No. 827,455. PATENTED JULY 31, 1906.

H. W. LEONARD.

RESISTANCE DEVICE.

APPLICATION FILED MAY 13, 1905.

2 SHEETS—SHEET 1.

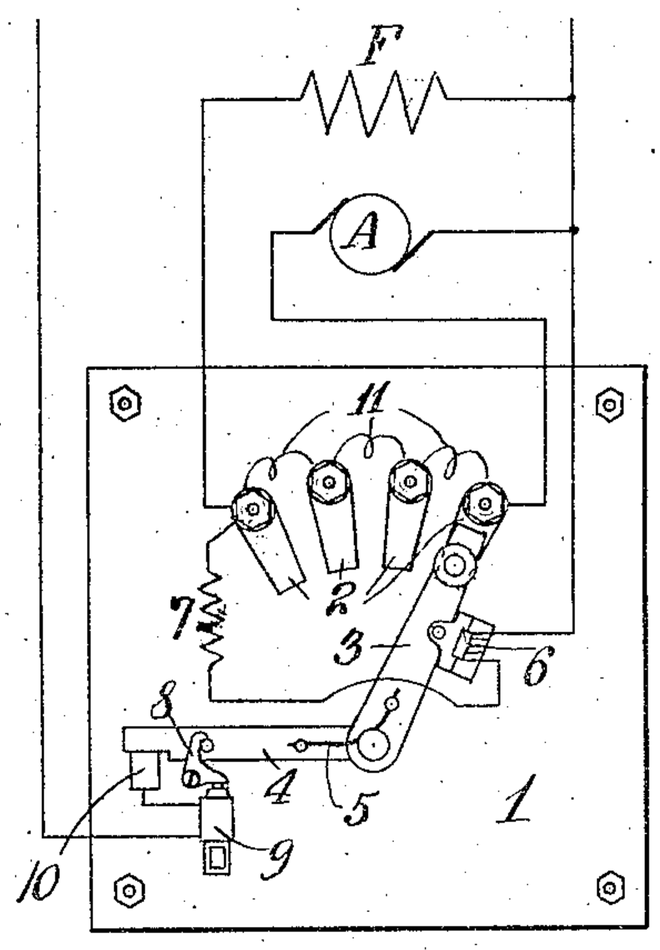

Fig. 1

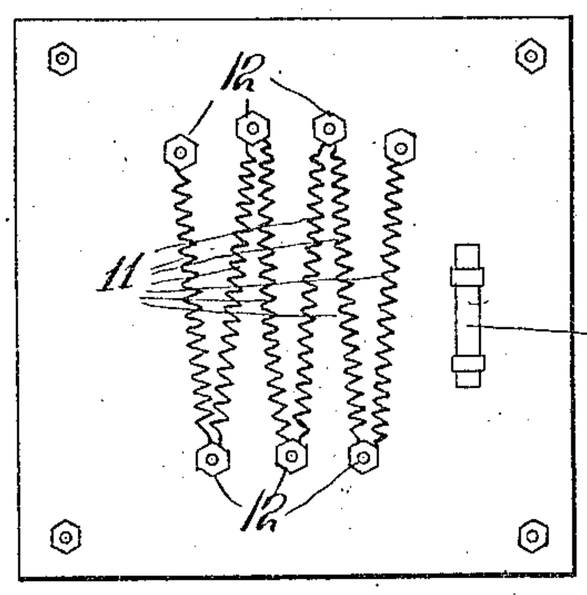

Fig. 2

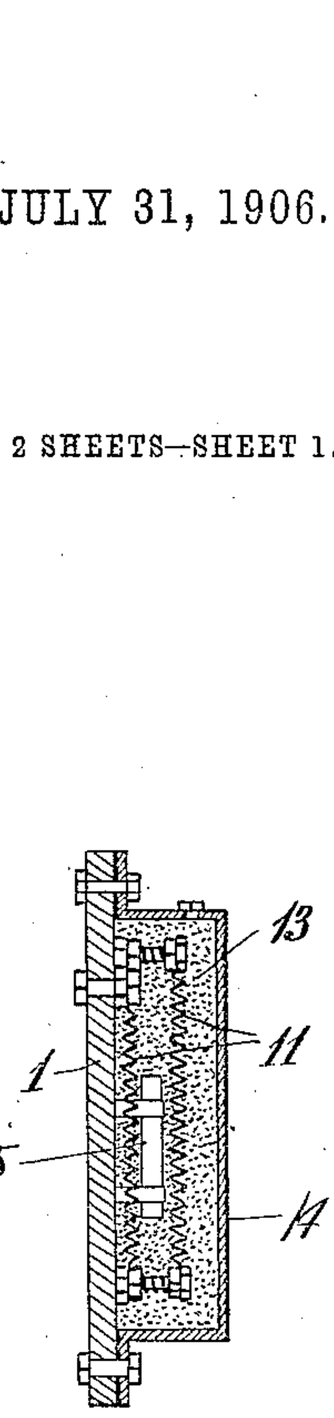

