(No Model.)

6 Sheets—Sheet 1.

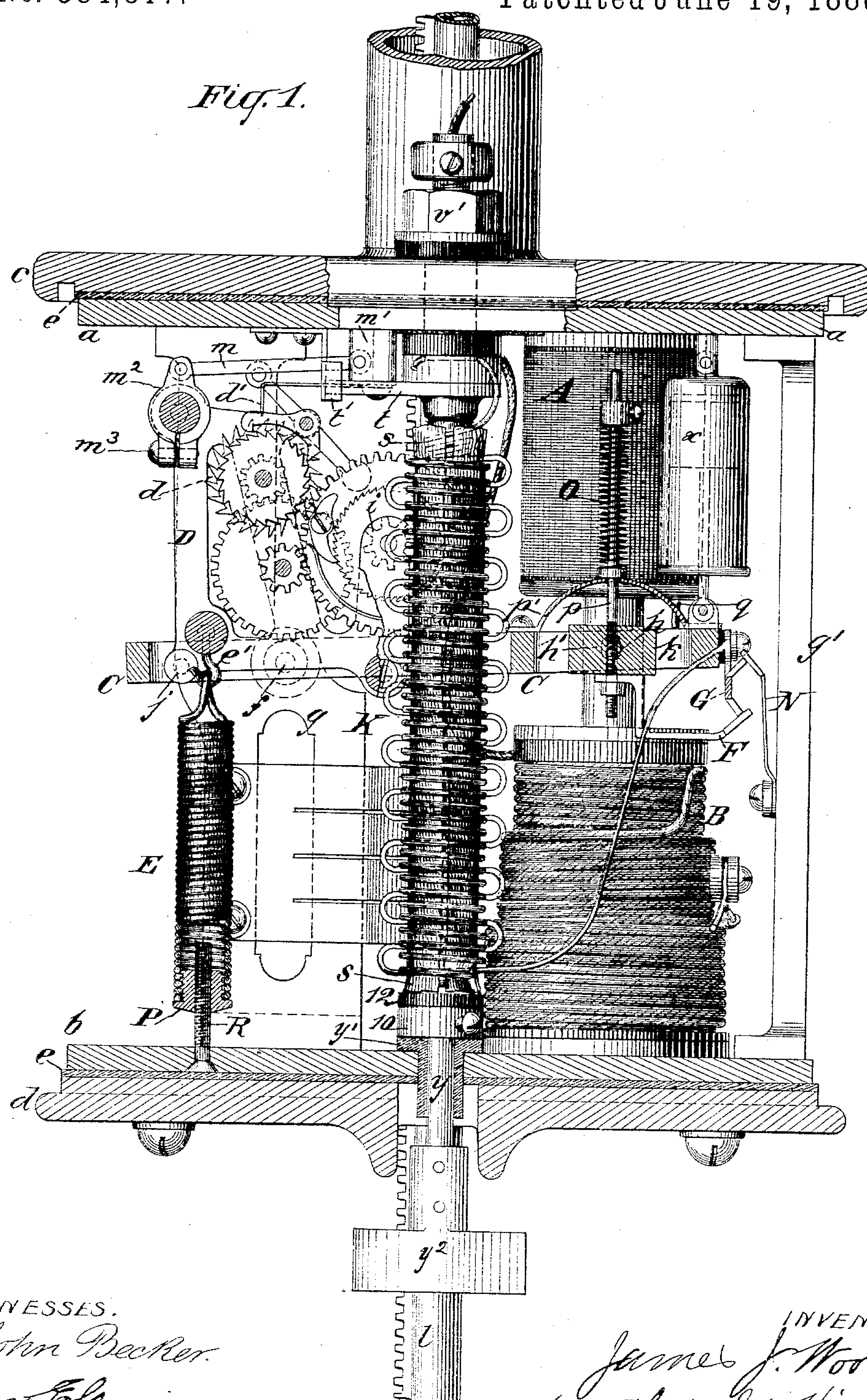
J. J. WOOD.

ELECTRIC ARC LAMP.

No. 384,817.

Patented June 19, 1888.

Fig. 1.



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6 Sheets—Sheet 2.

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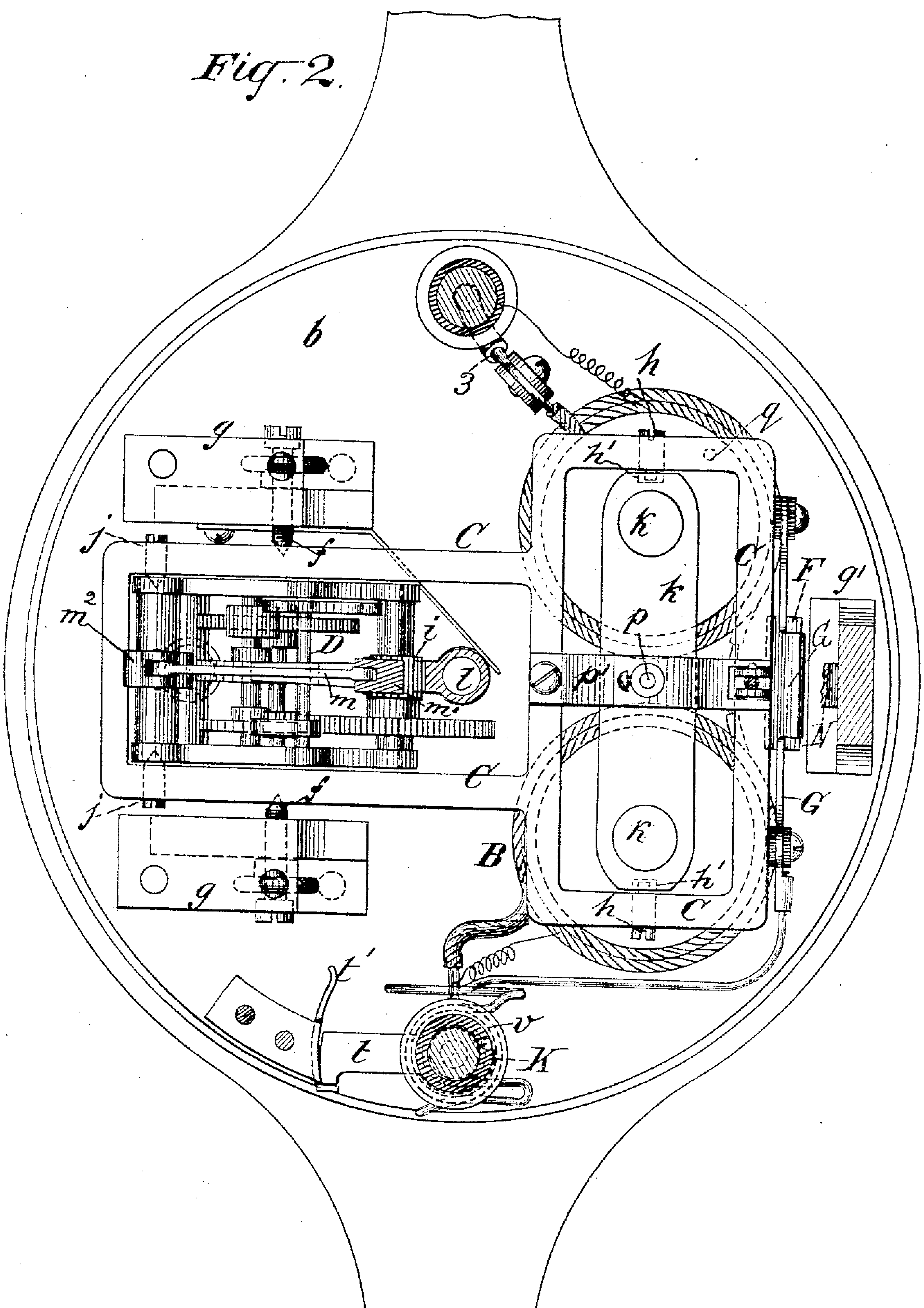
Fig. 2.



