No. 803,451. PATENTED OCT. 31, 1905.

G. E. STEVENS.

RHEOSTAT.

APPLICATION FILED OCT. 1, 1904.

Fig. 3.

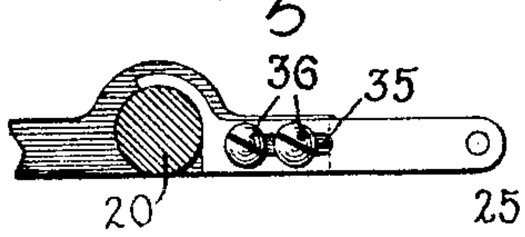


Fig. 1.

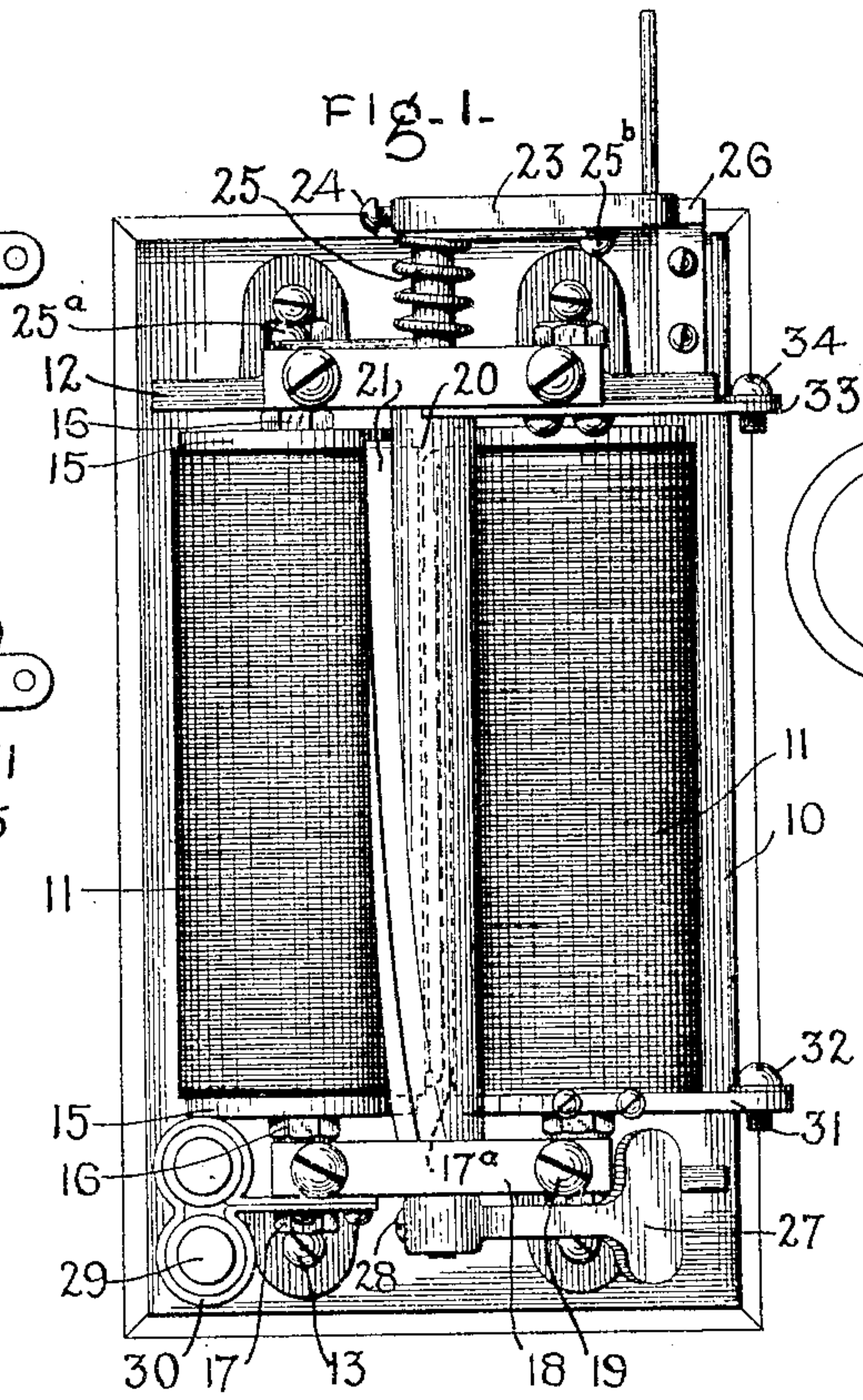


Fig. 4.

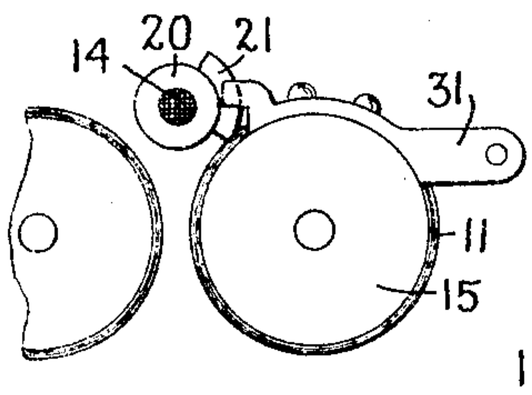


