(No Model.)

C. A. TUCKER.

ARC LAMP.

No. 436,465. Patented Sept. 16, 1890.

Fig. 2.

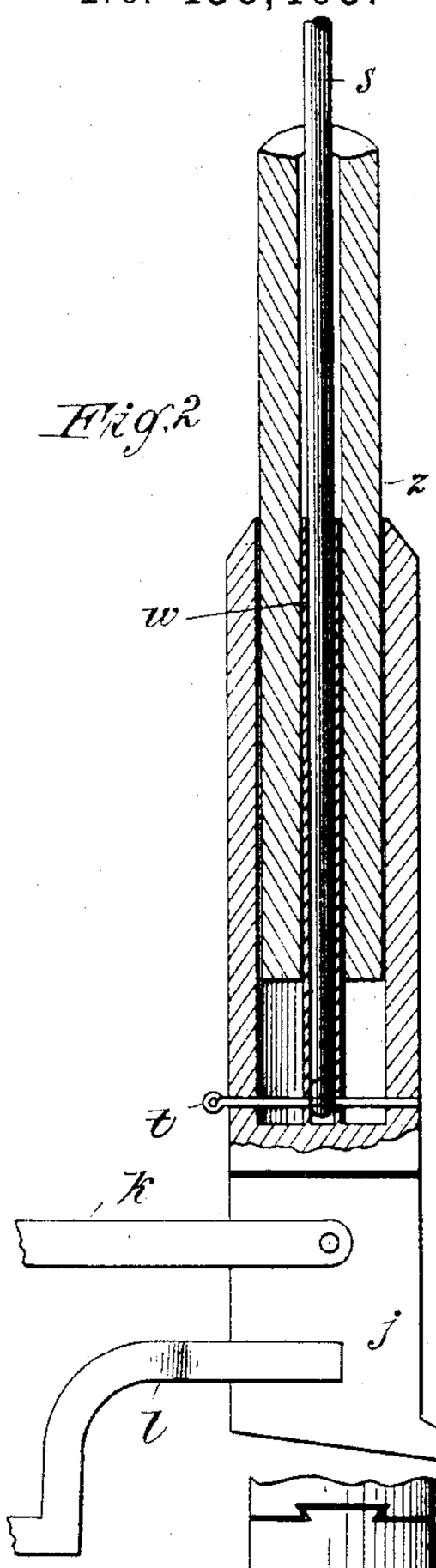


Fig. 3.

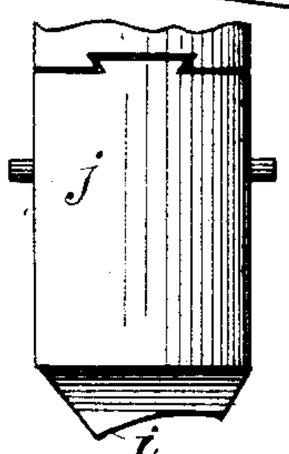


Fig. 4.

