(No Model.) 2 Sheets—Sheet 1.

H. L. PYLE.

ELECTRIC ARC LAMP.

No. 356,786. Patented Feb. 1, 1887.

Fig. 2.

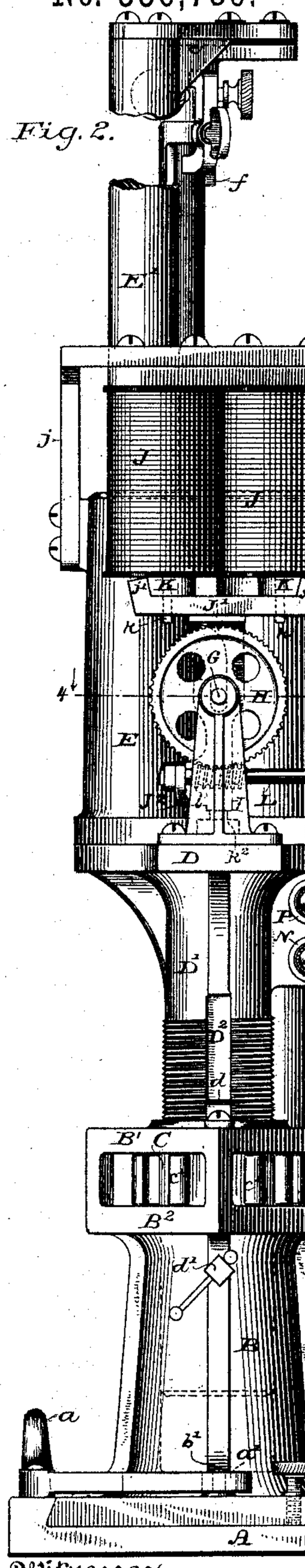


Fig. 3.

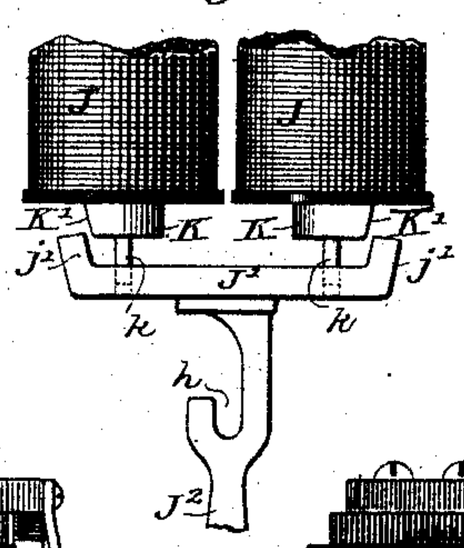
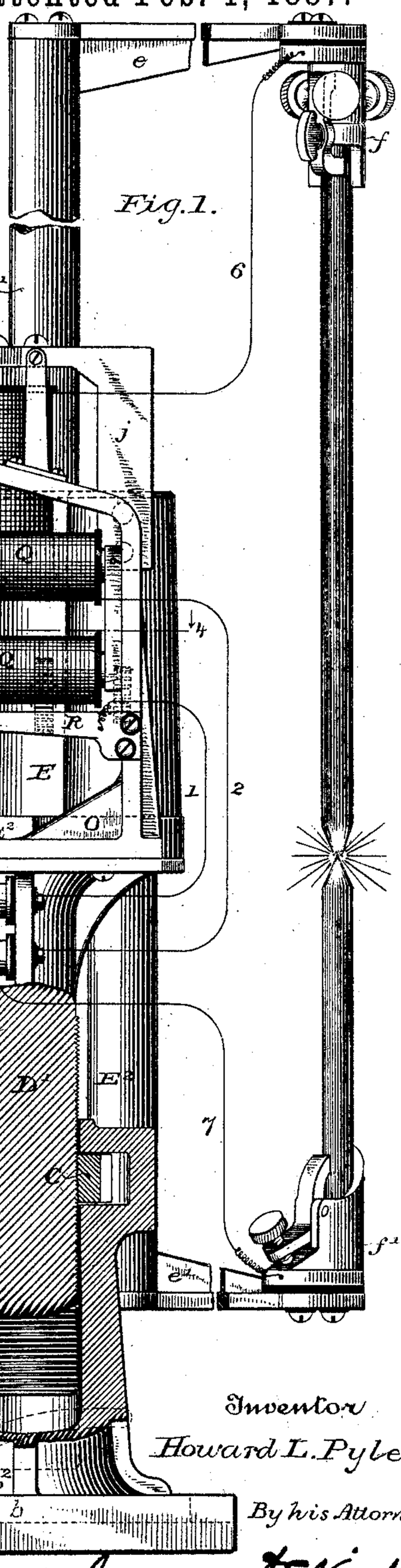


