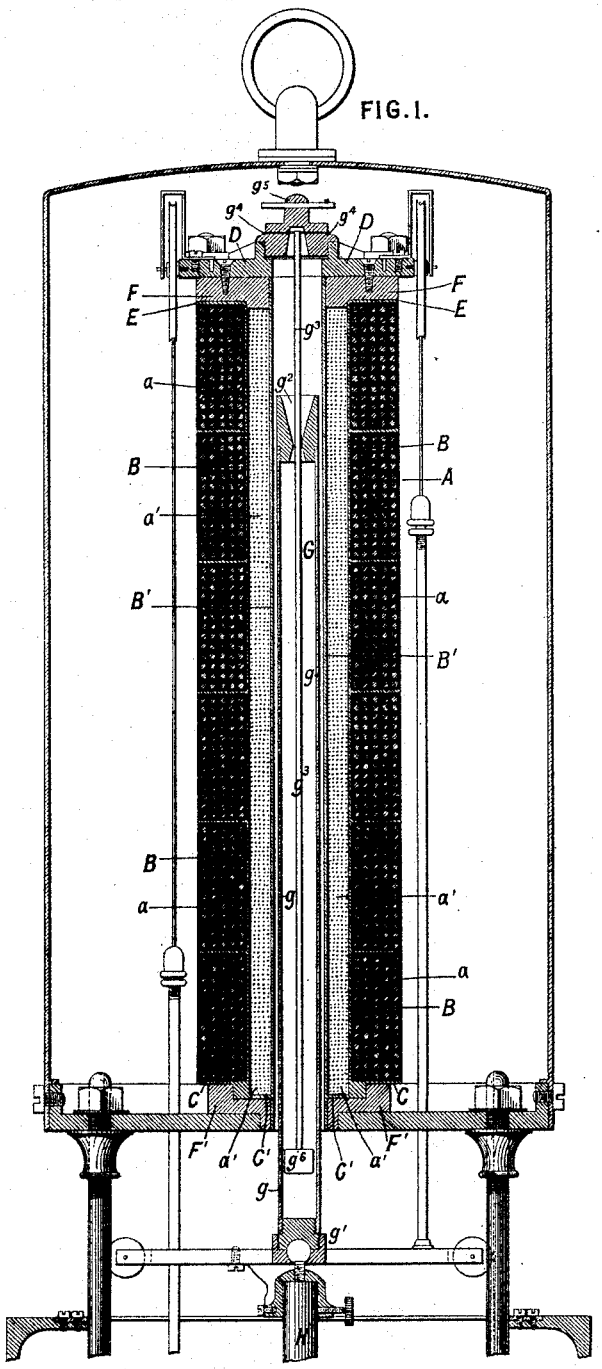
(No Model.) 2 Sheets—Sheet 1.

H. HARPER.

ELECTRIC ARC LAMP.

No. 492,200. Patented Feb. 21, 1893.

FIG. 1.



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(No Model.) 2 Sheets—Sheet 2.

