C. WIRT.

RESISTANCE UNIT AND METHOD OF MAKING THE SAME.

APPLICATION FILED JUNE 27, 1906.

994,355. **Patented June 6, 1911.**

Fig. 1

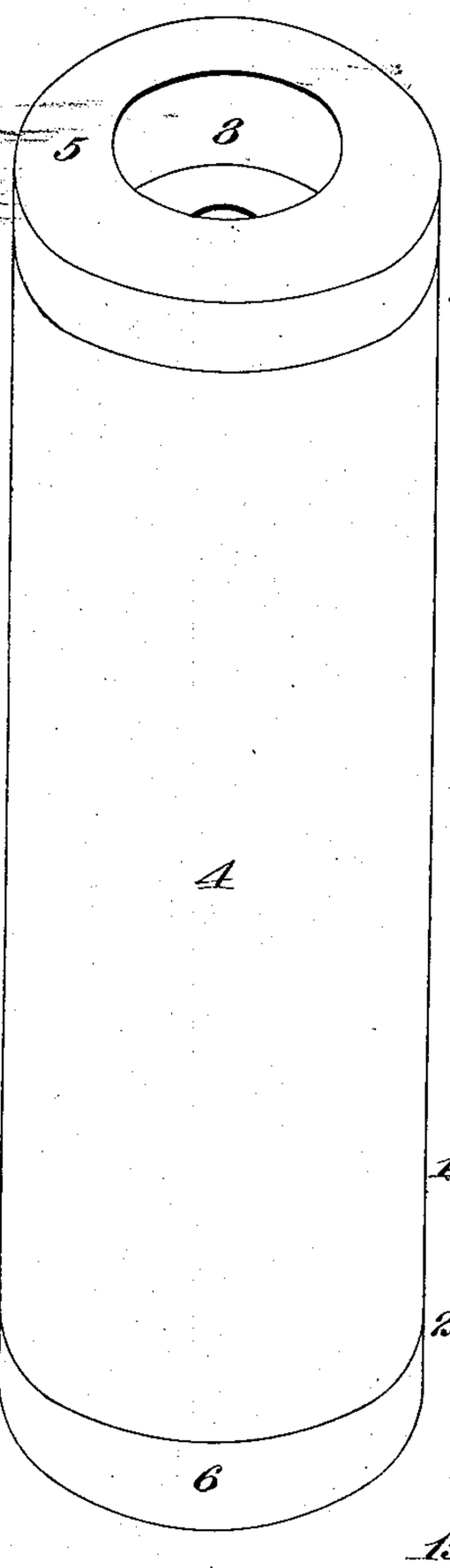


Fig. 3

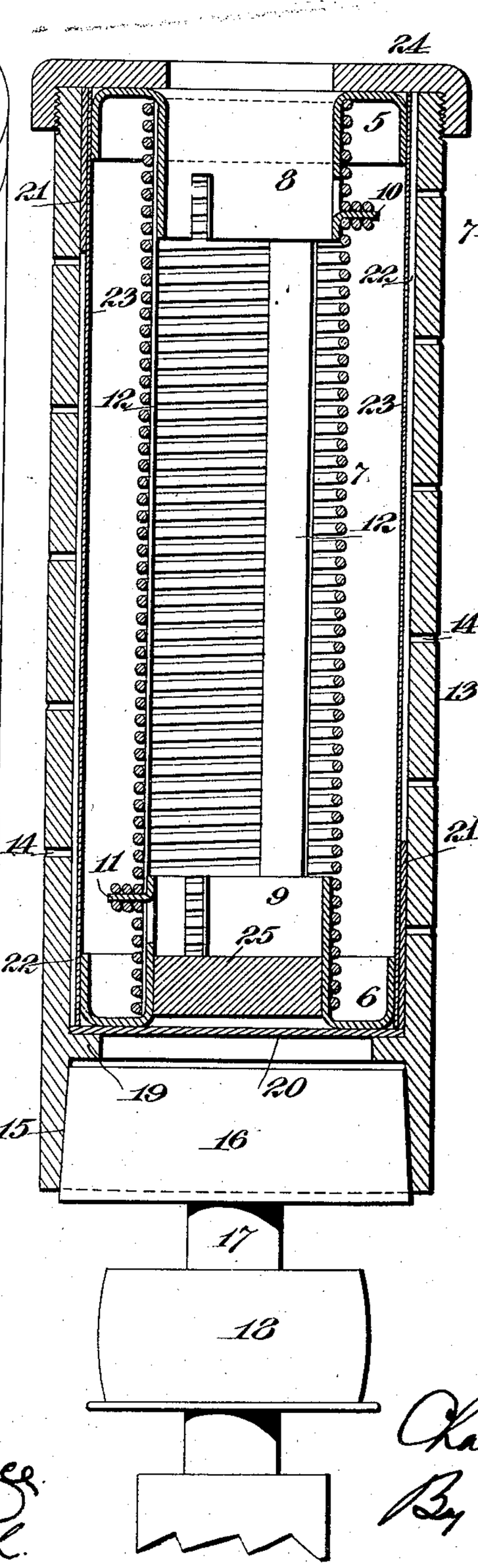
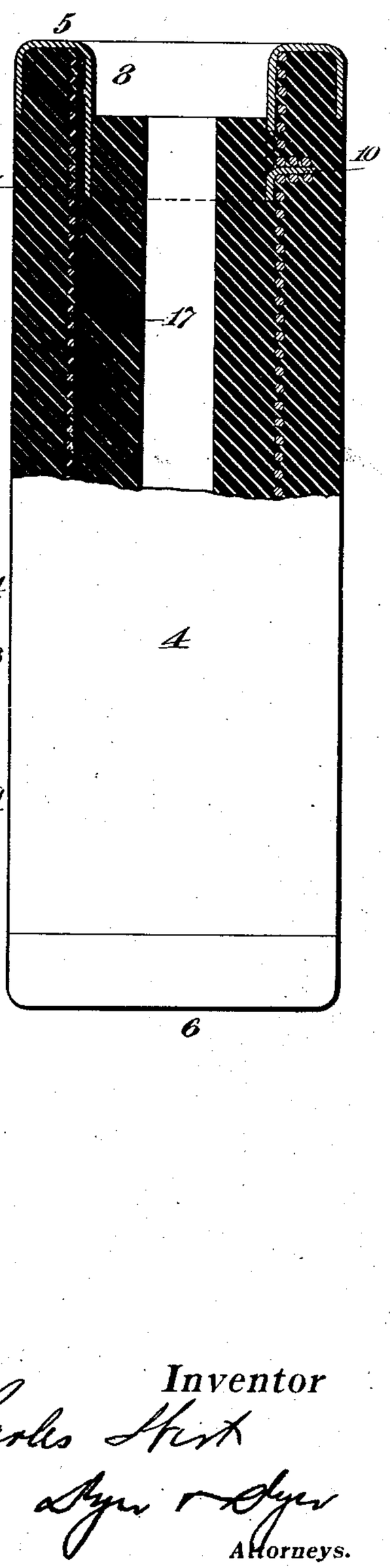


Fig. 2



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RESISTANCE UNIT AND METHOD OF MAKING THE SAME.

994,355. Specification of Letters Patent. **Patented June 6, 1911.**

Application filed June 27, 1906. Serial No. 323,747.

To all whom it may concern:

Be it known that I, CHARLES WIRT, a citizen of the United States, residing at Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented a certain new and useful Improvement in Resistance Units and Methods of Making Same, of which the following is a description.

The object I have in view is to produce a resistance unit which will be cheap to manufacture, convenient in form, not liable to injury in use, and having high insulating qualities.

My improved resistance unit consists of a cylindrical body of molded plastic material such as Portland cement, sand-lime or other artificial stone composition, the resistance wire being embedded in the walls of the molded cylinder and preferably connected with metallic caps which form the ends of the cylinder. The making of molded resistance units of this character involves many practical difficulties arising from the delicate and fragile nature of the resistance coil, the wire of which may be exceedingly fine, in some instances as small as .002 of an inch in diameter. These difficulties I have overcome by the employment of the centrifugal process of molding described in my co-pending application filed June 27, 1906, Serial No. 323,746.

