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E. THOMSON.

ELECTRIC ARC LAMP.

No. 461,144. Patented Oct. 13, 1891.

Fig. 1.

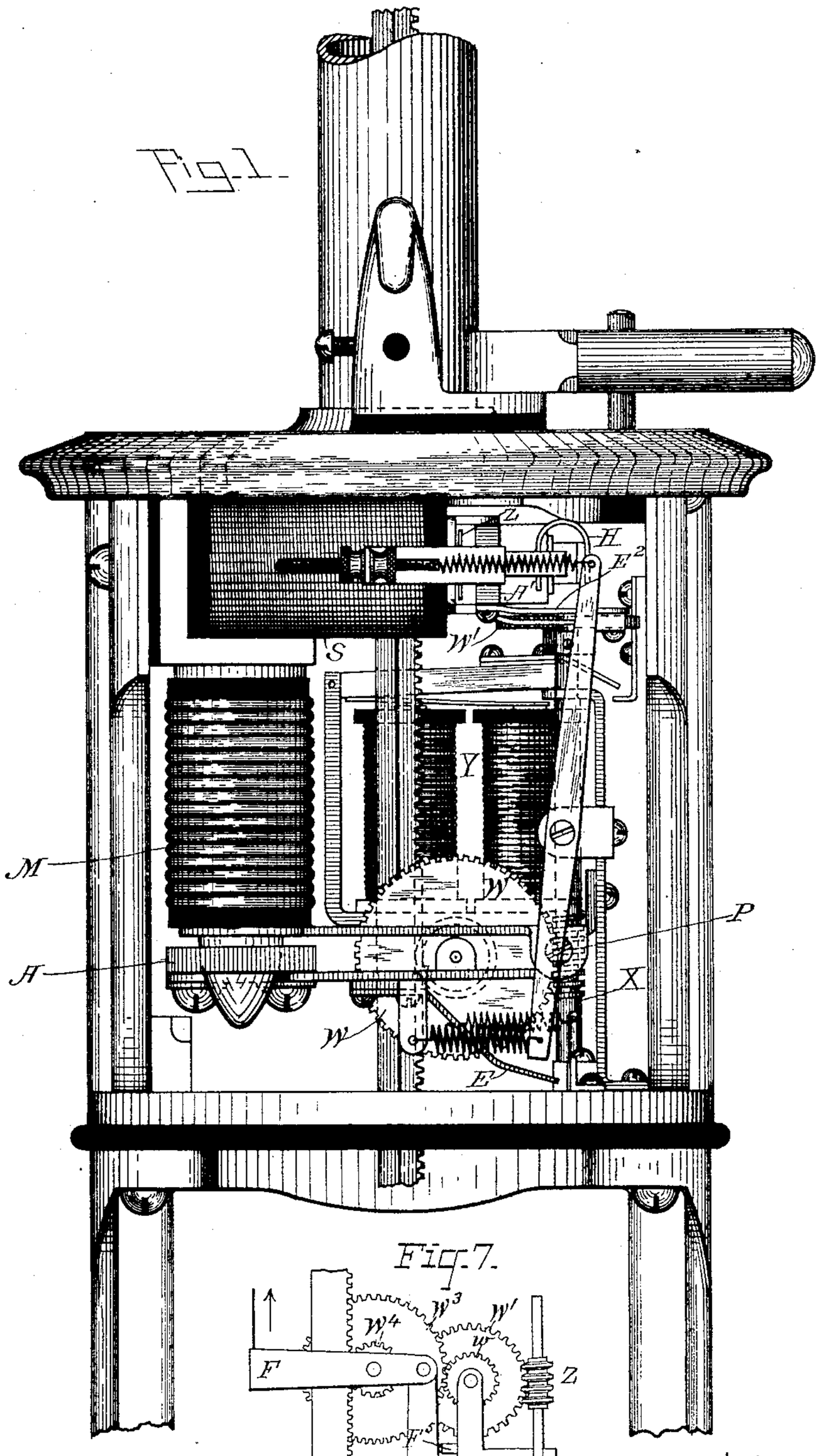

Fig. 7.