Fig. 1.



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(No Model.) 2 Sheets—Sheet 2.

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Fig. 4.

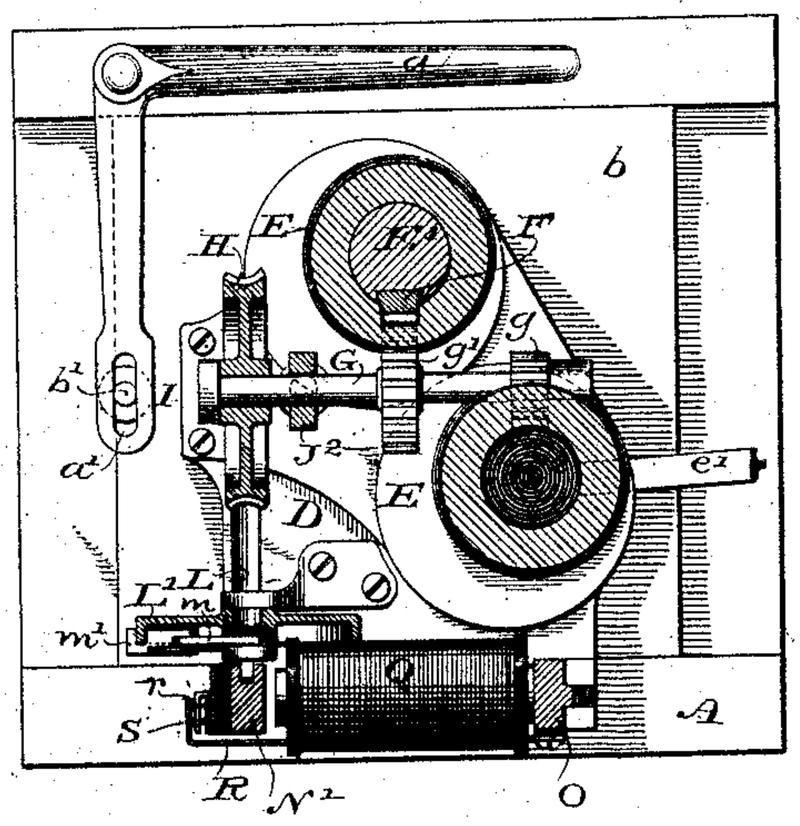


Fig. 5.

