(No Model.)

2 Sheets—Sheet 1.

C. D. SIGSBEE, T. S. HAYWARD & F. S. ANDERSON.

ELECTRIC CURRENT REGULATOR OR RHEOSTAT.

No. 454,969. Patented June 30, 1891.

Fig. 1

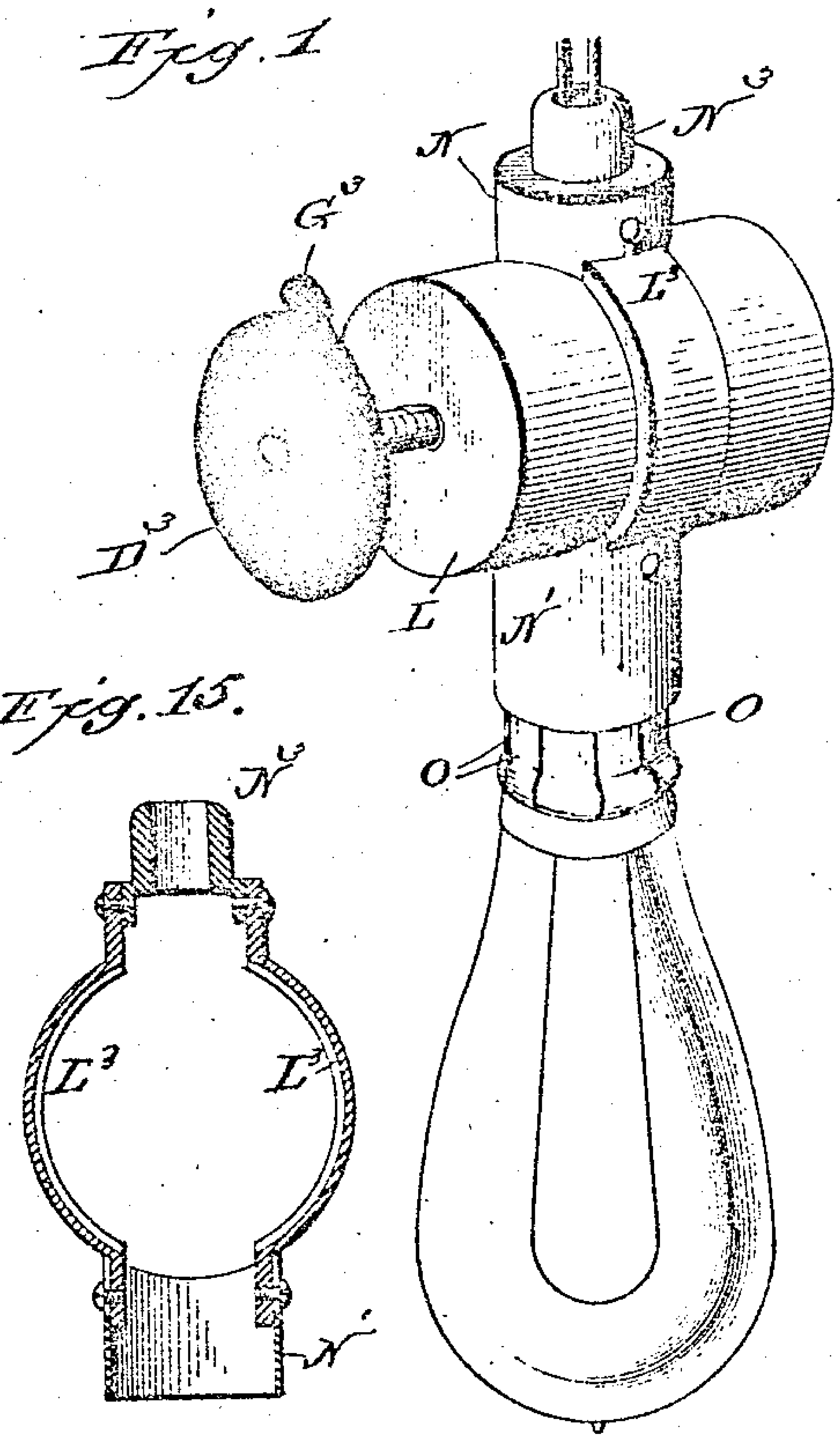


Fig. 7.

