(No Model.)

3 Sheets—Sheet 1.

J. CAIN.

ELECTRIC ARC LAMP REGULATOR.

No. 333,194. Patented Dec. 29, 1885.

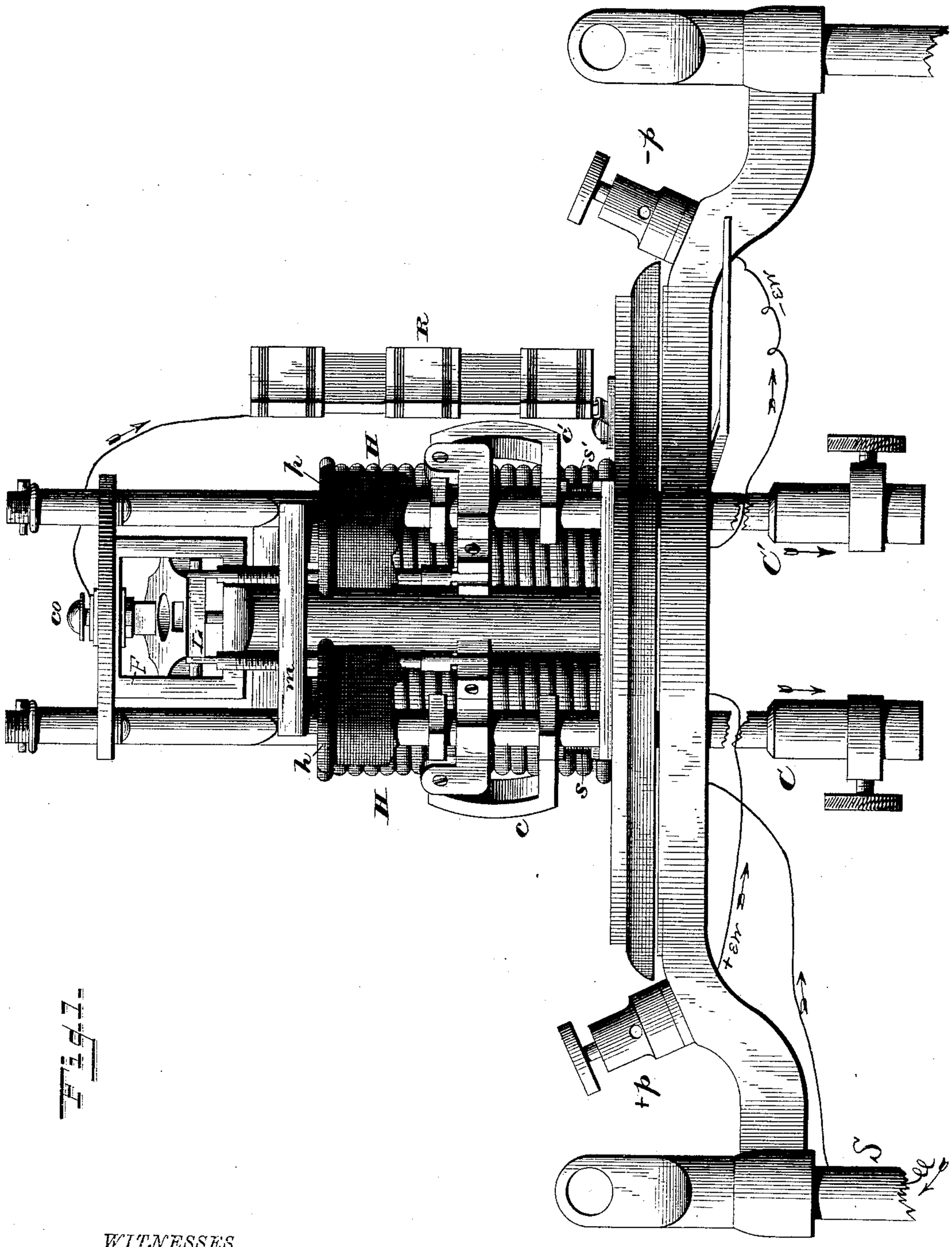

FIG. 1.

