(No Model.)

3 Sheets—Sheet 1.

# R. BELFIELD.

## ELECTRIC ARC LAMP.

No. 511,495. Patented Dec. 26, 1893.

*Fig. 1.*

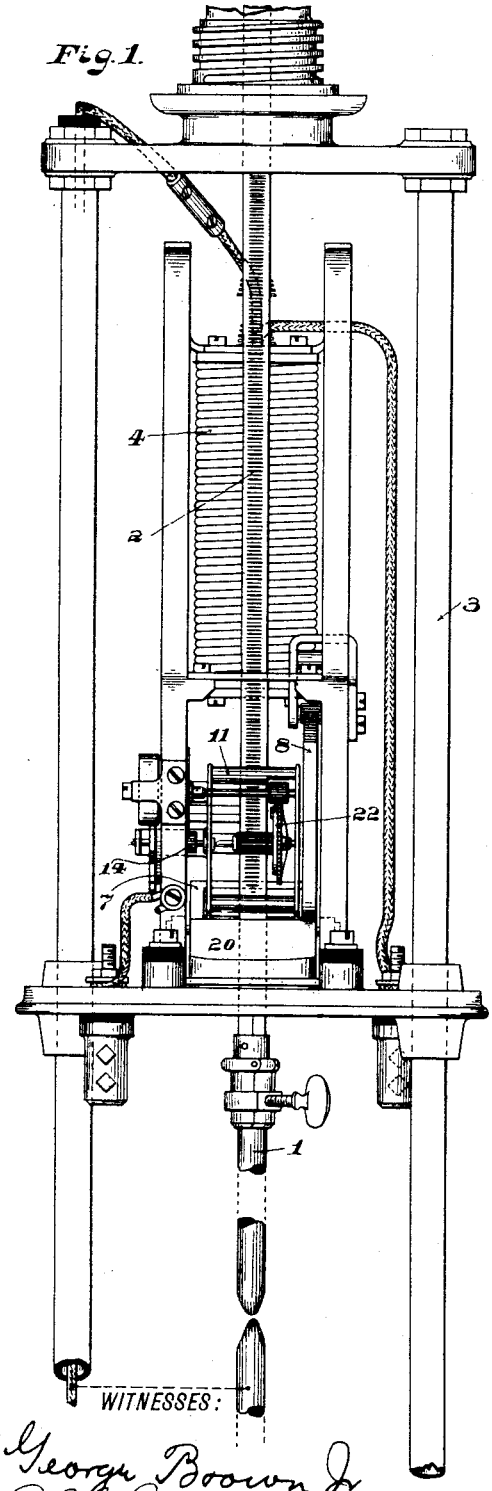
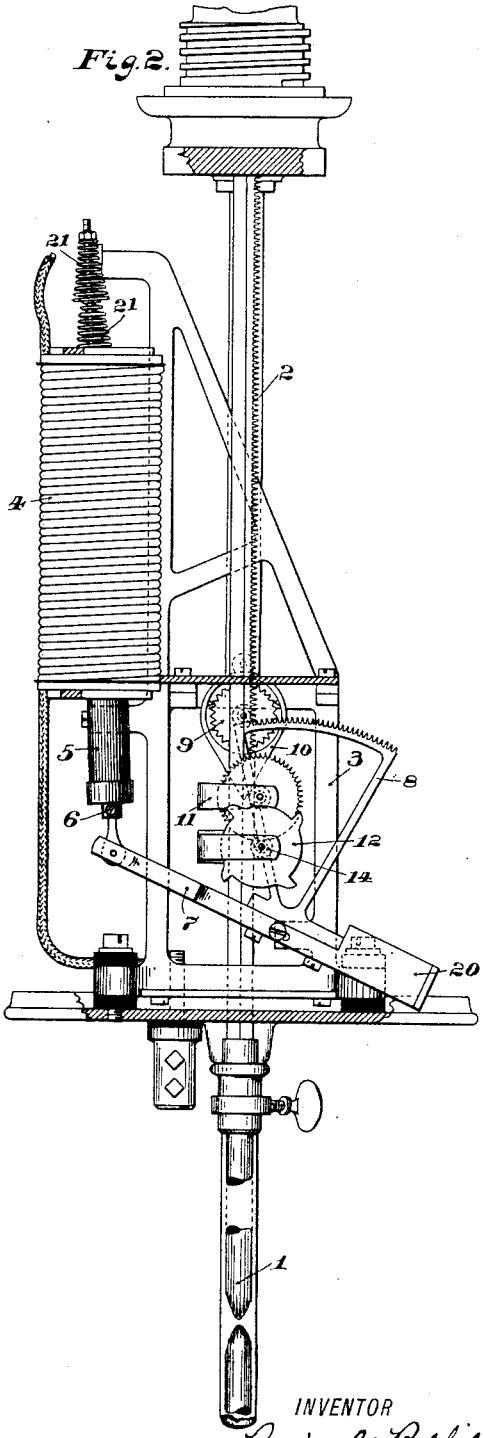



*Fig. 2.*

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(No Model.) 3 Sheets—Sheet 2.

