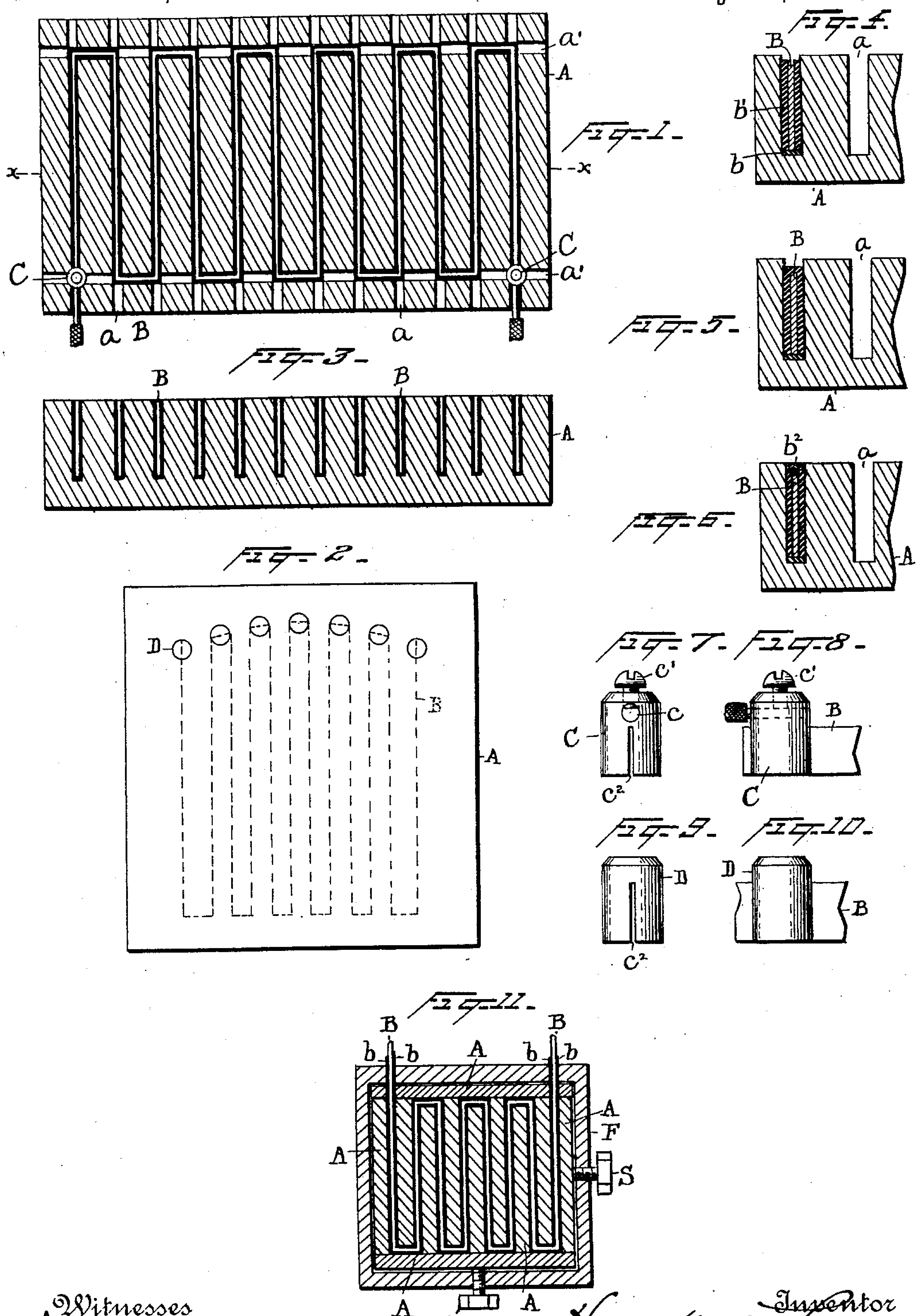
(No Model.)

H. W. LEONARD.

ELECTRIC RHEOSTAT OR HEATER.

No. 560,588. Patented May 19, 1896.



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HARRY WARD LEONARD, OF EAST ORANGE, NEW JERSEY.

ELECTRIC RHEOSTAT OR HEATER.

SPECIFICATION forming part of Letters Patent No. 560,588, dated May 19, 1896.

Application filed March 20, 1896. Serial No. 584,036. (No model.)

To all whom it may concern:

Be it known that I, HARRY WARD LEONARD, a citizen of the United States, residing at East Orange, in the county of Essex and State of New Jersey, have invented a certain new and useful Improvement in Electric Rheostats or Heaters, of which the following is a specification.

