(No Model.)

4 Sheets—Sheet 1.

H. L. PYLE.

ELECTRIC ARC LAMP.

No. 356,788. Patented Feb. 1, 1887.

Fig. 2.

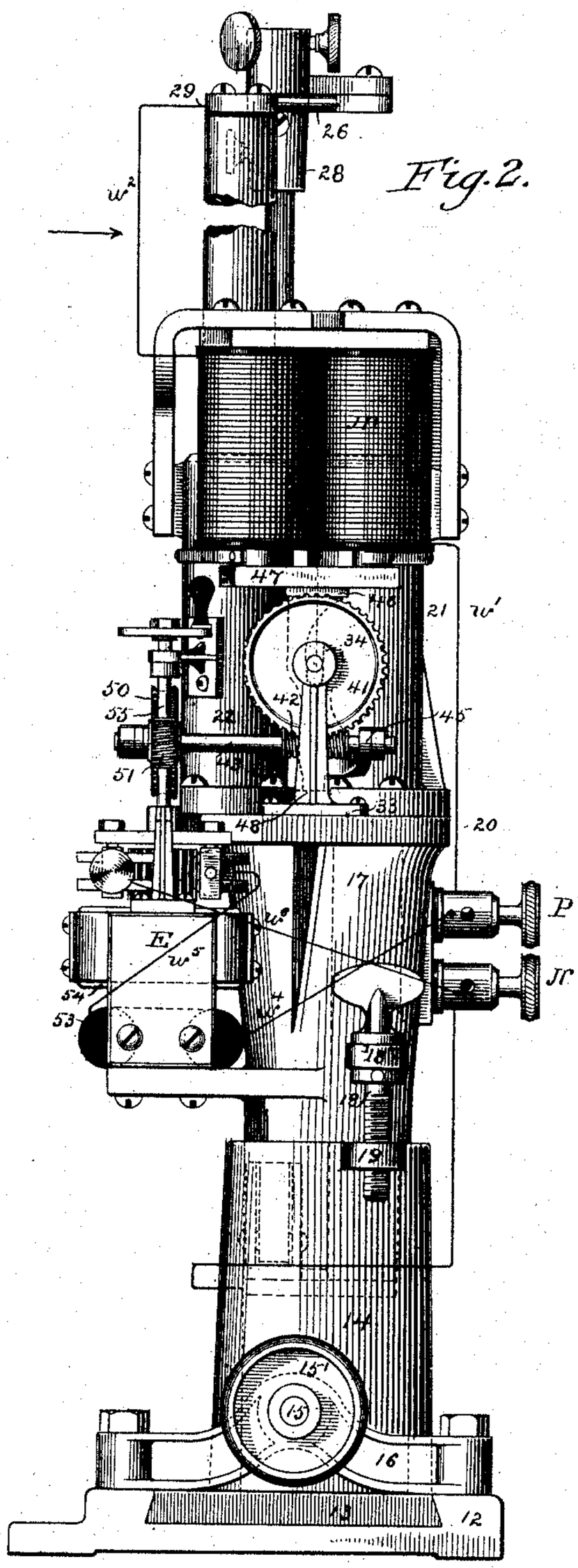
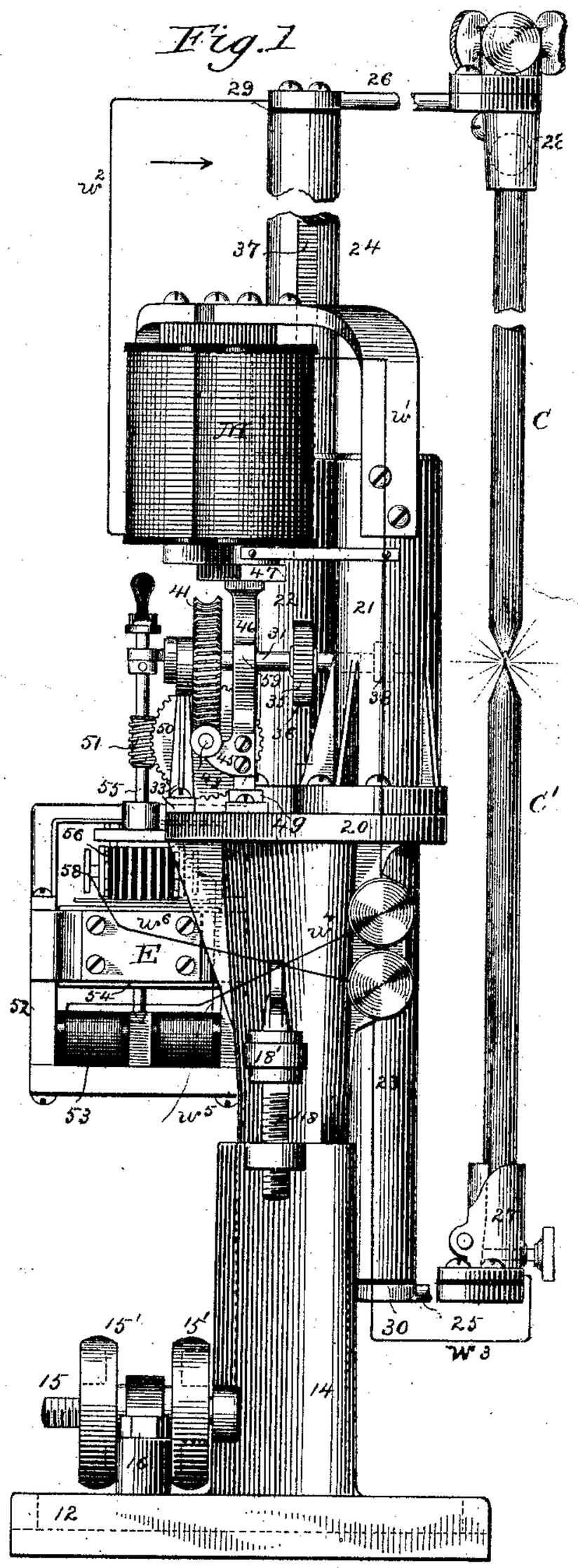


