(No Model.) 7 Sheets—Sheet 1.

J. J. WOOD.

ELECTRIC ARC LAMP.

No. 487,315. Patented Dec. 6, 1892.

FIG. 1.

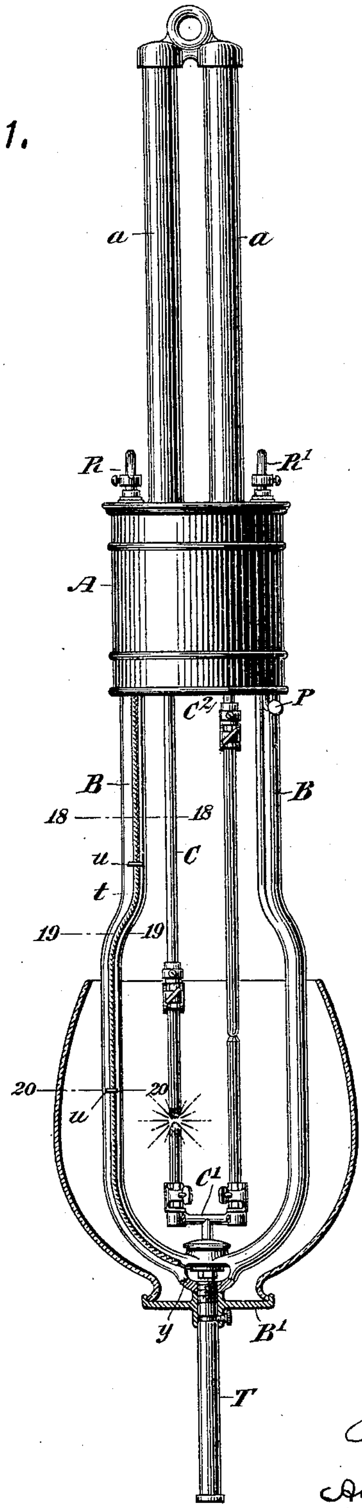


FIG. 18.

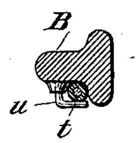


FIG. 19.

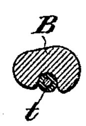
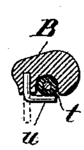


FIG. 20.



WITNESSES:

C. E. Ashley

H. W. Lloyd.

INVENTOR:

James J. Wood,

By his Attorneys,

Arthur C. Fraser & Co.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

(No Model.)

7 Sheets—Sheet 2.

J. J. WOOD.

ELECTRIC ARC LAMP.

No. 487,315.

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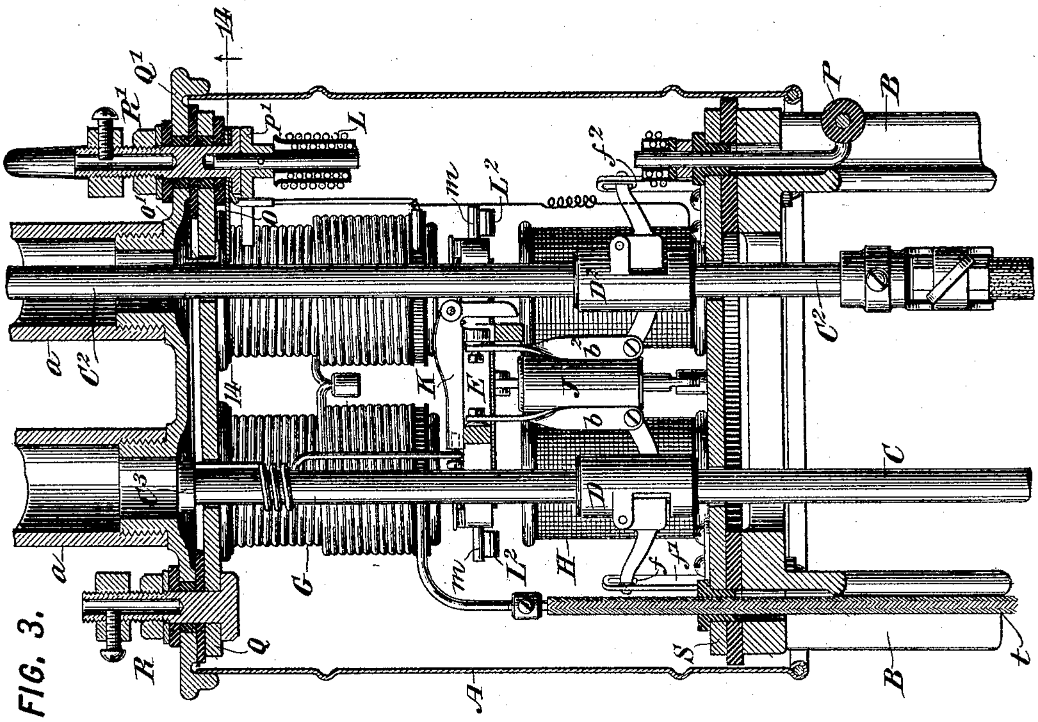

FIG. 3.

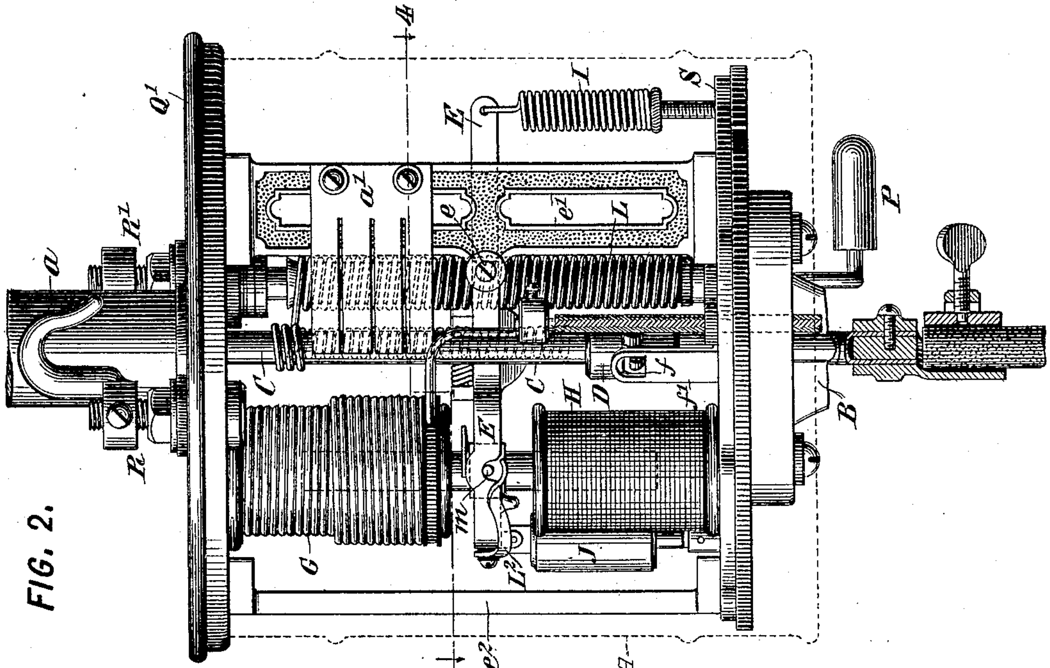

FIG. 2.