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(No Model.)

3 Sheets—Sheet 2.

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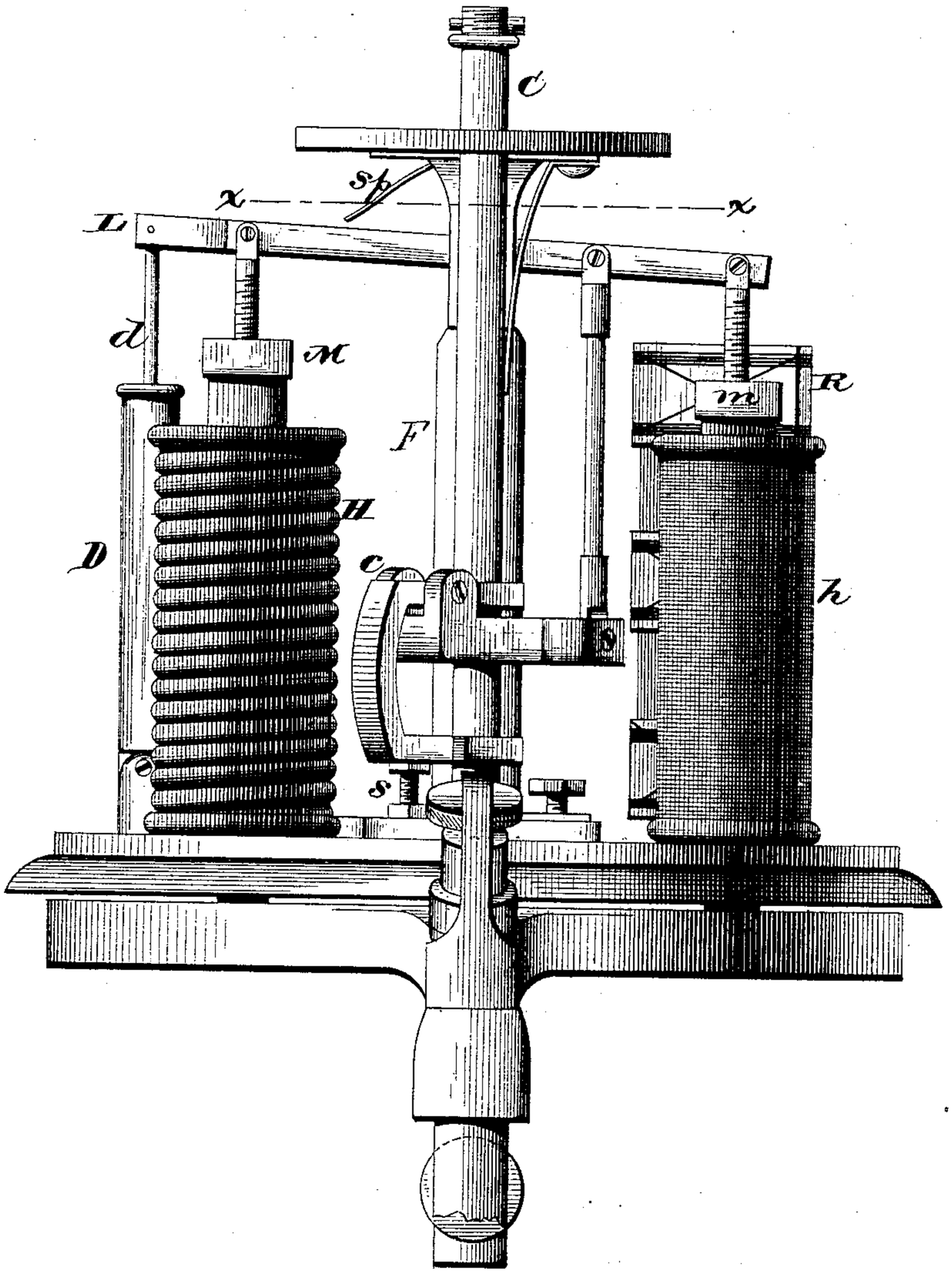
Fig. 2.