Fig. 3

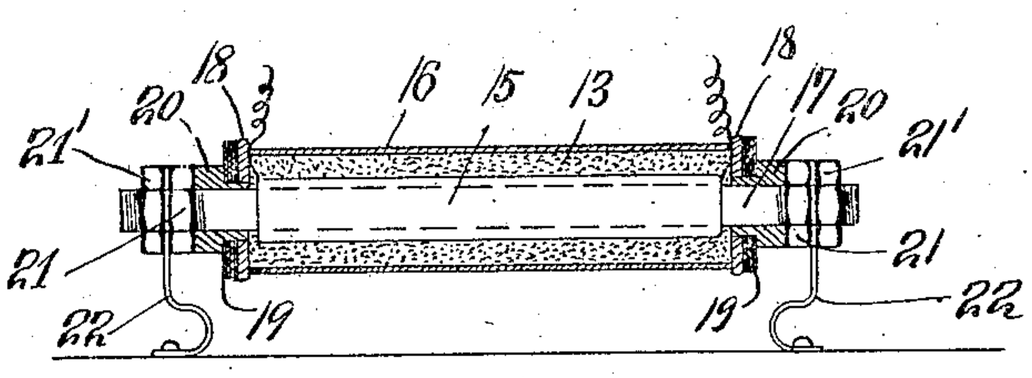

Fig. 4

Witnesses
L. R. Sager
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H. Ward Leonard Inventor
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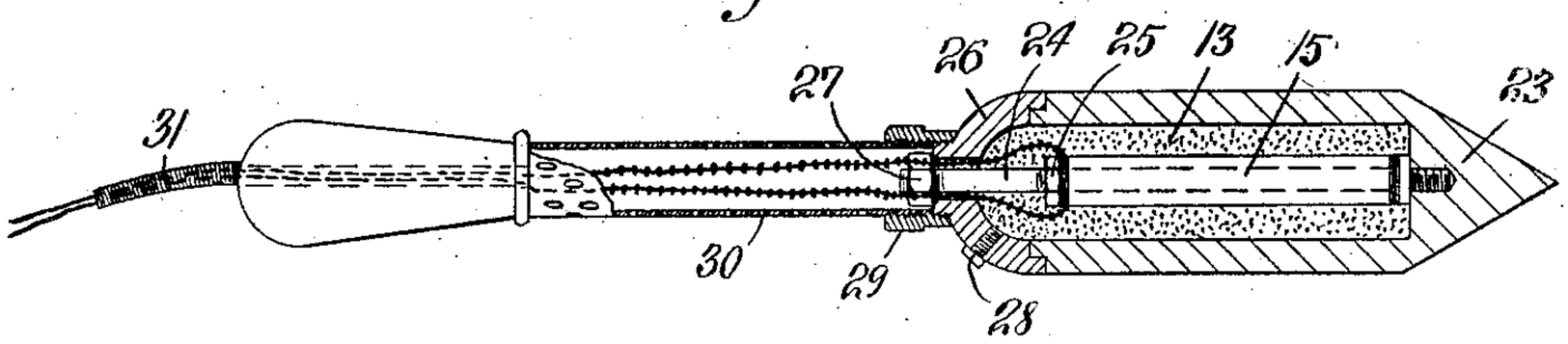
2 SHEETS—SHEET 2.

