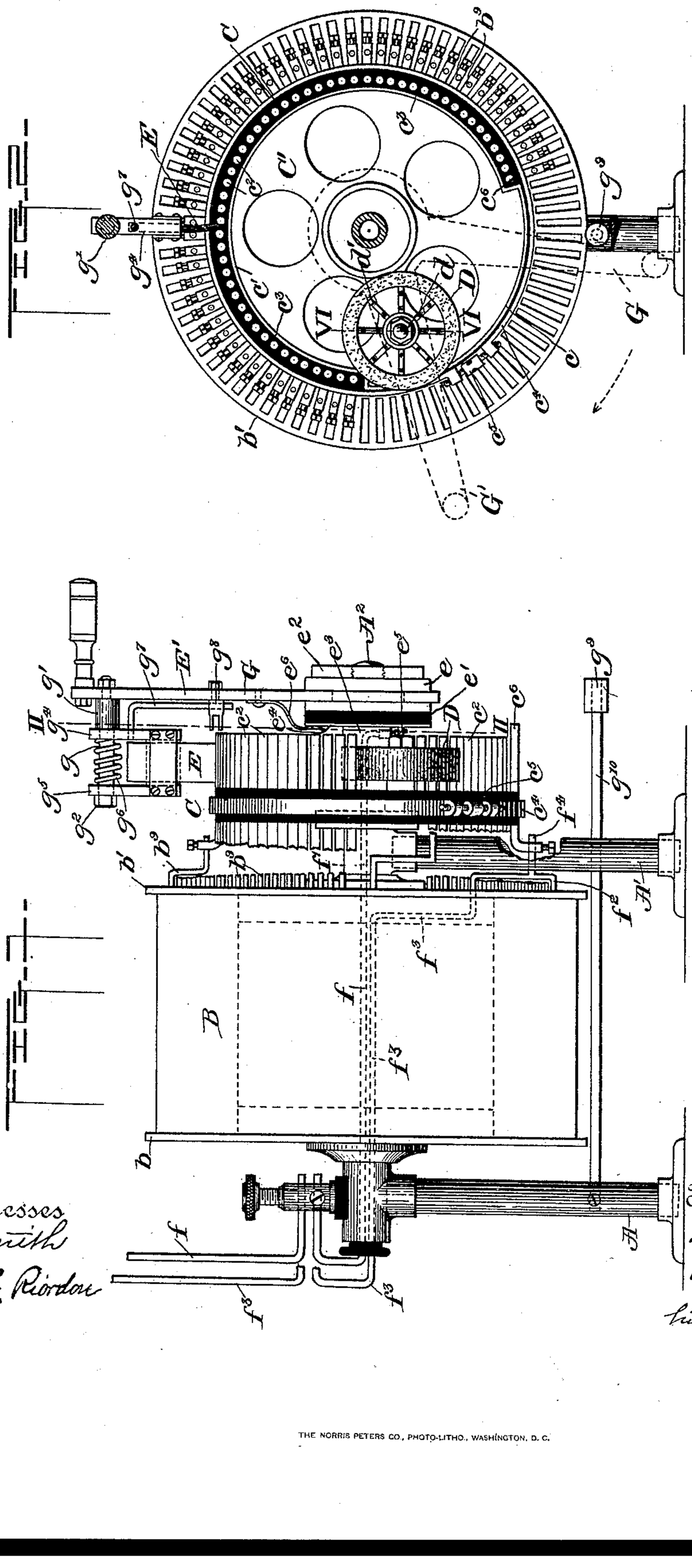
(No Model.) 2 Sheets—Sheet 1.

J. C. FYFE.

RHEOSTAT.

No. 528,539. Patented Nov. 6, 1894.



Witnesses
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(No Model.) 2 Sheets—Sheet 2.