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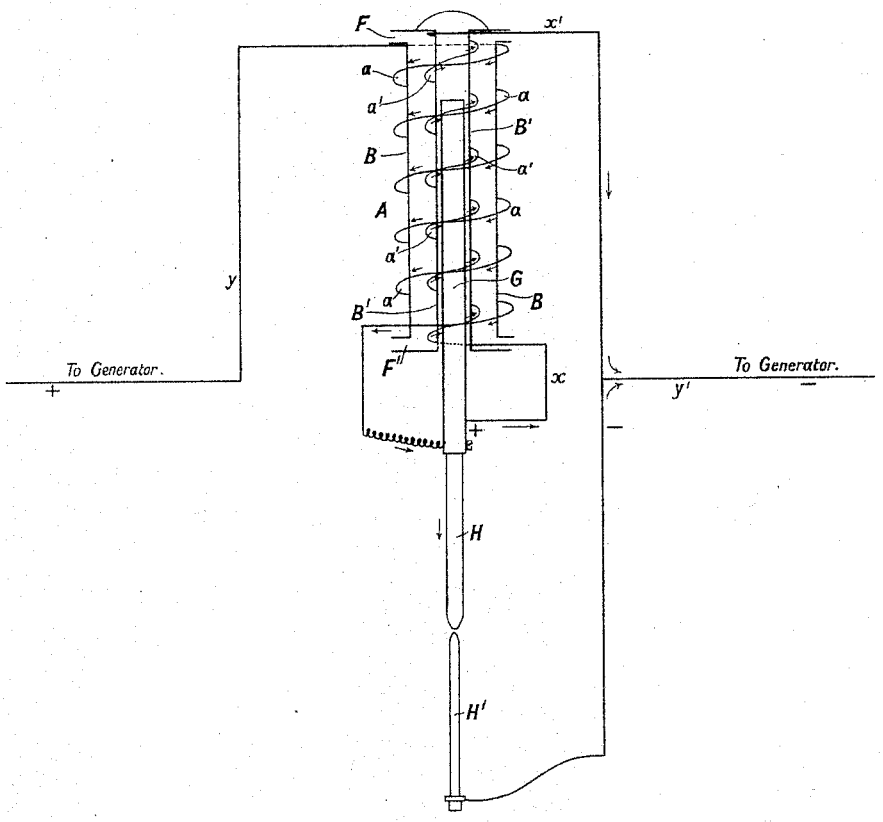
No. 492,200. Patented Feb. 21, 1893.

FIG. 2.



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UNITED STATES PATENT OFFICE.

HENRY HARPER, OF LONDON, ENGLAND, ASSIGNOR TO HIMSELF, JOHN TRYON, AND THOMAS GEORGE POOLE, OF SAME PLACE.

ELECTRIC-ARC LAMP.

SPECIFICATION forming part of Letters Patent No. 492,200, dated February 21, 1893.

Application filed July 10, 1891. Serial No. 399,107. (No model.) Patented in England August 24, 1889, No. 13,389.

To all whom it may concern:

Be it known that I, HENRY HARPER, electrical engineer, a subject of Her Majesty the Queen of Great Britain and Ireland, residing at 3 Cornwall Gardens, Queen's Gate, London, in the county of Middlesex, England, have invented new and useful Improvements in Electro-Magnets and in their Application to Arc Lamps, (for which I have applied for Letters Patent in Great Britain, dated August 24, 1889, No. 13,389,) of which the following is a specification.

This invention relates to electro-magnets or solenoids adapted for use with electric arc lamps, and consists of an improved method of constructing and arranging the core, and an improved mode of winding the solenoid coil, whereby the device is specially adapted for use with arc lamps.

In the accompanying drawings, Figure 1 is a vertical section of an electro-magnet constructed according to the present invention; Fig. 2 being a diagram showing the way in which the electric current flows through the solenoid coils.

Assuming the improved solenoid and core to be applied by way of example to regulating the working of one of a series of arc lamps, the solenoid proper or bobbin A consists of two bodies a and a' of wire arranged concentrically, but so wound or electrically connected as to conduct the current in opposite directions. The outer or "series" coil a, composed of coarse wire, in the circuit of the lamp, consists by preference of several coils arranged in series and wound upon a lining tube B which may be of brass. The inner shunt or "parallel" coil a' is composed of fine wire and is also mounted upon a brass lining tube B'. This coil may however be dispensed with in the case of a lamp which is one of a set connected "parallel." The lower end of the tube B is formed or furnished with a collar C for carrying the weight of the wire a; the lower end of the tube B' being also provided with a collar C' for carrying the weight of the wire a'. The upper extremity of the tube B' is fastened directly to a metal carrying plate D. The upper extremity of the tube B is secured by means of a flange E and through the intervention of an insulating vulcanite disk F to the carrying plate D. The lower extremity C of the outer tube is similarly insulated by a vulcanite disk F'. The wires x and x', conducting the current to and from the inner or "parallel" coil, are led through the vulcanite disks F and F'.

