No. 664,713. Patented Dec. 25, 1900.

R. E. BALL.

ELECTRIC ARC LAMP.

(Application filed Sept. 21, 1899.)

(No Model.) 3 Sheets—Sheet 1

Fig. 1

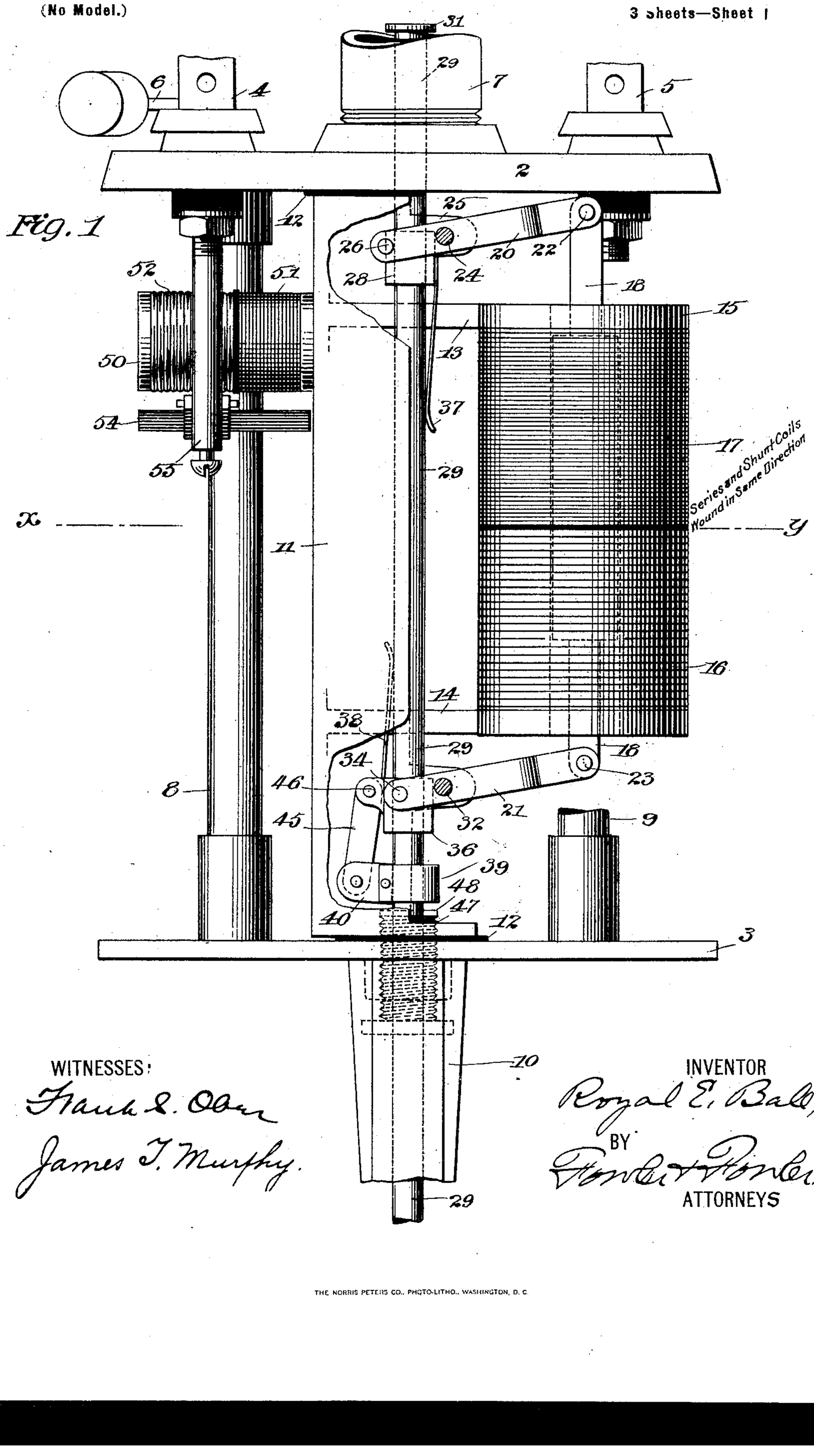

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Fig. 2.

