G. K. HARTUNG.

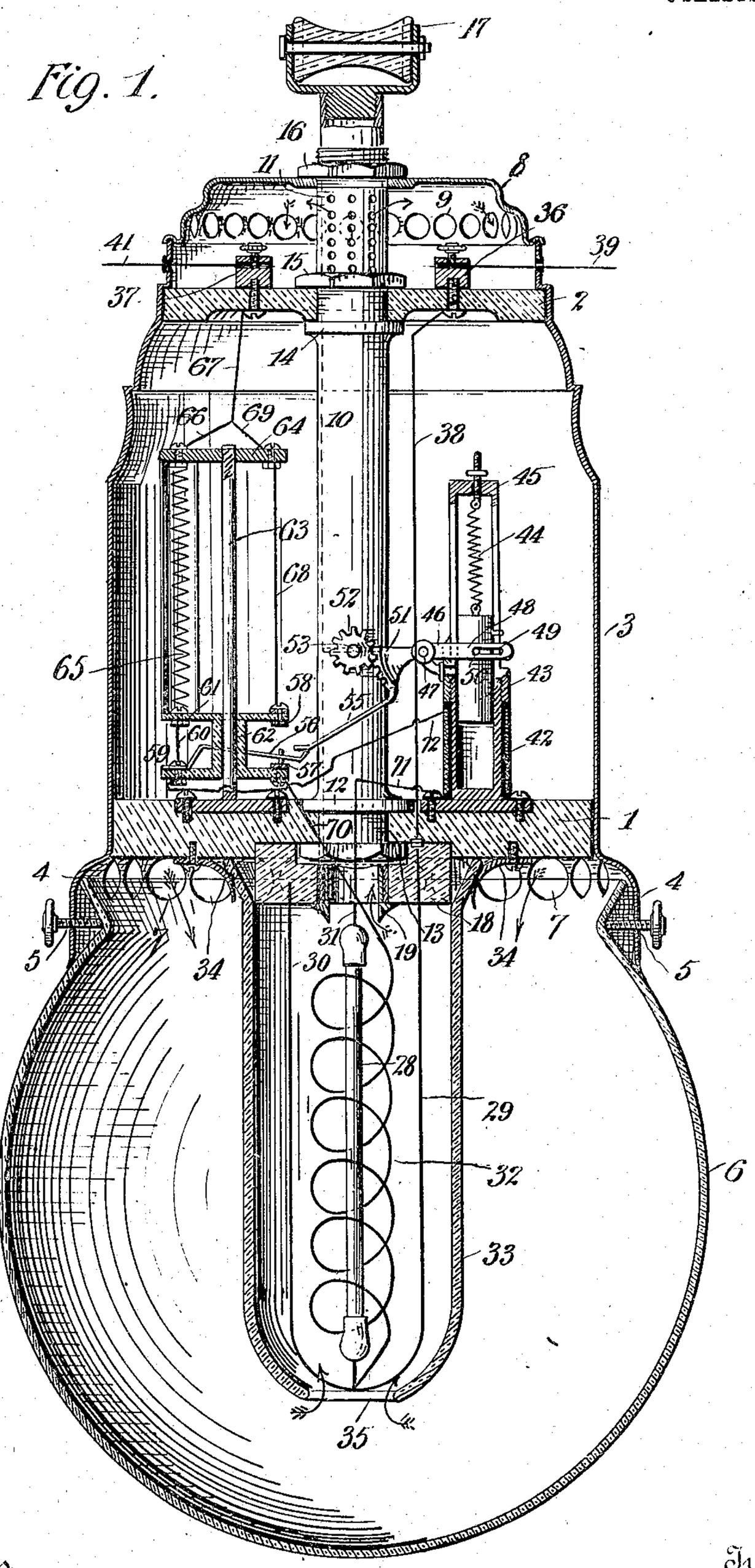
ELECTRIC GLOW LAMP.

APPLICATION FILED MAY 27, 1904.

930,958. Patented Aug. 10, 1909.

6 SHEETS—SHEET 1.

Fig. 1.



Witnesses
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6 SHEETS—SHEET 2.

Fig. 2.

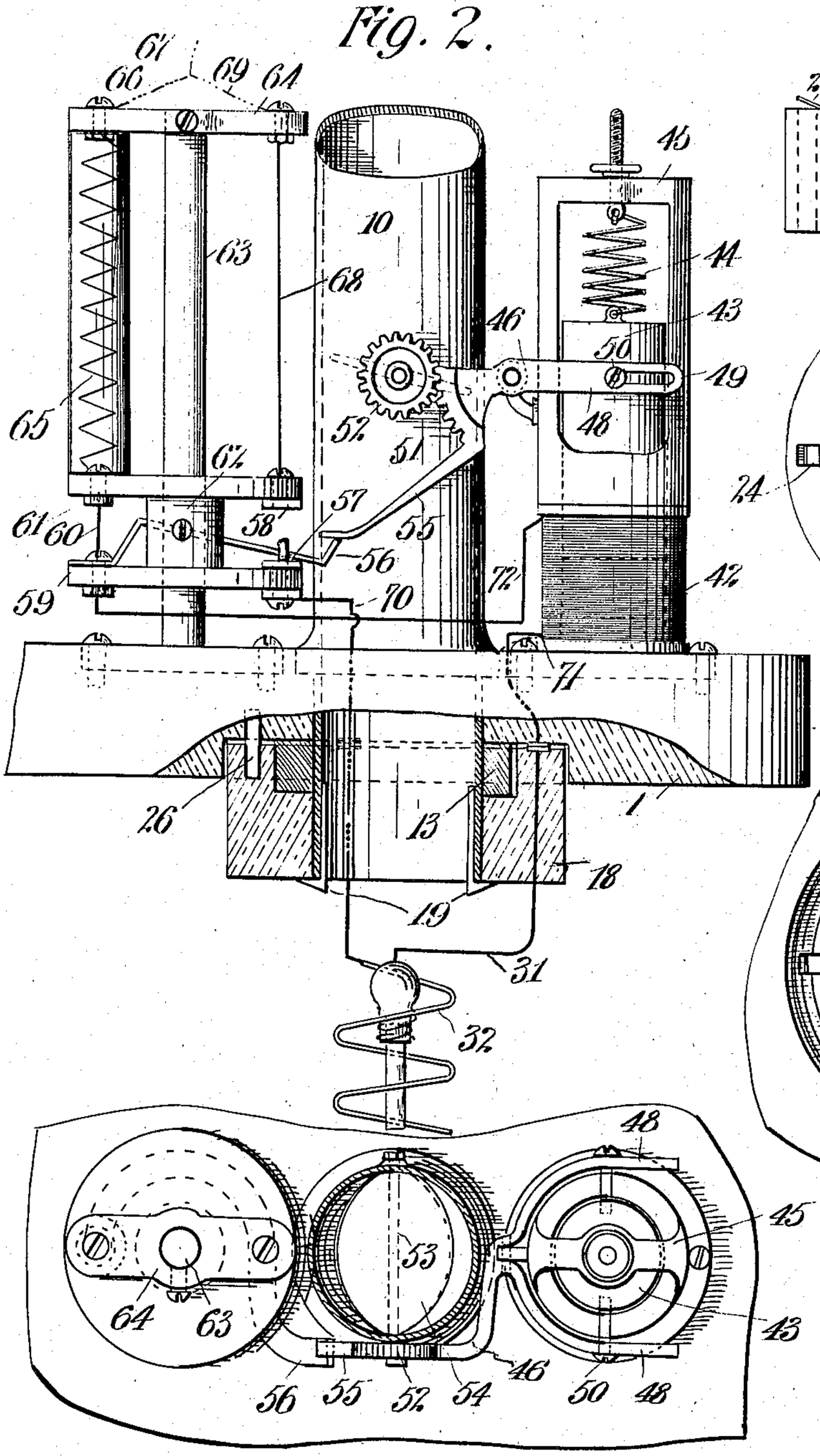
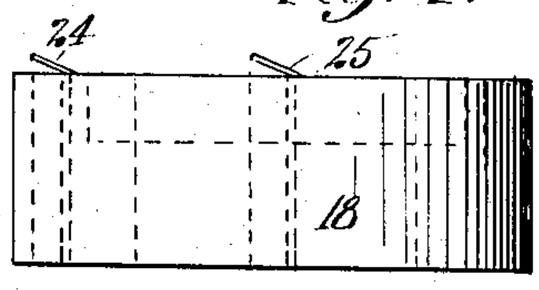


Fig. 3.

