No. 632,707. Patented Sept. 12, 1899.

T. M. FOOTE.

ELECTRIC ARC LAMP.

Application filed June 15, 1896.

(No Model.) 3 Sheets—Sheet 1.

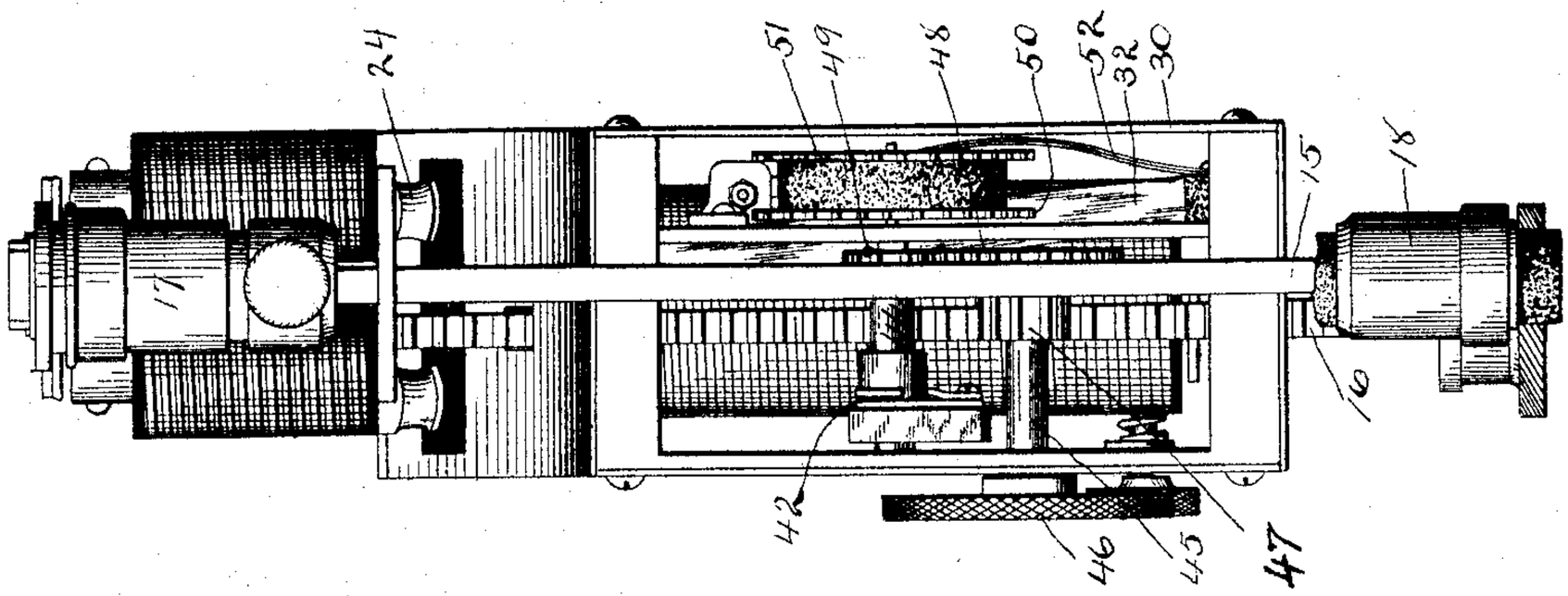

Fig. 2.

