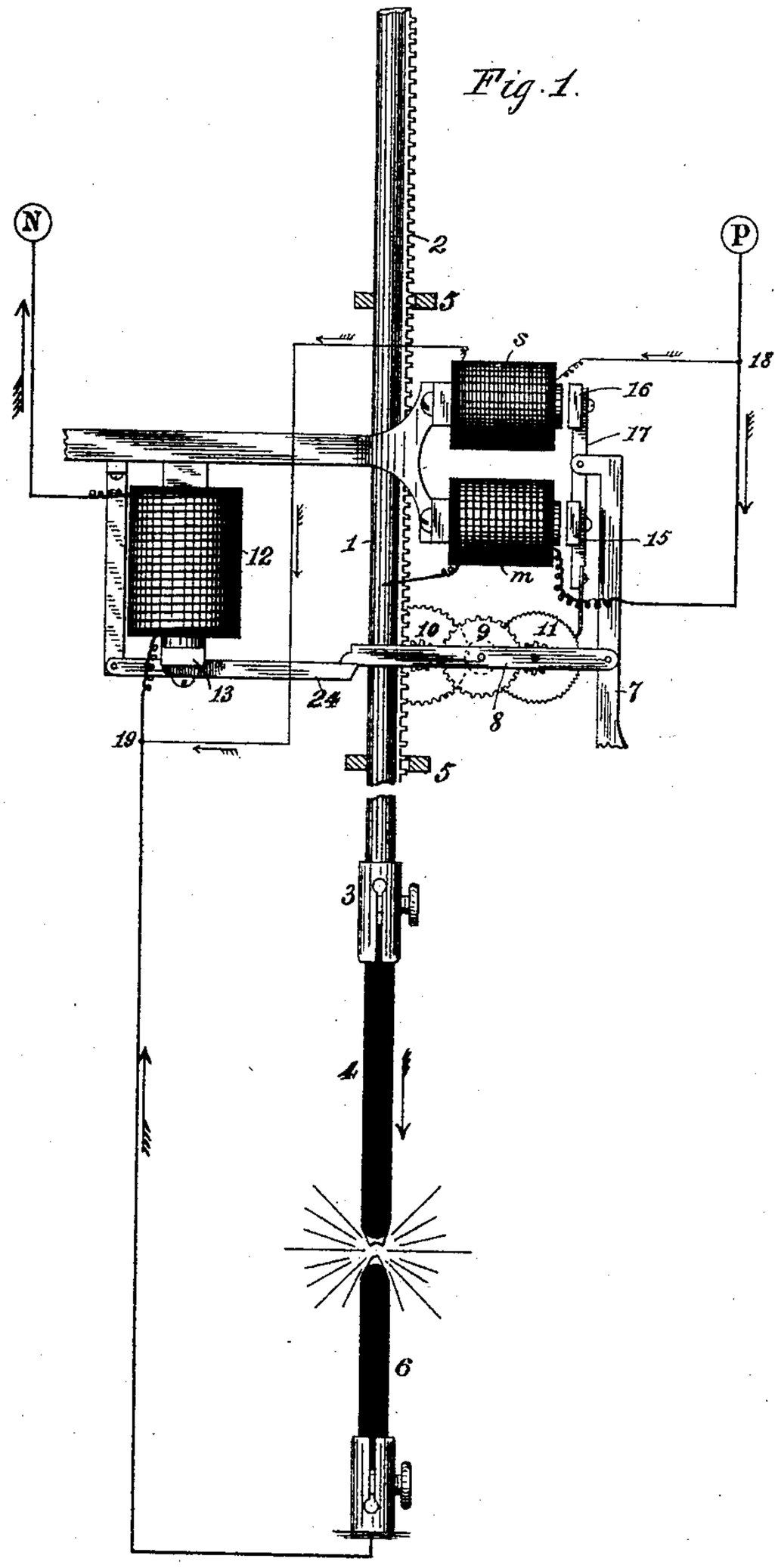
(No Model.)

J. H. BUNNELL.

ELECTRIC ARC LAMP.

