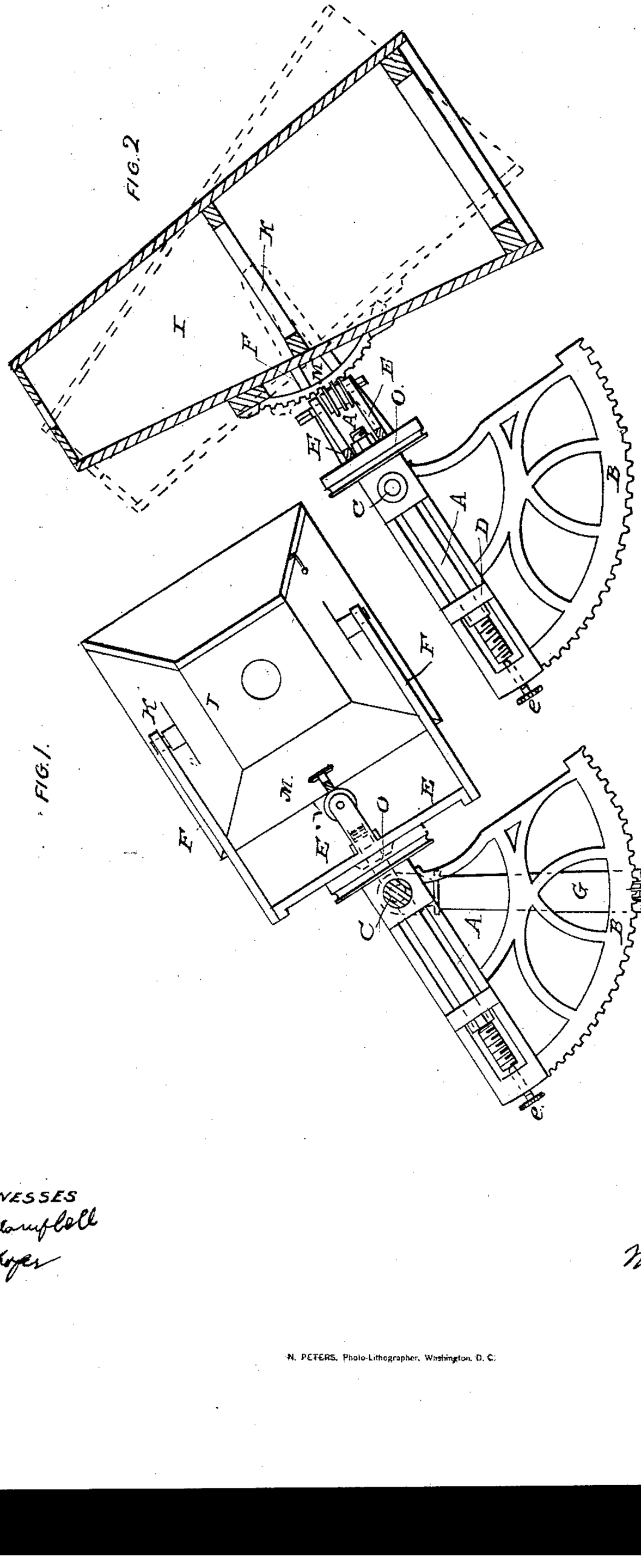
2 Sheets—Sheet 1.

MORAWETZ & VOLKMAR.

Automatic Heliotrope.

No. 55,523. Patented June 12, 1866.



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2 Sheets—Sheet 2.

MORAWETZ & VOLKMAR.

