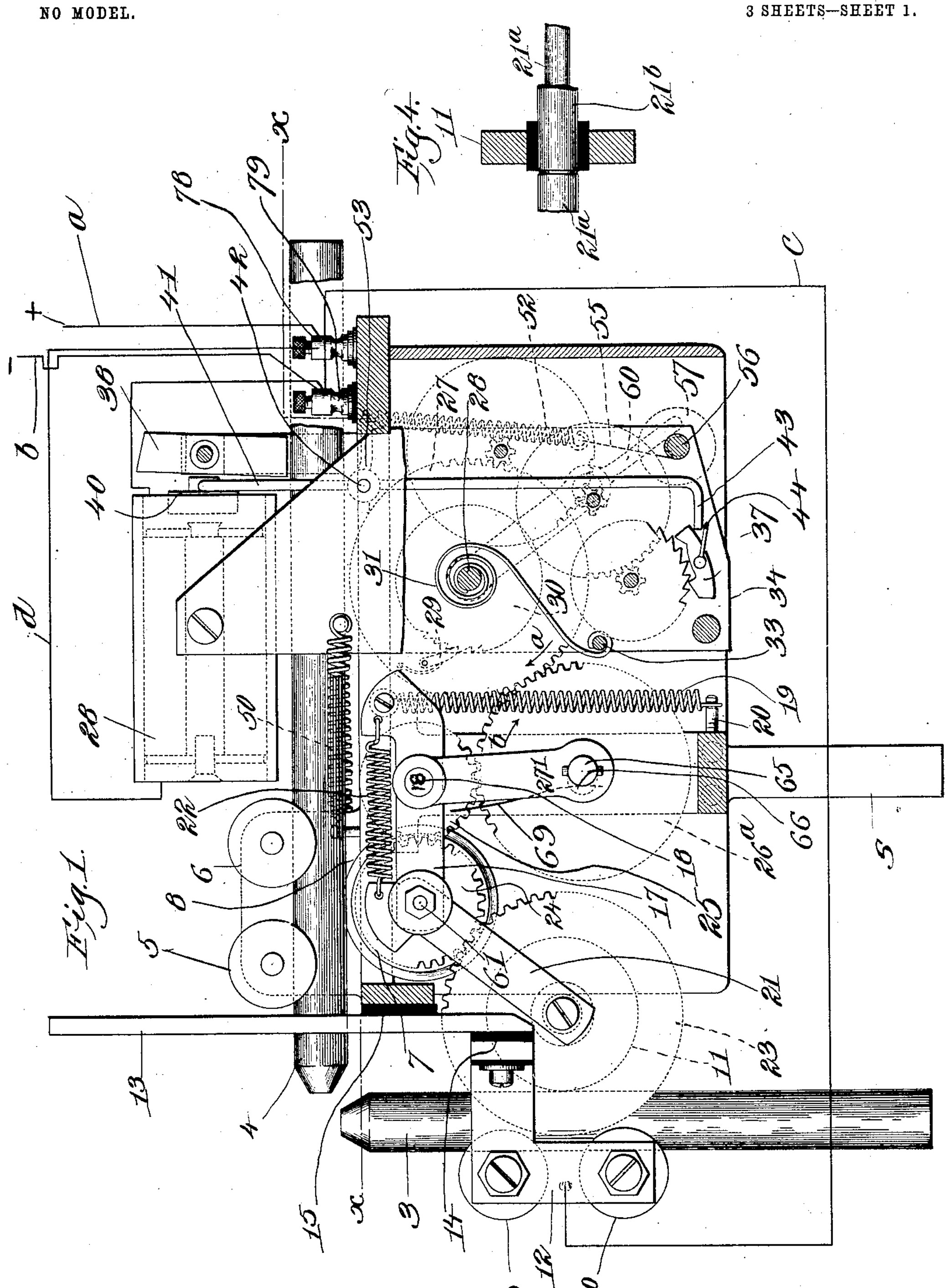
No. 748,121. PATENTED DEC. 29, 1903.

K. TORNBERG.

ELECTRIC ARC LAMP.

APPLICATION FILED NOV. 1, 1902.

NO MODEL. 3 SHEETS—SHEET 1.



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NO MODEL. 3 SHEETS—SHEET 2.

