No. 646,976. Patented Apr. 10, 1900.

G. S. GARDNER.

ASTRONOMICAL APPARATUS.

(Application filed July 30, 1898.)

(No Model.) 2 Sheets—Sheet 1.

FIG. 1

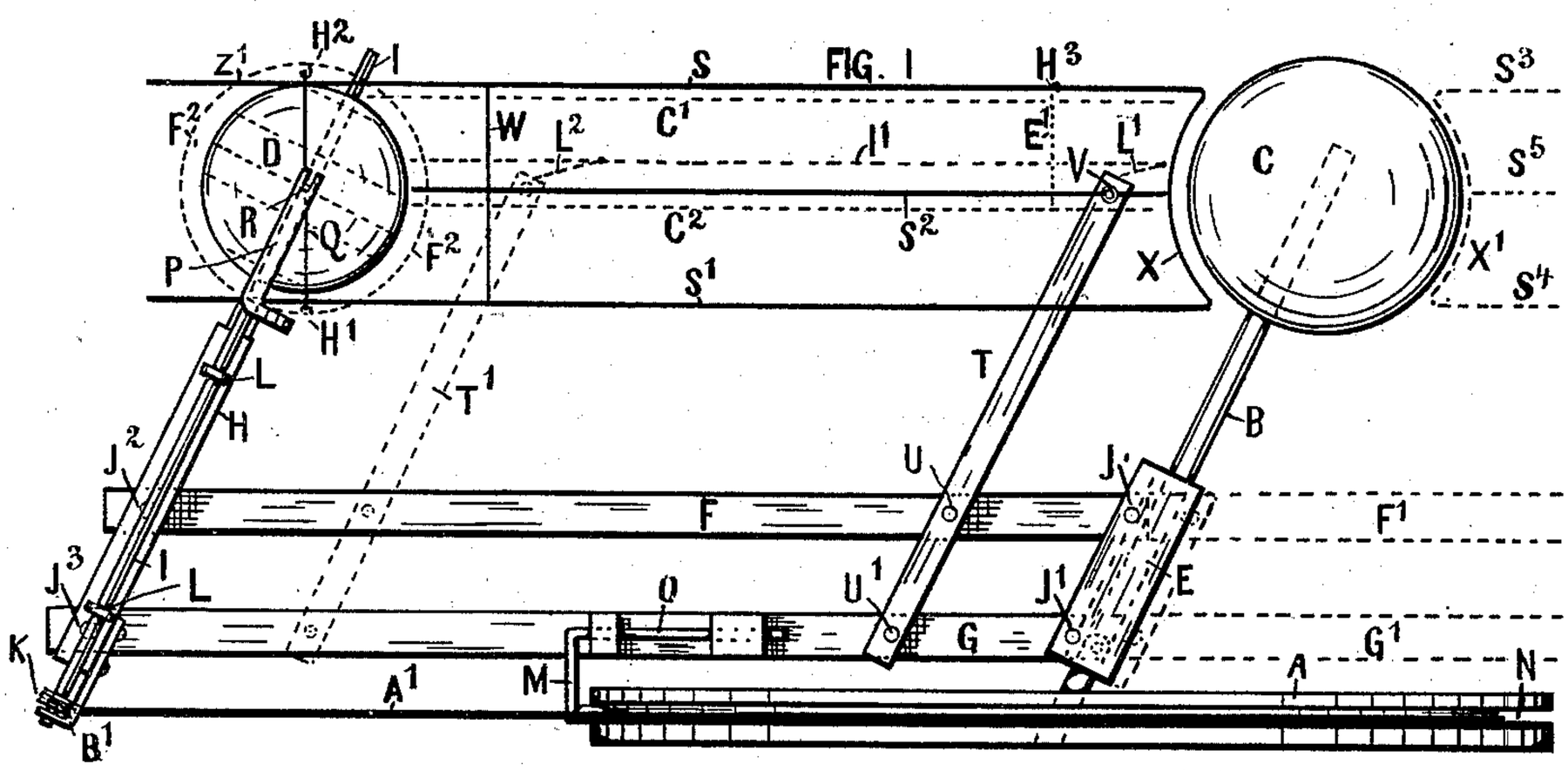

FIG. 2.