Fig. 1.



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(No Model.)

4 Sheets—Sheet 2.

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Fig. 4.

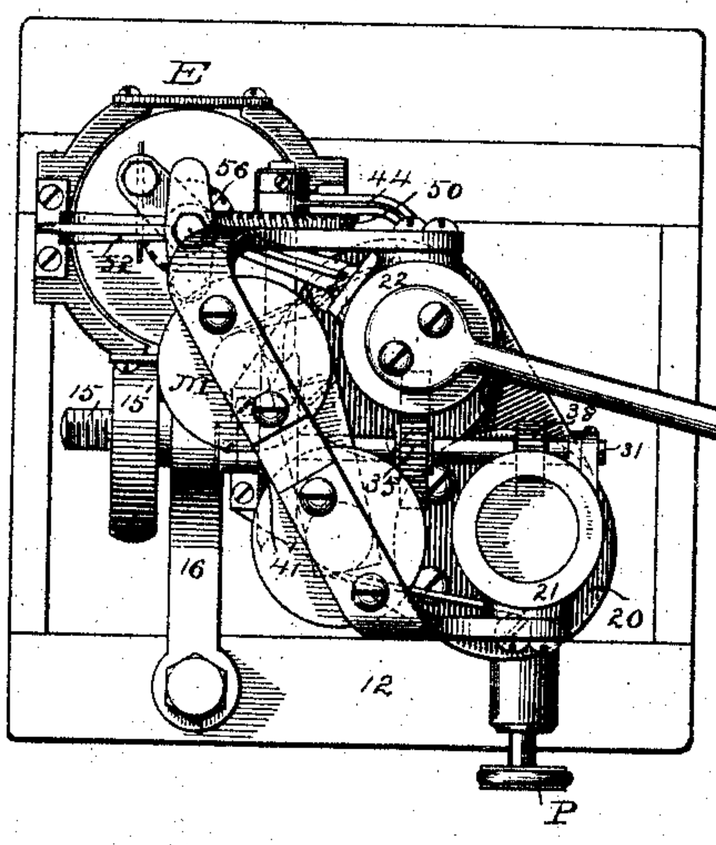


Fig. 5.