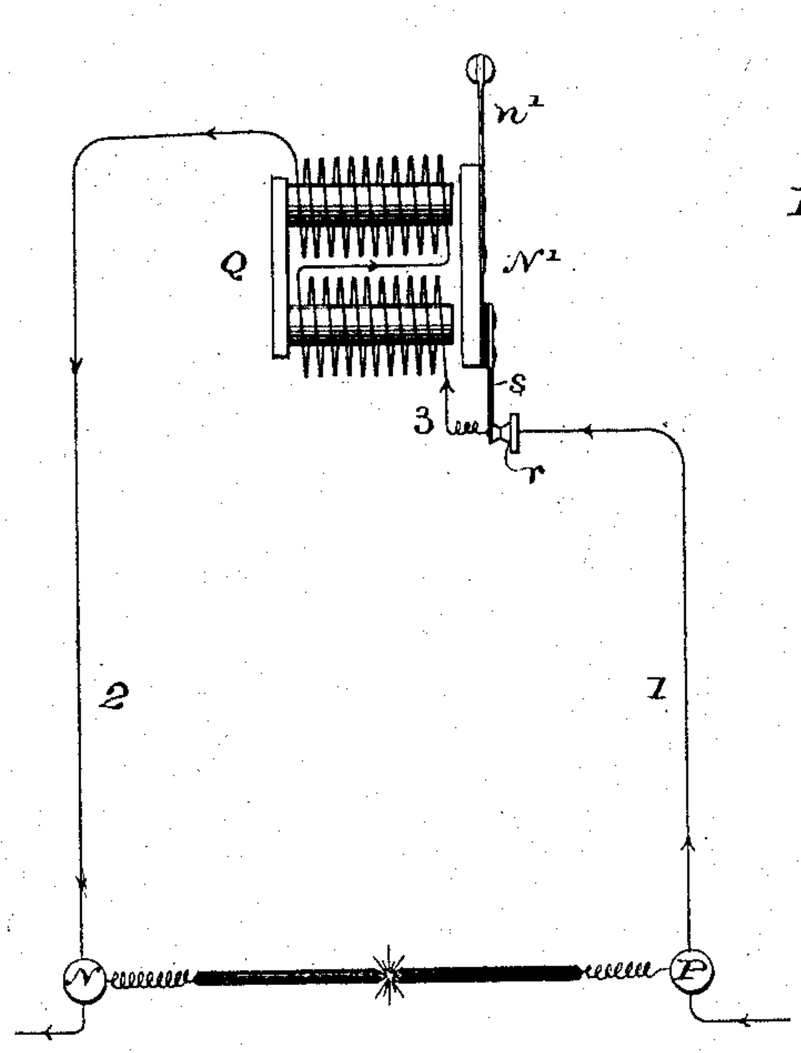


Fig. 6.