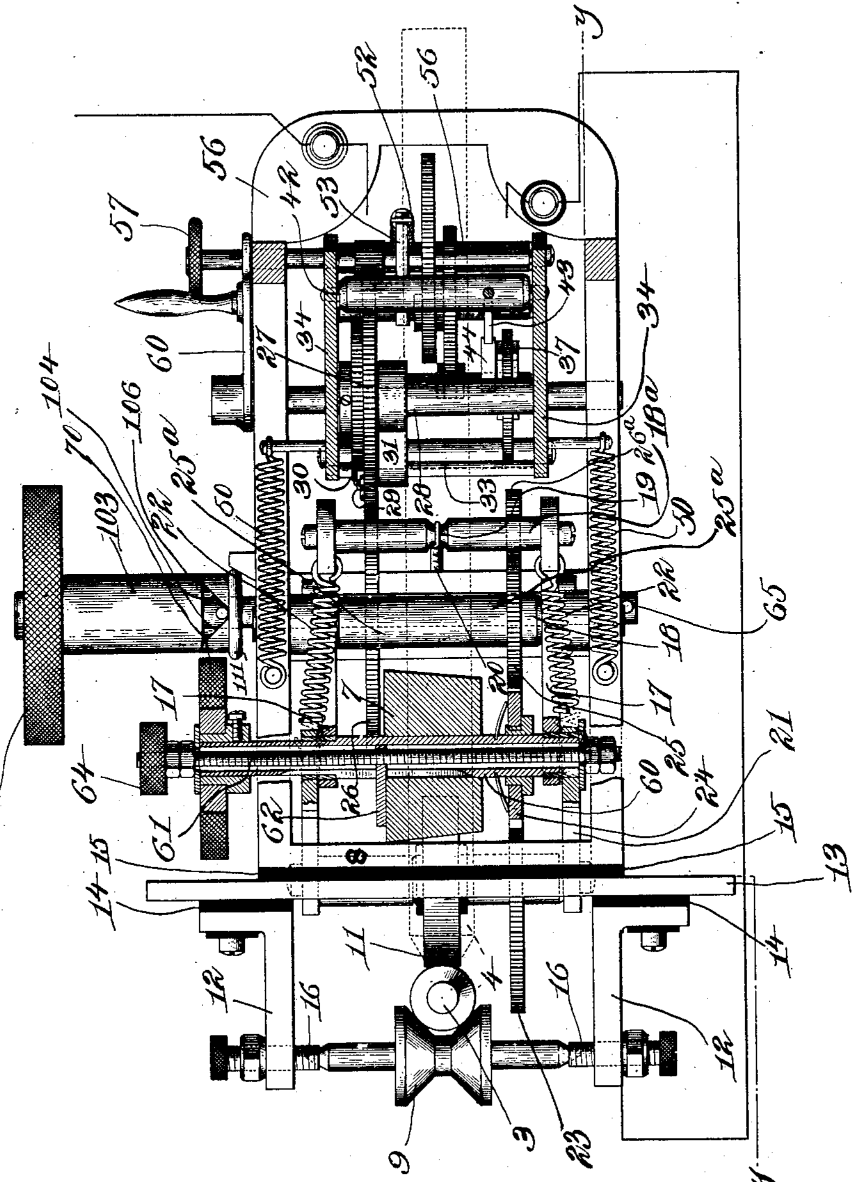

Fig. 2.

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NO MODEL. 3 SHEETS—SHEET 3.

Fig. 3.