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6 Sheets—Sheet 3.

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Fig. 3

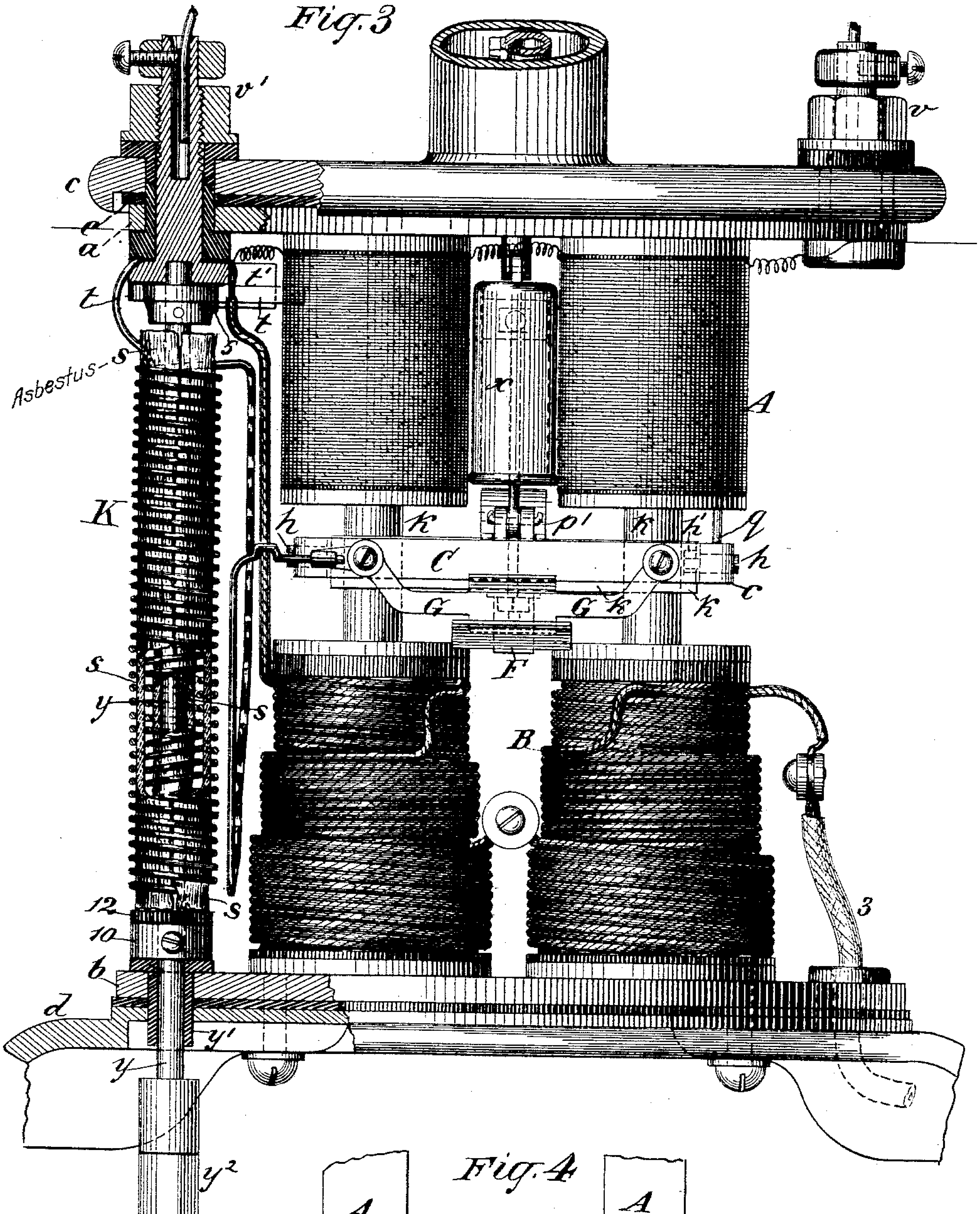