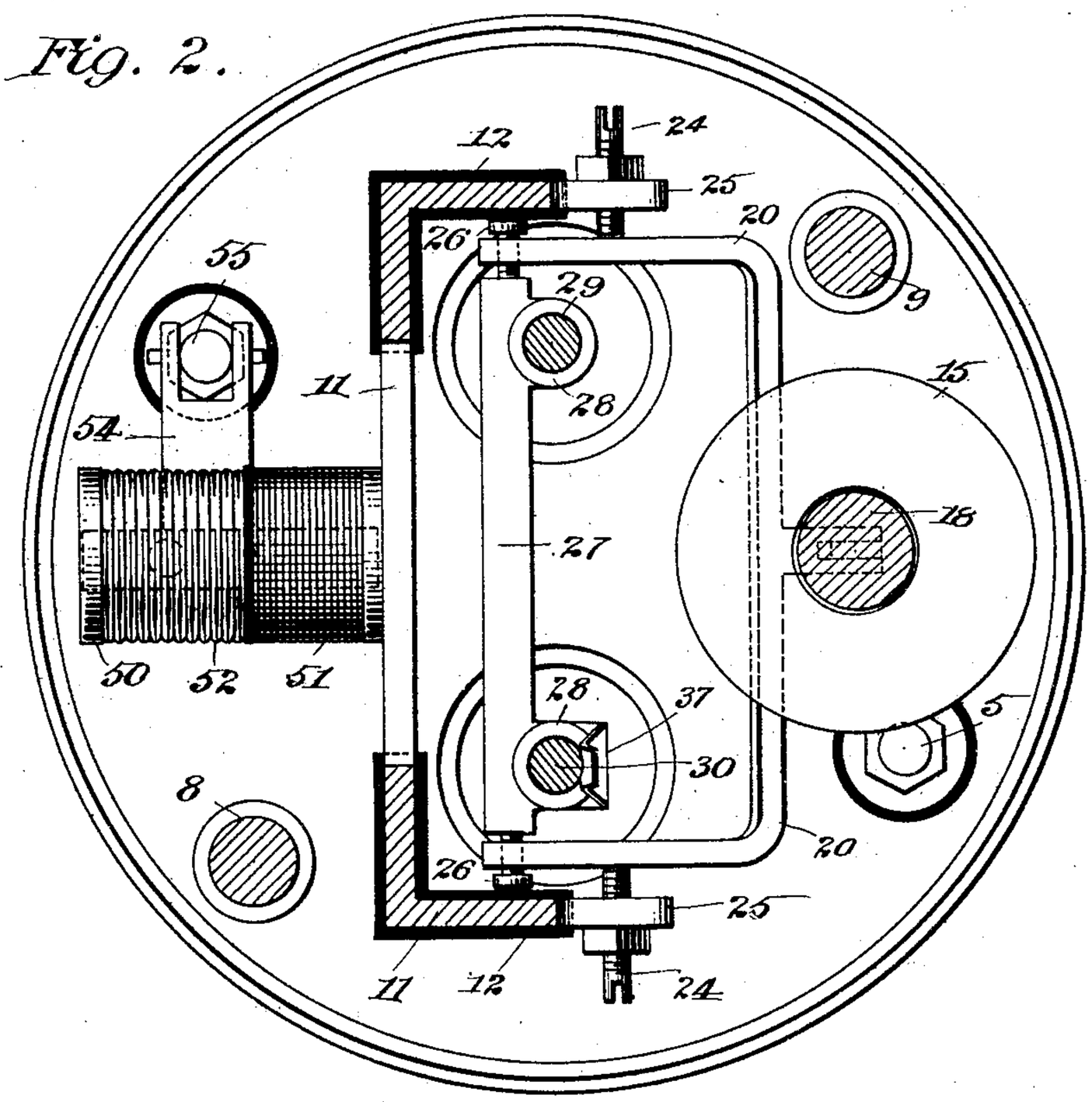