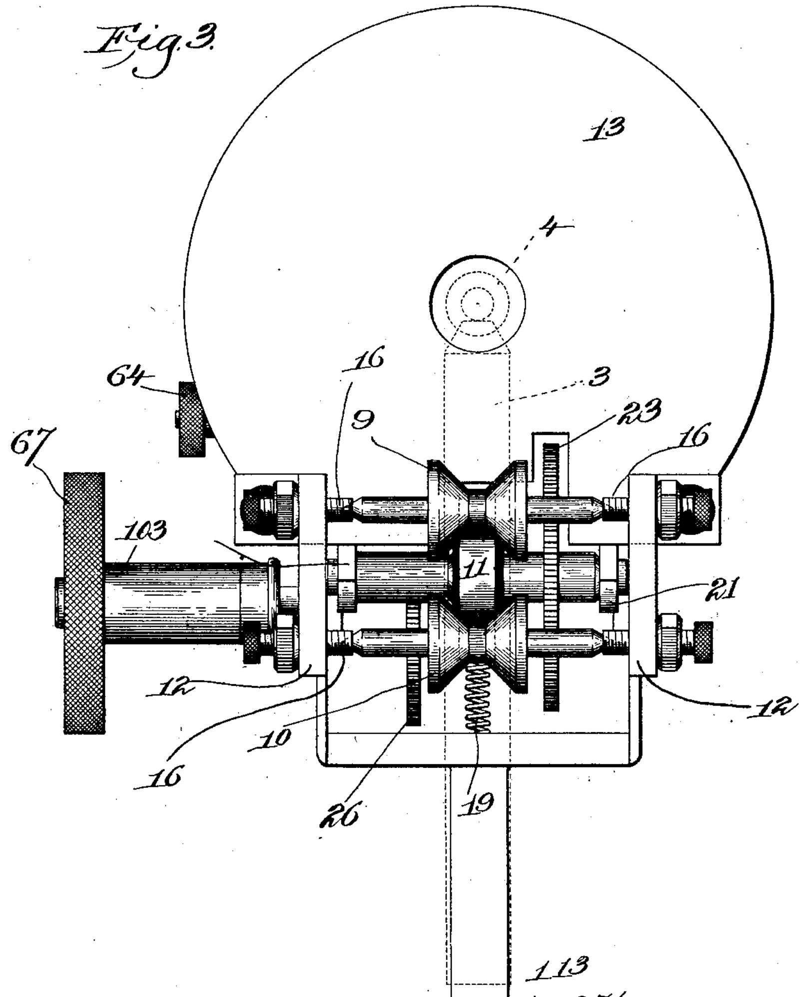
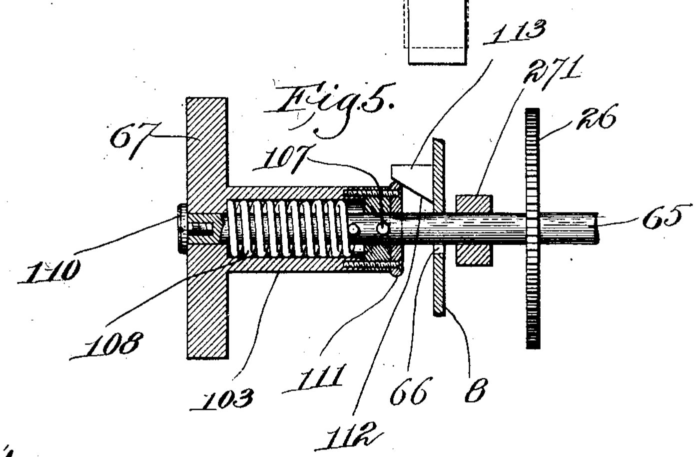


Fig. 5.



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No. 748,121. Patented December 29, 1903.

UNITED STATES PATENT OFFICE.

KNUT TORNBERG, OF MEDFORD, MASSACHUSETTS.

ELECTRIC-ARC LAMP.

SPECIFICATION forming part of Letters Patent No. 748,121, dated December 29, 1903.

Application filed November 1, 1902. Serial No. 129,695. (No model.)

To all whom it may concern:

Be it known that I, KNUT TORNBERG, a citizen of the United States, residing at Medford, in the county of Middlesex and State of Massachusetts, have invented an Improvement in Electric-Arc Lamps, of which the following description, in connection with the accompanying drawings, is a specification, like characters on the drawings representing like parts.

This invention relates to electric-arc lamps, and aims to provide a novel lamp of this class which has the following advantageous features: The carbons are held and guided in such a way as to greatly facilitate their insertion and removal, to insure that the carbons, of whatever size, shall always be held in the correct position without any special adjustments for the different sizes of carbons, and to insure a straight-line motion of the carbons while requiring a very small amount of power to feed them. The feed mechanism is so constructed that it can be operated either automatically or by hand, the latter operation being carried out without any other motion than the natural movement of the hand in turning a part, and the relative rate at which the carbons are fed can be varied while the lamp is burning if this is necessitated by variations in the density of the carbons. The lamp is so constructed that it will draw an arc of the proper length as soon as the current is turned on and maintain said arc in a fixed position during the entire time that the lamp is burning. Both the initial drawing of the arc and the subsequent regulation of the feed are accomplished by the same magnet or solenoid, whereby the construction of the lamp is simplified. The operative parts are so constructed that the lamp will work equally well in any position. The special construction by means of which these results are attained will be hereinafter described, and the novel parts thereof pointed out in the claims.

Figure 1 is a side elevation of my improved lamp with parts broken out to better show the construction. Fig. 2 is a section on substantially the line x x, Fig. 1. Fig. 3 is a front view of the lamp. Fig. 4 is a detail which will be hereinafter referred to, and Fig. 5 is a view showing the means for manually feeding the carbons.

