the base of the instrument on which diagrams and illustrations of times of events and motions of the earth are shown.

The same letters and numbers refer to the same parts in different figures.

S is the sun, E the earth, and M the moon.

For simplicity in showing and describing the construction and arrangement of connected and co-operating parts which are secured together and have no relative motion such parts are shown in Fig. 2 with common sectioning.

B is a base or support for the apparatus and has a flat top surface, on which illustrations and diagrams are shown.

C D is a column supporting the apparatus, and its axis passes through the sun S. The sun is supported on the top of the wire 34, which is secured in the end F of the column C D. The earth is supported and carried by the lever L, which is pivoted on the end F of the column C D, and moves in a horizontal plane about the vertical axis v^3 v^3 in the direction of the arrows *r r*, Figs. 3 and 4, which thus carries the earth around the sun in a direction from west to east.

The device is constructed to operate automatically and regularly, so that it will not require manipulation when used in lectures. A coiled spring 27, Figs. 2 and 3, is secured at one end to the top F of the column C D, and the other end is secured by the pin 28 to the lever L and is capable of turning the lever L about the pivot F in the direction of the arrows *r r*. Any suitable means may be employed for regulating the speed of rotation of the lever L under the force of the spring 27, as a pawl-and-ratchet device.

1 is a stationary spur-wheel on the column C, and 2 a pinion engaging the wheel 1 and supported on and turning with the bearing-pin Z, which is supported by a second lever N, pivoted to the column D by a boss Y, and which turns with the lever L by suitable connections.

31 represents a balance-wheel for controlling the speed of rotation about the column C D caused by the spring 27. Any other suitable speed-regulator may be connected to the bearing-pin Z for regulating the action of the spring 27 and the speed of the lever L.

The earth E is supported and carried by the crank-arm Q, which is secured to the upper end of the shaft W, that is held and turns in the boss O on the end of the lever L. The axis of rotation *a a* of the earth is inclined to the vertical line *v v* through the shaft W, so that the equatorial plane of rotation *e e* may be inclined twenty-three and one-half degrees to the plane of the earth's orbit *h h*, as shown in Fig. 2. The earth E is supported and turns on a sleeve V, shown made integral with or attached to the arm Q. A collar U, connected to the earth E, turns upon and about the lower end of the sleeve V and has a bevel-pinion 14, which engages the spur-wheel 13 on the shaft X, that is held and turns in the boss R on the end of the arm Q. The earth is rotated about its axis *a a* when the arm Q turns about the axis *v v* by the wheels 11 12 13. The spur-wheel 11 is connected to the boss O on the lever L and is stationary. When the arm Q turns about the axis *v v* in the direction of the arrow r^2, Fig. 3, the wheels 12 and 13 turn in the direction of the arrow r^3 and thus cause the bevel-pinion 14 and the earth E to rotate in the direction of the arrows r^4, Fig. 3, or from west to east. The arm Q is rotated by means of the bevel-wheels 3 4 5 6 and the shafts 17 and W. The shaft 17 is supported under the lever L by means of the lugs 29, and the shaft W is supported in the boss O on the end of the lever L. The bevel 3 is stationary, so that when the lever L carries the shaft 17 around with it the bevel 4 is caused to rotate, whence the bevels 5 and 6 rotate and cause the arm Q to turn in the direction of the arrow r^2, Fig. 3.

The apparatus so far described is designed to cause the earth to change its ecliptic inclination during the annular rotation of the earth around the sun. If the relative positions shown are those of the "1st of July," then on the "1st of January" the arm Q would project in the opposite direction relative to L, or toward the sun, and the earth's axis would then be inclined at the top away from the sun. When the bodies S and E come into the positions shown again, it will be the "1st of July" again, and the earth will have made an annual revolution. Consequently the operating mechanism must be proportioned so that the proper relative velocities will be given to the earth and moon in their motions about the sun.

The moon is revolved about the earth by means of the mechanism Q 7 8 9 10 18 21 22 24 15 16. The bevel 7 is secured to the hub P and is stationary. The bevels 8 and 9 are secured on the ends of a shaft carried in a bearing in the lug 30, cast to the under side of the arm Q. The bevel 9 drives the bevel 10 on the lower end of the shaft 18. The upper end 26 of the sleeve V is made square, and the spur-wheel 15 is thus secured thereon in a stationary manner.

21 is a lever pivoted by the pin 19 to the upper end of the shaft 18, so that its outer end may have a vertical movement.