My invention relates especially to apparatus in which electric energy is intentionally converted into heat, such as electric heaters or rheostats; but my invention is also applicable to other apparatus in which electric energy is unintentionally converted into heat, such as the armatures of dynamo-electric machines or motors. In all such apparatus to secure the greatest lasting qualities it is desirable to keep the temperature of the conductor as low as possible consistent with accomplishing the result desired, and to secure the lowest first cost it is desirable to develop in the conductor the greatest possible number of watts consistent with keeping the temperature of the conductor within safe working limits. To secure the maximum efficiency in heaters, there must be the least possible difference of heat potential between the conductor and the working surface, and there must also be the least possible idle surface from which heat energy may be wasted. In my Patent No. 522,718 I have pointed out the desirability of having the conductor thinly insulated from and closely surrounded by a mass of metal.

The object of my invention is to so arrange the conductor in which the heat energy is developed that it will have the maximum radiating-surface for a given cross-sectional area, and to so combine such a conductor with the heat-absorbing material that the heat developed in such conductor will be rapidly transmitted to the heat-absorbing material, whereby the watt capacity of the conductor is greatly increased.

In the construction of rheostats or heaters I preferably employ a flat ribbon-like conductor, which is placed in close proximity to a large mass of material having a high specific capacity for heat, such as iron. This mass of iron I preferably provide with a series of deep narrow grooves or channels, in which the ribbon-like conductor is placed edgewise and separated from the mass of metal by insulating material.

My invention is illustrated in the accompanying drawings, in which—

Figure 1 is a plan view of a heater, showing the grooves cut into the mass of metal and the conductor placed edgewise therein. Fig. 2 is a plan view illustrating the application of my invention to a rheostat, the contact-lever and other movable parts being omitted. Fig. 3 is a cross-sectional view on the line x x of Fig. 1. Figs. 4, 5, and 6 are enlarged cross-sections illustrating the method of insulating the ribbon-like conductor from the mass of metal. Figs. 7 and 8 are elevations of the binding-posts to which the ribbon-like conductor is adapted to be attached and provided with the usual means for attaching the line-wires. Figs. 9 and 10 are elevations of contact-plates for rheostats, to which the ribbon-like conductors are adapted to be attached; and Fig. 11 is a modified way of placing the ribbon-like conductor in close proximity to a mass of iron.

Referring to the drawings, A is the mass of material having a high specific capacity for heat, such as iron, and this body of metal is provided with a series of deep narrow lateral grooves or channels a and longitudinal channels a'. These channels may be formed in the body A by casting them directly therein, or the channels may be milled out, as will be readily understood. The ribbon-like conductor B is placed edgewise in the channels a, the conductor being carried back and forth by being bent and set into the longitudinal channels a'. The two ends of the conductor in the case of the heater are attached to binding-posts C of the form illustrated in Figs. 7 and 8. Such binding-posts are provided with the usual hole c for receiving the line-wire and the screws c' for binding the wire in place, and in addition these posts are provided with slits c^2, into which the ribbon-like conductor is inserted, and the two legs of the binding-post thus formed are caused to clench the conductor B by applying pressure thereto. In the case of a rheostat the contact-plates D are provided with slits c^2, similar to the slits in the binding-posts, and the ribbon-like conductors are inserted therein and clenched, as just stated.

The conductor B may be insulated from the body of metal A in various ways, and the material employed may be any pyro-insulating material—such as asbestos, mica, enamel, or glass, difficultly-fusible powders, or any material which may be employed to insulate the conductors by a thin wall of permanent insulating material—and in many instances it is desirable to have the conductor hermetically sealed in place, so as to be protected from chemical action.

In Fig. 4 I have illustrated one mode of insulating the conductor B from the mass of metal A. In that figure, b indicates a layer of some highly-infusible material covering the bottom of the channel, which material may be mica, asbestos, or the material employed for producing the ground coat for enamel, or sheet-glass of a kind such as will not become too fluid when subjected to the heat of the subsequent steps in the process of manufacture may be employed. The space on each side of the conductor is filled by strips of glass b' or other material in sheet form, or such materials may be employed in powdered form, in either case the filling extending above the upper edge of the conductor. When the conductor is thus placed in position with its surrounding insulating material, the whole apparatus is subjected to heat sufficient to cause the insulating material to fuse, and, upon hardening, the conductor will be firmly attached to the mass of metal and hermetically sealed by the insulating material, as illustrated in Fig. 5. Instead of fusing the insulating material b', I may close the top of each groove with an insulating material b^2, Fig. 6, which will fuse at a lower temperature than the insulating-walls b', which material may be low-fusing enamel or glass, which when subjected to heat will fuse and hermetically seal the conductor in the groove. The insulating material should have a melting-point higher than the working temperature of the apparatus in practice and lower than the melting-point of the conductor and the supporting-body. For this reason vitreous materials, such as enamel, are preferable for the insulating material, particularly for insulating the sides and upper edge of the conductor from the supporting-body.