The lamp may have two, three, or any number of carbons, as desired; but in the embodiment of the invention herein illustrated I employ two carbons, (designated by 3 and 4, respectively,) which are shown as being arranged at right angles to each other, though this particular arrangement is not essential to my invention, as they may be arranged in any position relative to each other. Each of the carbons is supported by a set of carbon-supporting rolls, one roll of each set constituting a driving or feeding roll for the carbon and having a frictional engagement with the carbon. The set of rolls supporting the carbon 4 comprises the rolls 5, 6, and 7 and the set supporting the carbon 3 includes the rolls 9, 10, and 11. The rolls 5 6 and 9 10 of the two sets constitute guiding-rolls and the rolls 7 and 11 constitute driving-rolls.

In order that the carbons may be held with the requisite steadiness and may be fed with right-line movement, I have provided the guiding-rolls 5 6 and 9 10, respectively, with the circumferential grooves in which the carbons are partially received.

It will be noted that the walls of the groove in each guiding-roll converge toward each other, whereby each roll has contact with the carbon in two or more places, with the result that the carbon is held from any lateral movement and is therefore maintained in its correct position. Another advantage of this construction is that any size of carbons may be employed without affecting the perfect operation of the device, for whatever the size of the carbons they will be held in their correct position by the tapered or substantially V-shaped grooves in the guiding-rolls.

The driving-roll 7 is shown as being situated beneath the carbon 4 and as having a frictional engagement therewith, whereby as the said roll is rotated by mechanism hereinafter described the carbon will be fed forward or backward, and the driving-roll 11 has a similar engagement with the carbon 3 and similarly actuates the latter.

It will be noted that the axes of all the rolls of each set are parallel to each other.

It is of course necessary for the two sets of rolls to be insulated from each other, and I have therefore shown the rolls 9 and 10 as being mounted in supporting-arms 12, secured to the shield-plate 13, but insulated therefrom by any suitable insulating material 14. The plate 13 is connected to the frame 8 and is preferably insulated therefrom by any suitable insulating material 15. This construction effectively insulates the rolls 9 and 10 from the frame and from any hood or casing in which the frame may be placed. The feeding-roll 11 is suitably insulated by means which will be hereinafter described.

I have shown the spindles of the rolls 9 and 10 as being supported in bearings in screws 16, which are adjustably supported in arms 12 to facilitate initial alinement of the said rolls.

Suitable means are provided for yieldingly sustaining each of the feeding-rolls 7 and 11 so that they will be held against the carbons with sufficient force to hold the latter firmly in the grooves of the guiding-rolls 5 6 and 9 10, respectively, and for this purpose the feeding-roll 7 is shown as being rotatively mounted in two arms 17, which are pivoted upon a rod or pivotal shaft 18, supported in the frame of the lamp. The arms extend to the rear of the pivotal shaft 18 and are rigidly tied together by a rod 18^a, to which one end of a spring 19 is connected, the other end of said spring being secured to some suitable fixed support, as at 20. By means of this construction the spring 19 normally tends to hold the feeding-roll 7 against the horizontal carbon with sufficient force, so that the rotation of said roll will feed the carbon back and forth as desired.

The feed-roll 11 is illustrated as being carried by a sleeve 21^b, mounted on a pin 21^a, rigidly connecting the arms 21, which are hinged to the arms 17 to turn about the axial line of the roll 7 as a center. Suitable springs 22, connecting the upper end of the arms 21 with the rear end of the arms 17, serve to maintain the proper frictional engagement between the feed-roll 11 and the carbon 3.

The arms 17 and 21 constitute a jointed frame or support, which is pivotally mounted upon the pivotal rod or shaft 18 and which serves as the support for the two feeding-rolls 7 and 11. This construction permits the rolls to each be yieldingly mounted and yet furnishes means for driving the rolls one through the other.

Since the arms supporting the feed-roll 11 are electrically connected with the carbon 4, I have insulated the feed-roll 11 from its supporting-shaft, so as to prevent any short-circuiting, as shown in Fig. 4.

Fast on the sleeve 21^b, which is rigid with the feed-roll 11, is a gear 23, which meshes with a gear 24 on the shaft of the feed-roll 7, said gear in turn meshing with a gear 25, which is carried by a sleeve 25^a on the shaft 18. The gear 25 meshes with and is driven by a gear 26^a, fast on a shaft 65, which is supported in arms 271, rigid with the pivotal shaft. The shaft 65 also has fast thereon a second gear 26 of the same size as gear 26^a, said gear 26 normally meshing with and being driven by the driving-gear or actuating-wheel 27. In order to distinguish said gear 26 from the other gears of the train, I will hereinafter refer to it, especially in the claims, as the "driven" gear. The operation of this latter gear is controlled by a suitable magnet or solenoid 28, the winding of which, as usual in this class of devices, is in a circuit shunted around the carbons. The gears 26 26^a and the sleeve 26^c form one integral member and serve to transmit motion from the actuating-gear 27 to the gear 25, and the reason for employing the two gears in this embodiment of the invention is because of the location of 27 with reference to gear 25. When the gear 27 is in line with gear 25, a single gear would be sufficient to connect them. It will now be observed that if the actuating or driving gear 27 moves in the direction of the arrow *a* the other gears of the train above described will be given a rotation in such a direction as to feed both of the carbons toward each other, while the movement of the said driving-gear in a reverse direction will separate the carbons.