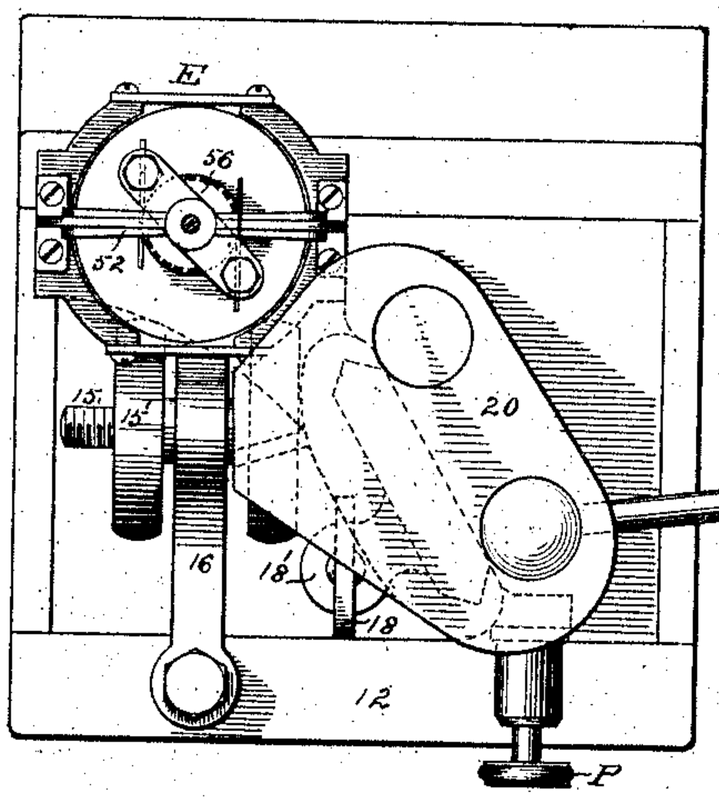
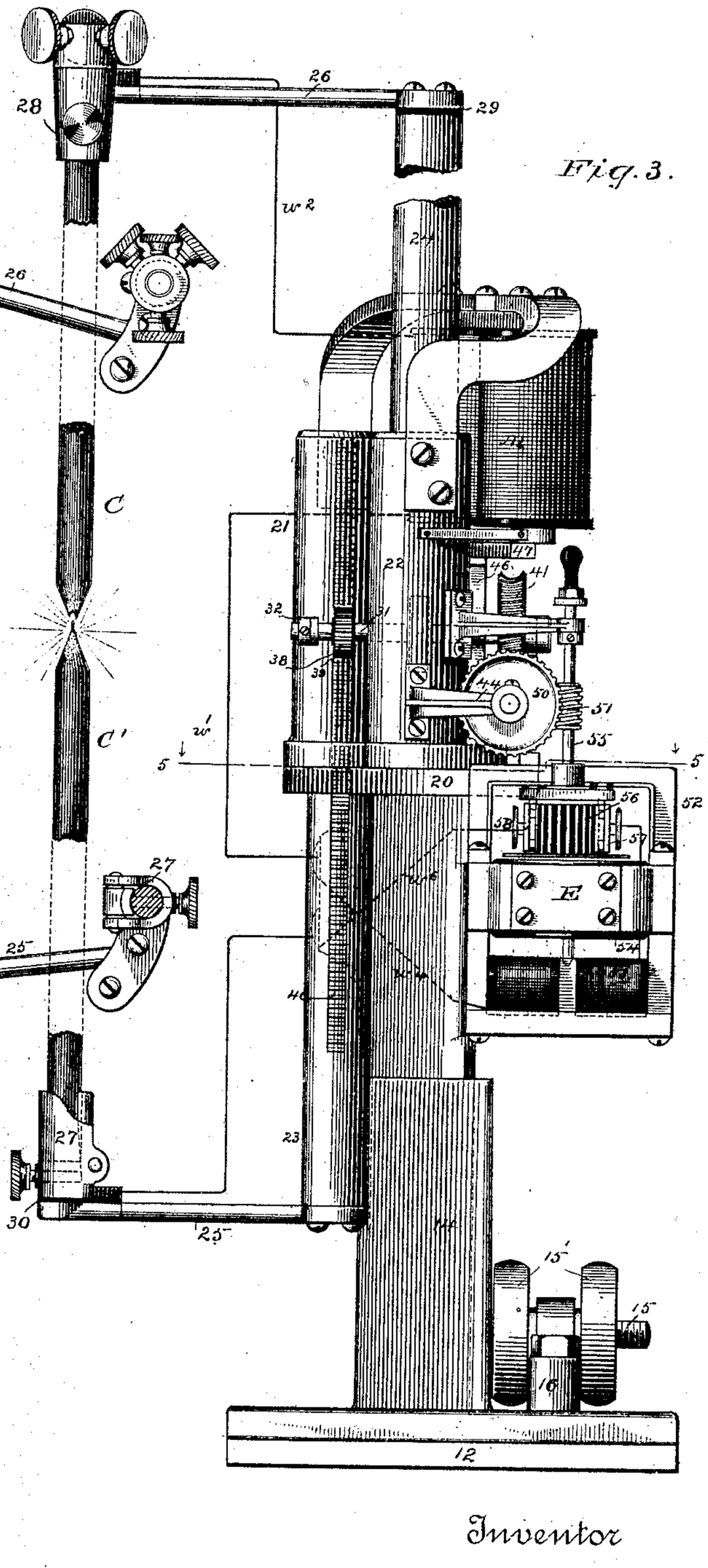


Fig. 3.



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4 Sheets—Sheet 3.

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ELECTRIC ARC LAMP.

No. 356,788. Patented Feb. 1, 1887.

Fig. 6.