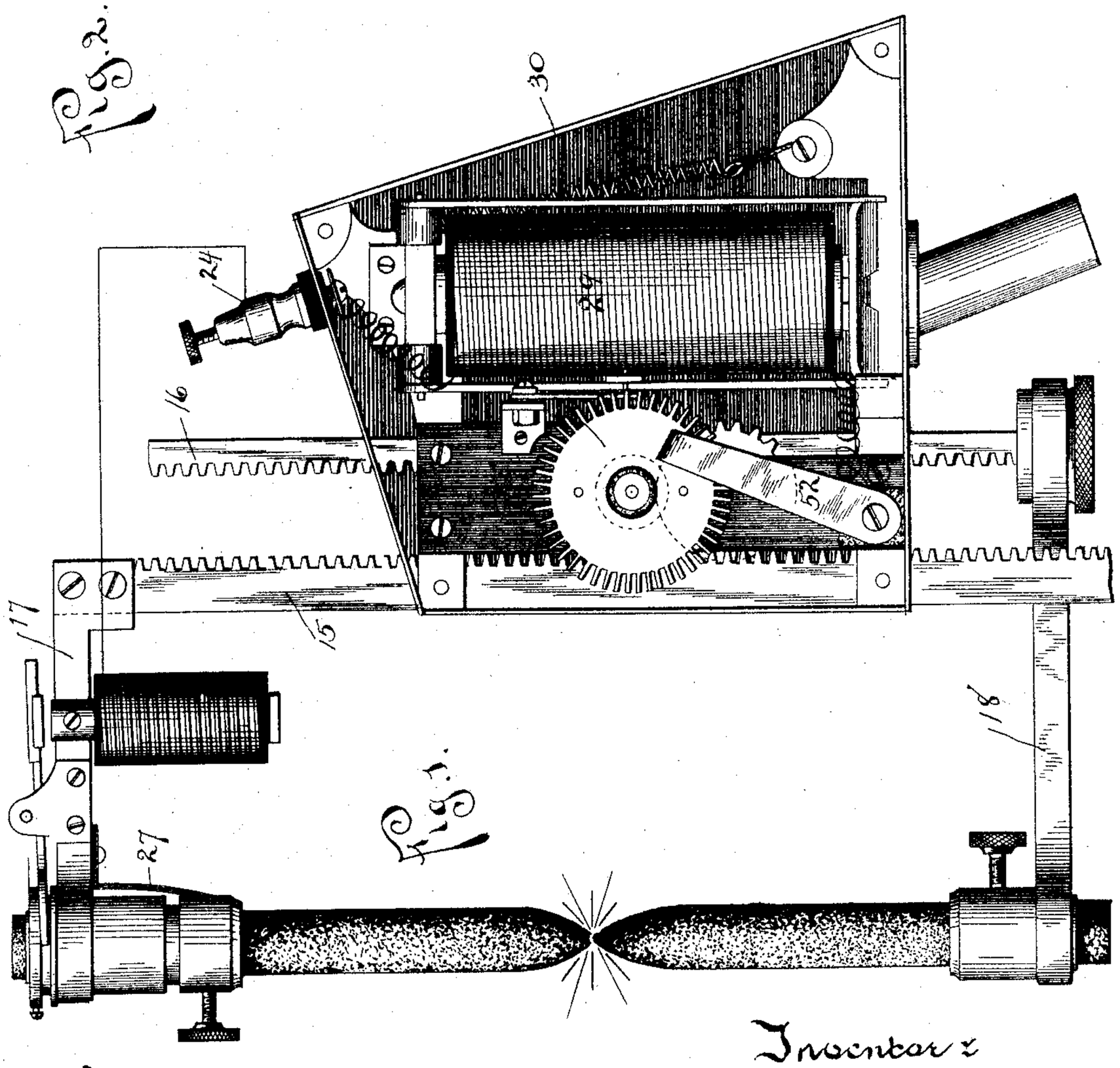

Fig. 1.

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Fig. 3.

