(No Model.) 3 Sheets—Sheet 1.

A. HARDING.

ELECTRIC ARC LAMP.

No. 380,435. Patented Apr. 3, 1888.

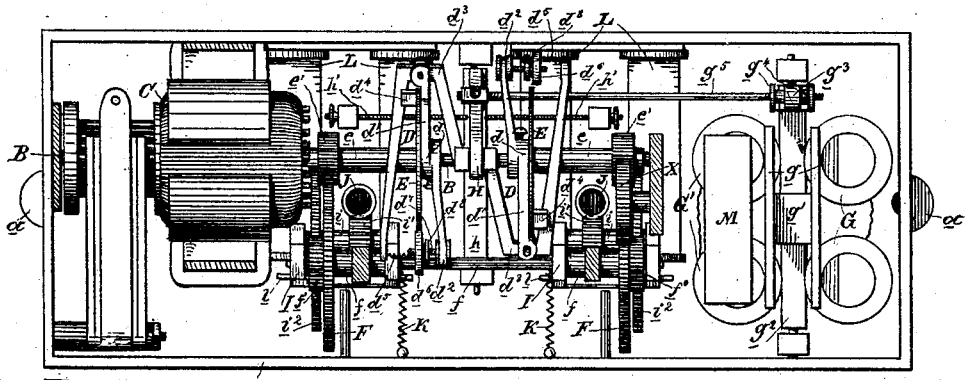

Fig. 1.