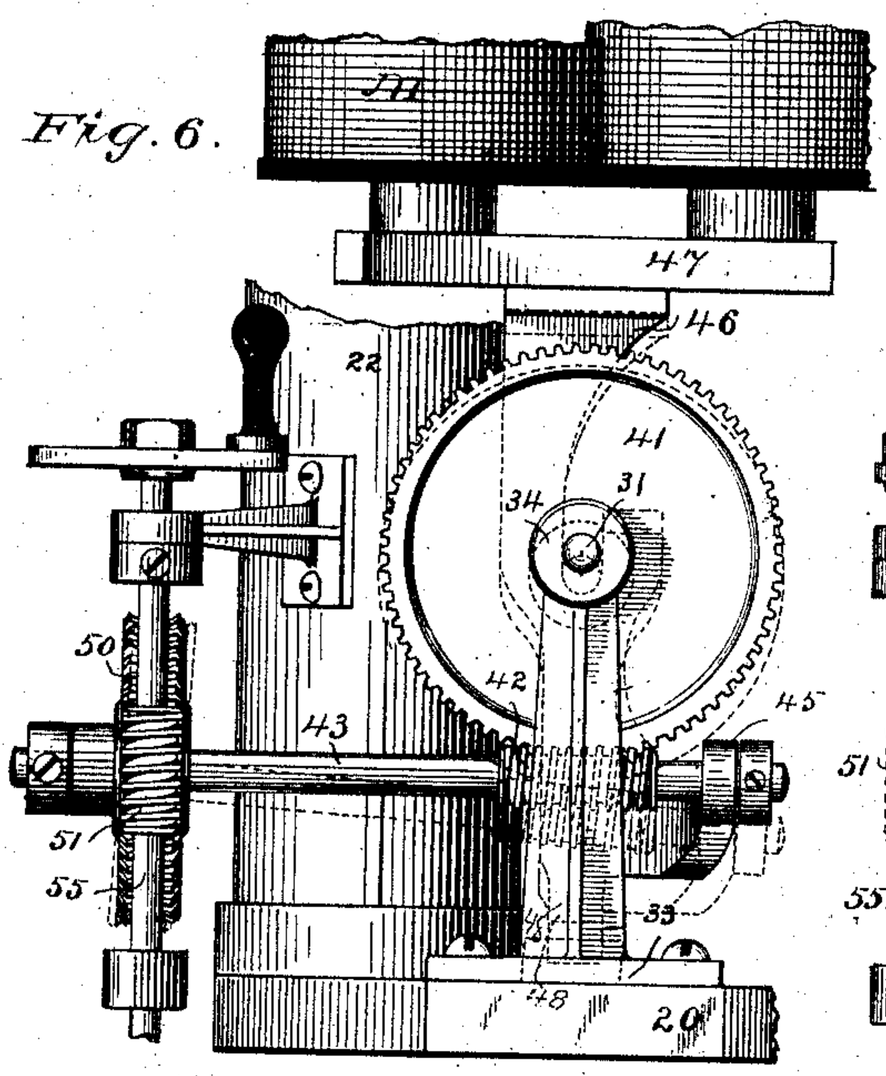


Fig. 7.

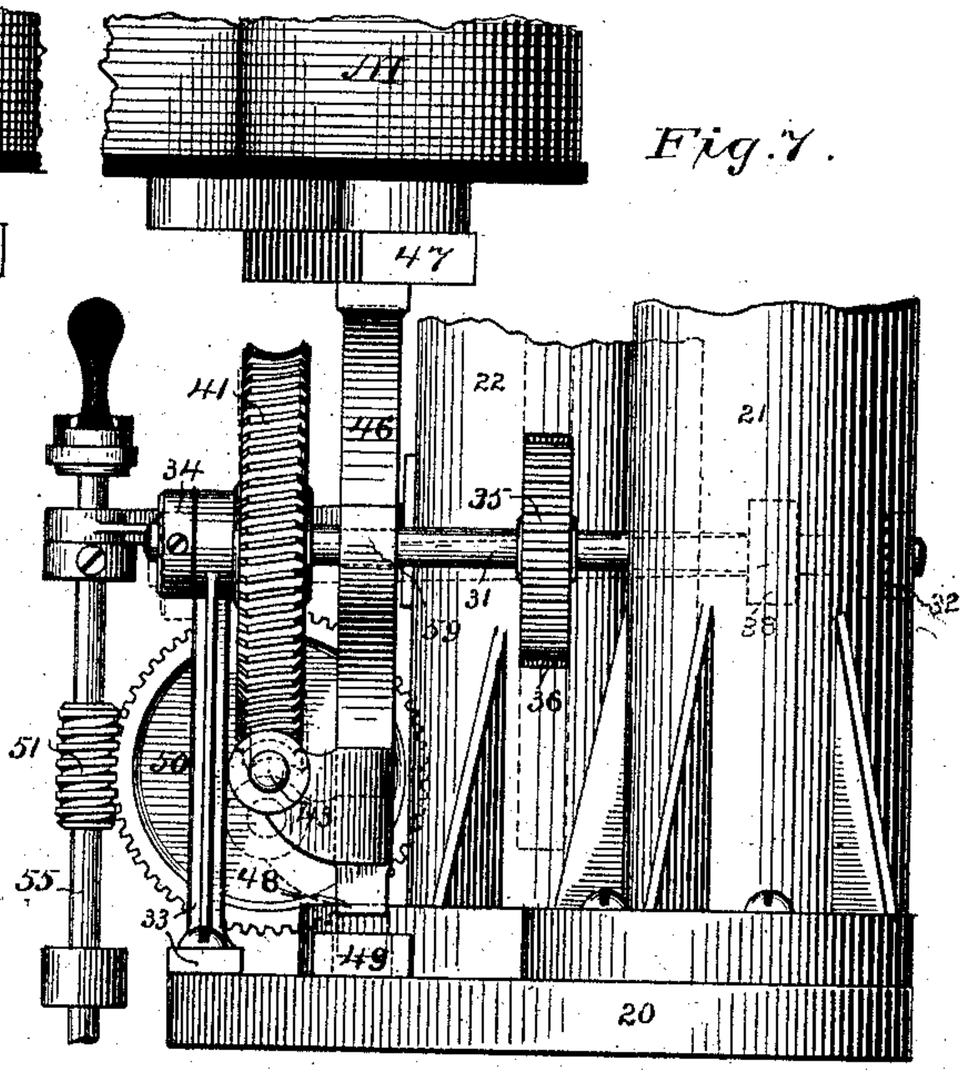
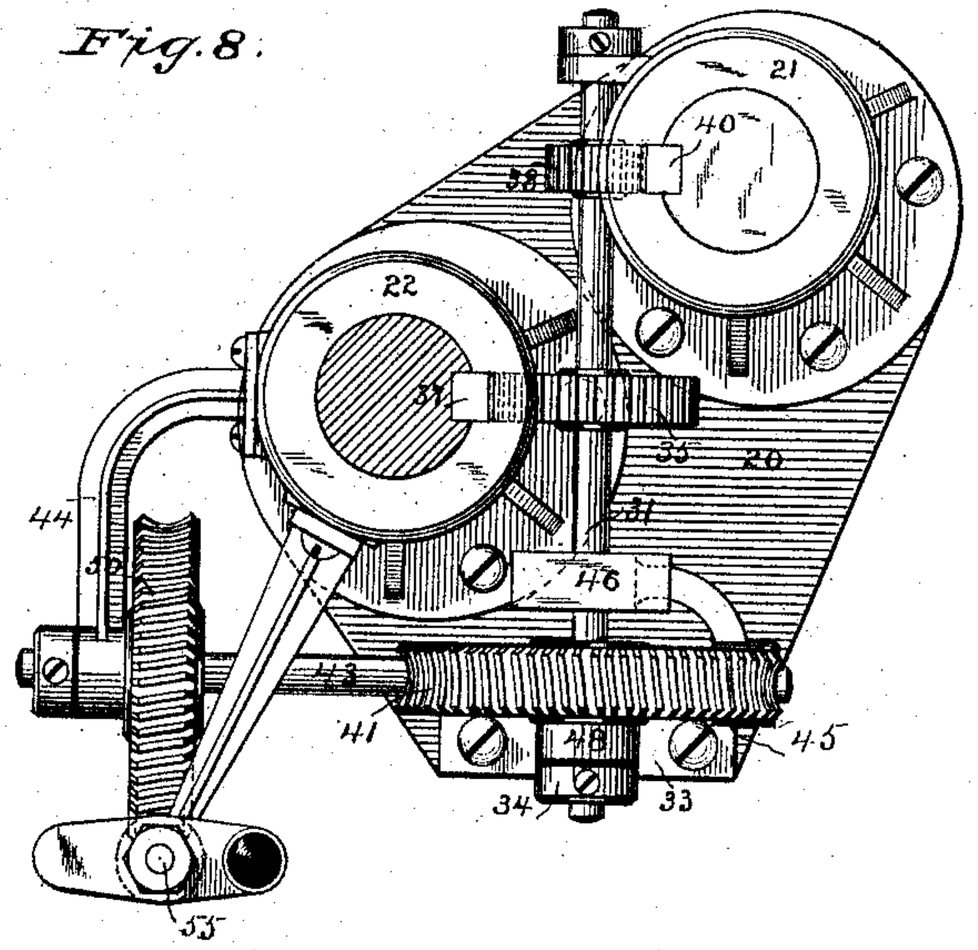