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Fig. 2.

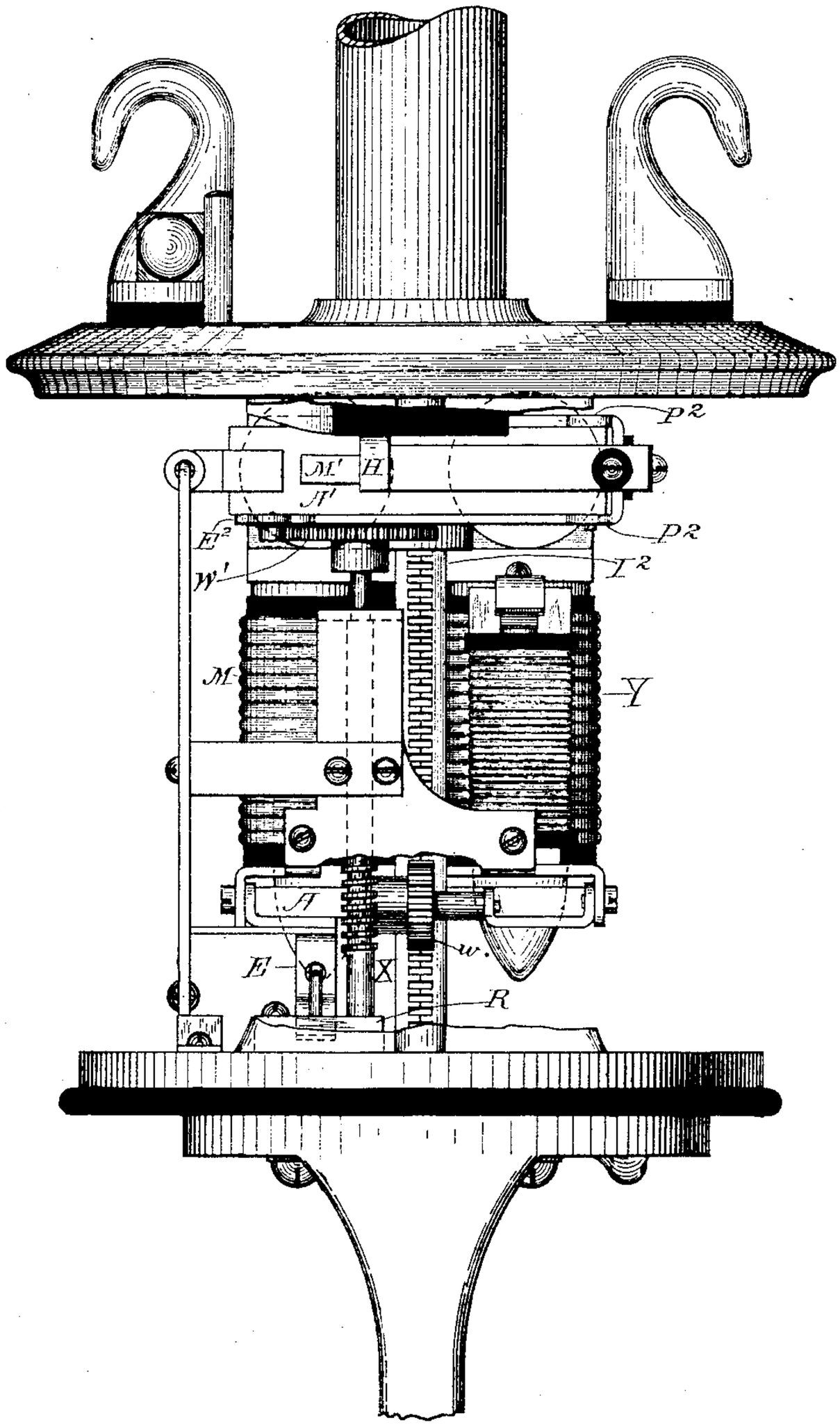

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