(No Model.)

4 Sheets—Sheet 1.

H. E. PAINE.

SOLAR HEATER.

No. 509,392. Patented Nov. 28, 1893.

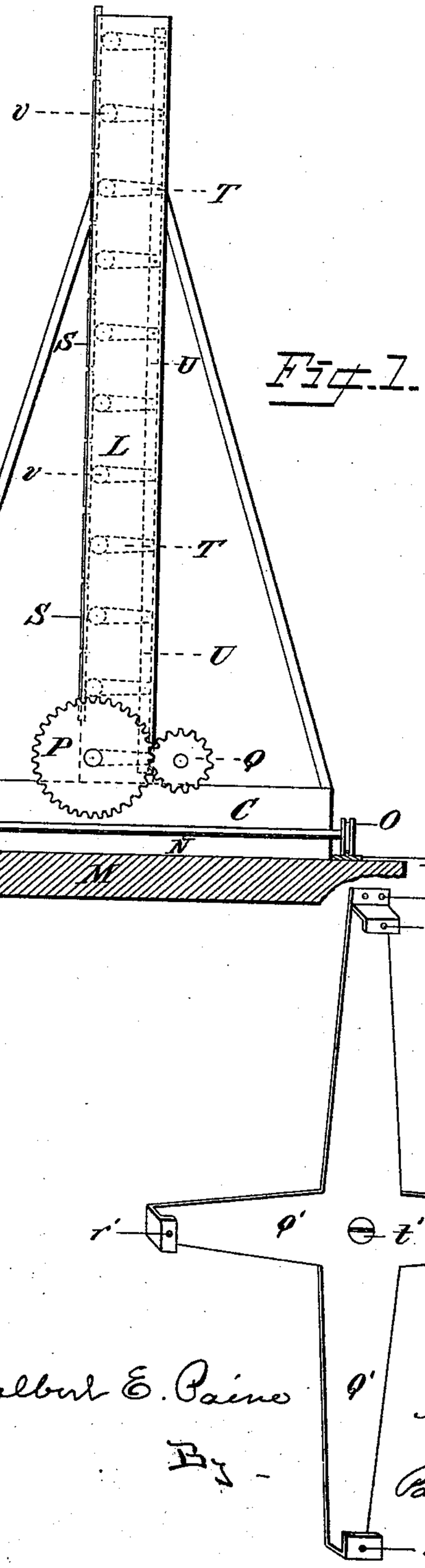

Fig. 1.

Fig. 5.

Fig. 4.