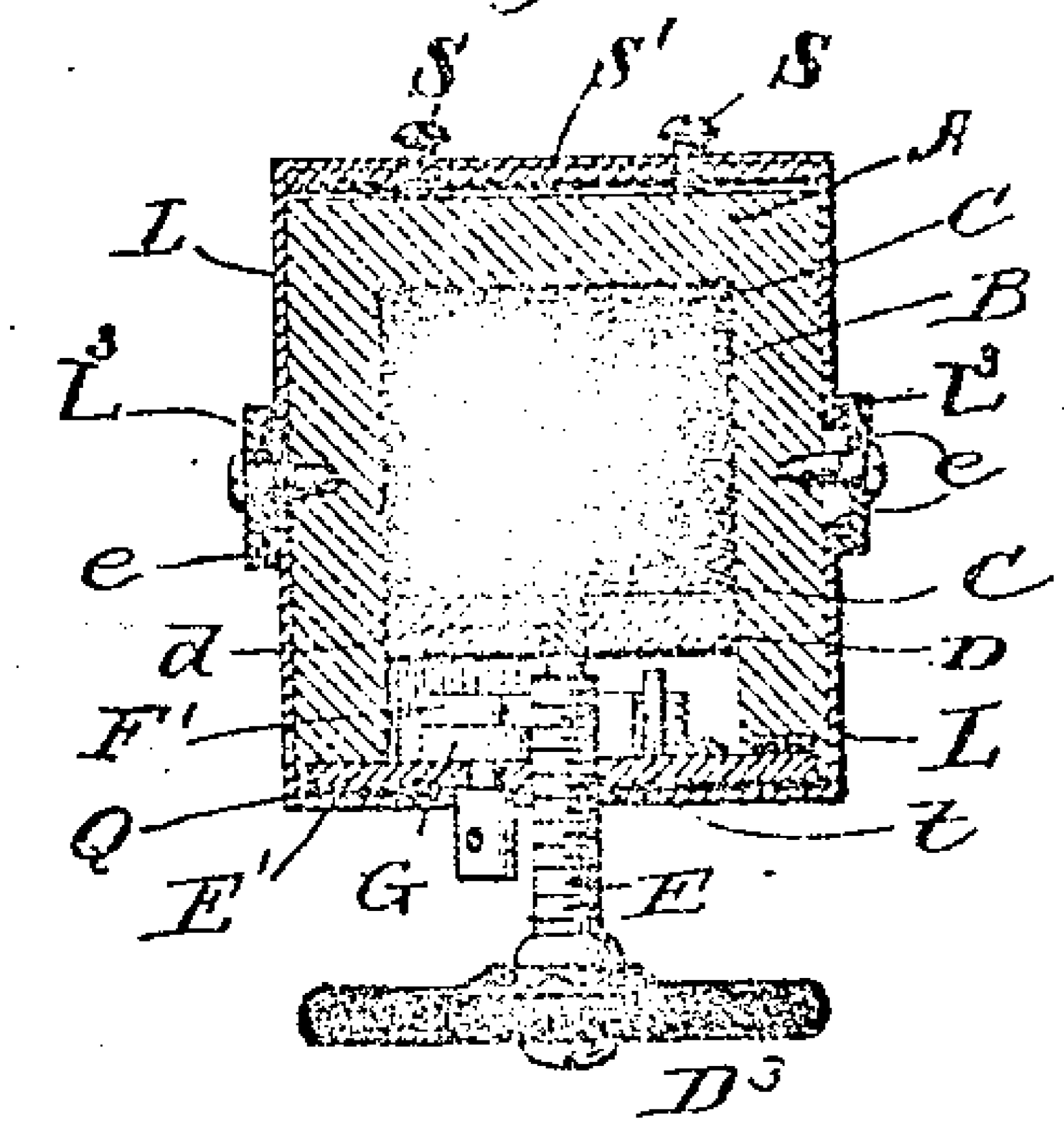


Fig. 15.

Fig. 9.

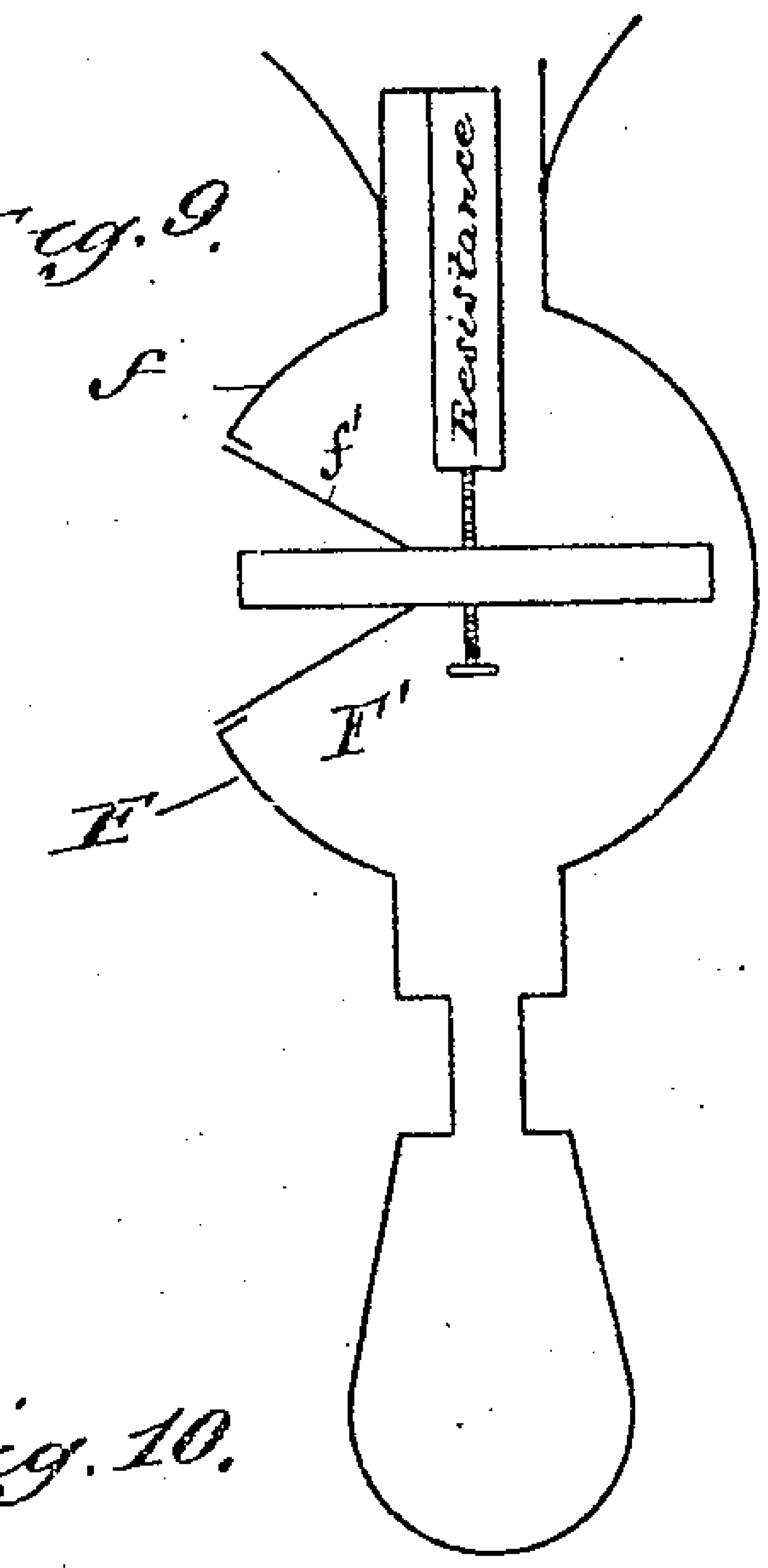


Fig. 12.

