(No Model.)

5 Sheets—Sheet 1.

R. H. MATHER.

ELECTRIC ARC LAMP.

No. 390,245. Patented Oct. 2, 1888.

Fig. 1

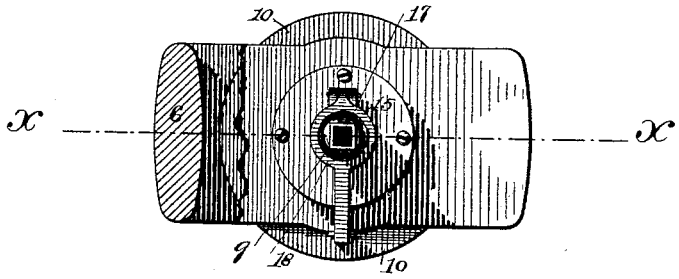
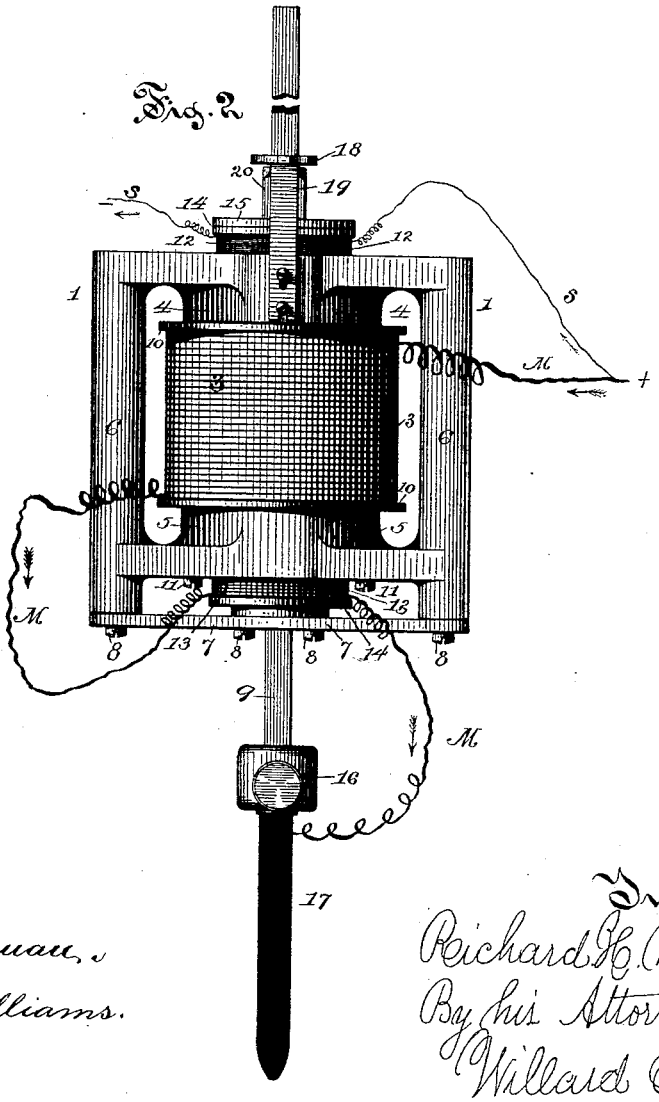


Fig. 2



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(No Model.)