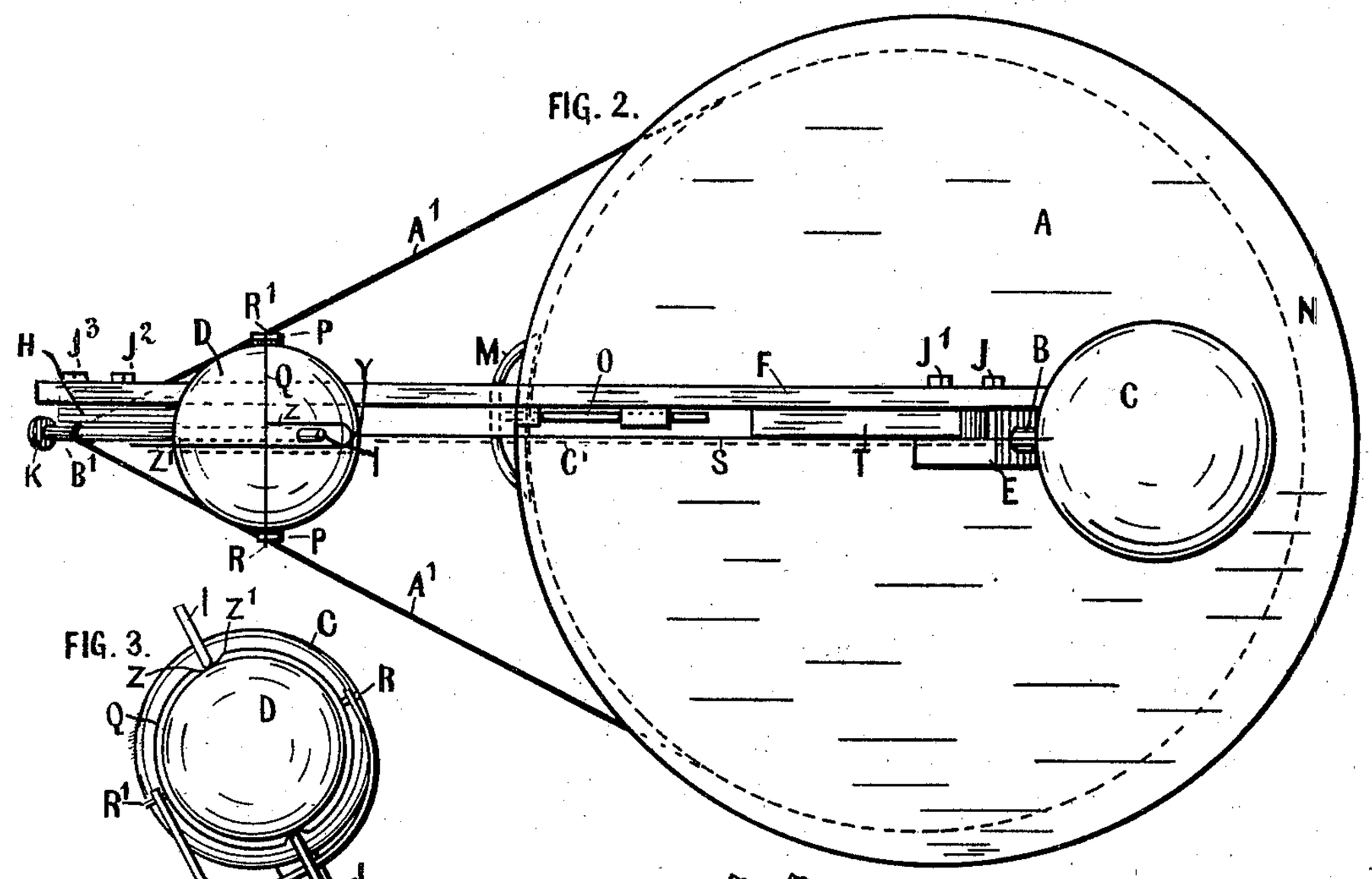

FIG. 3.