Fig. 5.

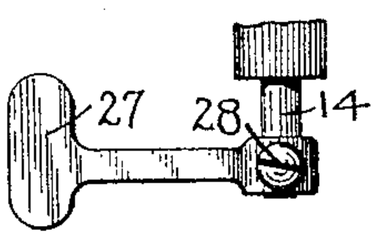


Fig. 6.

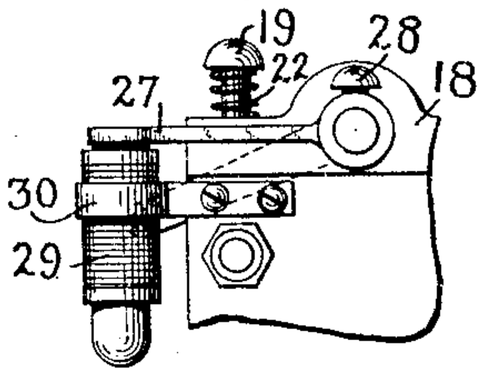
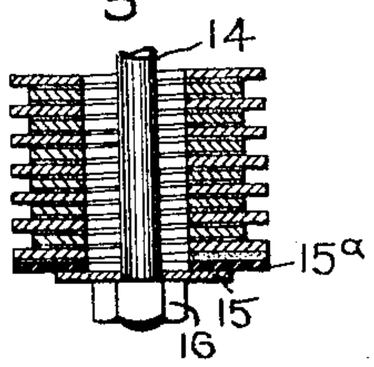


Fig. 9.



Witnesses:

Thaddeus E. Briggs.

Helen A. Forel

Fig. 2.