The gear 27 is the main gear of any ordinary clock-train, which is supported in a frame comprising the two plates 34 in any usual way, said clock-train including some suitable brake or stop device, preferably an escapement 37, and the usual actuating-spring 31, one end of which is fastened to a fixed point 33 on the frame and the other end of which is fast to the shaft 28, on which the gear 27 is mounted. The gear 27 is loose on said shaft, but has the usual pawl-and-ratchet connection 29 30 therewith.

The shaft 28, which is suitably supported in the frame of the lamp, also acts as the pivotal support for the rocking frame carrying the clock-train. The upper end of the rocking frame may have connected thereto either the armature or the coils of an operating and regulating magnet or solenoid, as found most convenient. In the present embodiment of my invention I have connected the said magnet or solenoid to the oscillating frame and have fixedly supported the armature 38 upon the frame 8. With this construction whenever the magnet is energized it will be drawn toward the fixed armature, which will result in oscillating the frame 34 and in feeding the carbons toward each other, as will be presently described.

The attaching of the magnet to the upper end of the oscillating frame has the advantage that the weight of the magnet or solenoid counterbalances that of the clock-train, so that the frame will rock with equal facility in any position of the lamp. This I consider as quite important, for it is sometimes desirable to place the lamp in some other than a vertical position, and by means of the construction herein illustrated this can be done without affecting in any way the operation of the lamp.

One of the features of the present invention is a construction wherein the same magnet operates both as a starting and regulating magnet, and for this purpose I have provided in addition to the fixed armature 38 a supplemental armature 40, the movement of which with reference to the magnet 28 locks or unlocks the escapement 37. As herein shown, said armature 40 is mounted on a rod 41, which is rigid with a hub or shaft 42, pivotally carried by the two plates 34, the lower end 43 of said rod 41 normally standing in the path of the projection 44 on the escapement 37 to thereby prevent movement of the escapement, and consequently lock the train of gearing connecting the escapement with the drive-gear 27 against rotation. The wires of the main circuit are designated by *a* and *b*, and these may lead to the two binding-posts 78 and 79, respectively. The binding-post 79 is insulated from the frame of the device and is connected by wire *c* to the arms 12 and carbon 3. A shunt-circuit *d*, connecting the two binding-posts, includes the coils of magnet 28.

The operation of the parts thus far described is as follows: Normally the carbons are in the position in which they were left when the current was turned off and are therefore separated, as shown in the drawings. When the current is turned on, therefore, it all will pass through the shunt-circuit *d*, thus energizing the magnet 28. Since the armature is fixed, the magnet will be drawn toward the former and the frame 34 rocked about the shaft 28. The frame, it will be noted, carries the clock-train, including the escapement and driving-gear 27, and therefore the movement of the frame will give the gear 27 a partial rotation in the direction of the arrow *a*, this rotation being sufficient to feed the carbons 3 and 4 together. As soon as the carbons meet the current will pass through them, and very little will traverse the shunt-circuit. The magnet 28 will therefore be partially deënergized, and the frame carrying the magnet will be drawn back toward its normal position, (shown in Fig. 1,) by means of springs 50, one end of which are connected to the plates 34 and the other end to the frame 8. This backward oscillation of the frame will give the driving mechanism a reverse movement and will separate the carbons to their initial distance, thereby drawing an arc, and bring them into the correct relative position to form an arc of the same length as that existing when the lamp was burning the time previous. The initial drawing of the arc is thus accomplished by the oscillation of the frame caused by the magnetic attractions between the magnet and the fixed armature 38. The regulation of the feed of the carbons after the arc has once been drawn is effected by the magnetic attraction between the magnet and the supplemental armature 40. As the carbons burn away and the arc increases the strength of the current in the shunt-coil correspondingly increases, as will be obvious, and such increase of current while not sufficient to effect the movement of the magnet relative to the armature 38 is sufficient to attract the armature 40, and thereby carry the end 43 of the supporting-rod 41 out from the path of the projection 44, thereby allowing the escapement to operate and releasing the train of gear. When this occurs, the spring 31 through the ratchet 30 and pawl 29 gives a slight forward movement to the driving-gear 27, and consequently feeds the carbons together to decrease the arc. When an arc of the proper length has been secured, the magnet 28 becomes deënergized sufficiently, so that a spring 52, which is connected to an arm 53, extending from the hub 42, overcomes the attraction of the magnet on the armature and throws the rod 41 into the position shown in Fig. 1, thereby locking the escapement and preventing further rotation of the driving-gear 27.