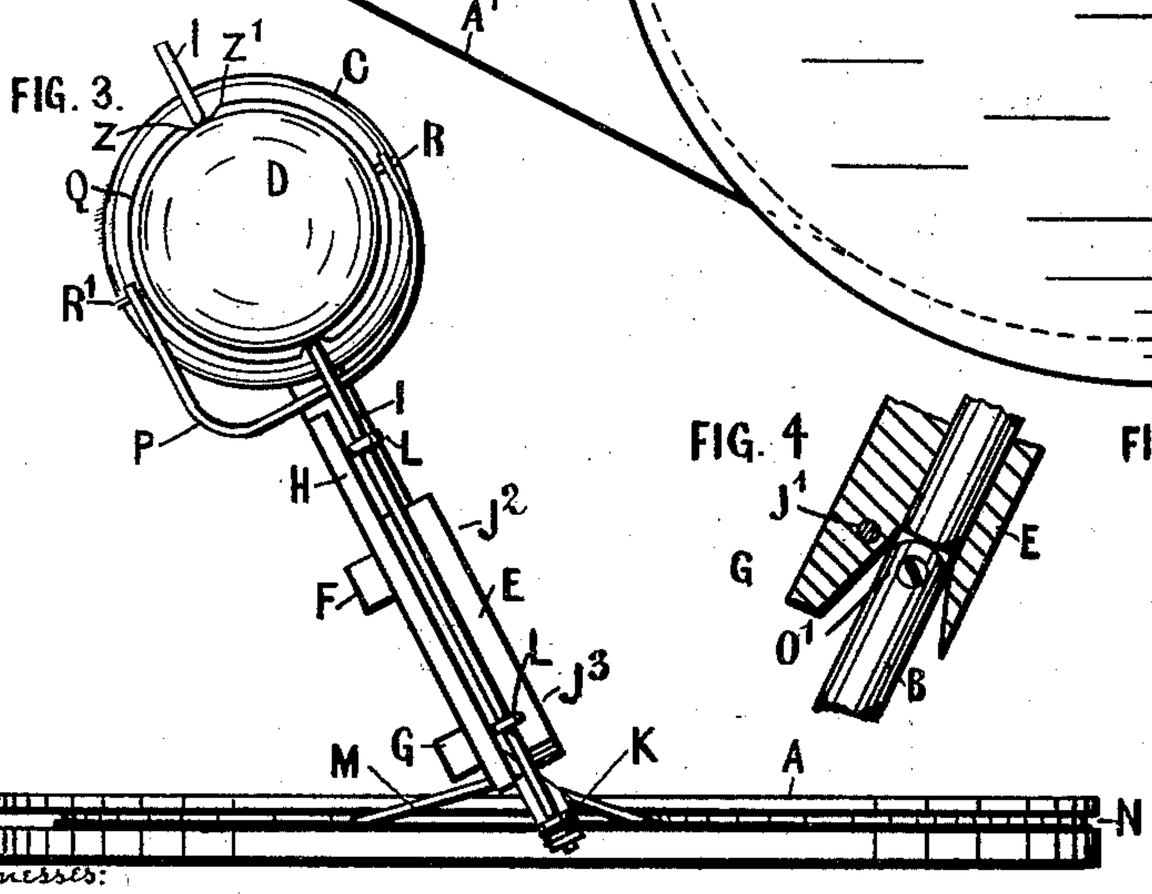

FIG. 4.

FIG. 5.

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FIG. 6.