Fig. 4.



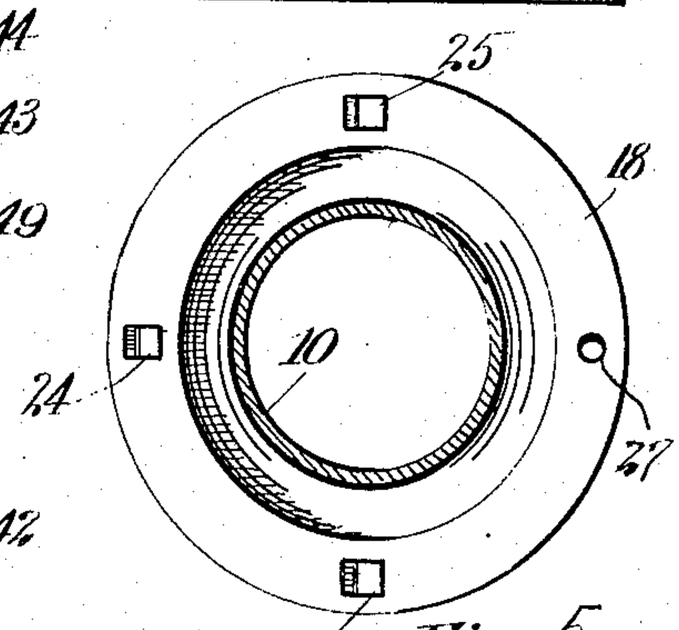


Fig. 5.

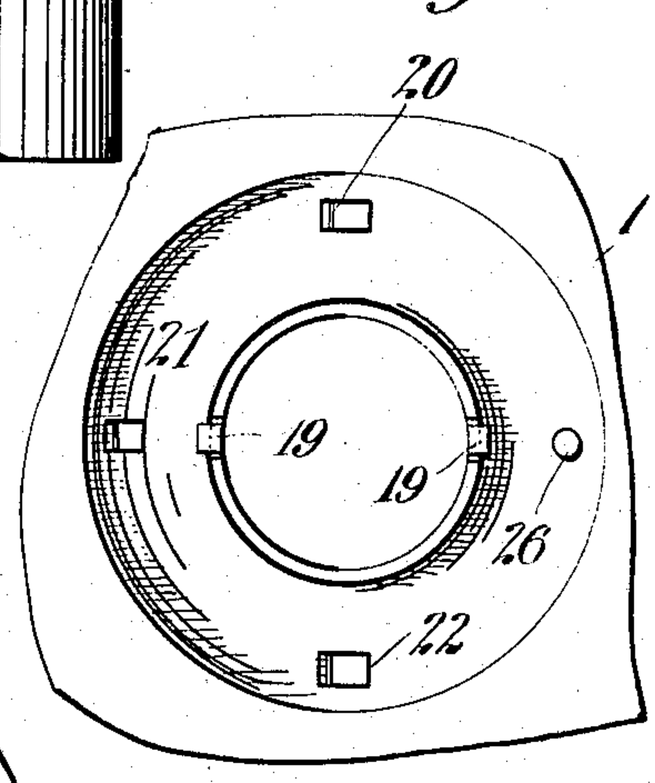


Fig. 6.

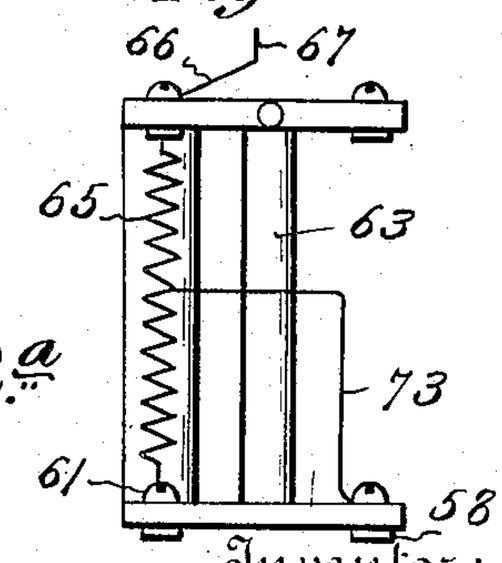


Fig. 2a.

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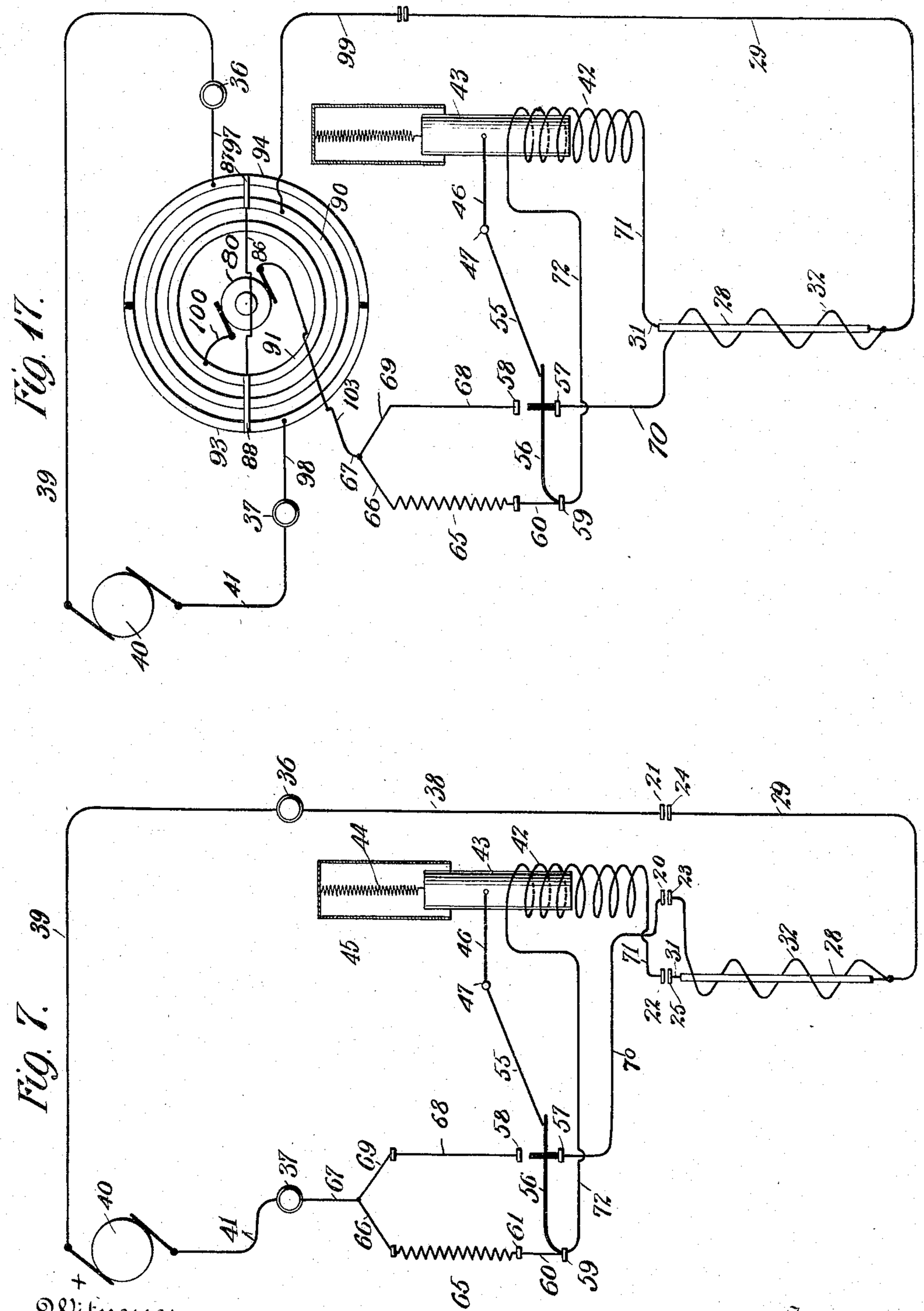
6 SHEETS—SHEET 3.