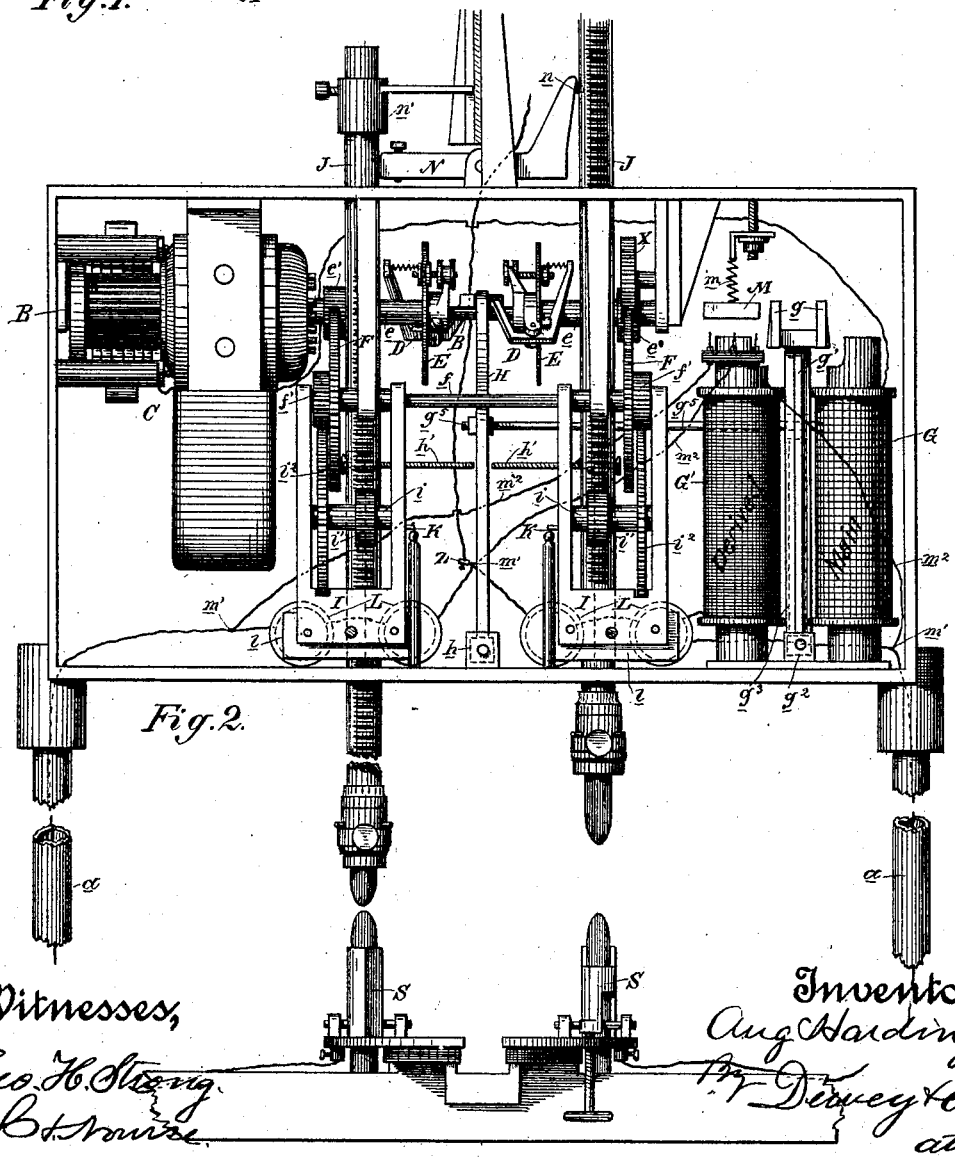

Fig. 2.

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Fig. 3.

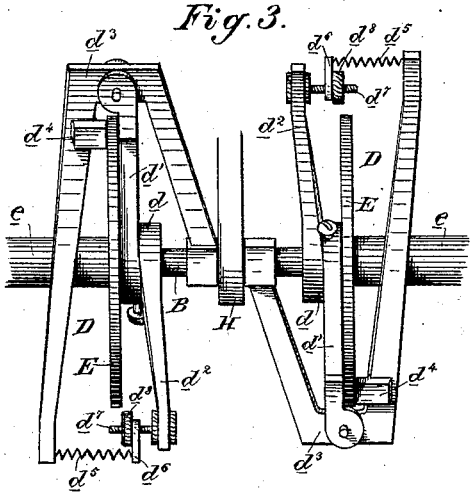
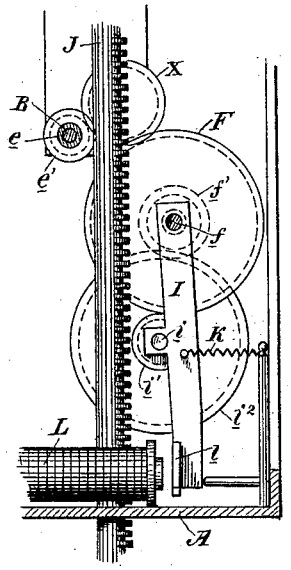


Fig. 4.



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(No Model.) 3 Sheets—Sheet 3.