5 Sheets—Sheet 2.

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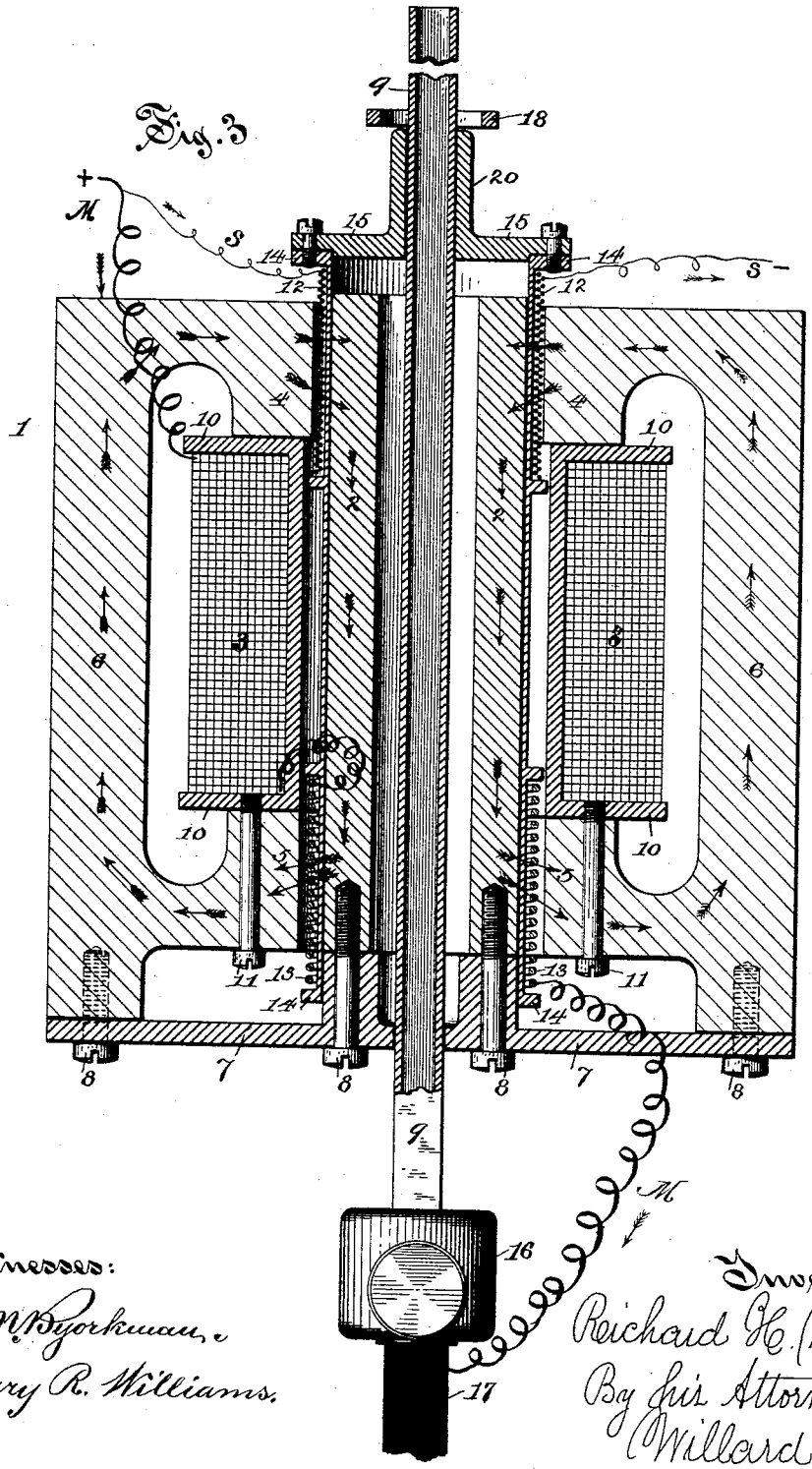
Fig. 3



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(No Model.) 5 Sheets—Sheet 3.