No. 418,444. Patented Dec. 31, 1889.

Fig. 1.



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ELECTRIC-ARC LAMP.

SPECIFICATION forming part of Letters Patent No. 418,444, dated December 31, 1889.

Application filed October 8, 1889. Serial No. 326,331. (No model.)

To all whom it may concern:

Be it known that I, JESSE H. BUNNELL, a citizen of the United States, residing at New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Arc Lamps; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to the construction of arc lamps in general, but is intended more especially for application in arc lamps of the general type in which the positive carbon-rod is moved downwardly by gravity.

One of the objects of my invention is to make the arc-striking mechanism independent from the feeding mechanism—that is to say, the feeding mechanism will operate to allow the downward movement of the positive carbon without in any way affecting the mechanism which has been used for constructing the arc, so that the electro-magnet structure used to effect the feeding of the positive carbon may be very small and the amount of work necessary to be performed in effecting the momentary feed exceedingly slight.

A further object of the invention is to accomplish the feed proper by the use of the differential arrangement of magnets, in the respective members of which the current may vary to any extent without in any way affecting the action of the arc-striking magnet.

A further object of the invention is to realize the utmost simplicity and cheapness in the construction of the lamp mechanism, and I aim at such construction as will dispense altogether with the use of solenoid and movable cores and construct the mechanism with the simplest and cheapest form—namely, the ordinary horseshoe electro-magnet with a plain bar armature.

To these and other ends my invention consists in the construction of parts and arrangement of circuits, substantially as hereinafter more fully described and claimed.

In the drawing which forms part of this specification I have shown the essential parts of an arc lamp, without, however, going into the mechanical details as to the frame and points of support for the various portions, as these in the present state of the art are well within the knowledge of those skilled in the construction of arc lamps.

The carbon-rod 1 is fitted with the rack 2 and the usual carbon-clamp 3, which holds the positive carbon 4, the rod 1 being suitably guided in any of the usual ways—for instance, by the guides 5. Negative carbon 6 is likewise suitably supported in the lower portion of the frame. (Not shown.) On a suitable support—such, for instance, as that shown at 7—I pivot the the frame 8, which carries a train of multiplying gear 9, the low-speed pinion 10 of which meshes directly with the rack 2 of the carbon-rod 1. According to well-known principles, if the high-speed member 11 of this train of gearing have a detent bearing upon it or taking into its toothed periphery, the entire train is held stationary by the application of an exceedingly small amount of power, and on the release of such detent the train will rotate by the weight of the carbon-rod 1, and its attachments forcing the pinion 10 to revolve. It is equally plain that if the train of gearing be locked by the detent and the swinging frame 8 have its free end lifted the carbon-rod 1 will be lifted accordingly.

I locate a simple ordinary form of electro-magnet 12 in a suitable position, and its bar-armature 13 is attached to the lever 24, pivoted at a suitable point and adapted upon attraction to lift the free end of the frame 3 for the purpose of striking the arc. The arrangement is such that the amount of movement necessary in the armature 13 to cause a separation of an eighth or even three-sixteenths of an inch at the arc is very slight, and therefore a very small amount of wire is sufficient for the purpose on the cores of the magnet 12.

In a suitable location and on suitable supports I arrange the magnet *m* and the magnet *s*, both preferably being in the form of the ordinary horseshoe, and the respective armatures 15 and 16 are attached to a lever 17, which is pivoted, for instance, on an extension of the support 7, the lever 17 extending downward and constituting a brake or detent for the high-speed member 11 of the train of gearing previously described.

Denoting the terminals of the lamp by the letters P and N, respectively, the circuits will

be as follows: The main circuit goes from P into and through the coils of magnet *m*, thence to carbon-rod 1, thence across the arc to the negative carbon 6, thence up to and through the magnet 12, and thence to the terminal N. The shunt-circuit of the differential system *m s* starts at any point between the terminal P and magnet *m*—for instance, the point 18—whence it passes to the fine-wire coil *s;* thence to a point 19, located between the negative carbon 6 and the magnet 12. It will thus be observed that the main current passes through magnet *m* and through the arc, the shunt-current passes round the arc, and then the main and shunt currents join and pass together through the magnet 12.