16 is a pinion having a bearing 22 in the end of the lever 21.

23 is a nut, which secures the pinion 16 to the lever 21, and the wire 24, which supports and carries the moon, is secured in its top. The end of the shaft 18 plays freely in a slot 20 in the lever 21. A washer 25 is placed between the top surface of the wheel 15 and the under surface of the lever 21, and its upper surface is inclined at an angle of five degrees, as indicated by the dotted line m, which is parallel with the line c m through the centers of the earth and moon and which shows the inclination of the moon's orbit to the plane through the centers of the earth and sun, or to the earth's orbit. The washer 25 may be adjusted to show the precession of the moon's orbit. Since the washer 25 is made wedge-shaped, by turning it about the stem 18 it will raise or lower the lever 21 and hence vary the precession of the moon. Of course the washer is stationary, and as the relative positions of the earth and moon are constant a change in the position of the washer will throw the moon up or down. When the arm Q is rotated about the axis v v, the stationary bevel 7 causes the bevels 8 9 10 to rotate and thus the shaft 18, which causes the lever 21 to rotate about the axis v^2 v^2. Since the wheel 15 is stationary, the motion of the lever 21 causes the pin 16 to rotate and hence the moon to revolve around the earth.

The apparatus described is so arranged that the moon revolves about the earth from west to east. Since when the moon revolves about the earth it always presents the same side to the earth, it will make one rotation on its axis, although rigidly connected to the support 24, so that the instrument shows the rotation of both the earth and the moon. The sun is placed at S centrally over the pivot F, about which the lever L and the earth rotate. A small sphere may represent the sun, or any suitable light may be located at that point.

This instrument is capable of showing the variation of the earth's motion or velocity in its orbit during an annular revolution. A regular speed of the lever L and the axis v v about the axis v^3 v^3 is produced by the spring 27 and suitable regulating means, as the balance-wheel 31. Since the earth makes one revolution around the sun in one year, the shaft W rotates once in one year, since the pinions 3 and 6 are equal, and also the pinions 4 and 5, and causes the pin 32, attached to the bevel 6, to describe a circle in a year. Since the lever N is pivoted to the column D independently of the lever L, these two levers are free to be moved independently about the axis v^3 v^3. When the pin 32 is in the position shown, the lever L is directly over the lever N; but when the shaft W rotates the pin 32 presses against the side of the slot 33 in the lever N and tends to force the outer end of the lever N forward, or contrary to the direction of the arrow r^2, Fig. 3. The motion of the lever N is the correct motion of the earth about the sun with reference to rapidity and regularity through space. Pin 32 plays around and is the same distance from the center of the bevel 6 (or axis v v) as the center of the earth. The earth must come nearer to and go farther from the sun. In the position shown pin 32 is farthest from the sun. Then the center of the earth, being over pin 32 is farthest from the sun. A movement of ninety degrees from the position shown of bevel 6 will result in an increasing retardation of the lever N until the lever N is behind the lever L the distance of the pin 32 from the center of the bevel 6. During the following ninety degrees the lever N will be brought backward, gaining until at the point indicating "January 1," when the levers N and L are together. During the following ninety degrees the lever N is brought forward. During the final ninety degrees the lever N is retarded until it and the lever L are coincident, as at first, or in the position of "July 1." The counter effect of the lever N is that of pulling backward during the time that the pin 32 is within the circle described by the center of the bevel 6 about the axis D, and from October to March, inclusive, and that of pushing backward while pin 32 is without the circle described by the center of bevel 6 about the axis D, and from April to September, inclusive, but always serving as a retardation, and the intensity varying with the movement caused by the pin 32 moving under the impulse of the spring 27. This will allow pin 32 to move to and fro with reference to the sun and also travel with the lever N, and the earth will be kept in true position, as it is over pin 32. Remember, I could regulate the lever L; but the center of the earth would not always be over the center of that lever, so I apply a second lever and regulate it, and by so doing the earth will move with the lever and receive regularity. Such action would be effective and observable, since the yearly motion would take place within a short space of time when operating the instrument to illustrate the relative motions and positions of the sun, earth, and moon.

Fig. 4 shows the base of the instrument made with a flat top surface and an elliptical margin of the same shape as the orbit of the earth. The axes coincide with the lines h^2 h^2 and h^3 h^3, and the sun S is shown in the focus near "January 1."