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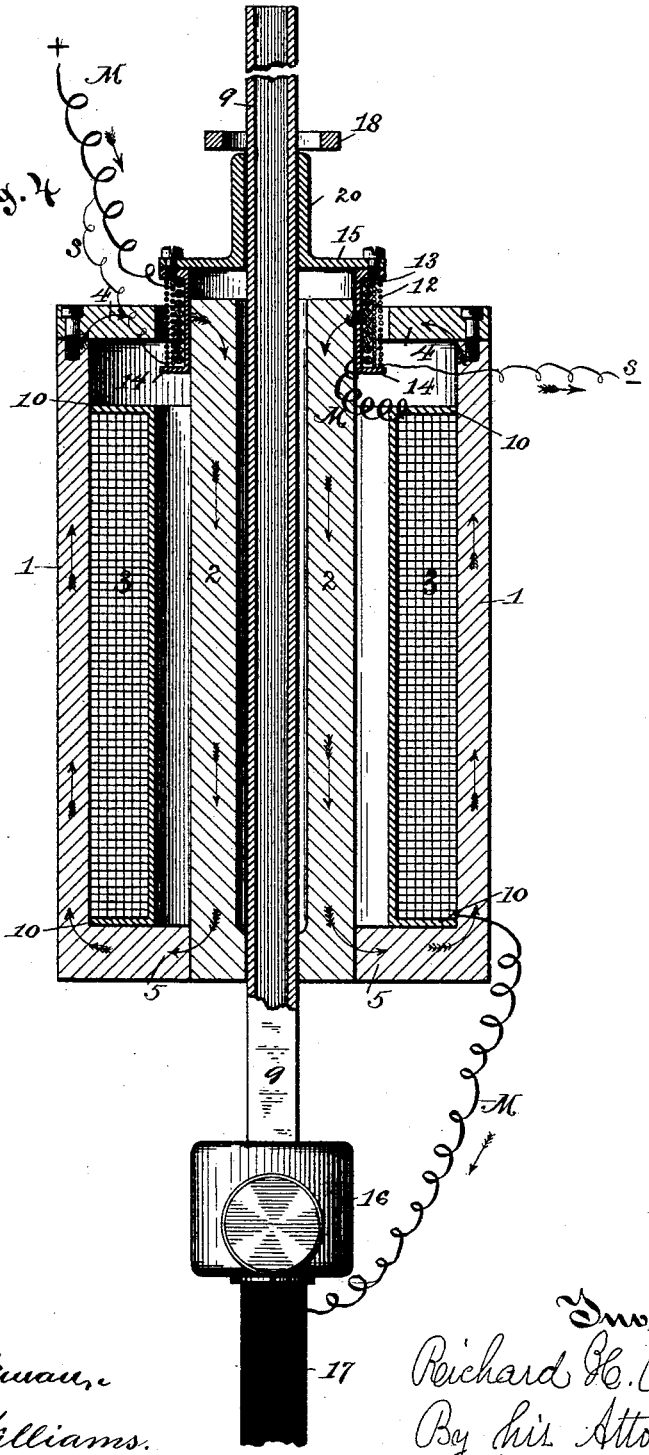
Fig. 4



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(No Model.) 5 Sheets—Sheet 4.

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ELECTRIC ARC LAMP.