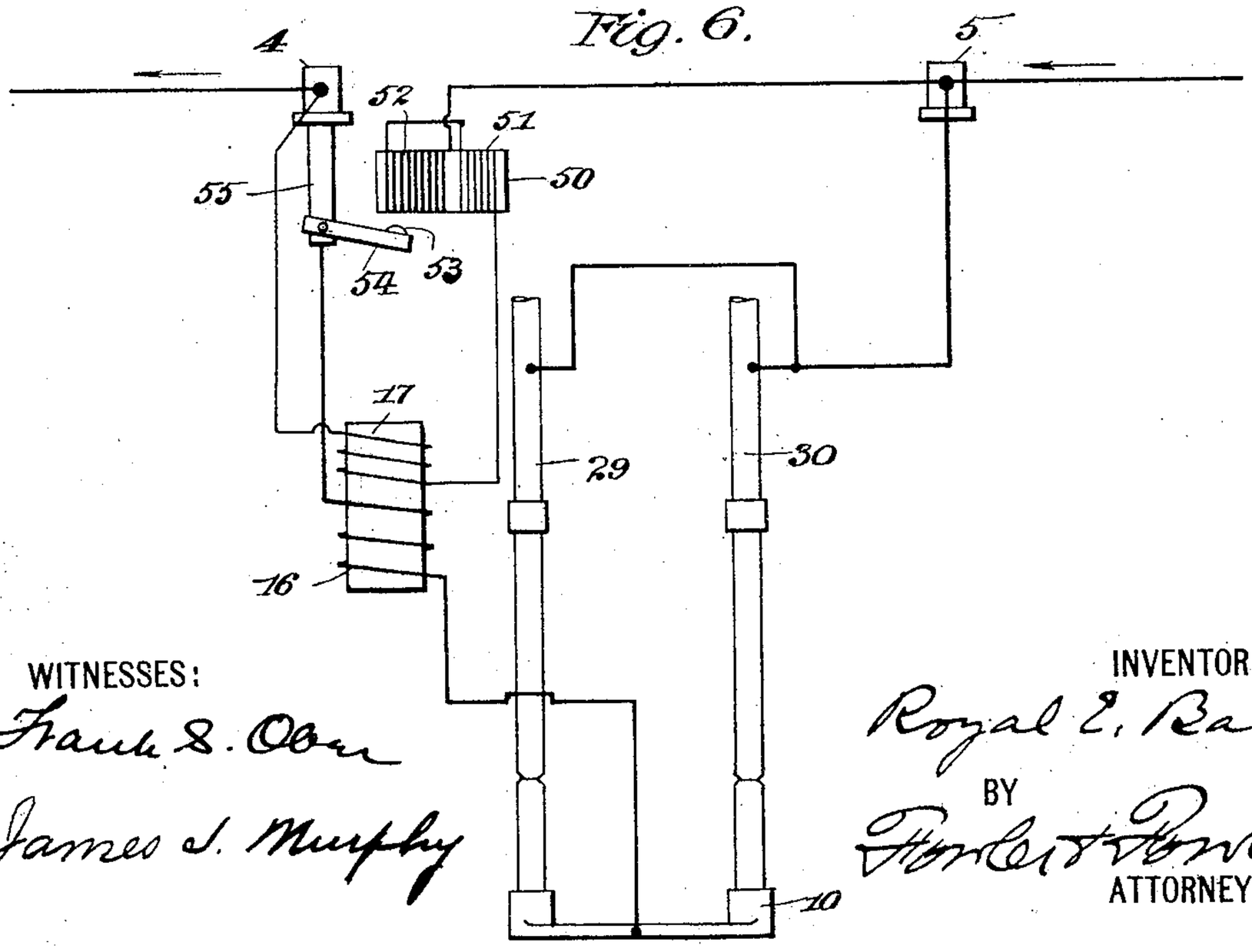