In applying my present invention to electrically-heated tools, such as flat-irons, I prefer to cut the channels a and a' quite deep, or, in other words, as close to the working surface of a flat-iron as is consistent with the necessary strength. The employment of the tape, strip, or ribbon-like conductor placed in channels cut in the supporting-body insures a uniform thickness of insulating material between the conductor and the supporting-body at all points, since the insulating material may be readily applied, and, as will be understood from the foregoing description, may be applied in such form as will insure the uniform thickness. This is of considerable advantage, since it is important that the flux of heat to the surrounding mass of metal should be uniform at all points to produce an efficient apparatus.

It is well known that a ribbon-like conductor of a certain cross-section and material will carry much more current at a certain temperature when exposed to the air than a round conductor of the same material and cross-sectional area. This is due to the much larger surface available for emitting the same amount of heat energy developed in the same length of conductor. The difficulty in the way of employing a ribbon-like conductor having the maximum surface for its cross-section is that the ribbon has little strength and rigidity and must be well supported throughout its length, and it is also very important to have its surface protected as far as possible from oxidation and other chemical action. I overcome these difficulties by my improved apparatus.

The great advantage in employing a ribbon-like conductor instead of a round conductor as, heretofore, may be shown by comparing a round conductor having a diameter of .05 of an inch with a ribbon-like conductor having the same cross-sectional area and a thickness of .002 of an inch, (which thickness I have found to be entirely commercial by experiment.) The cross-section of the round conductor assumed is about .002 of a square inch. The width of a ribbon-like conductor of .002 of an inch in thickness and having the same cross-sectional area as the round conductor will be one inch. In the case of the round conductor the available surface for emitting the heat energy per inch of length will be .157 of a square inch. In the case of the ribbon conductor the average distance the heat energy is conducted is the same as in the case of the round conductor, and the available surface for emitting the energy is two square inches for the same length of conductor. The conductivity for the heat energy through identical material will vary inversely as the distance through which the heat is conducted, and directly as the cross-section through which it is conducted. Hence the relative conductivity for heat in the case of the round conductor and the ribbon conductor will be as .157 is to 2 or as 1 is to 12.7.

Sometimes I prefer to take flat strips of metal to make up the walls adjacent to the conductor, and, after building up the apparatus, subject the whole to a pressure tending to press the conductor and the iron plates with the intervening layers of insulating material firmly together. This construction is illustrated in Fig. 11, in which A are the metal plates for absorbing the heat energy, B the ribbon-like conductor, and b the layer of insulating material. The metal plates with the ribbon-like conductor and the intervening layers of insulating material when placed together are mounted within a supporting-frame F, and by means of screws S the metal plates, the ribbon-like conductor, and the insulating material are pressed together into one solid mass.

What I claim is—

1. A ribbon-like conductor attached to a large mass of material having a high specific capacity for heat and insulated therefrom by a minimum thickness of insulating material, substantially as and for the purpose set forth.

2. A ribbon-like conductor attached to and practically surrounded by a large mass of material having a high specific capacity for heat and insulated therefrom by a minimum thickness of insulating material, substantially as and for the purpose set forth.

3. As a new article of manufacture, a rheostat or heater having a ribbon-like conductor attached to and insulated from a mass of material having a high specific capacity for heat, substantially as set forth.

4. As a new article of manufacture, a rheostat or heater having a ribbon-like conductor attached to and insulated from a large mass of cast-iron, substantially as set forth.

5. As a new article of manufacture, a rheostat or heater having a conductor of large surface and small cross-sectional area attached to but insulated from a large mass of material having a high specific capacity for heat, substantially as set forth.

6. An electric heater or rheostat consisting of a body of a material having a high specific capacity for heat and provided with deep, narrow grooves, in which is placed a ribbon-like conductor which is insulated from said body, and terminals to which said conductor is attached, substantially as set forth.

This specification signed and witnessed this 14th day of March, 1896.

H. WARD LEONARD.

Witnesses:
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