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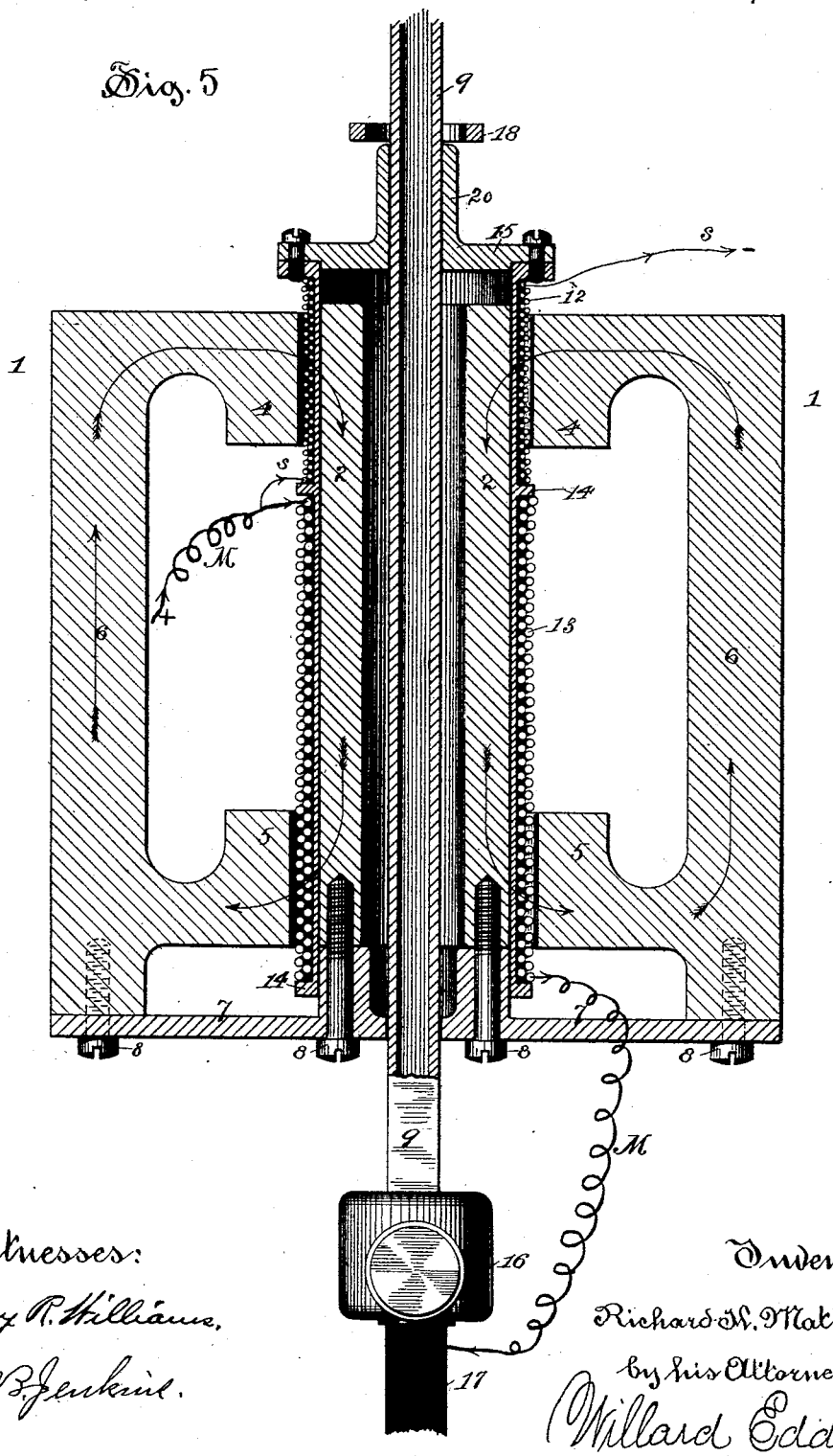
Fig. 5



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(No Model.) 5 Sheets—Sheet 5.

