Dec. 20, 1949 M. J. NEUMAN 2,491,872

LIQUID COOLED RESISTOR

Filed June 15, 1946

Fig. 1.

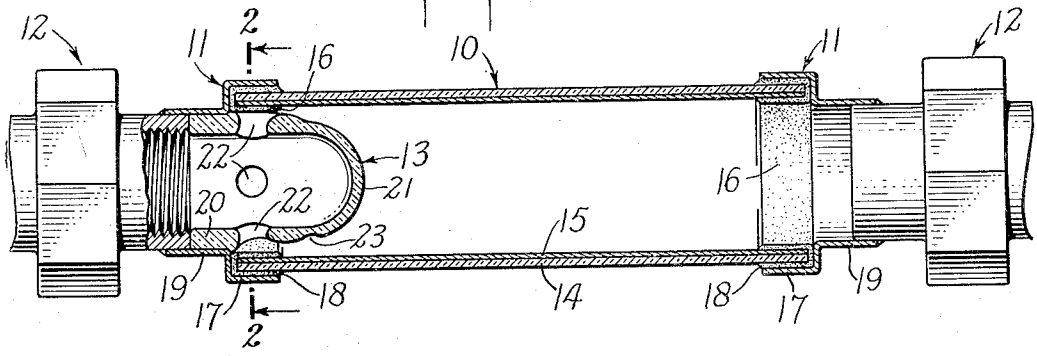


Fig. 2.

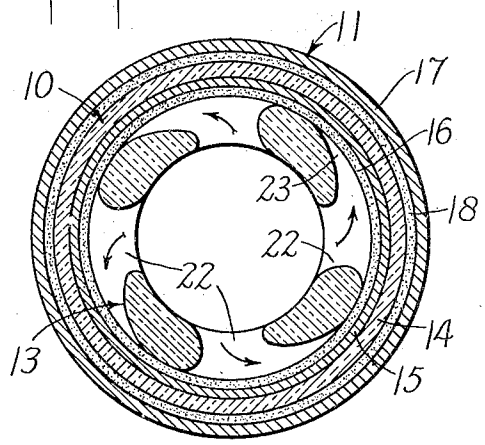


Fig. 3.

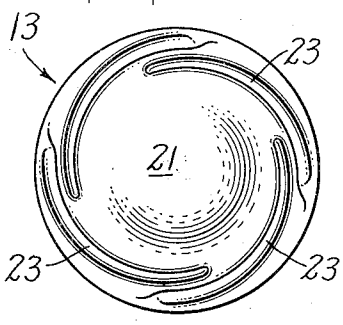
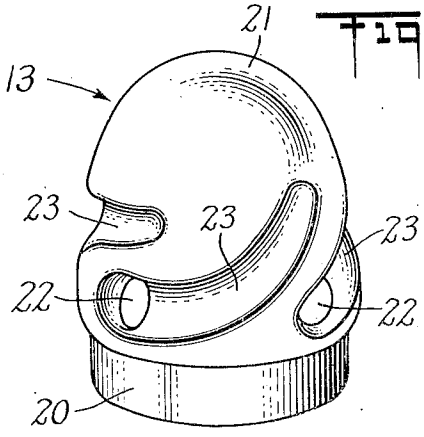


Fig. 4.



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LIQUID COOLED RESISTOR

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8 Claims. (Cl. 201—65)

1

This invention relates to a resistor construction and, more particularly, a resistor designed to be cooled by a liquid such as water.

One of the objects of this invention is to provide a resistor construction which will be simple, practical, thoroughly durable and economical in manufacture. Another object is to provide a construction of the above character in which the resistance coating is cooled by a fluid, such as water, to thereby increase the power rating of the unit. Another object is to provide a construction of the above character in which the fluid, such as water, is directed over the resistance layer in a helical path in order to produce a centrifugal field that will force gas and vapor bubbles inwardly, thus eliminating all air spaces or bubbles which might produce hot spots in the resistance layer, resulting in damage. Other objects will be in part obvious and in part pointed out hereinafter.

The invention accordingly consists in the features of construction, combinations of elements, and arrangements of parts as will be exemplified in the structure to be hereinafter described, and the scope of the application of which will be indicated in the following claims.

In the accompanying drawing in which is shown one of the various possible embodiments of this invention,

Figure 1 is a longitudinal elevation of the resistor construction as connected for operation with certain portions thereof shown in section;

Figure 2 is a sectional view taken along the line 2—2 of Figure 1;

Figure 3 is a top elevation of the impelling element as located in the left-hand portion of Figure 1; and

Figure 4 is a perspective view of the impelling element.

Similar reference characters refer to similar parts throughout the several views of the drawing.

As conducive to a clearer understanding of certain features of this invention, it should be pointed out that liquid-cooled and particularly water-cooled resistors, as now in use, have certain deficiencies in structure, making for imperfect operation and rapid deterioration. One of the reasons for this condition is the creation of air bubbles along the resistance surface as the water flows through the resistance unit; these air bubbles become extremely hot and often result in the burning out of resistance coatings at various points, thus making for a rapid deterioration of the unit. One of the objects of this

2

invention is to provide a construction in which the above-mentioned difficulties, as well as several others, are successfully overcome.