Fig. 8.



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4 Sheets—Sheet 4.

H. L. PYLE.

ELECTRIC ARC LAMP.

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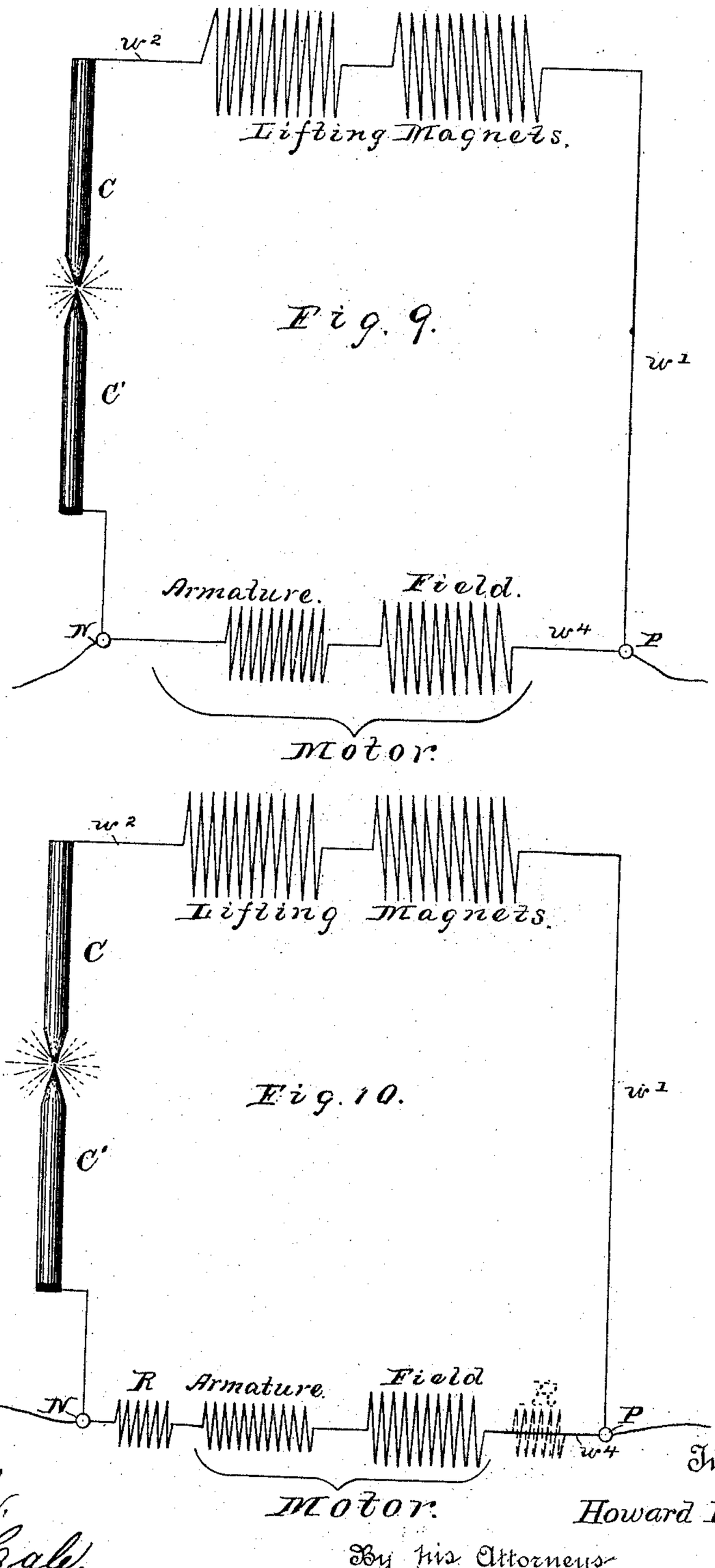