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3 Sheets—Sheet 3.

J. CAIN.

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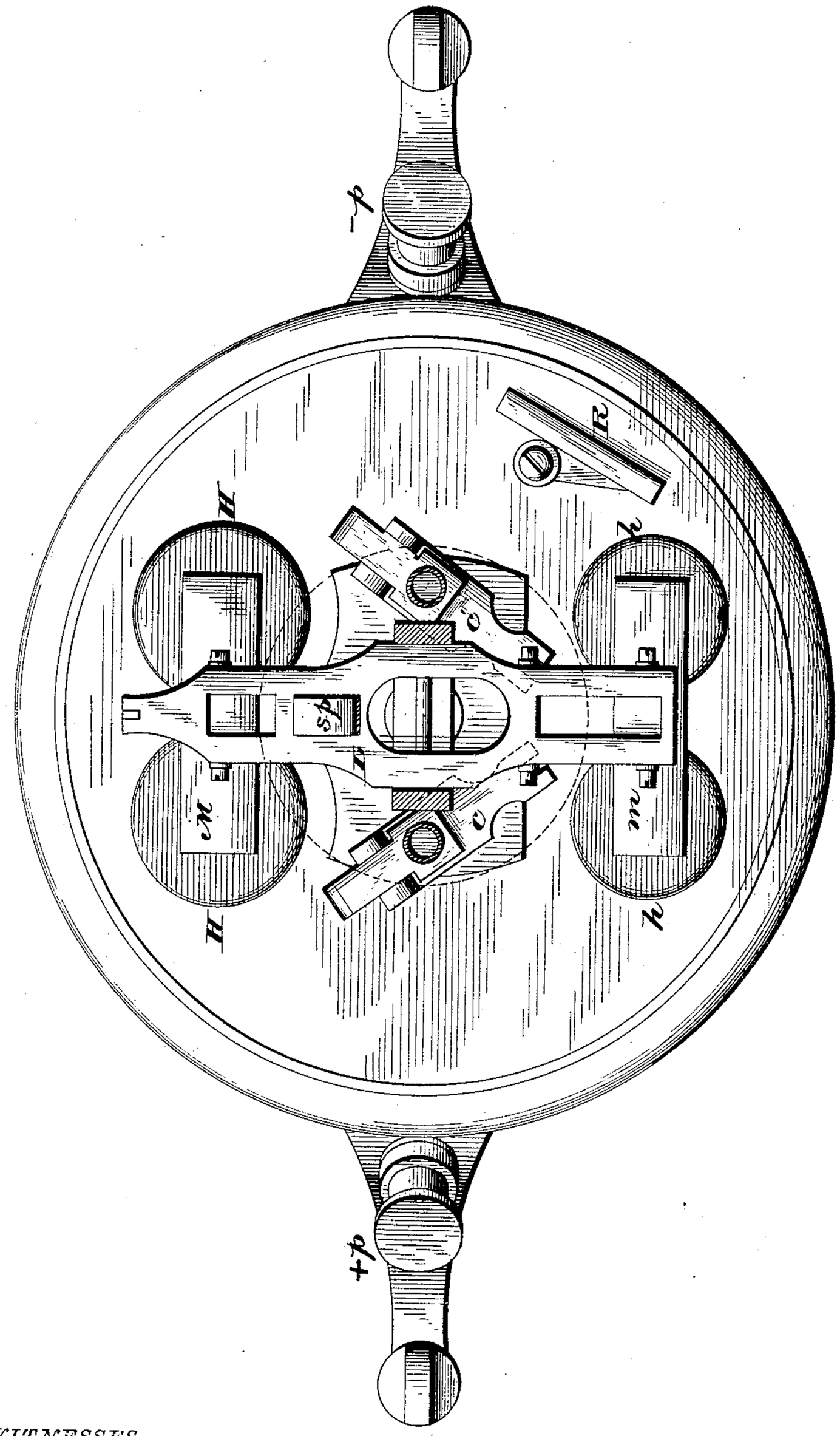

Fig. 1.