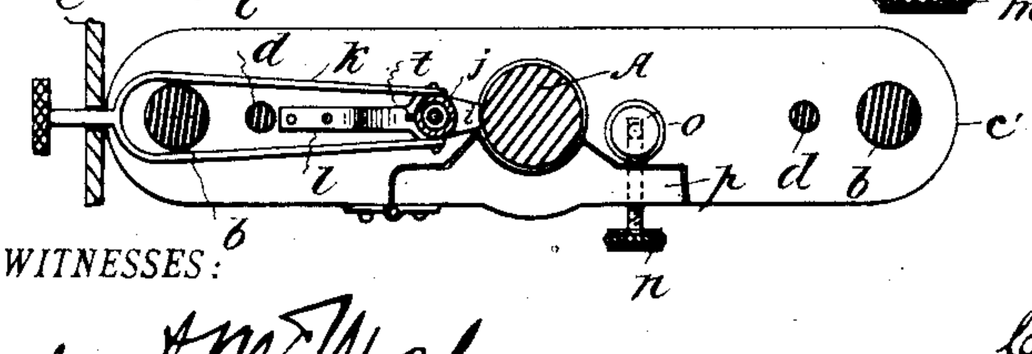
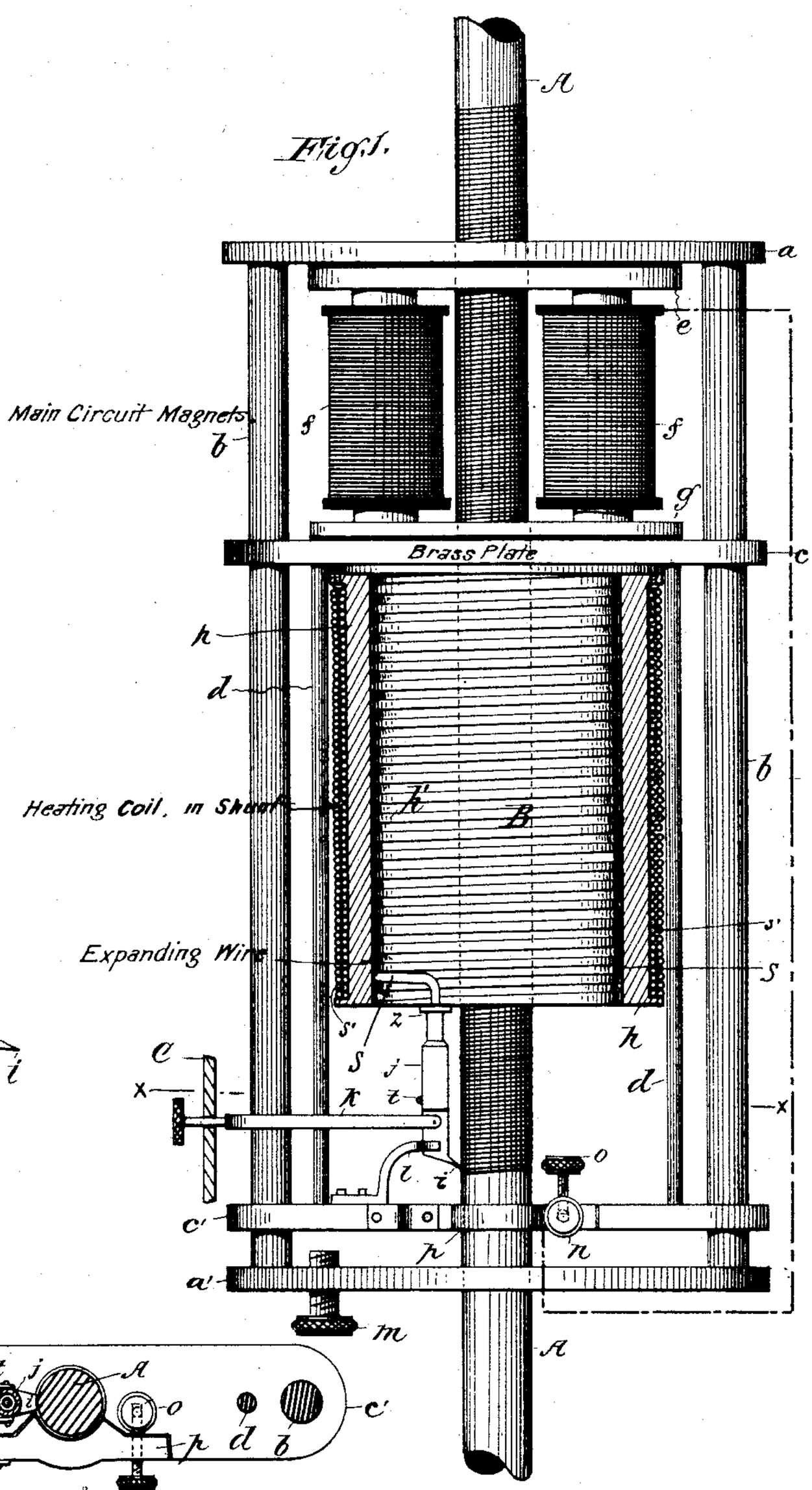


Fig. 1.



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ARC LAMP.

SPECIFICATION forming part of Letters Patent No. 436,465, dated September 16, 1890.

Application filed January 3, 1888. Serial No. 259,655. (No model.)

To all whom it may concern:

Be it known that I, CHARLES A. TUCKER, a citizen of the United States, and a resident of Islip, in the county of Suffolk and State of New York, have invented certain new and useful Improvements in Devices for Regulating the Carbon-Rods of Electric-Arc Lamps; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, which form part of this specification.

