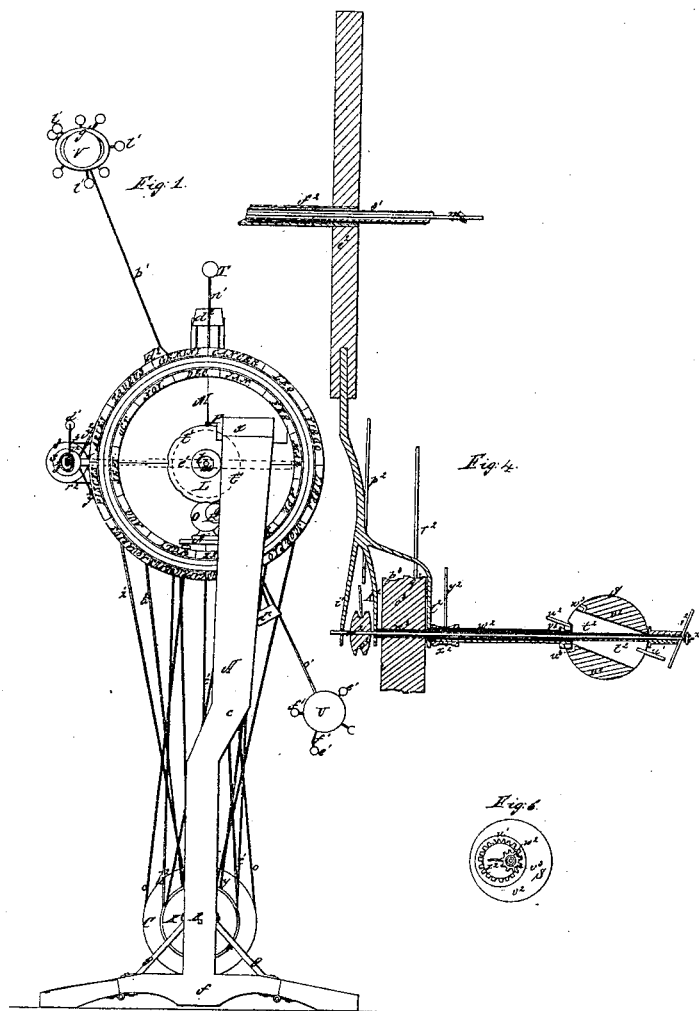


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PLANETARIUM.

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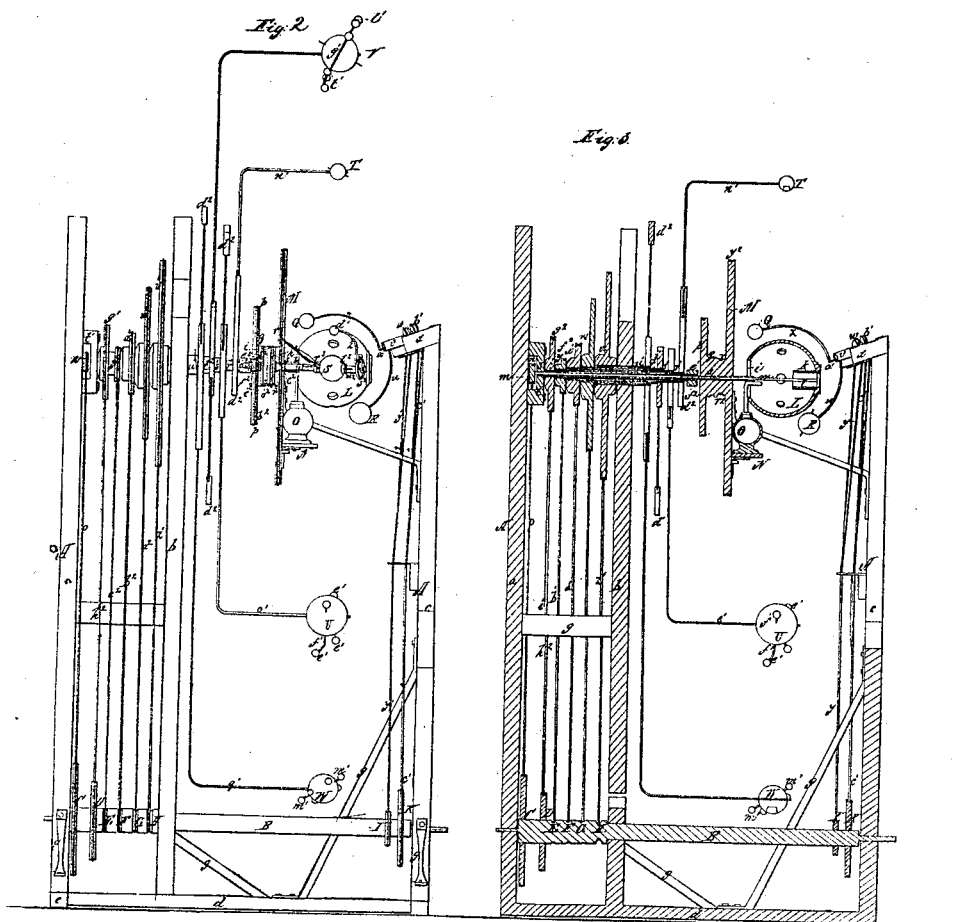
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UNITED STATES PATENT OFFICE.