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## ELECTRIC ARC LAMP.

No. 511,495. Patented Dec. 26, 1893.

Fig. 3.

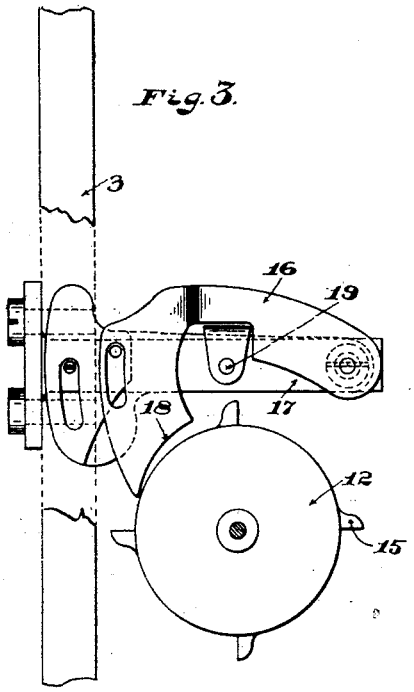
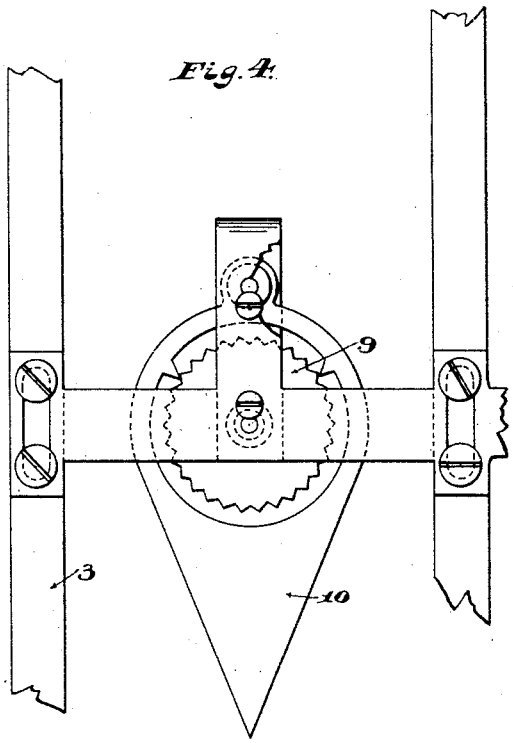



Fig. 4.

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(No Model.) 3 Sheets—Sheet 3.

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## ELECTRIC ARC LAMP.

No. 511,495. Patented Dec. 26, 1893.

Fig. 5.

