G. A. RICE.

RESISTANCE UNIT.

APPLICATION FILED APR. 18, 1922.

1,434,225.

Patented Oct. 31, 1922.

Fig. 1.

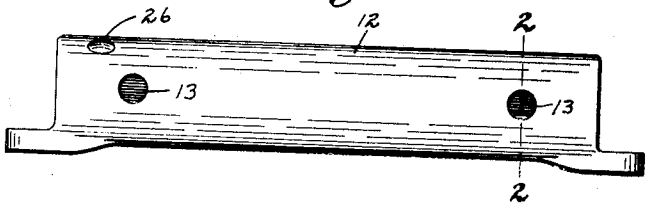



Fig. 2.

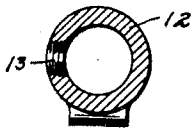



Fig. 3.

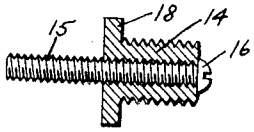



Fig. 4.

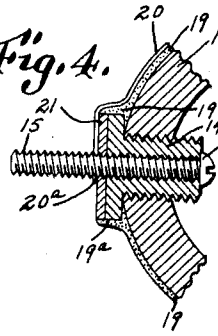



Fig. 5.

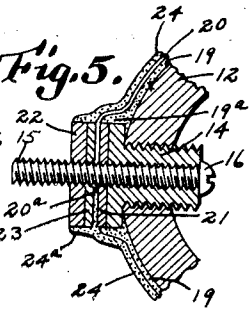



Fig. 6.

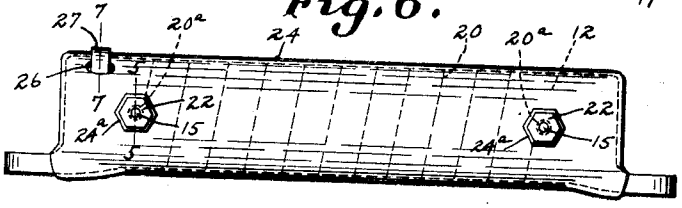



Fig. 7.

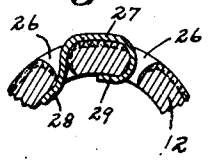
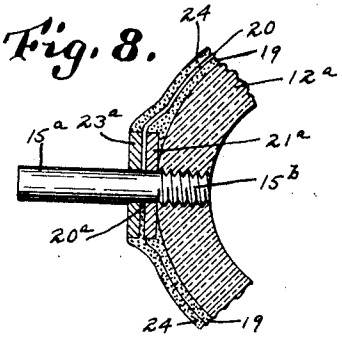



Fig. 8.




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Attys

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# UNITED STATES PATENT OFFICE.

GEORGE A. RICE, OF CAMBRIDGE, MASSACHUSETTS, ASSIGNOR TO ACME ELECTRIC HEATING COMPANY, OF BOSTON, MASSACHUSETTS, A CORPORATION OF MASSACHUSETTS.

## RESISTANCE UNIT.

Application filed April 18, 1922. Serial No. 555,110.

*To all whom it may concern:*

Be it known that I, GEORGE A. RICE, a citizen of the United States, residing at Cambridge, in the county of Middlesex and State of Massachusetts, have invented new and useful Improvements in Resistance Units, of which the following is a specification.

The object of the invention is to provide a resistance unit for electric circuits, of extremely strong and durable construction, adapted to form a self-contained unit for use either alone, or in connection with other similar units, the units being arranged and connected in series.

The invention is embodied in the improvements hereinafter described and claimed.

Of the accompanying drawings forming a part of this specification,—

Figure 1 is a side view of a rigid tube forming the body of my improved unit.

Figure 2 is a section on line 2—2 of Figure 1.

Figure 3 is an enlarged view of one of the inserts hereinafter described, shown partly in section and partly in elevation.

Figures 4 and 5 are fragmentary sectional views, showing different stages of the manufacture of the unit, Figure 5 being a section on line 5—5 of Figure 6.

Figure 6 is a side view of the completed unit.

Figure 7 is a section on line 7—7 of Figure 6.

Figure 8 is a view similar to Figure 5, showing an alternative construction.

The same reference characters indicate the same parts in all of the figures.

In Figs. 1 to 7, 12 represents a rigid tube, preferably of any suitable metal, although any other material providing suitable strength and rigidity may be employed. In one side of the tube and preferably near its opposite ends are formed lateral orifices 13. These orifices are filled by inserts, each composed of a bushing 14, of refractory insulating material, such as the material known as lava, of which gas-burner tips are ordinarily made, and a screw-threaded conducting terminal 15, filling the bore of the bushing, and preferably provided with a slotted head 16, seated on the inner end of the bushing, to prevent outward endwise displacement of the terminal. The bore of the bushing is preferably tapped to engage the external thread of the terminal. The terminal is therefore adapted to be screwed into the bushing, the screw-thread connection preventing accidental endwise displacement of the terminal in either direction from its operative position, so that the head or enlargement 16 is not absolutely essential.

The bushing 14 is engaged with the tube, so that it is not accidently displaceable endwise in either direction. I prefer to tap the orifices 13, and to provide the bushings with external screw-threads engaging the internal threads of the orifices, as shown by Figures 4 and 5. The bushings are preferably provided with heads or flanges 18, bearing on the external surface of the tube. The outer ends of the bushings form outwardly facing seats.