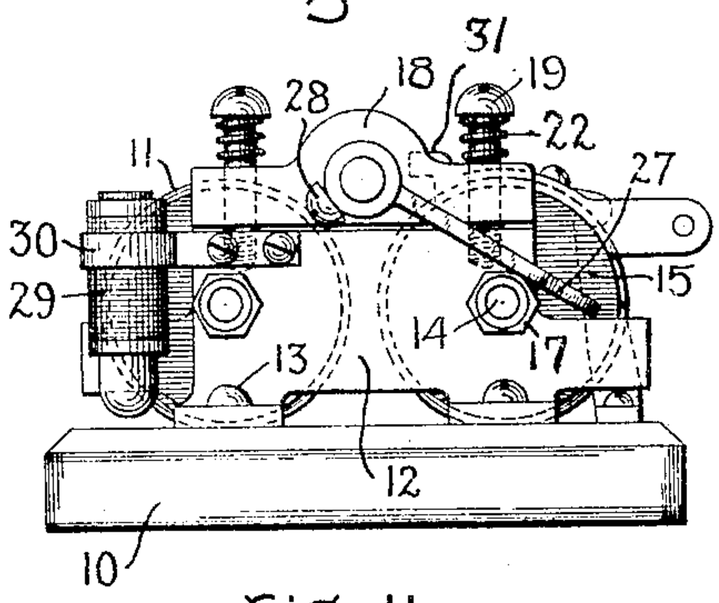


Fig. 11.

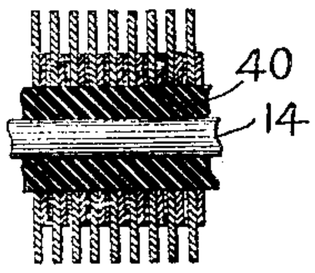


Fig. 7.

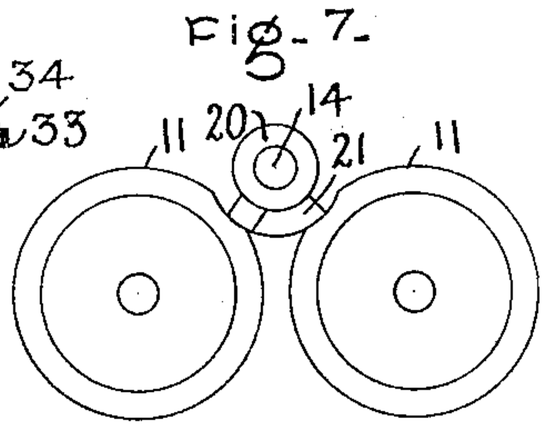


Fig. 8.

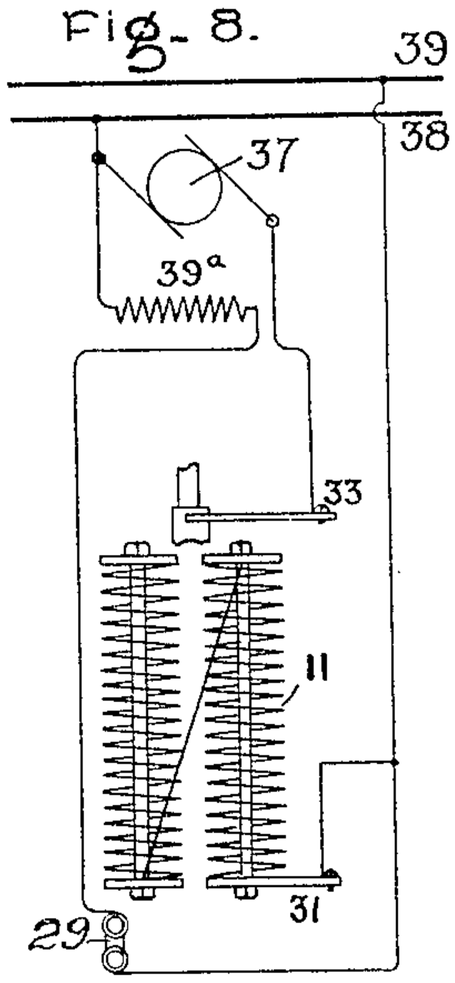
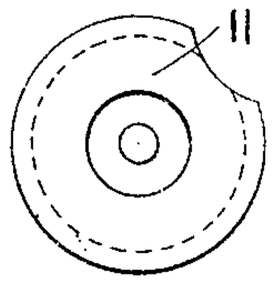


Fig. 10.



Inventor,

George E. Stevens,

By Albert G. Davis

Atty.

UNITED STATES PATENT OFFICE.

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RHEOSTAT.

No. 803,451. Specification of Letters Patent. Patented Oct. 31, 1905.

Application filed October 1, 1904. Serial No. 226,736.