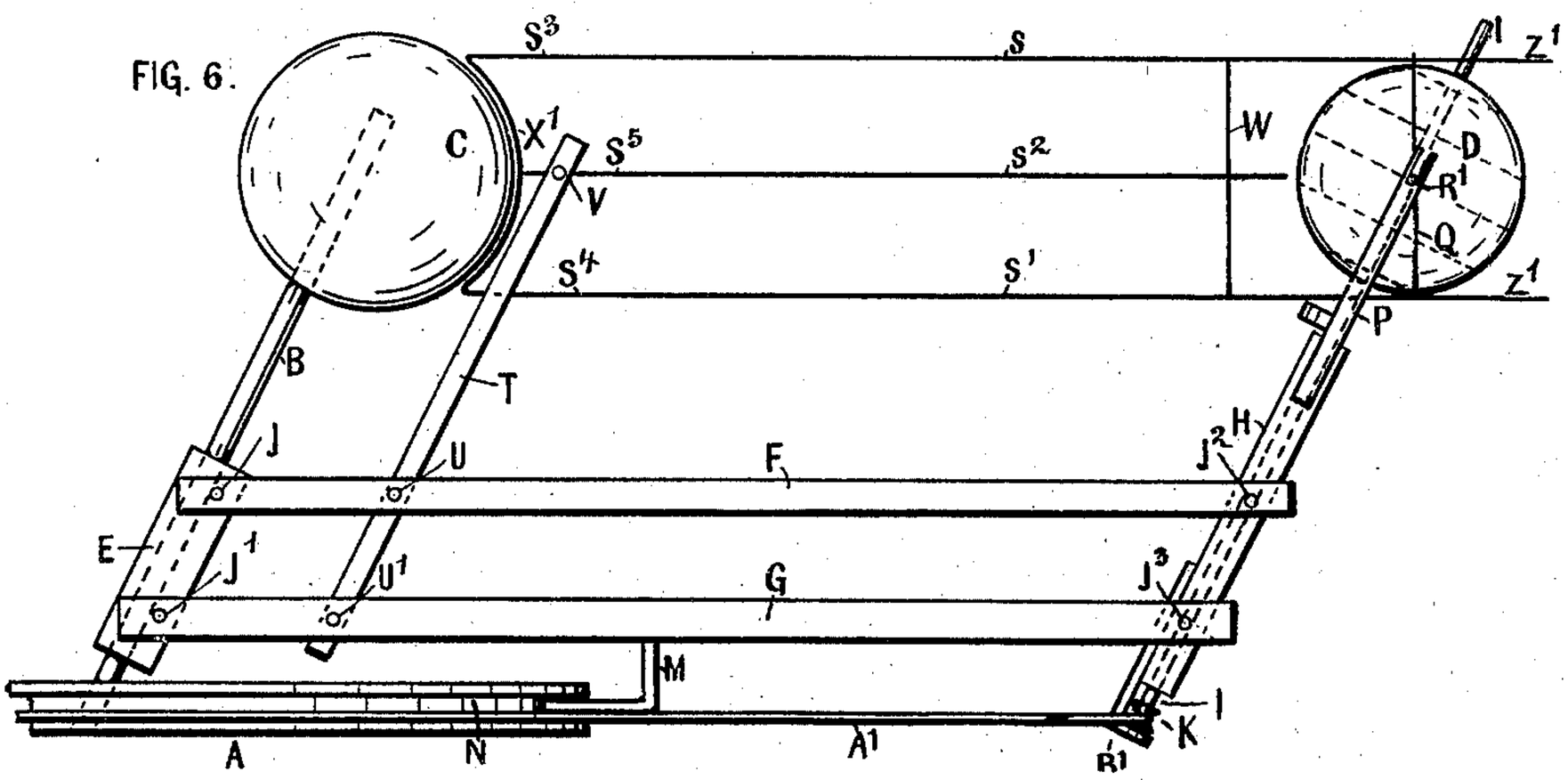


FIG. 7.