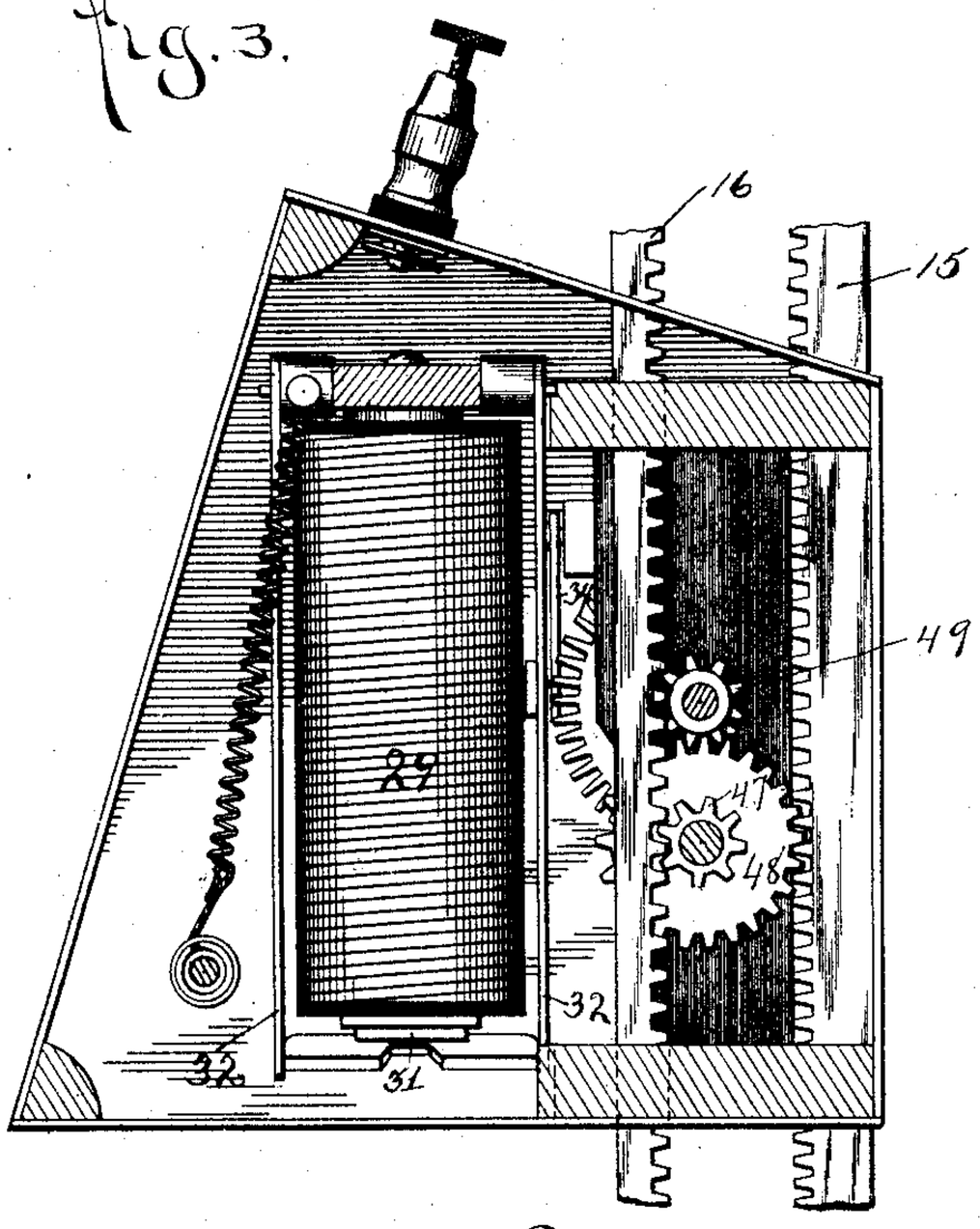


Fig. 4.