BENJN. O. SWAIN, OF ANNISQUAM, MASSACHUSETTS.

PLANETARIUM.

Specification of Letters Patent No. 6,656, dated August 21, 1849.

To all whom it may concern:

Be it known that I, BENJAMIN O. SWAIN, of Annisquam, in the county of Essex and State of Massachusetts, have invented certain new and useful Improvements in Planetariums or Orreries; and I do hereby declare that the same are fully described and represented in the following specification and accompanying drawings, letters, figures and references thereof.

Of the said drawings, Figure 1 denotes a front elevation of my improved orrery. Fig. 2 is a side elevation of the same. Fig. 3, is a vertical central and longitudinal section of it.

Such other figures as may be necessary to illustrate the construction and operation of the several parts will be hereinafter referred to and described.

In the said drawings A represents the main stand or frame for supporting the operative portions of the mechanism, the said frame being composed mainly of the upright posts or standards *a b c*, and a base formed of a bar *d*, and two leg bars *e, f*, arranged as seen in the drawings; the members or elements of the said frame being strengthened by braces *g, g, &c.*

B is the driving or main shaft from which all the motions of the various parts are derived. The said shaft is disposed as seen in Fig. 3, and has its bearings in the three posts *a, b, c*, and is revolved by a crank affixed to one end of it. The said shaft has eight grooved pulleys or wheels C, D, E, F, G, H, I, K, affixed upon it, as seen in the drawings, the relative diameters of which are shown in Fig. 3.

L is a hollow glass globe intended to represent the sun. It is made about four inches in diameter, and with a circular opening *i*, about two inches in diameter through one end, and with a hollow tube or neck *h* extending inward from its opposite end, a plug or cylinder of wood *l* being inserted in the said tube or neck for the purpose of fixing the globe to the horizontal axis or shaft *m*, which has a grooved pulley *n* (about three quarters of an inch in diameter) on its rear end. Around said pulley *n*, and the large grooved pulley C, an endless band *o* passes, and conveys a rotary motion from

the driving shaft to the glass globe and its shaft.

M is a large circular disk or plate which together with three grooved wheels *p, q, r*, is fixed on a stationary tubular shaft *s*, which is fastened at its rear end to a bearing block *t*, attached to the rear upright post of the frame. The external periphery of the disk M is grooved for the purpose of receiving an endless band as will be hereinafter described. The said disk M I term the zodiac. On the front face of it the months are marked, and so as to correspond with the signs (which are also marked thereon) through which the earth moves during its passage around the sun. A circle *t'*, to represent the polar circle is marked on the fact of the zodiacal plate, and in or near that circle is placed a star P to represent the pole star, which is really on that side of the pole of the ecliptic marked the first point of Cancer. A stage or shelf N, is fixed to the zodiacal disk M, a spirit lamp O being placed on the said stage. The wick tubes of the said lamp are bent so as to extend into the glass globe which represents the sun, they being carried through the circular aperture of its end next to the zodiacal plate. The object of the lamp is to illuminate the glass globe.

The inferior planets Mercury, and Venus, are seen at Q, R, respectively. They are arranged and made to revolve around the glass globe or sun as follows.

The planet Venus or R is fixed to the end of a bent rod or arm *u* which is made to extend from a short tubular shaft *v*, which is supported in suitable bearings in an inclined piece of wood or block *x* fixed in the top of the post *c*, and has a grooved pulley *w* one inch in diameter fixed upon it. An endless band *y* passes around the pulley *w*, and the grooved wheel I, before mentioned, and conveys motion to the shaft *v*, so as to cause the planet R, to revolve about the sun L.

The planet Mercury or Q, is mounted on a bent arm Z, which extends from a shaft *a'*, made to extend through the tubular shaft *v*, and to have a grooved pulley *b'*, fixed upon it in the position seen in the drawings. An endless band *c'* extends around the pul-

ley b' and the grooved pulley K, and is for the purpose of transmitting to the shaft a' a rotary motion so as to carry the planet Q about the sun L. The axis of the shaft a' is made to point directly to the center of the glass globe L, while that of the tubular shaft v , should be inclined to that of the shaft a' , and both are inclined in such manner as to cause each of the two planetary balls Q R, when put in motion around the sun L to cross the path of the ball representing the earth (to be hereinafter described) at or nearly at the proper angles, in other words to cause the respective inclinations of the orbits of the said balls or planets, to that of the ball representing the earth to be the same or nearly the same, as the inclinations of the orbits of the inferior planets with that of the earth.