Fig. 4

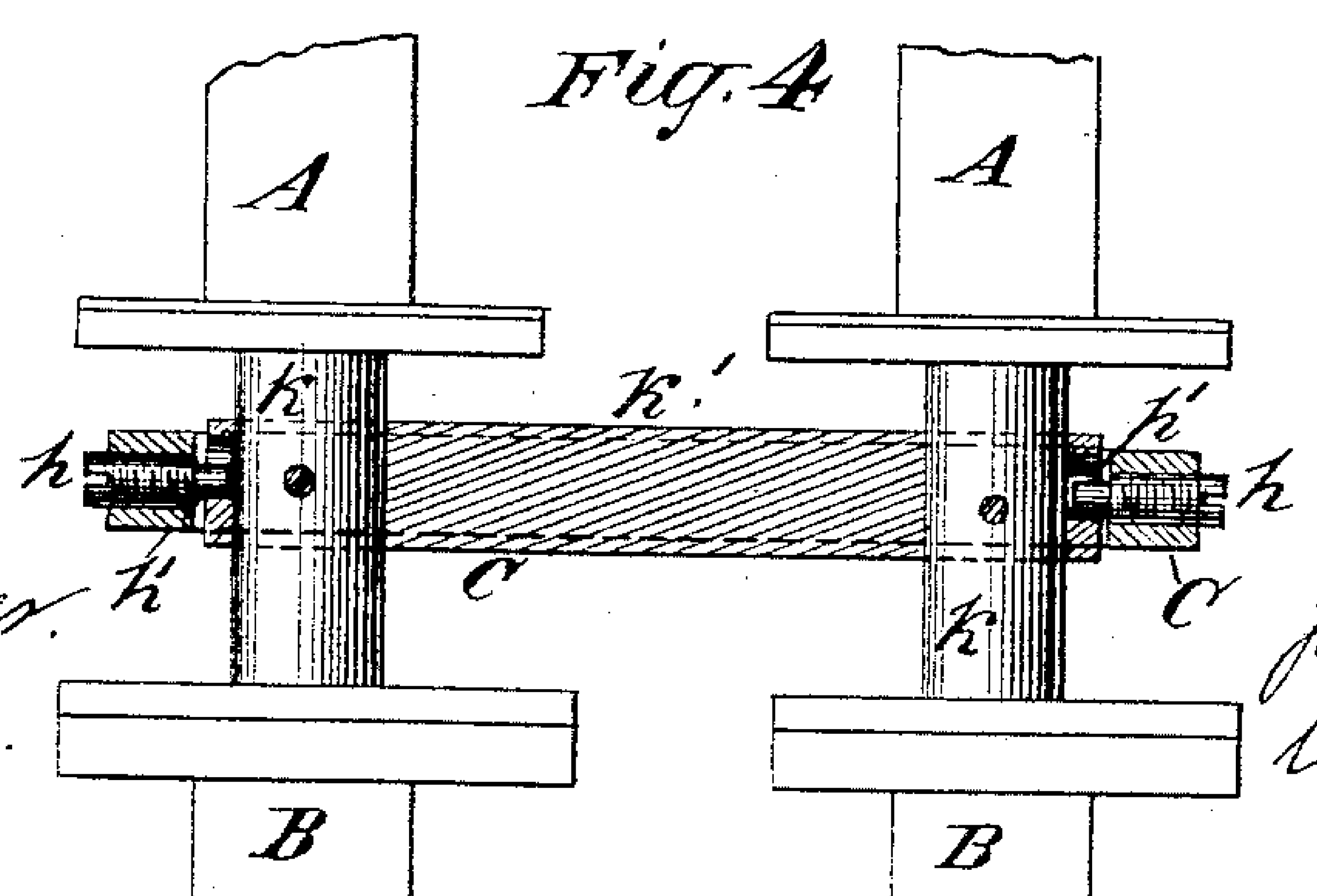

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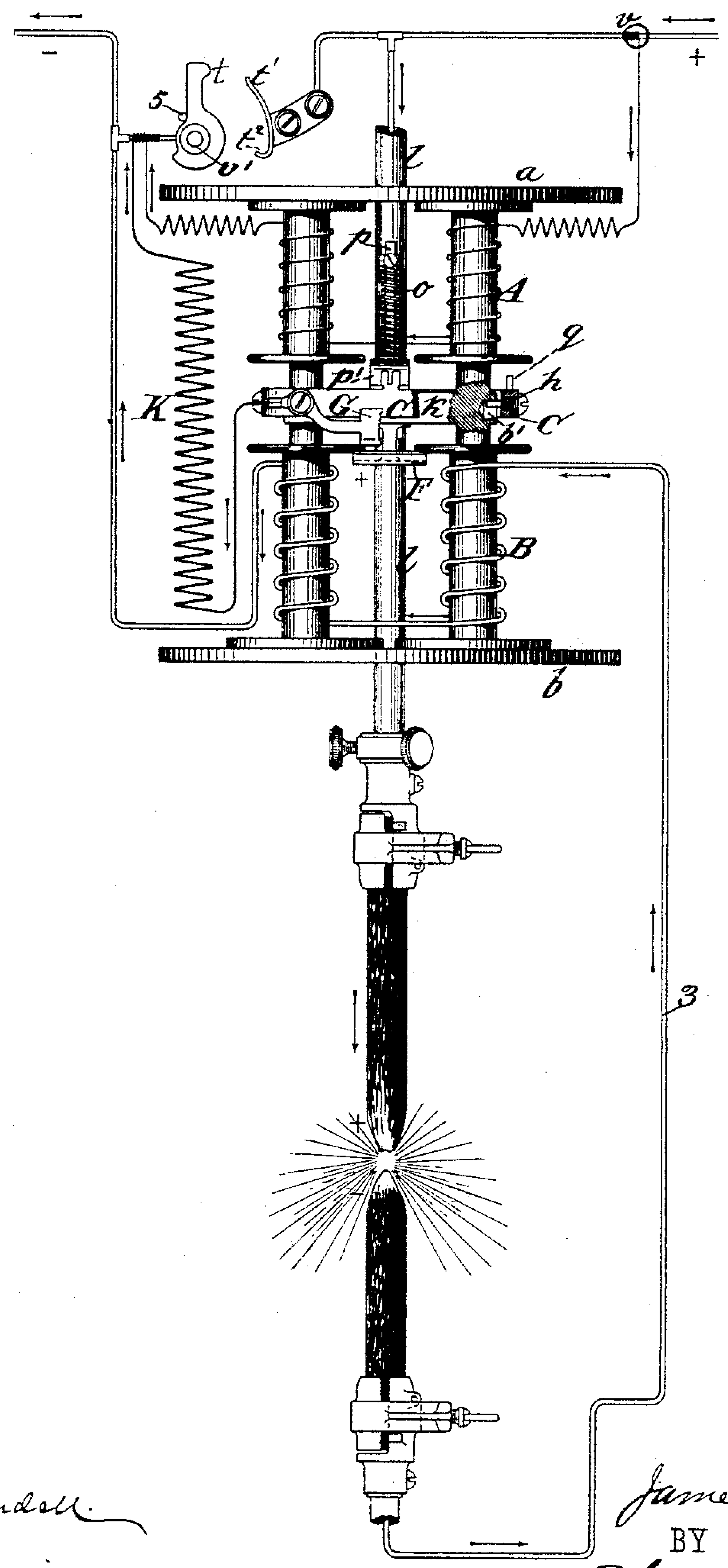
Fig. 5.