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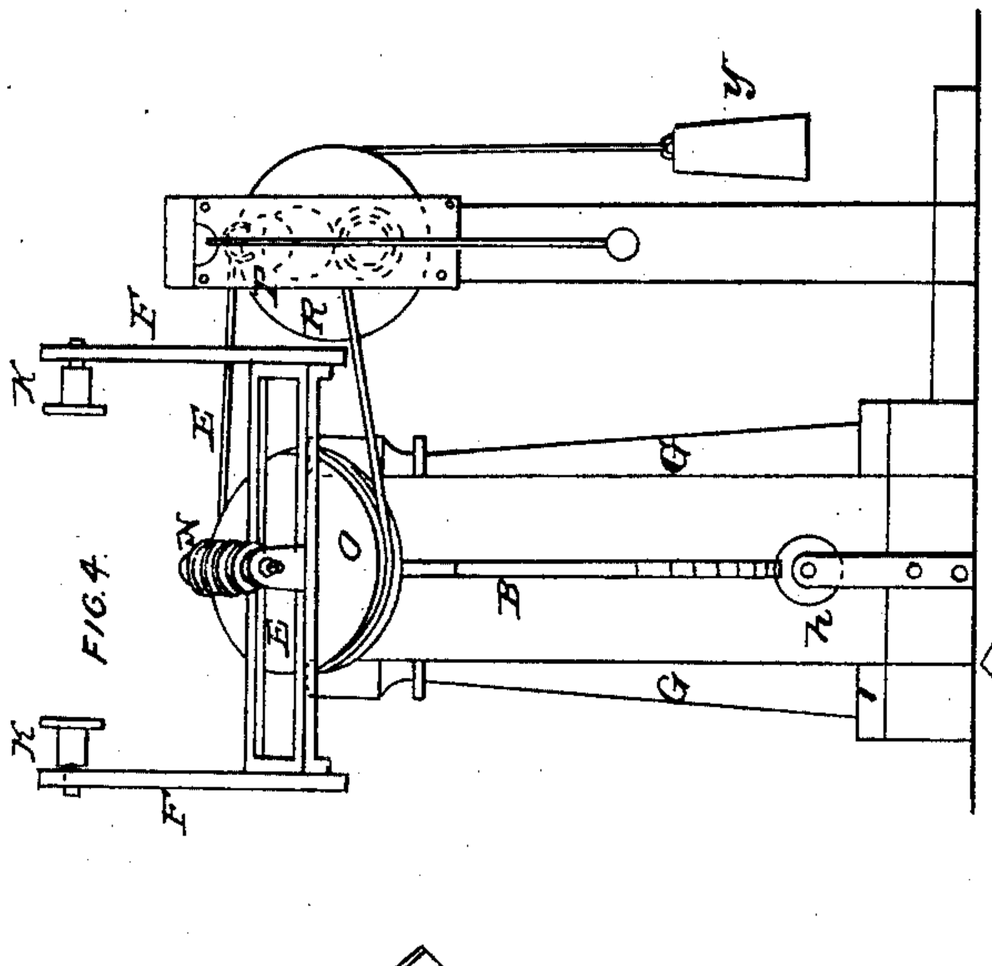

FIG. 4.