Fig-3

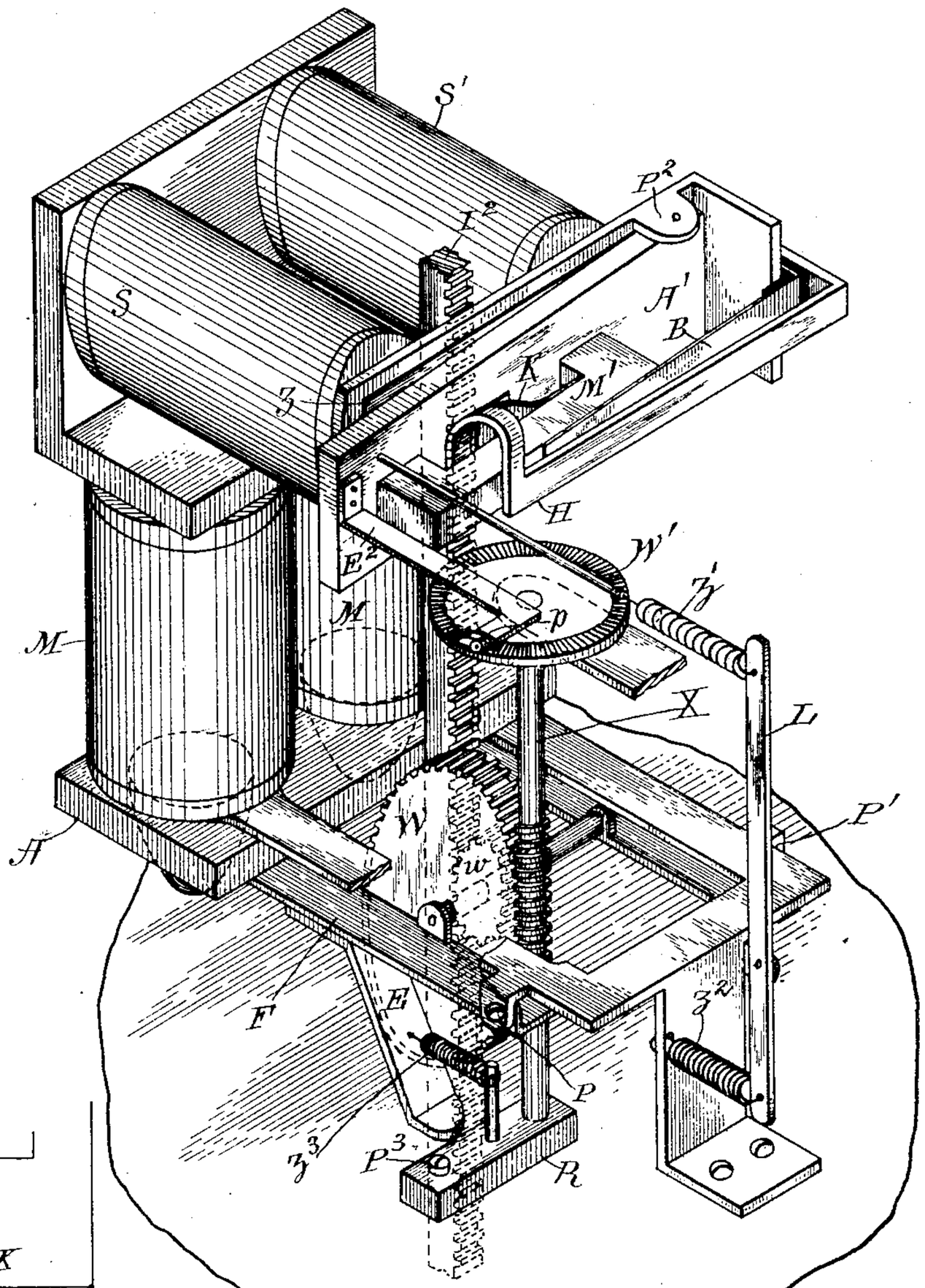

Fig-4-

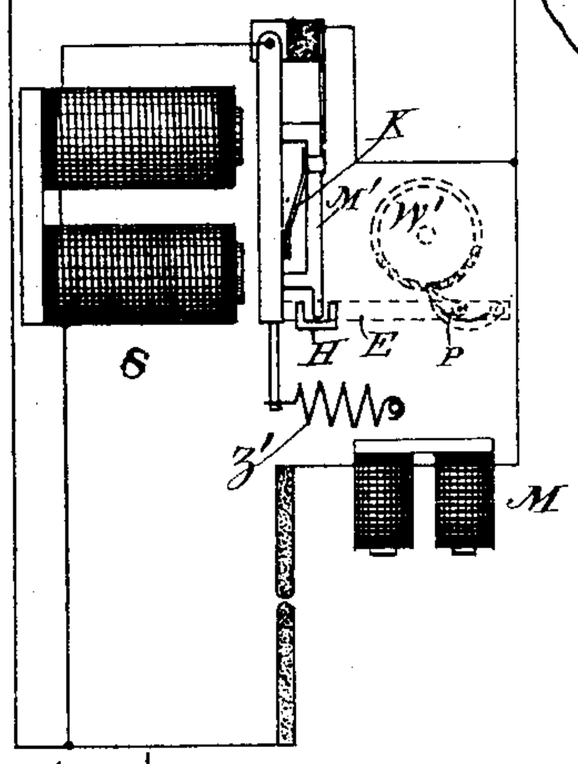

Fig-5-