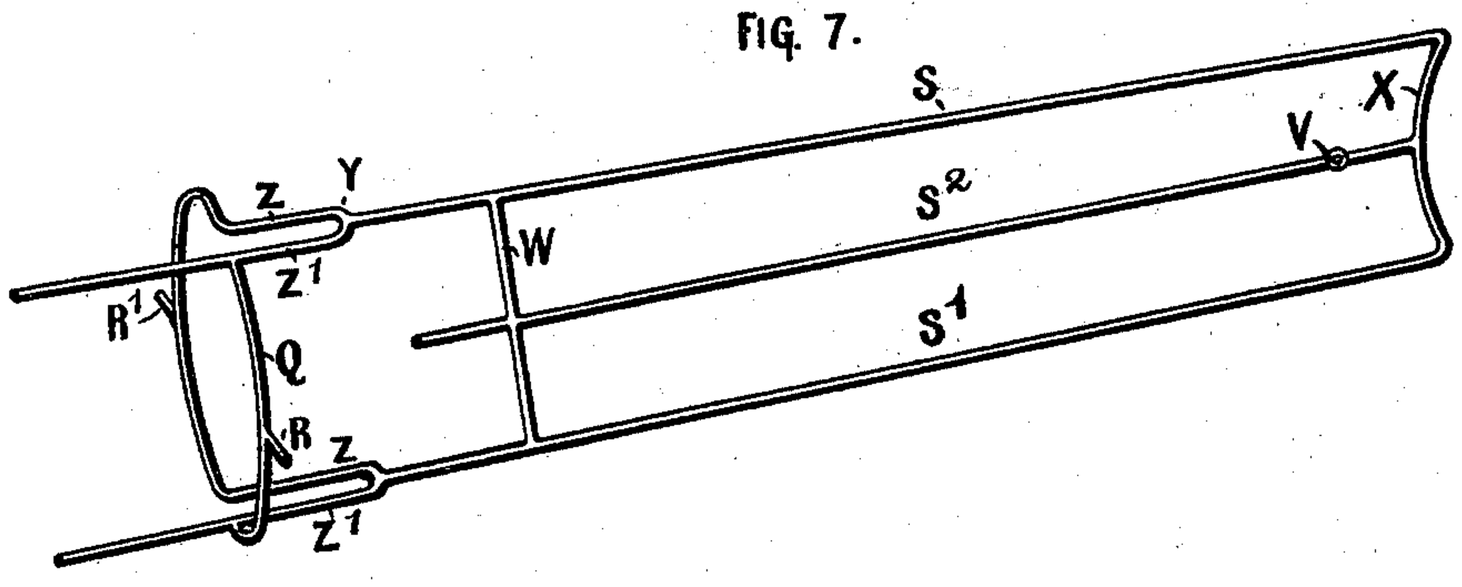
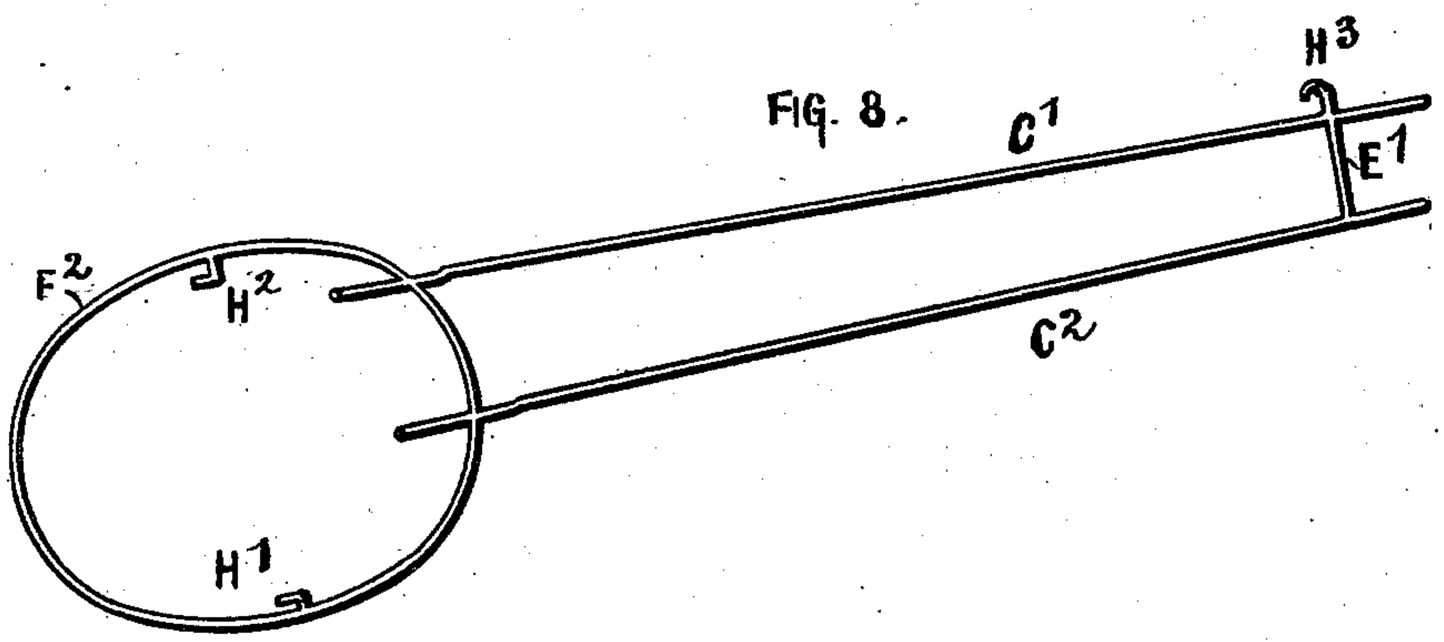


FIG. 8.



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UNITED STATES PATENT OFFICE.

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ASTRONOMICAL APPARATUS.

SPECIFICATION forming part of Letters Patent No. 646,976, dated April 10, 1900.

Application filed July 30, 1898. Serial No. 687,253. (No model.)