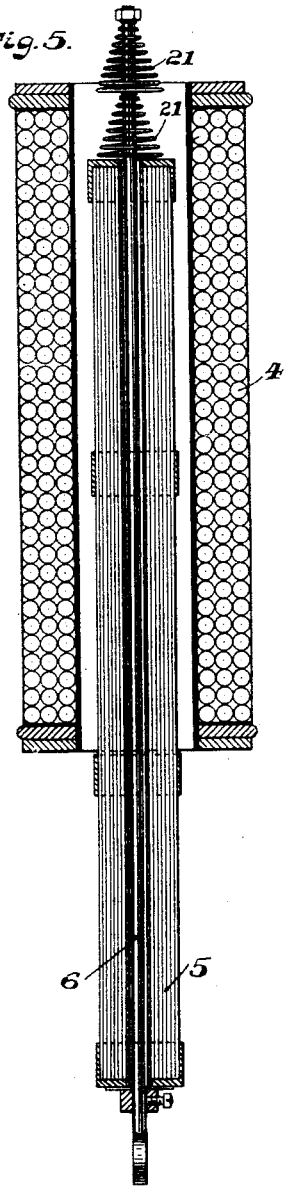
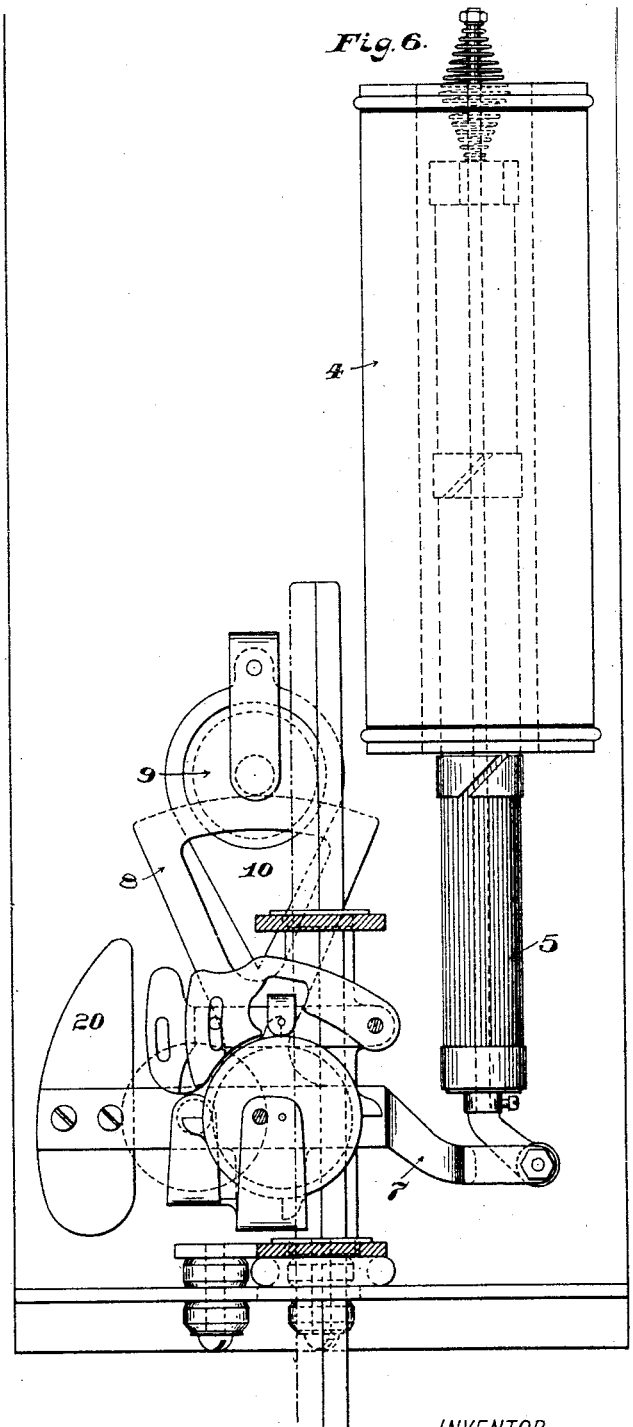



Fig. 6.

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# UNITED STATES PATENT OFFICE.

REGINALD BELFIELD, OF LONDON, ENGLAND, ASSIGNOR TO GEORGE WESTINGHOUSE, JR., OF PITTSBURG, PENNSYLVANIA.

## ELECTRIC-ARC LAMP.

SPECIFICATION forming part of Letters Patent No. 511,495, dated December 26, 1893.

Application filed April 5, 1893. Serial No. 469,149. (No model.) Patented in England April 2, 1892, No. 7,037.

*To all whom it may concern:*

Be it known that I, REGINALD BELFIELD, a subject of the Queen of Great Britain, residing in the city of London, in the county of Middlesex, England, have invented a new and useful Improvement in Electric-Arc Lamps, (Case No. 540,) (for which I have obtained a patent in Great Britain, No. 7,037, bearing date April 2, 1892,) of which the following is a specification.

My invention has relation to certain improvements in the construction of electric arc lamps.

The object of the invention is the provision of a simple and efficient form of arc lamp and one particularly adapted for use with an alternating electric current, although it is to be understood that many of the improvements are applicable also to continuous current lamps.

In electric arc lamps in which the position of the carbons with relation to each other is automatically adjusted by means of a solenoid or mechanism controlled thereby, the motion is liable to be sudden, causing rapid variations in the intensity of the light. In order to provide against these sudden movements, dash-pots are usually employed; but these are objectionable for various reasons, conspicuous among which is the spring action incident to the use of dash-pots, which caused a back-lash so to speak, introducing a disturbance which must be again compensated for by solenoid action.

My invention relates among other things to means whereby this sudden movement of the carbons may be avoided without the use of dash-pots.

My invention further provides means whereby the current flow through alternating current lamps may be kept as even as possible, particularly when used in constant potential systems of distribution; and such means are so related to the carbon controlling mechanism as to act in conjunction therewith, for the attainment of the above named ends.