We now come to speak of the earth and the superior planets, Mars, Jupiter, Saturn and Herschel.

The earth is represented at S, its satellite or moon being shown at d' . T denotes Mars, U Jupiter, its four satellites being seen at $e' e'$, &c., as affixed to wires f', f' , &c., extended from it. V denotes Saturn with its ring or belt g' and satellites $l' l'$, &c., while W represents Herschel with its satellites $m' m'$, &c.

Each of the balls denoting the planets, Mars, Jupiter, Saturn and Herschel, is supported on one of a series of bent arms or wires $n' o' p' q'$ which are respectively made to extend from tubular shafts $r' s' t'$, u' , which are disposed concentrically and upon one another as seen in Fig. 3. Each of the said shafts is provided with one of a series of grooved pulleys $v' w' x' y'$. Endless bands $z' a' b' c'$ extend around the pulleys and the peripheries of the pulleys H G F E. Each arm which supports the superior planets is extended some distance from its shaft in an opposite direction, and has a balancing weight d' affixed to it and arranged in such manner as to balance the weight of the planet on the other side of the shaft. The proportions of the diameters of the respective grooved pulleys, on the concentric shafts of the planets may be as represented in the drawings or thereabouts.

The arm e' which supports the earth, is fixed upon another tubular shaft f' , which plays within the system before mentioned and on that which supports the zodiacal disk in position. It has a grooved pulley g' fixed on the rear end of it, an endless band z' being carried around it, and the grooved pulley D.

Each of the balls which represent the planets Venus, Mars, Jupiter, Saturn; and Herschel, is made generally speaking in the same way as it is in other planetariums in common use, except that it has a plug of lead inserted in one side of it. Each of

the balls is made to turn or revolve freely on the bent end of its supporting arm, and so that the overweighted side or part of the ball may by the power of gravity always assume the lowest position during the circular path or passage of the ball around the sun L. The respective planetary balls above mentioned, including that of the earth, are all placed upon axes, each of which is arranged perpendicular to the plane of its orbit, which is a vertical plane. By means of suitable lines drawn upon the balls, the equator, Tropics, and polar circles may be represented on each, and so as to show the inclination of their respective axes to their orbits, the north pole of each being made to incline toward the right point of the zodiac. It will be evident that by suspending the balls (excepting the earth which is not so suspended) in the above described manner the parallelism of their axes will be preserved in any part of their passages around the sun. The satellites, except that of the earth, remain fixed to their planets, and revolve with them. The arm by which the earth is supported and revolved is made like a fork with three prongs, i^2, k^2, l^2 , as seen in Fig. 4, which represents a section of this arm, the earth and the shafts connected with it, and the prongs of the arm.

The two prongs $l^2 k^2$, support a shaft m^2 , which rests and turns in suitable bearings made in the outer ends of the said two prongs l^2, k^2 , and extends through a tubular shaft n^2 . There is a grooved pulley o^2 placed on the shaft m^2 . An endless band p^2 extends around the said pulley and the fixed or stationary grooved wheel p before mentioned.

The tubular shaft n^2 has a double grooved wheel or pulley o^3 placed upon it. The diameters of the wheels q, r , before mentioned are made to differ about three eightieths of an inch, that of the wheel r being the smaller. That of one of the grooves $p^3 q^2$ of the pulley o^3 , viz, the groove q^2 is made equal to the diameter of the smaller of the wheels q or r , while the diameter of the other groove is made as much smaller as the larger of the wheels q, r , is larger in diameter than the smaller one. An endless band r^2 is carried around one of the grooves of the pulley o^3 , and one of the wheels q, r , as seen in the drawings. On the outer end of the hollow shaft n^2 , an inclined circular index plate is attached. An inclined axle or cylindrical block t^2 is also fixed on the shaft, in the positions represented in the drawings, the axis of the said axle or block t^2 , being inclined to that of the shaft n^2 , and in such manner as to represent the inclination of the axis of the earth to the plane of its orbit, the said axis of the earth, being denoted by the wires u^2, u^2 , which extend in opposite directions from the center of the cylindrical

block or axle which block or axle is intended to make a part of the globe which represents the earth, the remaining part of said globe which is seen at v^2 being placed and made to revolve freely on it.