To all whom it may concern:

Be it known that I, GEORGE S. GARDNER, a citizen of the United States, residing at Rochester, in the county of Monroe, in the State of New York, have invented an Improved Astronomical Apparatus, of which the following is a specification, reference being had to the accompanying drawings.

My invention relates to an improved astronomical apparatus, which is fully described and illustrated in the following specification and the accompanying drawings, the novel features thereof being specified in the claims annexed to the said specification.

In the accompanying drawings, representing my improved astronomical apparatus, Figure 1 is a side elevation. Fig. 2 is a plan view. Fig. 3 is an end elevation representing the apparatus in position at right angles with Figs. 1 and 2. Figs. 4 and 5 represent the hinge-joint in the post of the sun-sphere. Fig. 6 is an elevation showing the parts in the position they occupy when the earth-globe has made half a revolution around the sun-sphere from the position shown in Fig. 1. Fig. 7 represents the day-and-night circle and the wires representing the sun-rays detached. Fig. 8 shows the atmosphere-circle and the wires representing the light-rays detached.

The object of my invention is to produce an apparatus to illustrate the laws regulating the change of the seasons and to point out clearly the climatic circles and the reasons for their situations. By my apparatus I am also enabled to show the change in the obliquity of the sun's rays at different seasons, the different effect of such obliquity on the intensity of the sun's heat, and the difference in the length of the day and the night. For these purposes my improved astronomical apparatus consists, essentially, of a suitable base, preferably circular, an inclined post inserted in the base at an angle of twenty-three and one-half degrees, a sun-sphere supported on the post, and a globe representing the earth, supported on a similarly-inclined axis and arranged to maintain such inclination during its revolution about the sun-sphere while carried by two parallel pivoted bars.

A represents the base, of any suitable material, circular in shape and provided with the circumferential groove N.

B is an inclined post projecting upward from the base near its center at an angle of twenty-three and one-half degrees. The post is firmly secured in the base, so that it does not revolve.

C is the sun-sphere, which is preferably removably supported on the top of the post.

D is a globe representing the earth, located at any suitable distance from the sun-sphere and supported by an inclined shaft or axis I, so as to revolve therewith. The axis I is parallel to the post B and remains so during its revolution around the sun-sphere. An arm H carries suitable journals L, in which the axis I revolves.

E is a central socket or sleeve which revolves freely on the post B.

F and G are two parallel bars pivoted at their inner ends to the sleeve E and at their outer ends to the arm H, which carries the axis of the globe. The inner pivots are shown at J J′, Fig. 1, as passing through the sleeve at one side of the post; but they are preferably so placed on the sleeve E that their central lines will be in the same plane as the central line of axis B. The outer pivots are shown at J^2 J^3. These joints are made in any suitable way, as by the bolts shown.

M is a guide attached to one of the bars and engaging in the groove N, so that the bars while revolving about the sun-sphere are caused to move in planes parallel with the base. Under these circumstances the axis I will remain always parallel with the post while revolving around it, and the axis of the globe will be all the time inclined to the plane of revolution at the proper angle. When the earth-globe is revolved about the sun-sphere, the arms F G turn slightly on their pivots J J′ J^2 J^3, and the axis I of the globe is always kept parallel to the post in whatever direction the arms may project outward from the post. The axis I and the sphere D are caused to rotate while traveling about the sun-sphere by the cord A′ and pulley K on the lower end of the axis. The cord A′ runs around the pulley K, being preferably crossed, as shown, and also around the base in the groove N,

which is made eccentric with the circumference of the base, as indicated by the dotted circle in Fig. 2, for the following reasons: In the construction shown in the accompanying drawings the foot of the fixed post is not intended to be exactly in the center of the circular base, but a point in the center line of the post in the same plane with the lower pivot J′ is located perpendicularly over the center of said base in order that the motion of the bar G and the guide M may be concentric with the base. Then in order to equalize the tension of the cord or belt A′ during revolution the groove N is made eccentric with the base, but with its center at the intersection of the axis of the inclined post B with the plane of the groove, and consequently concentric with the path described by the pulley K. The groove may be made concentric with the base when an elastic band is used or, better, by locating the pulley K at a level with the pivots J′ J³, allowing the cord to slant upward from the groove to meet it, when the motion of said pulley will become concentric with the circular base. An elastic cord in a groove of uniform depth may be employed.

B′ is a guide for the cord, attached to the lower end of the arm H. The guide is notched or perforated for the cord, and it may form a support for the lower end of the axis I.

