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ELECTRICAL APPARATUS.
APPLICATION FILED JULY 2, 1913.

1,158,488.

Patented Nov. 2, 1915.

Fig. 1.

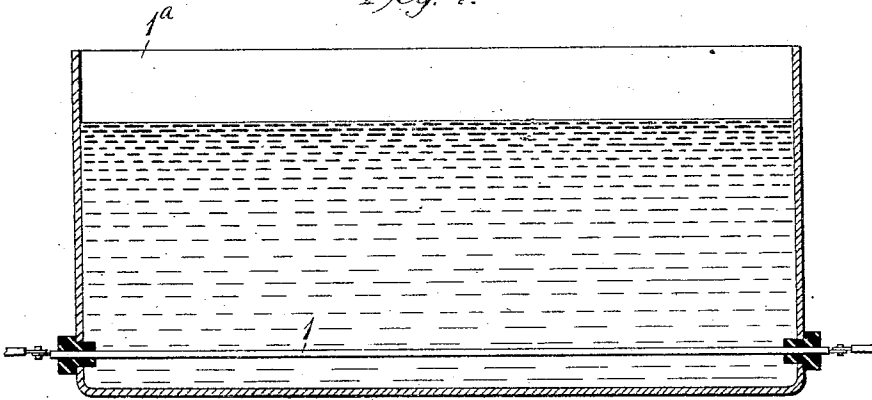


Fig. 2.

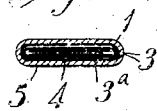


Fig. 3.

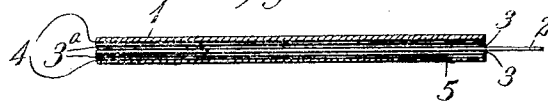


Fig. 5.

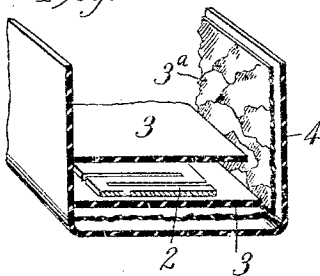
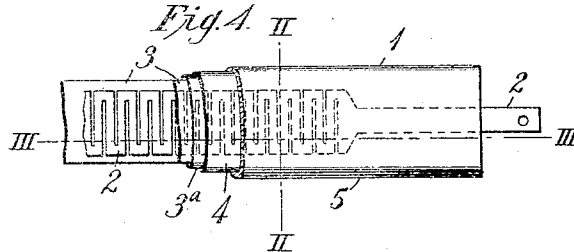


Fig. 4.



WITNESSES:

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ELECTRICAL APPARATUS.

1,158,488.

Specification of Letters Patent.

Patented Nov. 2, 1915.

Original application filed February 11, 1910, Serial No. 543,399. Divided and this application filed July 2, 1913. Serial No. 777,063.

To all whom it may concern:

Be it known that we, WILLIAM S. HADAWAY, Jr., and EDWARD E. ROSE, citizens of the United States, and residents, respectively, of New Rochelle, in the county of Westchester and State of New York, and Swissvale, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Electrical Apparatus, of which the following is a specification, this being a division of application, Serial No. 543,399, filed February 11, 1910.

Our invention relates to electrical apparatus and it has special reference to electric heating elements of the type adapted for immersion in a liquid.

One object of our invention is to provide an apparatus of the above-indicated character which shall be compact and durable in construction and efficient in operation.

Another object of our invention is to provide an electric heater unit which shall embody features that particularly adapt it for operation at a relatively high output per unit of weight and volume without deterioration of the parts.

In our co-pending application, Serial No. 543,399, filed February 11, 1910, of which this application is a division, we have shown and described the preferred embodiment of our heater units and have set forth their operation in a system of boiler heating. Hereinafter, therefore, we shall set forth only the construction of the heater unit itself, and it should be understood that many modifications in structural details may be made within the spirit and scope of our invention.

According to our invention, we provide an electric heater that embodies a conductor, a flexible dielectric cell therefor, and suitable heat-resisting insulating material disposed intermediate the conductor and the cell.

In the accompanying drawing, figure 1 is a view, in section, of a liquid-containing vessel embodying an apparatus shown in elevation and constructed in accordance with our invention; Figs. 2 and 3 are sectional views, on the lines II—II and III—III, respectively, of Fig. 4; Fig. 4 is an enlarged plan view, with parts broken away for clearness, of a heater unit shown in Fig. 1; and

Fig. 5 is a fragmentary perspective view of one of our heater units during the process of construction.