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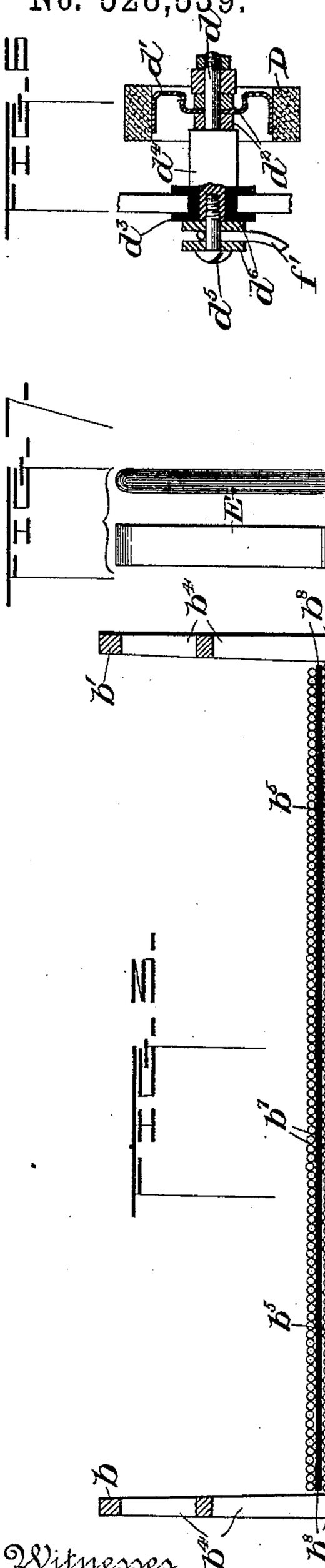