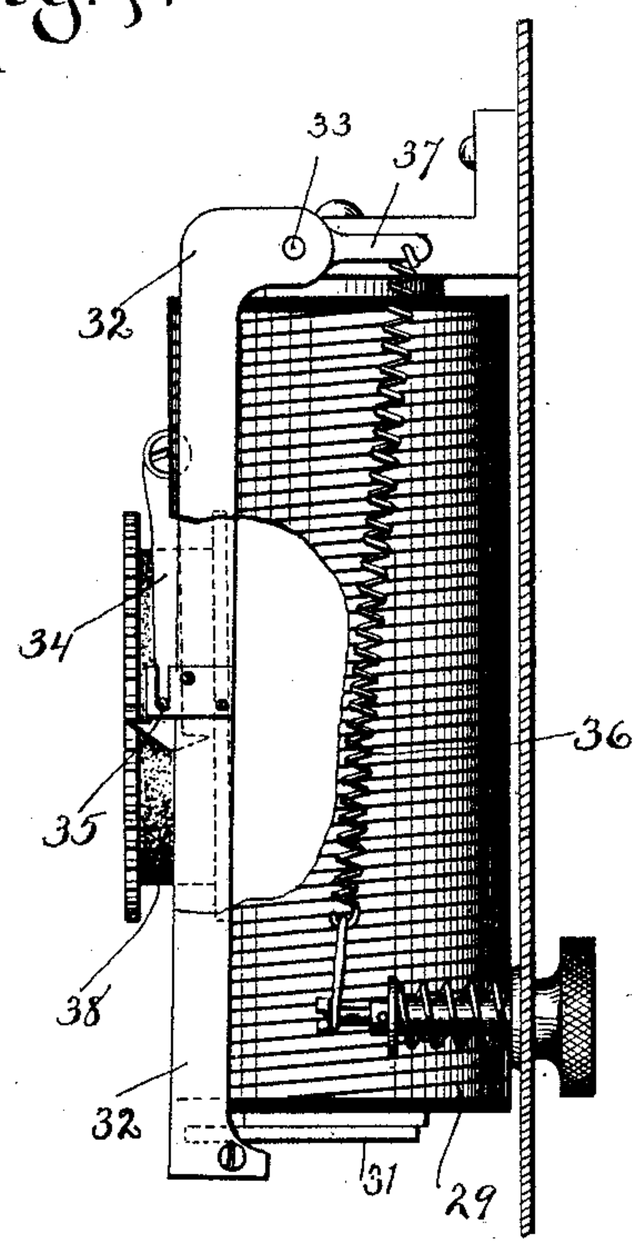


Fig. 6.

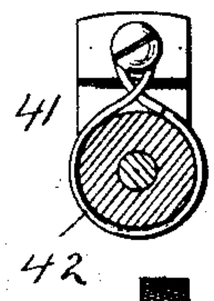


Fig. 5.

Fig. 8.

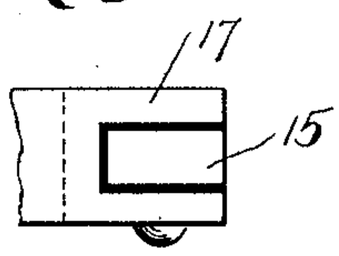
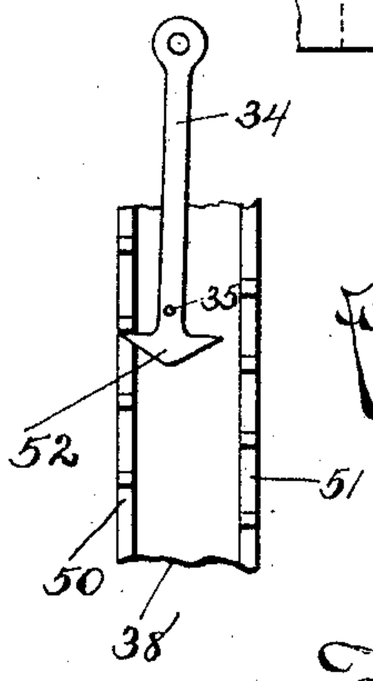


Fig. 7.



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(Application filed June 15, 1896.)