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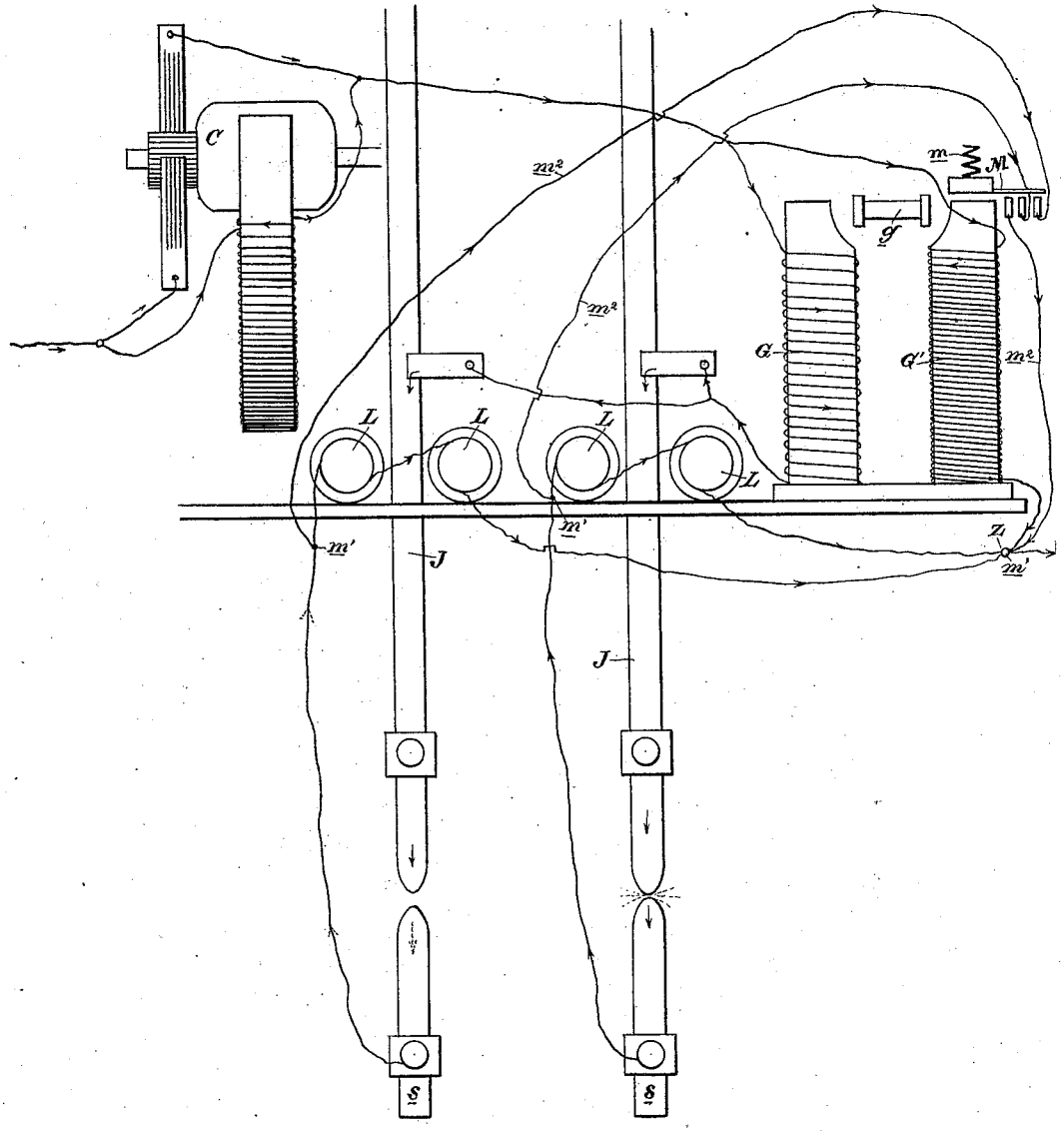
Fig. 5.



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UNITED STATES PATENT OFFICE.

AUGUST HARDING, OF OAKLAND, CALIFORNIA.

ELECTRIC-ARC LAMP.

SPECIFICATION forming part of Letters Patent No. 380,435, dated April 3, 1888.

Application filed April 23, 1887. Serial No. 235,934. (No model.)

To all whom it may concern:

Be it known that I, AUGUST HARDING, of Oakland, Alameda county, State of California, have invented an Improvement in Electric-Arc Lamps; and I hereby declare the following to be a full, clear, and exact description of the same.

My invention relates to that class of electric-arc lamps in which means are employed, controlled by an electro-magnet in the main circuit and an electro-magnet in a derived or shunt circuit around the arc, for automatically adjusting the carbon points; and it more especially relates to that kind of an electric-arc lamp which has heretofore been patented by me, No. 356,282, dated January 18, 1887, and in which there is employed a shaft and an electric motor tending to turn it in one direction only, said shaft being connected by suitable gearing with the carbon holder or rod, whereby it is both raised and lowered.

My invention consists in certain improvements in the means for transmitting the motion from the shaft to the carbon holders or rods, said improvements consisting in peculiarly-constructed clutches fixed upon the shaft and acting in connection with friction-gears loose thereon; in swinging brackets or hangers carrying pinions forming part of the chain of gearing and meshing with the ratchet-faces of the carbon-rods, said brackets or hangers being separately and independently controlled to throw their pinions into and out of engagement by electro-magnets forming part of and peculiarly connected with the main circuit, whereby one is brought in while the other is thrown out of the circuit; in the means for dropping either rod by short-circuiting said magnets when the arc becomes abnormally long, and in other details of construction, all of which I shall hereinafter fully describe.