To all whom it may concern:

Be it known that I, GEORGE E. STEVENS, a citizen of the United States, residing at Lynn, county of Essex, State of Massachusetts, have invented certain new and useful Improvements in Rheostats, of which the following is a specification.

The present invention relates to rheostats; and the principal object of the invention is to produce a rheostat which shall be of large capacity relative to its bulk, rigid and substantial in structure, efficient in operation, and cheap to manufacture. In pursuance of this object I preferably employ in the construction of the rheostat a resistance unit of the type disclosed and claimed in my prior application, Serial No. 193,713, filed February 15, 1904. This unit consists of a helical edgewise-wound conductor-ribbon having its turns insulated from each other and forced together so as to form a rigid tubular structure. The movable element of the rheostat comprises a contact which moves over the surface of the unit and progressively engages its turns to vary the resistance in circuit. In the specific embodiment of the invention herein disclosed two such units are mounted side by side upon a suitable base with an interposed rotary member, carrying a helical contact which engages the turns of the units successively.

The present invention also comprises an improvement in the coil structure above referred to by which its radiating-surface, and thereby its heat-dissipating capacity, is increased. This is accomplished by interposing between the turns of the helical conductor a heat conducting and dissipating medium, preferably consisting of an additional helical ribbon of greater width, thus providing two interleaved helical ribbons of different widths instead of the single ribbon. These ribbons also have their turns insulated and are pressed together to form a rigid unitary structure.

These and other features and advantages of my invention will be best understood upon reference to the following description, taken in connection with the accompanying drawings, in which—

Figure 1 is a front view of a rheostat constructed in accordance with my invention. Fig. 2 is an end elevation of the same, showing the retaining-magnet and its coöperating armature in "off" position. Fig. 3 is a detailed view illustrating an adjustable contact through which current is supplied to the helical contact member. Fig. 4 is a diagram illustrating the helical contact and the stop by which its movement in the forward direction is limited. Fig. 5 is a detail view of the locking-armature. Fig. 6 is an end view of a portion of the rheostat structure, illustrating the retaining-magnet and its coöperating armature in the locking position. Fig. 7 is a diagram illustrating the helical contact member in the mid-position. Fig. 8 is a diagram of an electric motor and its electrical connections with the rheostat. Fig. 9 is a sectional view of a portion of the modified resistance unit made up of conducting-ribbons of different widths. Fig. 10 is a diagram illustrating the manner of cutting such a unit so as to expose both ribbons to the coöperating helical contact, and Fig. 11 illustrates a modification in which the interior of the helix is filled with insulating material and adjacent wide and narrow ribbons are in electrical contact.

Referring in detail to the drawings, 10 designates a suitable supporting-base upon which the parts of the rheostat are mounted. The resistance units 11 are mounted side by side between the end lugs 12, which are secured to the base 10 by the screws 13. The resistance units 11 are constructed in the manner previously indicated by forming a thin ribbon of resistance-conductor into a helix by winding it edgewise. The turns of the helix are then drawn apart, and the whole is dipped into a bath of insulating material, preferably consisting of kaolin and silicate of soda in aqueous solution. The helix is then withdrawn, and the turns are forced together so as to squeeze out a portion of the adhering compound. A bolt 14 is then passed down through the winding and through end washers or plates 15, and the turns of the winding are forced together by means of the clamping-nuts 16, screwed onto the ends of the bolt. The unit is then allowed to dry and is subsequently baked. The resulting structure is an exceedingly compact and efficient resistance unit which may be heated to a red heat without danger to its electric continuity or its structure in any way, the intervening film of compound serving not only to insulate the adjacent turns of the winding, but also to cement them together, and thus increase the