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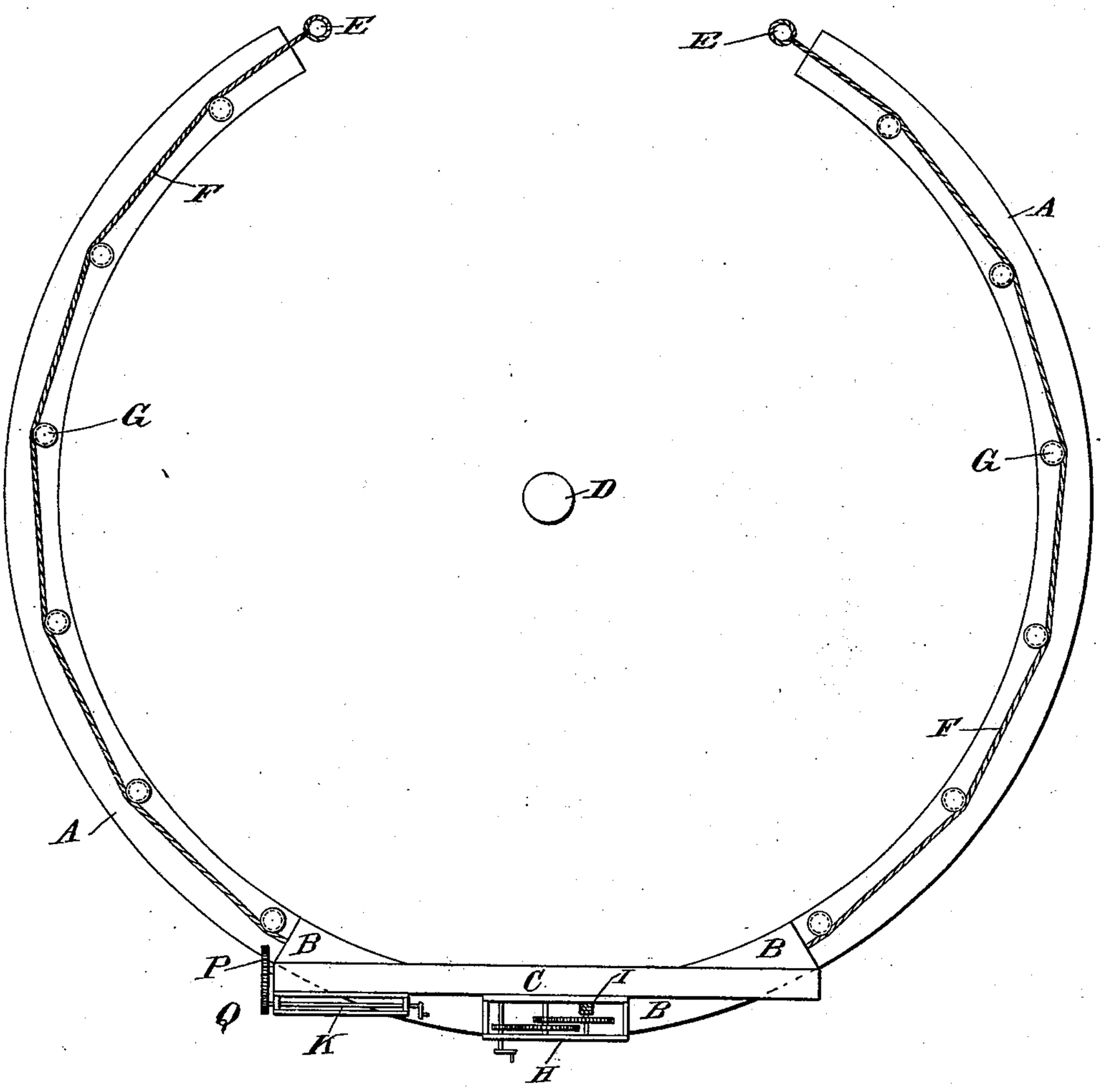
Fig. 2.



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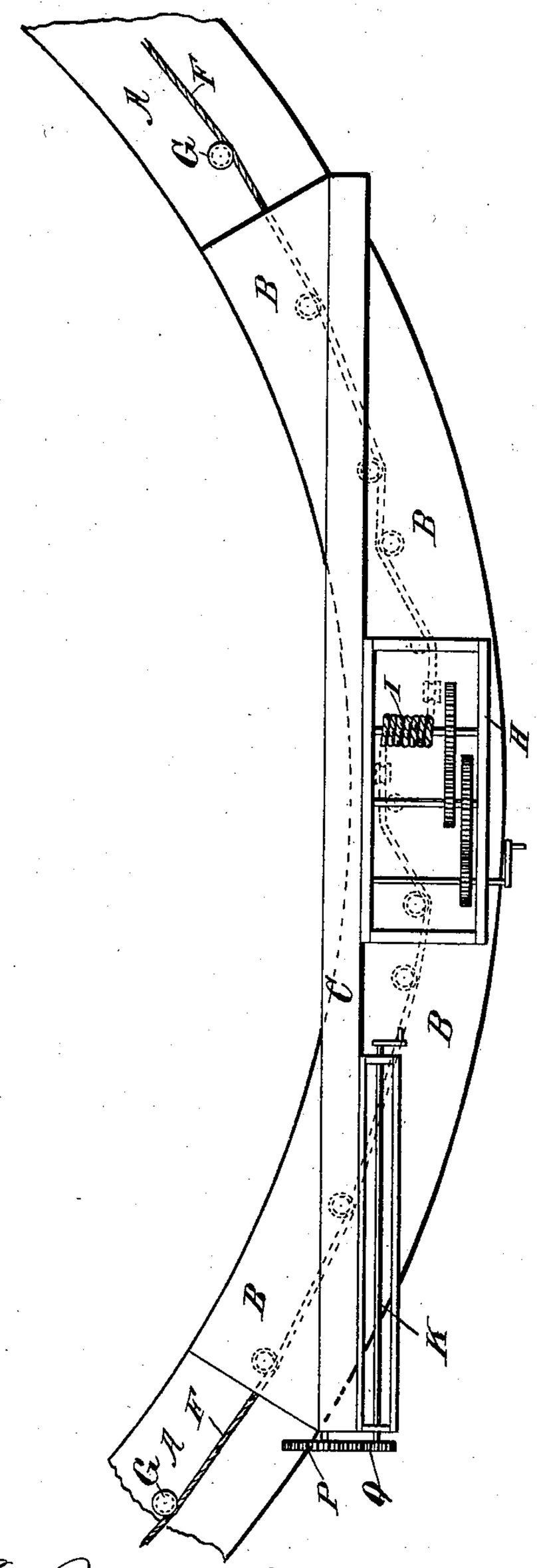