My invention has for its object a new device for regulating the movable carbon-rods for electric-arc lamps, by means of which the light is kept from flickering and is made to be much more constant or uniform than by the devices now employed, and this is accomplished with very little mechanism and by the employment of less electrical energy than is required in the devices heretofore known.

My invention comprises suitable forwarding devices—that is, any devices that will engage with and force the carbon-feed rods in the direction required when such forwarding devices are operated. For the purpose of operating such forwarding devices it comprises any suitable material which expands by heating and contracts by cooling, and this expanding and contracting material is disposed in relation to the forwarding devices in such manner that when it is heated it will by its expansion operate the forwarding devices to force the carbon-feed rods in the direction required, and upon cooling will contract, and by its contraction will permit the forwarding devices to resume or bring the same into suitable position to repeat the operation when the expanding material is again heated, and for heating such material I may employ a shunt-circuit around the arc in the main circuit through the lamp, which shunt may be formed in the usual or in any well-known manner.

I will now proceed to describe an example of my invention, which is illustrated in the drawings. This consists in interposing in the shunt-circuit above mentioned a bar or wire of comparatively great resistance and hardness. For this purpose I have found that German-silver wire will produce good results, and this wire is made of such length as will by its expansion give the necessary motive power to force the carbon-feed rod in the direction required.

Figure 1 is a perspective view of the upper part of an electric-arc lamp containing one form of device for carrying out my invention partly in section. Fig. 2 is an enlarged and detail side view of the shoe *j* partly in section. Fig. 3 is a back view of the lower part of the shoe *j*. Fig. 4 is a top view of the plate *c'*, looking down from the line *x x* of Fig. 1.

Similar letters of reference indicate like parts in all the drawings.

A is a carbon-rod, to the lower end of which, in any suitable manner, the upper carbon is to be attached. This carbon-rod A passes through a frame or cage composed of two disks *a* and *a'*, which are held together by the two rods *b b*. To the under side of the upper disk *a* the magnet-holding yoke *e* is to be secured with its magnets *f f* in any suitable manner. Two brass plates *c c'* are held together by rods *d d* and form a frame adjusted to move up and down on the rods *b b* below the magnets *f f*. On the upper side of the plate *c* a suitable armature *g* is secured, by which the frame *c c' d d* and all its parts may be drawn up to the magnets when these are excited.

On the under side of the plate *c* a wire-holder B is to be secured. This wire-holder may consist of any suitable device strong enough to support the wire against necessary strain, and the grooves in which the wire is supported are to be sufficiently large to permit the wire to expand or elongate freely as it is heated, but not large enough to permit the wire to double or "buckle" at any part. A convenient device for this purpose may be made of glass or other suitable non-conducting material not affected by the heating of the wire. The device shown in the drawings consists of a glass cylindrical tube *h'*, having the proper grooves made on its outer surface, in which a wire *s* is to be coiled. An outer cylindrical tube *h*, of the same material and of a size proper to receive the tube *h'*, is placed around it, the two together thus forming a suitable worm to contain the wire *s*. This case B may be made of such glass or material thick and strong enough to support the wire in its operation; or, if it is desired for

any reason to have the glass portion thin, outer and inner inclosing-cases of any suitable metal or other strong material may be employed to support the same against breakage. This wire-holding case is to be secured in a suitable position, and may be conveniently attached to and supported against the under side of the plate *c*, as by flanges or lips screwed directly to the plate, as shown in the drawings, or by any suitable collar or other support. The upper end of the wire *s* is to be supported in such a manner in the top of the case B that it will abut against an immovable part, so that any elongation of the wire *s* will be operative at the lower end of the same.