strength of the structure. In forming the units in the present case insulating strips or washers 15[a] are interposed between three of the washers 15 and the adjacent ends of the winding, and the bolts 14 are separated from the latter by an insulating air-space, as shown in Fig. 9, or by an insulating compound, as shown in Fig. 11. The units 11 are secured to the supporting-lugs 12 by passing their bolts 14 through the lugs and holding them in position by suitable end nuts 17, and the lower end of the left-hand coil and the upper end of the right-hand coil are electrically connected by the wire 17[a], as indicated in dotted lines in Fig. 1. The lugs 12 also support bearings 18, composed of fiber or other insulating material, which are held in position by the screws 19, which pass freely through openings in said bearings and are screwed into the lugs, as clearly illustrated in Fig. 2. The bearings 18 carry the movable contact member 20, which is provided with a helical contact 21, which engages the outer edges of the turns of the helical conductors of the units 11. The outer surface of the resistance units may obviously be covered with a coating of a refractory cement or other insulating material except at the points engaged by the helical contact 21. In order to establish suitable electrical contact with the latter, a portion of the unit adjacent thereto extending throughout its length is exposed and preferably cut away in the manner illustrated in Fig. 7, so as to present a smooth surface and to insure contact with each of the turns of the winding. In order to provide in case of irregularity and to maintain a uniform pressure between the contact 21 and the resistance units, the screws 19 are provided with coil-springs 22, which bear against the under sides of their heads and the upper sides of the bearings 18, thus yieldingly forcing the movable contact into engagement. The upper end of the rotary member 20 is provided with an operating-handle 23, securely held in place by a set-screw 24 and coöperating with the spring 25 to rotate the member 20, the spring 25 being connected at one end to the adjacent bearing 18 by the screw 25[a] and at the other end to the handle 23 by the screw 25[b]. The movement of the member 20 in response to the pull of the spring 25 is limited by means of a stop 26, secured to the base and projecting outwardly so as to engage the outer end of the handle 23. An armature 27 is firmly secured to the opposite end of the rotary member 20 by a set-screw 28. This armature is positioned on the member 20 so as to engage the pole-faces of the locking or retaining magnet 29 when said member has been rotated far enough to cut out all the resistance of the rheostat. This magnet is secured in place to the lower supporting-lug 12 by any suitable means, as the strap 30. In addition to the armature 27, which serves to stop the rotation of the member 20 when its limiting position is reached, a stop 31 is also provided at the lower end of one of the resistance units 11. This stop is secured in a position to engage the helical contact 21 when the limiting position is reached. The stop 31 is provided at its outer end with a binding-screw 32 and serves as one of the terminals of the rheostat. The other terminal comprises a laterally-adjustable contact 33, provided with a binding-screw 34 and adapted to frictionally engage with the rotary member 20 near the upper end of the helical contact 21, as clearly illustrated in Fig. 3. The adjustment of the parts is provided by means of a slot 35 and the clamping-screws 36, which may be screwed down to hold the contact in position when once set.

The rheostat, as above set forth, may be connected up with a shunt electric motor in the manner illustrated in the diagram shown in Fig. 8. In this diagram, 37 designates the motor-armature, which is connected between one supply-lead 38 and the terminal 33 of the rheostat. The other rheostat-terminal 31 is connected directly to the other lead 39 of the circuit, and the retaining-magnet 29 and motor-field 39[a] are connected in series in a branch in shunt to the rheostat, as clearly illustrated.

In the operation of the device a partial movement of the rotary member 20 from the off position (illustrated in Fig. 1) will establish electrical connection between the helical contact 21 and a number of the uppermost turns of the helical winding of the left-hand unit 11. The circuit through the rheostat will then be completed as follows: from the terminal 33 through rotary member 20, helical contact 21 to lowermost turn of the left-hand resistance unit, which is in contact with the helical contact 21, thence through the remaining portion of the left-hand unit to the lowermost turn of said unit, thence through the connecting-wire 17[a] to the uppermost turn of the winding of the right-hand unit 11. The circuit is then completed through the winding of the right-hand unit to the lower washer 15 and the terminal 31. At the same time the retaining-coil 29 is energized by current passing through the shunt which includes it. When the operating-handle 23 has been moved far enough to cut out all the resistance in the left-hand coil, the upper end of the helical contact 21 will begin to engage the upper turns of the right-hand unit 11, and upon further movement these turns will be successively cut out until the parts are stopped by the limiting-stop 31. When this position is reached, the armature 27 will be in engagement with the core of the retaining-magnet 29 and the spring 25 will be held under strain. The pull of the magnet 29 will retain the parts in this position under normal current conditions. However, in case of a failure of