Fig. 17.



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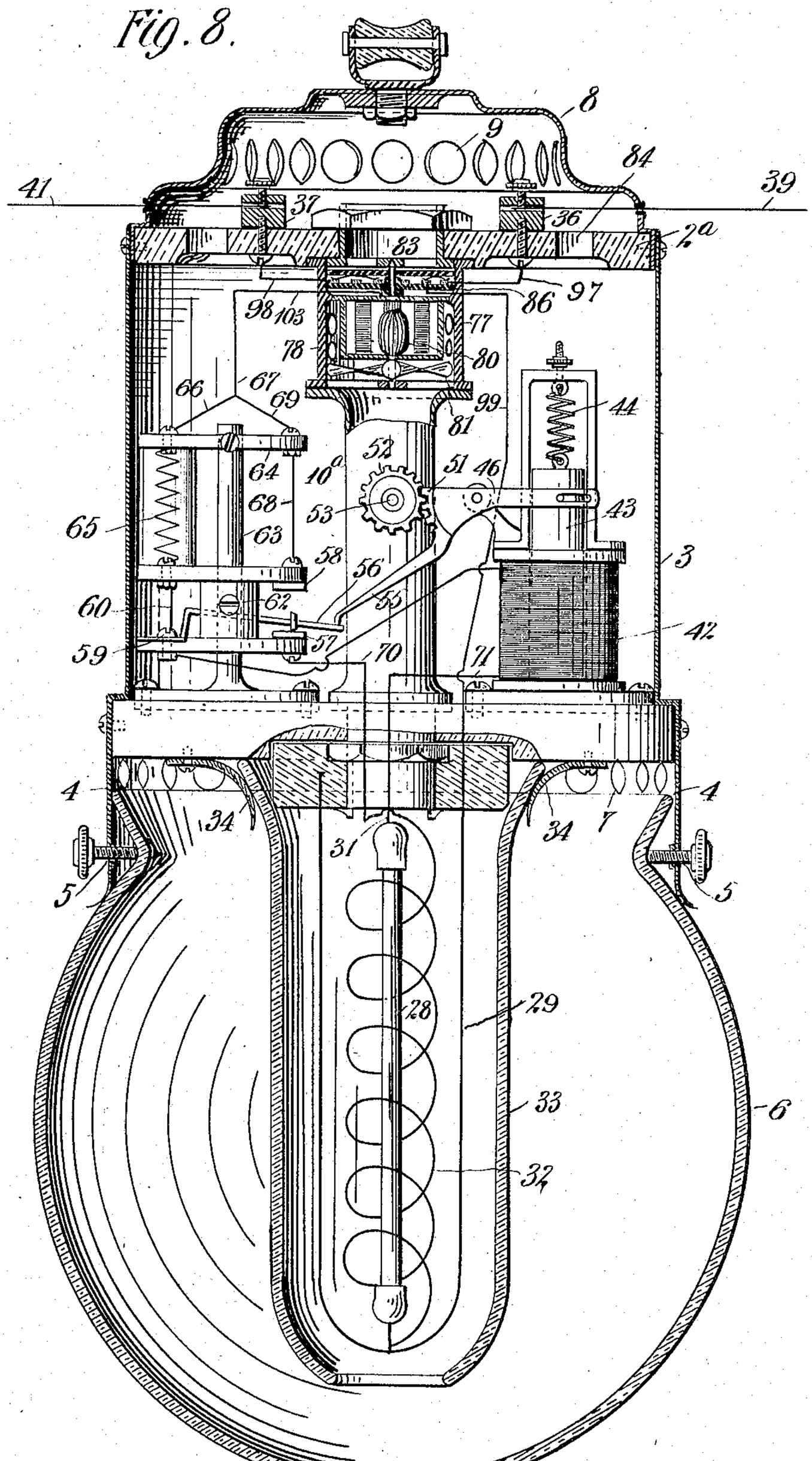
6 SHEETS—SHEET 4.

Fig. 8.



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6 SHEETS—SHEET 5.

Fig. 9.

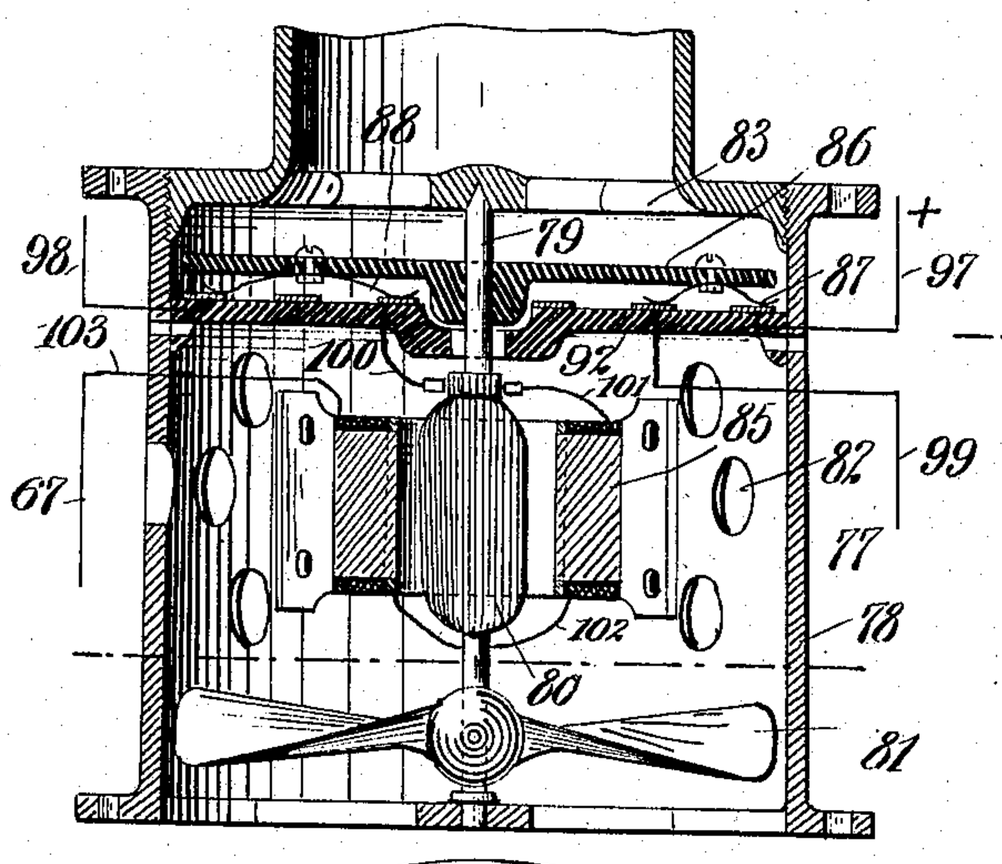


Fig. 10.