Fig. 3.

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4 Sheets—Sheet 4.

H. E. PAINE.

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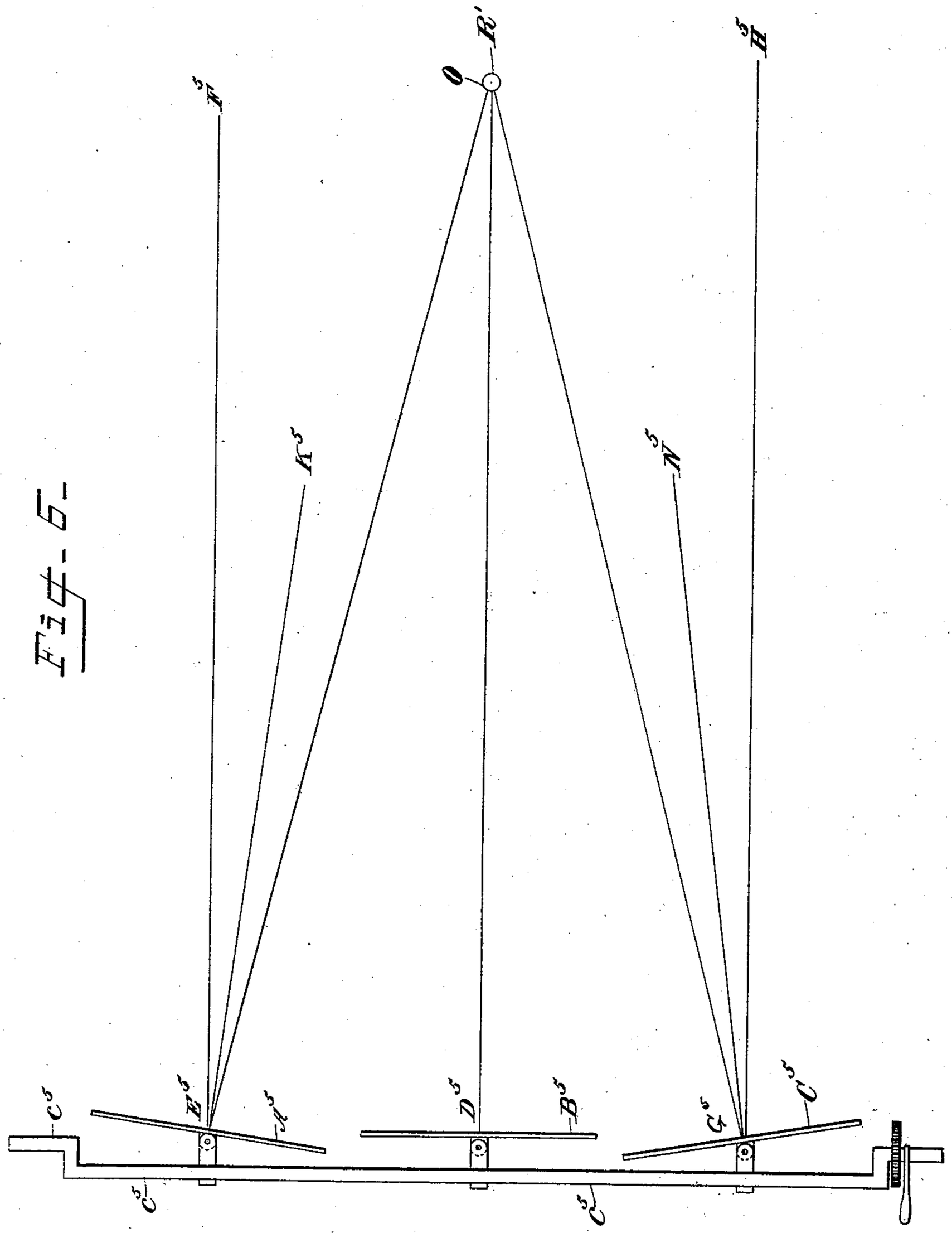
Fig 4.