The upper end or opening of this revolvable part of the globe is provided with a gear w^3 , whose teeth project toward its center as seen in Fig. 5, which denotes an end view of the earth and shows the position of the pinion v^3 , which work into the gear w^3 . The said pinion v^3 is fixed on the end of a tubular shaft w^2 , which is placed and turns on the shaft n^2 and has a small pulley x^2 on its other end. A crossed endless band y^2 , passes around this pulley x^2 and the grooved periphery of the zodiacal disk before described. On the outer end of the shaft m^2 a bent arm z^2 is jointed. This arm supports and carries the ball d' which represents the moon. The said arm z^2 is hinged or jointed to the shaft in such manner as to allow it to be freely moved in a direction either toward or away from the pulley o^3 . The arm is also bent around the outer periphery or edge of the circular inclined index plate s^2 , as seen in Fig. 1. From the above it will readily be seen that when the shaft m^2 , is put in revolution, so as to cause the moon to travel around the earth S, it will be moved about the same in a plane parallel with that of the inclined index plate, whose inclination is made to represent that of the moon's orbit to the axis of the earth.

There are two points in the periphery of the inclined index plate, which must be equally distant from the center of the earth S. At these points I place the signs of the moon's nodes. The points of the periphery which are situated half way between the nodes must differ, the most in their distance from the earth. Consequently if when the arm z^2 is on one of the nodes, the moon is in the plane of the ecliptic, the moon must be either on one side or the other of that plane, whenever the arm passes beyond the node or either of the nodes, or is at any intermediate point on the index plate, and it must moreover be at its greatest distance from that plane when it reaches either of the points which are half way between the nodes. Consequently the little index plate, may be said to represent the plane of the moon's orbit. By watching the arm z^2 as it passes over the face of the index plate, it can at once be seen what the position of the moon may be at any time, whether she is at her nodes, or north or south of the ecliptic, and also how far north or south. By means of the rotation of the pinion v^3 , the earth is made to rotate on the cylindrical block or axle t^2 , and so as to exhibit its diurnal revolution on its own axis, its annual revolution around the sun being produced by the move-

ment of the arm e . By making the pulleys or grooves r and q^2 of equal diameters, and running an endless band on them, the axis of the earth will be made to maintain its parallelism, throughout the entire revolution of the earth about the sun. But by making a difference in the diameters of the other pulleys or grooves q , and p^3 as above stated, and running the endless band on them, we can illustrate the precession of the equinoxes, as the axis of the earth will not maintain its parallelism during its revolution about the same, but will gradually vary therefrom.

What I claim as my invention, and desire to secure by Letters Patent, is as follows:

1. I claim the arrangement of the orbits of each planetary ball, excepting those representing the earth and Mercury, in a vertical plane in combination with overloading one side or part of said ball, in such manner that the action of gravity shall operate to rotate the ball once during each revolution of it about the sun L, or in other words, preserve the parallelism of the axis of the ball throughout its entire revolution; the said improvement enabling me to illustrate the seasons at each of the planets excepting the earth and Mercury.

2. I also claim the method of applying the lamp so as to illustrate the globe L, the same consisting in arranging the lamp on the outside of the globe, and extending the wick tubes into and through an opening made in the globe and around its axis of rotation as specified.

3. I also claim the arrangement of the inferior planets and the mechanism for operating them, with respect to the sun, and the superior planets, and their operating mechanism, the said arrangement enabling me to get the inclined motions of the inferior planets, and by so doing to illustrate the doctrine of the transits. This arrangement consists in placing the machinery by which the inferior planets are moved on the opposite side of the sun L, to that on which the other planets and their operating machinery are disposed. The vertical zodiac is so arranged that the equinoctial points are in a horizontal line and the solstitial points in a vertical line. The "vernal" equinox being on the left the "autumnal" falls upon the right. The ascending node of Mercury, is in the last of the sign Taurus, or in that point of the zodiac which is reached by the earth on the ninth or tenth of November. The descending node is of course at the opposite point. The machinery which operates the planet Mercury carries it across the plane of the earth's motion at these points.

4. I also claim the combination of mechanism by which the annual and diurnal revolutions of the earth S are produced and by

which the parallelism of the earth's axis during its annual revolution is preserved, the said machinery consisting of the stationary grooved zodiacal wheel and endless
5 belt thereon, the forked arm e^2 , its supporting shaft and rotating mechanism, the pulley x^2 , tubular shaft w^2 , pinion v^2 , gear u^3 , cylindrical block t^2 , and shaft n^2 , pulleys r , q^2 and their endless band, the whole being

applied to the globe S, and made to operate 10 substantially as specified.

In testimony whereof I have hereto set my signature, this eighteenth day of December, A. D. 1848.

BENJ. O. SWAIN.

Witnesses:

C. W. EVERETT,
GUSTAVUS A. LAND.