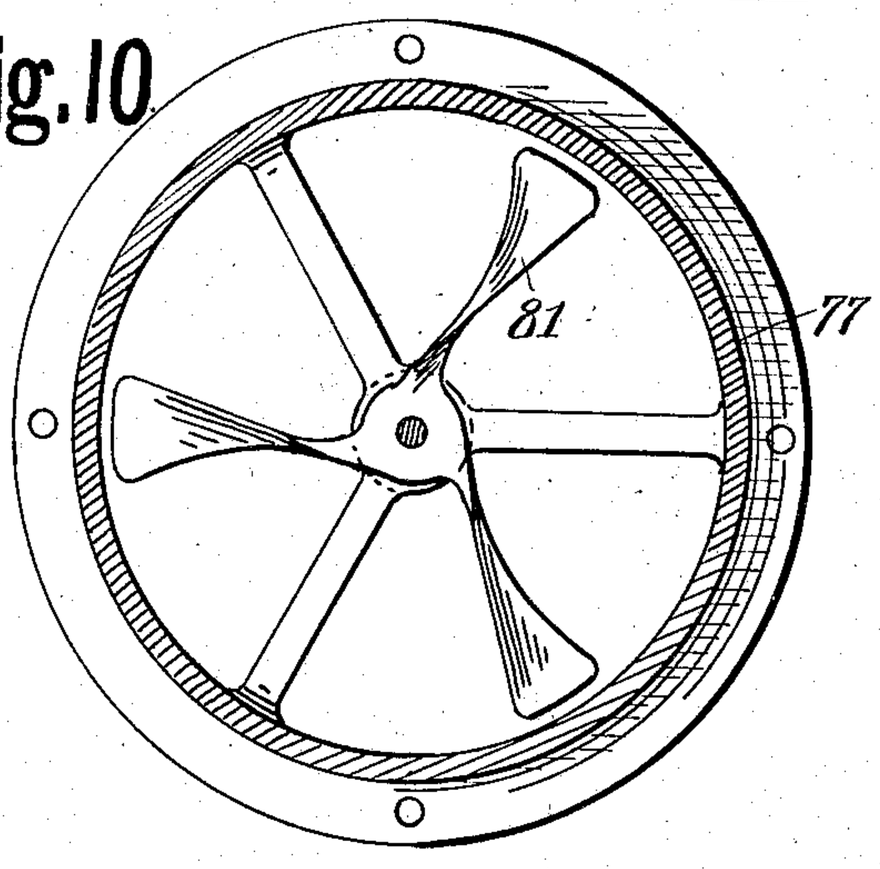


Fig. 11.

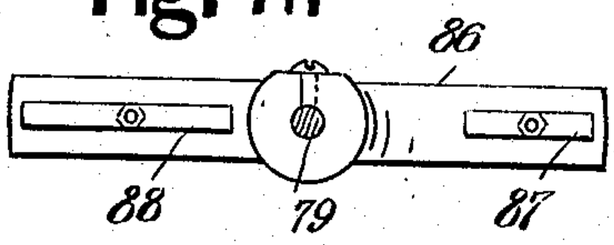


Fig. 12.

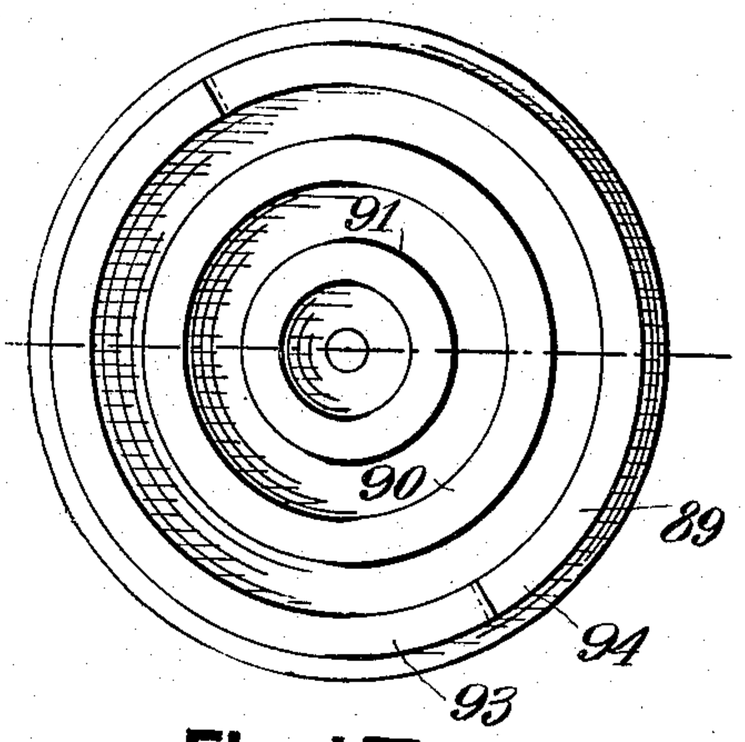


Fig. 13.

Fig. 14.

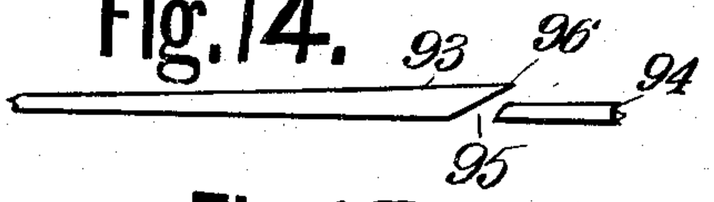


Fig. 15.

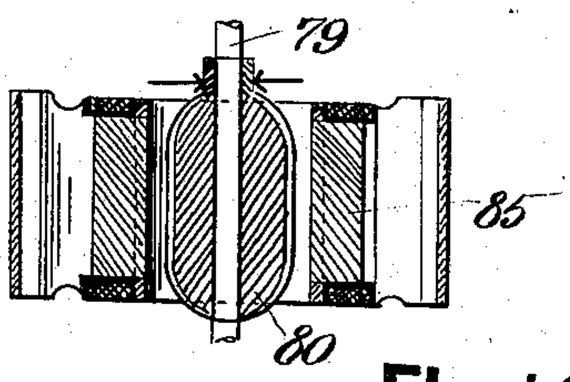
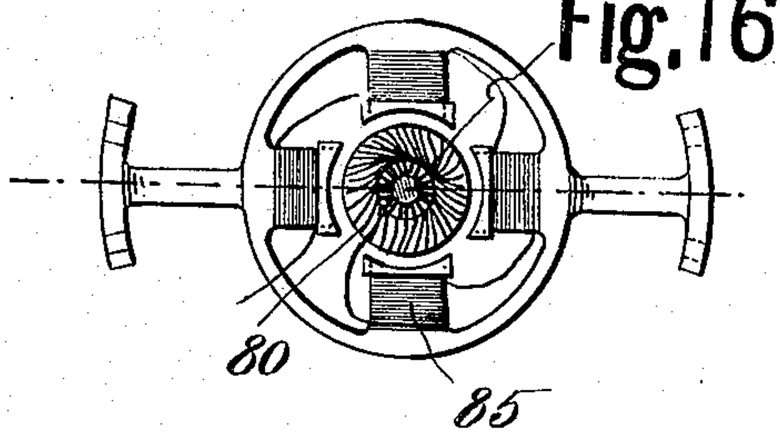


Fig. 16.