Fig. 5



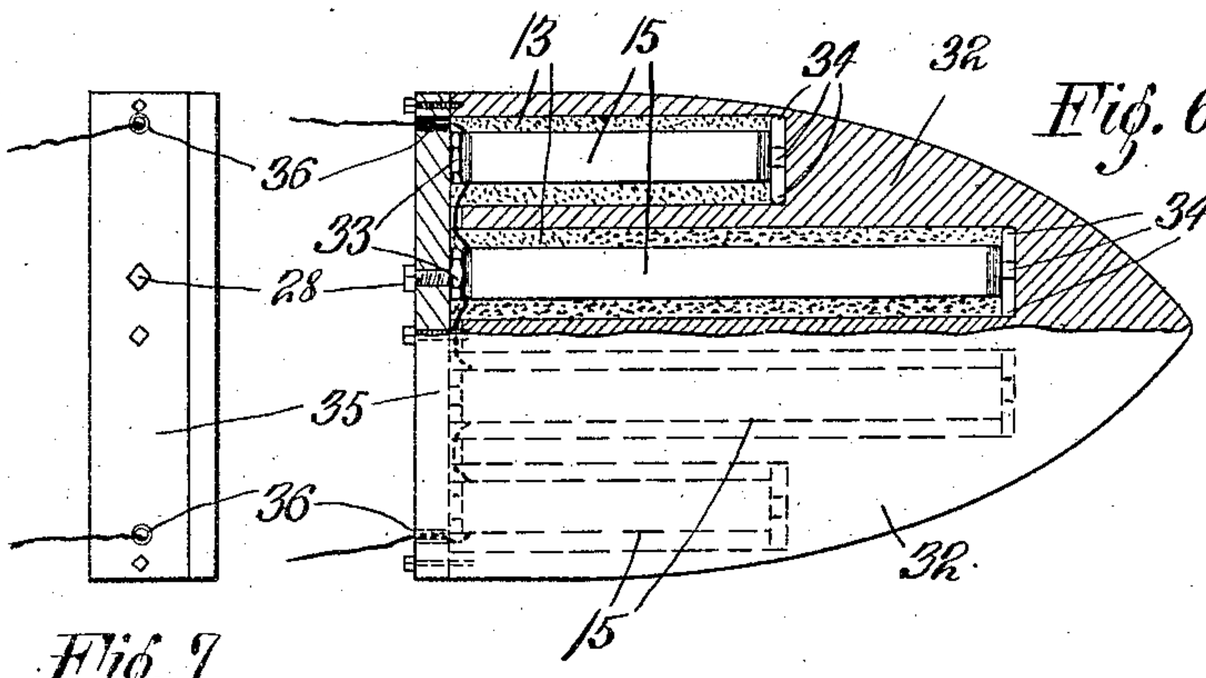
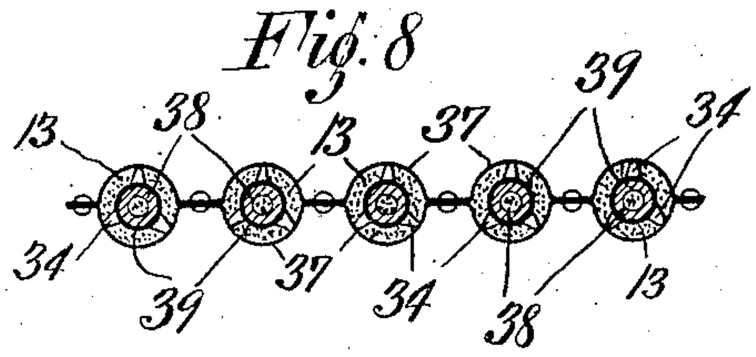


Fig. 6

Fig. 7

Fig. 8



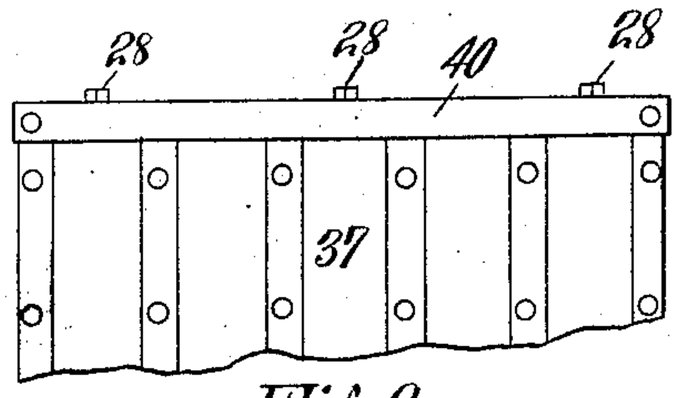


Fig. 9

Witnesses
L. K. Sager.
Geo. A. Hoffmann.