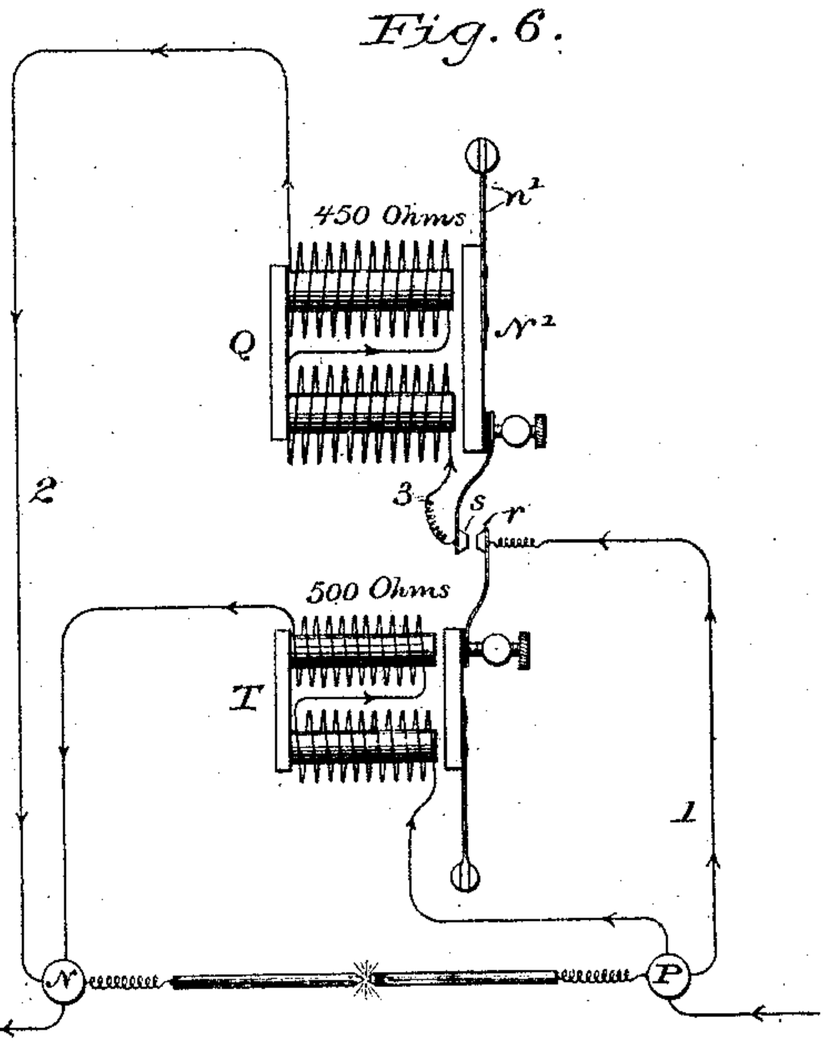
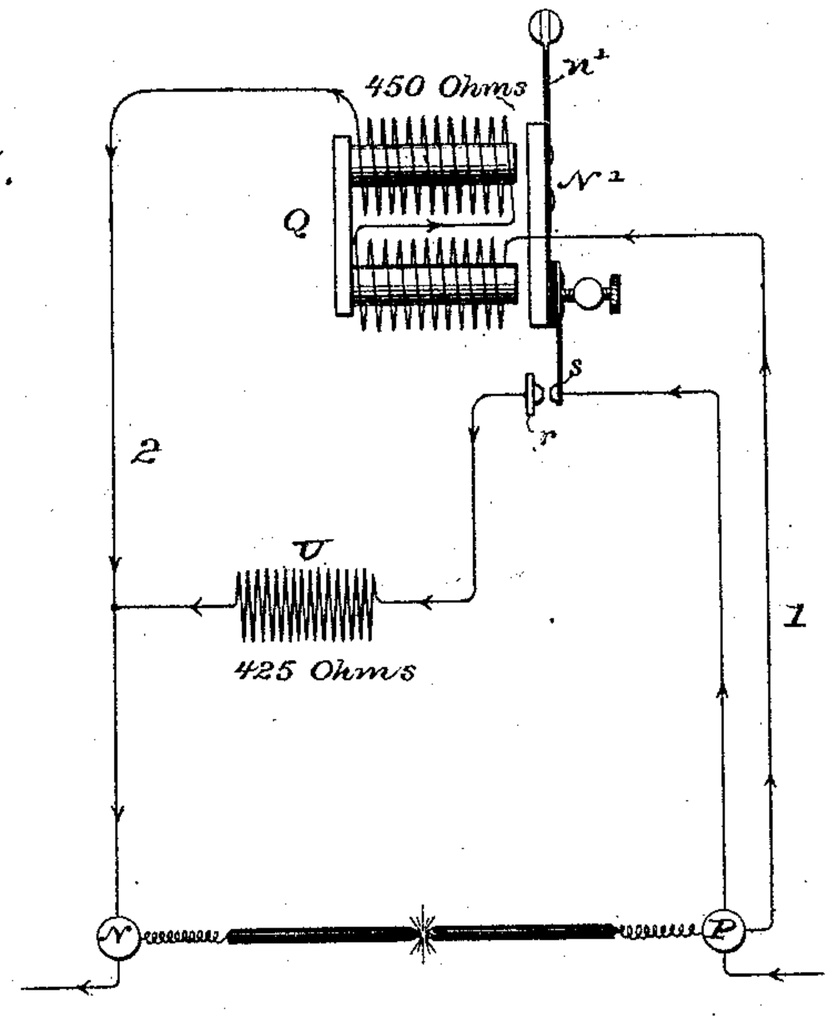


Fig. 7.



Witnesses
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UNITED STATES PATENT OFFICE.

HOWARD L. PYLE, OF AKRON, OHIO.

ELECTRIC-ARC LAMP.

SPECIFICATION forming part of Letters Patent No. 356,786, dated February 1, 1887.

Application filed March 23, 1886. Serial No. 196,271. (No model.)