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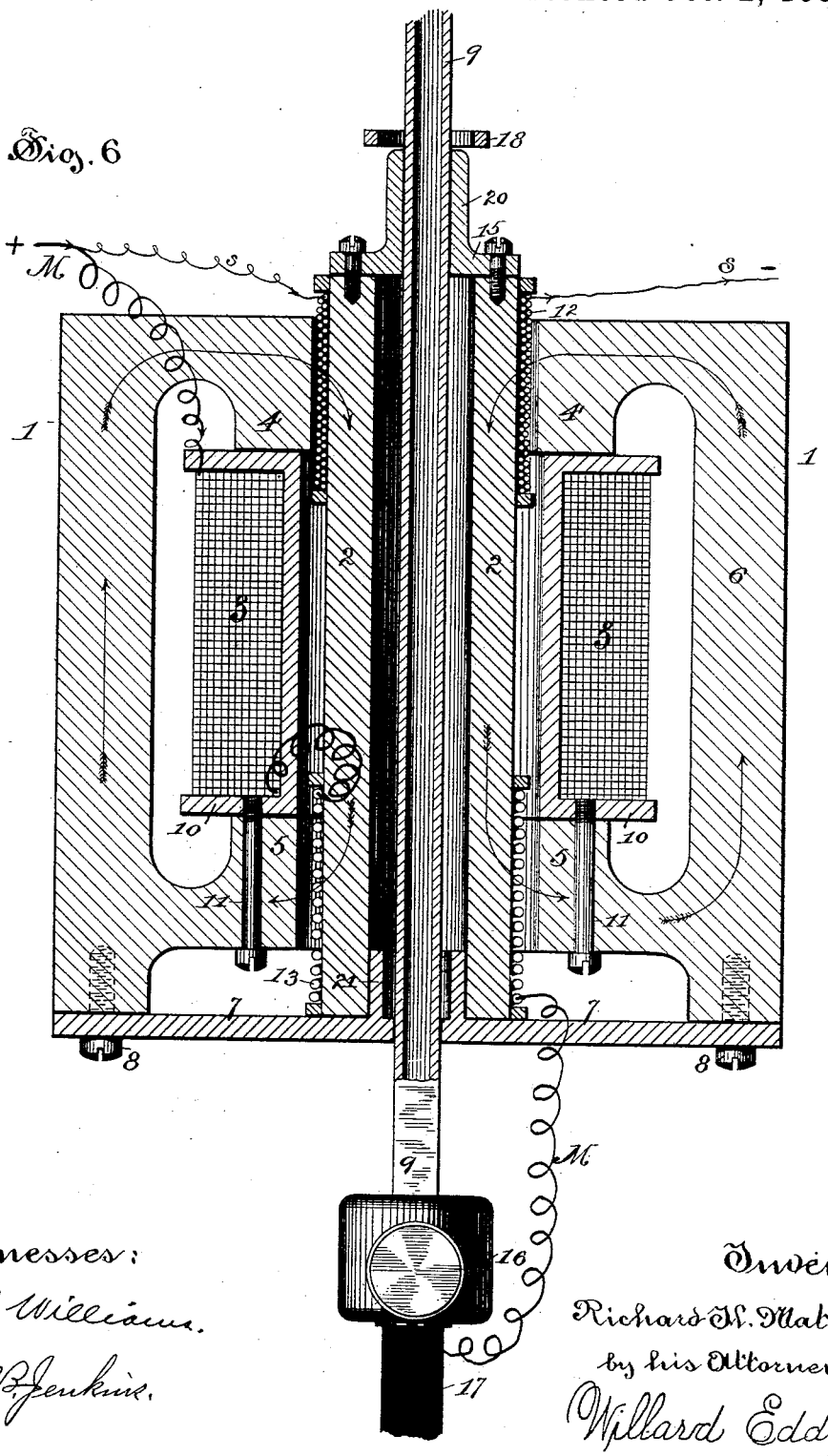
ELECTRIC ARC LAMP.

No. 390,245. Patented Oct. 2, 1888.

Fig. 6



Witnesses:
A. R. Williams.
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Willard Eddy.

UNITED STATES PATENT OFFICE.

RICHARD H. MATHER, OF WINDSOR, CONNECTICUT.

ELECTRIC-ARC LAMP.

SPECIFICATION forming part of Letters Patent No. 390,245, dated October 2, 1888.

Application filed February 20, 1888. Serial No. 264,698. (No model.)

To all whom it may concern:

Be it known that I, RICHARD H. MATHER, of Windsor, in Hartford county, Connecticut, have invented certain new and useful Improvements in Electric-Arc Lamps, which improvements are described in the following specification and are illustrated by the accompanying drawings.

This invention relates to feed mechanisms of electric arc lamps, and in particular to that class of said mechanisms in which a carbon-carrying rod or tube works through a friction-clutch or is controlled by other engaging mechanism.

The object of the invention is to produce a feed mechanism having great strength and sensitiveness and an ample range of movement with uniform power. To accomplish this result I use an electro-magnet whose armature is a compound-wound solenoid controlling the mechanism which engages the carbon-carrying rod.

The best method in which I have contemplated applying the principle of my invention is shown in said drawings, in which—

Figure 1 is a top view of the feed mechanism of an electric-arc lamp constructed in accordance with my invention. Fig. 2 is an elevation of the same. Fig. 3 is an enlarged vertical section on line *x x* of Fig. 1. Figs. 4, 5, and 6 are like sectional views of my invention in modified forms.