Fig. 9.

Fig. 10.

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UNITED STATES PATENT OFFICE.

HOWARD L. PYLE, OF AKRON, OHIO.

ELECTRIC-ARC LAMP.

SPECIFICATION forming part of Letters Patent No. 356,788, dated February 1, 1887.

Application filed January 12, 1886. Renewed November 9, 1886. Serial No. 218,418. (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 and State of Ohio, have invented certain new and useful Improvements in Electric-Arc Lamps; and I do 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, reference being had to the accompanying drawings, and to the letters and figures of reference marked thereon, which form a part of this specification.

My invention relates to electric-arc lamps of that class ordinarily known as focusing-lamps, in which the aim is so to feed the two carbon pencils toward each other that the arc will always be maintained at a fixed point, which fixed point is usually the focus or center of reflection of a concave mirror.

The object of my invention is to construct a lamp of this class in which the feed of the carbons shall be absolutely positive and steady, so that the position of the arc will not be varied by any jarring to which the lamp may be subjected; further, to so construct such a lamp that none of the electric current will be wasted in overcoming resistances extraneous to the arc and separating-magnet; further, to so construct such a lamp that after it is once set in operation the arc-establishing and carbon-feeding devices will always be under the control of the current and the operation of the lamp will be automatically recommenced after any accidental interruption of the current, and, finally, to embody the principles of my improved focusing-lamp in a simple and reliable mechanism which is prompt in action and not liable to get out of order.

My invention consists in certain novel constructions and combinations of devices, which will be readily understood from the following particular description in connection with the accompanying drawings, in which—

Figure 1 is a side elevation of my improved electric-arc lamp. Fig. 2 is a side elevation of the lamp viewed in a direction of the arrow in Fig. 1. Fig. 3 is a side elevation of the lamp viewed in the direction of the arrow in Fig. 2. Fig. 4 is a top view of the lamp. Fig. 5 is a horizontal section on the line 5 5 of Figs. 1, 2, and 3. Fig. 6 is an enlarged detail view illustrating the carbon-separating devices. Fig. 7 shows the same devices from a different point of view. Fig. 8 is a top view, in detail, of the feeding devices with the motor omitted. Fig. 9 is a diagram illustrating the electric construction of the lamp. Fig. 10 is a modified diagram.

Referring now especially to Figs. 1, 2, and 3, the number 12 indicates a base-piece, in which is dovetailed the horizontal slide 13, carrying a vertical socket-piece, 14, said slide and socket-piece being adjustable by means of a screw, 15, which passes through a bridge, 16, and is provided with suitable adjusting-nuts, 15′, on opposite sides of said bridge. In the socket-piece 14 is inserted the shank or lower portion of a pedestal, 17, which is vertically adjustable by means of a screw, 18, swiveled in a lug, 18′, projecting from the pedestal and taking into a threaded lug, 19, on the socket-piece.

At the top of the pedestal 17 is a horizontal flange or platform, 20, having mounted upon it vertical tubular guides 21 22, which are open at both top and bottom, their lower openings coinciding with openings in the flange 20. In these tubular guides are arranged carbon-operating rods 23 24, having the projecting arms 25 26, provided with the carbon-holders 27 28, in which are inserted the upper and lower carbon pencils, C and C′, as shown in Figs. 1 and 3. The construction of these carbon-holders is obvious and need not be enlarged upon. The arms 25 and 26 are insulated from the carbon rods by suitable interposed plates, 29 and 30, of hard rubber or other non-conducting material.