The resistance coil supported upon a suitable frame and connected with the end terminals is inserted in a cylindrical mold of the proper size, which mold is adapted to be rotated at a high rate of speed, such for example as a speed of from 6000 to 7000 feet per minute at the periphery of the mold, and the plastic material in a semi-liquid form is introduced into the mold and the mold closed, when by the rotation of the mold the excess of fluid in the plastic material is expelled through the perforate side walls of the mold by centrifugal action, and simultaneously the plastic material in a solid form is cast against the side walls of the mold in the form of a cylinder, in which the resistance coil and portions of the end terminals are embedded. The rotation of the mold is then stopped and the molded cylinder with the resistance coil and end terminals embedded therein is removed from the mold, when it is subjected to a hardening process suitable to the material employed. The centrifugal action does not displace or distort the resistance coils notwithstanding their delicate character.

In the accompanying drawing, Figure 1 is a perspective view of the preferred form of resistance unit; Fig. 2 is an elevation, with the upper part in section, of the resistance unit; and Fig. 3 is a longitudinal section of the mold in which the plastic composition is molded upon the resistance coils, the resistance coils and the metal end terminals with which they are connected being also shown in section in the mold.

The several figures are made on an enlarged scale so as to clearly show the parts.

The resistance unit is composed of the cylinder 4 of molded plastic insulating material, preferably of the character of artificial stone, having metallic terminals 5, 6 and a resistance coil 7 embedded in the walls of the molded cylinder. The terminals 5, 6 are in the form of annular caps having inwardly turned edges, the inwardly turned inner edges forming cylinders 8, 9 upon which the ends of the resistance coil are wound. The cylinders 8, 9 are provided with outwardly turned metal tongues 10, 11, around which the ends of the resistance wires are twisted to fasten such ends.

The resistance coil is formed by placing the metal caps 5, 6 upon a suitable spindle at the proper distance apart; the resistance wire is then twisted at one end around the tongue 10, and is wound around the cylinder 8 of the cap 5, strips 12, preferably of mica, being laid on the outside of the cylinder 8 and bound thereto by the winding of the wire thereon; the wire is then wound in even coils over the spindle and over the mica strips 12 until the cylinder 9 of the cap 6 is reached, when the wire is wound upon such cylinder, binding the mica strips 12 thereto, and the wire is finally twisted around the tongue 11 and cut off. The mica from which the strips 12 are cut is shellacked on one side and the shellac allowed to dry, and the shellacked side of the mica strips is turned outwardly, so that the resistance wire is wound on the shellacked surfaces of the mica strips. After the winding is completed, the shellac is softened by the application of heat, causing the coils of wire to stick to the surfaces of the mica strips and maintain their uniform separation. The

mica strips form an open-sided insulating cylinder of sufficient strength to hold the resistance coil in place prior to and during the molding operation.

13 is a cylindrical metal mold having perforations 14 in its side walls. This mold is provided with a socket 15 at one end, which engages with a head 16 on a spindle 17, said spindle being adapted to be driven by means of a pulley 18, or other suitable means, at a high speed of rotation. The mold 13 is provided near its bottom with an internal shoulder 19, upon which rests a removable metal plate 20 forming the bottom of the mold. The mold is provided with a metal lining 21 having slits 22 extending from opposite ends so as to be expansible to remove the molded article therefrom; and in addition there is preferably employed in the molding operation a lining 23 of paper, which is placed inside of the metal lining 21. The top of the mold is provided with a screw-cap 24 for holding the skeleton frame and coil within the mold.

The bottom plate 20 is first inserted in the mold and then the metal and paper linings 21, 23 are placed therein, when the resistance coil and its end caps are inserted in the mold, such end caps filling the entire width of the mold laterally and contacting with the paper lining. Prior to the insertion of the resistance coil in the mold, a plug 25 of cork or other suitable material is inserted in the hole 9 of the cap 6 so as to close the outer end of such hole. The cap 24 is then screwed upon the upper end of the mold, pressing downwardly on the cap 5 and holding the resistance coil in place. The mold is then filled with the plastic material in a semiliquid state, and the hole 8 of the cap 5 is closed by a plug or cork similar to the plug 25. The mold is then rotated at a high speed, preferably such as to give a surface speed of from 6000 to 7000 feet per minute at the periphery of the mold. The effect of the centrifugal action produced by this high speed is to instantaneously expel the excess of water from the composition out through the side walls of the mold, and to cast the material in a solid cylindrical form against the paper lining, the resulting molded cylinder being shown in Figs. 1 and 2 and having a central opening whose diameter is dependent upon the amount of water in the composition. The rotation of the mold is now arrested, the mold is removed from the head 16, the cap 24 unscrewed from the end of the mold, and the molded article within the mold is pushed out of the mold by pressure upon the bottom plate 20, which forces out of the mold the metal lining 21, carrying with it the molded cylinder with the resistance coil entirely embedded therein and with the terminal caps 5 and 6 secured to the end of the molded cylinder. The metal lining 21 is then removed from the molded resistance unit, and the paper stripped off of the same. The molded resistance unit is then subjected to any hardening operation suitable to the material employed, and is finally coated inside and out with a moistureproof insulating coating. After this coating has dried, the resistance unit is ready for use.