Fig. 6.



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(No Model.) 3 Sheets—Sheet 3.

Fig. 3.

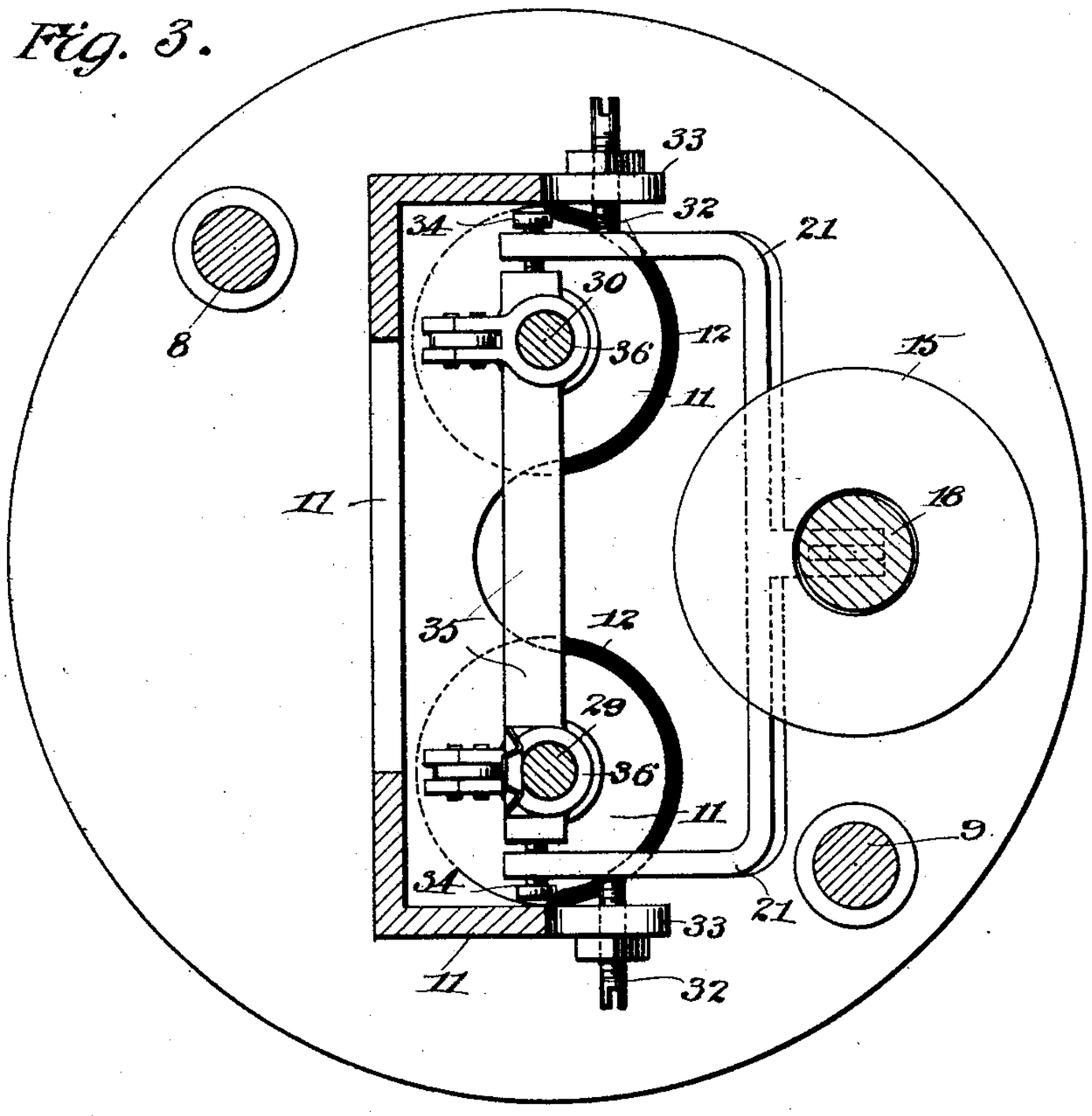


Fig. 4.

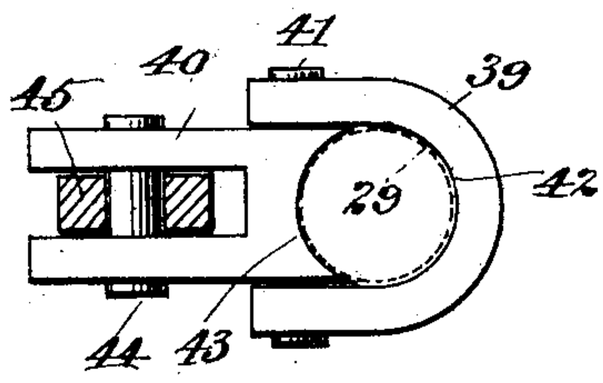
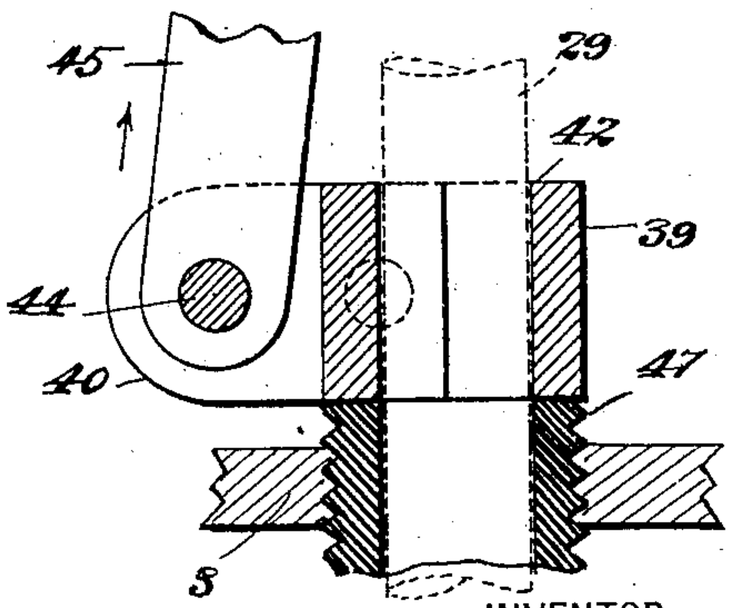


Fig. 5



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ELECTRIC-ARC LAMP.