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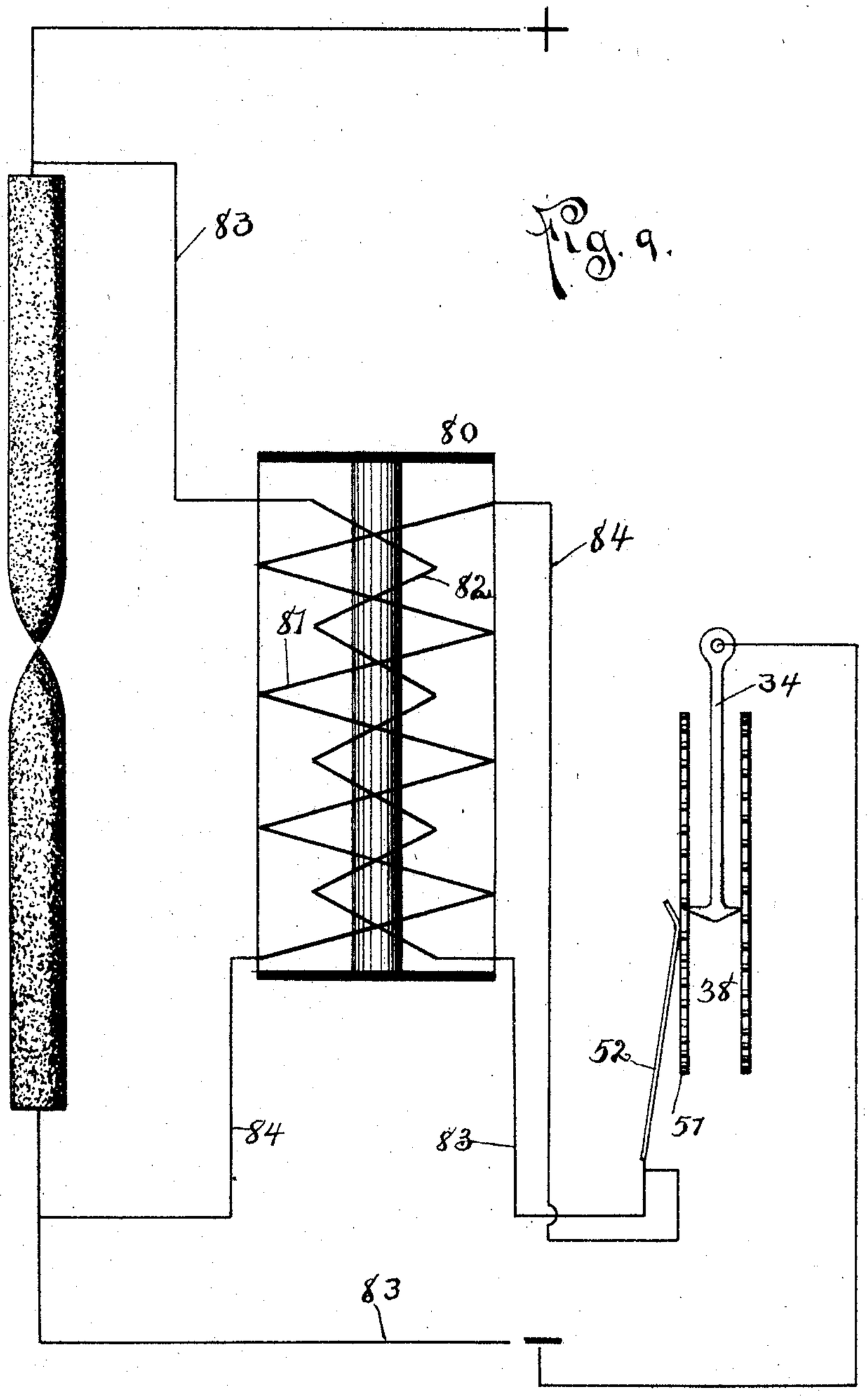

Fig. 9.

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UNITED STATES PATENT OFFICE.

THEODORE M. FOOTE, OF CHICAGO, ILLINOIS, ASSIGNOR OF ONE-HALF TO CHARLES H. SEEBERGER, OF SAME PLACE.

ELECTRIC-ARC LAMP.

SPECIFICATION forming part of Letters Patent No. 632,707, dated September 12, 1899.