The objects of my invention are to improve the mechanical transmitting devices by which the power of the rotating shaft is transmitted to operate the carbon holders or rods; to provide for operating one only at a time, the others being out of gear; to provide for dropping the rod or holder when the arc becomes abnormally long by reason of the failure of the controlling mechanism to operate, and to provide simple and effective means for hanging one rod up at the moment it disengages the other.

Referring to the accompanying drawings for a more complete explanation of my invention, Figure 1 is a top view of my lamp, the upper plate of the frame being removed. Fig. 2 is a front elevation. Fig. 3 is a detail view of the clutches and surroundings. Fig. 4 is a detail view of one hanger, I, and surroundings, looking at the edge of the hanger. Fig. 5 is a view showing the path of the current.

A is the frame, having the downwardly-extending posts or rods *a*. In the frame and near its top is mounted a shaft, B, to one end of which is secured an electric motor, C, the tendency of which is to rotate the shaft in one direction only.

Upon the shaft and near its center are fixed rigidly the friction-clutches D. These consist, as shown in Fig. 3, of hubs *d*, provided with a radially-extending arm, d', and an oppositely-extending arm, d^2. In the end of the former arm is pivoted an approximately U-shaped piece, d^3, having one short leg and one long leg, the latter of which carries the frictional shoe or clamp d^4 and has its end connected by a spring, d^5, with a sliding piece, d^6, mounted upon a screw, d^7, seated in the arm d^2 of the hub and adapted to be moved to adjust the tension or frictional power of the clutch by means of a nut, d^8.

E are two friction-gears having sleeves *e*, which are loose on the shaft B. The rims of these gears are pressed against normally by the frictional shoe or clamp d^4 of the clutch, whereby said gears are normally fixed to the shaft, but either may be released by forcing over the shorter arm of the U-shaped piece d^3, whereby the frictional shoe or clamp is forced over from the disk, thereby freeing it. The springs d^5 hold the clutches to their place and may be adjusted by means of the nut d^8 to regulate their frictional contact.

Upon the ends of the sleeves *e* are pinions e', the pinion of one sleeve meshing directly with a gear, F, on one end of a counter-shaft, *f*, while the pinion of the other sleeve meshes with the other gear F on the other end of the shaft through the intervention of an idler-pinion, X, so that it will be seen that the motion transmitted from one end of the shaft B is the reverse of that transmitted from the other end, and therefore as long as both clutches D, which are fast upon the shaft, remain fixed to

their engagement with the friction-gears E it is obvious that said shaft cannot move at all, because of the intervention of the idler-pinion on one side. In order, therefore, to permit said shaft to move, it is necessary to relieve one of the friction-gears E from its clutch, leaving the other friction-gear connected with the shaft, and through said gear and the parts on that side the counter-shaft *f* will be rotated in one direction. By releasing the second gear and holding the first the shaft *f* will be rotated in the opposite direction. It will be seen, therefore, that by gearing this counter-shaft with the ratchet-face of the carbon-holder said holder may be raised or lowered by power transmitted from the shaft B, though said shaft rotates in but one direction. This general result is the same as that attained by my previous patent heretofore referred to, and the difference thus far between that patent and the present one is in the employment of the independent friction-clutches on the shaft B instead of the single double-faced friction-gear shown in that patent.

The operation of the friction-clutches herein described is effected by the following mechanism:

G is an electro-magnet in the main circuit, and G′ is an electro-magnet in a derived or shunt circuit around the arc. Between these are armatures *g* upon the upper end of a standard, *g′*, having a pivoted cross-base, g^2, from which at one end extends upwardly an arm, g^3, to the upper end of which is adjustably connected by means of the nuts g^4 a rod, g^5, the other end of which is connected with a lever, H, having a pivoted cross-base, *h*, and its upper end fitted loosely upon the shaft B between the two short arms of the clutch-pieces d^3.

h′ are screw-stops for limiting the movement of lever H.