My invention is illustrated in the accompanying drawings, in which—

Figure 1 is a front elevation of my improved arc lamp. Fig. 2 is a side elevation of the controlling mechanism, with one side of the frame work removed. Fig. 3 is a detail elevation of the brake and stop mechanism. Fig. 4 is a detail elevation of the escapement brake. Fig. 5 is a section through the solenoid, showing the formation of the core and lifting stem as preferably constructed by me; and Fig. 6 is a modification, wherein the lifting frame is dispensed with.

In the drawings I have shown that form of lamp wherein one of the carbons only is movable, but it is evident that my invention is applicable to so called "focusing" lamps wherein the two carbons move together to and fro. The movable carbon is shown at 1, and the teeth ordinarily provided thereon are shown at 2. This toothed rod is guided by means of the usual frame 3, whereby the controlling mechanism is supported. The usual controlling solenoid, 4 is attached to the frame in any convenient manner and is adapted to cause movement of the core 5, and stem 6, for the purpose of controlling the carbon or carbons. The rocking frame 7 is pivoted to the frame 3, and is adapted to be moved with the stem 6. Attached to, or forming a part of this rocking frame, is the toothed sector, 8, adapted to cause revolution of the escapement wheel, 9. This wheel is controlled by an escapement of any desired form, 10; which I prefer to construct as shown, of a plate cut out to embrace the escapement wheel provided with inwardly projecting teeth adapted to engage with said wheel, and serving at once as pendulum and escapement. The purpose of this escapement and wheel is to provide a substitute for the ordinary dash-pot. This form of brake offers a very considerable resistance to sudden and violent movements but opposes little or no resistance to slow movements. The spring action or back lash which is such an objectionable feature in dash pots is entirely absent in this form of brake.

One form of lifting device which I may use in connection with this invention is shown in Figs. 1, 2 and 3, and consists of a lifting frame proper, 11, pivoted to the rocking frame, as shown, and bearing a train of gearing meshing with the teeth on the carbon rod, on the one hand, and with the stop and brake mechanism, 12, on the other. This gear is so pro-

portioned as to multiply velocity, so as to cause a number of revolutions of the brake mechanism 12 for every revolution of the pinion 13 which meshes with the teeth on the carbon rod.

The brake and stop mechanism is driven through the pinion 14, and consists of a compound wheel, one half of which is a smooth wheel, and the other half of which is a wheel provided with a number of teeth 15.

Pivoted to the frame 3, or an extension thereof, directly above the compound wheel, are two pieces 16 and 17, having preferably a limited movement, one being provided with a bearing surface, 18, and the other having a stop pin, 19. The brake and stop wheel, being borne upon the lifting frame moves with the same, and is adapted therefore to be brought in to and out of engagement with the bearing surface and stop above mentioned. The surface 18 extends down far enough so that the smooth wheel will come in contact therewith before any engagement can take place between the stop teeth 15 and the pin 19. The part 16 being pivoted as shown, will lift with the brake wheel, until finally the brake teeth are brought into such engagement. The rocking frame 7 is balanced by the core 5 on the one hand, and the counterweight, 20 on the other. When the frame is relieved of the weight of the core by the action of the solenoid, such action is aided by the weight of the part 20.

As shown, in Fig. 5, I prefer to construct the core separate from the stem which governs the frame 7, and to sleeve said core on said stem. At the top of the path of movement of the core there are placed one or more springs, 21 adapted to cushion any sudden blows caused by quick action of the solenoid, and also to transmit to the stem the positive pressure of the core as moved by the solenoid. It is evident that if desired an abutment without a spring may be provided at the top of the stem, or, indeed, the abutment may be entirely done away with and the action of the counterweight 20 be relied upon for causing movement of the rocking frame of itself. If desired, a spring may be placed at the bottom of the path of the core in order to cushion its fall.

When my lamp is used in alternating current circuits, the core consists of the usual bundle of wires, or is otherwise laminated. The solenoid itself, is shown as adjustably secured to the main frame. This feature is, of course, an optional one.

A form of lifting device which I find preferable to that hitherto described is shown in detail in Fig. 6. Here the lifting frame proper is done away with, and the multiplying gear is carried directly by the rocking frame, as is also the break and stop mechanism.

Various modifications of this invention are of course admissible without departing from the principle of my invention. The shape of the frames, and the forms of the solenoid, core, and other parts are particularly subject to wide mechanical variations. It is of course to be understood that the core is not necessarily loose upon the stem, but they may move rigidly together, if desired.