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UNITED STATES PATENT OFFICE.

JACOB CAIN, OF FORT WAYNE, INDIANA, ASSIGNOR TO THE FORT WAYNE ELECTRIC LIGHT COMPANY, OF SAME PLACE.

ELECTRIC-ARC-LAMP REGULATOR.

SPECIFICATION forming part of Letters Patent No. 333,194, dated December 29, 1885.

Application filed August 14, 1885. Serial No. 174,426. (No model.)

To all whom it may concern:

Be it known that I, JACOB CAIN, a citizen of the United States, residing at Fort Wayne, in the county of Allen, in the State of Indiana, have invented certain new and useful Improvements in Electric-Arc-Lamp Regulators; and I do hereby declare that the following is a full, clear, and exact description of the invention, which will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, which form part of this specification.

My invention is of an improved regulator for an electric-arc lamp containing two pairs of carbons to be brought successively into the circuit.

In the accompanying drawings, Figure 1 is a side view of the regulator. Fig. 2 is a second side view from a line at a right angle with the line of view taken for Fig. 1. Fig. 3 is a plan view, from above, at the line *x x* of Fig. 2.

Identical parts are represented by the same letters in all the figures.

The construction of the lamp is as follows:

H H are two coarse-wire helices wound contrariwise and set in the main circuit, and *h h* are two fine-wire helices wound contrariwise and set in a shunt-circuit which avoids the carbons. Each of these helices has a movable core playing freely in its hollow center, the two cores of each pair of similar helices being joined together at the top, so as to constitute a single soft-iron horseshoe-magnet with its poles in the helices. These magnets are shown at M and *m*.

L is a lever pivoted in the frame F, to which are pivoted said soft-iron magnets M and *m*, the piston *d* of the dash-pot D, and the supporting-links of the clutches *c* and *c'*, applied to the carbon rods C and C'.

At *co* is an insulated contact electrically connected with a brass spring, *sp*, adjusted to make contact with the lever L, as hereinafter specified.

R is a resistance-stack, of which one extremity is connected with *co* and the other with the exit-wire—*ew*.

At *s* and *s'* are adjusting-screws which limit the drop of the clutches *c* and *c'*, respectively.

The operation of the lamp is as follows: The main current entering at the binding-post $+p$ is conducted to the base of the frame F, and flows thence through the frame in all its parts through the carbon rods C and C', through the carbons to the insulated lower holders, (not shown in the drawings,) and thence by an insulated wire through the hollow standards S, into and through the main helices H H to the exit-post $-p$. The entrance-connection of the helices *h h* is from any part of the frame F, and their exit-connection is with the exit-wire $-ew$. The lever L is hung so that when there is no current passing through the lamp and all its parts are free the end of the lever carrying the clutches will be the heavier, and will tip downward by gravity, and so open the clutches *c* and *c'*, and allow the carbon rods to slide through their guiding-apertures until the carbons of each pair are in contact. Upon the establishment of the current the main helices H H are energized and attract the poles of the magnet M into their hollow centers. By this movement the clutches *c* and *c'* are closed upon the carbon rods, and they are lifted up, not simultaneously, but one after the other, as is hereinafter explained, and between the pair of carbons remaining longer in contact, and so last to separate, the arc is formed. As the arc increases in length by the wasting of the carbons, its increasing resistance diminishes the energy of the main helices H H and increases that of the shunt-helices *h h*, so that at length the preponderance of the forces acting on the lever L is reversed, the magnet *m* pulls down the clutch-carrying end of the lever, the clutch supporting the burning carbon is relaxed, and its carbon rod is allowed to feed downward. Thus by the mutual and antagonizing action of the main and shunt helices the arc is maintained continuously, and without any wide fluctuation.

