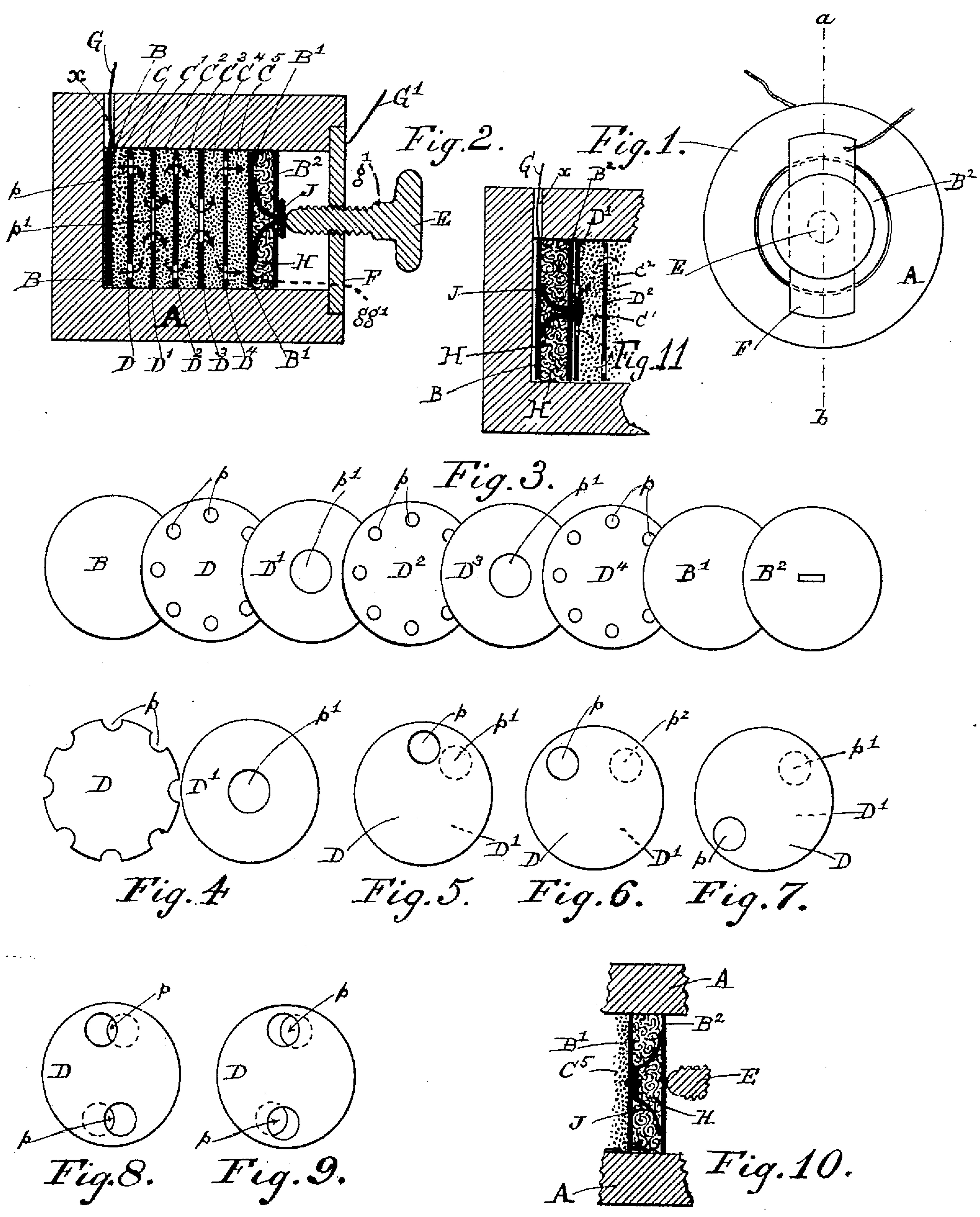
(No Model.)

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

ELECTRIC CURRENT REGULATOR.