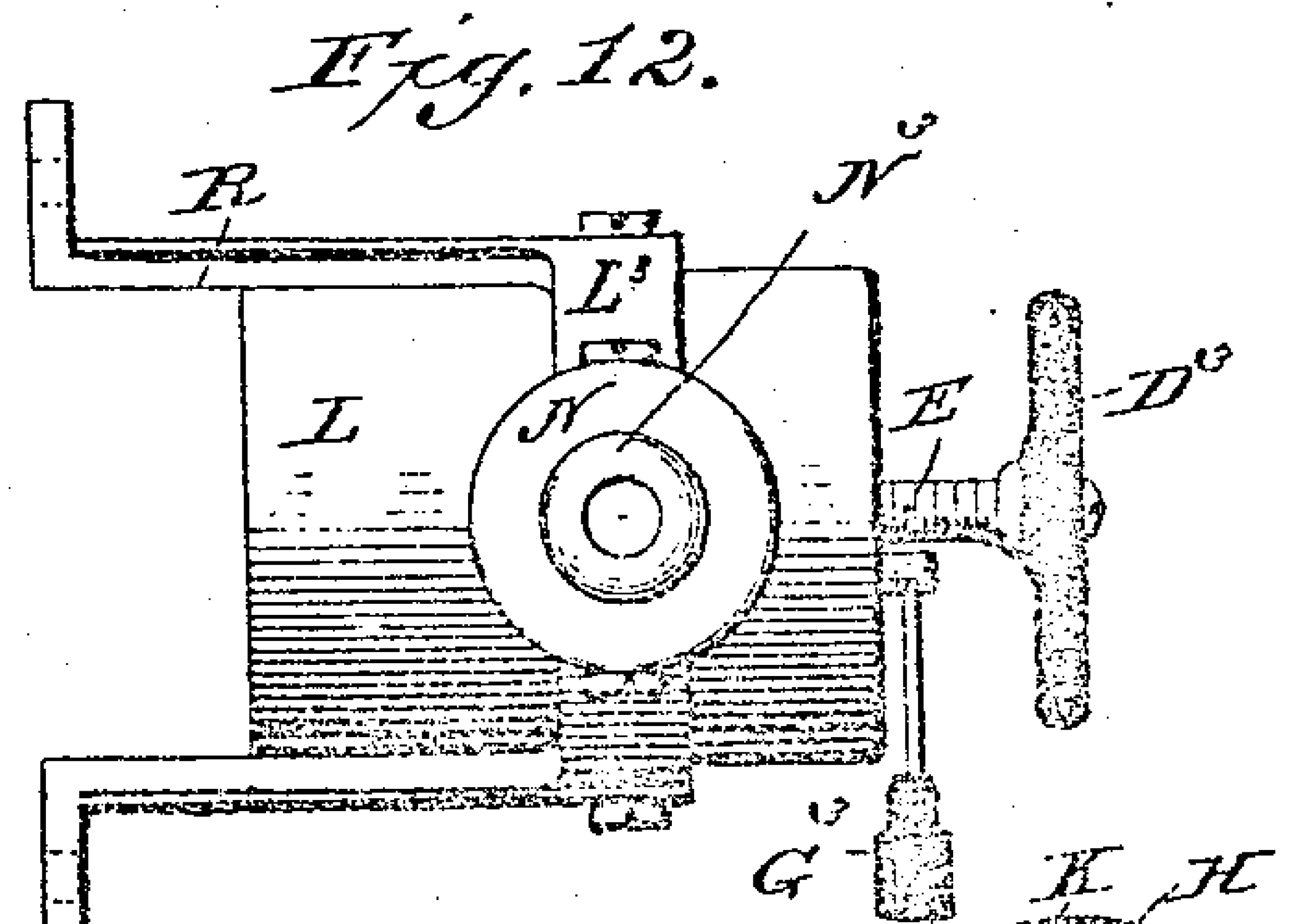
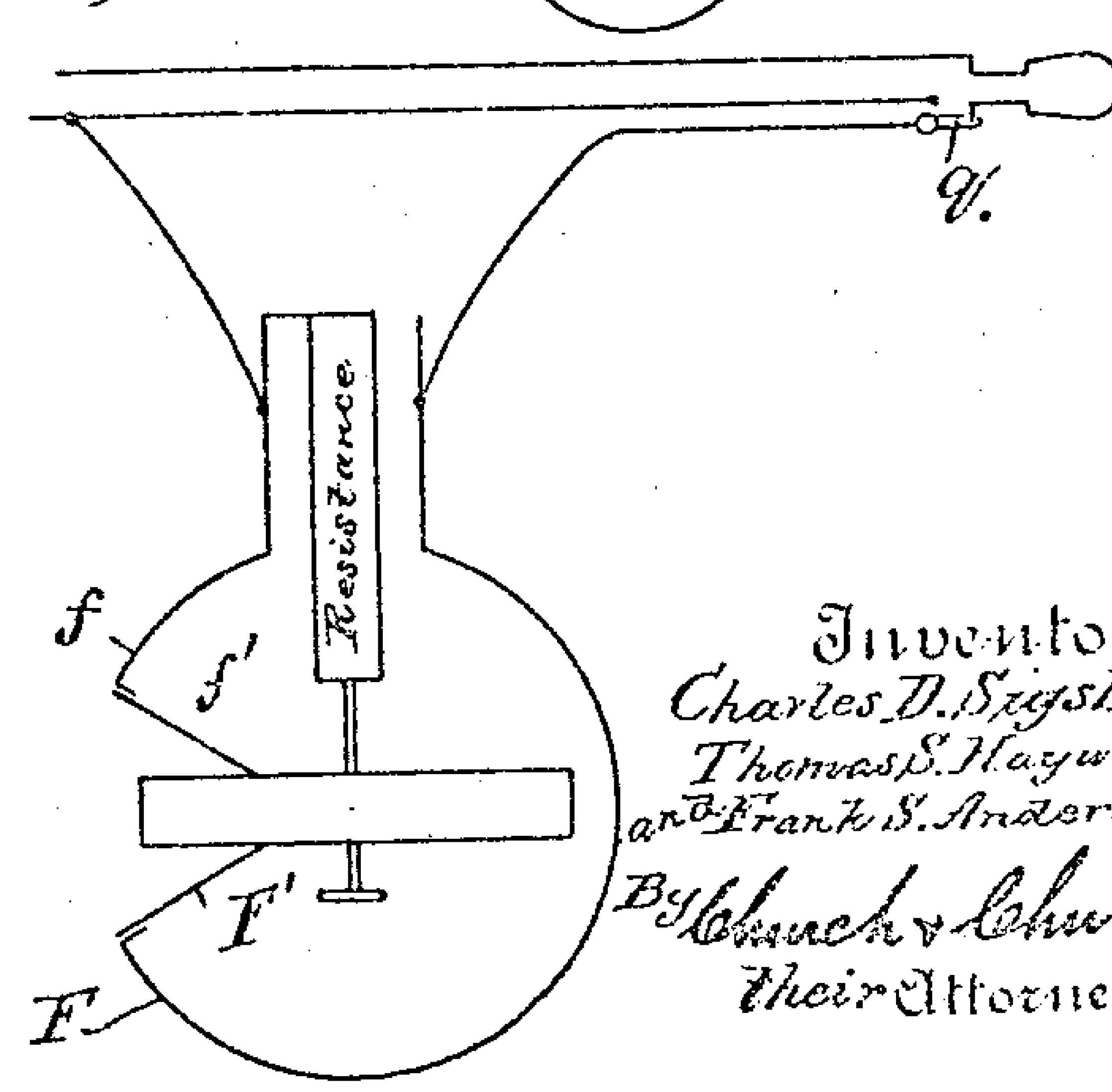