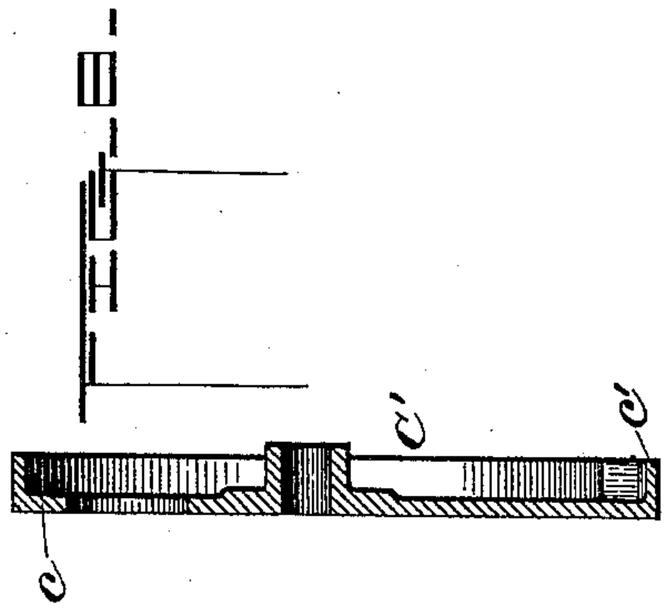

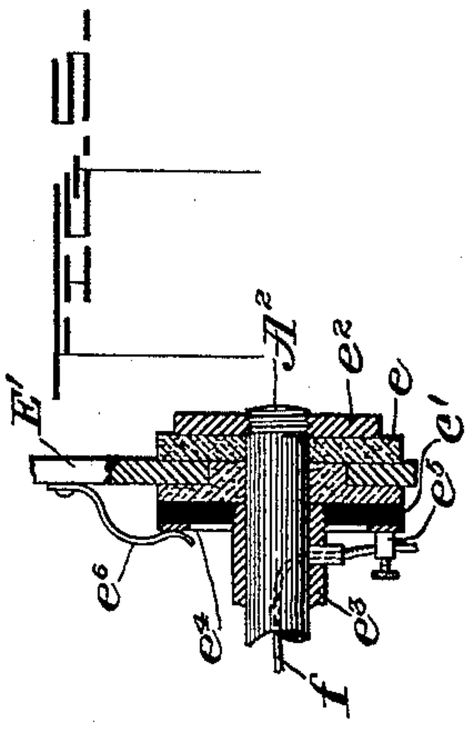

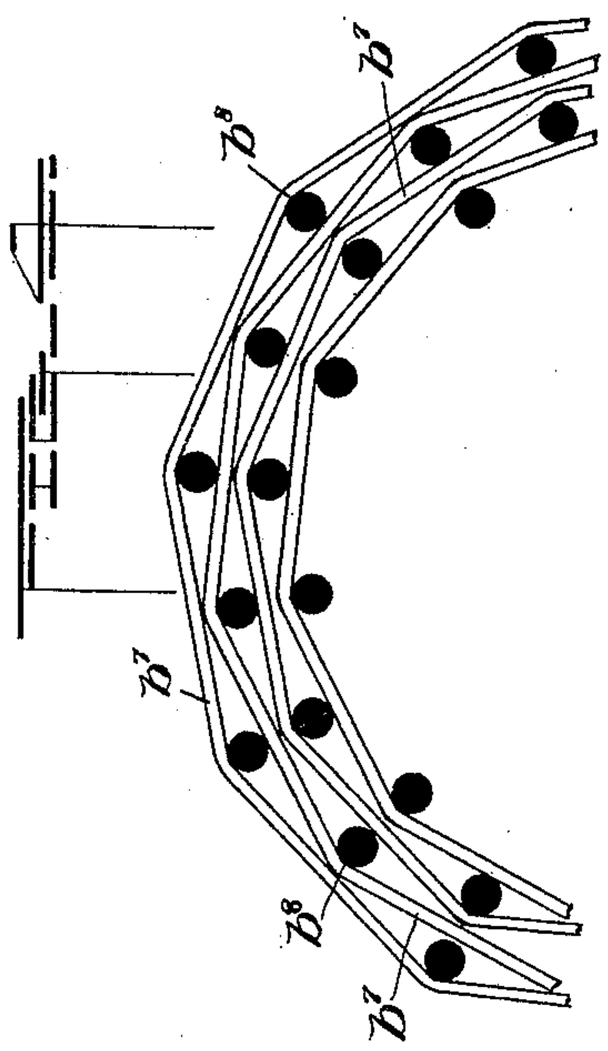

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UNITED STATES PATENT OFFICE.

JOHN C. FYFE, OF CHICAGO, ILLINOIS, ASSIGNOR OF ONE-HALF TO JAMES HAYES, OF SAME PLACE.

RHEOSTAT.

SPECIFICATION forming part of Letters Patent No. 528,539, dated November 6, 1894.

Application filed April 27, 1894. Serial No. 509,246. (No model.)

To all whom it may concern:

Be it known that I, JOHN C. FYFE, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Rheostats; and I 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.

My invention relates to improvements in rheostats and the method of insulating the parts which offer the resistance.

Primarily the object of my invention is to provide insulation for the resistance which will be comparatively fireproof; and which will permit free circulation of air around the resistance.

Other objects are to provide means for permitting the electricity to flow in varying quantities for use; to provide means for allowing free circulation of air within the resistance box or casing; and to rigidly suspend the wires or resistance and thereby prevent their coming in contact.

Further objects of the invention are to provide a commutator which will withstand high temperatures; to provide rigid but exposed commutator contacts having exposed connections between said contacts and the resistance loops; to provide a commutator the sections of which may be replaced without the destruction of said commutator; to provide a twist spring-controlled brush held in a yielding frame, and to provide an arc-rupturer in the path of travel of the brush.

With these objects in view the invention consists in the means and apparatus substantially as hereinafter described and particularly pointed out in the claims at the end of the description.