The mode of operation of my device is as follows. The carbons being in contact as usual, when the current is turned on, the solenoid lifts the core, and the counterweight co-operates with the upward pressure of the solenoid on the spring 21 to tilt the rocking frame. Owing to the opposition of the escapement brake to all sudden and violent movements, this action is quite regular and gradual. During the first period of this movement the multiplying gear is free to move under the influence of the teeth on the movable carbon rod. As the lifting gear is raised, however, the smooth wheel comes in contact with the brake 16, and the movement of the multiplying gear is interrupted without any jar. After this point is reached, further movement of the rocking frame under the influence of the solenoid and core, produces separation of the carbons, and an arc is drawn. This movement is continued until the proper feeding point is reached, when the stop pin 19 is in the path of the teeth 15, and the lifting mechanism is positively locked, thus preventing all accidental feeding of the carbons through jars due to the action of the alternating current when such is used or to other causes. When, by consumption of the carbons the arc becomes too long, the reduced current flowing through the solenoid is insufficient to sustain the weight of the core, and it is made to rest upon the stem end of the rocking frame. The counterweight 20 is thus overbalanced, and the brake and stop wheel are depressed. Being thus liberated, the multiplying gear is free to revolve under the weight of the movable carbon, and the arc is duly shortened. This causes the core to be again lifted, and the carbon to be once more supported. Thus the mechanism will be subject to slight movements to one side or the other of that point where revolution of the multiplying gear is just prevented and no more.

In adjusting the carbons, the toothed rod is raised to its highest point, and in order that this may occur the multiplying gear is actuated through a ratchet spring 22, which permits transmission of power in one direction, and free movement in the other.

Where arc lamps are employed in multiple arc, it is the usual practice to supply each lamp with a choking coil which shall prevent by self induction, too sudden changes in current which under some circumstances might otherwise arise. It is one of the features of my invention that, instead of providing a solenoid of few turns and low resistance and a separate choking coil, I make my solenoid and choking coil identical. In other words, I wind my solenoid with a sufficient number of turns to make it act as a choking coil.

The effect of the movable core is then a double one. Not only does it act to control the lifting and feeding mechanism, but by the position of the core within the solenoid its self induction is determined, and accidental changes in current are thus compensated for, by automatic self induction variations. This element of variable self induction also has its effect upon the feeding action; and by its agency the current supply is so to speak weighed against the weight of the core. In cases where choking coils are not necessary or desirable, the usual form of solenoid may be employed.

Where my form of lamp is used in series with other translating devices, the usual shunt solenoid is used in connection with the series solenoid in any well known manner.

What I claim is—

1. In an arc lamp, a rocking feeding mechanism, a geared sector carried thereby, a toothed wheel actuated by said sector, and a pendulum plate embracing said toothed wheel and provided with inwardly extending teeth engaging with said toothed wheel, substantially as described.

2. In an arc lamp, a rocking feeding mechanism, a loosely carried core and a counterweight on opposite ends thereof for balancing the same, and a solenoid in the main circuit for raising said core, substantially as described.

3. In an arc lamp, a feeding mechanism carrying an actuating stem, a core loosely sleeved on said stem, an abutment for the core at one end of said stem, and a solenoid for raising said core, substantially as described.

4. In an arc lamp, a rocking feeding mechanism, carrying an actuating stem at one end thereof, a core loosely sleeved on said stem, a spring abutment for the core at one end of the stem, and a solenoid for raising said core, substantially as described.

5. In a constant potential arc lamp, a feeding mechanism, a core for actuating the same, and a choking coil in series with the lamp carbons, adapted to act as a solenoid to move said stem, substantially as described.

6. In an arc lamp, a toothed carbon-bearing rod, a train of gearing engaging therewith, a compound brake and stop wheel actuated by said gearing and composed of a smooth portion and a toothed portion, a brake and a stop adapted to cooperate with the two portions of said brake and stop wheel respectively, and means for moving said gearing and said brake and stop wheel together in to and out of contact with said brake and stop, substantially as described.

7. In an arc lamp, a toothed carbon bearing rod, a train of gearing engaging therewith, a compound brake and stop wheel driven by said gearing, and carried on the same frame therewith, a pivoted piece carrying a stop, and a pivoted piece carrying a brake surface, said braking surface extending beyond said stop, the two pieces being adapted to cooperate with the two parts of the compound wheel, and means for moving said gearing and said compound wheel in to and out of contact with said brake and stop successively, substantially as described.

In testimony whereof I have hereunto subscribed my name this 6th day of February, A. D. 1893.

REGINALD BELFIELD.

Witnesses:
JAMES WM. SMITH,
HAROLD S. MACKAYE.