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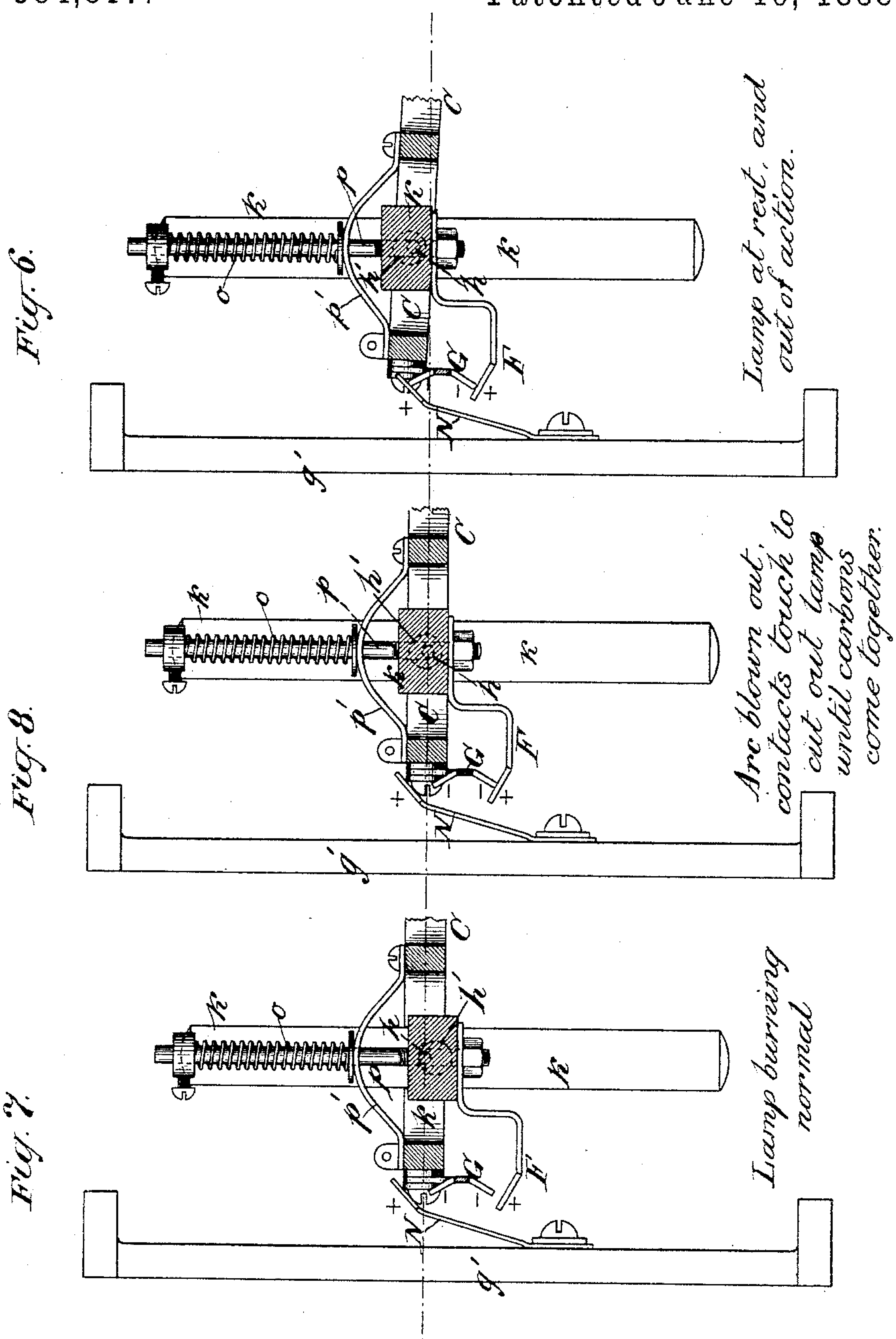

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6 Sheets—Sheet 6.

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ELECTRIC ARC LAMP.

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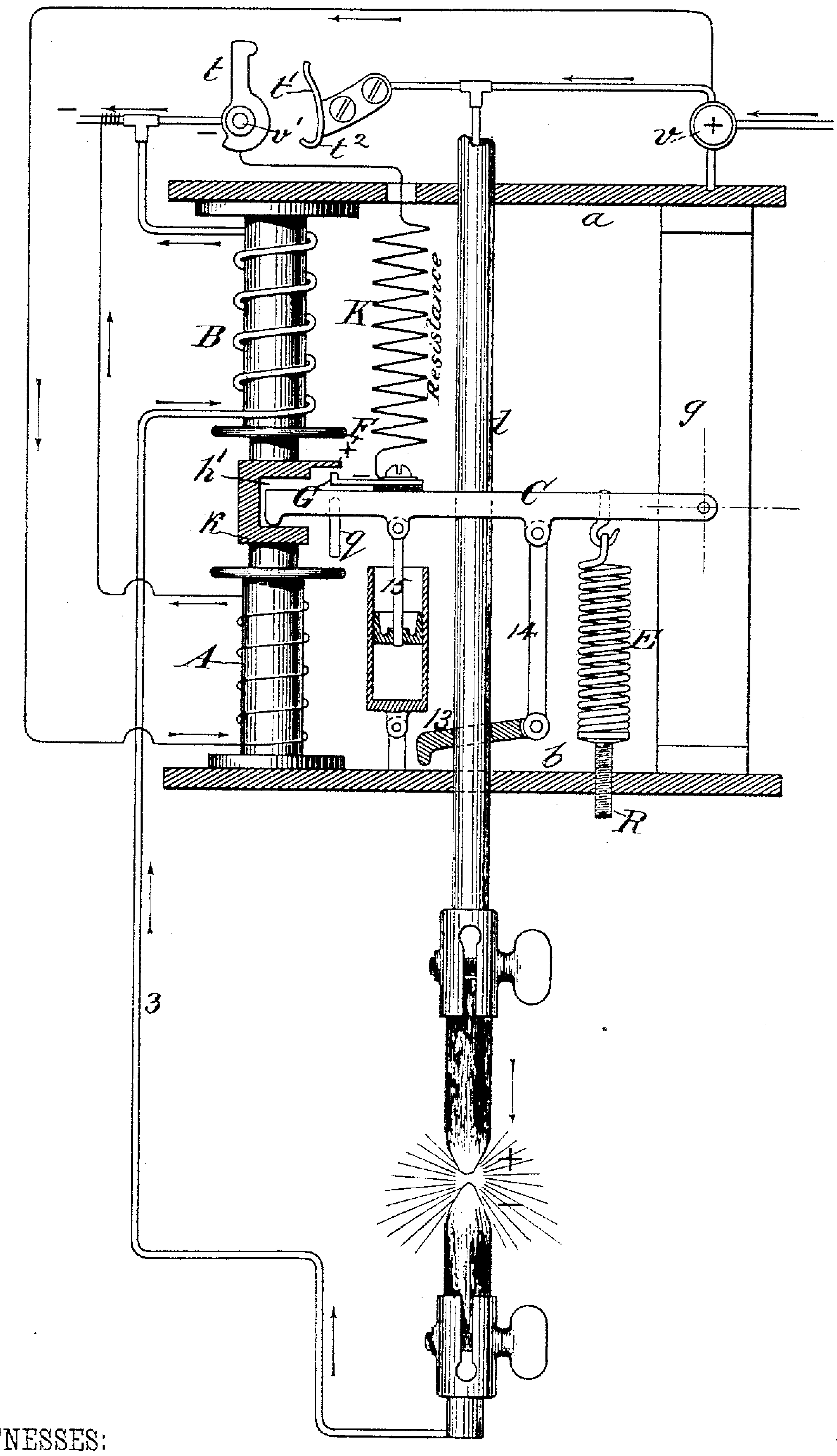
Fig. 9.