In the accompanying drawings, forming a part of this specification, Figure 1 is a side elevation of the invention with all but two of the resistance-loop connections and commutator sections broken away. Fig. 2 is a vertical sectional elevation taken on the line II—II of Fig. 1. Fig. 3 is a fragmentary longitudinal section through the resistance box or casing showing the manner of arranging the layers of resistance for ventilating same. Fig. 4 is a diagrammatic view on an enlarged scale illustrating the position of the layers with respect to each other, taken transversely of the arrangement shown in Fig. 3. Fig. 5 is a vertical section of the brush carrying arm, and its connection with the supporting shaft. Fig. 6 is a vertical section through the arc-rupturer taken on the line VI—VI of Fig. 2. Fig. 7 is a side and end view, respectively, of the commutator contact or brush; and Fig. 8 is a sectional view of the commutator skeleton plate or disk which supports the sections of the commutator upon the tubular shaft.

A, A′ designate standards having suitable bearings at their upper ends in which is held a shaft A^2. This shaft is preferably tubular and has secured thereto, between the standards, the resistance box or casing B having the skeleton frame plates b, b', in the rear and front thereof. The plates b, b', are provided with inwardly extending flanges or supports b^2 with openings b^3 below said flanges for the ingress of air, and openings b^4 above and located around the flanges or supports for the egress of air and for the passage of the resistance-loop connections, as will be hereinafter described. Upon the flanges b^2, extending in the plane of the axis of the casing and between the inner faces of the plates b, b', is a band of netting b^5 of suitable material and size which, with the plates, makes a reel of open-work. The reel or frame has the layers of resistance wire b^7 wound thereon, each layer being separated from the next adjacent layer by bars b^8, preferably made of slate, of suitable size and sufficient in number to separate said layers and prevent their touching each other. Each layer of slate bars alternates with the next adjacent layer which will arrange said layers at angles to each other, as shown in Fig. 4. The first layer of resistance is also separated from the band of netting by bars of slate, and each layer, at intervals of the proper resistance, has wires or resistance-loops b^9 extending outwardly through the openings b^3 of the plates b' to connect with the sections of the commutator. This construction and arrangement of the layers of resistance permits the circulation of air around said layers; but to materially aid in this ventilation I prepare the in-

sulation in a novel manner which is an important feature of my invention. Before winding the layers upon the frame or reel, the wire is caused to pass over or around pulleys, preferably grooved, located in a suitable vessel near the bottom thereof; the said vessel containing a solution of silicate of soda. The wire preferably has a covering of suitable material, usually cotton, and as the same passes around or over the pulleys through the solution of silicate of soda, the cotton will absorb or become saturated with said solution which enters the interstices of the cotton. The vessel is placed at a sufficient distance from the frame upon which it is to be wound to allow the soda time to become quite set or congealed. Thus, when the whole is wound, each layer will become a solid mass. The insulation permits the wires to take their proper positions consequently securing perfect uniformity and allowing the winding to be done very rapidly. When the winding of the resistance is completed the whole frame is placed in a drier and the temperature slowly raised to a sufficient height to burn the cotton or other combustible covering. The silicate becomes a glassy sponge or porous substance permitting ventilation, but rigidly retaining the wires in place in uniformity and safety from short circuiting or burning out.

C′ is a perforated disk or plate rigidly secured to the tubular shaft A^2 having a flanged periphery of varying diameter comprising an enlarged portion c extending about one quarter of its length, and a reduced or smaller portion c' extending the remainder of the length of the periphery. The smaller portion c' forms a rest or support for the commutor sections c^2, which are considerably longer than the disk is wide, and insulated from said disk and from each other by the insulation c^3. The insulation extends around the upper surface of the sections for a part of their length and around the portion c of the disk; the said sections and insulation being rigidly held to the disk by the band or binding strap c^4. The ends of the binding strap are drawn together by an oppositely threaded binding screw c^5, the ends of which engage the ends of the strap.