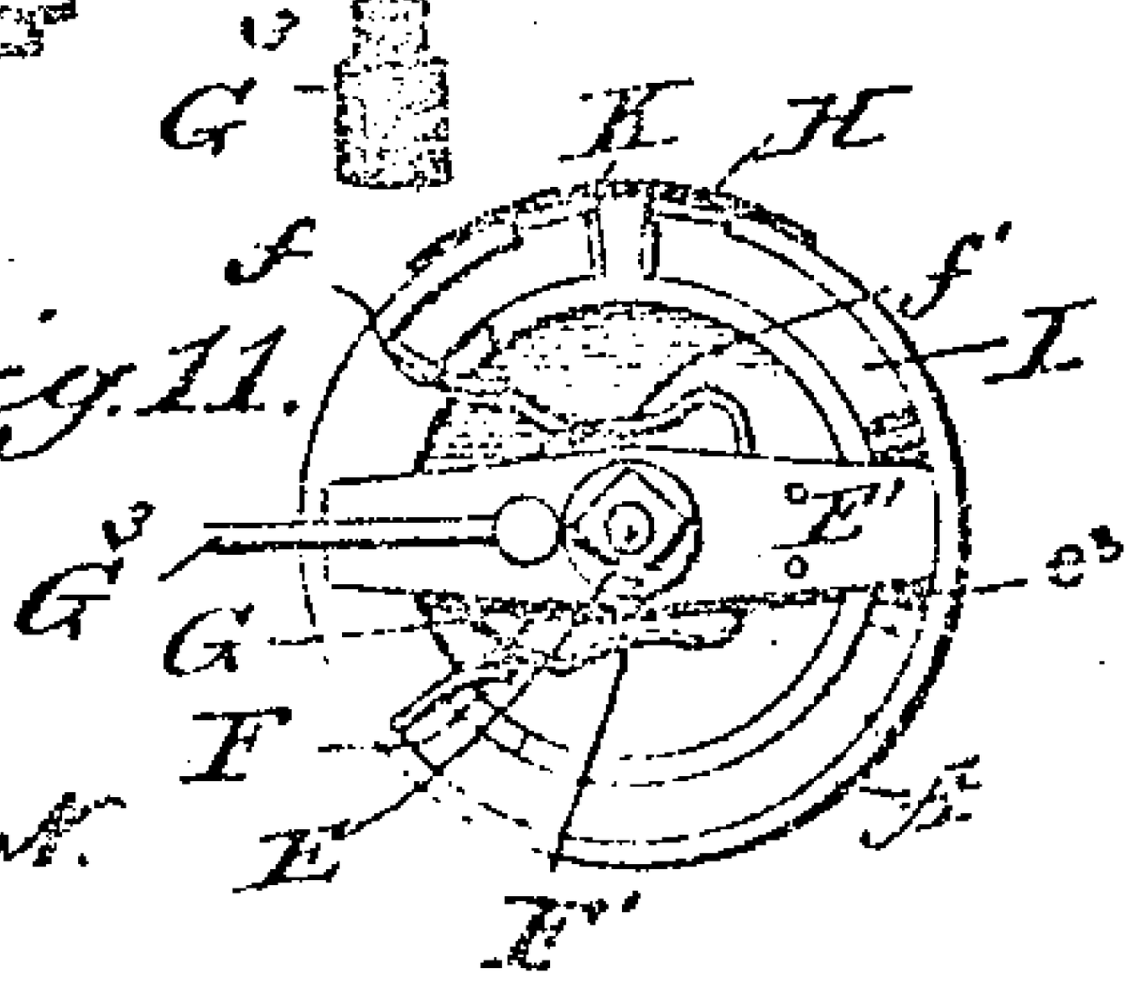