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UNITED STATES PATENT OFFICE.

HALBERT E. PAINE, OF WASHINGTON, DISTRICT OF COLUMBIA.

SOLAR HEATER.

SPECIFICATION forming part of Letters Patent No. 509,392, dated November 28, 1893.

Application filed March 22, 1893. Serial No. 467,127. (No model.)

To all whom it may concern:

Be it known that I, HALBERT E. PAINE, a citizen of the United States, residing at Washington, in the District of Columbia, have invented certain new and useful Improvements in Solar Heaters; 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, reference being had to the accompanying drawings, and to letters of reference marked thereon, which form a part of this specification.

My invention relates to improved means for utilizing solar heat for industrial purposes, wherein is employed a group, or assemblage, of mirrors adapted to move in the arc of a circle and in a horizontal, or proximately horizontal plane, the heat receiver being at, or near, the center of the circle.

The invention consists in a novel combination and arrangement of parts, substantially as hereinafter described and claimed.

Figure 1 is an outside end view of the mirror-car and mirror-frame, showing the mechanism by which the vertical inclination of the mirrors is adjusted. Fig. 2 is a plan of the track, showing the mechanism by which the car is moved and the vertical inclination of the mirrors adjusted. Fig. 3 is an enlarged view of the middle part of the arc of the track, showing the mechanism by which the car is moved and the vertical inclination of the mirrors adjusted. Fig. 4 is a mirror-holder. Fig. 5 is a top view of the mirror-axis, with a mirror attached. Fig. 6 is a top view of the mirror-axis, with the mirrors attached thereto, showing the relation between the horizontal angular movement of the sun and that of the mirrors.

In Fig. 1, of the drawings L is the end of the mirror-frame; M the cross tie of the track; C the platform of the mirror-car; O, O, the flanged car wheels inclosing the ribs of the rails R, R; S, S, the mirrors; *v*, *v*, the pivots or axes of the mirrors; T, T, the arms of the mirrors; U the rod to which the arms are pivoted; P a gear wheel actuated by the pinion Q and, by means of the arm rigidly connected to P, elevating and depressing the rod U. The adjusting device, in Fig. 1 of the drawings, is also shown in Fig. 5 of my application for Letters Patent filed March 15, 1893, (Serial No. 466,069) and also in Fig. 5 of my application for Letters Patent filed March 15, 1893, (Serial No. 466,070). It is not claimed, either in those applications or in this application, as a distinct substantive invention, but only as an element of the combinations described as including this adjusting device.

In Fig. 2, A is the track; B the mirror-car; C the mirror-frame; D the heat-receiver; E. E. the posts to which the cable is made fast at the ends of the arc of rotation; F the cable; G the drums by which the cable is held in position; H the train of gear-wheels actuating the drum I, which is encircled by the cable and rotates the car; K the shaft bearing the pinion Q, which actuates the wheel P and elevates and depresses the rod U of Fig. 1.

In Fig. 3, A is the track; B the car; C the mirror-frame; D the heat-receiver; F the cable; G the drums; H the train of gear wheels, which actuates the drum I encircled by the cable, and thereby rotates the car; K the shaft bearing the pinion Q, which engages the gear wheel P and elevates and depresses the rod U of Fig. 1.

In Fig. 4, Q′, Q′, represent the mirror-case-holder; *r′*, the orifices for set screws; *s′*, *s′*, the screw holes for the screws holding the upper clasp to the arm of the holder; *t′* the screw by which the mirror-frame is bolted to the stud shown in Fig. 5.

In Fig. 5, C^5 is the horizontal axis of the mirrors; Q′ the mirror-case holder; f^2, f^3, the set screws and counter acting screws holding the mirror case; *u′* the stud to which is pivoted the tongue *u* rigidly connected with the mirror-case-holder by the bolt *t′*; S^4 the pivot; *n′* the front extremity of *u′*; *x′* the rear extremity of *u*; *v′* the part of *u′* which passes through C^5 and is bolted thereto.