The arc-rupturer D is rotatably held upon a shaft or stud d in such position as to just prevent it coming in contact with the first section of the commutator. The arc-rupturer, best shown in Fig. 6, is preferably a cylinder or wheel made of carbon and is removably secured to the stud or shaft d by spring arms or spokes d' securely held between the collars d^2 which rotate on the stud. The stud is rigidly held to the plate C′ from which it is insulated by means of the insulation d^3 in which the stud d is held by the face of the collar d^4 abutting against the insulation and by a screw d^5 engaging the end of the stud and clamping the washers d^6 between the head and the insulation; the said washers and screw d^5 adapted to complete the circuit between the arc-rupturer and the resistance by the wire f' connected thereto, as will be hereinafter described.

The arc-rupturer D is arranged in the path of a movable brush or contact E carried by an arm E′ rotatably held but secured to the shaft A^2 by the insulation e which is held against the insulating collar e' by the nut e^2 arranged on the end of the shaft A^2. The insulation e' is secured upon a tube or sleeve e^3 secured to the shaft and is provided with a contact plate or ring e^4; the said plate having a binding post e^5 to which is secured the positive wire f. In positive engagement with the plate e^4 is a contact spring e^6 secured to the arm E′ and traveling therewith; the said spring e^6 being in engagement with the plate in whatever position the arm E′ may happen to be. The brush E, as shown in Fig. 7, is composed of plates or leaves of varying lengths. These plates or leaves when assembled form a V-shaped brush which extends between the sections of the commutator so that when said brush is moved, as shown in Fig. 2, the plates will separate and the shorter leaves or plates will engage the next adjacent section without breaking the contact, thus securing proper contact between the commutator sections. The brush is arranged upon the outer end of the arm E′ and is yieldingly held upon a stud g secured to said arm. The stud g has an abutting collar g' and a nut g^2 between which is held a yoke g^3 having the two arms g^4 and g^5 which are pressed against the collar and nut respectively by the spring g^6 for the purpose of keeping them in contact. The yoke has the brush E secured thereto and is yieldingly held on the stud g by the twist spring g^7 engaging said yoke and extending downwardly to loosely engage a projection or post g^8 secured to the brush carrying arm E′; the end of said spring adapted to pass through an aperture in the post. This post or projection g^8 serves a double purpose by having a bifurcated arm to form a contact with one of the commutator sections as will presently appear.

When the rheostat is not in use the brush-carrying arm is thrown to the position shown in dotted lines at G of Fig. 2, in which position the said arm rests against the rubber cushion g^9 secured to the end of the stop-bar g^{10}; the said arm being rigidly held in the standards A, A′.

To use the rheostat the arm E′ is moved in the direction of the dotted arrow till the brush comes in contact with the arc-rupturer, D, as shown in dotted lines at G′, at which time the circuit is complete. The current now passes through the positive wire f, Fig. 1, which extends through the tube or shaft A^2, and connects with the binding post e^6 of the contact plate e^4 through which the current passes by the contact spring e^6 to the brush-carrying arm E′, thence through the stud g, yoke arms g^4, g^5, brush E, arc-rupturer D, spokes d', stud d, screw d^5, washers

d^6, wire f', which connects with the first layer of resistance wires, through the several layers, the wire f^2, which is the terminal of the last layer, to the negative wire f^3, by which it is conveyed for the purposes required, but in necessarily small quantities determined by the amount of electromotive-force divided by the resistance. Should the arm E′ be moved the brush E as it passes the center of the arc-rupturer will tend to revolve the same by the action of the twist spring g^7 tending to return the brush to its normal position. This arc-rupturing being in close proximity to the first section of the commutator the shorter leaves of said brush will contact with this section before the longer leaves or plates leave the carbon wheel D. By continuing the rotary movement of the arm E the amount of resistance will be gradually reduced consequently increasing the strength of the current till the last section c^6 of the commutator is reached. At this point a special contact is made by extending the end sufficiently to engage the bifurcated end of the post g^8, located on the arm E′. This will allow the entire current to be used, as none of the resistance will then be in circuit, the said current passing from the wire f, binding post e^5, plate e^4, spring contact e^6, arm E′, post g^8, commutator section c^6, and wire f^4, to negative wire f^3.