To all whom it may concern:

Be it known that I, HOWARD L. PYLE, a citizen of the United States, residing at Akron, in the county of Summit, State of Ohio, have invented certain new and useful Improvements in Electric-Arc Lamps, of which the following is a description.

My invention relates to improvements in that type of electric-arc lamps known as "focusing lamps," and more particularly to such as are used in connection with a reflector for the purpose of throwing a concentrated and powerful beam of light in a given direction. The lamp in question is especially designed for use in locomotive head-lights, and it therefore comprises many details of construction and arrangement not ordinarily required, and such as will enable the feeding mechanism to automatically maintain a perfectly steady arc at the proper focal point, notwithstanding the constant and severe vibration and the many shocks and jars to which the entire apparatus is necessarily subjected when the locomotive is in motion.

The present invention consists largely of improvements in the method of operation, arrangement of parts, and details of construction over the lamp described in my former application, No. 188,318, filed January 12, 1886, the rotating motor for operating the carbon-feeding mechanism being replaced by a positively-acting vibrating motor device or clutch, which, together with various other improvements in construction, will be fully hereinafter set forth, together with a description of such portions of my former invention above referred to as are necessary to a full understanding of the completed apparatus.

In the accompanying drawings, which form a part of this specification, Figure 1 is a view in elevation of my improved head-light focusing lamp, a portion of the base and the devices controlling the vertical adjustment being shown in section. Fig. 2 is a side elevation of the lamp, viewed in the direction of the arrow in Fig. 1. Fig. 3 is an enlarged detail of a portion of the lifting-magnets, showing their polar extensions, armature, and a portion of the devices attached thereto. Fig. 4 is a transverse sectional view of the lamp on the lines 4 4 of Figs. 1 and 2. Fig. 5 is a diagrammatic view of the circuits, and Figs. 6 and 7 are modifications thereof.

Similar letters denote like parts throughout.

A represents a base-plate, of any suitable metal or material, and within a suitable slot or recess in the upper side thereof is mounted a hollow post, B, which latter is formed with a flange or extended lower portion, *b*, fitting into and adapted to move horizontally within the recess of the base A. A hand-lever, *a*, is pivotally secured to the base A and connected to the sliding flange *b* by a suitable pin, *b'*, working in a slot, *a'*, in the extremity thereof, whereby the post B and the parts supported upon it may be adjusted laterally, as desired; and I further provide a set-screw, b^2, working through the flange *b*, for the purpose of securing the same and holding it firmly in its adjusted position. The post B is hollow, and at its upper end is formed into a square open frame, between the upper and lower portions, B' B^2, of which is inserted a nut, C, which has a horizontal bearing within the said frame, is of circular form, and is provided along its exterior with extensions or wings C', by means of which it can be grasped and turned in either direction.

The working parts of the lamp are all mounted upon a table, D, which is formed at its under side with a downwardly-depending exteriorly-screw-threaded stem D', which passes through the nut C and into the post B, within which it is adjusted vertically by means of the said nut. The stem D' is formed with keyway D^2, within which fits a stop, *d*, secured to the top of the post B, for the purpose of preventing rotation of the stem D'. A set-screw, *d'*, passes through a lower part of the post B, and, fitting into the above-mentioned keyway, the stem is securely held thereby at the desired point.

Upon the table D is mounted a casting, E, which is bored to form two tubular guides, within which are supported carbon-carrying rods E' E^2. From the upper end of one and lower end of the other project arms *e e'*, at the extremities of which, but suitably insulated therefrom, are mounted the carbon-clamps *f f'*. The carbon-carrying rods are each provided on one side with a rack, F, which extends therefrom and fits into a vertical slot formed