current or the occurrence of other conditions which will sufficiently deënergize the magnet 29 the rotary member will be released, and through the action of the spring 25 the parts will be returned to the off position.

For the purpose of increasing the radiating-surface, and thus increasing the current carrying capacity of the resistance unit for a given temperature rise, the units 11, constructed of a single ribbon-conductor, as heretofore described, may be replaced by a unit composed of resistance-conductor ribbons of different widths wound on edge and interleaved in the manner disclosed in Figs. 9 and 11. These ribbons may be completely insulated from each other in the manner illustrated in Fig. 9, or adjacent turns may be electrically connected, as shown in Fig. 11. It is obvious also that the interior of the unit may be left with an air-space around the retaining-bolt 14, or this space may be filled with any suitable insulating compound 40, as desired. The insulation is preferably an insulating-cement of the character hereinbefore referred to. In order to bring the helical contact 21 into engagement with both of the edgewise-wound ribbons where resistance units of such structure replace the units 11, it is necessary to cut away a considerable portion of the wider ribbon at the contact-point, as illustrated in Fig. 10. Where the conducting-ribbons are not completely insulated from each other—as, for example, in the modification shown in Fig. 11—it is not necessary to cut away the outer ribbon so as to expose the edges of the inner ribbon, since the two ribbons are in electrical contact. Where the ribbons of different widths are completely insulated from each other, as in Fig. 9, the current upon leaving the helical contact 21 divides, part going through one ribbon and part through the other. In this construction obviously the wide ribbon conductor will carry more current than the narrow conductor, since its resistance will be less. At the same time, it will radiate a greater proportion of the energy supplied to it, because a greater proportion of its exterior surface is exposed to the atmosphere. Consequently the wide ribbon serves as a heat conducting and dissipating medium through which the energy supplied to the narrow ribbon is conveyed to atmosphere. By reason of this construction the capacity of the unit for a given temperature rise is greatly increased. In operation the heat of the narrow ribbon is communicated in part directly to the atmosphere, since the outer edge of the ribbon is exposed to atmosphere, in part through the adjacent film of insulating material to the atmosphere, and in part through the wide conducting-ribbon to atmosphere. The wide ribbon serves the double function of conducting current and conducting heat from the adjacent narrow ribbon. The wide ribbon is, in fact, a heat-conductor having a greater surface exposed to the atmosphere than the narrow ribbon. In the construction of Fig. 11 the wide ribbon conducts heat from the narrow ribbon in like manner.

It is obvious that the multiribbon resistance unit herein disclosed is capable of use in other connections than in rheostats. It may equally well be employed in heating devices, dimmers, and the like. It is also obvious that many alterations and modifications may be made in the structure herein shown without departing from the spirit and scope of my invention. I therefore do not wish to be limited to the specific matter disclosed, but aim to cover by the terms of the appended claims all such alterations and modifications.

What I claim as new, and desire to secure by Letters Patent of the United States, is—

1. A rheostat comprising a resistance unit consisting of a helical insulated conductor having its turns continuously forced together to form a rigid structure, and a contact coöperating therewith to progressively engage the turns of the conductor.

2. A rheostat comprising a resistance unit consisting of a helical insulated conductor having its turns continuously forced together to form a rigid structure, and a coöperating contact movable over the surface of said unit to progressively engage its turns.