To gradually reduce the current strength and break the circuit, the brush-carrying arm is reversed and retracing its course over the commutator sections till the brush has reached the carbon wheel D the entire resistance will again be in circuit. It makes little, if any difference, how slowly the movement is made when the brush reaches a point on the carbon wheel opposite the center, the twist spring g^7 will cause the brush to suddenly revolve the carbon wheel and spring away to its normal position, thereby rupturing the arc without harm or destruction to any part.

The treatment of the insulated wire, as described, renders the layers of wire longer lived, for there is no combustible material to be destroyed, and the glassy sponge or porous material due to the excessive heating of the silicate of soda not only acts as an insulator or separator but as a ventilator as well.

The rheostat may not be confined to any particular form as this may be varied according to the position and place it is to occupy. It may be made to stand on end or in a narrow square or oblong place. The resistance may be wound on a square frame superposing the layers of resistance at angles to each other in which case less slate bars would be necessary. The resistance may be made of superposing layers of sheet iron or wire by placing insulation, preferably of cotton, saturated with silicate of soda, between each layer, then burning the insulation in any suitable manner, such as by properly connecting the parts and passing a current of electricity through the layers. This dispenses with mica, which is expensive, substituting therefor a cheaper insulation.

The brush carrying arm may be operated by a crank-handle or by a cable-sheave in which case the cable is provided with the usual stop-button instead of the stop-bar g^{10} to limit the movement of the arm. I may dispense with the slate bars; and the combustible covering on the wire may, in some instances, be dispensed with, though ordinarily I prefer and do use this covering. I may use other non-combustible material for saturating the combustible covering if desired. It is obvious that other changes may be made without departing from the spirit of my invention.

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

1. The method of ventilating and insulating layers of electrical conductors, consisting in separating said layers with silicate of soda and then subjecting same to heat sufficient to crystallize the silicate, substantially as described.

2. The method of ventilating and insulating layers of electrical conductors, consisting in separating said layers with insulation saturated with a solution of non-combustible material, then subjecting same to the action of heat sufficient to burn the insulation, substantially as described.

3. The method of ventilating and insulating layers of electrical conductors for rheostats and the like, consisting in separating said layers with insulation saturated with a solution of silicate of soda, then subjecting same to heat sufficient to burn the insulation, substantially as described.

4. The method of ventilating and insulating layers of electrical conductors for rheostats consisting in covering each layer with silicate of soda and separating each layer from the next adjacent layer, then subjecting same to heat sufficient to crystallize the silicate, substantially as described.

5. The method of ventilating and insulating layers of electrical conductors for rheostats, consisting in covering each layer with insulation saturated with a solution of silicate of soda, separating each layer from the next adjacent layer, and then subjecting the whole to the action of heat sufficient to burn the insulation, substantially as described.

6. The method of ventilating and insulating layers of electrical resistance for rheostats, consisting in passing the wire having a covering of combustible material through a solution of silicate of soda, then winding said wires to form each layer in a solid mass, then subjecting the whole to heat sufficient to burn the covering, substantially as described.

7. The method of ventilating and insulating the electrical resistance for rheostats, consisting in passing the wire having a covering of combustible material through a so-

lution of silicate of soda, then winding same in layers, separating each layer from the layer next adjacent, then subjecting the whole to heat sufficient to burn the covering, substantially as described.

8. An electric resistance consisting of a series of layers of wire arranged upon supports, each wire being insulated from the other and the supports of each layer being placed alternately, thereby arranging each layer at angles to the next adjacent layer and electrically connected to said adjacent layer, as and for the purpose described.

9. In a rheostat, the combination with the frame having the skeleton end plates carrying supports alternately arranged thereon, of a series of layers of insulated conducting material arranged upon the supports, each layer thereby being at an angle to the next adjacent layer and connected thereto, substantially as described.