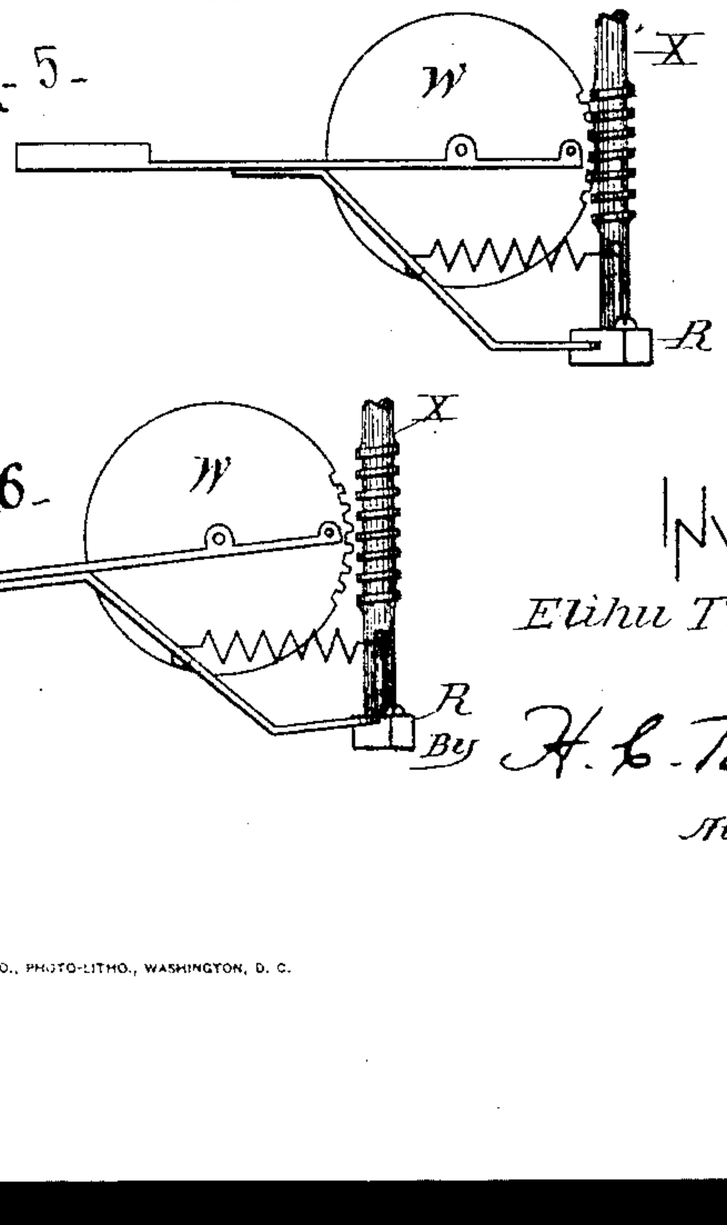

Fig-6-

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UNITED STATES PATENT OFFICE.