The mechanism by which the carbons are caused to ignite and consume successively operates as follows: The two carbons are carried by the same lever by clutches pivoted on opposite sides of it, as shown in Fig. 1. One of the adjusting-screws—say *s*—is set a trifle higher than the other, about an eighth of an inch being sufficient, so that upon the elevation of the lever the clutch *c'* will clamp upon the

carbon rod C′ and lift it before the clutch *c* can come into operation. The separation of one pair of the carbons will develop no arc while the other pair remain in contact, and so the energy of the main helices remaining substantially unabated, the lever continues to rise until the clutch *c* is clamped and the pair of carbons regulated by it are separated, when between them the arc appears. By this time the first separated pair of carbons are wide apart, and are held so until the second separated pair are entirely consumed, when the action of the current is transferred to the first pair, being the pair whose feed is regulated by the clutch adjusted to lift first. The lever L shifts the plane of its oscillation slightly when the arc is transferred from one pair of carbons to the other; but the extended field of force surrounding the magnets M and *m* permits this shifting without any variation whatever in the operation of the lamp. By this adjustment of the clutches it is impossible for both the carbon rods to be lifted at once, or in any other order than that predetermined by the adjustment; and if it should occur that they should both slide down to complete contact during the operation of the lamp, they will be separated again in the same order as at first.

The operation of the resistance-stack R is as follows: Whenever the flow of the current through the carbons is entirely cut off, or when it is abnormally obstructed, as by a very wide and flaring arc, the magnet *m* is so strongly attracted by its helices *h h* that it tips the lever L into contact with the spring *sp*. This closes a circuit which does not include the carbons, but which passes by the frame F, lever L, spring *sp*, contact *co*, and resistance R to the exit-wire —*ew*. If the obstruction of the path through the carbons proves to be total and permanent, the current is by this device as permanently short-circuited through the lamp. On the other hand, if the obstruction proves to be a temporary one, and the carbons, after a period of separation, come into contact again, the resistance R operates to divide the current and force a portion of it through the carbons. This renews the energy of the helices H H, and the magnet M is then sufficiently attracted by them to tip the lever L so as to break the contact at *sp*, and thus restore the main current to its proper path through the carbons. For these purposes the resistance of the stack R is made substantially equal to that of the lamp with its carbons in contact.

That which I claim as my invention is—

1. The combination, in an electric-arc lamp, of a pivoted lever, two electro-magnets, each formed of two movable core-pieces yoked together, opposing each other by means of said lever, two pairs of helices, one pair of low resistance set in the main circuit and one pair of high resistance set in the shunt-circuit, and acting on said electro-magnets, respectively, two clutches carried by said lever, each combined with and operating to feed its separate carbon rod, two clutch-tripping set-screws so adjusted relatively that one shall trip its superimposed clutch in advance of the other, and a resistance in a cut-out circuit closed automatically by the tipping of said lever under the influence of the opposing magnetic forces exerted by said helices when the circuit through the carbons is broken or the arc abnormally long and flaring, and also closed automatically by like tipping of said lever by the force of gravity when there is no current passing through the lamp.

2. In an electric-arc lamp, the helices H H and *h h*, the magnets M and *m*, the lever L, the frame F, the carbon rods C and C′, the clutches *c* and *c′*, the set-screws *s* and *s′*, the cut-out contacts *co* and *sp*, and the resistance R, each and all constructed, combined, and operating substantially as described and set forth.

In testimony whereof I do hereto subscribe my name, in the presence of two witnesses, this 12th day of August, 1885.

JACOB CAIN.

Witnesses:
BAYLESS SWIFT,
SAMUEL L. MORRIS.