The core G consists of a tube g of soft iron turned and bored cylindrical and of substantially the same length as the tube B. The tube g is closed at the lower end by means of a plug or cap g', and is provided at its upper end with a funnel-shaped and axially-perforated plug g^2 through which works a rod g^3. The rod is freely suspended at its upper extremity on a transverse pin g^4 mounted in a cap g^5 above the carrying plate D; while, attached to the lower extremity of the rod, is a plunger g^6, preferably of barrel shape and fitting loosely within the tube g.

Through the funnel-shaped plug g^2, the tube g is charged with glycerine or other suitable liquid. As the influence of the solenoid A upon the core G varies with each change of resistance in the circuit, such variations frequently taking place with great rapidity, the liquid-charged core (to which the upper or positive carbon H of the lamp is attached, and in which the suspended plunger g^6 is immersed) operates as a dashpot to prevent the flickering effect which would otherwise result from the sensitiveness of the apparatus.

The action of the improved electro-magnet is as follows:—The current is conducted from the positive pole of the generator through the wire y to one of the terminals of the lamp. Thence it flows in a certain direction through the coil a to the upper or positive carbon H, where it is subdivided; the greater part flowing across the voltaic arc into the lower or negative carbon H' and the remainder—a comparatively small portion—passing by x to the coil a'. The direction of the current while passing through the convolutions of the coil a' is opposed to that of the current passing through the coil a. The subdivided portions of the current flowing respectively from the lower or negative carbon H' and from the coil a' by x' reunite at the other terminal of the lamp and are thence conducted through the wire y' to the negative pole of the generator. When the carbons H and H' are in con-

tact, there is practically no resistance in the circuit and a current of full volume flows through the coil *a*, the core G being in consequence lifted and the carbons moved asunder until the resistance through the voltaic arc is such that equilibrium is established and the carbons are no longer moved apart. The movement of the carbons is governed and its suddenness controlled by the dashpot and suspended plunger. The greater the resistance through the arc, the greater is the difference of potential at the ends of the fine wire coil *a'*. Consequently, when the carbons are near together, a comparatively small current flows through the coil *a'*; but when the carbons are a considerable distance apart, a correspondingly larger current flows through that coil. The attractive force of the current flowing through the outer coil *a* is diminished by and in proportion to the current flowing in the opposite direction through the inner coil *a'*. The attractive force of the solenoid upon the core varies, therefore, inversely with the resistance of the arc; that is, the nearer the carbons are together, the greater is the force available for drawing them apart, and the farther the distance between the carbons, the less is the force available for keeping them separated.

What I claim, and desire to secure by Letters Patent of the United States, is—

1. In an electric arc lamp, the combination with a magnetic tubular core G, an upper carbon H, and a holder for the upper carbon in the end of the tubular core, of a compound solenoid, comprising an outer coil in the lamp circuit and an inner coil in a shunt circuit to the lamp circuit, a stationary piston in the tubular core, and a cushion charge submerging the piston, substantially as and for the purposes set forth.

2. In an electric arc lamp, the combination with a tubular magnetic dashpot, an upper carbon, and a holder for the upper carbon in the end of the tubular dashpot, of a solenoid surrounding the dashpot, a stationary piston arranged within the dashpot, and a cushion charge submerging the piston, substantially as and for the purposes set forth.

3. In an electric arc lamp, the combination with the solenoid, of the movable iron core thereof bearing the upper carbon and having a tubular bore adapted to receive a cushion charge and a perforated plug placed in its mouth the stationary piston arranged in the bore, the stem of the piston passing through the perforation in the plug, the bearing plate situated over the upper opening of the solenoid, and the cap by which the stem of the piston is supported, substantially as and for the purposes set forth.

4. In an electric arc lamp, the combination with a solenoid comprising an outer coil of low resistance in the lamp circuit and an inner coil of high resistance in a shunt circuit to the lamp circuit, of the movable iron core thereof bearing the upper carbon, having a tubular bore adapted to receive a cushion charge and furnished with a perforated plug placed at its mouth, the stationary piston arranged in the bore, the stem of the piston passing through the perforation in the plug, the bearing plate situated over the upper opening of the solenoid, and the cap by which the stem of the piston is supported, substantially as and for the purposes set forth.

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