No. 477,708. Patented June 28, 1892.



WITNESSES

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UNITED STATES PATENT OFFICE.

CHARLES DWIGHT SIGSBEE, OF THE UNITED STATES NAVY, AND THOMAS S. HAYWARD AND FRANK S. ANDERSON, OF EASTON, MARYLAND.

ELECTRIC-CURRENT REGULATOR.

SPECIFICATION forming part of Letters Patent No. 477,708, dated June 28, 1892.

Application filed September 11, 1891. Serial No. 405,435. (No model.)

To all whom it may concern:

Be it known that we, CHARLES DWIGHT SIGSBEE, of the United States Navy, residing at Washington, District of Columbia, and THOMAS S. HAYWARD and FRANK S. ANDERSON, residing at Easton, in the county of Talbot and State of 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 invention, such as will enable others skilled in the art to which it appertains to make and use the same.

Our invention relates to electrical regulators or rheostats, and has for its object to provide for electric currents a resistance that may be greatly varied in power while varying only slightly or not at all the mass and volume of the elements forming the resistance device.

It has for its further object to provide a resistance device adapted to withstand a high degree of heat.

Our regulator consists of a cell or barrel of well-known utility, preferably closed at one end, excepting a channel through the wall to admit the circuit or connections for the same, and open at the other end, said cell being a non-conductive receptacle for the elements composing our resistance device or combination and for contact-plates at the extremities of said device or combination. It also serves as a support for the means that we employ for varying the pressure upon our resistance device.

Our resistance device is composed of material of a moderate degree of conductivity, arranged in alternate layers, with regulating pieces or plates of a lower degree of conductivity or no conductivity, said regulating-plates being perforated in a manner to limit the flow of current through or past the plates and to direct the current in the desired route, devious or otherwise, through the more conductive material inclosed between the regulating-plates. The perforations in adjacent plates may be so arranged that by merely re-adjusting said plates, without otherwise altering the elements of our resistance device, the route of the current may be lengthened or shortened and the power of the resistance as originally established thus increased or diminished, as will be shown.

It is obvious that the longer the route of the current the greater will be the resistance also the greater the area of the perforations in the regulating-plates the greater the amount of current passing through the resistance device. Finally, having established the initial resistance of the mass of our resistance device the resistance as thus established may be varied by varying the pressure upon the mass, a well-known principle which we put into execution by means of a compressor-screw, the conductivity of the mass increasing with the pressure.

The regulator is placed in the circuit of an electric lamp, machine, or apparatus to which the current is supplied from any generator, and the circuit may be supplied with any suitable switch or circuit-breaker, or both.

We may use our resistance device as described herein in lieu of the resistance substance set forth in our patent for an electric-current regulator or rheostat, No. 454,969, dated June 30, 1891, using any or all of the mechanical details set forth in that patent; but having claimed said details in said patent, they are not claimed herein.

Referring to the accompanying drawings, Figure 1 is a front view of the outside of our regulator. Fig. 2 is a vertical section of the regulator on the line *a b* of Fig. 1. Fig. 3 shows a series of pieces or plates such as are contained in the cell of Fig. 2, and shown therein in section. Fig. 4 shows a pair of adjacent regulating-plates perforated in a slightly-different manner from those shown in Figs. 2 and 3. Fig. 5 illustrates a pair of adjacent regulating-plates, one being assumed to be behind the other, with conductive material between the two, the perforations of the front plate being shown in full line and those of the rear plate in dotted line. Figs. 6 and 7 are continuations of Fig. 5, and show the same pair of regulating-plates rearranged in successive stages to lengthen the route of the electric current through the successive perforations—*i. e.*, through the resistance device. Figs. 8 and 9 show a modification in which two regulating-plates are in contact, the two forming practically one plate. The perforations of the said plates being made to overlap each other more or less, the area of the common aperture is thereby increased or diminished. Figs. 10 and 11 are modifications of Fig. 2, which will be explained hereinafter.