C′ is the hole in the center of the base, in which the stud C, Fig. 2, is secured.

The sun is shown in the focus in Fig. 4 in order to show its relative position to the earth's orbit. The sun would be placed in the instrument vertically over the center of the column C, as shown in Fig. 2. Since the ellipse of the earth's orbit approximates closely to a circle, the base can be made circular, as in Fig. 3, and answer the purpose equally well.

The wheel 1 on the column C may be made as large as the disk B, Fig. 3, and serve both as a wheel and the part having the diagrams and illustrations shown in Fig. 4.

In the design of a base shown in Fig. 4 the margin is marked off into three hundred and sixty-five and one-fourth days. Within the margin are two ellipses concentric with each other and with the margin, and they are divided circumferentially into spaces. Lines drawn radially inward from the margin separate the said spaces from each other, and the radial lines mark the positions of the first day of each month, and the intervening space between two such adjacent lines shows the intervening month. The name of the month is placed in the space between the two adjacent radial lines and the inner ellipse, and the names of the days are placed in the space between the margin and the adjacent ellipse and just inside of the marginal row of day-marks. The name of each month and the figure "1" are placed by the radial line separating months and drawn from the marginal mark indicating the first day of the particular month. The names of other important days are also written in the marginal space at the marks denoting those days. Radial lines are drawn from the inner ellipse inward, forming twelve central spaces, in which the names or signs of the zodiac are placed.

The arrangement shown in Fig. 4 furnishes the longest line for the divisions denoting days and convenience of referring any day of any month to that month and to the whole year and places the signs of the zodiac in a less conspicuous place and also where they can be made large and more ornamental. The names of days, months, and signs are written in the spaces where they belong; but the base would be elaborately lettered and illustrated. The positions of the wheel 1 and the lever L are shown in dotted outline to show the relative positions of the parts and the amount of chart unobstructed by the apparatus. The arrows r r indicate the direction of the motion of the lever L and also the path of the earth in its orbit. Starting with "January 1," the earth would pass over the margin of the chart. By following the day-marks around all of the days of January will be passed and "February 1" reached. In that manner all days of the year may be passed over and the corresponding particular features and phases observed. Each month has its particular number of days, and the month of February is shown with one-fourth of a day over three hundred and sixty-five, which illustrates how in four years a complete additional day is added to the twenty-eight days of February. The days limiting the different periods of the zodiac are marked in the day marginal space, and radial lines are drawn from these marks inward, separating the contiguous spaces which represent the periods during which those signs are associated with particular portions of the year. An index I, Fig. 4, may be attached to the under side of the end 35 of the lever L and be bent downward over the wheel 1 and have its point pass over and near the day-marks on the margin of the base B. The index is shown in Fig. 4 pointing to the first day of July, which is the time of aphelion. Perihelion occurs January 1, and is marked on the margin of the base.

In using the instrument the spring 27 would cause the lever L and supported parts to rotate regularly around the pivot F in the direction of the arrow r and the pointer I would indicate the relative positions of the sun and earth in space during such motion and also the time of month and year, the chart and index being referred to in observing positions in space at certain times and the moving earth and moon being referred to in observing the motions of those bodies, since the pointer is at "July 1" when the earth is in the position of "January 1."

The essential features of this invention embodied in this instrument consist in a stationary central support supporting framing carrying the earth and moon and pivoted to the said support, stationary toothed wheels, and turning toothed wheels engaging the latter and mounted on proper shafts.

The drawings are made to a scale in which four inches equal one foot, and the proportions are intended to be practicable for construction and use. The mechanism must be designed with dimensions and speeds which will cause correct relative motions of the earth about the sun and the moon about the earth. If the bevels 3 and 6 have the same number of teeth and the bevels 4 and 5 have the same number, then the arm Q will rotate about the axis $v\ v$ in the same time that the lever L rotates about the axis $v^3\ v^3$.

In order to have the earth rotate once every twenty-four hours and make three hundred and sixty-five revolutions in one year, two hundred and ninety-two teeth would be made on wheel 11, twelve on pinion 12, one hundred and fifty on wheel 13, and ten on the bevel-pinion 14. In order to have uniformity of action between the shaft W and the lever L, the wheel 1 would have two hundred and ninety-two teeth also. In the figures the diameter of the earth is nine inches, that of the moon two and one-half inches, and the distance of the center of the sun from the center of the earth is twenty inches, and that of the moon from the earth nine and one-half inches.