3. A rheostat comprising a resistance unit consisting of a helical insulated resistance having its turns continuously forced together to form a rigid structure, and a coöperating helical contact movable over the surface of said unit to progressively engage its turns.

4. A rheostat comprising a plurality of resistance units, each consisting of a helical insulated resistance having its turns continuously forced together to form a rigid structure, and a coöperating contact disposed between said units and movable over the same to progressively engage their turns.

5. A rheostat comprising a plurality of resistance units, each consisting of a helical insulated resistance having its turns continuously forced together to form a rigid structure, and a coöperating helical contact disposed between said units and movable over the same to progressively engage their turns.

6. A rheostat comprising two oppositely-disposed resistance units each having an exposed contact-surface extending throughout its length, and a coöperating rotary helical contact movable over said surfaces to vary the electrical resistance in circuit.

7. A rheostat comprising two parallel resistance units, each having an exposed contact-surface extending throughout its length, and a coöperating contact rotatable about an axis parallel to said units to engage their contacting surfaces to vary the electrical resistance in circuit.

8. A rheostat comprising two parallel re-

sistance units, each having an exposed contact-surface extending throughout its length, and a coöperating helical contact rotatable about an axis parallel to said units to engage their contacting surfaces to vary the electrical resistance in circuit.

9. A rheostat comprising a resistance unit consisting of a helical insulated conductor having its turns forced together to form a rigid structure, a coöperating contact movable over the surface of said unit to progressively engage its turns, an operating-handle, a spring for returning the movable contact to "off" position, and electromagnetic means for holding said movable contact against said movement.

10. A rheostat comprising two oppositely-disposed resistance units each having an exposed contact-surface extending throughout its length, a coöperating rotary contact movable over said surfaces to vary the electrical resistance in circuit, an operating-handle, a spring for returning said movable contact to off position and electromagnetic means for holding said contact against said movement.

11. A resistance unit, comprising a rigid tube consisting of a helical resistance material, a refractory-film insulation between successive turns, a heat conducting and dissipating medium interposed between turns of said helix, and means adapted to force said turns together.

12. A resistance unit, comprising a rigid tube consisting of two or more substantially helical resistance-conductors, a refractory-film insulation between the turns of said conductors, and means adapted and arranged to continuously force said turns together.

13. A resistance unit, comprising a plurality of interleaved helices of edgewise-wound resistance-ribbon of different widths having a refractory-film insulation between turns, a bolt passing down through the helices, and clamping-nuts on the bolt for forcing the turns of the ribbon together.

14. A resistance unit comprising a plurality of interleaved helices of insulated edgewise-wound ribbon of different widths, and means adapted and arranged to continuously force said turns together.

15. A resistance unit, comprising a helical edgewise-wound resistance-conductor, and insulation between the turns arranged so as to leave the edge and a portion of the adjacent flat sides of the turns exposed to atmosphere.

16. A resistance unit, comprising a helically-arranged resistance-conductor, and insulation between the turns extending only part way to the outer edge of the winding, thereby leaving a large heat-radiating surface.

17. A resistance unit, comprising a helically-arranged resistance-conductor and insulation between the turns engaging only a portion of the opposing adjacent surfaces thereby leaving a large heat-radiating surface.

18. A resistance unit, comprising a helical edgewise-wound resistance-ribbon conductor having an insulating-spacer between the turns engaging only a portion of the flat opposing surfaces of the turns thereby leaving a large heat-radiating surface.

19. A resistance unit, comprising a helical edgewise-wound resistance-ribbon conductor having an insulating-spacer between the turns engaging only a portion of the flat opposing surfaces of the turns thereby leaving a large heat-radiating surface, and means for forcing the turns together to form a rigid structure.

In witness whereof I have hereunto set my hand this 29th day of September, 1904.

GEORGE E. STEVENS.

Witnesses:
JOHN A. MCMANUS, JR.,
DUGALD MCK. MCKILLOP.