Inventor
H. Ward Leonard
By his Attorney
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UNITED STATES PATENT OFFICE.

HARRY WARD LEONARD, OF BRONXVILLE, NEW YORK.

RESISTANCE DEVICE.

No. 827,455. Specification of Letters Patent. Patented July 31, 1906.

Application filed May 13, 1905. Serial No. 260,197.

To all whom it may concern:

Be it known that I, HARRY WARD LEONARD, a citizen of the United States, residing at Bronxville, in the county of Westchester and State of New York, have invented certain new and useful Improvements in Resistance Devices, of which the following is a full, clear, and exact specification.

My invention relates principally to devices in which electric energy is intentionally converted into heat, such as resistance units, rheostats, electric heaters, &c.

My invention is particularly applicable to resistive conductors, which are formed of a fine wire and made of a material which is very susceptible to oxidation or equivalent chemical depreciation. When using a very fine wire, the resistance may be comparatively high; but to get the very high resistances desired in practice it is very advantageous to make the fine wire of a material having the highest possible specific resistance. The material I prefer to use which has a very high specific resistance is an alloy generally containing iron, manganese, or similar metal and which very rapidly depreciates if exposed to moist air, salt air, gases containing sulfur or other agencies, which might combine with the very susceptible material of the alloy. This is particularly true, in that alloys of this character are not very homogeneous in their nature, and consequently there are occasional places in such wires where the lack of homogeneity of the alloy results in this tendency to rapid chemical depreciation.

One way of protecting and supporting resistance-wires is by coating the wire with a vitreous enamel, which adhesively attaches the wire to a supporting-tube. When fine wires are employed, particularly when made of alloys above referred to, it is important to keep the heat of manufacture down to a minimum and to use the minimum number of successive heatings in order to reduce to a minimum the tendency of the alloy to deteriorate chemically. I have found that high-resistance tubes manufactured in this way, while satisfactory if kept in a dry place, will deteriorate comparatively quickly when exposed to moisture to some degree—as, for example, when used on shipboard. Although the enamel surface on the tube is apparently perfect and continuous, there are in many instances microscopic pin-holes or cracks in the enamel through which moisture might reach the sensitive fine wire, and this is probably the reason why protection from chemical depreciation is not perfectly attained with such construction. I have, therefore, found it necessary after manufacturing the high-resistance tube as carefully as possible to provide additional protective means which will remedy the difficulty above referred to. This I accomplish by surrounding the resistance-tube with a material which shall be practically non-hydroscopic. The material which I prefer to use for this surrounding material is a pure grade of white silicious sand, and this is preferably again surrounded by a casing which is hermetically sealed as perfectly as can be accomplished by ordinary processes, such as by a joint of putty or some equivalent material. With this construction I am able to employ wires which are as fine as can be drawn, even when made of alloys of very high resistivity above referred to. I thus obtain a very compact, inexpensive, and efficient form of resistance, which is desirable in certain types of apparatus. I have found that it is impossible to attain this result commercially by using a very fine wire of such material when merely embedded in sand, and also that it is impossible to attain the result when such a wire is protected by enamel or other character of coating. It is only by combining these fine wires embedded in a suitable coating with the surrounding sand or equivalent surrounding material that the result can be commercially attained. I prefer to use iron or steel for the inclosing case; but in some instances the case may be partially metal and partially non-metallic. I sometimes use a plurality of resistance units in one case.

One important application of my invention is in connection with the starting and protective devices for motors, as will be further explained. Other applications are in the construction of devices in which the heat developed in the resistive conductor must be efficiently conducted to the surface which is to be maintained at a high temperature, such as in certain forms of rheostats, soldering-irons, flat-irons, and cooking utensils.

In many cases it may be desirable to operate the resistive conductor under such conditions that the conductor is burned out in the course of time, and is expected to, and I therefore provide means for simply and quickly replacing the resistance unit. For

example, it may give better results to operate a soldering-iron at a high temperature and relatively short life and renew the resistance unit when it is burned out in a simple and inexpensive way rather than to attempt to make a soldering-iron which will not burn out.