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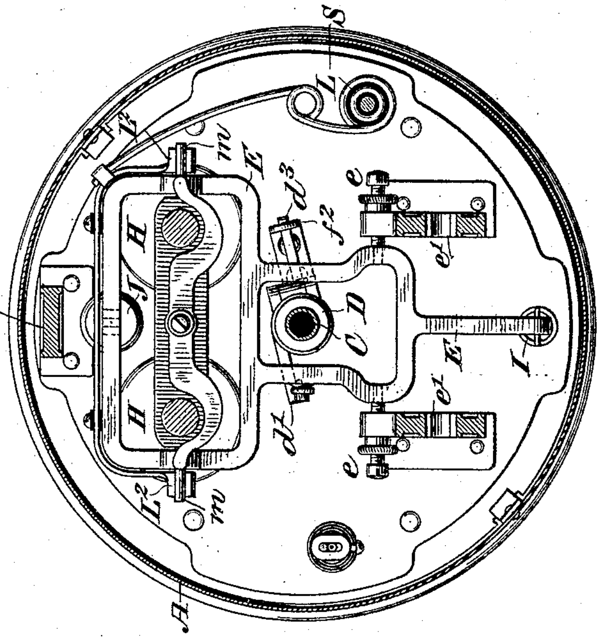
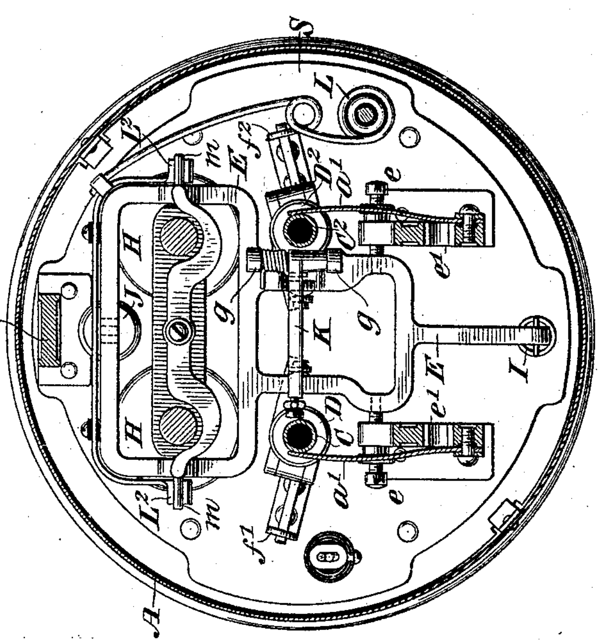
FIG. 16.



Single Lamp

FIG. 4.



Double Lamp

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(No Model.) 7 Sheets—Sheet 4.

J. J. WOOD.

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FIG. 5.

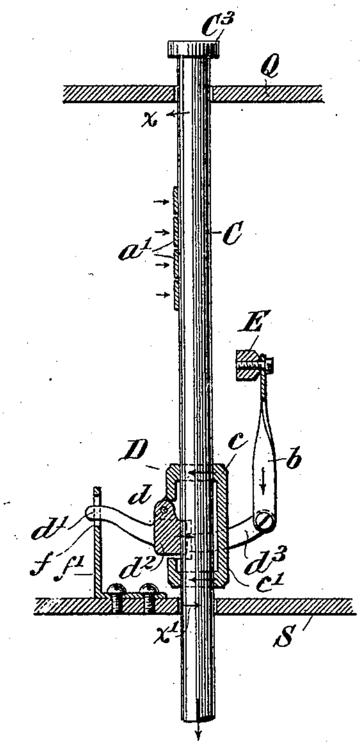

FIG. 6.

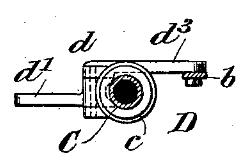

FIG. 7.

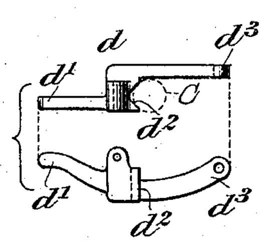

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FIG. 9.

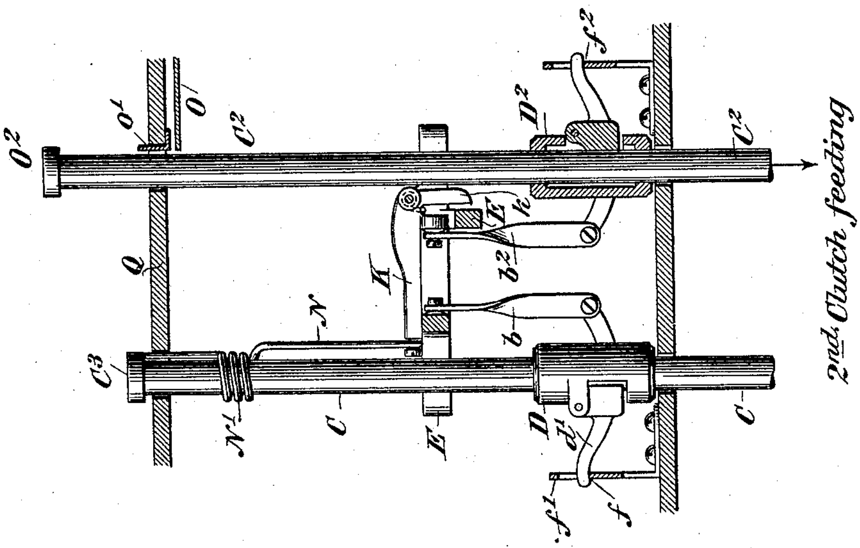
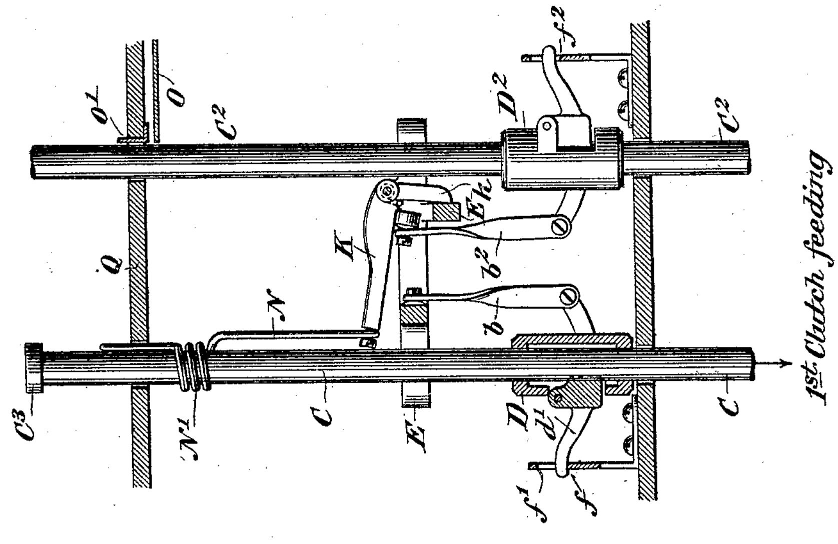