Between the tubular guides 21 22 is arranged a horizontal shaft, 31, one end of which is loosely supported in a bearing, 32, projecting from the guide 21, while its other end is supported by a standard, 33, and is capable of a slight vertical movement in an elongated bearing or vertical slot, 34, formed in the top of said standard. At about its middle portion the shaft 31 carries a pinion, 35, the teeth of which project through a slot, 36, in the tubular guide 22 and engage with a rack, 37, on carbon rod 24. The shaft 31 carries another pinion, 38, half the diameter of pinion 35, and having its teeth projecting through a slot, 39, in the guide-tube 21 to engage with a

rack, 40, on the carbon rod 23. It will be observed that when this shaft is rotated the carbon rods will be driven in opposite directions, the rod 24 moving twice as rapidly on account of the difference in diameter between the pinions 35 and 38. Besides these pinions, the shaft 31 carries a worm-wheel, 41, which at proper times is caused to engage with a worm, 42, as will presently appear. This worm 42 is carried by a shaft, 43, having one end mounted loosely in a bearing in the outer end of an arm, 44, which projects from the tubular guide 22 and may have a slight vertical play in said bearing. The other end of this shaft 43 has its bearing in a bracket, 45, projecting from the lower portion of a leg, 46, which at its top carries a horizontal armature, 47, and at its lower end terminates in a toe, 48, having a slight vertical movement in a socket, 49. The shaft 43 also carries a worm-wheel, 50, which engages with a worm, 51, fixed upon the shaft of an electric motor, E, which is supported by a suitable frame-work, 52, attached to one side of the pedestal 17. This motor need not be further described than to say that 53 indicates its single field-magnet; 54, its armature; 55, its vertical shaft carrying the worm 51; 56, its commutator, and 57 and 58 the commutator-brushes. The only peculiarities of the motor are that both its field-magnet and armature are wound for high resistance, and they are connected in series and included in a shunt around the arc and connecting the two main binding-posts P and N of the lamp.

At one side of the leg 46 is a hook, 59, just below the shaft 31, and adapted to form a bearing for said shaft, though it does not engage the same except when the lamp is in operation.

The letter M indicates a lifting-magnet, the function of which is to separate the carbons for establishing the arc, which it does by attracting the armature 47 from its normal position of rest. When the lamp is not in operation, the toe 48 of the leg 46 rests at the bottom of the socket 49, and at this time the worm 42 is out of engagement with the worm-wheel 41, the hook-bearing 49 does not touch the shaft 31, said shaft rests at the bottom of the bearing 34, and there is a slight distance between the armature 47 and the poles *m* of the lifting-magnet M, this distance being such that through the intermediate mechanism a proper separation of the carbons will take place for establishing the arc when the magnet M attracts its armature.

The electrical connections of the lamp are as follows: A wire, w', connects binding-post P with one coil-terminal of the magnet M, the other coil-terminal of which is connected by a wire, w^2, with the upper-carbon holder 28, and the lower-carbon holder 27 is connected by a wire, w^3, with the binding-post N. It will be seen, then, that the course of the current is from the binding-post P, over wire w', through the coils of the magnet M, over wire w^2, over carbon pencils C C′ and wire w^3 to binding-post N, and when the circuit is closed the first operation in the lamp is that the magnet M attracts the armature 47, thus causing the leg 46 to rise and lift the shaft 31 by its hook-bearing 59. This shaft being engaged with the upper carbon rod, 24, through the pinion 35 and rack 37, the upper carbon, of course, will be raised and a greater distance than the lower carbon, on account of the difference in positions between the pinions 35 and 38, so that a separation will occur between the carbons, resulting in the establishment of the arc. When the leg 46 completes its upward movement, it has lifted the worm 42 into engagement with the worm-wheel 41, and thus an operative mechanical connection is formed between the vertical shaft 55 of the motor E and the shaft 31, carrying the pinions 35 and 38, which control the feeding of the carbon. This motor is operated by being included in a shunt around the arc, as follows: From the binding-post P the wire w^4 leads to one coil-terminal of the motor field-magnet 53, from the other coil terminal of which the wire w^5 leads to the brush 57, while from the other brush, 58, a wire, w^6, leads to the binding-post N. These binding-posts, of course, are properly insulated from each other, and the lamp-frame and the wires used for making the electrical connections are properly covered and arranged to permit the parts to which they are connected to make their necessary movement.

I prefer ordinarily that the resistance of the shunt, including the motor E, shall be about one hundred times greater than that of the arc when established, so that but a very small portion of the current will be diverted for the operation of this motor, the current, of course, entering this motor-armature in a proper manner to cause it to turn in a required direction for transmitting a feeding motion to the carbons through the intermediate mechanism, which has already been described.

I propose usually to include the entire resistance of the shunt in the field-magnet and armature of the motor; but this is not essential, it only being necessary that the shunt as a whole shall have a very high resistance as compared with that of the arc. I may therefore include in the shunt one or more resistance-coils and place the balance of the resistance of said shunt in the field-magnet and armature connected in series.