My invention will be understood and will be explained with reference to the accompanying drawings, in which—

Figure 1 is a face view of a motor-starting device provided with protective means and showing the electrical connections. Fig. 2 is a rear view thereof with the casing removed. Fig. 3 is a sectional view of the starting device. Fig. 4 is a longitudinal sectional view of a single resistance unit having its own individual casing. Fig. 5 is a part-sectional and part-side view of a soldering-iron embodying my invention. Fig. 6 is a part-face and part-sectional view of a flat-iron embodying my invention. Fig. 7 is an end view of the face of the flat-iron. Fig. 8 is a sectional view, and Fig. 9 an elevation, of a modified form of my invention.

Referring to Fig. 1, the panel of the motor-starter, which is preferably slate, is indicated at 1 and is provided with resistance-contacts 2, over which the resistance-controlling arm 3 passes. The arm 3 is connected with the overload-switch 4 by a spring 5, tending to force them toward each other. The resistance-arm is retained in its final position by the no-voltage-retaining magnet 6, which is connected in an independent circuit across the line in series with a high resistance 7. In running position, as shown, the overload-arm 4 is retained by a latch 8, which is adapted to be tripped to release the arm by the overload-coil 9, the circuit then being broken between the arm 4 and the contact 10. The current passes from one supply-line through the overload-coil 9, contact 10, arms 4 and 5, through the armature resistance 11 when starting, and through the armature A to the other side of the line. The field-winding F is connected from the initial resistance-contact in an independent circuit across the line, and the no-voltage magnet 6 is also connected in an independent circuit across the line through the high resistance 7, as above stated. This form of connection is very advantageous as compared with connecting the no-voltage magnet 6 in series with the field-winding F, as has been common practice. A considerable difficulty is met with in providing an efficient and economic high resistance 7 for connecting in series with the no-voltage magnet, particularly on high voltages. My present invention is particularly applicable for obtaining the result desired, and by practicing the same I have no difficulty in obtaining satisfactory results with voltages of six hundred and upward.

The resistances 11 are shown in Figs. 2 and 3 as bare wire in spiral form suspending between studs 12. These may be arranged in any suitable manner, and in order to preserve their life and to increase their capacity are embedded in sand 13, the whole being inclosed by an iron casing 14. The resistance 7 is also placed within the casing and embedded in sand and is made up of a porcelain tube with a very fine wire wound thereon, the wire being made of an alloy having a very high specific resistance above referred to and embedded in a coating of vitreous enamel. The resistance-tube is indicated by the reference character 15 and is suitably fixed in position. An opening is provided at the top of the casing 14 for introducing the sand into the casing, which opening may afterward be closed with a screw-plug. The sand should be thoroughly dried before introducing into the casing.

By the above construction I not only secure the advantage of embedding the starting resistance in sand, but by combining in the same casing the enameled high-resistance unit I secure a commercial form of resistance adapted to be connected in the circuit of the no-voltage magnet across the line.

In Fig. 4 I have shown the enameled resistance unit 15 inclosed in an individual casing in the form of an iron tube 16. The resistance unit is supported in place upon a rod 17, and over the ends of the iron case 16 are placed caps 18, of asbestos, and sheet of mica 19. A porcelain bushing 20 fits within the mica and asbestos cap and serves as a guide for the rod 17. The terminals of the resistance unit are passed out between the ends of the iron case and the asbestos caps 18. The nuts 21 are threaded onto the ends of the rod 17 to hold the parts firmly together, and a support 22 is clamped between the nuts 21 and outer nuts 21′. The space between the resistance-tube and the inclosing case is filled with sand 13.

The soldering-iron shown in Fig. 5 is formed of the usual outer part 23, which in this case is hollowed out to receive the high-resistance unit 15 and which is surrounded with the sand 13. The resistance unit is supported on a rod 24, which passes into the end of the soldering-iron. The resistance-tube is held in position by the nut 25. A cap 26 is adapted to fit over one end of the soldering-iron and is fixed thereto by a nut 27 on the rod 24, which serves to clamp the parts together. The sand may be introduced into the chamber of the soldering-iron through the opening closed by the screw 28. Onto the part 26 is screwed a bushing 29, which in turn receives a perforated metal part 30 for dissipating the heat, so that it will not be transmitted to the handle. The leads from the resistance may pass through the soldering-iron through suitable openings out through the flexible guide 31 at the end of

the handle. The leads may be insulated and protected by glass beads thereon, as indicated. The flat-iron shown in Figs. 6 and 7 comprises a series of holes bored or drilled into the iron 32 and the enameled resistance units, which are supported one in each opening by a screw-bolt 33, which engages the inner end of the openings. The insulating-supports for the resistance are preferably provided with projections 34 at the ends in order to properly space and position the resistance units. The end of the iron is capped by a plate 35, which is removable and which is provided with lava bushings 36 for receiving the leads to the resistances. A screw 28 closes an opening adapted to be used for filling in the sand.