After engaging said inserts with the tube, I provide the external surface of the tube with an inner coating 19, of enamel, adapted to be fused by firing, and solified by cooling, and to constitute an insulating shell which has extensions $19^a$ covering the projecting marginal portions of the bushings. After solidifying the coating 19, I wind upon the same a resistance wire 20, to form a helix, the convolutions of which are spaced apart, as indicated by dotted lines in Figure 6. The end portions $20^a$ of the wire 20 are in contacting engagement with the terminals 15, and preferably bent around said terminals. Before engaging the ends $20^a$ with the terminals, I prefer to place inner metal washers 21 upon the terminals; and in contact with the seats formed by the outer ends of the bushings 14, the margins of said washers being covered by the portions $19^a$ of the inner coating 19, and the wire ends $20^a$ contacting with the washers.

The terminals 15 project considerably from the outer ends of the bushings, and upon the projecting portions are screwed clamping nuts 22, which confine the wire ends $20^a$. Preferably outer metal washers 23 are placed upon the terminals 15 before the nuts are applied, so that the wire ends $20^a$ are interposed between two washers, as shown by Figure 5. After the nuts have been screwed home to exert clamping pressure on the wire ends, I apply an outer coating 24 of enamel, said coating covering the convolutions of the resistance wire and the inner coating 19. Portions $24^a$ of the coating 24 cover the margins of the outer wash-

ers 23 and nuts 22. The firing of the outer coating 24 completes the unit, which is now in the condition shown by Figure 6, the terminals 15 projecting sufficiently to engage other clamping nuts, or connecters, whereby conducting wires contacting with the terminals may be secured.

It will be seen that the terminals 15 are rigidly secured to the tube 12, and that said terminals and the resistance wire are effectively insulated.

To identify the unit I provide the same with a tag, adapted to bear identifying indicia. The tube 12 is provided, between one of its ends and the adjacent convolution of the resistance wire, with two slots 26, located side by side. 27 represents a tag strip of copper, or other flexible material, having a bent end portion inserted in one of the slots 26, and including a tongue 28, bearing on a portion of the internal surface of the tube. The strip has an intermediate portion bridging the portion of the external surface of the tube between the slots, and a hooked portion 29 inserted in the other slot 26, and bearing on another portion of the internal surface of the tube, as shown by Figure 7. The desired indicia may be applied in any suitable manner to the intermediate portion of the strip.

As above indicated the screw threads of the terminals 15 are adapted to engage connecters, formed as clamping nuts adapted to engage conducting wires with the terminals. I am not limited, however, to screw-threaded terminals, as the connectors may be formed to have an operative engagement with the terminals by friction, and the terminals may be rods not provided with screw threads.

The structure which includes the bushings 14, is employed when the tube 12 is of metal, such as iron or steel, the bushings insulating the terminals 15 from the tube.

In case the tube is made of a ceramic material, or of any other suitable insulating material, the bushings may be omitted, as indicated by Figure 8, in which $12^a$ represents a tube of insulating material, and $15^a$ one of the terminals, which is here shown without a screw thread, and closely fitted in a lateral orifice in the tube.

The inner washer $21^a$ bears on the tube, and the end portion $20^a$ of the resistance wire 20 is interposed between this washer and an outer washer $23^a$.

The major portion of the resistance wire may contact directly with the external surface of the tube, when the latter is of insulating material, in which case the inner coating 19 may be omitted, the coating 24 being applied and fired, after the mounting of the wire, to form an insulating casing adhering to the tube between the convolutions of the wire and covering said convolutions, leaving the end portions $20^a$ of the wire exposed for connection with the terminals.

The terminals $15^a$ may be corrugated at their inner portions, as shown at $15^b$, and rigidly engaged with the tube $12^a$ by embedding the corrugations in the tube material while the same is soft, and then hardening the material by firing or otherwise.

The major portion of the resistance wire, while preferably coiled helically, may be otherwise disposed.

I claim:

1. A resistance unit comprising a rigid tube having lateral orifices, conducting terminals secured in said orifices and projecting from the tube to engage connecting devices, an insulating casing on the periphery of the tube, and a resistance wire including a major portion insulated by said casing, and end portions connected with said terminals.

2. A resistance unit comprising a rigid tube having lateral orifices, inserts filling said openings and composed of refractory rigid insulating bushings engaged with the tube, and conducting terminals engaged with the bushings, insulated by the bushings from the tube, and projecting outwardly from the bushings, to engage connecting devices, an inner insulating coating fired upon the tube, a resistance wire, including a major portion mounted on the inner coating, and end portions engaged with the projecting portions of said terminals, and an outer insulating coating fired upon the inner coating and covering the major portion of the resistance wire, said coatings forming an insulating casing in which the major portion of the resistance wire is embedded.

3. A resistance unit substantially as specified by claim 2, comprising also inner metal washers bearing on the bushings, and marginally covered by said inner coating, and outer metal washers bearing on the inner sides of the clamping nuts, and marginally covered by the said outer coating, the end portions of the resistance wire being interposed between said washers.

4. A resistance unit, substantially as specified by claim 1, the said tube being provided with slots arranged side by side, between one end of the tube and the adjacent end convolution of the resistance wire, the unit being provided with a tag composed of a flexible strip having a tongued end portion inserted in one of said slots and bearing on a portion of the inner surface of the tube, an intermediate portion bridging the external surface portion of the tube between the slots, and a hooked end portion inserted in the other slot, and bearing on another portion of the inner surface of the tube.

In testimony whereof I have affixed my signature.

GEORGE A. RICE.