The following phases and events are shown on the chart in Fig. 4: January 1, earth in perihelion; February, sun slowest, time later than clock-time; March 21, spring equinox; April 15, sun and clock coincide; June 14, sun and clock coincide; June 21, sun twenty-three and one-half degrees north of the equator; July 1, sun in aphelion; September 22, autumnal equinox; November 1, sun fastest; December 21, sun twenty-three and one-half degrees south of the equator; December 24, sun and clock coincide.

All phenomena due to the relative motions and positions of the sun, earth, and moon can be shown by means of the instrument in the hands of a lecturer.

I claim—

1. In a tellurian, the combination of a stationary support, a frame-lever pivoted to turn horizontally about its bearings, an integral boss at the extremity of the lever, having a vertical axis, a vertical shaft turning in the lever-boss and having an integral horizontally-projecting arm at its upper end, with its boss resting and supported on the end of the frame-lever boss, whereby it supports the connected shaft, a bevel-wheel on the end of the vertical shaft below the boss, a stationary bevel on the frame-lever support and concentric with its axis, and a horizontal shaft having a bevel-wheel on each end and supported by the frame-lever, one bevel on the horizontal shaft engaging the stationary bevel on the stationary support and the other bevel engaging and driving the bevel on the vertical shaft at the end of the frame-lever, and the rotation of the frame-lever about its pivot causing the described gearing to operate, substantially as set forth.

2. In a tellurian, the combination of a stationary support, a frame-lever pivoted to turn horizontally about its bearing, an integral boss at the extremity of the lever, having a vertical axis, a vertical shaft turning in the lever-boss and having an integral horizontally-projecting arm at its upper end, a toothed wheel at its lower end, a stationary toothed wheel secured directly to the frame-lever boss, a vertical shaft turning in a boss at the end of the projecting arm, a pinion on the lower end of the latter shaft, engaging the stationary wheel on the frame-lever, a wheel on the upper end of the same shaft, a pinion engaging the latter toothed wheel and connected to and arranged to rotate the earth-sphere, a horizontal shaft supported and carried by the frame-lever, having a toothed wheel at each end, and a stationary toothed wheel connected concentrically to the frame-lever support and engaging and driving the said mechanism intervening between it and the earth-sphere, substantially as set forth.

3. In a tellurian, the combination of a stationary support, a frame-lever pivoted to turn horizontally about its bearing, a boss at the extremity of the lever, a vertical shaft turning in the lever-boss, an arm secured to the top of the said shaft and projecting horizontally and having a boss at its outer end, a second vertical shaft held and turning in the end boss of the projecting arm, a toothed wheel on each end of the second shaft, a stationary toothed wheel secured concentric with and to the frame-lever boss and engaging the lower wheel on the second vertical shaft, a support for the earth-sphere, connected to the projecting arm of the first vertical shaft, a toothed wheel connected to the earth-sphere and engaging the upper toothed wheel on the second vertical shaft, a horizontal shaft carried by the frame-lever and having a toothed wheel at each end, and a stationary toothed wheel connected concentrically to the frame-lever support and engaging and driving the said mechanism intervening between it and the earth-support, substantially as set forth.

4. In a tellurian, the combination of a stationary support, a frame-lever pivoted to turn horizontally about its bearing and having a boss at its extremity, a vertical shaft turning in the boss and having connected thereto the earth-sphere support and also a toothed wheel, a stationary toothed wheel connected concentrically to the frame-lever support, a horizontal shaft carried by the frame-lever and having one toothed wheel at one end engaging the stationary toothed wheel and a toothed wheel at the other end engaging the toothed wheel on the vertical shaft, and a motor device connected to and arranged to automatically operate the frame-lever and connected apparatus, substantially as set forth.

5. In a tellurian, the combination of a stationary support, a frame-lever pivoted to turn horizontally about its bearing and having a boss at its extremity, a vertical shaft turning in the boss and having connected thereto the earth-sphere support and also a toothed wheel, a stationary toothed wheel connected concentrically to the frame-lever support, a horizontal shaft carried by the frame-lever and having one toothed wheel at one end engaging the stationary toothed wheel and a

toothed wheel at the other end engaging the toothed wheel on the vertical shaft, and a spring connected to the frame-lever support and to the frame-lever and arranged to automatically operate the frame-lever and connected apparatus, substantially as set forth.