FIG. 8.



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(No Model.)

7 Sheets—Sheet 6.

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No. 487,315.

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FIG. 10.

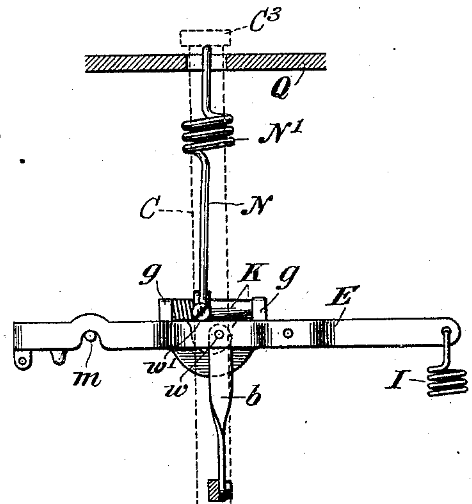


FIG. 11.

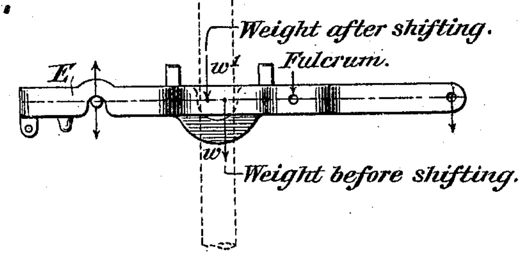


FIG. 12.

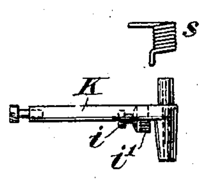
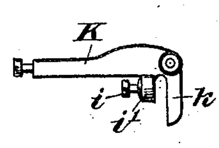


FIG. 13.



WITNESSES:

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(No Model.) 7 Sheets—Sheet 7.

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ELECTRIC ARC LAMP.

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FIG. 17.

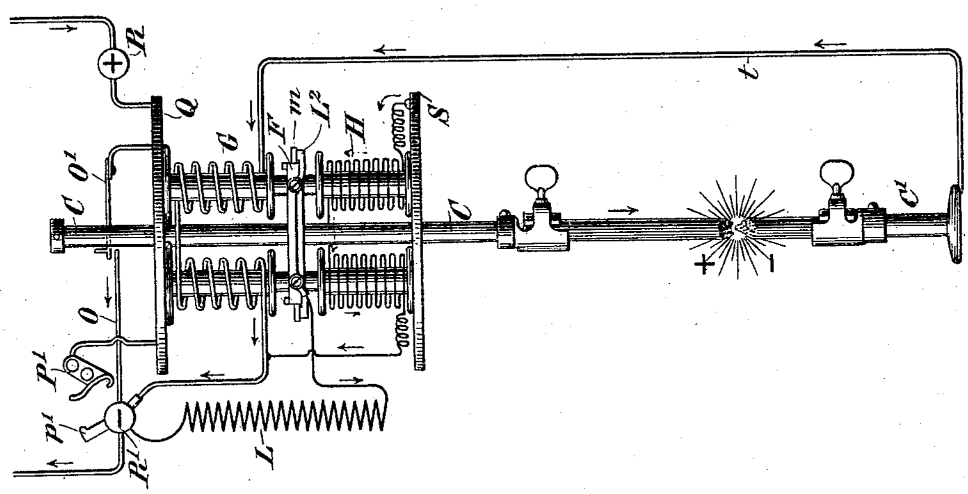


FIG. 14.

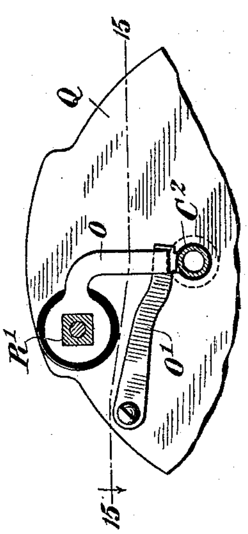
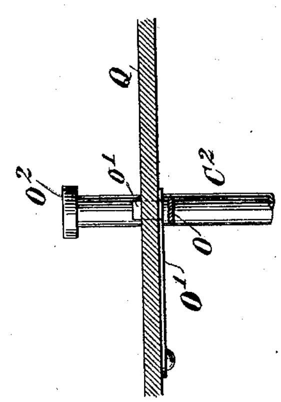


FIG. 15.



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Arthur C. Fraser & Co.

UNITED STATES PATENT OFFICE.

JAMES J. WOOD, OF FORT WAYNE, INDIANA.

ELECTRIC-ARC LAMP.

SPECIFICATION forming part of Letters Patent No. 487,315, dated December 6, 1892.

Application filed July 25, 1892. Serial No. 441 098. (No model.)

To all whom it may concern:

Be it known that I, JAMES J. WOOD, a citizen of the United States, residing at Fort Wayne, in the county of Allen and State of Indiana, have invented certain new and useful Improvements in Electric-Arc Lamps, of which the following is a specification.