Referring to the drawing, a heater unit 1 is suitably embodied in a liquid-containing vessel 1^a and comprises a conducting member 2, insulating material 3 disposed adjacent thereto, a supporting cell 3^a, an insulating cell 4, and a suitable inclosing protective member 5.

The conducting member or resistance unit 2 comprises a strip or ribbon, the ends of which may constitute suitable terminals for the heater unit 1 and the intermediate portion of which may or may not be provided with a series of slots cut alternately in the opposite edges to provide a zig-zag path for electric current.

Ordinary insulating fabrics are unsuitable for embodiment in our heater unit since, in general, they are composed of materials, or contain materials, which become carbonized when subjected to high temperatures. If such materials are employed, after a short time they become incapable of withstanding high voltages since they are partially conducting when carbonized, and we accordingly provide the special combination of insulating materials 3, 3^a and 4, which permits of a high temperature and, consequently, a high heat output and which is preferably produced as follows: A molded cell 4 is first formed by building up white mica splittings, in the usual manner, a minimum amount of insulating varnish or other bonding material being employed. As shown in Fig. 5, the cell is molded into the form of a channel bar or strip having very thin walls. Relatively large white mica splittings 3^a are next spread over the inner surface of the cell, with their edges overlapping, until a mica lining of the desired thickness is produced. Two layers of clear white mica strips 3, which are cut to the exact width of the cell and are of uniform lengths, are next carefully placed within the layers of mica already provided, in such manner that the strips in each layer are end to end and the spaces between the strips in one layer do not come opposite the spaces in the other layer.

The resistance ribbon 2 is provided with spacing strips of mica, each of which is pro-

vided with a slot through which the ribbon is threaded, and then the ribbon is placed in position in the cell 3^a. The strips through which the ribbon is threaded correspond in width to the cell and are spaced apart in such manner as to keep the ribbon in the center of the cell throughout its entire length. Still more mica is next laid over the ribbon and finally, the cell 4 is heated and is bent over to envelop the ribbon and is allowed to cool while it is held in this position, under pressure.

The cell 3^a, which is molded as above indicated, is intended to hold the clear mica strips 3 in position and it may be replaced by a thin sheet metal cell or other suitable structure of either insulating or conducting material. Outside of this cell the wrapping or outer cell 4 of flexible molded mica insulation is provided for the purpose of electrically separating the resistance element from the flattened metal tube or armor 5 with which the insulation is protected and separated from the fluid in the vessel.

The outer insulating cell 4 has a very high dielectric strength and is sufficient in itself to prevent the grounding of the resistance element within. At the same time, the temperature to which it may be subjected without abnormal deterioration is limited, and, for this reason, the clear mica is interposed between the resistance element, which is very hot, and the outer insulating cell, which, as hereinafter pointed out, is in close contact with the metal sheath or containing tube 5 which, in turn, is in contact with the fluid in the vessel and, consequently, is maintained at a much lower temperature than the resistance element.

After the resistance ribbon is insulated, as above indicated, it is threaded through a flattened metal tube 5 which is afterward further flattened under high pressure in order that the heat generated in the resistance ribbon may be readily conducted to the fluid in the vessel.

Each of the metal sheaths in which the re-

sistance elements are disposed may consist of two strips of metal welded together at their edges instead of the flattened tube 5 above described.

We claim as our invention:

1. A resistance unit comprising a conducting member, a flexible dielectric cell, and interposed heat-resisting insulation.

2. A resistance unit comprising a conducting member, a flexible dielectric cell, and interposed clear mica insulation.

3. A resistance unit comprising a conducting member, an outer cell or wrapping of high dielectric strength and interposed overlapping sheets or flakes of clear mica.

4. A resistance unit comprising a current-conducting member, a covering therefor of heat-resisting insulation, means for holding the said covering in position, and an outer cell or wrapping of insulating material having a high dielectric strength.

5. A resistance unit comprising a current-conducting member, a clear mica covering therefor, means for holding the clear mica in position, an outer cell or wrapping of flexible insulating material of high dielectric strength and a metal casing or armor which is pressed into close engagement with the inclosed parts.

6. A resistance unit comprising a conducting member, a dielectric enveloping cell surrounding the said conducting member, and interposed heat-resisting insulation.

In testimony whereof, I have hereunto subscribed my name this 14th day of June, 1913.

WILLIAM S. HADAWAY, JR.

Witnesses:

G. P. BROCKWAY,

ARTHUR NEHLS,

In testimony whereof, I have hereunto subscribed my name this 27th day of June, 1913.

EDWARD E. ROSE.

Witnesses:

B. B. HINES,

M. C. MERZ.