Application filed June 15, 1896. Serial No. 595,622. (No model.)

To all whom it may concern:

Be it known that I, THEODORE M. FOOTE, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Electric-Arc Lamps, of which the following is a specification.

My invention relates more particularly to certain improvements in the type of arc-lamp known as a "focusing-lamp."

The object of my invention is to accomplish a feed of the carbons through the instrumentality of a shunt-magnet or solenoid, a train of transmitting wheelwork and a shunt-circuit maker which normally maintains closed the shunt-circuit, including the shunt-magnet, said shunt-magnet when energized by abnormal arc acting to operate the circuit-maker, which serves also to withhold the train of wheelwork, whereby said train in turn feeds or permits a feed of the carbons, the movement of said train in feeding and the movement of the circuit-maker in releasing the train operating conjointly to completely sever or break the shunt-circuit in such a manner as to discharge the shunt-magnet and permit the circuit-maker to again engage the train and reëstablish the shunt-circuit.

My invention, to this end, consists in the provision of a train of feeding wheelwork the driver of which has a toothed periphery, a contact-maker engaging the toothed driver and holding the train stationary when the arc is normal, a shunt-magnet the armature of which withdraws the circuit-maker to permit a feed, and a circuit so arranged as to include the shunt-magnet, the circuit-maker, and the train-driver in a shunt-circuit relative to the arc interval, the point of electrical contact being between that tooth of the driver engaged by the contact-maker and the engaging end of the contact-maker, whereby when the circuit-maker is withdrawn the point of contact on the driver moves away from the circuit-maker, thereby fully and completely severing the shunt-circuit.

My invention has certain other objects in view; and it consists in certain features of construction and arrangement about to be particularly described, and pointed out in my claims, reference being now had to the accompanying drawings, in which—

Figure 1 is a side elevation of my improved lamp, the side of the regulating-mechanism-inclosing casing being removed, showing said mechanism from one point of view. Fig. 2 is an end elevation. Fig. 3 is a side elevation showing the regulating mechanism from a point of view on the side opposite to that shown in Fig. 1. Fig. 4 is an enlarged rear elevation of the shunt-magnet and connected mechanism. Fig. 5 is a detail sectional view of the means whereby the carbons may be manually adjusted independent of the lamp-regulating mechanism. Fig. 6 is a detail cross-sectional view on the line $x\,x$ of Fig. 5. Fig. 7 is an edge view of the shunt-circuit maker and driver for the train of wheelwork. Fig. 8 is a detail view of the insulation for the upper carbon-holder arm. Fig. 9 is a diagram showing the circuits of the lamp.

In carrying out my invention I provide many parts which are common to lamps of the focusing type, which I will now briefly describe.

I employ two vertical rack-bars 15 and 16, carrying the two carbon-holder arms 17 and 18, respectively, for the upper and lower carbons 19 and 20. Depending from the holding-arm 17 are the main or series magnets or solenoids 21 and 22, which act upon one end of a pivoted lever 23, carrying on its other end a carbon-holder 24, slidably mounted in the end of the holding-arm 17. By means of this construction and arrangement the arc interval is initially established. The course of the current through the main magnets and arc is from the positive binding-post 24 through the frame of the lamp, through the leads 25 to the main magnets, and from thence through the holding-arm 17, by reason of the insulation shown in Fig. 8, over contact-strip 27 to the upper carbon, thence across the arc to the lower carbon-holding arm 18 to the rack-bar 16, and thence through the frame of the lamp to the negative binding-post 28.

I will proceed to describe the construction and arrangement involved in my invention, which, as stated, has as its object the provision of more sensitively and positively acting means whereby to feed the carbon.