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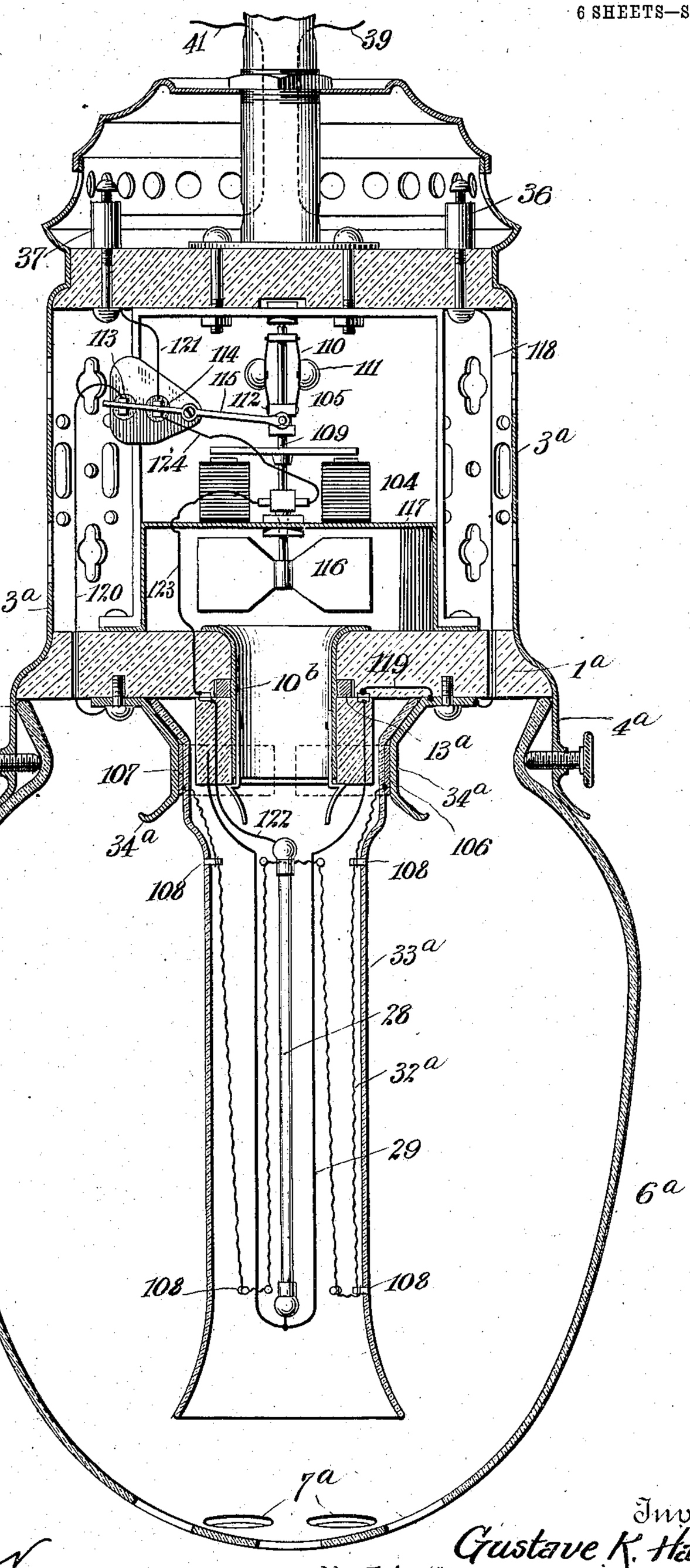
6 SHEETS—SHEET 6.

Fig. 18.



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UNITED STATES PATENT OFFICE.

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ELECTRIC GLOW-LAMP.

No. 930,958. Specification of Letters Patent. Patented Aug. 10, 1909.

Application filed May 27, 1904. Serial No. 210,042.

To all whom it may concern:

Be it known that I, GUSTAVE K. HARTUNG, a subject of the Emperor of Germany, residing at the city of New York, in the borough of the Bronx and State of New York, have invented certain new and useful Improvements in Electric Glow-Lamps, of which the following is a full, clear, and exact description.

In electric glow lamps, of the Nernst type, in which the glower or light-emitting element consists of a conductor of the second class, generally made of a mixture of the oxids of the rarer earths, it is commonly recognized that the life of the glower is of very limited duration and that its life is very materially shortened by increases in the voltage of the current to which it is subjected. This is due to the fact that with an increase in the voltage, the glower becomes more highly heated and consequently more conductive, and offers less resistance to the current. The rise in temperature of the glower beyond its critical point, is what causes the destruction thereof. Various means have been suggested for overcoming this difficulty, prominent among which is the introduction into the circuit, in series with the glower, of a resistance or ballast which is intended to serve as a compensating device for protecting the glower from the destructive effects of the rise in temperature caused by an increase in the voltage of the current to which the glower is subjected. This ballast is generally supposed to care for an increase of about 5% in the voltage; consequently if the increase is greater than 5%, or that which the ballast is able to care for, the excess passes through the glower with the destructive effect referred to. In addition to the inefficiency of this resistance or ballast, a waste of current is caused by its use, which is generally estimated at about 20%. Furthermore with the old form of apparatus, the variations in the voltage will cause variations in the candle power of the lamp.

The purpose of my invention is to overcome the objections enumerated, the main objects of the same being to increase the life of the glower by the provision of means for automatically maintaining it at a constant or uniform temperature, to avoid the waste of current which is consumed in the resistance or ballast now employed in series with the glower, and to maintain a constant candle power, notwithstanding variations in the voltage on the circuit. These results may be obtained by creating a current of air in the lamp around and in contact with the glower and automatically regulating the amount of this current, in accordance with variations in the voltage of the electric current. This serves to regulate the temperature of the glower by counteracting the heating effect of the electric current thereon. That is to say, when the voltage increases, the increase in heat which would ordinarily occur, is absorbed or prevented by the air current, and the temperature and resistance of the glower are maintained constant.

My invention may be carried out in various ways and I have illustrated in the accompanying drawings certain forms of apparatus which are at the present time preferred by me. It will be obvious, however, that the invention may be carried into effect by other forms and arrangements of instrumentalities than those shown.

In the drawings referred to: Figure 1 is a vertical sectional view of an electric glow lamp, illustrative of my invention; Fig. 2 is an elevation, partly in section, of portions of the same; Fig. 2[a] is a detail view of a modification; Fig. 3 is a plan view of the parts shown in Fig. 2; Fig. 4 is a side elevation of a block upon which the glower and heater are carried; Fig. 5 is a top plan view of the same, showing the air tube or conduit which extends therethrough, in section; Fig. 6 is a bottom plan view of Fig. 2, with the supporting block for the glower and heater removed; Fig. 7 is a diagrammatic view, showing the circuit connections; Fig. 8 is a view similar to Fig. 1, showing a modified construction; Fig. 9 is an enlarged sectional view of the motor employed in the construction shown in Fig. 8; Figs. 10, 11, 12, 13, 14, 15 and 16 are enlarged detail views of the parts shown in Fig. 9; Fig. 17 is a diagrammatic view, showing the arrangement of the circuits employed in the construction shown in Fig. 8, and Fig. 18 is a vertical sectional view of another modified construction.

Like reference numerals indicate like parts in the different views.

As heretofore stated, it is the purpose of my invention to maintain the glower at a substantially uniform temperature and to maintain the candle power of the lamp constant, while at the same time dispensing with the ballast or resistance in circuit with the glower while the lamp is in operation. This

is accomplished by providing means for causing a current of air, or other cooling medium, to pass around and in contact with the glower, the volume of the air current being automatically varied in accordance with variations in the potential of the electric current. That is to say, if the potential of the current increases, which action would, under ordinary conditions, increase the heat and conductivity of the glower, the volume or amount of the air current passing over and in contact with the glower, is increased, with the result that the temperature of said glower is not allowed to rise. Likewise, when the potential of the current decreases, which action would ordinarily cause a decrease in the heat of, and an increase in the resistance of, the glower, the air current around and in contact with the glower is cut off or diminished, with the result that the temperature of the glower is not allowed to fall and the resistance offered thereby remains unchanged. The candle power of the glower is thus maintained constant, there is no loss or waste of current in the needless resistance or ballast in circuit with the glower, and the life of the glower is increased by not subjecting it to destructive variations of temperature.

The lamp shown in Figs. 1 to 6 of the drawings, comprises a base-piece 1 of porcelain or other suitable insulating material, a disk 2 of similar material, and a metallic casing 3 connected in any suitable manner to the base-piece 1 and the disk 2, the lower end of said casing being flared and extended downwardly below the base-piece 1 to form the flanges 4. The said flanges with the screws 5 extending therethrough, serve as the means for securing in place an outer globe 6, of ordinary con struction, and said flanges are provided with the openings 7 for the admission of air, for a purpose to be described later. Secured to the upper end of the casing 3 is a metallic cap or cover 8, provided with openings 9 for the escape of air, and extending through the cap 8, the disk 2 and the base-piece 1, is a tube or conduit 10. The lower end of the tube or conduit 10 is open and the upper end thereof is provided with a series of perforations 11 for the escape of air from the interior. The said tube is secured to the base-piece 1 by means of a shoulder 12 and a collar 13, these two parts being located on opposite sides of said base-piece, and the said base-piece is provided with a central opening for the passage of said tube. The tube 10 is secured to the disk 2 in a similar manner, that is, by means of the shoulder 14 and the collar 15. The upper end of the tube 10 projects through a central opening in the cap 8, when the parts of the device are assembled, and said cap is secured in place upon the upper end of the casing 3 by means of a nut or collar 16. From the foregoing description it will be seen that the base-piece 1, the disk 2, the casing 3 and the tube 10 are all permanently connected together, and that the cap 8 may be readily removed or disconnected for the purpose of obtaining access to the interior of the casing. A hanger 17 by means of which the lamp may be supported, has been shown as screwed into the upper projecting end of the tube 10.