This invention introduces certain improvements in electric-arc lamps, pertaining principally to lamps of the "clutch-feed" class. The improvements are in part applicable to both single and double lamps and in part pertain solely to double or duplex lamps—that is to say, those which burn two pairs of carbons in succession.

In clutch-feed lamps as ordinarily heretofore constructed the feeding movement has acted first to lower the upper carbon bodily until the limit of downward movement of the clutch is reached and then by the abnormal elongation of the arc to disengage the clutch and permit the carbon to drop downward, whereupon it is instantly re-engaged by the clutch and lifted by the feed mechanism to draw out the arc again to its normal length. Ordinarily the upper carbon falls until it touches the lower carbon before the clutch can re-engage it. This results in a momentary interruption of the light, causing an annoying flicker. This flickering and the abnormal brightening of the light by the lengthening of the arc just before each feeding movement constitute practical defects in clutch-feed lamps, which have led the more perfectly operating but more expensive gear-feed lamps to be preferred wherever a steady light is demanded. My invention seeks to overcome these defects in clutch-feed lamps and to introduce other improvements therein tending to approximate lamps of this class in perfection of operation to the best gear-feed lamps.

As applied to double or duplex lamps my invention provides a novel and simple means for transferring the feeding movement from the clutch of the first carbon to that of the second carbon and introduces improvements whereby the first and second pairs of carbons burn with arcs of equal length.

I will proceed to describe in detail the preferred construction of electric lamps embodying my invention with reference to the accompanying drawings, wherein—

Figure 1 is a front elevation of a double lamp on a reduced scale, the view being partly in section. Fig. 2 is a side elevation of the lamp mechanism, the cylindrical case thereof shown in dotted lines being removed. Fig. 3 is a front view of the mechanism in vertical mid-section cut in the plane of the line 3 3 in Fig. 4. Fig. 4 is a horizontal section thereof cut on the line 4 4 in Fig. 3. Fig. 5 is a fragmentary vertical section showing the clutch and the mounting of the carbon-holding or feed rod. Fig. 6 is a plan of the clutch, showing the rod in section. Fig. 7 includes a plan and elevation of the clutch-lever. Figs. 8 and 9 are fragmentary vertical sections showing the feed-rods and clutches of a double lamp and the means for transferring the feed from the first to the second clutch. Fig. 10 is a fragmentary side elevation, looking in the same direction as Fig. 2, partly in vertical section. Fig. 11 is a diagrammatic side elevation of the armature-lever. Figs. 12 and 13 are respectively a plan of the feed-transfer lever and its spring and a side elevation of said lever. Fig. 14 is a fragmentary horizontal section cut on the line 14 14 in Fig. 3 and looking upwardly. Fig. 15 is a fragmentary vertical section cut on the line 15 15 in Fig. 14. Fig. 16 is a horizontal section answering to Fig. 4 and showing the arrangement of the parts for a single lamp. Fig. 17 is a diagram illustrating the circuit connections. Figs. 18, 19, and 20 are cross-sections through the lamp-frame on the like-numbered dotted lines in Fig. 1.

Referring to Fig. 1, it will be seen that the lamp is in general of the usual arrangement, having a mechanism case or box A and a pendent frame or loop B, extending thence downwardly and carrying a globe-holder B′, into which the usual glass globe is fastened, the lower or negative carbon pencils being carried in a negative-carbon holder C′ and fastened to the lower part of the frame and the upper or positive carbons being carried by vertically-sliding carbon-holding rods or feed-rods C C^2, movable up and down through the mechanism-case, and the portions thereof projecting above the case being housed in protecting-tubes a a, all in substantially the usual manner.

The feeding or regulating mechanism in the case A is in general of similar construction to mechanisms shown in prior patents granted to me, except for the substitution of feeding-clutches for the rack and pinion and gear-train heretofore generally employed in lamps of my invention and the addition of the improvements hereinafter to be described.

The feed-rods C C^2 are smooth round rods and are provided within the case with feeding-clutches (lettered D D^2, respectively) engaging them and operatively connected by links b b^2 with an armature-lever E, which is fulcrumed between pivot-screws e e, Fig. 4, and is pivotally or otherwise connected to the armature F of two opposed electro-magnets G and H. The magnet G is wound with coarse wire and connected serially in the main circuit, as shown in the diagram Fig. 17, being commonly called the "main magnet," while the magnet H is wound with fine wire, so as to oppose a high resistance, and is connected in a shunt or derivation around the arc, being commonly called the "shunt-magnet." The magnet G is the lifting-magnet for lifting the upper-carbon holder when the circuit is established through the lamp, and thereby striking the arc. The magnet H is the feeding or regulating magnet for causing the feed-rods to travel downwardly in order to compensate for the wasting away of the carbons. Preferably these magnets G and H are of the solenoid type, as shown, the armature F, which plays between them, being of H shape, as in the prior constructions of Wood lamps. The two magnets thus act oppositely to each other, the main magnet striving to pull the armature up, while the shunt-magnet strives to pull it down.

The armature-lever E is preferably made in the form of an open frame (see Fig. 4) having at one end the form of an open rectangular ring within which the horizontal portion or cross-bar of the armature F is arranged, the remaining portion of the frame extending forward between two stationary uprights e' e', to which it is pivoted by the screws e e. The lever is extended to the opposite side of the fulcrum and terminates in an arm or tail which is engaged by a regulating-spring I, the tension of which is adjustable by means of a screw beneath it, secured to the lamp-case. By varying the tension of this spring more or less resistance can be offered to the pull of the shunt-magnet, and thereby the length of arc which the lamp shall maintain can be adjusted at will. The armature-lever is connected to a dash-pot J of usual construction in order to resist any sudden or rapid movements and prevent the effect known as "jumping."

The current enters the lamp by the positive binding-post R, which is in metallic connection with the inner top plate Q of the mechanism-case A, which is insulated from the outer roof-plate Q'. This inner plate is in connection through the uprights e' e' e^2 with the bottom plate S of the case, which in turn is insulated from the looped frame B. The current passes through the top and bottom plates Q and S and the usual copper conducting-springs a' a' to the feed-rods C C^2. The current passes down through one or other of these rods, the primary carbon, the arc, the secondary carbon, and the negative-carbon holder C', passes thence upwardly through a wire t, traverses the coils of the main magnet G, and passes out by the negative binding-post R', which is insulated from the conducting-frame of the case. The coil of the shunt-magnet H is connected between the bottom plate S and the binding-post R'. The circuits may be traced in Fig. 17.