I provide a shunt-magnet or solenoid 29, disposed within the casing 30 in a vertical position, the lower end of the core 31 of said shunt-

magnet acting to attract and oscillate in one direction the armature-frame 32, pivoted at 33. As shown more particularly in Fig. 4, an escapement-lever 34 is pivotally mounted on an extension from the frame and connected at its lower end by a pin 35 with the armature-frame 32. A spring 36, connected at its upper end to an arm 37, secured to the armature-frame 32 near its pivot-point 33, serves to normally hold the armature-lever away from the core 31 of the shunt-magnet 29. When the armature-frame 32 is attracted by the core 31 of the shunt-magnet 29, the escapement-lever 34 is also vibrated by said armature-frame 32. Referring now to the train of feed-wheel work, the driver of the train is designated at 38, of particular construction to be described, and is mounted upon the shaft 39 in a fixed position. Also mounted upon the shaft 39 in like manner is a clutch-arm 40, carrying the clutch 41, consisting of the spring-arms 42, embracing the collar 43 of a sleeve-shaft 44, mounted loosely upon the shaft 39. A counter-shaft 45, having on its end exterior of the casing 30 a hand-wheel 46, which also has respectively mounted thereon the pinion-wheel 47, meshing with the rack-bar 16, and also carrying fixedly on said shaft 45 a gear-wheel 48, which meshes with a pinion 49, fixed on the sleeve-shaft 44, the gear-wheel 48 also meshing with the rack-bar 15. When it is desired to separate the carbon-holders manually, the hand-wheel 46 is operated to rotate the shaft 45, causing the gear-wheel 47 to move the rack-bar 16 vertically in one direction, while the gear-wheel 48 moves the rack-bar 15 in an opposite direction. In this operation the gear-wheel 48 simply rotates the sleeve-shaft 44, which slips through the spring-arms 42 of the clutch 41; but it is evident, however, that the driver-wheel 38 of the same may be rotated in unison with the sleeve-shaft 44 by means of the clutch-arm 40, fixed on the shaft 42, and the clutch 41.

The driver-wheel 38 of the train of wheel-work is constructed of two disks or wheel-sections 50 and 51, held together mechanically, but insulated from each other. Each of the wheel-sections 50 and 51 is toothed to permit the engagement alternately of the head 52 of the escapement-lever 34, the said escapement-lever serving to withhold the driver-wheel 38 from rotation under the influence of the rack-bars 15 and 16, which normally tend to rotate said driver-wheel by the influence of gravity, the said escapement-lever 34 normally engaging the teeth of the wheel-section 51. The wheel-section 51 is insulated from the shaft 42, and, as stated, is also insulated from the wheel-section 50, which latter is electrically connected with the frame of the lamp through the shaft 42.

One terminal of the shunt-magnet 29 is connected with the positive binding-post 24 and the other with the contact-spring 52, which latter bears upon the side face of the wheel-section 51 of the driver-wheel 38, so that the course of the current upon abnormal arc increase is from the positive binding-post through the shunt-magnet 29 and contact-spring 52 to the wheel-section 51 and from thence through the escapement-lever 34 to the frame and to the negative binding-post. When the shunt-magnet 29 is energized to a sufficient degree the pivoted swinging armature-frame 32 is attracted by its core 31, thereby withdrawing the escapement-lever 34 from its normal engagement with the wheel-section 51 of the driver-wheel 38 and engaging said escapement-lever 34 with the wheel-section 50, electrically connected with the frame and negative binding-post by the shaft 42. By this means the shunt-magnet 29 thus breaks or severs or opens its shunt-circuit, completely discharging said shunt-magnet, whereby the spring 36 is afforded free opportunity to swing the armature-frame 32 away from the core 31 of the shunt-magnet and carry the escapement-lever 34 again into engagement with the driver-wheel section 51, which by the gravity influence of the rack-bars 15 and 16 has fed forward one step, this reëngagement of the escapement-lever 34 serving from further rotation and also reëstablish or to check or withhold the driver-wheel 38 close the shunt-circuit. It is evident that the gravity movement of the rack-bars 15 and 16, carrying the carbons, operates to approach the carbons toward each other, and if by such movement the proper arc interval be not restored the shunt-magnet 29 is again energized, and withdrawing the escapement-lever 34 permits a further movement of the carbons toward each other. Thus by this means the proper arc interval is restored through a step-by-step movement caused by alternately opening and closing the shunt-circuit and energizing and completely discharging the shunt-magnet 29.