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

To carry into execution our invention, we have the non-conductor cell A, open at one end and closed at the other, as shown, and provided with the channel x to admit the electrical wiring or connections. Within the cell are the metallic contact-plates B and B′ and the metallic presser-plate B^2. Included between the contact-plates are layers of conductive material C C′ C^2 C^3, &c., alternating with regulating-plates D D′ D^2 D^3, &c., the said layers and plates constituting what we style our "resistance device"—*i. e.*, our resistance device proper. The regulating-plates are perforated with holes of any suitable size and shape and in any suitable positions in said plates, and are fitted neatly to the chamber of the cell, but adapted to free movement therein.

In Fig. 2, which repeats in section the contact-plates, regulating-plates, and perforations shown in Fig. 3, the course of the current through the resistance device in this arrangement of perforations exhibited is clearly shown by means of arrows passing through the perforations p p', &c.

In order to vary the conductivity of our conductive layers C C′ C^2, &c., by varying the pressure thereon, we have provided the compressor-screw E, working in the bearing-plate or bridge F, which is seated in the wall of the cell. Contacts with the circuit are made at the contact-plate B and the bearing-plate F, the circuit-wires or connections being shown at G and G′. The contact of G′ may be made on the compressor-screw, as g', or on the contact-plate B′, as g g', if desired. It should be understood that the adjacent layers of conductive material C C′ C^2, &c., are so formed or disposed as to have mutual contact or continuity through the perforations of their corresponding regulating-plate, although in Fig. 2 the perforations are left white for clearness of illustration as a whole.

Our conductive layers may be formed of any suitable material; but we prefer that they shall be of moderate conductivity only, yet of a higher conductivity than the regulating-plate. Our purpose is best secured by a material having considerable elasticity under pressure, in order that a wide range of compressor action may be secured. While a solid or fibrous substance or material may be used for this purpose, we prefer a comminuted or powdered substance, as powdered graphite or other carbons, or powdered metals; also, simple powders having the grains plated or coated with a substance of higher or lower conductivity than the grains themselves. Powdered graphite has been found to give good results and has a great capability to withstand heat.

Our perforated regulating-plates may be made of any suitable material of low conductivity, or, practically, no conductivity; but we prefer mica for its compactness, non-conductive quality, stiffness, smooth surface, and capability of withstanding heat.

To increase the range of compressor action and to prevent the escape or leakage of the conductive material C C′ C^2 C^3, &c., we use the elastic packing-pad H, inclosed between the contact-plate B′ and the presser-plate B^2, as shown in Fig. 2, the chief office of the presser-plate being to transmit pressures from the compressor to the packing-pad and the resistance device. The said pad is composed of elastic fibrous material, as spun silk or cotton, but preferably of asbestus or other fiber of non-conductive quality. We also employ the metallic spring conductor-piece J to conduct the current from the contact-plate B′ of Fig. 2 to the compressor screw or presser-plate. We may, however, make the pad H of fiber, coated or plated or polished with graphite or other conductor to a degree that shall be highly conductive, in which case we dispense with the spring conductor-piece J. When we use a pad of this quality, we do not use it as a resistance, but as a conductor of high conductivity and as a packing.

In Fig. 10 is shown a modification of the position of the spring conductor-piece J. This arrangement allows the pad to be more readily inserted into the cell and adjusted therein.

We may also use our elastic packing-pad at the bottom of the cell-chamber, as shown in Fig. 11, which figure is a section through the bottom of the cell similar to Fig. 2, to prevent the leakage of powder or other conductive substance of our resistance device through the channel x of the cell, in which case we gain an additional range of our compressor action. We may also use one or more pads at intermediate positions in our resistance device.