A "relighting cut-out" is provided, being of the improved construction shown in my patent, No. 430,722, dated June 24, 1890. It is constructed of an insulated conducting-strip L^2, arranged to be touched by conducting-pivots m m on the ends of the armature F in order thereby to short-circuit the lamp through a resistance-coil L, as described in said patent.

The lamp is provided with a short-circuiting switch or hand cut-out consisting of an arm p', in electrical contact with the negative binding-post R' and adapted to be turned to touch an elastic contact-plate P', Fig. 17, in metallic contact with the top plate Q, and hence with the positive binding-post. The switch is turned by a handle P, all as shown in my patent, No. 426,405, dated April 22, 1890.

The features of the lamp thus far described are not new, being embodied in the previous patents granted to me. I will now proceed to describe the improvements which constitute my present invention.

The clutch D or its duplicate D^2 (shown best in Figs. 5, 6, and 7) is of novel construction. The clutch consists of a sleeve c, which makes a free sliding fit with the feed-rod, and a clutch-lever d, pivoted to this sleeve and having an arm d^3, the end of which is jointed to the link b, which connects it to the armature-lever E, while on the opposite side of its fulcrum it is formed with an arm or tail d', which as the clutch falls is engaged by a stop or abutment f. This stop is preferably formed as a shoulder constituting one side of a slot cut in an upright f', fastened to the bottom-plate S, but may be otherwise arranged. The clutch-lever d is formed at or near its middle portion with a frictional brake-shoe or grip d^2, which bears against one side of the feed-rod. In order to admit this brake-shoe, the sleeve c is cut away on one side, leaving only upper and lower guiding collars, at its top and bottom, engaging the feed-rod, and an intermediate connecting portion c', which partly incloses the rod.

During the operation of the lamp the feed-rod C is hung from the armature-lever E through the medium of the clutch D, the rod being embraced between the brake-shoe d^2 on one side and the bearing-surfaces of the sleeve c above and below on the opposite side. The weight of the rod is communicated through the arm d^3 of the clutch-lever to the link b, by which it is hung from the armature-lever, the tail d' being supported above the stop f, as shown in Fig. 5. As the arc burns longer and diverts more current through the shunt-magnet H, the latter gradually overcomes the upward pull of the main magnet G sufficiently to permit the armature-lever E to tilt downward under the weight of the carbons and feed-rods until the tail d' of the clutch-lever is stopped by the abutment f, whereupon the further lengthening of the arc and descent of the armature-lever cause the clutch-lever d to be tilted in such manner as to relax the pressure of its brake-shoe d^2 against the feed-rod, whereby the feed-rod is released and permitted to slide slowly downward, being prevented from dropping suddenly by the frictional contact with it of the bearing-surfaces in the sleeve c and the bearing-face of the brake-shoe d^2. Upon the sliding down of the rod and the consequent shortening of the arc the diminution of current through the shunt-magnet enables the main magnet to instantly draw up the lever again, thereby lifting the clutch, causing it to resume its firm engagement with the feed-rod and elevating the latter until the normal length of arc is restored. As the carbons continue to waste away the same operation is repeated—that is to say, the clutch and feed-rod are first lowered bodily until the tail d' is stopped by the abutment f, after which the clutch is partially released to permit the feed-rod to slide downwardly, and the clutch is then again elevated to its initial position. In practice, assuming the lamp to be in perfect order, with the feed-rod smooth and clean, there is ordinarily no actual dropping of the feed-rod; but instead the rod maintains an almost incessant and imperceptible slow downward-sliding movement, the clutch-tail d' being continually in light contact with the abutment f. It is only when the feed-rod slides downwardly a little too far, as occasionally happens, that the clutch is lifted bodily, so as to raise the tail d' above the abutment.

My new clutch constitutes, practically, an important improvement over the clutch devices heretofore employed in clutch-feed lamps. In lamps having ring clutches or other equivalent clutch devices the releasing movement due to an abnormally-long arc wholly disengages the clutch from the feed-rod and permits the latter to fall until the positive-carbon pencil touches the negative before the feeding mechanism can recover itself and re-engage the clutch. When the rod is once wholly disengaged by the clutch, it falls, ordinarily, too quickly to enable the mechanism to re-engage it before the carbons can come into contact, since the mechanism is necessarily somewhat sluggish in its action by reason of the hysteresis of the core of the shunt-magnet, the inertia of the moving parts, and the retarding action of the dash-pot. When the mechanism does act, it instantly re-engages and lifts the rod, drawing out the arc again to its normal length and holding the rod suspended by the clutch. The complete disengagement of the clutch in ordinary clutch-feed lamps is due to the shifting of the weight of the feed-rod and carbon from the armature-lever to the mechanism-case before the clutch is disengaged. At first the weight of the feed-rod, carbon, and clutch is suspended wholly from the armature-lever; but as the rod is lowered the clutch strikes a stop or abutment on the case, to which part of the weight is transferred, so that a pause occurs in the feeding movement, the arc having to burn enough longer to divert enough additional current through the shunt-magnet to strengthen it sufficiently to cause its increased pull against the armature-lever to compensate for the portion of the weight which has been taken from this lever and been transferred to the case, and when the shunt-magnet has been strengthened to this point, so that its pull effects the disengagement of the clutch, this magnet has become so saturated that it cannot be demagnetized upon the shortening of the arc to re-engage the clutch in the time that the rod is falling and before the carbons come together. The ordinary ring clutch disengages instantly upon the relaxation of the pressure of its engaging edges or angles upon the rod, since these edges in fact indent the rod to a minute extent in such manner as not to permit of a gradual downward-sliding movement of the rod. Hence for these reasons the feeding action of an ordinary clutch-lamp is uneven, consisting in first gradually lowering the carbon, then pausing, then dropping it until the carbons come together and the arc is extinguished, and then instantly taking a fresh hold and lifting the upper carbon again to restore the arc. With my improved clutch-feed, however, the operation is quite different. Instead of the descent of the clutch bringing it into contact with an abutment by which the greater part of the weight of the rod and carbon is transferred to the case, only a lever arm or tail comes into contact with the abutment, so that but a very minute portion of the weight is transferred from the armature-lever. The abutment acts through this long lever arm or tail to relieve the engaging pressure of the clutch without taking any considerable portion of the weight from the armature-lever. The longer the clutch-lever tail is made the less will be the proportion of weight transferred from the armature-lever when the tail touches the abutment. The length shown is that which is deemed preferable. Furthermore, the clutch, instead of engaging the rod by means of corners or angles tending to indent it, is provided with smooth frictional contact-surfaces in engagement with the rod, so that when the clutch is gradually relieved by the releasing movement it does not wholly release the rod, but gradually relaxes its pressure upon it while still maintaining a frictional contact therewith sufficient to effect a retardation of the descending movement of the rod, so as to prevent its falling. This same result has heretofore been secured by resort to retarding mechanism, such as a dash-pot; but such expedients involve an objectionable degree of mechanical complication which my invention avoids while accomplishing the same practically-desirable result.