The form of resistance device shown in Figs. 8 and 9 is adapted for use in apparatus, such as a heater or a rheostat. This form comprises a casing composed of thin metal 37 in two similar parts, which when joined together form a series of tubular openings. Each opening is adapted to receive a resistance unit of the type described, having the tubular support 38 and a coating of enamel 39 for embedding the resistance-wire. The support 38 preferably has projections 34 for positioning the unit in the center of the opening. The remaining space is filled with the sand 13 or other suitable material. The leads from the resistance units may be passed through suitable notches or openings and protected by glass beads. The device is closed by caps 40 at the ends, a suitable joint being provided so as to seal the device as a whole. The screws 28 may be provided for permitting the insertion of the sand.

It will be understood that the resistive conductor, its support, its insulation, its protective material, the removable material, and the case may be varied in form and construction, and I therefore do not wish to have the scope of my invention limited, except as the claims indicate.

Having thus described my invention, I declare that what I claim as new, and desire to secure by Letters Patent, is—

1. The combination of a resistive conductor, a support for the same, a protective and insulating material embedding the conductor, and a casing inclosing, protecting and hermetically sealing the parts.

2. The combination of a resistive conductor, a support for the same, a coating embedding the conductor, an inclosing casing and a protective filling material surrounding the resistance unit within said casing.

3. The combination of a resistive conductor, a support for the same, a coating embedding the conductor, an inclosing casing and sand surrounding the resistance unit within said casing.

4. The combination of a tubular enameled resistance unit, the resistive conductor being of fine wire and an alloy having a very high specific resistance, an inclosing casing, and a protective filling material surrounding said resistance unit within said casing.

5. The combination of a tubular enameled resistance unit, the resistive conductor being of fine wire and an alloy having a very high specific resistance, an inclosing casing, and sand surrounding said resistance unit within said casing.

6. The combination of a motor-starting rheostat, a high resistance adapted to be connected in a circuit across the supply-line independently of the resistances of said rheostat, a single casing for inclosing the starting resistances and said high resistance, said high resistance comprising a resistance unit embedded in an adhesive protective insulating material, and a protective filling material within said casing and surrounding said starting resistances and said resistance unit.

7. The combination of a motor-starting rheostat, a high resistance adapted to be connected in a circuit across the supply-line independently of the resistances of said rheostat, a single casing for inclosing the starting resistances and said high resistance, said high resistance comprising a resistance unit embedded in an adhesive protective insulating material, and a filling of sand within said casing and surrounding said starting resistances and said resistance unit.

8. The combination of a motor-starting rheostat, a high resistance adapted to be connected in a circuit across the supply-line independently of the resistances of said rheostat, a single casing for inclosing the starting resistances and said high resistance, said high resistance comprising a resistance unit embedded in an adhesive protective insulating material, and a solid mobile insulating material within said casing and surrounding said starting resistances and said resistance unit.

9. A resistance device comprising an enameled resistance unit, sand surrounding said unit, and an inclosing casing, the said parts being adapted to permit the removal of said unit.

10. A resistance device comprising a resistance, a protective insulating material embedding said resistance, an inclosing casing, and a solid mobile insulating material surrounding said embedded resistance and within said casing.

11. The combination of a resistive conductor, a protective adhesive insulating material embedding the conductor, an inclosing casing, and an insulating protective filling of material interposed between said embedded conductor and the inclosing casing.

12. The combination of a resistive conductor, a protective adhesive insulating material embedding the conductor, an inclosing casing, and an insulating protective solid

mobile filling material interposed between said embedded conductor and the inclosing casing.

13. The combination of a resistive conductor, a protective adhesive insulating material embedding the conductor, an inclosing casing, and a filling of sand interposed between said embedded conductor and the inclosing casing.

14. The combination of a resistive conductor, said conductor being helically wound, adhesive protective insulating material embedded between the adjacent turns of said conductor, an inclosing casing, said embedded conductor being adapted for removal from said casing, and solid protective insulating material interposed between said embedded conductor and said casing.

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

H. WARD LEONARD.

Witnesses:
L. K. SAGER,
GEO. A. HOFFMAN