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JAMES J. WOOD, OF BROOKLYN, NEW YORK.

ELECTRIC-ARC LAMP.

SPECIFICATION forming part of Letters Patent No. 384,817, dated June 19, 1888.

Application filed August 10, 1887. Serial No. 246,559. (No model.)

To all whom it may concern:

Be it known that I, JAMES J. WOOD, of Brooklyn, Kings county, New York, have invented certain new and useful Improvements in Electric-Arc Lamps, of which the following is a specification.

The chief part of my present improvement relates to an automatic cut-out and relighter to cut out any lamp in a series in case of the blowing out of its arc or any other abnormality, and to automatically relight the lamp as soon as the carbons are again brought together. To effect this result, I arrange an armature to move between main and shunt magnets, as usual, and this armature is connected, as usual, to the mechanism which regulates the feed of the carbons; but there is an idle play in the connection between the armature and the regulating mechanism, or the armature-lever, and contacts are operated by this play to put a resistance-coil or by-pass into or out of parallel circuit with the arc. The arrangement is such that when the lamp is out of circuit a light spring takes up this play and closes the contacts and puts the resistance-coil in parallel circuit with the main magnet and carbons, so that when the lamp is put in circuit the current will divide between the coil and the magnet and carbons, sufficient current being, however, diverted to the main magnet as to partly energize it, and thus enable it to attract and move the armature to take up the play, and thus separate the contacts, which thereby cuts out the coil and diverts the entire current through magnet and carbons, so that the magnet, which will now be fully energized, attracts the armature fully, and forcibly moves the regulating mechanism to separate the carbons and thus form the arc. Should the arc in any lamp now tend to become blown out, the shunt-magnet will become instantly and strongly attracted before the arc can be actually blown out, and will instantly move the armature in the direction of its play and again close the contacts and cut the lamp out of circuit through the coil, the contacts being then held closed by the spring, thus maintaining the current to the other lamps. As soon as the carbons come together the contacts will be again separated and the lamp relighted automatically by the action of the main magnet, as at first described.

My invention therefore consists, mainly, in the features above outlined, also in certain details of construction, as hereinafter fully set forth.

In the annexed drawings, Figure 1 presents a side elevation of my improved lamp, partly in section. Fig. 2 is a sectional plan. Fig. 3 is a front elevation or elevation from the right of Fig. 1, also partly in section. Fig. 4 is a fragmentary front elevation to show the connection of the armature and armature-lever, with the play between the two. Fig. 5 is a general diagrammatic view to illustrate the circuit and action of the parts when the lamp is in action. Figs. 6, 7, and 8 are fragmentary details of the armature, armature-lever, and their contacts, showing the different positions of the same under the different conditions of the lamp. Fig. 9 shows my invention applied to a clutch-lamp, the figure being partly a sectional side elevation and partly a diagram.

Referring first to Figs. 1, 2, and 3, it may be seen that the general mechanical construction of the lamp is of a well-known type, and is substantially the same as shown in my former patent, No. 303,245, in which main and shunt magnets act on an H-shaped armature hung in an armature-lever, which carries a train of wheel-work which meshes at the initial pinion with a rack on the carbon-holder, and the terminal scape-wheel of which is engaged or disengaged by a stop-tooth, so as to effect the separation or feed of the carbons according as the lever and wheel-train is swayed up and down.

In Figs. 1, 2, and 3, A indicates the shunt-magnets, and B the main magnets, which are secured, respectively, to the upper and lower head-plates, *a b*, which are insulated from the exterior covering-plates, *c d*, by the interposed insulation *e*, as seen best in Fig. 1, according to my Patent No. 303,245. Between the heads of the magnets is arranged the armature-lever C, which in plan view has the form of an open T-shaped frame, as seen in Fig. 2, and is fulcrumed on the trunnion-screws *f* in the standards *g g*. In the broad end and long arm of this armature-lever is pivoted the H-armature *k* on the pivot or trunnion screws *h*, which engage the cross-bar of the H, while the limbs or cores on opposite sides fit into the bores of the shunt and main solenoids A B, as will be understood from Figs. 1, 2, and 3. The piston of a dash-pot, *x*, connects to the long arm of the lever, as usual. In the short arm of the lever is mounted the wheel-train D, which is pivoted to the lever on the pivot-screws j, while the initial pinion i of the train engages the rack on the carbon-holder l in the usual manner, which carbon-holder moves centrally in the heads and carries the positive carbon at its lower end, as is usually the case. The upper end of the wheel-train is connected by the pivoted link m to a lug, m', on the upper head, which forms a parallel motion-link practically parallel with the armature-lever to insure a straight up-and-down motion of the wheel-train when the lever is swayed up and down, as will be understood. Normally the retracting spring E depresses the wheel-train and the short end of the lever and raises the long end of the lever toward the heads of the shunt-magnet until stopped by the stop-pin q, which movement will withdraw the scape-wheel d of the train from the fixed stop-tooth d', and thus release the train and allow the carbon-holder to freely descend until the upper carbon touches the lower one. The circuit through the lamp will therefore be completed as follows: From the positive post v (see Fig. 3) the current flows to the inner head-plate, a, and from thence to the inner frame-work and the carbon-holder, and descending from the upper to the lower carbon the current returns by the wire 3 (see Figs. 3 and 5) to the main magnet B, and from the main magnet to the negative post v'. The shunt-magnet A is connected at the opposite ends with the opposite terminals or posts v v', as shown in Figs. 3 and 5. It will hence be seen that the general mechanism of the lamp and the circuit of the magnets so far as described is the same as usual in lamps of this character, and therefore a general description of the operation will not be necessary, as it is the same as usual.