The guide M is arranged to slide lengthwise of the bar G, so that it can be shifted outward and disengaged from the groove N to permit the apparatus to be readily disconnected. O is a stem which carries the guide M and which is arranged to slide in lugs on the bar.

The yoke P on the upper end of the arm H carries the circle of illumination Q, which indicates the division between day and night. The yoke P is bent, so as to avoid contact with the axis I. The circle Q, which may be made of any suitable material, is located at any convenient distance outside of the globe, and it is supported in place by the pivots R R′, which project outward and engage in notches in the upper ends of the yoke.

The wires S S′ S² indicate the light-rays. At their outer ends the rays S S′ are supported by the circle Q and the central wire S² is supported by the cross-wire W. The upper wire S is connected at Y, Fig. 2, to the wires or forks Z Z′, which pass the axis I on opposite sides and are connected with the circle Q. A similar arrangement is adopted for the wire S′. The forks are made long enough to permit the axis I of the earth-globe to tip back and forth twenty-three and one-half degrees or more in them. The inner ends of the wires representing the rays of light are supported by the inclined arm T, which is pivoted to the parallel bars F and G at U and U′, so as to be always parallel to sleeve E and axis I, and is also pivoted to the central wire S² at V. This wire S² represents the rays of light which strike the surface of the earth vertically. The inner ends of the wires S S′ S² are connected by the curved wire X. When the globe has been swung half-way around the sun-sphere, the bars and wires occupy the positions F′ G′ X′ S³ S⁴ S⁵, Figs. 1 and 7. If the sun-sphere is properly mounted, with its equator at an angle of seven and one-fourth degrees with the base, the wire X′ will be nearer the sun-sphere when on this side of it, this representing the variation of the distance of the earth from the sun. The wire S² points alternately to the tropical circles and the equator. The wires S and S′ represent, respectively, the northernmost and southernmost tangential rays. S touches earth at pole at equinoctial seasons, arctic circle beyond the pole at summer solstice, and arctic circle short of pole at winter solstice. S′ works similarly about the south pole. The equator, polar circles, and any other desired lines are plainly marked on the earth-globe.

C′ C² are additional wires, representing light-rays, which are connected with the circle F², which represents the depth of the earth's atmosphere. The wires C′ C² are connected together at their inner ends by the cross-wire E′, and they are applied to the circle Q and the wires S S² by suitable hooks H′ H² H³. The wires S C′ and S² C² show two parallel beams of light, of equal width, for the purpose of indicating the difference in intensity due to the greater spreading and greater atmospheric absorption in the case of the outer beam on account of its obliquity. Other rays or beams may be placed conveniently between S and S′ to show the direction or intensity of light at any latitude or for other purposes. In the post just opposite to the pivot J′ is a hinge-joint O′, allowing the part of the post above the hinge to be turned at any desired angle with the base or perpendicular to it. This arrangement adapts the apparatus for showing seasonal conditions for planets having different degrees of obliquity of axis—such as Jupiter, for instance; also that the condition of planetary axis perpendicular to the plane of the orbit would give no seasonal variations. The screw in the joint clamps the post at any desired inclination, the sleeve being cut away, as indicated in Fig. 4, to permit adjustment. I may also apply a wire I′, Fig. 1, which will indicate the direction of the light-rays striking the earth at any desired latitude—say forty degrees north—at different seasons of the year. For this purpose the arm T′, parallel to T, is employed, and wire I′ is pivoted to arms L′ L² arranged parallel to the radius of the earth at the desired latitude. The arm T′ is pivoted to the bars F and G. The arms L′ L² are carried by the arms T T′. Another wire may be supported parallel to and constantly equidistant from I′, which, with I′, will represent a beam of light, to show the variation of the surface covered by this beam at different seasons.

Any suitable astronomical information may

be printed or otherwise affixed to the base. It may be provided with circles showing the signs of the zodiac, the months of year, &c., the positions of the solstices, the equinoxes, of perihelion and aphelion, the direction of the revolution of the earth about the sun, that of its rotation on its axis, and any other desired astronomical facts or data may be displayed on the base.

The socket or sleeve E, which revolves on the fixed post B, may be of any suitable form or construction adapted to support the pivoted parallel bars during their traverse about the post. In a modification the bearings L may be pivoted directly in the bars, being made long enough to properly support the shaft or axis of the earth-globe.