ELIHU THOMSON, OF SWAMPSCOTT, MASSACHUSETTS, ASSIGNOR TO THE THOMSON-HOUSTON ELECTRIC COMPANY, OF CONNECTICUT.

ELECTRIC-ARC LAMP.

SPECIFICATION forming part of Letters Patent No. 461,144, dated October 13, 1891.

Application filed June 14, 1890. Serial No. 355,503. (No model.)

To all whom it may concern:

Be it known that I, ELIHU THOMSON, a citizen of the United States, and a resident of Swampscott, in the county of Essex and State of Massachusetts, have invented a certain new and useful Electric-Arc Lamp, of which the following is a specification.

My invention relates to electric-arc lamps of the kind in which the carbon-carrier is lifted to form the arc by a magnet which retains its position during operation of the lamp, and the feed of the carrier as the carbon consumes is a positive feed produced or controlled by a derived-circuit magnet. Preferably I impel the mechanism step by step by the magnetic power of the derived-circuit magnet, which is provided with a suitable commutator, whereby an automatic oscillation of its armature is kept up so long as the magnet is excited to a strength permitting it to overcome the retractor for its armature, the derived-circuit magnet thus becoming an impelling electric motor in which the parts reciprocate.

My present invention relates more particularly to a simplified construction of that class of lamp mechanism which combines with the carbon-carrier a gear mechanism comprising a worm-wheel and endless screw, means for rotating the screw step by step to produce the feed, and means whereby the member of the gear connected to the carbon may be brought into or out of engagement with the portion of the train which is employed to produce a feed.

My invention also consists in the special combinations and organization of apparatus hereinafter more fully described, and then specified in the claims.

In the accompanying drawings, Figures 1 and 2 are side views, taken at right angles to one another, of an electric-arc lamp embodying my invention. Fig. 3 is an isometric perspective view of the lamp mechanism, a part being slightly modified for the sake of clearness. Fig. 4 is a diagram illustrating the connections of the derived-circuit magnet. Figs. 5 and 6 show the worm and screw mechanism in two positions. Fig. 7 illustrates a modification of the invention.

I^2 indicates the carbon rod or carrier, while W and X indicate, respectively, a worm-wheel and a vertical endless screw forming parts of a gear-train connecting the carbon-carrier with some impelling mechanism, whereby it may be fed positively downward. The carbon-carrier I^2 is geared with the wheel W in any desired manner and through one or more members of a gear-train, but preferably and for simplicity of construction in the manner shown—that is to say, by means of a cog-wheel *w*, carried on the shaft of wheel W and engaged by a rack on the side of the carbon-carrier. The shaft of the wheel W is mounted in suitable bearings in a horizontal movable frame or support F, which is pivoted at the points P′ and may be lifted by the action of an electro-magnet M in the main circuit with the carbons, as indicated in Fig. 4, so as to cause the free end of the lever or frame to swing and at the same time cause the wheel to swing in the arc of a circle to and from the vertical screw-shaft. A is the armature of said magnet, which armature is attached in any suitable manner to the frame or support F. The screw-shaft X is mounted at its upper end and preferably rather loosely in a fixed part of the frame of the lamp. Its lower end is stepped in a movable block R, adapted to permit the shaft to move laterally in a direction to and from the worm-wheel W. The block or step R is pivoted at P^3. A spring Z^3 or other device tends to move the step and the shaft toward the wheel W, while a projection or arm E from the frame F serves, when the frame F is depressed, to engage with the step R for the purpose of holding it away from the wheel W or preventing it from following such wheel under the action of the spring Z^3. By properly proportioning the parts the arm E might be made to positively move the shaft X in a direction away from the wheel W as the frame F moves down in a direction to disengage the wheel W from said shaft. The spring Z^3 may be attached to the arm E or a part of the frame F, or to any other support, as desired, but by attaching it, as shown, to a part of the frame its tension will increase as the frame is raised by the magnet M, and the shaft X will be drawn over more forcibly into engagement with the wheel W.