Now, according to my present improvement, the armature k has a limited play in its connection with the armature-lever C in the direction of its stroke by means of elongated holes or slots h', in which the trunnion-screws h engage, as shown by full and dotted lines in Figs. 1, 3, and 4. Now, this play is normally taken up in one direction—that is, toward the shunt-magnet—by a minor retracting-spring, o, which abuts at one end upon a collar fixed to a slender rod, p, which is secured at the base to the armature, and which is free to slide through a bridge-piece, p', fixed to the armature-lever, and on which the opposite end of the spring bears. The effect of the spring o is therefore to normally overbalance the weight of the armature and lift it to one side of its play in the trunnion-slots h' from the main magnet toward the shunt-magnet, as shown in Figs. 1, 3, and 4. When the armature is thus lifted by the spring and its play taken up as described, a contact-tongue, F, fixed on the armature, will be pressed against a contact-tongue, G, fixed on the armature-lever, as seen best in Figs. 1 and 3. Now, this contact G on the lever is insulated from the lever, but connected to one end of a resistance-coil, K, the opposite end of which connects to the negative post, as well shown in Figs. 1 and 3. (See also the diagram in Fig. 5.) The other contact, F, being in connection with the armature, and therefore with the frame and carbon-holder, it is always positive, while the contact G is negative, and it hence follows that when the contacts are closed, as described, a by-pass or circuit is formed through the coil parallel with that through the main magnet and carbons, as is shown best in Fig. 5. Hence when the lamp (with it parts in normal position,) as shown in Figs. 1, 2, and 4, is put in circuit, (see Fig. 5,) the current can divide in two paths, one directly through the main magnets and carbons, and the other through the contacts F G and the resistance-coil K. The coil K will, however, be so proportioned as to offer somewhat more resistance than the magnet and carbons, so as to divert enough preponderance of current to the magnet to partly energize the same sufficient to attract the armature against the stress of the minor retracting-spring o, and thus move the armature to the opposite side of its play, as shown by full lines in Fig. 5, thus separating the contacts F G, and thereby cutting out the coil K, which action will thus divert the entire current through the main magnets and carbons. The main magnets will therefore be now fully energized and will fully attract the armature and move the armature-lever C, and thus actuate the regulating mechanism to separate the carbons and form the arc in the usual way. As the carbons consume and the arc varies, the armature and armature-lever will sway up or down by the opposing attractions of the main and shunt magnets, so as to regulate the feed or separation of the carbon points in the usual way. When the lamp is therefore burning normal, as described, the contacts F G will be in about the position shown in Figs. 7 and 5, separated, but oscillating toward and from each other, due to the regulating oscillations of the armature-lever without touching. If, however, a strong gust of wind should now blow out or tend to blow out the arc, the shunt magnet will instantaneously and greatly increase in strength and lift the armature bodily, with the assistance of the spring o, to the opposite side of its play, and thus bring the contacts together, as shown in Fig. 8, and thus cut the lamp out of circuit through the coil; or, rather, put the coil in parallel circuit with the carbons, which coil will now safely carry all the current to the other lamps in the series, and thus maintain the continuity of the circuit intact. When the lamp is thus cut out, the shunt-magnet of course entirely loses its power, but the spring o still continues to hold the contacts together to keep the lamp cut out. Now, this cutting out of the lamp will not of course be permanent or constant, like the usual short-circuit or safety-shunting devices, but temporary only so long as the abnormality of the arc or carbons continues, for as soon as the carbons are again brought together by the normal action of the feeding mechanism the main magnet will again act to separate the contacts and cut out the coil, and thus switch the entire current again through the main magnet and carbons to again form the arc, as already described, and shown in Figs. 5 and 7.

It will thus be seen that by this system each lamp is provided with an automatic cut-out and relighting device, which will not only automatically cut the lamp out of circuit and keep the circuit intact to the other lamps in case the arc becomes dangerously long or is blown out, but will also automatically switch in or relight the lamp as soon as the condition causing such abnormality ceases. This is an important advantage over the ordinary cut-out, which cuts the lamp out permanently, whether the abnormality is temporary or permanent. Hence with the improved cut-out no attention to the lamps when the circuit is in operation is necessary, for if any lamp is cut out momentarily it will be immediately afterward relighted if there is no actual defect therein, whereas if a real defect exists it will remain cut out until such defect is corrected, so that the attendant can thus tell at once when a cut-out lamp is defective and needs his attention, which is not the case with the permanent cut out, and is a great objection thereto in causing the permanent extinguishment of non-defective lamps and requiring much more attention on the part of the operators to keep the lamps in action.