It will be seen from this connection that when the magnet G attracts the armature the lever H is moved over to one side into contact with the short arm of the clutch-piece d^3, thereby freeing said clutch clamp or shoe from the friction-gear E on that side and throwing said gear out of engagement with the shaft B, so that said shaft rotates with the friction-gear E on the other side, thereby transmitting its power through the chain of gearing on that side to the carbon holder or rod. When the shunt-magnet G′ attracts the armature, the reverse operation takes place and the power of the shaft B is transmitted through the gearing on the other side to the carbon holder or rod, reversing its movement.

I need describe but briefly the manner in which the magnets operate in this connection, as their function in this class of lamps is well known. As the carbon burns out and the resistance of the arc grows greater, the current through the shunt-circuit becomes stronger, and the armature *g* is attracted by the said magnet, whereby the carbon holder or rod is fed down by the mechanism, operating as I have just described. As the carbons get close, the resistance of the arc is weakened, and the magnet G in the main circuit becomes relatively strong enough to attract the armature *g*, and through the mechanism I have just described the carbon holder or rod is raised. It will be seen, therefore, that the rod is under perfect control. This is the operation supposing the chain of gearing to be a continuous one between the counter-shaft *f* and the carbon holder or rod; but in case the current is interrupted for any cause and at the time of the interruption the carbon points are separated it is obvious that, as the governing-magnets are no longer in operation, the points will remain separated, and will thereby prevent the re-establishment of the current; but if by the breaking of the current the chain of gearing is also broken, then the carbon-rod, being free, will drop so as to bring the points into contact, in order to permit the re-establishment of the current. To accomplish this result and also to provide for the employment of two or more carbon rods or holders, all but one of which shall be out of engagement when the lamp is in operation, I have the following mechanism: Upon the counter-shaft *f* are pivoted the depending brackets or hangers I, which carry small shafts *i*, having pinions *i′* and large gears i^2, which mesh with pinions *f′* on the ends of the counter-shaft. The pinions *i′* mesh with the ratchet-faces of the carbon holders or rods J, two of which are here shown. The brackets or hangers are held back, so that their pinions do not engage the ratchet-faces of the carbon holders or rods, by means of springs K.

L are electro-magnets in the main circuit, as I shall presently describe, said magnets being for the purpose of attracting the armatures *l* on the lower ends of the swinging brackets or hangers I. Now, when the lamp is set in operation, the magnet L is energized, so that it attracts its armature, thereby drawing in the swinging bracket and throwing its pinion to engagement with the carbon holder or rod. When the current is interrupted or broken, the magnet L is de-energized, whereby the spring K draws back the swinging bracket, thereby throwing its pinion out of engagement with the carbon-holder, thus permitting it to drop down again and re-establish the current; but in order to provide for the operation of but one carbon holder or rod at a time I provide that each bracket or hanger I shall be operated by its own magnet L, and I connect these magnets electrically, as shown at Z, Fig. 2, where the current passes out, and let both magnets into the main circuit, which for the purpose I intend is made to include the frame-posts *a*, the lower-carbon holders S and their carbons, and the carbon holders or rods J and their carbons, said circuit being branched through these parts. Thus, though both magnets L are in the main circuit, the current can flow only through that branch including that magnet L whose rod J is then in operation, be-