Fig. 10.



Witnesses Fig. 11.



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(No Model.) 2 Sheets—Sheet 2.

C. D. SIGSBEE, T. S. HAYWARD & F. S. ANDERSON.

ELECTRIC CURRENT REGULATOR OR RHEOSTAT.

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Fig. 2.

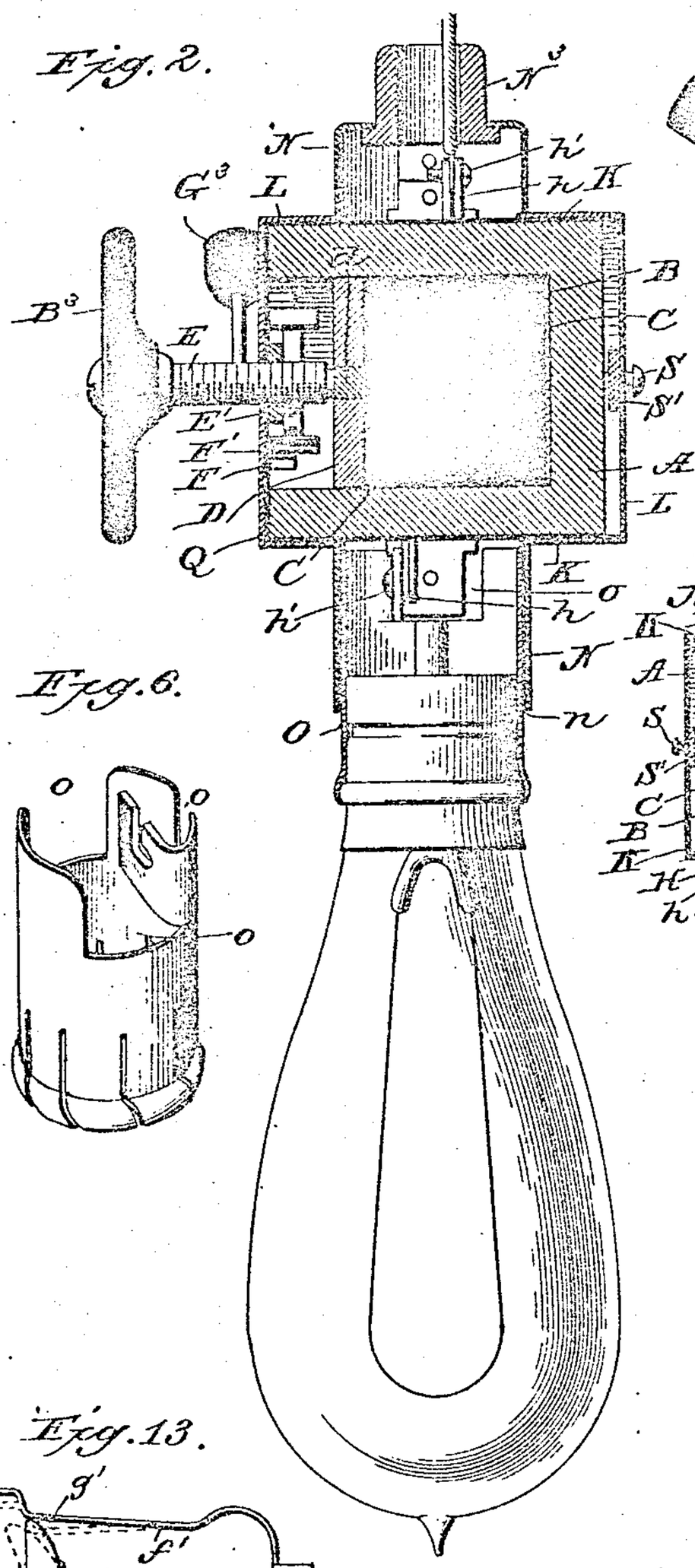


Fig. 3.

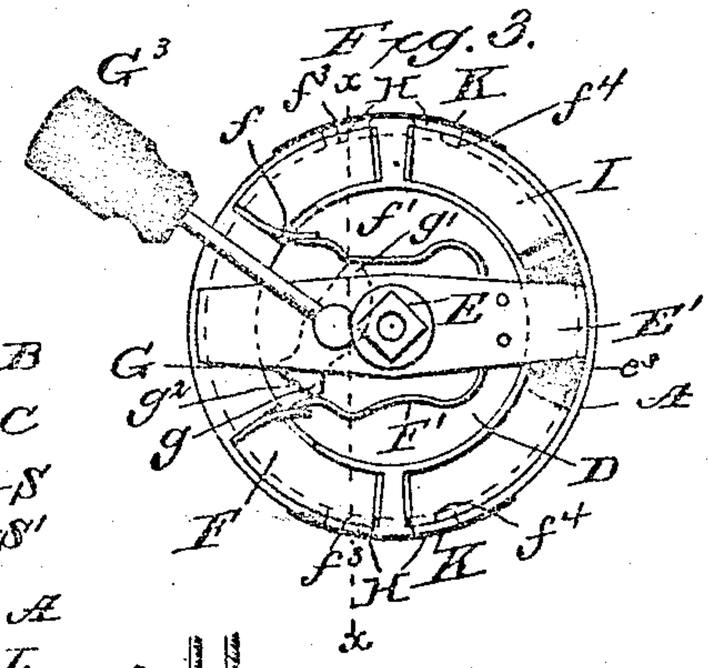


Fig. 4.

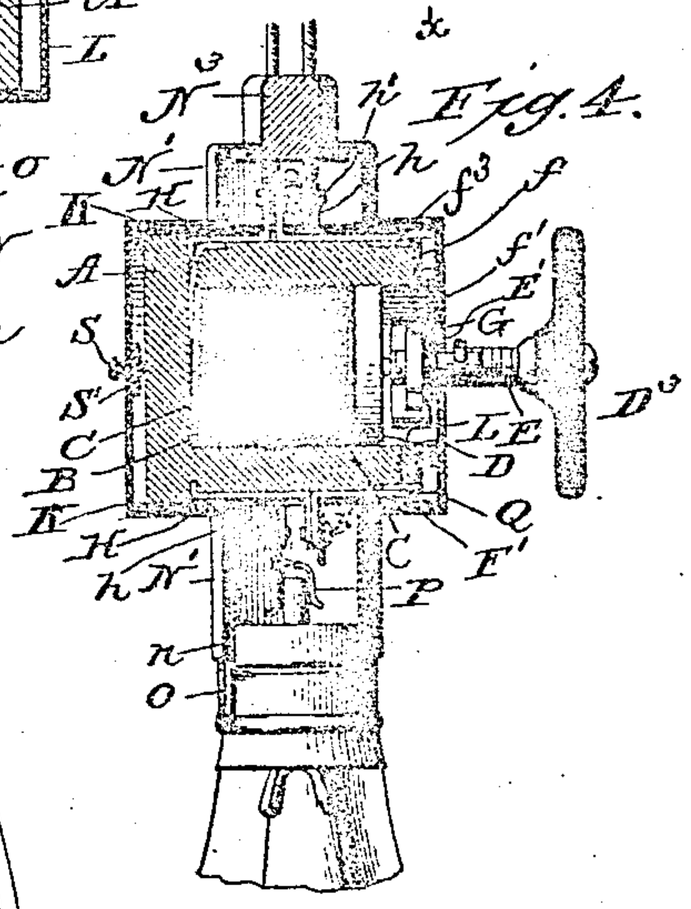


Fig. 6.

Fig. 5.

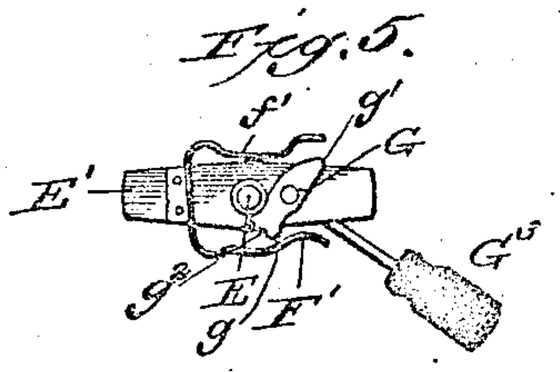


Fig. 13.

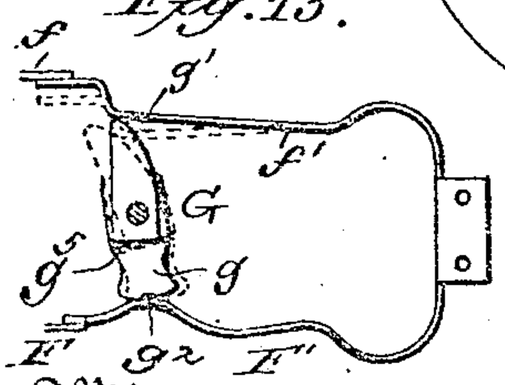


Fig. 12.