In the primary form of my invention, as seen in Figs. 1, 2, and 3, the controlling electro-magnet, aside from its solenoid-armature, consists of an iron frame, 1, a hollow cylindrical core, 2, and an interposed helix, 3, of insulated wire. Frame 1 consists of two cylindrical or annular pole-pieces, 4 and 5, and two connecting arms or pillars, 6, which are formed integrally therewith. Core 2, which is made of the best wrought-iron, occupies a central position in frame 1. Poles 4 and 5 respectively surround the opposite terminal portions or poles of core 2 concentrically, and are separated therefrom by annular spaces. Core 2 is held in the described position by a support, 7, which is secured to frame 1 and core 2 by screws 8, and has a central perforation for the accommodation of the carbon-carrying rod 9, which is hereinafter described. Helix 3 is wound upon a hollow spool, 10, which is made of brass or other non-magnetic material, and is secured in frame 1 by means of screws 11. The solenoid-armature of this electro-magnet consists of two helices, 12 and 13, wound upon opposite terminal portions of a brass spool, 14, which surrounds core 2 like a sleeve and is longitudinally movable thereon. To upper end of the spool 14 is secured an annular cap, 15, which is provided with a central hub or sleeve, 20, for the accommodation of rod 9. This rod, which is preferably square in cross section, and also tubular, carries a holder, 16, for the upper carbon, 17, and is adapted to move up and down through core 2 in sliding contact with sleeve 20 and support 7 as guides. A friction-clutch, 18, embracing rod 9, is mounted upon sleeve 20, and is provided with a dog, 19, which is mounted adjustably upon frame 1.

Core 2, helix 3, rod 9, spool 10, cap 15, sleeve 20, clutch 18, and dog 19, which have been described with primary reference to Figs. 1, 2, and 3, are present without material change in the modified form of my invention, which is shown in Fig. 4. In this modification the frame of the magnet consists of a cylindrical iron case, 1. Core 2, having one end driven into a hole in the solid bottom of case 1, occupies an axial position throughout the length of that case. An annular iron cap, 4, which is secured by screws to the top of case 1, surrounds the free end of core 2 concentrically, but is separated therefrom by an annular space. A solenoid-armature consisting of helices 12 and 13, which are wound differentially upon an insulating-spool, 14, occupies this annular space, and is freely movable up and down in it. This spool 14, unlike the spool 14 of Fig. 3, embraces only one of the poles of core 2, and the opening through the latter is contracted at the lower end to serve as a guide for rod 9.

The modification which is illustrated by means of Fig. 5 differs structurally from the above-described primary form of my invention by the omission of helix 3 and by the increased dimensions of helix 13. In this modification the last-mentioned helix, being wound upon that portion of spool 14 which is not occupied by helix 12, is sufficient to thoroughly magnetize core 2.

The modification which is illustrated by Fig.

6 differs structurally from said primary form of my invention in several particulars. Spool 14 is omitted, and helices 12 and 13 are wound immediately upon the opposite terminal portions of core 2. Cap 15, having sleeve 20, is fastened upon the top of said core, and support 7 is provided with a central guide, 21, which enters the bottom of said core. The latter is movable vertically, and with it said helices 12 and 13.

The described helices of my invention in its primary and modified forms are connected in the manner which is indicated in the drawings. The sign + indicates the positive terminal of the generator which supplies current to the lamp. Helices 3 and 13, being formed of coarse wire, are arranged in series with the carbons of the lamp, while helix 12 is placed in a derived circuit. The connections to helices 12 and 13 are such as to lead the current through the latter in one and the same direction, excepting only in the modification which is shown in Fig. 4. In that instance said helices are differential, as already indicated. These connections are indicated in the drawings by main-circuit wires M M and shunt-circuit wires *s s*.

All remaining particulars of construction of the invention will sufficiently appear from the drawings and from the mode of operation, which is now to be described.