cause the circuit is then completed through the arc. The other rod being held up, its circuit is open and the current will not pass through its magnet L. It follows, therefore, that but one of the magnets L is energized at a time, so that the gear-chain of the other rod is broken, as I have heretofore described. It will thus be seen that by this construction I accomplish the double object of providing for a renewal of the current when it is interrupted, and also for operating but one of the rods at a time. Now, in case that any accident happens to the mechanism whereby it or any of its parts—such as the motor or the shaft B—fails to operate, and consequently through an undue separation of the carbons the arc becomes abnormally long, I provide for cutting out of the circuit the magnets L, so that the swinging hangers will fall away, and thus break the chain of gearing, permitting the carbon-rods to drop down, and, the mechanism being out of order, they will remain so, thus avoiding any interference with the current. To accomplish this I provide for short-circuiting said magnets by connecting, as shown in Fig. 2, their inleading and outleading wires at points m' by wires m^2, the upper ends of which are electrically disconnected except when an armature, M, placed above the shunt-magnet G′ and held back by a spring, m, moves down to contact. Now, when the arc becomes abnormally long by a failure of the mechanism to properly feed the carbon down, and the resistance through the arc thereby becomes greater, the shunt-magnet becomes stronger and will attract its armature M, whereby a short circuit is established, so that the magnets L are de-energized and the hangers are permitted to drop away, thus breaking the chain of gearing and effecting the desired object.

N is a lever pivoted on the top of the frame A and having on one end a pin, n, which engages a notch or socket in the side of one of the carbon-holders, whereby said holder is held in an elevated position. The other arm of the lever projects to one side, so as to adapt a collar or shoulder, n', on the other carbon holder or rod to come in contact with it, whereby the lever is rocked sufficiently to remove the pin in its other end from the socket in the other carbon-holder, thereby releasing said holder and allowing it to drop down to position, this drop taking place when the limit of motion of the other rod or holder has been attained.

It is obvious that by means of the independent hangers I, with their gears and circuit-connections, I may have three, four, or more carbon holders or rods, as may be found convenient.

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

1. In an electric-arc lamp, and in combination with a shaft and an electric motor tending to turn the shaft in one direction, independent friction-clutches fast on the shaft, independent friction-gears loose on the shaft, each engaged normally by a clutch, power-transmitting mechanism between the loose friction-gears and the carbon holder or rod, and a means controlled by an electro-magnet in the main circuit and an electro-magnet in the shunt-circuit around the arc for throwing either of the clutches from its engagement with its friction-gear, substantially as herein described.

2. In an electric-arc lamp, and in combination with a shaft and an electric motor tending to turn the shaft in one direction, independent friction-clutches fast on the shaft, independent friction-gears loose on the shaft, each engaged normally by a clutch, power-transmitting mechanism between the loose gears and the carbon holder or rod, an electro-magnet in the main circuit and an electro-magnet in the shunt-circuit around the arc and armatures operated thereby, and pivoted levers operated by the armatures and connecting devices, whereby either of the fast clutches is thrown from its engagement with its friction-gear, substantially as herein described.

3. In an electric-arc lamp, and in combination with a shaft and a motor tending to turn the shaft in one direction, independent friction-clutches fast on the shaft, independent friction-gears loose on the shaft, each engaged normally by a clutch, power-transmitting mechanism between one of the loose gears and the carbon holder or rod, so as to feed said holder down, power-transmitting mechanism between the other loose gear and the carbon holder or rod, whereby it is raised, and a mechanism controlled by an electro-magnet in the main circuit and an electro-magnet in a shunt-circuit around the arc for throwing either of the clutches out of engagement with its friction-gear, substantially as herein described.

4. In an electric-arc lamp, the loose friction-gears E, forming a part of the chain by which the power is transmitted to operate the carbon holders or rods, in combination with the independent clutches D, consisting of the hubs fast on the power-shaft and having oppositely-extending arms, U-shaped pieces pivoted in one of said arms and having a friction shoe or clamp bearing against the friction-gear, and an adjustable spring-connection between one of the arms of said U-shaped pieces and the other arm of the hub, whereby the shoe is held to its engagement, substantially as herein described.

5. In an electric-arc lamp, two or more vertically-adjustable independent carbon holders or rods and mechanism normally out of gear for operating them, in combination with independent electro-magnets for throwing said mechanism into gear with each carbon holder or rod separately, said magnets being electrically connected and let into the main circuit by-branches through the holders or rods and the arcs of their carbons, whereby the operating mechanism of but one holder is effected at one time, substantially as herein described.