The adjusting device, shown in Fig. 5 of the drawings, is also shown in Fig. 7 of the drawings of my application for Letters Patent filed March 15, 1893, (Serial No. 466,069) and is also shown in Fig. 8 of my application for Letters Patent filed March 15, 1893, (Serial No. 466,070). It is claimed in those applications and in this, not as a distinct invention, but only as an element of the combinations described as including that device.

In Fig. 6, C^5 is the horizontal axis of the mirrors; A^5, B^5, C^5 are the mirror-case holders; O the heat-receiver; R′ the sun; E^5, F^5 and G^5, H^5, sun's rays parallel to D^5, R′. A vertical rod is erected at O in the center of the circle. The mirror-car revolves around the heat-receiver, on a track laid in a horizontal or proximately horizontal plane and in the arc of a circle equal, in degrees and minutes, to the longer arc of the circle of the horizon contained between the points at which the sun rises and sets at the seat of operations, at the summer solstice. The mirror-frame (preferably rectangular in form) is mounted on the car and rigidly fastened thereto. It may be either vertical, or inclined from the sun at an angle not exceeding forty-five degrees. The car moves on wheels, their number being determined by the length of the car. The individual mirrors Q′ are rigidly bolted to tongues *u* which are pivoted, at S^4, to studs *u′* which studs are bolted to the horizontal bent axes C^5. The pivots S^4 are the vertical, or proximately vertical, axes of the individual mirrors. The axial line of the bent axis c^5 passes through the extremities of that axis and through the pivots S^4. To prevent lateral movement of the car the rails are ribbed and the wheels double flanged.

The rotation of the car is effected by a train of gear wheels, giving great power with little speed. This train is located on the car, in rear of the mirror frame. It actuates a drum I, around which the cable F, coming up from below, is wound several times. The cable is made fast to the posts E, E, at the extremities of the arc of rotation, and is kept in position by the drums G, G, which may be either rotary or immovable. The tension of the cable must be such that the revolution of the drum I, which it encircles, will effectually move the car on the track.

The mirrors are inclosed in heremetically sealed metallic cases, the metal covering the back and a narrow margin of the face of the mirror. The mirror-case is held in the mirror-case-holder Q′, its position therein being adjusted by set screws and counteracting screws.

The first adjustment of the horizontal inclination of the mirrors is to be effected as follows: The track having been accurately laid, with the required radius, and the position of the center fixed, so adjust the central mirror that a vertical plane passing through the sun, at midday, shall bisect this mirror at right angles, the planes of all the mirrors of that series or tier being in, or parallel to, the plane of the central mirror. Then rotate the common axis of this tier of mirrors until the central mirror reflects the rays of the sun upon a vertical rod erected at the center of the circle of which the track is an arc. Prepare a large scale drawing, exhibiting all the mirrors in the middle tier, and also the rod at the center of the circle, as represented in Fig. 6, wherein, for convenience, is shown only a single series of three mirrors. The vertical planes of incidence and reflection of the sun's rays will then both coincide, on the drawing, with the vertical plane O D^5. The sun's rays being regarded, at a given instant of time, as all parallel, draw E^5 F^5 and G^5 H^5 (Fig. 6), from the middle of each mirror in the horizontal tier containing the central mirror, parallel with O D^5. Draw lines E^5K^5 and G^5 N^5 bisecting the angles O E^5 F^5 and O G^5 H^5, and draw the middle horizontal lines of the respective mirrors perpendicular to these bisecting lines. The drawing will then represent all the mirrors of the middle tier in such positions as to reflect the sun's rays, in a sufficiently limited field, upon the rod at the center of the circle. The mirrors of that tier are then to be rigidly fixed to their common axis, in the respective angular positions shown on the scale drawing. All the mirrors of the several tiers are, in like manner, so adjusted as to reflect the sun's rays upon the vertical rod at the center of the circle simultaneously with the central mirror of the middle tier. The adjustment of the horizontal inclination of all the mirrors to the vertical rod at the center of the circle is then complete.