An important feature of my improved clutch is the arrangement of the brake-shoe d^2 beneath the pivot of the clutch-lever, the practical effect of which is that a downward pull upon the feed-rod, by which the rod and clutch are pulled down bodily, tends upon the engagement of the clutch-tail with the abutment to release the clutch and permit the rod to be pulled freely down through it. Heretofore in two-part clutches, wherein a lever is employed engaging the rod, this lever has been so mounted as to increase its frictional bite against the rod in proportion as the latter is pulled downward, so that it is impossible to draw the rod down by hand when the clutch is engaged.

My improved construction renders the lamp less liable to injury in the hands of ignorant or violent workmen. The brake-shoe d^2 is arranged sufficiently close to the fulcrum to give all the advantage of leverage necessary for efficiently upholding the weight of the feed-rod and carbon when in action and so long as the rod is not forcibly pulled downward. The feed-rod, being supported through the clutch from the link b, is hung from a point at one side of its center of gravity, so that it tends to swing out of a vertical position, its upper end tending to swing toward the opposite side from the link b, as shown by arrow x in Fig. 5, while its lower portion tends to swing toward the same side as the link, as shown by the arrow x'. Ordinarily in clutch-lamps the rod bears wholly against one side of the bearing or hole in the upper plate Q and against the opposite side of the bearing or hole in the lower plate S of the mechanism-case, due to this cause. In my lamp, however, this tendency is in great part overcome by the arrangement of the conductor-springs a' to bear against the feed-rod on the opposite side from the link b, so that their pressure tends to restore the rod to the vertical and to counteract the deflection due to its one-sided suspension. The action of these springs is best shown in Fig. 5, where they are shown in section pressing against the side of the rod in the direction of the arrows marked against them, so that their tension opposes that in the direction of the arrow x and relieves the sidewise thrust at the lower bearing in the direction of the arrow x'. This is done without adding to the friction upon the rod, since the pressure exerted by the spring a' is only the same firm pressure essential to insure a good electrical contact with the rod.

In some arc lamps wherein attempts have been made to overcome the disadvantages inherent in clutches of the tilting-ring type expedients have been resorted to that involve the communication of thrusts or tensions in opposite directions in the lamp mechanism and require multiple adjustments. It is one of the advantages of my improved lamp that it has only one part requiring adjustment—namely, the retracting-spring I, by which the length of the arc is determined. There is, also, no transmission of thrusts or tensions between any two connected parts in more than one direction, so that any wear that may occur at the joints is automatically taken up and no lost motion is introduced.

When the carbons of an arc lamp burn out, it is essential that the lamp shall be cut out of circuit, this operation being performed by an automatic cut-out, known as the "final cut-out." This final cut-out is operated by the descent of the feed-rod, or in a double lamp by the descent of the second feed-rod, to its lowest position. In my former gear-feed lamps a pin on the feed-rod has been arranged to come into contact with a spring-arm projecting from the negative binding post or terminal and thereby short-circuiting the lamp. In a clutch-feed lamp it is desirable to leave the feed-rod free, so that it may turn or be turned, and to admit of this I have devised an improved construction. To the negative binding-post R', which is insulated from the top plate Q, is conductively connected an arm O of spring metal, which projects beneath the top plate and terminates adjacent to the feed-rod, (or in a double lamp to the second feed-rod,) as shown in Figs. 3 and 14. A spring-arm O' of elastic metal plate is fastened at one end to the under side of the top plate Q, so as to be in electrical connection therewith, and hence with the positive binding-post, and at its other end it is formed with an upwardly-turned toe o', which passes up through an opening in the top plate and projects some distance above the upper side thereof into position to be engaged and pressed down by an annular shoulder formed by the under side of a head O^2, formed on the feed-rod. Normally the elasticity of the spring-arm O' holds it up out of contact with the arm O, as shown in Fig. 15; but when the rod feeds down to its lowest position, the head O^2 strikes the toe o' and presses it down until the arm O' rests in contact with the arm O, thereby forming a short circuit between the binding-posts. This improved construction avoids any necessity for introducing any insulation for permitting the arm O to communicate through the top plate. By reason of the uninterrupted lower side of the head O^2 it can be freely turned to any relative position.

I will now describe those features of the lamp mechanism which are peculiar to double or duplex lamps. It will be seen that substantially the same mechanism is used in both single and double lamps, the principal difference being that whereas in a single lamp the feed-rod passes through the center, as shown in Fig. 16, and inside the armature-lever in a double lamp the two feed-rods are arranged on opposite sides of the armature-lever and the shape of the latter is slightly changed in order to admit of the attachment to it of a transfer device for shifting the feeding action from the clutch of the first rod to that of the second rod after the first pair of carbons has been consumed.