6. In an electric-arc lamp, a shaft having an

electric motor tending to turn it in one direction only and a carbon holder or rod, in combination with a chain of gearing between the rotating shaft and said holder or rod, a swinging bracket or hanger carrying gears forming part of said gear-chain, and an electro-magnet in the main circuit for completing and breaking the chain of gearing by swinging the bracket, substantially as herein described.

7. In an electric-arc lamp, a shaft having a motor tending to turn it in one direction and vertically-adjustable carbon holders or rods, in combination with the chain of gearing between said shaft and said holders or rods by which they may be raised and lowered, independent swinging brackets or hangers carrying gears forming part of said chain of gearing, and electro-magnets for swinging the brackets or hangers to make or break the chain of gearing, said magnets being electrically connected and let into the main circuit by branches which include the carbons and their holders or rods, whereby but one carbon may be in operation at one time, substantially as herein described.

8. In an electric-arc lamp, and in combination with a shaft and an electric motor tending to turn the shaft in one direction, independent friction-clutches fast on the shaft, independent friction-gears loose on the shaft, each engaged normally by a clutch, a chain of gearing from one end of the shaft to feed the carbon holder or rod down, a chain of gearing from the other end of the shaft to raise said holder or rod, a mechanism controlled by an electro-magnet in the main circuit and an electro-magnet in a shunt-circuit around the arc for throwing either of the clutches out of engagement with its friction-gear, whereby one gear-chain is rendered operative and the other broken, a swinging bracket or hanger carrying gears forming part of the gear-chains, and an electro-magnet in the main circuit for swinging the bracket or hanger to make or break the chains of gearing, whereby the carbon holder or rod is relieved to drop to contact when the current is interrupted, substantially as herein described.

9. In an electric-arc lamp, a shaft having an electric motor tending to turn the shaft in one direction and carbon holders or rods, in combination with independent friction-clutches fast on the shaft, independent friction-gears loose on the shaft, each engaged normally by a clutch, chains of gearing from said shaft to the carbon holders or rods, whereby they may be raised or lowered, a mechanism controlled by an electro-magnet in the main circuit and an electro-magnet in a shunt-circuit around the arc for throwing either of the clutches out of engagement with its friction-gear, a swinging bracket or hanger for each holder or rod and carrying gears forming part of the chains of gearing, and an electro-magnet for each hanger, said magnets being electrically connected and let into the main circuit by branches which include the carbons and their holders or rods, whereby the chain of gearing to each holder or rod may be completed or broken and but one carbon operated at one time, substantially as herein described.

10. In an electric-arc lamp, a rotating shaft, a carbon holder or rod, and a gear-chain by which the holder or rod is operated, in combination with a swinging bracket or hanger carrying gears forming part of the chain of gearing, an electro-magnet in the main circuit for completing said chain by swinging the bracket or hanger, a short circuit, and an electro-magnet and armature in said circuit, whereby the hanger-controlling magnet is short-circuited when the arc becomes abnormally long and the chain of gearing thereby broken to allow the holder or rod to drop, substantially as herein described.

11. In an electric-arc lamp, a shaft having an electric motor tending to turn it in one direction and carbon holders or rods, in combination with independent friction-clutches fast on the shaft, independent friction-gears loose on the shaft, each engaged normally by a clutch, chains of gearing from said shaft to the carbon holders or rods, whereby they may be raised or lowered, an electro-magnet in the main circuit and an electro-magnet in a shunt-circuit around the arc, mechanism controlled by said magnets for throwing either of the clutches out of engagement with its friction-gear, a swinging bracket or hanger for each holder or rod and carrying gears forming part of the chains of gearing, an electro-magnet for each hanger, said magnets being electrically connected and let into the main circuit by branches which include the carbons and their holders or rods, and a short circuit around said magnets normally open but brought into operation by the abnormal lengthening of the arc, whereby the hanger-controlling magnets are cut out and the holders or rods relieved, substantially as herein described.

In witness whereof I have hereunto set my hand.

AUGUST HARDING.

Witnesses:
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H. C. LEE.