The bottom wall of the base-piece 1 is shown as provided with a circular recess for the reception of a block 18 of insulating material, and the upper surface of said block, is provided with a recess for the reception of the nut or collar 13 heretofore referred to. The lower end of the tube 10 is provided with spring hooks 19 for the purpose of holding the block 18 in position. The lower surface of the base-piece 1 within the recess referred to, is provided with a series of contact springs 20, 21 and 22, and the upper surface of the block 18 is provided with similar contact springs 23, 24 and 25, the said springs being so disposed that when the block 18 is properly connected up with the base-piece 1, electrical connection will be formed between the springs 20 and 23, 21 and 24, and 22 and 25. To insure the proper registration of these contact springs one with the other, a pin 26 is secured to, and projects downwardly from, the base-piece 1, which is adapted to fit within an opening 27 in the block 18. To the block 18 is connected the glower 28, the same being supported in position by the wires 29 and 30, the wire 29 serving, during the operation of the lamp, as a conducting wire, the same being connected to the contact spring 24 on the block 18. The wire 30 serves merely as a supporting wire, the same being embedded in, or otherwise secured to, the block 18 at its upper end. From the extreme upper end of the glower 28, leads a wire 31 to the contact spring 25. Leading from the wire 29 at a point adjacent to the connection of the latter with the glower 28, is a wire 32 which surrounds said glower and constitutes a heater therefor; the upper end of the wire 32 is connected to the contact spring 23. The inner globe 33 of the lamp is connected to the base-piece 1 in any suitable manner, as by the spring clips 34, the same surrounding the glower and its heater and provided with an opening 35 at its lower end. It will be seen from the foregoing that the globe 33 may be readily removed, when desired, and also that the block 18 with the glower 28 and the heater 32, may be readily disconnected from, and reconnected to, the base-piece 1 which forms part of the body of the lamp.

Secured to the disk 2, heretofore referred to, are the binding posts 36 and 37, the same constituting the terminals of the lamp. From the binding post 36 leads a wire 38 to the contact spring 21 on the base-piece 1. Also connected with the binding post 36, is a

wire 39 leading from the positive pole of the generator 40 or other suitable source of current supply. A wire 41 leads from the other pole of said generator to the binding post 37.

Mounted upon the upper side of the base-piece 1 is a solenoid 42, whose core 43 is supported upon a spring 44 attached to a yoke or bracket 45. Connected with the core 43 is a lever 46, the same being fulcrumed at 47 upon a suitable support and having a forked end, the branches 48 of which embrace the core 43 and are connected to said core through elongated slots 49 in said branches by pins or screws 50 projecting outwardly from said core. The lever 46 is provided with a segmental rack 51 which meshes with a pinion 52 secured to the end of a shaft 53, extending through the air tube or conduit 10 and having a damper 54 thereon. The said damper 54 is located within the tube 10 and is adapted to control the area of the passage through said tube. When the parts of the device are in their normal positions, that is, when there is no current flow through the lamp, the damper 54 is horizontally disposed and forms a complete obstruction to the passage through the tube 10. When, however, the lever 46 is rocked, the damper 54 is turned, through the action of the rack 51 on the pinion 52, to open or partially open the passage through said tube. Secured to, and carried by, the lever 46 beyond the rack 51, is an arm 55 which bears against an upwardly, spring-pressed switch lever 56 movable between the contacts 57 and 58. The switch lever 56 is connected to a contact 59, which, in turn, is connected through the wire 60 with the contact 61. The contacts 57 and 59 are mounted upon the lower flange of a supporting spool 62, of insulating material, and the contacts 58 and 61 are mounted upon the upper flange of said spool. The said spool is itself secured to, and supported from, an upright or standard 63 rising from the base-piece 1 and the upper end of said standard has connected to it a cross-piece 64. Extending between the spool 62 and the cross-piece 64 is a resistance coil 65, the same being connected at its lower end to the contact 61 and at its upper end through the wires 66 and 67 with the binding post or terminal 37. Also extending between the spool 62 and the cross-piece 64, is a wire 68 which is connected at its lower end with the contact 58 and its upper end, through the wire 69 and the wire 67, with the binding post or terminal 37. Leading from the contact spring 20 on the base-piece 1, to the contact 57, is a wire 70; leading from the contact spring 22 on the base-piece 1, to the solenoid 42, is a wire 71, and leading from the solenoid 42 to the contact piece 59, is a wire 72.

Constructed as above described, the operation of this form of my invention is as follows: When the current is first turned on to the lamp, the parts are in the positions shown in Figs. 1, 2 and 7 of the drawings; that is, the core of the solenoid 42 is raised, the damper 54 occupies a position directly across the tube 10 and the switch lever 56 is in contact with the contact piece 57. The flow of current is then over the following path: generator 40, wire 39, binding post 36, wire 38, contact springs 21 and 24, wire 29, heater 32, contact springs 23 and 20, wire 70, contact 57, switch lever 56, contact 59, wire 60, contact 61, resistance coil 65, wires 66 and 67, binding post 37 and wire 41 back to generator. The heater 32 is now in operation, and in a short period of time raises the glower 28 to such temperature as to render the same conductive. When this temperature is reached, there is a short period of time when the current between the wire 29 and the contact 59 will divide over the path last traced, which includes the heater 32, and over the following path: glower 28, wire 31, contact springs 25 and 22, wire 71, solenoid 42 and wire 72. As soon as the solenoid 42 is energized, however, by the flow of current therethrough, the core 43 thereof will be drawn downwardly, with the result that the lever 46 will be rocked, the arm 55 thereof will be raised and the switch lever 56 will be disconnected from the contact 57. The heater 32 will thus be cut out of the circuit and the entire flow of current will be over the following path: generator 40, wire 39, binding post 36, wire 38, contact springs 21 and 24, wire 29, glower 28, wire 31, contact springs 25 and 22, wire 71, solenoid 42, wire 72, contact 59, wire 60, contact 61, resistance 65, wires 66 and 67, binding post 37 and wire 41 back to generator. As the core 43 of the solenoid 42 is drawn down still further, however, which will be done almost instantaneously, the switch lever 56 will be brought into engagement with the contact 58 and then the resistance 65 will be shunted out of the circuit by providing a path of lower resistance, the current passing from the contact 59 through the switch lever 56, contact 58, wires 68, 69 and 67, binding post 37 and wire 41 back to the generator. In this position the lamp is in full operation and the only resistance in the circuit besides the glower 28, is the solenoid 42. When the core 43 is moved downwardly, as just described, it performs in addition to the function of cutting out the heater 32 and shunting out the resistance 65, the function of rotating the shaft 53, through the action of the rack 51 upon the pinion 52, and thereby turning the damper 54 so as to open to a greater or less degree, the passage through the tube 10. When the tube 10 is thus opened, there is a flow of air through the lamp around the glower 28, the same entering the globe 6 through the openings 7, thence passing through the opening 35 in the