The construction of the resistance unit herein described, wherein the resistance wire is wound in the form of a helix and is embedded in a cylinder of molded plastic insulating material, the axes of the helix and cylinder being coincident, is one possessing numerous practical advantages due to equable heating and expansion. Where the molded plastic insulation is in the form of a hollow cylinder and the resistance helix is embedded within and at or near the middle of the thickness of the wall of the cylinder, the strains due to sudden heating are materially reduced compared with the case where the resistance helix is placed upon or near either the inner or outer surface of the cylinder. The employment of the hollow cylinder is also advantageous, in that it enables the resistance unit to be increased in diameter without the excessive weight due to a solid cylinder.

What I claim is:

1. A resistance unit comprising a helical resistance coil, a cylindrical body of insulating material in which said coil and the ends thereof are entirely embedded, and terminals secured to the ends of said coil and partially embedded in the ends of said cylindrical body of insulating material.

2. A resistance unit having in combination a resistance coil, a skeleton frame of insulating material upon which such resistance coil is wound, and a body of molded plastic insulating material in which such resistance coil and its supporting frame are embedded, substantially as set forth.

3. A resistance unit having in combination a self-supporting cylindrical body of artificial stone composition, and a resistance coil wound upon a skeleton insulating supporting frame, such coil and supporting frame being embedded in the walls of such molded cylindrical body, substantially as set forth.

4. A resistance unit having in combination a self-supporting cylindrical body of molded plastic insulating material, a resistance coil embedded in the walls of such body, and metallic terminals molded in or on the ends of such body and connected with such coil, substantially as set forth.

5. A resistance unit having in combination metallic terminals, a skeleton insulating frame connecting such terminals, a resistance coil wound upon such frame and connected with said terminals, and a self-sup-

porting body of insulating plastic material molded around such resistance coil and frame and around portions of said terminals, substantially as set forth.

6. A resistance unit having in combination a self-supporting cylindrical body of molded plastic insulating material, a resistance coil embedded in the walls of such body, and metallic terminals molded in or on the ends of such body, and connected with such coil, said terminals having concentric flanges, an inner flange adapted to connect with and support a resistance unit, and an outer flange adapted to interlock with the insulating body to reinforce and protect the same.

7. A resistance unit having in combination a self-supporting cylindrical body of molded plastic insulating material, a resistance coil embedded in the walls of such body, and metallic terminals molded in or on the ends of such body, such terminals being in the form of annular caps having inwardly turned edges, the inwardly turned edges forming cylinders upon which the resistance coil is wound.

8. A resistance unit having in combination a self-supporting insulated body of molded plastic insulating material, a resistance coil embedded in the walls of such body, and metallic terminals molded in or on the ends of such body, said terminals being in the form of annular caps having inwardly turned edges, the inwardly turned edges forming cylinders upon which the resistance coil is wound, said cylinders being provided with outwardly turned metal tongues around which the ends of the resistance wire are twisted to fasten such ends.

9. A resistance unit having in combination a self-supporting cylindrical body of artificial stone composition, metallic terminals molded in or on the ends of such body, such terminals being in the form of annular caps having inwardly turned edges, these edges, forming cylinders, and a skeleton frame formed of mica strips laid on the outside of the cylinders, and a resistance coil wound upon the strips and which binds them to the cylinders.

10. The method of making molded resistance units which consists in placing strips previously shellacked on one side, with the shellacked sides turned outwardly and engaging the strips with end caps to form a skeleton frame, winding a resistance wire around the frame and softening the shellac by the application of heat, causing the coils of wire to stick to the surface of the mica strips, and maintain their uniform separation.

This specification signed and witnessed this 10th day of March, 1906.

CHARLES WIRT.

Witnesses:
RUTH KEE,
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