In a double lamp the first or primary clutch D is of the same construction already described and is hung directly from the armature-lever E, as is seen by comparing the parts on the left in Fig. 8 with the corresponding parts in Fig. 5. The second or secondary clutch D^2 is itself of the same construction; but instead of being hung directly from the armature-lever E it is hung by a link b^2 from a transfer-lever K. This lever, which is shown detached in Figs. 12 and 13, is mounted on the armature-lever E by being pivoted thereto between lugs g g. It extends transversely of the armature-lever and is pressed up normally to the position shown in Fig. 8 by means of a coiled spring s, coiled around the hub of the lever K, reacting at one end on the armature-lever and at the other end pressing upwardly beneath the lever K. The upward movement of this lever K under the tension of this spring is limited by a tail k, which comes into contact with one side of the lever E, as shown in Fig. 8. The link b^2 is loosely connected to the lever K by engaging a screw i, entering an arm i', formed on the lever K and projecting downwardly. The free end of the lever is loosely jointed to a push-rod N, which projects up adjacent to the primary feed-rod C, passing up through the top plate Q, and terminating above this plate in position to be encountered by any part of an annular or continuous shoulder formed by the under side of a head C^3, formed on the feed-rod C. It results from this that as the first pair of carbons is consumed and the primary feed-rod C descends to its lowest position it presses down the push-rod N and throws the lever K from the position shown in Fig. 8 to that shown in Fig. 9, where this lever is stopped by resting upon the armature-lever. To admit of this, the tension-spring s, which presses up the transfer-lever K, while being necessarily sufficient to uphold the weight of the second clutch, feed-rod, and carbon, which are hung from the transfer-lever, is not strong enough to uphold, also, the weight of the primary feed-rod C, multiplied by being hung from the long arm of the lever, so that when this added weight is transmitted to it through the rod N the transfer-lever is depressed. In the first or upper position of the transfer-lever the clutch D^2 is suspended higher than the clutch D and so that its tail is out of contact with the abutment f^2 of the secondary clutch during the entire range of up-and-down or feeding movements of the armature-lever—that is to say, the extreme downward movement of the armature-lever is insufficient to bring the tail of the secondary clutch against the abutment f^2, and consequently this clutch remains engaged and inoperative, serving simply to uphold the rod C^2; but upon the throwing down of the transfer-lever K the clutch D^2 is lowered a short distance and sufficient to bring it into operative engagement with its abutment, and consequently cause it to act to feed the rod during the normal range of feeding movements of the armature-lever. This is the condition shown in Fig. 9. The transfer-lever K and push-rod N constitute a transfer device for transferring the feeding action from the first to the second carbon-holding or feed rod. Other mechanical expedients might be substituted for this rod and lever to constitute such transfer device, it being only essential that during the feeding operation of the first or primary clutch the secondary clutch shall be elevated so high as to be impotent to feed and that when the first rod is fed down to its lowest position it shall cause the second clutch to descend sufficiently to enter into operative engagement with its abutment, while both before and after the transfer of the feed the secondary clutch is hung from or supported by the armature-lever. The transfer device is in the nature of an adjustable connection between the secondary clutch and the armature-lever (or other equivalent part of the regulating mechanism) and operated by the complete descent of the primary feed-rod to elongate the connection, so that the secondary clutch is dropped lower down, and thereby thrown into operation.

The push-rod N is made elastic or yielding in order to provide against damage in case the primary rod were to be dropped or forcibly pulled downward after the transfer of the feed. This is preferably accomplished by making the rod N of wire and coiling a portion of it into a spiral N′, constituting a spring. This spiral is most conveniently carried around the rod C, being made somewhat larger than the rod, so that the latter moves freely through it. The push-rod N is of wire stiff enough so that the mere weight of the feed-rod C does not compress the spring N′; but in case this rod is forcibly pulled downward the spring N′ is compressed, its convolutions closing somewhat together, until the feed-rod is stopped by its head C^3 striking the top plate Q. Without the spring N′ or some equivalent yielding connection the rod N would be bent or sprung by the pulling down of the feed-rod; or if the rod N were made stiff enough to resist this strain it would throw an injurious strain upon the transfer-lever. By employing the spring N′ this lever can receive a strain no greater than the tension of the spring.

In double-carbon lamps having a clutch-feed the feed-regulator or its armature-lever ordinarily carries the weight of both the first and second feed-rods and their carbons, and as the first carbon burns away the weight upon the regulator is reduced, so that the arc between the first pair of carbons becomes gradually longer, and upon the transferring of the feed the second arc starts at the same length that the first arc had attained to when extinguished, so that the arc continues to burn longer from the lighting of the lamp between the first carbons to its extinguishment when the second pair is consumed. The gradual lengthening of the arc involves a corresponding increase in electro-motive force, and consequently in the power absorbed by the lamp. To cause the lamp to burn with as nearly as possible a uniform arc, my present invention provides means whereby, although the arc gradually lengthens during the burning of each pair of pencils, yet when the feed is transferred to the second carbon the second arc starts at the same length that the first arc had at starting, so that both the first and second pair of carbons burn under like conditions. I accomplish this result by causing the weight of the primary feed-rod to be shifted, at the instant of transferring the feed, in such manner that it acts at greater mechanical advantage, and the rod and remaining fragment of carbon exert the same downward pull on the regulator that the rod and full length of carbon did at starting. This result is accomplished in the following manner: While the primary carbon is feeding its weight is carried by the primary clutch which hangs from the armature-lever E, so that the weight of the carbon and feed-rod acts upon the armature-lever at the point w in Figs. 10 and 11, where the link b is pivoted to this lever. Upon the transferring of the feed the weight of the feed-rod is shifted to the push-rod N, and as it depresses this rod and the transfer-lever K until the latter strikes the armature-lever the weight of the feed-rod is thereby transferred to the armature-lever at the point w' in Figs. 10 and 11, where the rod N is pivoted to the transfer-lever K. This point w' is located somewhat farther from the fulcrum than the point w, as most clearly shown in Fig. 11, the difference being sufficient to compensate for the difference in weight of the primary carbon before and after being burned. The lesser weight after burning, being thrown farther from the fulcrum, exerts the same pull upon the lever that the full weight did at starting.

My improved double lamp has the advantage over double-carbon clutch-feed lamps as ordinarily heretofore constructed in that the second pair of carbons burns under exactly the same conditions as the first pair. Ordinarily double-carbon clutch-feed lamps are made with a dissimultaneous feed, the primary clutch being operated by the up-and-down movements of the armature-lever within a given normal range of movement and the secondary clutch being connected higher and requiring an abnormal movement of the armature-lever corresponding to an abnormal pull of the shunt-magnet to operate the secondary clutch, from which it results that the second pair of carbons burns with a longer arc than the first, so that the lamp requires correspondingly-more electro-motive force. By the automatic dropping of the secondary clutch upon the burning out of the first pair of carbons the secondary clutch is caused to feed by the same range of up and down movements of the armature-lever as the first clutch, requiring, consequently, only the same variations in strength of the shunt-magnet. This feature, in connection with the shifting of the weight of the primary carbon and feed-rod upon transferring the arc, places the mechanism in exactly the same condition upon commencing the feed of the second carbon as when the arc was first started between the carbons of the first pair.

My improved feed mechanism for double-carbon lamps is applicable with many other constructions of electro-magnets, armatures, and armature-levers than that shown. Any of the various electro-magnetic feed-regulators heretofore employed in arc-lamp mechanisms may be substituted for the respective electro-magnets, armature, and armature-lever herewith illustrated as equivalents thereof, provided only that they be adapted to perform the same functions. Other electro-motive devices operated by the electric current might be substituted for the electro-magnetic devices shown as the means for controlling the feed. In this specification and the claims I have used the expression "feed mechanism" to include the entire mechanism by which the carbons are fed together, and the term "feed-regulator" I have used to designate the electro-magnetic devices and the armature or other moving part operated thereby, or any known or suitable equivalents thereof by which the feeding-clutches are operated to effect the feeding of the carbon-holding rods.