lower end of the globe 33 around and in contact with the glower, and thence passing up through the tube or conduit 10 and out through the perforations 11 in said tube and the openings 9 in the lid 8. This air current is what I utilize for maintaining the temperature of the glower constant. The same is created by the heat generated by the glower, so that there is a constant current through the lamp. In the event that there is an increase in voltage on the circuit, the ordinary effect would be to raise the temperature of the glower, thereby increasing its conductivity and consequently permitting an increased flow of current through said glower. This rise in temperature of the glower, is the cause for the rapid disintegration and destruction of the glowers of the lamps of this type which are now in use. According to my construction, the effect of an increase in voltage is different from what it is ordinarily. That is to say, the first effect thereof is to more strongly energize the solenoid 42 and to draw the core 43 thereof further down. When this is done, the damper 54 is more widely opened and a stronger current or draft of air through the lamp, around and in contact with the glower 28, is produced. The temperature of the glower 28 is not raised therefore, and instead of becoming a better conductor, and thereby allowing an increased flow of current through it, the glower has the tendency to become less conductive, by reason of the cooling effect of the air current thereon. The candle power of the lamp is therefore constant under variations in the voltage on the circuit and the destructive effects upon the glower of the increases in voltage are therefore overcome. Moreover it will be seen that while the lamp is in operation, the resistance 65 is shunted out and there is none of the usual waste of current which is ordinarily consumed by the ballasting resistance which is now always employed in the circuit with the glower. I may say in this connection, however, that under some conditions it may be deemed advisable to employ the resistance 65, or a portion of it, in the glower circuit, such as, for example, when the lamp is used upon a power circuit where there are wide variations in the voltage, and the solenoid 42 cannot act quickly enough to compensate therefor. When it is desired to use a portion of the resistance 65 in circuit with the glower, the wire 68 may be dispensed with, and in lieu thereof a wire 73 employed, which is connected to the contact 58 and to the resistance 65, at a point intermediate the ends of the latter. This arrangement is clearly shown in Fig. 2ª.

It is a well recognized fact, in this art, that the life of a glower is much longer when used upon an alternating current circuit, than when used upon a direct current circuit. I have therefore provided means for rapidly changing the polarity of the current supplied to the glower so that the same may be acted upon by an alternating current from a direct current source of supply. I have also provided means whereby the draft or current through the lamp around and in contact with the glower, may be augmented and made more positive. These features of construction are illustrated in Figs. 8 to 16 of the drawings. In addition to the features of construction heretofore described, I employ at the upper end of the air tube or conduit 10ª, shown in Fig. 8 of the drawings, an alternating current motor 77 which may be of any suitable form and construction. As shown, the same comprises a casing 78 secured to the upper end of the tube 10ª and communicating therewith, and also secured to the disk 2ª similar to the disk 2 heretofore described. The shaft 79 of the armature 80, is mounted in suitable bearings at its upper and lower ends, the form of bearing preferred by me being a graphite bearing, or one which requires no lubrication. Upon the lower end of the armature shaft 79 is mounted a suction fan 81, preferably composed of a series of spiral blades, and the casing 78 is provided with openings 82 for the escape of air from the tube 10ª. The upper end of the casing 78 communicates with a central opening 83 in the disk 2ª and said disk is also provided with openings 84 for the passage of air therethrough. Except so far as the motor 77 and the parts which coöperate therewith are concerned, the construction shown in Fig. 8 is substantially the same as that shown in the preceding figures; certain differences in detail will be noted, but no material differences are present. The armature 80 rotates as usual within the fields 85 and the armature shaft carries at its upper end a cross-bar 86, constituting the movable part of a commutator or polarity changer. Upon the under side of said cross-bar are secured the contact springs 87, 88, which coöperate with the conducting rings 89, 90 and 91 secured to the upper surface of a stationary insulating support 92. This support is located within the motor casing 78, as clearly shown. The conducting rings 90 and 91 are continuous or unbroken throughout their lengths, whereas the ring 89 is formed of two insulated or separated sections 93 and 94, separated at diametrically opposite points. A gap 95 is preferably formed at the adjacent ends of these two sections, and the end of one section is raised slightly, as shown at 96, above the end of the adjacent section, so that during the passage of the springs 87 and 88 thereover, there will necessarily be a break in the connections without bridging the contact between said sections. The commutator or polarity changer described, consisting of the rings 89, 90 and 91 and the rotating cross-bar 86, with the contact springs 87 and 88

thereon, is of a form which is preferred by me at the present time, but it is obvious that any other suitable form of commutator may be employed. The purpose of the same is to transform a direct current from the generator 40, over the wires 39 and 41, to the binding posts 36 and 37, respectively, into an alternating current to be supplied to the motor 77 and the glower 28. From the binding post 36 leads a wire 97 to the section 94 of the ring 89, and from the binding post 37 leads a wire 98 to the section 93 of the ring 89. One end of each of the springs 87, 88, moves in contact with the ring 89, whereas the other end of the spring 87 moves in contact with the ring 90 and the other end of the spring 88 moves in contact with the ring 91. From the ring 90 leads a wire 99 to the wire 29, and from the ring 91 leads a wire 100 to one of the commutator brushes of the motor armature 80. From the other brush of said commutator lead wires 101, 102, to and through the fields 85 of the motor and from said fields leads a wire 103 which is connected to the wire 67, heretofore referred to. The other circuit connections to and through the lamp, are exactly the same as those shown and described with reference to the form of my invention illustrated in Fig. 1 of the drawings.

When the circuit is closed through the lamp shown in Fig. 8, the current flow will be over the following path from the generator 40: Wire 39, binding post 36, wire 97, section 94 of ring 89 and one or the other of the springs 87, 88,—according to which one is in contact with said section 94,—to the ring 90 or to the ring 91. If to the ring 90, the current passes over the wires 99 and 29 to the heater 32, and thence over the wire 70, contact 57, switch arm 56, contact 59, wire 60, resistance 65 and wires 66, 67 and 103 to and through the fields 85 and armature 80 of the motor 77, and through the wire 100 to the ring 91; it then passes through the spring 88 to the section 93 of the ring 89, and and thence over the wire 98, binding post 37 and wire 41, back to the generator. Of course, if the spring 88 bridges the space between the ring 91 and the section 94 of the ring 89, the flow of current will be directly opposite to that above traced. The commutator described causes the supply of an alternating current to the glower 28, motor 77, and solenoid 42, from a direct current source of supply. When the circuit is closed over the path traced, the heater 32 and the motor 77 are both thrown into operation, with the result that the glower 28 is raised to a conductive heat, said heater is cut out and the resistance 65 is automatically shunted out of the circuit, and the solenoid 42 cut in, as heretofore described. The current instead of passing through the coils of the heater 32 therefore, passes entirely through the glower 28 and the temperature of this glower is regulated and controlled by means of the damper-operating mechanism and the current of air which is positively drawn through the latter around and in contact with the glower 28, by the action of the fan 81 connected with the motor 77. By the construction described, therefore, I am able to accomplish all that is attained by my first described construction, and in addition obtain a forced or positive draft through the lamp instead of a natural draft, and supply an alternating current instead of a direct current to the glower.

The form of my invention illustrated in Fig. 18 of the drawings, is slightly different from that shown in Fig. 8, in that the resistance 65, the solenoid 42, the valve or damper 54, operated by said solenoid, and the alternating current motor 77 are dispensed with, and in lieu of the same a direct current motor 104 is employed, to which is connected a governor 105 which serves to operate a switch for cutting out the heater. The tube 10^b is also of slightly different construction, in that it is connected solely to the base-piece 1^a by means of a flange upon its upper end and a nut or collar 13^a which screws upon said tube and bears against the lower surface of said base-piece. The glower 28 is of substantially the same construction as that heretofore described, and the globe 33^a is similarly supported from the spring clips 34^a. To the outer surface of the globe 33^a, however, are secured a pair of contact strips 106, 107, which are adapted to form electrical connection with the clips 34^a. The heater 32^a is also of a slightly modified construction, in that it is made up of a wire which extends vertically back and forth within the globe 32^a, around the glower 28, the same being supported from inwardly extending projections 108 on the sides of the said globe. The governor 105 is connected with the armature shaft 109 of the motor 104, and, as shown, consists of the pivoted arms 110, the balls or weights 111, centrally connected thereto, and the collar 112 which is loosely mounted on the shaft 109 and is capable of longitudinal movement thereon. The switch which is operated by the governor 105, consists of the two contacts 113, 114, and the switch lever 115. The said switch lever is connected with the collar 112 and is adapted to bridge the circuit between the contacts 113 and 114. A fan 115 connected to the lower end of the armature shaft 109, is located just above the tube 10^b and is mounted for rotation within the fan-casing 117, which has an opening at one point which communicates with the space within the casing 3^a. The said casing is provided at intervals with suitable openings for the escape of air. A wire 118 leads from the binding post 36 to the clip 34^a on one side

of the lamp, and from said clip leads a wire 119, through the base-piece 1ª to the wire 29. From the clip 34ª on the opposite side of the device, leads a wire 120 to the switch contact 113, and from the switch contact 114 leads a wire 121 to the binding post 37. From the upper end of the glower 28 lead the wires 122 and 123 to the motor 104, and from said motor leads a wire 124 to the switch contact 114.