The adjustment of the vertical inclination of the mirrors to the heat-receiver is effected as follows: The arms or links, T, T, (Fig. 1) which are rigidly attached to the common axes of the several tiers of mirrors, are all to be pivoted, as shown in Fig. 1, to the rod U. The link rigidly connected with the gear wheel P is also to be pivoted to the rod U, so that, when the pinion Q is actuated, uniform changes in the inclination of the several mirrors may be effected. This is accomplished as follows: The car being on the track, in such a position that a vertical plane passing through the sun bisects the central mirror at right angles, rotate the axis of the tier of mirrors, to which the central mirror is attached, until this mirror reflects the sun's rays upon the heat-receiver. All the mirrors of the same tier will then reflect the sun's rays upon the heat-receiver, in a sufficiently limited field, if their connection with the common axis has been accurately made. Moving the car along the track, so as to keep the image of the sun, which is reflected by the central mirror, constantly on the heat-receiver, where it must remain until the adjustment is consummated, correct any inaccuracies in the attachment of the mirrors of this tier to their common axis. The rod U being made temporarily immovable, pivot upon it the arm of this common axis, without moving the mirrors. Then move the arms of all the other axes, in succession, until all the mirrors reflect the sun's rays upon the heat-receiver and pivot their respective arms upon the rod U, correcting any inaccuracies in the angles at which the individual mirrors may have been fastened to the axis, and keeping the reflection of the central mirror meantime constantly on the

heat-receiver. Then pivot to the rod U the crank arm which is rigidly attached to the gear wheel P, and the adjustment is completed. At the commencement of work, in the morning, the car is moved around on the track until the mirror-frame fronts the rising sun. By means of the crank K, pinion Q, and gear wheel P, the rod U is elevated until all the mirrors reflect the sun's rays upon the heat-receiver. The operator then, by means of the train of gear wheels H, moves the car upon the track and, at the same time, depresses the rod U, by means of the crank K, so as to keep the reflections of all the mirrors constantly on the heat-receiver. The operator may either ride upon the car or walk. Steam, electric, or other power may be used to effect and to regulate the movements of the train of gearing H and the crank K.

I claim—

1. In mechanism for utilizing solar heat for industrial purposes, the combination of a group of plane mirrors; a mirror-frame to contain the mirrors; a car upon which the mirror-frame is mounted, being rigidly attached thereto; a circular track laid in a horizontal or proximately horizontal plane; a cable made fast at the two extremities of the arc of rotation; a train of gear wheels actuated by a crank, actuating a drum encircled by the cable, and rotating the car; a device for changing the vertical inclination of the mirrors; and a heat receiver.

2. In mechanism for utilizing solar heat for industrial purposes, the combination of a group of plane mirrors; a mirror-frame; a circular track laid in a horizontal or proximately horizontal plane; a cable made fast at the two extremities of the arc of rotation; a train of gear wheels actuating a drum encircled by the cable, and rotating the car; and a heat receiver.

3. In mechanism for utilizing solar heat for industrial purposes, the combination of a group of plane mirrors a mirror-frame; a mirror-car; a circular track laid in a horizontal or proximately horizontal plane; a cable made fast at the two extremities of the arc of rotation; a device for changing the vertical inclination of the mirrors; and a heat-receiver.

4. In mechanism for utilizing solar heat for industrial purposes, the combination of a mirror-car; a circular track laid in a horizontal or proximately horizontal plane; a cable made fast at the two extremities of the arc of rotation; a crank actuating, through a train of gear wheels, a drum encircled by the cable, and rotating the car; a device for changing the vertical inclination of the mirrors; and a heat-receiver.

5. In mechanism for utilizing solar heat for industrial purposes, a circular track laid in a horizontal or proximately horizontal plane; a cable made fast at the two extremities of the arc of rotation; a train of gear-wheels actuated by a crank, actuating a drum encircled by the cable and rotating the car; and a heat-receiver.

6. In mechanism for utilizing solar heat for industrial purposes, a circular track laid in a horizontal or proximately horizontal plane; a cable made fast at the two extremities of the arc of rotation; a train of gear wheels actuated by a crank, actuating a drum encircled by the cable; a device for changing the vertical inclination of the mirrors; and a heat-receiver.

7. In mechanism for utilizing solar heat for industrial purposes, a group of plane mirrors revolving upon a car around the heat-receiver, in the arc of a circle, and in a horizontal or proximately horizontal plane; a cable made fast at two extremities of the arc of rotation; and a train of gear wheels actuated by a crank, actuating a drum encircled by the cable, and rotating the car.

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

HALBERT E. PAINE.

Witnesses:

THOS. S. HOPKINS,

STORY B. LADD.