By referring again to Figs. 6, 7, and 8 the relative position and action of the contacts under different conditions of the lamp will be more fully appreciated. In Fig. 7 it will be noted by referring to the central dotted line that the armature-lever is in its horizontal or balanced position, where the attraction of the magnets balances the retracting-spring, and hence where the regulating mechanism just holds the carbons separate at their normal position for the normal arc, in which position the lamp is burning normal. In this position it will be noted that the armature is attracted downward to the full extent of its play in the slot *h'*, and the spring *o* is slightly compressed, while the contacts F G are of course separated. Suppose now that a gust of wind should blow out or nearly blow out the arc. The attraction of the main magnet being now counteracted by the increase of the shunt-magnet, the armature-lever would tend to sway out of the horizontal position, so as to move the regulating mechanism and thus feed the carbons together; but owing to the inertia of the parts this would not occur quickly enough to be effective. Instead, however, of the armature-lever moving, inertia will hold it still in the horizontal position shown in Fig. 8; but as the shunt-magnet will become instantly and strongly attractive, it will lift the armature *k* bodily and move it to the opposite side of its play, as shown in Fig. 8, thus bringing the contacts F G together and temporarily cutting out the lamp until the abnormality ceases. It will therefore be seen that as the armature is free to move or play a limited distance in the armature-lever independent of the lever and the regulating mechanism therewith connected, and as its inertia is slight and its weight is balanced or more than balanced by the spring *o*. Hence the shunt-magnet has great mechanical advantage and can act in an absolutely instantaneous manner to move the armature on the very instant and cut out the lamp before the arc can be fully extinguished by a gust of wind. After the lamp is cut out the armature-lever will be swayed by the main retracting-spring E into the position in which it allows the free downfeed of the carbon, as indicated in Fig. 6, in which the lever appears inclined from the level dotted line, and the contacts F G will be still kept in contact, but will have been moved or scaped over each other, as will be seen by comparing Figs. 6 and 8. It will be noted that the contact F always moves vertical with the armature, while the contact G moves in a curve from the fulcrum of the lever and at a longer radius than the contact F, and hence a scaping sliding contact will always take place when the contacts F G act, which will of course serve to keep the contacts clean and bright and in good conducting condition. When the armature-lever is swayed to the limit of its retracted position, an upward prong on the contact G may be arranged to contact with a contact-tongue, N, on the standard *g'*, (see Figs. 6 and 7,) which contact N is positive, and thus makes a second point of contact to render the cut out more certain. This double contact will therefore always be made when the armature-lever is fully retracted, and will therefore render the contact more sure when the lamp remains cut out for a long period, due to some actual defect. In most cases, however, I prefer to omit the second contact N, which is, however, substantially the same as shown in my patent, No. 233,589, of 1880.

It may now have been observed that my lamp always presents two paths for the current when the carbons are separated—viz., one through the shunt and the other through the resistance coil K, which latter is able to carry the entire current. Hence, when the hand-switch is operated to put the lamp in or out of circuit, it is impossible to injure or burn the shunt or cause the switch to flash or burn whether the carbons are separated or not, for at the moment when the switch is opened the current can always pass through the resistance-coil if the carbons are apart, or through the carbons themselves if they are in contact. Hence, whether the carbons are separated or not at the moment the hand-switch is operated, no harm can be done, as would be the case if the shunt-magnet were the only path for the current when the carbons were separated and the switch opened.

Now, the hand-switch in my present lamp embodies some novel details of construction, and is also arranged to support the resistance-coil in a peculiar way, as best shown in Figs. 1 and 3. The axis of this switch consists of a vertical spindle or rock-shaft, y, which passes through a non-conducting sleeve, y', in the lower head-plates, b d, while the upper end is stepped into the base of the negative post v', as best seen in Fig. 3. The lower end of the spindle below the frame or plate d is provided with a non-conducting T-handle, y^2, for manipulation. On the upper end of the spindle, just under the post v', is fixed a contact-making crank-arm, t, arranged to contact with a circumferential contact-spring, t', in the path of the crank or tangent to its sweep, as seen best in Fig. 2, also in diagram in Fig. 5. The spring t is secured to the head-plate a, and is therefore positive, whereas the crank, being in contact with the negative post, is negative, and when the two are swung into contact, as in Fig. 2, the lamp will be switched out in a short circuit from post to post through the head-plate a, crank t, and spring t'. When the crank is swung in the opposite direction by a partial turn of the handle y^2, the switch will be open, as seen in Fig. 5. The opening motion of the switch is limited by a pin, 5, on the post v', (see Figs. 3 and 5,) while the closing motion is limited by a hook, t^2, on the spring t'.

The resistance-coil K is preferably made of German silver wire wound in two spiral layers upon the switch-spindle y, between the heads a b. The inner spiral is of reverse inclination to the outer, as shown in Fig. 3, and both spirals connect continuous at the lower end. The upper end of the inner spiral connects to the post v', while the terminal of the outer spiral is bent into horizontal zigzag folds descending to the bottom of the coil, and finally connecting to the contact G on the armature-lever C, thus providing a very flexible or yielding connection of the coil with the lever contact, which permits the lever to move freely without obstruction from the coil. The spirals of the coil are separated from the spindle y and from each other by vertical strips s of asbestus paper, mica, or similar heat-proof non-conductor, which, as will be noted, also allows free ventilation of the coil when heated by the passage of the current. The spindle, as will be understood from Figs. 1 and 3, is free to turn within the coil, which loosely encircles it, and the spindle is supported on the insulating bushing y' by the fixed collar 10, and over the collar is placed an insulating washer, 12, to prevent contact of the coil with the collar. It will therefore be seen that the described manner of forming and arranging the coil disposes it in the lamp in a manner which is very compact and convenient, and also very safe and simple.

By referring to Fig. 1 it may be noted that the parallel motion-link m, instead of connecting directly to the clock-work movement D, connects to an adjustable crank-hub or toggle-hub, m^2, mounted on one of the cross-bars of the movement, on which it may be partly turned or adjusted and held by a clamp-screw, m^3. This adjustment, it will be seen, will have the effect of practically lengthening or shortening the link m, and will thus project the clock-movement farther from or nearer to the carbon-holder, and thus regulate the mesh of the pinion i in the rack l.

The main retracting-spring E, as seen best in Fig. 1, has a loop at its upper end to engage a hook, e', on the lower cross-bar of the clock-movement, as usual; but the lower end is secured to a nut, P, which screws upon a fixed screw, R, which projects upwardly from the head-plate b. It will therefore be seen that by unhooking the spring at its upper end it may then be turned in one way or the other, so as to screw its nutted end up or down on the screw, and thus regulate the spring to the desired tension, and when the attaching end is again slipped on the hook this adjustment will be retained proof to any chance of change by jarring or unscrewing, as the hooked engagement prevents, of course, the turning of the spring. Hence by this means the use of jam-nuts or locking devices to hold the spring at the desired adjustment is obviated, and while such jam-nuts are not certain in their holding action, but frequently jar loose, I provide by the means described a very simple adjustable tension device which cannot possibly alter itself when once set, which has been a very desirable thing to secure in electric lamps. I prefer to fasten the spring to the nut by cutting a shallow thread thereon of the same pitch as the wind of the spring, and screwing the end of the spring thereon down to a shoulder, as shown in Fig. 1; but the spring may be secured by soldering or other means. Instead of having the nut fixed to the spring to turn on a fixed screw, the screw may be fixed to the spring to turn in a fixed nut, as seen in Fig. 9.