My invention introduces an improvement in the means for mounting the wire t by which the current passes up from the negative-carbon holder C'. The frame B is made at its upper portion and adjacent to the mechanism case A of T shape in cross-section, as shown in Fig. 18; but farther down and where it passes within the glass globe it is made of an approximately oval or egg-shaped section, as shown in Fig. 19. The insulated wire t is carried down from the mechanism-case in one of the angles of the T-shaped cross-section, as shown in Fig. 18, and as the cross-section changes to an oval the wire is deeply sunk in a groove in the frame, as clearly shown in Fig. 19. The wire is thus protected against injury and the frame is given a sightly appearance. The wire is held in place at intervals by pins u, driven into the frame and bent down to closely embrace the wire, as shown in Fig. 20.

The globe-holder B' is mounted on an upright globe-holding rod T, so that it may be slid down thereon to lower the globe in recarboning, as usual. This rod T, instead of being connected to the frame B through the medium of a separate cross-piece fastened to the frame by screws, as heretofore, is screwed directly into a bridge-piece y, formed integrally with the frame B and spanning the insulated connection of the negative-carbon holder C′ with the frame, this insulated connection being made with the cross-bar v of the frame, as shown in Fig. 1. The construction is thus simplified and cheapened.

I claim as my invention the following defined novel features, substantially as hereinbefore specified, namely:

1. In an arc lamp, in combination with a fixed clutch-releasing abutment, a feed-clutch consisting of a sleeve embracing the feed-rod and a clutch-lever pivoted to said sleeve, having a brake-shoe engaging the rod, an arm connected to the feed-regulator, and a tail adapted upon the lowering of the clutch to strike an abutment, and thereby to tilt the lever in the direction to release the clutch.

2. In an arc lamp, a feed-clutch consisting of a sleeve embracing the feed-rod and a clutch-lever pivoted to said sleeve, having a brake-shoe engaging the rod beneath its pivot, an arm connected to the feed mechanism, and an opposite tail engaging an abutment to release the clutch.

3. In an arc lamp, the combination, with the feed-rod and the feed-clutch hung at one side so that the rod tends to hang out of the vertical, of the conductor-springs arranged to press against the rod in such lateral direction as to tend to correct the canting effect of its one-sided suspension.

4. In an arc lamp, a final cut-out consisting of a metallic spring-arm in electric connection with one terminal beneath the top plate and having a toe projecting upwardly through the top plate to be engaged by a projecting shoulder on the feed-rod when the latter reaches its lowest position and a conducting-arm in electric connection with the opposite terminal, arranged beneath said spring-arm, to be touched thereby when the latter is pressed down, and thereby short-circuit the terminals through the respective arms.

5. In an arc lamp, the top plate of the mechanism-case in electric connection with the positive terminal, a spring-arm mounted beneath the top plate in conductive contact therewith, having a toe projecting up through the top plate, the feed-rod having an annular shoulder or head arranged to depress said toe when the rod feeds down to its lowest position, and a conducting-arm in electric connection with the insulated negative terminal, projecting beneath said spring-arm in position to be touched thereby when the latter is depressed.

6. In a double-arc lamp, the combination, with a feed-regulator comprising a lever E and with primary and secondary feed-clutches D D^2 and links b b^2, by which said clutches are hung therefrom, and releasing-abutments f f^2 for said clutches, the secondary clutch being initially hung above the range of feeding movement of the lever, so that it does not touch its abutment f^2, and consequently does not feed during the feeding of the primary clutch, of a transfer-lever K, mounted on said lever E and to which the link b^2 of the secondary clutch is hung, a spring for normally pressing up said transfer-lever, and a push-rod N, arranged to be depressed by the first feed-rod on descending to its lowest position and connected to said transfer-lever to depress it and lower the secondary clutch into operative contact with its abutment.

7. In a double-arc lamp, the combination, with a feed-regulator comprising a lever E, and with primary and secondary feed-clutches D D^2, hung therefrom, the secondary clutch being initially hung above the range of feeding movements, of a transfer-lever K, pivoted on said lever, having a stop-arm k abutting against said lever to limit the ascent of the transfer-lever, and a spring for pressing up the transfer-lever.

8. In a double-arc lamp, the combination, with a feed-regulator and primary and secondary feed-clutches connected thereto and supported thereby, the secondary clutch being initially connected above the range of feeding movement, of a transfer device for lowering the secondary clutch into operative position, consisting of a movable part from which the secondary clutch is hung, mounted on the regulator, a push-rod arranged to be depressed by the first feed-rod when it reaches its lowest position and connected to said movable part to press it down, and a spring interposed between the first feed-rod and said movable part, through which spring the movement is communicated, whereby no greater thrust can be exerted against the said movable part than the tension of said spring.

9. In a double-arc lamp, the combination, with a feed-regulator comprising an armature-lever E and primary and secondary feed-clutches connected to said lever, of a transfer device consisting of a transfer-lever K, mounted on the armature-lever and from which the secondary clutch is hung, a spring s for pressing it up, and a push-rod N, connected to said lever and projecting up through the top of the case into position to be depressed by the first feed-rod upon completing its descent and formed with a spring portion N′.

10. In a double-arc lamp, the combination, with a feed-regulator and primary and secondary feed-clutches connected thereto and supported thereby, of a transfer device operated by the descent of the first feed-rod to its lowest position to transfer the feed to the secondary clutch, the primary clutch being hung from said regulator at less mechanical advantage than the engagement therewith of said transfer device, by which the weight of the primary feed-rod is transferred to the regu-

lator, the difference in mechanical advantage being proportioned to compensate for the lightening of the primary feed-rod by reason of the consumption of the carbon.

11. In a double-arc lamp, the combination, with a feed-regulator comprising an armature-lever E, of primary and secondary feed-clutches hung from said lever and a transfer device acted on by the weight of the primary feed-rod when it reaches its lowest position to transfer the feed to the secondary clutch, the primary clutch being hung from said lever at a point nearer its fulcrum than the point to which the weight of the primary feed-rod is transmitted by said transfer device in order that the weight of the primary feed-rod after transferring may exert the same pull upon said lever that the weight of said rod and its carbon did before starting the lamp.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

JAMES J. WOOD.

Witnesses:

ARTHUR C. FRASER,

GEORGE H. FRASER.