On the admission of current to the lamp the actions are as follows: The carbons being in contact, practically no current flows through the shunt-magnet *s*. Current through magnet *m* attracts armature 15 and locks the train of gearing 9 10 11. Current passing through magnet 12, after having traversed the carbons, powerfully draws armature 13, and by means of lever 24 lifts the frame 8 and its train of gearing, and thus lifts the carbon-rod 1 and the positive carbon 4 to the full extent to which the lamp is adjusted—say one-eighth of an inch—and this attractive movement of armature 13 is once for all, as the latter remains in attracted position so long as current flows through the lamp; and therefore the frame 8 is rigidly held in a stationary position, since the local variations of current through the arc can produce no change of strength in the attractive power of the magnet 12. On the establishment of the arc the resistance of the latter causes the flow of a proportionate amount of current through the shunt-magnet *s*, and the latter will begin to attract the armature 16, not, however, with sufficient power to overcome the attraction of magnet *m* for its armature 15. The adjustment, however, will be such that the slightest increase of current through the magnet *s*, together with the slight reduction of current through magnet *m*, will cause the attraction of magnet *s* to preponderate to a sufficient extent to release the detent 17 from the wheel 11, and permit the latter to rotate under the propelling force of the weight of the rod 1 and its carbon. The latter at once feeds downwardly, but is immediately checked by the weakening of magnet *s*, due to this shortening of the arc, and a corresponding slight strengthening of the magnet *m* for the same reason. The wheel 11 is immediately again locked and remains so until a further feed is necessary. While I have described the operation of feeding as being, so to speak, intermittent, or step by step, it is obvious that the construction which I have adopted and the principles underlying the action of the mechanism are such that remarkable delicacy of action is obtainable. This is due to the fact that the differential system *m* 15 *s* 16 has no work to do except that of oscillating the lever 17 and impressing a sufficient friction on the wheel 11 to lock it, and this force is so small that the system may be made exceedingly sensitive.

In a lamp constructed on these principles there is no tendency to "pumping," no possibility of variations of current in the main line causing a chattering of the feed or oscillation of the arc striking mechanism. The positive carbon may be forcibly lifted to an abnormal length repeatedly, and it will immediately run down rapidly to the exact point at which it should stop, and there it will stop suddenly without failure, no matter how often the operation may be repeated. The consequence of this is that no amount of jarring can shake the carbons into contact. A further consequence, which is important in the matter of cost and friction in the lamp, is that I am enabled to dispense entirely with all dash-pots and retarding mechanism commonly found necessary to adopt in arc lamps for the purpose of softening the movements and giving time for the electro-magnet attractions to take place. For this reason I am able to construct the magnets of the ordinary typical form and use plain bar armatures in all cases, and I therefore very considerably reduce the cost of construction. Further, as a given power can be obtained from such magnets when made of very small size, I am able to reduce the size of the case containing the mechanism to the smallest dimensions consistent with a tasteful appearance. A further result, due to the extremely small amount of power needed in the differential system, is that I can wind the shunt-magnet *s* with a comparatively small number of turns of a high-resistance wire, the only object of the high resistance in this case being to keep down the amount of current through it, whereas in the ordinary differential arc lamps a large number of turns in the shunt is of primary importance. A further result of the foregoing invention is that no special attention is necessary when winding the various coils to have them come to an exact dimension as to number of turns, and therefore it becomes a matter of the simplest character to adapt the lamp to any of the existing systems with respect to length of arc and volume of current under which it is to operate.

I claim as my invention—

In an arc lamp, the combination of an electro-magnet and armature for striking the arc, and an independent differential electro-magnet system for effecting the feed, one magnet of said system being in series with the carbons and the arc-striking magnet, and the other magnet of said system being in shunt around the arc but in series with the arc-striking magnet.

In testimony whereof I affix my signature in presence of two witnesses.

JESSE H. BUNNELL.

Witnesses:

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