SPECIFICATION forming part of Letters Patent No. 664,713, dated December 25, 1900.

Application filed September 21, 1899. Serial No. 731,149. (No model.)

To all whom it may concern:

Be it known that I, ROYAL E. BALL, a citizen of the United States, residing at New York city, borough of Manhattan, county and State of New York, have invented certain new and useful Improvements in Electric-Arc Lamps, of which the following is such a full, clear, and exact description as will enable any one skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, forming part of this specification.

My invention relates to electric-arc lamps, and certain features thereof are more particularly applicable to what are known as "duplex" lamps and in which are used two sets of carbons which are burned in succession in a manner well known.

The principal objects of my invention are to reduce the cost of manufacture of the lamp and at the same time increase its efficiency, so that a material saving may be made in the operation of the lamp.

To these ends my invention consists in the various novel and peculiar arrangements and combinations of the several parts of the apparatus, all as hereinafter fully described and then pointed out in the claims.

I have illustrated a type of my invention in the accompanying drawings, wherein—

Figure 1 is a side view of my improved arc-lamp with the upper and lower portions of the frame thereof broken away and with portions of the supporting-bracket for the working parts of the lamp also broken away. Fig. 2 shows a horizontal section of the lamp, taken on a plane indicated by the line $x\ y$, Fig. 1, the view being taken looking upwardly. Fig. 3 is a similar section of Fig. 2, the view being taken looking downwardly. Fig. 4 is an enlarged plan view of one of the clutches for the carbon-rods. Fig. 5 is a vertical central sectional view of the clutch shown in Fig. 4, together with the adjustable trip for opening the clutch. Fig. 6 is a diagram showing the arraugement of the various circuits of the lamp.

Referring to the drawings, in which like numbers of reference designate like parts throughout, 2 and 3 are the top and bottom plates of the lamp. Upon the upper plate 2 are the usual binding-posts 4 and 5, to each of which is connected the line-wire, and 6 is the cut-out switch-lever, which makes contact with the binding-post 4 in the usual way. In each of two circular openings in the top of plate 2 and through which the carbon-rods pass is secured by screw-threads a vertical tube 7 for housing the carbon-rods in the usual manner. The top and bottom plates 2 and 3 are secured firmly together by two standards 8 and 9, which are screwed fast into suitable sockets formed on the top and bottom plates, respectively. From the bottom plate 3 depends the usual frame 10 for supporting the lower carbons.

Between the upper and lower plates 2 and 3 is arranged a peculiarly-shaped supporting bracket or standard 11, which is made fast to each of the plates and is completely insulated therefrom by insulating-pieces 12 12. This bracket is designed to carry all of the working parts of the lamp, and as it is insulated thoroughly from the other parts of the lamp it thereby possesses manifest advantages. This bracket 11 is provided with forwardly-extending horizontal arms 13 and 14, to which are secured the upper and lower ends, respectively, of the spool 15, carrying the main or line-wire coil 16 and the shunt 17, which coils together form a solenoid which is provided with a movable magnetic core 18. Both the line-wire coil 16 and the shunt 17 are wound about the spool 15 in the same direction and are suitably insulated from each other at 19, so that the current flows through both coils in the same direction. This is an important feature of my lamp, as the two coils thus constitute a common solenoid, and the electrical center, which the core 18 seeks, shifts according as the strength of current varies in the shunt and line circuits, respectively. The advantage of this construction is that as both the shunt and line are wound in the same direction instead of opposite ones I obtain a greater magnetizing power of the solenoid, and consequently am able to more nearly saturate the core, and thereby avoid impulsive movements and dispense with the mechanical dash-pots which are so generally used. It will thus be noted that the combined solenoid does not act in the usual differential way—that is, with the current flow-

ing in opposite directions, making the shunt oppose the line and causing the regulating power to depend upon the difference between the two currents.