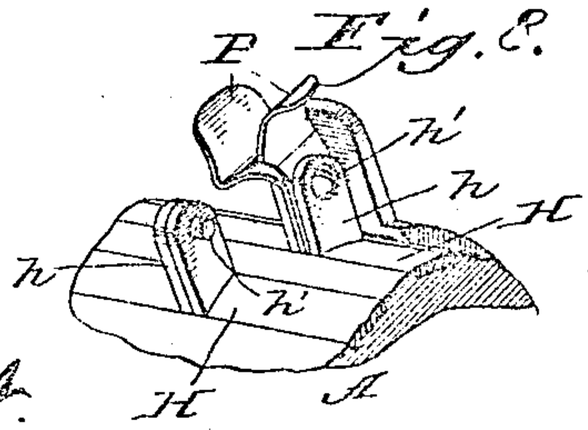
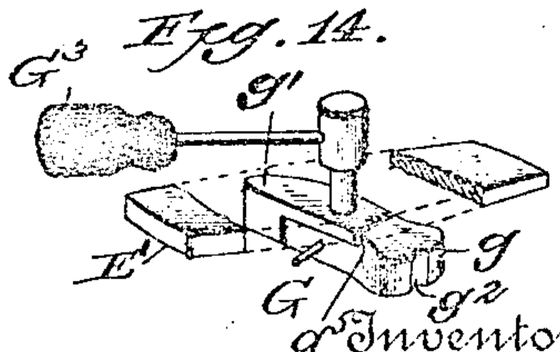


Fig. 14.



Witnesses

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UNITED STATES PATENT OFFICE.

CHARLES D. SIGSBEE, OF THE UNITED STATES NAVY, AND THOMAS S. HAYWARD AND FRANK S. ANDERSON, OF EASTON, MARYLAND; SAID ANDERSON AND HAYWARD ASSIGNORS, BY DIRECT AND MESNE ASSIGNMENTS, TO SAID SIGSBEE.

ELECTRIC-CURRENT REGULATOR OR RHEOSTAT.

SPECIFICATION forming part of Letters Patent No. 454,969, dated June 30, 1891.

Application filed March 10, 1891. Serial No. 384,451. (No model.)

To all whom it may concern:

Be it known that we, CHARLES D. SIGSBEE, commander in United States Navy, located at Annapolis, Anne Arundel county, Maryland, and THOMAS S. HAYWARD and FRANK S. ANDERSON, both of Easton, Talbot county, Maryland, have invented certain new and useful Improvements in Electric-Current Regulators or Rheostats; and we do hereby declare the following to be a full, clear, and exact description of the same, reference being had to the accompanying drawings, forming a part of this specification, and to the figures and letters of reference marked thereon.

This invention relates to improvements in electric-current regulators or rheostats which are particularly adapted for application and use in connection with incandescent lamps to vary the intensity of the light by placing more or less resistance in the lamp-circuit, as desired, although the device as a whole, as well as many features incident to the structure, are capable of a general application wherever rheostats are employed.

The invention has for its object to produce a highly-efficient, compact, and easily-applied device which shall give a wide range of variation in the current and that without injuring the resistance medium by heat or sparking or permitting the leakage of small quantities of current; to which ends the invention consists, first, in a novel resistance medium composed, essentially, of a fibriform substance, and, second, in certain novel details of construction and combinations and arrangements of parts, all of which will now be described, and pointed out particularly in the appended claims.

Referring to the accompanying drawings, Figure 1 is a perspective view of a regulator and incandescent-lamp attachment in the preferred form. Fig. 2 is a vertical section through the same. Fig. 3 is an end view with the top of the casing removed and the hand-wheel in dotted lines. Fig. 4 is a section of the regulator on the line $x\,x$, Fig. 3, looking toward the center. Fig. 5 is a bottom plan view of the bridge and switch and adjusting-screw carried thereby. Fig. 6 is a detail perspective view of the lamp-socket removed. Fig. 7 is a section through the regulator at right angles to Fig. 2. Fig. 8 is a detail perspective of the connectors for the lamp and its socket. Fig. 9 is a diagrammatic view of the circuits, and Fig. 10 is a similar view showing a different manner of coupling up where the regulator and lamp are not fastened together; Figs. 11 and 12, views of a modified form. Figs. 13 and 14 are details of a modified form of switch. Fig. 15 is a sectional view showing the clamping-bands.

Like letters of reference in the several figures denote the same parts.

In carrying out our present invention we make use of the well-known element of a body portion A, which constitutes a barrel or receptacle for the resistance medium B, having contact-plates C at each end, one or both of which are adapted to be moved inward to vary the density of the resistance medium, and thereby vary the conductivity of the medium or the resistance offered to the passage of the electric current through the same; but in lieu of the resistance medium heretofore employed, consisting of comminuted substances having a low conductivity, we now employ an elastic body having a cellular structure, in the sense that it is filled with air-spaces, and preferably having an elastic fibriform structure, the elastic fibers themselves being of a substance having a low conductivity, or, as in the form shown, little or no conductivity until coated, covered, impregnated, charged, or plated with a conductive material, the quantity and nature of which will determine the conductivity of a mass under a given compression. The fibriform substance preferably employed is asbestus having the fibers relatively long and elastic, and each or a portion of the fibers are coated or covered with graphite, plumbago, or some substance or compound capable of coating or adhering to the surface of the fibers and constituting a medium of low conductivity. The mass thus formed is highly elastic, and its conductivity varies in proportion to its density, as will be

readily understood by those skilled in the art. The variation, however, will be found to be much more gradual and regular than in prior devices, making the most minute variations possible, and at the same time the mass does not get out of shape when the position of the barrel is changed, nor is there danger that any portion of it will escape from the barrel and injure the contacts, create dirt, or injure the device, as might happen if the mass were comminuted.