6. In a tellurian, the combination of a stationary support, a frame-lever pivoted to turn horizontally about its bearing and having a boss at its extremity, a vertical shaft turning in the boss and having connected thereto the earth-sphere support and also a toothed wheel, a stationary toothed wheel connected concentrically to the frame-lever support, a horizontal shaft carried by the frame-lever and having one toothed wheel at one end engaging the stationary toothed wheel and a toothed wheel at the other end engaging the toothed wheel on the vertical shaft, a motor device connected to and arranged to automatically operate the frame-lever and connected apparatus, and a speed-regulating device constructed to operate as a dead-weight, connected to the frame-lever, and adapted to control the motion of the lever, substantially as set forth.

7. In a tellurian, the combination of a stationary support, a frame-lever pivoted to turn horizontally about its bearing and having a boss at its extremity, a vertical shaft turning in the boss and having connected thereto the earth-sphere support and also a toothed wheel, a stationary toothed wheel connected concentrically to the frame-lever support, a horizontal shaft carried by the frame-lever and having a toothed wheel at one end engaging the stationary toothed wheel and a toothed wheel at the other end engaging the toothed wheel on the vertical shaft, a motor device connected to and arranged to automatically operate the frame-lever and connected apparatus, and a speed-regulating device consisting of a lever pivoted to the frame-lever support, a pin on the toothed wheel of the vertical shaft at the end of the frame-lever, working in a slot in the extremity of the second pivoted lever, a stationary toothed wheel secured concentrically to the frame-lever support, and a pinion carried by the second lever and engaging the stationary wheel and having connected thereto a balance-wheel, substantially as set forth.

8. In a tellurian, the combination of a stationary support, a frame-lever pivoted to turn horizontally about its bearing and having a boss at its extremity, a vertical shaft turning in the boss and having connected thereto the earth-sphere support and also a toothed wheel, a stationary toothed wheel connected concentrically to the frame-lever support, a horizontal shaft carried by the frame-lever and having a toothed wheel at one end engaging the stationary toothed wheel and a toothed wheel at the other end engaging the toothed wheel on the vertical shaft, a stationary toothed wheel at the top of the boss on the end of the frame-lever, a horizontal shaft carried by the earth-sphere's support and having a toothed wheel at each end, an upright shaft supported by and having bearings in the earth-sphere's support and extending through the center of the earth-sphere and having a toothed wheel at its upper end, and means supported above the earth-sphere by the latter's support, capable of supporting and moving the moon, and the stationary toothed wheel on the frame-lever boss, driving the horizontal shaft, the upright shaft, and the moon-moving apparatus by means of their toothed wheels when the earth-sphere support is rotated, substantially as set forth.

9. In a tellurian, the combination of a stationary support, a frame-lever pivoted to turn horizontally about its bearing and having a boss at its extremity, a vertical shaft turning in the boss and having connected thereto the earth-sphere support and also a toothed wheel, a stationary toothed wheel connected concentrically to the frame-lever support, a horizontal shaft carried by the frame-lever and having a toothed wheel at one end engaging the stationary toothed wheel and a toothed wheel at the other end engaging the toothed wheel on the vertical shaft, a stationary toothed wheel at the top of the boss on the end of the frame-lever, a horizontal shaft carried by the earth-sphere's support and having a toothed wheel at each end, an upright shaft supported by and having bearings in the earth-sphere's support and extending through the center of the earth-sphere, a stationary toothed wheel secured to the top of the earth-sphere's support, a lever pivoted to the upper end of the said upright shaft, and a pinion at the extremity of the said lever for supporting and moving the moon, and the stationary toothed wheel on the frame-lever boss, driving the horizontal shaft, the upright shaft, and the moon-moving apparatus by means of their toothed wheels when the earth-sphere's support is rotated, substantially as set forth.

10. In a tellurian, the combination of an earth-sphere supporting and moving apparatus, an earth-sphere supported and moved thereby, an upright moon-apparatus-moving shaft extending through the earth-sphere, a stationary toothed wheel supported above the earth-sphere, a lever pivoted to the upper end of the upright shaft, a pinion at the extremity of the said lever for supporting and moving the moon, and means constructed in connection with the said pivoted lever for causing an inclination of the moon's orbit during the revolution of the moon about the earth-sphere, substantially as set forth.

In testimony whereof I now affix my signature in presence of two witnesses.

SAMUEL M. REAVIS.

Witnesses:

OWEN E. BRUMBAUGH,

JAMES T. HOCKMAN.