When the lamp is burning, the parts are in

the position indicated in Figs. 3 and 5, the shaft and worm-wheel being held in engagement by the spring Z^3, and the carbon-rod will be prevented from feeding down by the locking of the worm and screw and until such time as the shaft X may be turned positively by some mechanism, such, for instance, as that hereinafter described.

When no current is flowing through the magnet M, the parts will be in the position shown in Fig. 6, the shaft X beind held away from the wheel by the arm E, engaging with the step R. When current first flows in the magnet, the frame F will be raised upward, thus bringing the wheel W over toward position of engagement with screw-shaft X, while at the same time the shaft X moves toward the wheel W under the influence of the spring Z^3, when the step R is freed from the arm E. As soon as the worm and wheel are in engagement and the gear-train between the carbon-carrier I^2 and shaft X is thus completed, the movement downward of the carbon-rod, which will before take place freely, will cease, and a further movement upward of the frame F under the influence of the magnet M will therefore lift the carbon-carrier and form the arc. During this part of the operation the wheel W will be prevented from rotation, owing to engagement with the worm on the shaft X. During such movement, also, the wheel W may continue its movement freely in a direction toward the shaft X, because the shaft X, being stepped in movable block R, may yield and move slightly the wheel engaged by the wheel W. By this means the movement of the frame F necessary to lift the carbon-rod and form the arc may take place, whereas if the shaft X were rigid at both ends the free upward movement of the frame would be prevented after engagement of the wheel W with the shaft. It is obvious that this feature of my invention is applicable to other forms of positive gear-frames employed for feeding the carbons down positively.

I do not limit myself to employing the worm and screw as the movable members of the gear which are clutched and unclutched, but may use any part of the gear-train between the carbon rod or carrier and the shaft X, especially in those cases where additional intermediate gear besides what is shown in the present case is employed between the carbon rod or carrier and the wheel W.

When the frame F moves downward or in an opposite direction, the disengagement of the two members of the gear-train from one another permits the carbon-rod to move downward freely and bring its carbon against the opposite carbon, owing to the fact that it is virtually disconnected or unclutched from the portion of the train composed of the worm and screw.

The shaft X may be impelled by any device suitable for moving the same when the length of the arc increases, so as to require a feed of the carbon-carrier I^2 downward. I preferably employ as the impelling mechanism an electric motor which is energized or operated by the current in such derived circuit and which will continue or keep up its movement so long as the current continues to flow in such derived circuit in abnormal amount. Preferably I employ a reciprocating electric-motor device such as herein shown and described, the reciprocation of its parts serving to actuate the pawl *p*, which engages with a ratchet-wheel W′ on the shaft X. In practice the wheel W′ may have a rim-ratchet to be engaged by the pawl, as indicated in Figs. 1 and 2, although in Fig. 3 the ratchet-wheel is shown as a crown ratchet-wheel. The pawl is carried by an arm E^2, which extends from the armature A′ of a derived-circuit magnet S of any suitable kind. A spring Z of some non-magnetic and elastic metal, such as phosphor-bronze, interposed between the armature A′ and the magnet S, prevents the armature sticking to the poles of the magnet by permanent magnetism of the cores. M′ is a permanent magnet carried on a thin elastic arm B, permitting movement of the magnet, the range of movement being limited by the hook H, bent, as shown, around the magnet M′. The pawl is preferably arranged to rotate the wheel when the armature is attracted by the magnet. The armature is held against the retractive forces of the magnet by any suitable retracting devices—as, for instance, by springs Z′ Z^2, connected through a lever L. The spring Z^2 may be a rather stiff spring and give the rough adjustment and the spring Z′ provide the fine adjustment provided for the regulation of the feeding operation.

The permanent magnet M′ tends to stick to the back of the armature A′ and carries a circuit making and breaking contact-spring K, (shown more clearly in Fig. 4,) which by making contact with the armature A′ closes an electric circuit for the electro-magnet S. The supporting-spring B is suitably insulated from the frame and from the armature A′, as indicated in Fig. 3. The various connections of the parts are made by wires or otherwise, as well understood in the art.