I claim—

1. The combination with the circular grooved base, of the inclined post inserted therein, the sun-sphere supported on said base, the sleeve revolving on the inclined post, the parallel bars pivoted to the sleeve, the outer inclined arm pivoted to the bars, the earth-globe supported on an axis carried by the arm parallel to the post, and a guide for one of the bars traveling in the groove around the base, substantially as described.

2. The combination with the circular grooved base, of the inclined post inserted therein, the sun-sphere supported on said base, the sleeve revolving on the inclined post, the parallel bars pivoted to the sleeve, the outer inclined arms pivoted to the bars, the earth-globe supported on an axis carried by the arm parallel to the post, the guide for one of the bars traveling in the groove around the base, and the pulley and cord adapted to secure the rotation of the globe on its axis, substantially as described.

3. The combination with the circular eccentrically-grooved base, of the inclined post inserted therein, the sun-sphere supported on said base, the sleeve revolving on the inclined post, the parallel bars pivoted to the sleeve, the outer inclined arm pivoted to the bars, the earth-globe supported on an axis carried by the arm parallel to the post, the guide for one of the bars traveling in the groove around the base, and the pulley and cord adapted to secure the rotation of the globe on its axis, substantially as described.

4. The combination with the circular grooved base, of the inclined post inserted therein, the sun-sphere supported on said base, the sleeve revolving on the inclined post, the parallel bars pivoted to the sleeve, the outer inclined arm pivoted to the bars, the earth-globe supported on an axis carried by the arm parallel to the post, the guide for one of the bars traveling in the groove around the base, the light-indicating wire extending between the sphere and the globe, and the wire-supporting arm pivoted to the bars parallel to the post, substantially as described.

5. The combination with the circular grooved base, of the inclined post inserted therein, the sun-sphere supported on said base, the sleeve revolving on the post, the parallel bars pivoted to the sleeve, the outer inclined arm pivoted to the bars, the earth-globe supported on an axis carried by the arm parallel to the post, the guide for one of the bars traveling in the groove, and the latitude-indicating wire supported by parallel arms pivoted to the bars, substantially as described.

6. The combination with the circular grooved base, of the inclined post inserted therein, the sun-sphere supported on said base, the sleeve revolving on the post, the parallel bars pivoted to the sleeve, the outer inclined arm pivoted to the bars, the earth-globe supported on an axis carried by the arm parallel to the post, the guide for one of the bars traveling in the groove, the central wire and the latitude-indicating wire supported by parallel arms pivoted to the bars and to the central wire, substantially as described.

7. The combination with the circular grooved base, of the post inserted therein, the joint in the post, the sun-sphere supported on said base, the sleeve revolving on the post, the parallel bars pivoted to the sleeve, the outer arm pivoted to the bars, the earth-globe supported on an axis carried by the arm parallel to the post, and a guide for one of the bars traveling in the groove around the base, the said joint being located opposite one of the bars, whereby the inclination of the apparatus may be varied, substantially as described.

8. The combination with a suitable base of the inclined post inserted therein and adapted to support the sun-sphere, the revolving sleeve on the post, the parallel bars pivoted to the sleeve, the inclined axis carried by the outer ends of the bars parallel with the post and adapted to support the earth-globe and to convey it in a circular orbit about the post with its axis parallel thereto, and the sun-ray wires supported at their outer ends in fixed relations with the center of the globe and at their inner ends by an arm pivoted to the parallel bars, as and for the purposes set forth.

9. The combination with a suitable base of the inclined post inserted therein and adapted to support the sun-sphere, the revolving sleeve on the post, the parallel bars pivoted to the sleeve, the inclined axis carried by the outer ends of the bars parallel with the post and adapted to support the earth-globe and to convey it in a circular orbit about the post with its axis parallel thereto, the sun-ray wires supported at their inner ends by an arm pivoted to the bars, and the illumination-circle surrounding the globe and carrying the outer ends of the sun-ray wires, as and for the purposes set forth.

10. The combination with a suitable base of

the post provided with a movable joint inserted therein, and adapted to support the sun-sphere, the revolving sleeve on the post above the joint, the parallel bars pivoted to the sleeve, the axis carried by the outer ends of the bars parallel with the post and adapted to support the earth-globe, whereby the post and axis may be adjusted at any angle with the base while maintaining their parallelism, as and for the purposes set forth.

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