for its reception on the inside of each of the tubular guides, where it also serves to prevent the rods E′ E² from turning in their said supports, thereby insuring the vertical position of the carbons with respect to each other. A tilting shaft, G, pivoted at one end in a yielding bearing, extends between the tubular guides and is provided with a pinion, *g*, engaging the rack upon the carbon rod E², and a larger pinion, *g′*, engaging the rack on the rod E′. The pinions are of such relative sizes that when rotated simultaneously they will produce a sufficiently greater motion of the upper or positive carbon toward the lower or negative one that the point of separation and arc will remain practically stationary during the entire operation of the lamp, both carbons being fed toward it at the same speed as they are consumed. The outer end of shaft G is provided with a worm-gear, H, and is suitably supported in an open bearing supported upon a pillar, I, secured to the table D. A pair of lifting-magnets, J, wound with coarse wire and permanently included in the main circuit, are fixed to a suitable bracket, *j*, secured to the casting E, by which they are suspended with their lower extremities or polar extensions in proximity to and above the worm-wheel H, above referred to. The poles K of the magnets J are formed with sloping sides K′, and their armature J′ is provided with upturned ends *j′* that overlap and move parallel with the sloping sides referred to, so that when the armature is at the lowest point of its stroke the upper portion of the upturned ends thereof will not have passed beyond the influence of their magnetic field.

A second tilting shaft, L, provided with a worm-gear, *l*, at one end and a flanged wheel at the other, is mounted in a suitable bracket at or near the end carrying the flanged wheel L′ and at its other end in a bearing carried by an arm or projection, J², secured to and depending from the armature of the lifting-magnet. The worm-gear *l* is directly below the wheel H and, as the armature J′ is drawn up, is brought into engagement therewith. The depending arm J², besides carrying the moving end of the shaft L, is also provided with a recess, *h*, within which lies the shaft G. As the armature J′ rises the gear *l* is first brought into engagement with its pinion H, and the two together are then carried up to the full extent of the movement of the armature, which operation not only connects the two portions of the feeding-train, but also separates the carbons to form the arc.

The armature J′ is guided in its descent by means of pins *k*, which project from the pole-pieces K therethrough. The lower end, *k′*, of the arm J² fits into a step-bearing, *k²*, where, at the lowest point of its stroke and in connection with the pins *k*, it firmly supports and holds the parts depending upon it, and will be found very convenient where the lamp is subject to such constant and violent vibration as is the head-light of a locomotive traveling at high speed. This portion of the mechanism is substantially the same as that previously described in my former application, to which reference is made for further description of any portion of the device common to both applications. Instead of the motor in my previous case, I actuate the "feeding mechanism" by means of a vibrating motor device or clutch, which, while intermittent in its action, may become practically continuous by the rapidity thereof, and is not only simpler in every respect, but is also much less expensive both to operate, construct, and maintain than the rotating electric motor heretofore described by me, being at the same time more accurate and sensitive.

Various devices may be employed for this purpose; but for the sake of illustration I have shown an arrangement comprising a flanged wheel or disk, L′, which is secured on the shaft L of the feeding-train. Upon the axis of said disk is pivoted an arm, M, which extends upward and is at its outer end pivotally connected to an armature, N′. From the lower portion of the arm M extends a link, *m*, to the end of which is pivoted a block, *m′*, formed with a slot in one side that fits over the flange of the disk L′, so that when pulled upon by the link *m* it will grasp said flange and partially rotate the disk. A spring, *n*, is attached to the arm M and arranged to bear upon the block *m′* and move it downward or forward upon the flange of the wheel or disk L′ at each vibration of the arm M.

The armature N′ is supported by a flat spring, *n′*, depending from the outer end of a frame, O, which extends upward and forward from one side of the table D, and to the vertical portion of which is secured an electro-magnet formed of the two coils Q, of high resistance, which are connected between the binding-posts P and N by the conductors 1 and 2, constituting a shunt of high resistance around the arc, and at the same time are so located and the conductor 1 is so arranged that their poles *q* actuate and control the armature N′ and the mechanism for operating the carbon-feeding train.