We do not confine ourselves to any particular arrangement of perforations in our regulating-plates, nor to any particular sizes or shapes of the perforations, as our invention admits of many modifications in these respects. For example, Fig. 4 shows a pair of adjacent regulating-plates, one being perforated centrally and the other along its edge, an arrangement calculated to provide a very long route for the current through our resistance device. Also in Figs. 5, 6, and 7 we show how in a single regulating device we can alter the initial power of resistance of said device without increasing or diminishing the materials composing said device—*i. e.*, by simply readjusting one or both plates, so that their corresponding perforations shall have different relative positions. It is obvious that in Fig. 5 the resistance would be less than in Fig. 6, and in the latter less than in Fig. 7, an increase due in each case to lengthening the route of the current. Also, in Figs. 8 and 9 we show what is practically one regulating-plate, but one composed of a double layer of the material or substance that we employ for our regulating-plates. In said figures one layer is assumed to be behind the other, but both layers are in contact and no adjacent regulating-plates of either single or double structure are shown. Said figures show that by readjusting one or both of said layers composing the double plate the common aperture may be increased or diminished in area, and the current through the aperture correspondingly varied in amount.

In action and office the modified regulating-plate of Figs. 8 and 9 is the same as the regulating-plate shown in other figures.

We do not limit ourselves to any particular number of regulating-plates that we may employ in our resistance device. We may employ more or less, according to the special purpose to be secured. Even one may in some cases serve the purpose. We may also provide special mechanism for rotating our regulating-plates about their axes to obviate opening the cell and removing any of the contents. We may also place a regulating-plate in contact with one or both of the contact-plates B and B′ of Fig. 2 on the inner side of said contact-plate, or we may place it similarly in contact with the presser-plate B^2 of Fig. 11.

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

1. A resistance device or mass of compound structure for electric currents, composed of electric conductive material and one or more perforated regulating-plates of lower conductivity, substantially as set forth.

2. A resistance device or mass of compound structure for electric currents, composed of electric conductive material arranged in alternate layers with one or more perforated regulating-plates of lower conductivity, substantially as set forth.

3. A resistance device or mass of compound structure for electric currents, composed of powdered graphite and one or more regulating-plates of perforated mica, substantially as set forth.

4. A resistance device or mass of compound structure for electric currents, composed of powdered graphite arranged in alternate layers with one or more regulating-plates of perforated mica, substantially as set forth.

5. In a rheostat, the resistance device or mass of compound structure, composed of electric conductive material and one or more perforated regulating-plates of lower conductivity and in combination therewith the contact-plates at the terminals of said structure, substantially as set forth.

6. In a rheostat, the resistance device or mass of compound structure, composed of electric conductive material and one or more perforated regulating-plates, together with the contact-plates at the terminals of the resistance device, in combination with the compressor-screw and the cell or receptacle, substantially as set forth.

7. In a rheostat, the combination, with the compressor, the cell, and the resistance device or material contained in the cell, of one or more elastic packing-pads and one or more presser-plates, substantially as set forth.

8. In a rheostat, the combination, with the compressor, the cell, and the resistance device or material contained in the cell, of one or more packing-pads of asbestus, and presser-plates B^2 and conductor-pieces J, substantially as set forth.

9. In a rheostat, the combination, with the compressor, the cell, the contact-plates, and the resistance device or material contained in the cell, of one or more packing-pads of arbestus fiber carrying a conductive substance, and of one or more presser-plates, substantially as set forth.

10. In a rheostat, a perforated regulating-plate of low conductivity, substantially as set forth.

11. In a rheostat, a perforated regulating-plate of mica, substantially as set forth.

12. In a rheostat, a regulating-plate composed of two or more layers of material of low conductivity, perforated, relatively, in a manner whereby the common aperture or apertures through said plates may be varied in area by varying the relative positions of contact of said plates, substantially as set forth.

13. In a rheostat, two or more regulating-plates perforated, relatively, in a manner to direct the electric current flowing through said perforations in a more or less devious route through the conductive material of said rheostat, substantially as set forth.

In testimony whereof we affix our signatures in presence of witnesses.

CHARLES DWIGHT SIGSBEE.
THOMAS S. HAYWARD.
FRANK S. ANDERSON.

Witnesses as to signature of Charles Dwight Sigsbee:

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Richard Rush.

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I. C. Hardin,
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