I have herein shown means for adjusting the tension of the spring 52, so as to render the regulating device more or less sensitive, and for this purpose I employ a flexible connection 55, such as a cord, tape, or other suitable material, which is connected at one end to the spring 52 and is wound at the other end about an adjusting-shaft 56, supported in the oscillating frame and carrying at one end the knurled end 57, by means of which it may be turned. It will thus be seen that I have provided a single magnet, which acts both to draw the arc and to regulate the feed of the carbons as they are consumed.

The shaft 28 may be provided with a suitable handle 60, by means of which the spring 31 may be wound up as it gradually becomes unwound during the burning of the carbons.

The carbons frequently vary in density to such an extent that the relative rate at which they are consumed varies, and as the fact whether any two carbons have the same or different densities can ordinarily be discovered only after the lamp has been in operation for a time it is highly important in order to maintain the arc at a fixed point that some means be provided to regulate the relative rate at which the carbons are fed while the lamp is burning. I have consequently provided means whereby the relative rate of feeding of the two carbons may be varied while the lamp is burning and as necessary to maintain the arc at the desired point. As herein shown, this regulation of the relative rate of feed of the carbons is accomplished by making the roll 7 a conical roll, as shown in Fig. 2, and providing means whereby said roll may be given a longitudidal movement on its shaft, thus bringing a larger or smaller portion of said roll in active contact with the carbon 4, as circumstances require.

The shaft 60, which supports the roll 7 and which is supported by the arms 17, is shown as a hollow shaft, on the interior of which is a screw-threaded rod or shaft 61, which has screw-threaded engagement with a nut 62, projecting through a slot in the shaft 60 and made fast to the roll 7 in any suitable way.

The screw-threaded shaft 61 is held from movement longitudinally of the shaft 60 by any suitable means and is shown as being provided with a head 64, by means of which it may be rotated. As it is turned in one direction or the other the roll 7 will be moved longitudinally of the shaft 60, as will be obvious, and if it is desired to feed the carbon 4 faster with relation to the carbon 3 the roll 7 will be moved to bring its larger diameter in engagement with the carbon 4, while if a slower relative movement between the carbons is desired the roll will be moved in a reverse direction.

Another feature of my invention relates to means whereby the carbons may be fed by hand, and for this purpose I have provided means whereby the shaft 65 may be manually rotated in either direction, said means being so constructed that the turning of the manual devices to rotate the shaft operates to disengage automatically the driven gear 26 from the driving-gear 27. As herein illustrated, the shaft 65 extends at one end through a slot 66 in the frame 8, and loose on the projecting end thereof is a handpiece in the form of a sleeve 103, having a head 67, by means of which it may be turned. The end of the sleeve is cut away to form the cam-surfaces 104 and the shoulders 106, which coact with a pin or projection 107, extending from the shaft 65. A spring 108, confined between the sleeve and shaft, operates normally to hold the sleeve in the position shown in Fig. 5, so that the projection stands between the lower ends of the cam-surfaces, the screw 110 operating to prevent the sleeve from sliding off from the end of the shaft. Secured to the end of the sleeve is a ring 111, having a rounding bearing edge adapted to contact with the inclined face 112 of a lug 113, fast on the frame 8. It will now be observed that whenever the sleeve is turned in either direction one of the cam-surfaces will engage the pin 107, thereby giving the sleeve a movement longitudinally of the shaft and bringing the ring 111 against the inclined face 112 of the lug 113. Continued turning of the sleeve will force the ring against said inclined face, and thus crowd the shaft to the left, Fig. 1, and carry the gear 26 out of engagement with the gear 27. By the time the gears 26 and 27 are disengaged the pin 107 has been brought against one of the shoulders 106, whereby further turning movement of the sleeve by means of the head 67 operates to turn the shaft 65, and thus rotate the feeding-rolls. When the rolls have been fed into the desired position and the sleeve is released, the spring 108, together with a spring 69, which bears against the shaft 65, operates to bring the parts to their normal position, with the gears 26 and 27 in mesh. It will thus be seen that the carbons may be fed by hand and that in doing so no other movement of the hand is necessary than the natural movement in turning the sleeve by means of its head 67.