The conductor 1 is connected to an insulated arm, R, secured to the frame O and extending to a point in front of the armature N′, where it is provided with a platinum contact, *r*. The armature N′ carries a spring-arm, S, which is suitably insulated therefrom and provided at its lower extremity with a second platinum contact, *s*, which strikes against the fixed contact *r* at each vibration of the armature. A conductor, 3, extends from the vibrating arm *s* and is permanently connected to one terminal of the shunt-magnet Q, the other extremity thereof being connected to the negative binding-post by conductor 2, as heretofore described. The main circuit through the lamp is from the positive binding-post P, by conductor 5 to the lifting-magnets J, thence by conductor 6 to the upper carbon-clamp, *f*,

and from the lower carbon-clamp, f', by the conductor 7 to the negative binding-post N, and thence to line.

When no current is passing through the lamp, the lifting-coils J are demagnetized and the armature J′ is at its lowest point, at which time the worm-gear l being entirely free from the pinion H, the said pinion, together with the pinions $g\ g'$, are free to be rotated by the weight of the upper carbon and its rod, bringing their points together, no matter what the amount of separation. The same action will take place should a carbon prove defective while the lamp is in operation or a piece be broken out by the exceptionally-violent agitation and jarring to which the device is subjected. The junction of the carbons being always effected by gravity, it is certain to occur rapidly whenever the circuit is broken and without the addition of circuits and apparatus for that purpose. The working-circuit being closed, the magnet J is instantly energized, the feeding-train is connected and put in working condition, and at the same time the carbons are separated and the arc established. The spring n' normally holds the armature N′ away from the poles $q\ q$, and against the contact r, completing the shunt-circuit. As the resistance of the arc is increased by the consumption of the carbons the shunt-magnet becomes more and more energized, and, finally overcoming the tension of the spring n', they attract the armature N′, vibrate the arm M, and rotate the disk L′, and through it the carbon-feeding gear-train, causing both carbons to approach each other. The frequency with which this movement occurs will depend altogether upon and be in accordance with the consumption of carbon at the arc, and, being controlled by the electrical condition of the shunt-coils, will at all times be sufficiently rapid to maintain the carbons in their best and most favorable relative positions.

As shown and described, my improved lamp contains a shunt-circuit which is broken by means of a vibrating armature, the movements of which operate the feed mechanism. I contemplate modifying this arrangement in several ways—as, for instance, as shown in Fig. 6, where two shunt-circuits are shown. When the resistance of the arc is normal, the magnet Q is demagnetized, its armature held against its back stop by the tension of its spring n', and the circuit controlled by the said vibrating armature is open. During this time a second shunt-circuit of higher resistance than that through the magnet Q, always closed and including an electro-magnet, T, carries the current to be shunted. A second armature, actuated by the auxiliary magnet T, carries the second contact, r, connected to the conductor 1, and when it is drawn against its magnet T by the magnetism produced therein by abnormal resistance at the arc the contacts s and r are brought together, the circuit through the magnet Q is established, the armature vibrated, and the carbon-feeding devices actuated.

In Fig. 7 is shown an arrangement similar to that of Fig. 5, except that a resistance, U, somewhat smaller than that of the coils of the magnet Q, is interposed and so arranged that as the magnet Q draws in its armature and operates the clutch a second shunt-circuit is closed through the resistance U, demagnetizing the magnet Q, but through a smaller resistance, the current normally passing through the clutch-operating magnet as soon as its circuit is closed by the movement of the armature N′ in opposition to the action of the spring n', and the resistance U cut out, the object of the resistance U and also of the magnets T being simply to produce the same action in the shunt-magnets Q, operating the carbon-feeding motor device, as is shown and described with reference to Fig. 5, the latter embodying the simplest arrangement of shunt-circuits of which my invention is capable.

There being several points of resemblance between the present application and the one previously filed by me, I do not herein claim any of the matters shown, described, and claimed in that application.

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

1. In an electric-arc lamp, the combination, with carbon separating or lifting magnets permanently in the main circuit, the armature whereof is provided with a depending arm having a bearing at its free end, in which is mounted the free end of the feed-actuating shaft, and a hook within which the carbon feeding and separating shaft is lifted into working position and there supported in pitch relation to the gear on the actuating-shaft, of an electro-magnet of high resistance in a shunt spanning the arc, a vibrating armature in the field of the shunt and carrying a movable contact, whereby the shunt-circuit is intermittently magnetized during the continuance of abnormal resistance at the arc, and a carbon-feeding motor device connected to and arranged to be operated by the vibrations of the said armature, as set forth.