The operation of the apparatus is as follows: In its idle condition the magnet M of the lamp is unenergized and the armature A in its lowest position, so that the wheel W is out of engagement with the worm on the shaft X. The wheel W is therefore free to rotate and the rack I^2, and geared to the small wheel *w*, free to descend and bring the points of the carbons into contact. When current is started through the lamp, the frame F is lifted, and the arc is established between the carbons. The wheel W is now, however, in engagement with the worm on the shaft X, and the carbon-rod I^2 is held from feeding. When the points of the carbons are consumed, so that the arc is too long, the shunt-magnet S overcomes the spring Z′ and attracts its armature A′ until the permanent

magnet M′ is caught against the hook H. Then if the magnet S is strong enough it pulls the armature A′ away from the permanent magnet M′ with a jerk, rotating the wheel W′ and turning the wheel W through the screw in such a manner as to feed the carbons together. The permanent magnet M′ and its circuit-closing spring are now retracted to their extreme position by the spring B through a space which must be traversed by the armature A′ when said armature is retracted and which is sufficient in extent to cause the pawl to take hold of a fresh tooth or teeth of the wheel W′. By the attraction of the armature A′ away from the permanent magnet M′, however, the shunt-circuit through the magnet S, which is closed through the contacts at K, Fig. 4, is interrupted or broken, and the spring Z′ pulls back the armature to again complete this circuit. If the arc is still too long, the action is repeated, and this occurs as often as is necessary to maintain the proper arc length. In practice the regulation is so exceedingly perfect that the lamp feeds every few seconds by a movement of one or two teeth of the wheel W′, and the feeding movements are quite imperceptible.

Fig. 7 illustrates a modification hereinbefore referred to, wherein the engagement and disengagement between members of the gear-train take place at a different point. In this case another gear is interposed between the rack I^2 and the worm and screw. The worm-wheel and screw may be mounted on a support, which will yield slightly, for the purpose before described, when the frame F is lifted, and brings the gear-wheel W^3 against the pinion *w*, carried by the shaft of wheel W′. The wheel W^3 is mounted on the frame F, and its shaft carries the pinion W^4, with which rack I^2 engages. The construction, while not so simple, will obviously operate in substantially the same manner. The movable or yielding support might have its movement toward the member of the train carried by frame F, limited by a stop F^5, engaging with the fixed part of the frame of the lamp, as indicated in Fig. 7. When the stop thus engages the frame it will be prevented from following the portion of the train carried by frame F as the latter moves downward. At the same time the yielding action, before described, will be secured, so that the frame F may rise and separate the carbons after the gear is engaged.

What I claim as my invention is—

1. The combination, in an electric-arc lamp, of a positive feed-gear, such as a worm and screw, a pivoted frame sustaining one member of the gear and the carbon-carrier connected with said member, an electro-magnet for actuating said frame to bring the two members of the gear into engagement and form the arc, and a derived-circuit actuating-magnet for operating the other member of the gear to cause a feed of the carbon.

2. The combination, in an electric-arc lamp, of a carbon-carrier, a worm-wheel mounted in a pivoted frame, a carbon or carbon-carrier gearing with said wheel and sustained with said wheel on the frame, and a screw-shaft with which the worm-wheel is brought into and out of engagement by the movement of the frame, as and for the purpose described.

3. In an electric-arc lamp, the combination, substantially as described, of the vertical screw-shaft connected to the actuating devices for producing the feed, a pivoted frame, an actuating lifting-magnet operating in said frame, a worm-wheel upon a horizontal shaft journaled on said frame, and a carbon or carbon-carrier engaging with a wheel on the same shaft, as and for the purpose described.

4. The combination, with the worm-wheel and pivoted frame carrying the same, of the screw-shaft, and a movable bearing therefor, engaged by said frame, and a spring tending to hold the shaft and wheel in engagement.

Signed at Lynn, in the county of Essex and State of Massachusetts, this 11th day of June, A. D. 1890.

ELIHU THOMSON.

Witnesses:
JOHN W. GIBBONEY,
DUGALD MCKILLOP.