In the same shunt-circuit a3 and connected in series with the expanding wire or rod *s* is placed a suitable electric resistance, as the wire *s'*, which is to be insulated wire, and may be wound around the case B or disposed in any other convenient manner, the sum of these wires *s* and *s'* being so proportioned to the resistance of the normal arc as to permit only the proper current to pass through the shunt according as the resistance of the arc varies. These parts *s* and *s'* may be connected by suitable binding-posts, and a binding-post may also be provided to interpose them in the shunt-circuit, or the shunt wire or path may be connected therewith in any suitable manner. The lower portion of the wire *s* passes out of the case B through a glass or glazed tube *z* into the metal shoe *j*, to which the lower end of the wire *s* is securely attached, as by a pin *t* passing through the same. The tube *z* may be fused or otherwise securely connected to the case B, and the shoe *j* is suspended on the end of the wire *s*. A suitable aperture is made in the shoe *j*, so that it may freely move up and down on the tube *z*, and a thin interior tube or part *w* of the shoe *j* surrounds the lower part of the wire closely, so that it cannot double up or buckle as the shoe *j* is pushed down. The lower part of the shoe *j* is separated from the upper part, and the two are held together by a flaring strip on one playing into a corresponding groove in the other, forming a gib-slide, as clearly shown in Fig. 3, so that the lower part of the shoe *j* may be moved laterally while the upper portion remains rigid. The shoe *j* terminates in a toe *i*, which is held against and engages with the carbon-rod A by a suitable spring *l*, secured to the upper face of the plate *c'*. A pull *k*, yoke-shaped and terminating in a handle which projects beyond the outer lamp-case C, may be attached to the lower part of the shoe, so that it can be drawn away from engagement with the rod A from without the lamp-case, when desired. The carbon-rod A passes through the disks *a a'*, plates *c c'*, and case B; but is firmly grasped and held in the desired position by a suitable clamp *p*, attached to the plate *c'*, which is closed in upon it by a screw *n*, passing through one end of the piece *p* and into the plate *c'* at the side. A screw *o*, passing into the plate *c'* from above, bears against the screw *n* and holds it firmly in the position required.

An adjusting device to limit the downward movement of the frame *c c' d d* may consist of the adjusting-screw *m*, arranged in the lower disk *a'*.

The carbon-feed rod A is to be threaded on its face with V-threads of fine pitch, and the toe *i* is to have a corresponding pitch at its engaging edge, so that the parts may readily engage with each other. The lower carbon-holder may be in the usual form.

A wire from one pole of the source of electricity is carried to the lower carbon of the lamp in the usual manner, and a wire from the other pole is carried to the magnets *f f*, and from them a wire is connected with the feed-rod A in any convenient manner, as by fixing it to the clamp *p*.

A shunt-circuit is to be taken around the arc in the main circuit through the lamp in any suitably manner, and the wire *s* and supplementary wire *s'* are to be interposed in such shunt-circuit. A convenient way of doing this in the structure shown is by connecting the upper end of the wire *s* electrically with the supplementary resistance-wire *s'* and this with the outer lamp-frame, which is in electrical connection with the lower carbon. The lower end of the wire *s* is then to be placed in electrical connection with the upper carbon main wire. As in the structure shown the lower end of the wire *s* is in electrical connection with the shoe *j*, and that through the toe *i* is in electrical connection with the carbon-rod A, there will be a shunt-path to the lower end of the wire *s* from the rod A, toe *i*, and shoe *j*, heating the wire *s* when the resistance at the arc in the main circuit is sufficiently increased, or, if preferred, a shunt-wire may be attached to the upper end of the shoe *j*, as to the pin *t*, and the lower part of the shoe may be insulated, as by interposing suitable insulating material between the parts in the gib-slide.

The best effects in applying this device for regulating these lamps will be obtained when the wire *s* is kept heated by the current while the carbons are giving the required light. To do this the resistance of the shunt, including the wire *s*, is to be so regulated in relation to the resistance of the carbon-circuit that a current sufficient to affect this will pass through the shunt when the carbons are held at the proper normal distance to give the required light. This of course can be readily done, depending upon the length of the wire *s* and of the supplementary resistance *s'*. Keeping the wire *s* heated will make it sensitive to operate more rapidly than if it had first to be heated when the current passes into the shunt. I have obtained good results with a German-silver wire No. 22, "Brown & Sharpe gage," using a current of one-half an ampère.

In carrying out my invention with the device shown and described the operation will

be as follows: By means of the adjusting-screw *m* the frame *c c' d d* is so adjusted that the carbons will touch in the usual manner, and that when the armature *g* touches the magnets *f* the carbons will be at the proper distance apart. As soon as the current is turned on at the source of electricity the magnets *f f* become excited and draw up the armature *g*, and with it the carbon-rod A and the entire frame *c c' d d*, leaving the required space between the upper and lower carbons. So long as this distance is maintained the current passing through the shunt will be only sufficient to keep the wire *s* heated, as above stated. As the upper carbon burns away and the resistance in the carbon-circuit increases, the quantity of the current passing through the shunt increases, heating the wire *s*, which is thereby expanded and elongated and forces down the shoe *j*. The toe *i*, engaging in one of the threads of the rod A, forces down that rod, and with it the upper carbon, until the carbons resume the proper distance, when the current is diverted from the shunt and the wire *s* is allowed to cool. As it cools it contracts and draws up the shoe *j*, so that the toe *i* will engage with a corrugation higher up on the rod A, and as the upper carbon burns away the operation is repeated until the carbon is exhausted.