The bracket-arms 13 and 14 support the combined solenoid in a vertical position and at a considerable distance from both the top and bottom plates 2 and 3, so that there is provided between the plates and the ends of the solenoid ample space for the rocking movements of the horizontal pivoted rockers 20 and 21, the former of which is pivoted at 22 to the upper end of the solenoid-core 18, while the latter is pivoted at 23 to the lower end of the solenoid-core 18. The rockers 20 and 21 are substantially alike in construction, and each comprises a U-shaped frame, from the back of the center of which extends a piece which is pivoted to the end of solenoid-core 18. The upper rocker 20 is pivoted at opposite points of its two sides on the adjustable screws 24 24, which are mounted in fixed ears 25, projecting from the bracket 11. Between the ends of the arms of the upper rocker 20 is pivoted, by means of adjustable screws 26 26, a cross piece or bar 27, which carries near each end a suitable circular guide 28 for receiving the carbon-rods 29 and 30, respectively, each of which carbon-rods is provided with a flange or head 31 on the upper end, which is adapted to rest upon its upper guide when the carbon-rod is dropped to the lowest point of its range of movement, so that the weight of the carbon-rod can then be taken up by the upper rocker 20, for a purpose hereinafter described.

The lower rocker 21 is likewise pivoted at two opposite points of its sides by means of adjustable screws 32 32, which are mounted in fixed ears 33, projecting forwardly from the bracket 11. Between the ends of the rocker 21 there is pivoted, by means of adjustable screws 34 34, a cross piece or bar 35, which carries a circular guide 36 near each end thereof and one in vertical alinement with one of the guides 28 on the upper rocker 20. The carbon-rods each pass through a guide 36, carried by the lower rocker, and a guide 28 on the upper rocker, so that the carbon-rods are thus guided entirely by means of devices mounted upon the moving parts of the lamp, and as the rockers are so constructed as to move in parallelism the upper and lower guides having a pivotal relation with their rockers serve to guide the carbon-rods with the least possible friction. This arrangement prevents any possible binding between the guide and the carbon-rod, and as the friction is materially reduced I am enabled to operate the lamp with less current than I otherwise would be, and consequently use a comparatively small spool for the solenoid 16 17. This results in the lamp being operated more economically, and it can, moreover, be made lighter, more compact, and at smaller cost.

One of the upper guides 28 carries a contact brush or finger 37, which projects downwardly and keeps in firm contact with the carbon-rod 30 for completing the circuit thereto, while one of the lower guides 36 carries a similar contact-brush 38, which projects upwardly and remains in firm contact with the other carbon-rod 29. By thus having the contact-brush mounted on a movable guide I thereby maintain a more perfect contact and at the same time reduce the friction as compared with the construction wherein the contact-brush is attached to a fixed part.

A serious objection to other forms of double-carbon lamps has been that the second carbon burns with a larger light than the first carbon. This drawback is due to the change of adjustment caused by the reduction of weight by the consumption of the first carbon. In my present invention I overcome this drawback and cause the second carbon to burn with the same-sized arc as the first by increasing the amount of leverage exerted upon the moving parts after the first carbon has been consumed, and I lay a broad claim to this feature. In the present construction I accomplish this increased leverage when the second carbon comes into play by making the pivotal centers 24 and 26 of the upper rocker 20 a greater distance apart than the corresponding pivotal centers 32 and 34 of the lower rocker 21. The distance between the pivotal points 24 and 22 of the upper rocker is, however, the same as the distance between points 32 and 23 of the lower rocker. In other words, the long arms of the lever constituted by each of the rockers are the same in length, while the short arms thereof vary, the short arm of the upper rocker being longer than that of the lower. This difference is in about the proportion of four to three. The difference in leverage is brought into play in the following manner: As soon as the current is switched on the weight of both carbon-rods 29 and 30, together with that of the carbons carried by each of them, is thrown upon the lower rocker, because the guides on the lower rocker support the clutches which engage the respective carbon-rods, as hereinafter described. It will be sufficient now to know that the weight of the carbon-rods and carbons combined being transmitted through the clutches to the guides of the lower rocker, such combined weight acts upon such rocker with a certain leverage which is represented by the distance between the pivotal centers 32 and 34. When the first carbon has been consumed, the carbon-rod carrying such carbon is dropped to its lowest limit of movement, so that the head 31 thereof rests upon the upper end of the guide 28, carried upon the short arm of the upper rocker 20. Thus the weight of this carbon-rod is taken off of the lower rocker and transferred to the upper, and such weight is more effectively exerted upon such upper rocker by reason of the leverage of its short arm being greater than the leverage of the short arm of the lower rocker—that is to say, that the distance between the pivotal centers 24 and 26

being greater than the distance between the pivotal centers 32 and 34 of the lower rocker an increased leverage will thereby be brought about, so that the loss of weight due to the consumption of the first carbon is at once compensated for as soon as the second carbon is brought into use.