I desire to emphasize the fact that no special manipulation of any parts is necessary in order to manually feed the carbons, as the natural movement of the hand of the operator in turning the head 67 in either direction operates, first, to disengage automatically the gear on the shaft 65 from the driving-gear, and thus free the driving-rolls from the clock-train, and, second, to turn the said shaft, and thereby rotate the feeding-rolls.

The spring 69 operates to hold normally the gears 26 and 27 in engagement.

I have also provided the extended end of the shaft 60 with a head or thumb-piece 70, by means of which it may be turned, and to permit the carbon 4 to be manually fed independently of the carbon 3 I have provided some well-known form of friction connection between the shaft 60 and the gear 24, as seen best in Fig. 2, the friction connection being such that normally the rotation of the gear 24 will be transmitted to the shaft 60. When sufficient power is applied to the thumb-piece 70, however, the shaft and roll 7 may be rotated independently of the gear 24.

S indicates any suitable stand by which the lamp may be supported.

While I have herein shown one embodiment of my invention, I desire to state that the invention is not limited to the particular structure shown, as many changes may be made in the arrangement and form of the parts without departing from the spirit of the invention.

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

1. In an electric-arc lamp, carbon supporting and feeding mechanism comprising two successively-arranged freely-rotatable guiding-rolls situated on the same side of the carbon, and each having a V-shaped peripheral carbon-receiving groove, a non-grooved straight-faced feeding-roll situated on the opposite side of the carbon between the two guiding-rolls, and means to rotate said feeding-rolls positively and thus feed the carbons.

2. In an electric-arc lamp, two pairs of successively-arranged guiding-rolls each having a V-shaped peripheral carbon-receiving groove, a yieldingly-mounted non-grooved feeding-roll coöperating with each pair of guiding-rolls, and means to drive positively one feeding-roll, and means to drive the other feeding-roll from the first-named roll.

3. In an electric-arc lamp, two sets of carbon-supporting rolls, each set containing a driving-roll in frictional engagement with the carbon, means to rotate said driving-rolls,

and means to vary the relative surface speed of the active portions of said rolls.

4. In an electric-arc lamp, two carbon-feeding rolls in frictional engagement with the carbons, and means whereby one carbon may be fed at any desired rate within certain limits relative to the other carbon.

5. In an electric-arc lamp, carbon-feeding mechanism including means whereby one carbon may be fed at any desired rate within certain limits relative to the other carbon.

6. In an electric-arc lamp, two carbon-feeding rolls, one of which has a varying diameter, means to positively rotate said rolls, and means to shift the roll of varying diameter on the line of its axis, whereby the relative surface speed of the active portions of the feeding-rolls will be varied.

7. In an electric-arc lamp, two carbon-feeding rolls adapted to engage the carbons, a driving-wheel, gearing connecting said driving-wheel with one of the feeding-rolls, gearing connecting said latter feeding-roll to the other, and a magnet controlling the action of said driving-wheel.

8. In an electric-arc lamp, a pair of guiding-rolls for each carbon, said rolls being mounted in stationary bearings, pivoted arms carrying a feeding-roll to engage one carbon, a second pair of arms carrying a second feeding-roll to engage the second carbon, said second pair of arms being pivoted to the first pair of arms to turn about the axis of the first-named feeding-roll, and means for operating said feeding-roll.

9. In an electric-arc lamp, a plurality of guiding-rolls for each carbon, a pivotally-mounted jointed frame, a feeding-roll carried by said frame at the joint thereof, and adapted to engage one carbon, a second feeding-roll at the end of the frame and adapted to engage the other carbon, a gear rigid with each feeding-roll, said gears meshing together, a gear mounted to turn about the pivotal support for the frame and meshing with the gear rigid with the first feeding-roll, and means to operate said gear.

10. In an electric-arc lamp, a pair of guiding-rolls for each carbon, each of said rolls having a V-shaped peripheral groove, a pivotally-mounted support carrying a feeding-roll to engage one carbon, a second support pivoted to the first support to turn about the axis of said feeding-roll, a second feeding-roll carried by said second support and adapted to engage the other carbon, and means to operate said rolls one through the other.

11. In an electric-arc lamp, two yieldingly-mounted carbon-feeding rolls adapted to frictionally engage the carbons, a pivoted frame, a driving-gear mounted on the axis of the frame, gearing connecting the driving-gear with the feeding-rolls, a magnet to rock the frame, and means whereby the oscillation of the frame gives a movement to the driving-gear.

12. In an electric-arc lamp, two yieldingly-mounted carbon-feeding rolls adapted to engage the carbons, gears rigid with said rolls and meshing together, a pivoted frame, a spring-impelled driving-gear mounted on the axis of the frame, a train of gears including an escapement carried by the frame and meshing with the driving-gear, a magnet to rock the frame, and gears connecting said driving-gear with the gear rigid with one of the feeding-rolls.