In the mechanical construction of the device we locate one of the contact-plates C in the bottom of the barrel and the other at the open end, and over this we place a compressor-plate D, preferably of non-conducting material, and in the present instance having a central stud or conductor *d*, adapted to contact with the plate C below and with the compressing-screw E above. The plate is made of non-conducting material to prevent any short-circuiting should the screw be withdrawn and the plate come in contact with a switch or a stud *t*, arranged to arrest it. The compressing-screw E passes through a cross-plate or bridge E′, held by the barrel and preferably employed to support the switch mechanism controlling the passage the current shall take through the device. The switch referred to may be of any ordinary construction, adapted simply to make or break the circuit leading from the resistance to one of the lamp-wires; but in the preferred construction it not only permits the circuit passing through the resistance to be made or broken, but by a single continuous movement to complete said circuit or cut the resistance out entirely. To carry this idea into effect, the contact F, constituting the terminal of the lamp-wire, is located at the end of the barrel in position to be engaged by the spring-arm F′ on the bridge-piece when moved outward by the arm *g* of the key G, and on the opposite side of the barrel is located a contact *f*, which constitutes a terminal of the branch of the leading-in wire passing to the bottom plate C. This last-mentioned contact *f* is in position to be engaged by the spring-arm *f′* when moved outward by the arm *g′* of the switch-key, the parts being so positioned relative to each other as that the spring-arm F′ is first moved out and the circuit completed through the resistance before the circuit is completed through the branch terminal *f*, the result being, as before stated, that by a single movement of a key the circuit may be first made through the resistance and then the resistance cut out. The spring-arms F′ *f′* are preferably formed in a single piece attached to the under side of the bridge, and the arm *g* on the key is provided with a relatively long operative face, with a slight depression g^2 therein to constitute a retainer for holding said key in position with the circuit made through the resistance medium.

As one of the objects of the invention is to form an extremely compact device with the parts firmly united, the location, relative arrangement, and construction of the parts is important. Thus it will be seen that both the contacts F *f* are located in recesses in the walls of the barrel, and to make proper circuit connections with these contacts they are each provided with depending arms f^s, lying in recesses formed longitudinally in the outer face of the barrel, the arms being preferably somewhat elastic and pressing outward to make perfect contact with the connector-strips H, which overlie the same and are retained within the recesses by the casing. These strips H are all duplicates, one of each pair slightly longer than the other for a purpose to presently appear, and each having outwardly-extending arms *h*, through which screws *h′* pass to connect the strips and serve as a means for connecting the leading-in wires or lamp wires or connections, as the case may be.

The construction of the connector-plates is such that they are capable of a longitudinal movement without interrupting the circuit, thereby permitting connections to be made without difficulty, but in order to prevent excessive longitudinal movement the ends of the lower strips are bent inward and enter depressions in the wall of the barrel, besides serving as a ready means for making connections between one of the leading-in wires and the bottom plate C, as will be seen in Fig. 4. A recess is formed in each edge, extending way around the side opposite the terminals F *f*, and in this is located a connecting-strip I for completing electrical connection of the leading-in wire passing straight through the device, said strip being provided with arms f^4 similar to those on the terminals just mentioned.

Over the connector-strips H in each side of the barrel I locate insulating-plates K, preferably of mica, and having central apertures for the arms *h*, the whole being then held in place by tight-fitting caps or casings L, slipped over the barrel from each end and held rigidly in place by centrally-arranged clamping-bands L^s, having depressions therein, into which project the flanges or rims *e* on the casing, and themselves held in position by a bridge N^3, covered by a cap-piece N at one side, which serves as a covering and protector for the terminals of the leading-in wires, and at the opposite side by a cap-piece N′, which also serves as a cover for the lamp-socket O, a sheet of mica *n* or other non-conductor being interposed between the two to prevent electrical contact.

The socket O is formed of a cylindrical piece, provided with cut-out portions *o* at the upper end to prevent all possibility of a short circuit, the section of material from one of said cut-out portions being bent inward and slotted or perforated for the reception of the screw-head *h′* to make the proper electrical connection with the socket.

A pair of spring-arms P or other equiva-

lent connecting mechanism for the central lamp terminal is held by the arm *h* of the other connecting-strips, and as said arms are in slightly different planes, due to the difference in length before mentioned, the arms P will be brought into proper position without danger of contact with the opposite terminal.

The lamp employed is preferably one in which the contact is made through the collar for one leading-in wire and through a central stud or projection for the other leading-in wire, and when passed into the socket the proper connections are made, as will be readily understood.

To prevent any possibility of a short circuit being formed through the cap-pieces or casing, they may be lined in every instance, or, if desired, formed of non-conducting material, although it will generally be found sufficient to employ in addition to that already mentioned simply an insulating-disk Q within the top casing to hold the terminals and switch-arms away from the casing. The device as thus made is entirely inclosed, the screw and switch-stem only projecting through the casing at one end, both of which are provided with suitable operating-handles, that on the screw being in the form of a hand-wheel D^8 and that on the switch-stem a simple handle G^3, the device appearing as shown in Fig. 1.

We prefer to employ a barrel or body formed of insulating substance—such as wood, vulcanized fiber, rubber, glass, or equivalent—and in case the same varies in size or is at all irregular it may be set forward in the casing or caps by means of the set-screws S, passing through the bottom cap or a plate S′ within the same and bearing against the bottom of the barrel, and to hold the bridge out of connection with the connector-strip a piece of mica or non-conductor e^3 is placed beneath the same, Fig. 3.

It is obvious that the device is capable of many modifications and uses other than herein set forth—for instance, as shown in Figs. 11 and 12, it is adapted for employment as a rheostat device and may be placed in circuit with a distant lamp or other device, the circuit connections being, as shown in Fig. 10, with the contact or terminal *f*, passed way around the edge of the barrel, (see Fig. 11,) and thence off to the lamp, the other terminal of the lamp being connected directly in line, and, if desired, as shown in said Fig. 10, a branch of the other line-wire may extend directly to the lamp to cut the rheostatic device out entirely when the lamp-switch *q* is shifted from the rheostat terminal to the branch-line terminal. When this form of device is employed, the clamping-bands are provided with bracket-arms R, which are adapted to be fastened to the wall or other support.

By referring to Figs. 13 and 14 it will be seen that instead of a switch having rigid arms, the arm *g′*, operating the contact connected directly with the line, is loose and has a limited independent movement, regulated by the shoulders g^5 on the arm *g*, which latter is rigidly secured to the pintle, as in the former instance. This construction, it will be seen, enables us to operate the line-contact arm without danger of stopping at the point where sparking or leakage would occur, inasmuch as the moment the arm *g′* is moved beyond its center the spring throws it to the other extreme of its movement with relation to arm *g* and breaks the contact suddenly.

In the practical operation of the device none of the internal parts need be touched, and in putting the device in circuit the electrician or lineman need simply loosen the screws *h′* and make the proper line connections, at once covering up the points with the cap-plates, where they are out of harm's way. Then to regulate the passage of current through the device it is only necessary to compress the resistance medium by means of the hand-wheel and operate the switch to make the proper connections through the device.