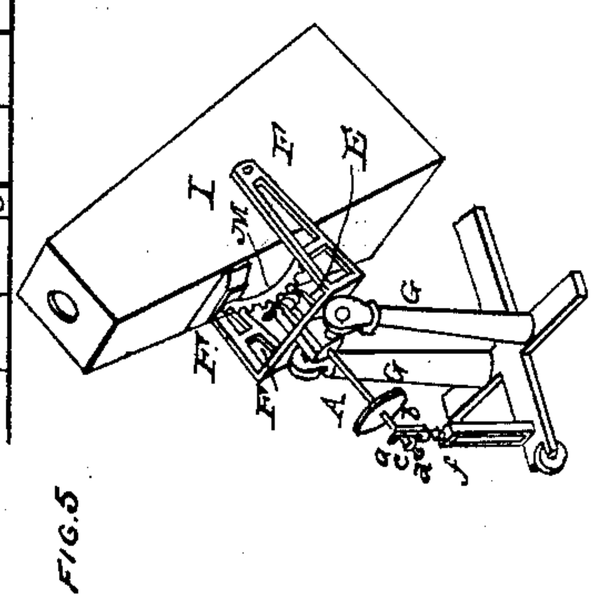

FIG. 5

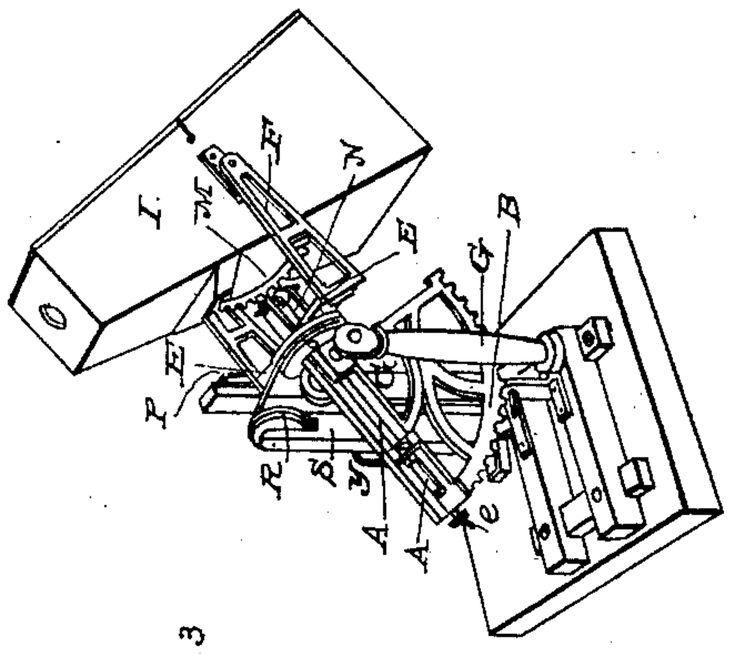

FIG. 3

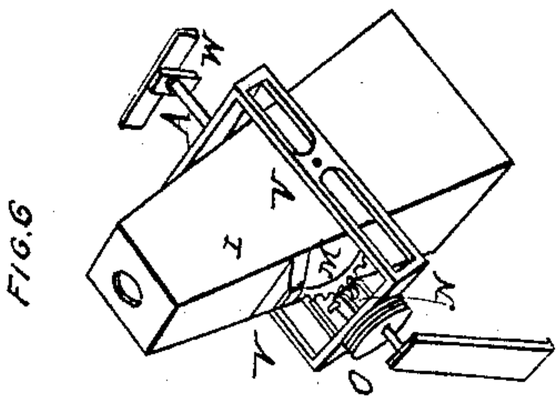

FIG. 6

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UNITED STATES PATENT OFFICE.

LEOPOLD F. MORAWETZ AND CHARLES VOLKMAR, OF BALTIMORE, MD.

IMPROVEMENT IN AUTOMATIC HELIOTROPES.

Specification forming part of Letters Patent No. **55,523**, dated June 12, 1866.

To all whom it may concern:

Be it known that we, LEOPOLD F. MORAWETZ and CHARLES VOLKMAR, of the city and county of Baltimore, and State of Maryland, have invented a new and useful instrument which we denominate an "Automatic Heliotrope;" and we do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, making a part of this specification, in which—

Figure 1 is a sectional elevation of one side of our instrument. Fig. 2 is a side view of the quadrantal arc and adjustable attachments. Fig. 3, Sheet 2, is a perspective view of the instrument. Fig. 4, Sheet 2, is a front elevation of the instrument with the solar box or optical instrument removed. Figs. 5 and 6 are perspective views of modifications of our instrument.

Similar letters of reference indicate corresponding parts in the several figures.

This invention relates to a new and improved instrument which at any place on the earth and at any time of the year will direct itself by its own action toward the sun, so that either the parallel or the collected rays of the sun are kept constantly in a vertical direction or any other desired angle of incidence upon one and the same place within or upon the instrument, thereby securing as long as the sun is visible the uninterrupted action of its rays for optical and chemical purposes, as may be required in the art of photography and of photography in connection with microscopy, as will be hereinafter described.

To enable others skilled in the art to understand our invention, we will describe its construction and operation.

The principal part of the instrument is the horizontal axis A, which forms the upper limit of the quadrant-arc B. It is secured in its position by the fulcrum C and the disk D, through both of which it passes. The lower end of this axis rests upon the point of the screw *e*, the upper end of which extends beyond the fulcrum C and has immovably fastened to it, at right angles, the brackets E, and these carry on their ends the props or arms F F. The fulcrum C turns by means of pivots between the supports G G, and can be moved in a vertical direction within the fourth part of a circle by the endless screw *h*, working on the cogs of the quadrant-arc B, and the same screw and cogs serve to keep it in a given position.

This construction serves to bring the axis into any desired angle to the horizon between the horizontal and vertical direction, and as it revolves in this given position it will carry with it the brackets E and arms F and any instrument or object which may be supported upon them. The mode of effecting and regulating this rotary movement is as follows: For the sake of explanation, a box, I, properly inserted between the arms of the brackets E, is shown in the drawings, which box may be supposed to contain a solar microscope. It will become evident that without any change in the working of the instrument this box may be replaced by any other instrument or contrivance the use of which requires that it be kept uninterruptedly in such a direction toward the sun that the rays of light shall strike a given point of it invariably at the same angle of incidence.

The box I moves between and upon the props F F by the pivots *k k*, which are fastened to it at right angles to the optic axis of the inserted lenses. These pivots and the brackets E have to be carefully adjusted with respect to the optical axis, to the revolving axis, and to each other, so that planes laid respectively through each of these parts should cross each other at right angles. Upon this construction depends the correct action of our automatic heliotrope.

The arc M, which is fastened to the under side of the box I, is a part of a circle the center of which is a point in a line drawn through the axes of the pivots *k*, and as the endless screw N, working in the teeth of said arc, is turned the optical axis can be adjusted to any required angle of inclination to the axis A. This arc therefore has to be long enough to admit of giving to the optical axis an inclination of 23° 28′—the sun's greatest declination—to both sides of the revolving axis if the position exactly at right angles to the revolving axis is taken as zero.