Each carbon-rod is provided with a clutch consisting in a U-shaped member or strap 39 and a block 40, which is pivoted between the ends of member 39 by means of a pin 41. The interior surface 42 of the strap and the face 43 of the block are curved, so that together they form a circular opening for loosely receiving the cylindrical carbon-rod which they engage. The outer end of the block 40 of the clutch is pivoted at 44 to a link 45, the upper end of which is pivoted at 46 to a projection extending rearwardly from the guide 36. Whenever the link 45 is drawn up by the upward movement of either of the lower guides, the clutch grips the carbon-rod by the surface 42 of the strap engaging the surface of the rod flatly and the upper edge 47 (see Fig. 5) of the face 43 of the block biting into the carbon-rod. Thus the clutching is effected by the two clutching members 39 and 40 being relatively moved, so that their surfaces which engage the carbon-rods are thrown out of parallel. This form of clutch has the advantage of presenting to the carbon-rods a large flat surface—namely, surface 42 of the strap—which causes the carbon-rod to move with a smoother action through the clutch than where sharp edges of the clutch member are presented to the rod, for it is well known that any rough place on the carbon-rod will effect its smooth operation whenever the same is presented to the sharp edge of a clutch member. The clutch is opened or released by lowering the clutch, so that the strap or block touches a fixed part and rights the two pivoted members of the clutch, so as to bring them parallel. This is done in the present construction whenever the descending guide lowers the link 45 sufficiently to let the clutch touch a trip device 47, arranged beneath it. This trip device consists in an externally-screw-threaded sleeve 47, screwed upwardly through the bottom plate 3 of the lamp, and is adjustable vertically to trip the clutch at the proper time. This trip-sleeve 47 surrounds the carbon-rod, and there is one for each clutch, and they are set at different heights, as shown at 47 and 48 in Fig. 1, 47 representing the trip-sleeve of the clutch nearest the observer, while 48 represents that of the clutch farthest away. The trip device of one clutch is set at such a height as to open the clutch to its greatest degree when the two carbon-rods are down and the carbons closed on each other, as shown in the diagram in Fig. 6, while the trip of the other clutch is set higher, so that such clutch is open to a less degree as compared with the other. Under this condition when the current is turned on and passes through both sets of carbons while they are closed the solenoid-core 18 is drawn downwardly in the position shown in Fig. 1, thereby raising the short ends of the rocker and lifting the guides, and consequently pulling up the clutches, which do not at once engage both carbon-rods, one carbon-rod being engaged in advance of the other by virtue of the difference in vertical adjustment of the trips 47 and 48. The carbon first raised produces a longer arc, so that the carbon last raised retains its arc and continues to burn, while the other does not, and so becomes the first carbon to be consumed. As the lamp proceeds to regulate the arc now established the clutch of the carbon first raised is lifted so far above its trip that it cannot be tripped so long as there remains any of the first-burning carbon. As soon, however, as the first carbon is consumed the clutch of the second carbon is carried down so far as to be tripped and opened, thereby regulating the arc.

Upon the back of the bracket 11 is secured by one end a small cut-out magnet, which comprises an iron spool 50, around which is wound a fine coil 51, which leads from the fine-wire coil 17 of the solenoid, and a coarse coil 52, which is connected through binding-post 5 direct to line by one end, while the other end is connected to the fine-wire coil 51. Both the fine-wire coil 51 and the coarse coil 52 are wound around the spool 50 in the same direction, so that the current passes through each in the same direction about the magnet. A portion of the outer coils of the coarse wire is laid bare for making electrical contact with the contact point or button 53, carried on armature 54, which is pivoted to and electrically connected with a depending post or arm 55, which is insulated from the lamp-frame. The depending arm 55 is electrically connected with the binding-post 54, and therefore with the line-wire. When the iron spool of the cut-out magnet is magnetized by the passage of current through the coils surrounding it, the ends of the spool serve to attract the armature 54, and this closes the circuit from binding-post 5 through the coarse coil by way of the bared exterior thereof and contact-point 53, armature 54, and depending arm 55 to line by way of binding-post 4, thus serving to cut out the lamp.

My invention is not limited to the particular means herein set forth, as various modifications may be made in the several parts thereof without departing from the spirit of the invention.