10. In a rheostat, the combination with the frame having the skeleton end plates carrying supports thereon and having a band of netting arranged upon said supports, of a series of layers of insulated wire arranged around the band of netting; the said layers being connected to each other, substantially as and for the purpose set forth.

11. In a rheostat, the combination with the frame having end plates carrying supports thereon, of a series of layers of insulated conducting material connected to each other and arranged between the plates, and a series of layers of bars of slate each layer arranged alternately to separate the layers of conducting material at an angle to the next adjacent layer, substantially as described.

12. In a rheostat, the combination with the frame having the skeleton end plates carrying supports thereon, and a band of netting surrounding said supports, of a series of layers of insulated conducting material connected to each other and arranged around the netting, together with a series of layers of slate bars arranged to separate the layers of conducting material, substantially as and for the purpose described.

13. In a rheostat, a commutator composed of exposed sections removably connected to a support by a binding strap, the sections being insulated from said support and strap, the said strap being split and provided with lugs or up-turned ends in which is a bolt for tightening the same substantially as described.

14. In a commutator, the combination with the plate or disk having a varying diameter, of a series of sections arranged upon the portion having the smallest diameter and insulated therefrom, the said sections being secured to the disk by a binding strap which is insulated from the sections and the disk, substantially as described.

15. The combination with the commutator plate or disk and the stud secured thereto but insulated from said disk, of an arc-rupturer rotatably held upon said stud, substantially as described.

16. The combination with the commutator plate or disk having a stud secured thereto but insulated from said disk, of an arc-rupturer removably held upon a rotatable support arranged upon said stud, substantially as described.

17. The combination with the commutator plate or disk having a stud secured thereto but insulated from the disk, of a collar rotatably held upon said stud and having yielding spokes extending therefrom, together with an arc-rupturer removably held upon said spokes, substantially as described.

18. The combination with an electric resistance, of an arc-rupturing carbon wheel connected to the resistance circuit, as described, and adapted to be energized by a movable contact when engaging said wheel, substantially as described.

19. The combination with an electric resistance and the fixed contact sections connected thereto, of a movable contact and a rotatable arc-rupturer arranged in the path of movement of the contact and forming an initial and final contact of the series of sections, substantially as described.

20. The combination with an electric resistance and the fixed contact sections connected thereto, of a yielding movable contact and a rotatable arc-rupturer arranged in the path of movement of the yielding contact and forming an initial and final contact of the series of sections, substantially as described.

21. The combination with a movable arm having a stud secured thereto, of a brush carrying yoke pivotally held upon said stud, the said yoke having two arms which are pressed in electrical contact with portions of the stud, and a twist spring engaging the yoke and the arm to allow the yoke to yield on its pivot, substantially as described.

22. The combination with an electric resistance and a commutator comprising a number of fixed contact sections connected to the resistance, one of said sections being longer than the others, of a movable arm carrying a bifurcated contact to engage the longest section of the commutator to complete the circuit through that section, substantially as described.

23. In a rheostat, the combination with a stationary support, of a wheel or cylindrical arc-rupturer arranged to rotate on the support, substantially as described.

24. In a rheostat, the combination with a support, of a wheel arc-rupturer made of carbon arranged to rotate on said support, substantially as described.

25. In a rheostat, the combination with a series of exposed contacts or sections separated by insulation for a part only of their length leaving a space between the sections the remainder of their length, of a brush ar-

ranged to rotate around and contact with the sections and to one side of the insulation, the said brush being composed of a series of plates or leaves of varying lengths arranged to form a V-shaped end and yieldingly connected together, whereby the end of the brush may enter the space between the contacts so that some of the leaves may spread sufficiently to engage two adjacent sections to prevent an arc from forming as the brush leaves any one section, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

JOHN C. FYFE.

Witnesses:
JNO. L. BLAINE,
A. M. LEWY.