In preparing the instrument for use the axis has to be brought into the direction of the meridian, and, after leveling the instrument by plumb or spirit level, the axis has to be made parallel to the axis of the earth. For this purpose serves the endless screw *h*, acting upon the cogs of the quadrantal arc B, by which the

axis A is moved from the horizontal position through an angle the value of which is equal to the numerical value of the geographical latitude of the place of operation. The nearer to this value the inclination of the axis is brought the more correct will the instrument work, though for most practical purposes a difference of some minutes will not act unfavorably. For daily use it will then only be necessary to bring the optical axis, or the point upon which the rays of the sun shall fall, into a parallel direction to these rays. This is done by rotating the axis toward the sun as the time of day may require, and by giving, by means of the screw N, to the optical instrument I the due inclination corresponding with the declination of the sun on that day, or, what is the same, till the optical axis points toward the center of the sun. It will now be perceived that if the optic system of the instrument is brought to the proper direction, the axis A has only to revolve or move about its axis at the same rate as the sun moves from east to west, and the rays of the sun will be constantly kept in the direction of the optical axis of the lenses. The inconsiderable increase or decrease of declination between sunrise and sunset can be easily adjusted two or three times a day, if it should be necessary, by a slight turn of the screw N, without disturbing the action of the instrument.

To perform the rotation above mentioned automatic and synchronic with the sun the following arrangement may be adopted: The driving-wheel O is fastened to the axis A, and around the rim of this wheel passes a cord or chain, with one end fastened to the wheel. The other passes over the pulley R upon the stand S, and has a weight, Y, attached to it, which weight is heavy enough to turn the driving-wheel O, and with it the axis A and everything connected to it. A second cord or chain, L, runs around the driving-wheel O in opposite directions to the first cord, and to this cord is attached one of a train of wheels forming a pendulum movement or escapement, P. The automatic movement is not effected by clock-work, but by attaching sufficient weight at *y* for this purpose, as the case may require; and the working of this weight is regulated by a pendulum. By changing the position and weight of the stand S with the roller or pulley R, according to the change of inclination of the driving-wheel O in different latitudes, an equal effect of the weight *y* is produced and the slipping of the cord from the inclined rim of wheel O is prevented.

The drawings represent an instrument which can be used at any place on the globe and at any time; but as it is very likely that the greatest use of the instrument will be made for photographic purposes, and then each instrument will be restricted to a certain place, or even to a certain floor of a building, the arrangement of the several parts may be changed, according to the size of the instrument, the locality where it is to be used, and whether it is to be movable or stationary; but these alterations produce no change in the essential parts or features of the invention.

In Figs. 5 and 6 we have represented two modifications of the instrument above described. The modification represented by Fig. 5 relates to portable instruments and such as are intended particularly for photographic purposes. The axis A may be shortened and the quadrantal arc B dispensed with in this modification. It will then be necessary to bring the axis A to an inclination commensurate with the latitude of the place where the instrument is to be used, and to keep it in this position by the movable disk *a*, which is fastened to the support *b*. The yoke *c*, which is connected to the disk, serves for the insertion of the screw *d*, on the point of which the axis A revolves, and by which this axis is prevented from sliding backward. By making the upper part of the support *b* to slide upon the stand *f* by means of a set-screw, *f'*, or other means, this arrangement will be sufficient for all latitudes in the United States. It furthermore gives room for placing the driving-wheel O between the supports of axis A instead of in front of them.

With instruments which have an established place, or which are not to be moved for a long time from the place where they are located, another alteration may be instituted by interposing the optical instrument between the ends of the revolving axis, instead of placing it at the end of it. This plan is shown in Fig. 6.

As the brackets and the props E F shown in Figs. 1, 3, 4 may be considered the split end of the axis A, between which the optical part I of the instrument moves, so can the same effect be produced by forming a frame, V, in the middle of the length of said axis and inserting the part I within this frame by means of pivots; but in this case the supports G, Figs. 1, 3, 4, will have to be removed, as they would interfere with the swinging of part I and the support or fulcrum W, or its equivalent, used for the upper end of the axis A, which support must be fastened to the ceiling or to a cross-beam.

In putting up an instrument thus constructed for use care must be taken in arranging the end supports for the axis A at such a distance and direction over each other that the inclination of the axis A will agree with the latitude of the place. The length of the axis being known, the position for the supports can easily be ascertained by computation.

Having thus described our invention, what we claim as new, and desire to secure by Letters Patent, is—

1. The axis A, adapted to revolve on one or more fulcra, so that it can be adjusted to a position parallel to the axis of the earth, in conjunction with a solar instrument, substantially as specified.

2. The driving-wheel O, applied at a suitable point on the axis A, in combination with

a weight or its equivalent, and with or without an escapement, substantially as described.

3. The construction of the main revolving axis of the heliotrope, so that its supports a solar camera for photographic and other purposes, and revolves said camera, as well as permits it to be revolved, in such manner that the main supporting axis and the camera may be brought into any required angle of inclination with relation to each other, substantially as described.

4. Automatically moving an optical or solar instrument in the plane of the daily course of the sun, and synchronic with the sun, so that the solar rays shall fall directly or continually with the same angle of incidence upon a certain point of said instrument, by means substantially as herein specified.

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