The electrical plan of the lamp is fully illustrated in the diagrams 9 and 10, in which the parts are either named or numbered, as in the other figures, and in Fig. 10 the letter R indicates the resistance-coil, forming part of the resistance of the shunt on one side of the motor. A similar coil is also shown in dotted lines on the other side of the motor, it being immaterial whether the extra resistance outside of the motor be either on one side or the other thereof, or divided and placed on opposite sides.

From the mechanical construction of the lamp it will be seen that it is impossible that the carbon pencils can ever be jarred sufficiently to change the position of the arc, and it will also be seen that, owing to the difference in diameters between the pinions 35 and 38, the carbons will be fed toward each other in proportion to the rapidity with which they are relatively consumed.

The devices by which the carbon-controlling mechanism is connected to its source of power and disconnected therefrom are not herein claimed, since they form part of the subject-matter of another pending application.

I am aware that it is not new to use electric motors as a means for operating the carbon-feeding mechanism of electric-arc lamps of the type known as "force-feed," and I therefore do not claim such use, broadly, since, according to my invention, the carbon-controlling mechanism consists, as a whole, of a combination of the "force" and "gravity" methods of feeding.

In all force-feed lamps when the main circuit is broken the carbons remain separated, and it is necessary to establish the circuit through and operate the feeding motors of the entire series of lamps by the main current at starting. With the previously-described construction the carbon-feeding mechanism is brought into operative position and held there by a low-resistance magnet permanently in the main circuit, the carbons being always in contact at starting, after which the arc is established and then adjusted by means of a motor, the coils of which are of high resistance, and constitute the carbon-regulating shunt-circuit of the lamp. This action would not be possible with the well-known force-feed lamps, that operate in any position, but is so in the present instance, because when the circuit is broken by the occurrence of any unusual disturbance or irregularity the lifting-magnets instantly release the carbon-feeding mechanism and the carbons are brought together by the action of gravity alone, thereby at once closing the main circuit.

Having now described my invention, what I claim is—

1. In an electric-arc lamp, the combination, with gravitating carbons and positively-actuated feeding mechanism adapted to be released when the main circuit is interrupted or broken, of a lifting-magnet of low resistance, permanently in the main circuit and arranged to act on the carbon-feeding mechanism at starting the lamp to produce the initial separation between the carbons and establish the arc, an electric motor arranged to operate the carbon-feeding mechanism after the arc has been established, and having armature and field-magnet coils of relatively high resistance, both permanently connected in a derivation spanning the arc, and together constituting a shunt carbon-regulating circuit therefor, substantially as set forth.

2. In an electric-arc lamp, the combination, with the carbon-feeding devices, of an electric motor having its armature-shaft connected to operate said feeding devices, and its armature-coils and field-magnet coils permanently connected in series, and together constituting a shunt around the arc of relatively high resistance as compared with that of the arc, the entire resistance of said shunt being either included in the armature and field-magnet coils thereof or divided between the same and an extra resistance coil or coils, all permanently in the said shunt-circuit, essentially as set forth.

3. In an electric-arc lamp of the class described, the combination, with the carbon-feeding devices, of an electric motor the armature and field-magnet coils of which are permanently connected and together constitute a shunt of high resistance around the arc, and having its armature-shaft arranged for connection with said feeding devices, a lifting-magnet permanently included in the main circuit and arranged to produce the initial separation between the carbons and establish a connection between the motor-shaft and feeding devices, whereby the motor will be adapted to control the feed, essentially as set forth.

4. In an electric-arc lamp of the kind described, the combination, with the carbon-feeding gear-train adapted to be actuated by the weight of the upper carbon rod to allow the carbons to come together by gravity when the main circuit is interrupted or broken, a lifting-magnet of low resistance permanently connected in the main circuit and having its armature connected to the gear-train, so that when the lamp is started up said armature will be raised, the initial separation produced between the carbons, and the parts suspended thereby during the operation of the lamp, and an electric motor arranged to operate the carbon-feeding mechanism, having armature and field-magnet coils of relatively high resistance, both permanently connected, and together constituting the shunt across the arc, whereby its action and the feed of the carbons are regulated, as set forth.

5. The combination, with the tubular guides having slots in their sides, of the carbon rods arranged in said guides and provided with racks, the horizontal shaft provided with pinions of different sizes engaging said racks through the slots in the guides, and the electric motor connected with said shaft through intermediate gearing and included in a shunt, substantially as described, and for the purpose set forth.

6. The combination, with the suitably-supported tubular guides having openings in their sides, and the carbon-carrying rods arranged in said guides, of the horizontal shaft carrying the pinions of different sizes engag-

ing with racks on said carbon rods, of the electric motor having its vertical shaft arranged for connection with said horizontal shaft, and the lifting-magnet having its armature arranged to lift the horizontal shaft for separating the carbons and for making connection through intermediate gearing between the motor-shaft and said horizontal shaft, substantially as described.

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

HOWARD L. PYLE.

Witnesses:
GEO. C. POULTON,
P. W. HALE.