It is convenient to describe first the operation of my invention in its primary form, which is illustrated by Figs. 1, 2, and 3, and in the modified form, which is illustrated by Fig. 4. When no current is supplied to the lamp, the solenoid-armature occupies its position of maximum depression, and clutch 18, being tripped by dog 19, is disengaged from rod 9, so that the upper and lower carbons rest in contact with each other. In this position of affairs, if a normal current be supplied to the lamp, that current immediately energizes helices 3 and 13. By the energy of helix 3 a magnetic field is produced in the described annular spaces which are occupied by helices 12 and 13. The magnetic current may be assumed to circulate through core 2 and the frame or case in which it is contained in directions which are indicated by arrows. Circulating in this manner, the magnetic current or lines of force across the described field pass directly through the interposed coils of helices 12 and 13. The energy of helix 13, acting in said field and tending to move upward, raises the described armature, and thereby causes clutch 18 to grip rod 9 and carry it upward. In this manner the carbons are separated and the voltaic arc is produced between them. The separation of the carbons causes current to flow through the shunt-circuit *s s*, including helix 12. The energy of this helix, acting in said field and tending to move downward, neutralizes to a greater or less extent the described upward tendency of helix 13, so that the armature tends to rise or to fall or to remain stationary, according to the varying distribution of current through its said helices 12 and 13. Through the differential effect which is so produced in the described armature the latter raises, sustains, lowers, and controls clutch 18 in such a manner as to maintain the carbons constantly at a normal distance from each other.

The principle which is involved in the described upward tendency of helix 13 and in the described downward tendency of helix 12 is the same principle by which any conductor disposed in a magnetic field and carrying an electric current tends to cut the lines of force of that field by moving across them in a direction which is dependent upon the direction of that current and upon the polarity of the field. Those individual coils of either of the solenoids 12 and 13 which are at any time within a magnetic field are for the time being severally and collectively impelled in accordance with this principle. In the primary form of my invention the described differential effect is produced by placing similarly-energized helices in magnetic fields of opposite polarity, while in the modified form of my invention, which is shown in Fig. 4, the same effect is produced by placing differential helices in a single field.

In the modification which is illustrated by Fig. 5, helix 13 performs the two functions which are performed by helices 3 and 13 in the primary form of my invention, as illustrated by Figs. 1, 2, and 3. In accordance with the principle which is above stated, this helix imparts an upward tendency to the armature, and by magnetizing core 2 the same helix, either with or without the assistance of helix 12, creates magnetic fields of opposite character in the described annular spaces which are occupied by helices 12 and 13.

In the modification which is illustrated in Fig. 6 the movable core 2, with its attached helices 12 and 13 and its cap 14, is actuated in the same manner and with the same results as is the described armature of my invention in its primary form.

Frame 1, with its poles 4 and 5, is not essential to my invention, for if that frame be omitted in construction or be made of non-magnetic material the principle and mode of operation are the same, though the action is less energetic. My invention is not confined to the use of clutch 18 for the purpose of engaging and controlling rod 9, but contemplates the use of a rack and pinion, clock-work, or any other regulating mechanism which may engage a feeding-rod, and may be controlled by the armature of an electro-magnet.

Such being the construction and operation of an electric-arc lamp embodying my invention, I claim and desire to secure by Letters Patent—

1. In an electric arc lamp, an electro-magnet provided with a solenoid-armature which is wound with two independent helices—namely, a main-circuit helix and a shunt-circuit helix—both having constantly-closed circuit-connec-

tions, substantially as and for the purpose specified.

2. In an electric-arc lamp, an electro-magnet having a solenoid-armature which consists of two separate helices—namely, a main-circuit helix and a shunt-circuit helix—both wound upon a hollow insulating-spool and provided with constantly-closed circuit-connections, substantially as and for the purpose specified.

3. In an electric-arc lamp, an electro-magnet core having two fields, in combination with an armature having two solenoid-helices—namely, a main-circuit helix and a shunt-circuit helix—which are respectively located in said fields and are provided with constantly-closed circuit-connections, substantially as and for the purpose specified.