In the leading figures I have shown my automatic cut-out and relighting device applied to what is known as "wheel-work" or "clock-work" lamps, for which it is more particularly adapted; but it may of course be applied to clutch-lamps or any other type of arc lamp. Fig. 9 shows the invention applied to a clutch-lamp, in which 13 indicates the tilting-clutch collar encircling the carbon-holder, and connected by link 14 with the armature-lever C.

E indicates the retracting-spring, and 15 the piston of a dash-pot, also connecting to the armature-lever.

A B indicate the shunt and main magnets, which are reversed in position—that is, the main being above the shunt, as illustrated.

k indicates the armature, which plays between the two magnets, as usual, but in the middle or cross-bar of which is a recess, k', in which the end of the armature-lever is engaged in such a way as to allow a limited idle play between armature and lever with the same effect as shown in the other lamp.

G is the negative contact-point, secured to and insulated from the armature-lever, as before described, and F the positive contact-point on the armature.

K is the coil connected with the contact G and terminal v', as before. The action is, therefore, as follows: When the lamp is at rest, the armature k gravitates toward the lower plate, b, and the lever C is retracted toward the shunt-magnet until the stop-pin q rests on the head of the magnet, in which position the armature will have gravitated out of contact with the armature-lever in the recess h'; but the contact F will rest on the contact G, thus putting the coil K in circuit. As soon as the switch t is opened and the carbons are together, the current will divide between the coil K and the main magnet B, energizing the latter weakly, but just enough to lift the armature as far as the play in the recess h' will allow, and thus separate the contacts F G, which will then cut out the coil and send the entire current through the carbons and main magnet, causing the latter to be energized fully and to forcibly move the armature-lever C and lift the clutch-collar 13 and the carbon-holder, and thus form the arc, as illustrated in Fig. 9. The lamp will now continue to burn uniformly, the carbons being regulated in the usual way by the actions of the regulating-magnets, &c., until a sharp blast of wind or other cause—such as failure to feed—should tend to extinguish the arc, when the shunt-magnet would instantly draw down the armature and close the contacts F G, and thus cut out the lamp through the coil K until such abnormal condition ceased, when the lamp would become again automatically relighted in the manner already described as soon as the carbons came in contact. The course of the current in the different parts can be readily followed from the diagram lines in Fig. 9, which shows the lamp in normal action.

It will be seen that one great advantage of the main feature of my lamp is that by the play in the connection between the armature of the regulating-magnets and the armature-lever or regulating mechanism with the cut-out contacts operated by such play, I make the usual regulating-magnets serve as the automatic cut-out and relighting-magnets; but I do not, of course, limit myself strictly to this, as the magnets which operate the cut-out contacts may be the regulating-magnets or special magnets without departing from the essence of my invention.

It will be also understood that my invention may be modified or varied in many of its details without making any departure from its principle, and I do not therefore confine myself to the exact arrangements shown in the drawings; but

What I claim as the essential features of my invention are as follows:

1. In an electric-arc lamp, the combination with a regulating-magnet and its armature and armature-lever, having a play in the connection between the lever and armature, of a contact on the armature and a contact on the lever, and a by-pass around the arc connected to and completed through said contacts, substantially as and for the purpose set forth.

2. In an electric-arc lamp, the combination, with the adjustable carbons and mechanism to adjust the same, of an electro-magnet in the circuit of the lamp, an armature actuated thereby interposed between the magnet and the regulating mechanism and connected with the same, with a limited play in the connection, contacts operated by said play, and a short circuit or by-pass around the arc which is completed through said contacts, substantially as and for the purpose set forth.

3. In an electric-arc lamp, the combination, with a main magnet in the arc-circuit and a minor magnet in a shunt to the arc, of an armature moving between and actuated by the two, regulating mechanism to control or adjust the carbons connected with said armature with a limited play in the connection, a movable contact on the armature and a second contact adjacent thereto, which contacts are opened or closed by the independent play of the armature, a by-pass or resistance-coil parallel to or around the arc completed through said contacts, whereby the main magnet will pull the armature on one side of its play, open the contacts and cut out the coil, cut in the lamp, separate the carbons, and form the arc, while the shunt-magnet will move the armature to the other side of its play, close the contacts, cut in the coil, and continue the current to the other lamps until the arc in the abnormal lamp is restored, substantially as herein shown and described.

4. In an electric-arc lamp, the combination, with movable or adjustable carbons, an electro-magnet in circuit with the carbons, an armature actuated thereby, an armature-lever for adjusting the carbons connected with said armature with an idle play in the connection, contacts operated by said play, an auxiliary conductor or resistance-coil parallel with or around the arc connected with and completed through said contacts, and a retracting-spring, such as o, which normally takes up the play between the armature and armature-lever and closes said contacts, substantially as herein set forth.

5. The combination, in an arc lamp, with mechanism to adjust the carbons, a magnet to control the regulating mechanism, an armature actuated thereby and connected to said mechanism with a limited play in the connection, contacts operated by said play, and an auxiliary conductor in a parallel path with the arc completed through said contacts, with a minor retracting device acting to retract the said armature directly to take up the said play and close said contacts, and a main retracting device connected with the regulating mechanism to move it in opposition to the main attraction of the magnet, substantially as herein shown and described.

6. In an electric-arc lamp, the combination,

with a regulating-magnet, an armature actuated thereby, and an armature-lever therewith connected with a limited play in the connection, of a contact on the armature and a contact on the lever of opposite polarities, and a contact on the fixed frame of the same polarity as that on the armature, the lever-contact being adapted to make and break contact with the other two, with a short circuit or by-pass around the arc connected with the lever-contact and put into or out of circuit by the meeting or separation of said contacts, substantially as herein shown and described.

7. In an electric-arc lamp, a hand switch having an elongated rotary spindle, with a resistance-coil wound over and mounted loosely upon the said spindle.

8. In an electric-arc lamp, the combination, with a hand-switch having an elongated rotary spindle extending vertically between the heads of the lamp-frame and journaled therein, of a fixed resistance-coil wound over and encircling the spindle between the heads, but unattached to or loose upon said spindle, substantially as herein shown and described.

9. In an electric lamp, the combination, with a switch-spindle, *y*, of a resistance-coil, K, mounted upon and loosely encircling the same, and interposing strips *s* of heat-proof insulating material, substantially as described.

10. In an electric lamp, in combination with a rack carbon-holder and a wheel-train meshing therewith, the adjustable crank or toggle-hub *m′* and connecting-link *m*, arranged and operating substantially as and for the purpose set forth.

JAMES J. WOOD.

Witnesses:
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