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

1. An electric-arc-lamp comprising the combination of two carbon-rods, feeding mechanism for said carbon-rods provided with two separate levers one of which has a greater leverage than the other and the lever having

the lesser leverage normally sustaining the weight of the carbon-rods during the burning of the first carbon, and means for transferring to the lever having the greater leverage, when the first carbon has been consumed, part of the weight sustained normally by the lever having the lesser leverage, whereby the loss of weight due to the consumption of the first carbon is compensated for by the increased leverage thrown upon the feeding mechanism, substantially as and for the purpose set forth.

2. An electric-arc lamp comprising the combination of two carbon-rods, feeding mechanism for the carbon-rods comprising two separate rockers one of which has a greater leverage than the other, the weight of the carbon-rods and carbons being sustained by the rocker having the lesser leverage until the first carbon is consumed, means for transferring the weight of the carbon-rods carrying the carbon first consumed to the rocker having the greater leverage, whereby the loss of weight of the consumed carbon is compensated for by the increased leverage exerted by its carbon-rod on the feeding mechanism, substantially as and for the purpose set forth.

3. An electric-arc lamp having carbon-feeding mechanism comprising a solenoid and its core, said solenoid consisting in a spool having the line and shunt circuit wound on the respective ends thereof and in the same direction so that both the line and shunt currents flow around the spool in the same direction, whereby the position of the magnetic core is determined by the variation in the strength of the line and shunt currents, substantially as and for the purpose set forth.

4. The combination of a carbon-rod and feeding mechanism therefor comprising a vertically-moving rocker and a solenoid for actuating said rocker, a guide for said carbon-rod pivoted to said rocker, and a feed-clutch for said carbon-rod consisting in a strap embracing the carbon-rod, a clutch-block pivoted to said strap for engaging the carbon-rod, and a link pivoted between said clutch-block and the rocker, substantially as and for the purpose set forth.

5. An electric-arc lamp comprising the combination of a carbon-rod, movable feeding mechanism for said carbon-rod, a pivoted guide for said carbon-rod mounted upon said movable mechanism, and a contact-brush carried by said guide, substantially as and for the purpose set forth.

6. An electric-arc lamp consisting in the combination of a carbon-rod, feeding mechanism comprising a solenoid and its core, a rocker fulcrumed on a fixed point and having one end pivoted to the core of the solenoid, and a guide for said carbon-rod pivoted to the other end of the rocker, a second rocker pivoted to said core of the solenoid and provided with a guide for said carbon-rod, a feed-clutch for said carbon-rod mounted upon the guide of said second rocker, substantially as and for the purpose set forth.

7. An electric-arc lamp consisting in the combination of a carbon-rod, feeding mechanism for the carbon-rod comprising a solenoid and its core, an upper and a lower rocker fulcrumed on a fixed point and each having one end pivoted to the solenoid-core, a guide pivoted to the other ends of said rockers for receiving the carbon-rod, substantially as and for the purpose set forth.

8. An electric-arc lamp consisting in the combination of two carbon-rods, feeding mechanism comprising a solenoid and its core, an upper and lower rocker moving in parallelism and each having its long arm pivoted to the end of the solenoid-core, a bar pivoted across the short arm of each rocker and two guides secured to each of said bars for receiving the carbon-rods and holding them in alinement, substantially as and for the purpose set forth.

9. An electric-arc lamp consisting in the combination of two carbon-rods, a solenoid and its core, an upper and a lower rocker pivoted so as to move in parallel and each having its long arm pivoted to the solenoid-core, a pair of guides pivoted to the upper rocker and a pair of guides pivoted to the lower rocker in alinement with each other, the pair of guides on the upper rocker being pivoted thereon at a greater distance from the fulcrum of the rocker than the pair of guides on the lower rocker, and means for transferring the weight of the carbon-rod carrying the carbon first consumed to its guide on the upper rocker, substantially as and for the purpose set forth.

10. An electric-arc lamp consisting in the combination of a carbon-rod, a solenoid and its core, an upper and a lower rocker pivoted so as to move in parallel and each having an arm pivoted to the solenoid-core, a guide for the carbon-rod mounted on the other end of each of said rockers, a clutch for the carbon-rod, said clutch being connected with and carried by the said guide on the lower rocker, substantially as and for the purpose set forth.

11. The combination of the upper and lower frame-plates of an electric-arc lamp, said plates being secured together for containing the working parts of the lamp between them, a single supporting-standard secured to each of said frame-plates and insulated therefrom, feeding mechanism comprising a solenoid and its core, said standard being provided with horizontal arms for supporting the solenoid in operative position, substantially as and for the purpose set forth.

In testimony whereof I have hereunto set my hand in the presence of the two subscribing witnesses.

ROYAL E. BALL.

Witnesses:
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