Devices constructed in accordance with the present invention present little or no opportunity for the leakage of current of less quantity than would be observed in a lamp, owing to the fact that the circuit is absolutely interrupted by a switch without the necessity of manipulating the screw at all when the device has once been properly regulated, although the hand-wheel presents a most ready and convenient means for regulating the intensity of the light at will, and, if desired, interrupting the circuit entirely; but we do not wish to be understood as limiting ourselves to the use of the particular substances mentioned for coating or impregnating the fiber, inasmuch as this may be accomplished in various ways. Perhaps the most effective manner of accomplishing the desired result is to heat the fiber with a volatilizable metal in a powdered state combined with a zinc or other oxide. Then expose the treated fiber to the fumes of sulphur. Excellent results have been secured by treating the fiber with metallic bismuth, oxide of zinc, and sulphur, also by treating the fibers with a compound of graphite and oxide of zinc to cause the same to adhere to the fibers and reduce the conductivity of the graphite, the resulting fibrous substance forming at once a most perfect resistance medium, and at the same time one which is not affected by heat and has a very wide range of compression. The fibrous body may consist of ordinary asbestus fabric—such as wicking—which has been treated with a conductive substance and where little conductivity is wanted the outer fibers only of the fabric may be treated, and when the fabric is coiled in the barrel an attenuated course for the current is formed, while the remainder of the mass serves to absorb the heat generated, and which might otherwise be harmful.

It is obvious that the harmful influence of heat generated in the resistance material may be obviated by scoring, perforating, or other-

wise forming air-spaces in the casing in the ordinary well-understood manner, although, as before stated, we prefer to form the entire device of material unaffected by heat and inclosed in a solid metallic casing.

Having thus described our invention, what we claim as new is—

1. A resistance for rheostats, composed of relatively long elastic fibers coated with a conducting substance, substantially as described.

2. A resistance medium for rheostats, composed of relatively long fibers of asbestus coated with graphite, substantially as described.

3. A resistance medium for rheostats, composed of asbestus fabric coated with a conducting substance, substantially as described.

4. In a rheostat, the combination, with the barrel or receptacle having the conducting-plate at the bottom, of the resistance medium composed of the relatively long elastic fibers and conducting substance carried thereby, and the adjustable conducting-plate overlying said medium, substantially as described.

5. In a rheostat, the combination, with the barrel or receptacle having the resistance medium therein, of the screw for varying the resistance of the medium, the bridge carrying the screw, and the key for controlling the flow of current through the medium journaled in the bridge, substantially as described.

6. In a rheostat, the combination, with the barrel or receptacle having the resistance medium therein, and means for varying the resistance, of the connecting-strips and contacts held in recesses in the wall of the barrel, and the switch within the barrel, substantially as described.

7. In a rheostat, the combination, with the barrel or receptacle having the open end and recesses in the end face of the wall thereof, and the resistance medium within the barrel, of the contact-strips held in said recesses, and the connector-strips for the terminals of the leading-in wires, substantially as described.

8. In a rheostat, the combination, with the barrel or receptacle containing the resistance medium and the conducting-plate overlying the same, of the non-conducting compressor-plate overlying the conducting-plate, and the conducting-stud therein through which the circuit is established, substantially as described.

9. In a rheostat, the combination, with the barrel or receptacle containing the resistance medium and having the longitudinal recesses in the outer surface, of the connector-strips lying in said recesses, the contacts, and the inclosing casing for holding said strips in place, whereby the strips are permitted a limited longitudinal movement, substantially as described.

10. In a regulator such as described, the combination, with the cylindrical receptacle containing the resistance medium, the screw for compressing the same projecting at the end of the receptacle, and the connector-strips having the arms projecting at right angles to the receptacle, of the clamping-strips passing around the receptacle, and the cap-pieces or covers for the connectors held by said strips, substantially as described.

11. In a rheostat, the combination, with the receptacle containing the resistance medium, the adjustable contact-plate overlying said medium, the screw for adjusting said plate, and the bridge or support for the screw, of the leading-in wire having a branch in electrical connection with the bottom of the resistance medium and a branch terminating in a switch-contact, a switch-contact in electrical connection with the contact-plate at the opposite end of the medium, a co-operating line-contact, and a switch engaging said contacts to establish the circuit through the resistance medium or around the same, as may be desired, substantially as described.

12. In a rheostat, the combination, with the barrel or receptacle containing the resistance medium, the screw for compressing said medium, the bridge carrying the screw, and the two spring-switch arms and the switch journaled in said bridge, of the leading-in wire having a branch passing to one end of the resistance medium and a branch terminating in a contact in position to co-operate with the spring-arm last operated, and a line-wire contact in position to engage the spring-arm first operated, whereby the current may be established through the resistance medium or around the same, substantially as described.

13. In a rheostat, the combination, with the barrel or receptacle containing the resistance medium, of the casings or caps inclosing said receptacle, and the central clamping-strips for holding said caps in position, substantially as described.

14. In a rheostat, the combination, with the barrel or receptacle for the resistance medium, the connector-strips on the outside of the same, and the caps or casings inclosing the receptacle and holding the strips in place, of the insulating-plates interposed between said strips and the caps and casing, and the clamping-strips embracing the ends of the caps, substantially as described.

15. In a regulator, the combination, with the connectors for the direct and derived circuits, of a key, a contact-arm included in the derived circuit and moved by the key, a contact-arm for cutting out the derived circuit, and a loose arm carried by the key and having a slight independent movement for operating said contact-arm, substantially as described.

16. In a regulator, the combination, with the resistance and the line-contacts, of the two spring switch-arms engaging said contacts, respectively, the key having the rigid arm engaging one of said spring-arms, and the loose arm mounted on said key and en-

gaging the other spring-arm, with the shoulders on the rigid arm for moving the loose arm, substantially as described.

17. A resistance medium for rheostats, composed of fibers of non-conducting substance treated with graphite and oxide of zinc, substantially as described.

18. A resistance medium for rheostats, composed of fibrous asbestus coated with a compound of graphite and oxide of zinc, substantially as described.

19. A resistance medium for rheostats, composed of asbestus fabric treated with graphite and a metallic conductor, substantially as described.

20. In a regulator such as described, the combination, with the device to be governed and a direct circuit, a resistance medium located in a branch circuit, and contact-arms included in the branch and direct circuits respectively, of a key or switch co-operating with and operating the contact-arm to establish the branch circuit and the contact-arm to establish the direct circuit, successively, whereby the current through the device to be governed may be manipulated through three stages—*i. e.*, full through the resistance and off by a single movement of the key, substantially as described.

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