13. In an electric-arc lamp, a single magnet having two armatures at the same end thereof, and means whereby the relative movement between one armature and the magnet draws the arc, and the relative movement between the other armature and the magnet regulates the feed of the carbons.

14. In an electric-arc lamp, carbon-feeding mechanism including a spring-impelled driving-gear, a magnet having two armatures at the same end thereof, means whereby the relative movement between the magnet and one armature operates said gear to draw the arc, and the relative movement between the other armature and magnet regulates rotation of said gear.

15. In an electric-arc lamp, carbon-feeding mechanism constructed to feed the carbons toward and from each other and including means whereby one carbon may be fed at any desired rate within certain limits relative to the other carbon, said carbon-feeding mechanism being so constructed that the rate of feed of one carbon relative to the other may be changed while the lamp is burning.

16. In an electric-arc lamp, carbon-feeding mechanism comprising a pair of guiding-rolls and a feeding-roll frictionally engaging each carbon, gearing connecting said rolls whereby one is driven through the other, a frame pivoted at substantially its center of gravity, a magnet to rock said frame, and connections between said frame and one of the feeding-rolls whereby the rocking of the frame operates to feed the carbons.

17. In an electric-arc lamp, carbon-feeding mechanism including a driving-gear, a driven gear normally meshing with the driving-gear, one of said gears being mounted in movable bearings, a handpiece for operating the driven gear, and means whereby the turning of the handpiece operates first to disengage the driven gear from the driving-gear and then turn the former gear.

18. In an electric-arc lamp, carbon-feeding rolls, a driving-gear common to said rolls, a train of gearing connecting said driving-gear to the carbon-feeding rolls, said train including a driven gear meshing with the driving-gear and mounted in movable bearings, a handpiece for turning said driven gear, and means whereby the turning of the handpiece operates first to disengage the driven gear from the driving-gear and then turn said driven gear.

19. In an electric-arc lamp, carbon-feeding mechanism including a driving-gear, a driven

gear normally meshing with the driving-gear, one of said gears being mounted in movable bearings, a handpiece carried on the shaft of the driven gear, and having a limited movement thereabout, and means whereby the turning of the handpiece relative to the shaft of the driven gear operates to disengage said gear from the driving-gear.

20. In an electric-arc lamp, carbon-feeding mechanism including a driving-gear, a driven gear normally in mesh with the driving-gear, one of said gears being mounted in movable bearings, a handpiece for operating the driven gear, and means whereby the turning of the handpiece in either direction operates first to disengage the driven gear from the driving-gear, and then turn the former gear.

21. In an electric-arc lamp, carbon-feeding rolls, a driving-gear common to said rolls, a train of gearing connecting said driving-gear to the carbon-feeding rolls, said train including a driven gear meshing with the driving-gear and mounted in movable bearings, a handpiece for turning said driven gear, and means whereby the turning of said handpiece in either direction operates to first disengage the driven gear from the driving-gear, and then turn said driven gear.

22. In an electric-arc lamp, carbon-feeding mechanism including a driving-gear, a driven gear normally meshing therewith and mounted in movable bearings, a handpiece carried on the shaft of the driven gear and having a limited movement thereabout, and means whereby the turning of the handpiece relative to the shaft in either direction operates to disengage the driven gear from the driving-gear.

23. In an electric-arc lamp, carbon-feeding mechanism including a driving-gear, a driven gear normally meshing with said driving-gear and mounted in movable bearings, a handpiece carried on the shaft of the driven gear and having a limited movement thereabout, said handpiece having a cam-surface, a projection on said shaft coacting with said cam-surface whereby turning movement of the handpiece relative to the shaft gives the former a longitudinal movement on the latter, and a stationary cam projection adapted to be engaged by the handpiece during its turning movement whereby the driving-gear is disengaged from the driven gear.

24. In an electric-arc lamp, carbon-feeding mechanism, including a driving-gear, a driven gear normally meshing with said driving-gear and mounted in movable bearings, a handpiece carried on the shaft of the driven gear and having a limited movement thereabout, said handpiece having cam-surfaces, a projection on said shaft coacting with said cam-surfaces whereby turning movement of the handpiece relative to the shaft in either direction gives the former a longitudinal movement on the latter, and a stationary cam projection adapted to be engaged by the handpiece during its turning movement whereby the driving-gear is disengaged from the driven gear.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

KNUT TORNBERG.

Witnesses:
LOUIS C. SMITH,
JOHN C. EDWARDS.