In Fig. 9 I have diagrammatically represented a shunt-magnet or solenoid 80 which is differentially wound with two coils, designated as the "outer" coil 81 and the "inner" coil 82. The inner coil 82 is connected with the positive binding-post and also with the contact-spring 52, bearing on the wheel-section 51 of the driver-wheel 38, said inner coil and the leads thereto constituting a shunt-circuit 83, normally closed through the escapement-lever 34. The outer coil of the shunt-magnet may be said to be included within a branch or derived circuit 84. When the shunt-circuit 83 is broken or opened by the escapement-lever 34 disengaging from the teeth of the wheel-section 51 in the manner as described, the current normally circulating through the inner coil 82 is now caused to circulate through the outer coil 83, and thus the current in circulating through the differentially-wound coils on the shunt-magnet 80 effectually demagnetizes and completely discharges the same.

From the foregoing it is evident that the escapement-lever coöperates with the toothed

driver of the train of the wheelwork to completely sever the shunt-circuit, the point of contact between the lever and wheel being widely separated in the movement of the said driver.

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

1. In an arc-lamp, a main magnet or solenoid for establishing the arc, a shunt-magnet or solenoid to initiate the operation of the feed-regulating mechanism, a shunt-circuit including said shunt-magnet, a train of wheelwork, for feeding or permitting a feed of the carbons, a circuit-breaking escapement-wheel constituting the driver of said train, a contact-making escapement-lever engaging said escapement-wheel, said escapement wheel and lever being included in the shunt-circuit when so engaged, the shunt-magnet operating to withdraw the lever into a position by which the escapement-wheel in its rotation severs the shunt-circuit, thereby permitting a feed of the carbons.

2. In an arc-lamp, the combination of a couple of vertically-disposed sliding racks whereof one has its upper end provided with a laterally-extending arm which provides a holder for the upper carbon, and the other one has its lower end similarly provided with an arm which provides a holder for the lower carbon; a rotary shaft provided with two differently-sized pinions, whereof the relatively large one meshes with the rack supporting the carbon, and the relatively small one meshes with the rack supporting the lower carbon; a driver-wheel which comprises a couple of separated and insulated toothed wheels, and which is carried by a shaft-gear connected with the aforesaid shaft carrying the two differently-sized pinions; an escapement-lever which can vibrate between the two toothed wheels of the driver-wheels, and can alternately engage the same; a shunt-circuit including a shunt-magnet which is energized upon the weakening of the arc; and means for operating the escapement-lever upon the energization of the shunt-magnet.

3. In an arc-lamp, the combination with the shunt and shunt-magnet or solenoid included therein, and with mechanism for permitting or causing a feed of the carbon or carbons, of a vibratory lever for operating or causing the operation of the feed mechanism; and means for actuating the vibratory lever upon the energization of the shunt-magnet or solenoid comprising a swinging frame pivotally supported near the upper end of such magnet or solenoid and having its lower end provided with a transversely-extending armature which can be attracted by the same and so vibrate the swinging frame, a spring having its upper end attached to an arm extending laterally from the swinging frame, and its lower end connected to the lamp-frame, so as to keep the armature of the swinging frame normally away from the end of the magnet or solenoid, and a pin secured to the vibratory lever and arranged to work in a slot formed in the swinging armature-frame, substantially as described.

4. In an arc-lamp, a shunt-circuit, an escapement-lever and train of wheelwork, a driver, a shunt-magnet which together with the escapement-lever and driver is included within the shunt-circuit, said driver consisting of two toothed gear-wheels insulated from each other and between which the escapement-lever oscillates to alternately engage the said gear-wheels.

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

THEODORE M. FOOTE.

Witnesses:

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L. M. BULKLEY.