2. In an electric-arc lamp, the combination, with carbon separating or lifting magnets permanently in the main circuit and carbon holding and feeding devices therefor, substantially as shown and described, of an arm depending from the armature of the said lifting-magnets and having a bearing at its free end, in which is mounted the free end of the feed-actuating shaft, and a hook within which the carbon feeding and separating shaft is lifted into working position and there supported in pitch relation to the gear on the actuating-shaft, a vibrating armature connected to and controlling the carbon-feeding mechanism, and an electro-magnet of high resistance spanning the arc and constituting the shunt-circuit therefor, and operating, when energized by the abnormal re-

sistance of the arc, to vibrate said armature and actuate the carbon-feeding mechanism, substantially as described.

3. In an electric-arc lamp, the combination of suitable carbon-holding devices and mechanism, substantially as described, for feeding the carbons toward each other, a pair of lifting-magnets permanently in the main circuit, the armature whereof is provided with an arm connected to the carbon-feeding mechanism, whereby on establishing the current said mechanism is raised into working position and there supported during its continuance, an electro-magnet of high resistance located in a shunt around the arc and provided with a vibrating armature carrying a movable contact, whereby the shunt-circuit is intermittently magnetized during the continuance of abnormal resistance at the arc, and a carbon-feeding motor device connected to and arranged to be operated by the vibrations of the said armature, as set forth.

4. In an electric-arc lamp of the kind described, the combination, with the carbon-holding devices, of a pair of lifting-magnets, J, having pole-pieces K, sloped at their outer sides and provided with the pins *k*, an armature, J′, therefor formed with upturned ends *j*′, lapping said poles and supported upon the pins *k*, feeding devices arranged to be supported by said armature, a positively-actuated motor device for rotating the feed mechanism, and an electro-magnet of high resistance located in a shunt around the arc and provided with a vibrating armature, and means connected to said armature and to the carbon-feeding mechanism whereby the armature is vibrated and the carbons caused to approach whenever the resistance of the main circuit exceeds a predetermined point, substantially as shown and described.

5. The combination, in an electric-arc lamp of the kind described, of a stationary base, a post moving transversely thereon, a lever for adjusting the post transversely, and a set-screw whereby the post is secured in its adjusted position, as set forth.

6. In an electric-arc lamp of the kind described, the combination of a hollow post or support provided with a screw-threaded rotatable nut secured within its upper portion, a table or frame adapted to support the working parts of the lamp and formed with a stem extending through the nut and into the post, and suitably screw-threaded, whereby it is rendered vertically adjustable therein, substantially as described.

7. In an electric-arc lamp of the kind described, the combination of a hollow post or support having a screw-threaded rotatable nut secured at its upper portion, a table or frame adapted to support the working parts of the lamp and formed with a stem extending through the nut, whereby it is rendered vertically adjustable, and having a keyway at one side of the said stem, a stop registering with said key and secured to the post, and a set-screw also registering with said keyway and secured to the post, as set forth.

8. In an electric-arc lamp of the kind described, the combination of carbon-holders formed with racks on one of their sides, a tilting shaft having pinions engaging the racks and arranged to move the carbon rods in opposite directions simultaneously, a worm-wheel at its tilting end, and a fixed support therefor, a second tilting shaft having at its fixed end a motor device and at its tilting end a worm-gear, a lifting-magnet in the main circuit, the armature whereof is provided with a depending arm having a bearing at its free end, in which is mounted the free end of the motor-shaft, and a hook within which the carbon separating and feeding shaft is lifted from its fixed support into working position and there supported in pitch relation to the worm on the motor-shaft, substantially as described.

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

HOWARD L. PYLE.

Witnesses:
GEO. W. YOUNG,
HENRY A. LAMB.