4. In the feed mechanism of an electric-arc lamp, a magnetic core, in combination with a solenoid-armature having independent helices—namely, a main circuit helix and a shunt-circuit helix—which surround said core and are provided with constantly-closed circuit-connections, substantially as and for the purpose specified.

5. In the feed mechanism of an electric arc lamp, a stationary magnetic core and an iron frame which surrounds said core but is separated therefrom by an annular space, in combination with a solenoid-armature having independent helices, which surround said core and are movable in said annular space, substantially as and for the purpose specified.

6. A magnetizable cylindrical core, a magnetizing-helix surrounding said core, and an iron frame holding said core in a fixed position and surrounding the terminal portions of the same, in combination with a hollow spool wound with helices which are movable in an annular space between said core and frame, substantially as and for the purpose specified.

7. In an electric-arc lamp, an electro-magnet and a solenoid-armature thereof, said armature having two helices—namely, a main-circuit helix and a shunt-circuit helix—which are respectively located at the opposite poles of said electro-magnet and are provided with constantly-closed circuit-connections, substantially as and for the purpose specified.

8. An iron frame and a cylindrical core which have concentric poles of opposite character, in combination with a solenoid-armature having two helices—namely, a main-circuit helix and a shunt-circuit helix—which are provided with constantly-closed circuit-connections and are movable in the annular field between said poles, substantially as and for the purpose specified.

9. An iron frame and a cylindrical core which have concentric poles of opposite character, a magnetizing-helix which surrounds said core, and a solenoid-armature having two helices—namely, a main-circuit helix and a shunt-circuit helix—which are provided with constantly-closed circuit-connections and are movable between said poles, in combination with controlling mechanism which is engaged by said armature and a carbon-carrying rod which is controlled by said engaging mechanism, substantially as and for the purpose specified.

10. In an electric-arc lamp, an upper and a lower carbon, a rod carrying said upper carbon, and controlling mechanism engaging said rod, in combination with a magnetic core and an iron frame which have concentric poles of opposite character, a magnetizing-helix which surrounds said core, and a solenoid-armature having one helix which is arranged in series with said magnetizing-helix and said carbons and having another helix which is located in a derived circuit about said carbons, substantially as and for the purpose specified.

11. In an electric-arc lamp, a pair of carbons, a carbon-rod, and controlling mechanism engaging said rod, in combination with an electro-magnet and a solenoid-armature thereof having one helix in series with said carbons and another helix in a derived circuit about them, substantially as and for the purpose specified.

12. In an electric-arc lamp, a pair of carbons, a carbon-rod, and controlling mechanism for said rod, in combination with a magnetic core and frame which have concentric poles of opposite character, a magnetizing-helix which surrounds said core, and a solenoid-armature having one helix, which is arranged in series with said magnetizing-helix and with said carbons and having another helix which is located in a derived circuit about said carbons, substantially as and for the purpose specified.

13. In an electric-arc lamp, a carbon-carrying rod and controlling mechanism engaging said rod, in combination with a magnet having concentric poles of opposite character and having a solenoid-armature which operates said controlling mechanism and is provided with two helices—namely, a main-circuit helix and a shunt-circuit helix—both located in the annular spaces between said poles and having constantly-closed circuit-connections, substantially as and for the purpose specified.

14. In an electric-arc lamp, an electro-magnet having two fields, in combination with a cylindrical armature wound with two solenoid-helices—namely, a main-circuit helix and a shunt-circuit helix—which are respectively located in said fields and are provided with constantly-closed circuit-connections, substantially as and for the purpose specified.

15. A magnetizable core, in combination with two movable solenoid-helices—namely, a main-circuit helix and a shunt-circuit helix—which surround said core, and are provided with constantly-closed circuit-connections, substantially as and for the purpose specified.

In testimony whereof I hereunto sign my name in the presence of two witnesses.

RICHARD H. MATHER.

Witnesses:
JOHN H. KIRKHAM,
WILLARD EDDY.