The operation of this form of my invention is as follows: When the current is turned on to the lamp, the circuit is closed through the following path: wire 39, leading from one pole of the generator or other source of supply, binding post 36, wire 118, globe supporting clip 34ª on one side of the device, contact 106, heater 32ª, contact strip 107, clip 34ª, on the other side of the device, wire 120, contact 113, switch lever 115, contact 114, wire 121, binding post 37 and wire 41, back to the source of supply. The flow of current over the course traced, throws the heater 32ª into operation and the latter serves to raise the temperature of the glower 28 so as to render the same conductive. When said glower becomes conductive, the current will divide at the supporting clip 34ª, to which the wire 118 is connected, and pass over the following course: wires 119 and 29, glower 28, wires 122 and 123, motor 104, wire 124, contact 114, wire 121, binding post 37 and wire 41 back to the source of supply. The motor 104 is now in operation and the action thereof is to immediately cut out the heater 32ª by the operation of the switch lever 115. That is to say, the balls or weights 111 of the governor 105 are thrown outwardly by centrifugal force, the collar 112 of said governor is elevated and the lever 115 is moved on its fulcrum so as to disconnect the contacts 113 and 114 from each other. The entire flow of current therefore is then through the glower 28 and motor 104, over the path last traced. The action of the fan 116 is to create an upward current of air through the tube 10ª, around and in contact with the glower 28, the action of which is, as in the other forms of my invention, to counteract the tendency of the electric current to raise the temperature of the glower 28, and to maintain the temperature of said glower constant. If the voltage of the current increases, the operation of the motor 104 also increases, a stronger current of air is drawn through the lamp, and the cooling effects of the air current on the glower 28 are increased. The air enters the globe 6ª through the openings 7ª therein, instead of through openings in the flanges 4ª on the casing 3ª.

Having described my invention, I claim:—

1. In an electric glow lamp, means for creating a current of a cooling medium through the lamp in contact with the glower, and means for regulating the flow of such cooling means in accordance with variations in the potential of the current supplied.

2. In an electric glow lamp, means for creating a current of a cooling medium through the lamp in contact with the glower, and means for automatically regulating the flow of such cooling means in accordance with variations in the potential of the current supplied.

3. In an electric glow lamp, a tube in which a current of air through the lamp in contact with the glower, is created, and means for controlling the area of the passage through said tube in accordance with variations in the potential of the current supplied to the glower.

4. In an electric glow lamp, a tube in which a current of air through the lamp in contact with the glower, is created, and means automatically thrown into operation under variations in the potential of the current supplied to the glower for controlling the area of the passage through said tube.

5. In an electric glow lamp, a tube in which a current of air through the lamp in contact with the glower, is created, a valve or damper in said tube and means for automatically shifting said valve under variations of the potential of the current supplied to the glower.

6. In an electric glow lamp, a tube in which a current of air through the lamp in contact with the glower, is created, a pivoted valve or damper for controlling the passage through said tube, an electro-magnet in circuit with the glower and operative connections between said damper and the armature of said magnet, as and for the purpose set forth.

7. In an electric glow lamp, a tube in which a current of air through the lamp in contact with the glower, is created, a valve or damper for controlling the passage through said tube, a pinion connected thereto for operating it, a solenoid in circuit with the glower and a lever connected with the core of said solenoid and having a rack thereon in mesh with said pinion, as and for the purpose set forth.

8. In an electric glow lamp, a heater for the glower, in parallel therewith, a resistance in the heater circuit, and means automatically thrown into operation when the glower becomes conductive for cutting out the heater and shunting out the resistance.

9. In an electric glow lamp, a heater for the glower, and means automatically thrown into operation when the glower becomes conductive for cutting out said heater and creating a current of a cooling medium around and in contact with said glower, the said means acting under variations in the potential of the electric current through the glower, for varying the amount of the current of said cooling medium.

10. In an electric glow lamp, a heater for the glower, in parallel therewith, a resistance in the heater circuit, and means automatically thrown into operation when the glower becomes conductive for cutting out the heater and shunting out the resistance and for creating a current of a cooling medium around and in contact with said glower.

11. In an electric glow lamp, a heater for the glower, in parallel therewith, a resistance in the heater circuit, and means automatically thrown into operation when the glower becomes conductive for cutting out the heater and shunting out the resistance and for creating a current of a cooling medium around and in contact with said glower, the said means acting under variations in the potential of the electric circuit through the glower, for varying the amount of the current of said cooling medium.

12. In an electric glow lamp, a heater for the glower, in parallel therewith, a resistance in the heater circuit, a switch for cutting out the heater and shunting out the resistance, a solenoid in the glower circuit, connections between the core of said solenoid and said switch for throwing the latter into operation, a tube through which a current of air is created around and in contact with said glower, a valve or damper in said tube for controlling the passage therethrough, and operative connections between said valve and said core.

13. In an electric glow lamp, a fan for creating a current of air around and in contact with the glower.

14. In an electric glow lamp, a fan for creating a current of air around and in contact with the glower, and means for regulating the speed of said fan in accordance with variations in the potential of the current supplied to the glower.

15. In an electric glow lamp, a fan for creating a positive current of air around and in contact with the glower, and an electric motor in circuit with the glower for actuating said fan.

16. In an electric glow lamp, a tube arranged adjacent to the glower and means for creating a positive draft through said tube, around and in contact with the glower, and means controlled by variations in the potential of the current supplied to the glower, for increasing and decreasing said draft.

17. In an electric glow lamp, a tube arranged adjacent to the glower, an electric motor in circuit with the glower whose casing communicates with said tube, and a fan actuated by said motor for creating a positive current of air through said tube around and in contact with the glower.

18. In an electric glow lamp, a tube arranged adjacent to the glower, a damper in said tube, means for creating a positive current of air through said tube, around and in contact with the glower and means controlled by variations in the potential of the current supplied to said glower for actuating said damper.

19. In an electric glow lamp, a tube arranged adjacent to the glower, a damper in said tube, a fan for creating a positive current of air through said tube around and in contact with the glower, an electric motor for actuating said fan and a solenoid for actuating said damper, the said motor and solenoid being in circuit with the glower.

20. In an electric glow lamp, a heater for the glower, in parallel therewith, a tube arranged adjacent to the heater, a damper in said tube for controlling the passage therethrough, a fan for creating a positive current of air through said tube around and in contact with said glower, an electric motor for actuating said fan, in circuit with the glower, and means thrown into operation when the glower becomes conductive, for cutting out said heater and opening said damper.

21. In an electric glow lamp, a heater for the glower, in parallel therewith, a tube arranged adjacent to the heater, a damper in said tube for controlling the passage therethrough, a fan for creating a positive current of air through said tube around and in contact with said glower, an electric motor for actuating said fan, in circuit with the glower, a switch for cutting out said heater, and an electro-magnet in circuit with said glower and operatively connected with said switch and said damper, whereby said switch is actuated and said damper is opened when said glower becomes conductive.

22. In an electric glow lamp, an electric motor in circuit with the glower, means operated by said motor for creating a positive current of air around and in contact with the glower, and means for supplying an alternating current to said motor and glower from a direct current source of supply.

In witness whereof, I subscribe my signature, in the presence of two witnesses.

GUSTAVE K. HARTUNG.

Witnesses:

WM. M. STOCKBRIDGE,

FRANK S. OBER.