In applying the device herein described to a focusing-lamp, or a lamp in which both carbons are to be forwarded, it would be necessary only to place the lower carbon-feed rod in a suitable support provided with a clamp corresponding to the clamp *p* to hold it in position, and then arranging the shoe *j* and the wire *s* and its case B in the structure to force the carbon-feed rod upward instead of downward. The shoe *j* of the upper carbon-feed rod, and the corresponding shoe *j* of the lower carbon-feed rod would then be electrically connected in the shunt, and the necessary supplementary resistance would be disposed in the shunt at any convenient point. As the lower carbon burns away only half as fast as the upper carbon, the expanding wire *s*, actuating the lower carbon, would require to be only half as long as the wire *s* of the upper feed-rod, and the lower case B would be reduced in proportion.

In this device for regulating the distance between the carbons no clock-work or other similar mechanism is required, and the operation of adjusting the carbons is direct and positive, whereas heretofore the carbons have been adjusted by indirect action, as by gravity, some mechanism being employed by means of which the upper carbon is held suspended, the mechanism being set in operation to release the carbon when required to feed, so that it may drop and then be again clutched and held in position.

In operating the carbon it is of primary importance that any regulating necessary should be regular and positive, and heretofore this has never been possible, for the reason that perceptible intervals of time elapse to overcome the inertia of the parts, and besides this the clutching device is apt to be irregular and vibratory in its feeding, owing to the difficulty of feeding to the exact point required, and no farther. The feeding is liable to be beyond or short of the required point, and then further regulating is necessary. By my invention, however, regulative action is constant and regular. It will thus be seen that my invention provides for the firm but not immovable clutching of the carbon-feed rods, the interposing of a suitable expanding device between an immovable part of the structure, and an engaging-point on the rods, the heating of such interposed expanding part to expand or elongate it, and thereby to drive or force the feed-rods to the desired position.

I do not claim in this application the method or art of regulating carbon-feed rods for electric-arc lamps by means of heat and material adapted to be expanded by heat and disposed so as to operate the feed-rod, such art or method being the subject of independent application for a separate patent.

I do not limit myself to the forms of the parts or to the structure shown in the drawings and described, as these may all be changed without departing from my invention.

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

1. A device for regulating electric-arc-light carbons, consisting of a support for the carbon-holder which will retain the same in any desired position firmly but not immovably, a bearing adjusted to such carbon-holder, and a suitable part capable of being expanded by heat and contracted by cold, as a rod of metal, one part of which is held rigidly in position and another part of which is adjusted to operate upon such bearing, in combination with a suitable shunt adapted to divert the current from the carbon-circuit into the expansible part as the resistance in the carbon-circuit increases, and thereby to expand such expansible part and force the carbon-rods together to the desired distance, substantially as described and shown.

2. A device for regulating electric-arc-light carbons positively by heat, consisting of a suitable case, as B, to support the expanding part, a forwarding device, as the shoe *j* and its parts, adapted to engage with the carbon-feed rod, in combination with an expanding part, as *s*, adapted to be expanded by heat, and a suitable supplementary resistance, as *s'*, in a series therewith, such expanding part *s* supported to adapt the same to operate upon the shoe *j* and push said shoe and the carbon-feed rod in the desired direction as the part *s* is expanded by heat, substantially as described and shown.

3. In a device for operating the carbon-feed rod by the expansion of a part of suitable material, an inclosing-case for such expansi-

ble part consisting of an interior form, as *h'*, of suitable material, grooved to receive the expanding part, and an exterior support, as the part *h*, adapted to fit over the expansible part and confine the same within the grooves, substantially as described and shown.

4. In a device for operating the carbon of an electric-arc light by an expansible part of suitable material capable of being expanded by heat and contracted by cold, a suitable carrier, as the frame formed of plates *c c'*, rods *d d*, provided with the armature *g*, a suitable expanding device, and a carbon-feed rod, as A, in combination with the clasp *p*, adapted to hold the same firmly but movably in position, and screws *n* and *o*, substantially as described and shown.

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