Referring now to the drawing, there is shown in Figure 1 a tubular resistance element generally indicated at 10, having cup-shaped terminal connectors generally indicated at 11, fitting over its ends and shaped to be connected to plumbing fittings generally indicated at 12 in a water line so that water will flow through the tube 10. An impelling element, generally indicated at 13 fits within the inlet end of the resistance tube 10 and is shaped to direct the water in spiral or circular paths throughout the length of the tube. Thus a desired helical flow is created to eliminate the formation of air or steam bubbles and additional turbulence is created to increase heat transfer.

More particularly, the tube 10 comprises an elongated cylinder 14 formed from any suitable dielectric material, such as a ceramic, glass or any of the well-known resins. The inner surface of the tube 14 is coated with a resistance material 15 or a wire winding having the desired electrical characteristics for the resistor. At the opposite ends of the tube 14, there is a highly conductive coating 16, such as silver, extending from the resistance coating 15, around the ends of the tube and along the outer surface thereof.

The cups 11 are adapted to act as electrical terminals and thus have enlarged portions 17 fitting over the coatings 16 on the outer surface of the tube 14. The cups are secured in this position preferably by a solder connection indicated at 18 in Figure 1.

Still referring to Figure 1, the smaller portions 19 of the cups 11 are shaped to fit over the usual plumbing elements 12, and connection may be made as by soldering or threading if desired. Accordingly, the resistor, as shown in Figure 1, is constructed to receive a flow of water longitudinally therethrough in a general direction from left to right, as viewed in this figure.

The impeller 13 is shown in greater detail in Figures 2, 3 and 4. The bottom portion 20 (Figure 4) of the impeller is cylindrical and designed to fit snugly within the smaller portion 19 of the left-hand cup-shaped member 17. This may be force-fitted into this position, or a suitable cement may be employed to assure a firm connection between the impeller 13 and this cup-shaped member 17.

As shown best in Figures 1 and 4, the impeller member has an upper surface 21 which is substantially spherical.

Holes 22, preferably four in number and equal-

ly spaced around the circumference of the impeller, as indicated in Figures 1 and 2, extend from the interior of the impeller to the exterior thereof. Thus, the holes 22 direct fluid entering its interior from the left-hand end of the resistor outwardly and adjacent the resistance coating or surface 15.

Each of the holes 22 is located adjacent one end of a spiral-shaped groove 23, extending along the outer surface of the impeller 13, as can be best seen from comparison of Figures 2, 3 and 4 of the drawing. These grooves 23 are substantially adjacent the resistance surface 15 so that the water, as it is directed along the grooves with considerable force, assumes substantially spiral paths, covering the resistance coating 15.

The creation of these spiral paths of rushing water along the surface of the resistance coating 15 overcomes a natural tendency of the water to create bubbles on such surface. The turbulent water in the passage in a curved path causes a centrifugal field that will force all occurring gas or air bubbles away from the coating. In this way the bubbles are avoided and hot spots are eliminated along the surface of the resistance coating thereby avoiding rapid deterioration and faulty operation.

It will thus be seen that I have provided a practical and efficient resistance construction in which the several objects hereinabove referred to have been successfully and practically accomplished.

As many possible embodiments may be made of the above invention and as many changes might be made in the embodiment above set forth, it is to be understood that all matter hereinbefore set forth or shown in the accompanying drawing is to be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. In a resistor construction, in combination, a hollow, elongated member having an interior surface coated with resistance material, means connecting the opposite ends of the member with a water supply to direct water in a longitudinal direction therethrough, means forming electrical connections with the opposite ends of said resistance coating, and means substantially adjacent the inlet of said member adapted to give a turbulent direction to the water as it passes over said resistance coating, said last-mentioned means being shaped to create an angular velocity of such magnitude that the centrifugal field created is sufficient to force all air or vapor bubbles produced toward the central core of the flow.

2. In a resistor construction, in combination, a hollow tube having a resistance coating on the inner surface thereof, cup-shaped members interfitting with the opposite ends of said tube and shaped to be connected to the inlet and outlet of a water supply designed to direct water longitudinally through the tube, and an impeller located adjacent the inlet end of the tube, said impeller being shaped to direct streams of water in spiral paths over said resistance coating at an angular velocity sufficient to force air and vapor bubbles in water away from said resistance coating.

3. In a resistor construction, in combination, a hollow tube having a resistance coating on the inner surface thereof, cup-shaped members interfitting with the opposite ends of said tube and shaped to be connected to the inlet and outlet of a water suuply designed to direct water longitudinally through the tube, and an impeller located adjacent the inlet end of the tube, said impeller being shaped to direct streams of water in curved paths over said resistance coating during its passage through said tube at an angular velocity sufficient to force air and vapor bubbles in said water away from said resistance coating.

4. In a resistor construction, in combination, a hollow tube having a resistance coating on the inner surface thereof, cup-shaped members interfitting with the opposite ends of said tube and shaped to be connected to the inlet and outlet of a water supply designed to direct water longitudinally through the tube, and a hollow impelling element fitting over the inlet end of said tube and having openings into the tube substantially adjacent said resistance coating and shaped to direct water in curved paths over said resistance coating during its passage through the tube at an angular velocity sufficient to force air and vapor bubbles in said water away from said resistance coating.

5. In a resistor construction, in combination, a hollow tube having a resistance coating on the inner surface thereof, cup-shaped members interfitting with the opposite ends of said tube and shaped to be connected to the inlet and outlet of a water supply designed to direct water longitudinally through the tube, and a hollow, substantially spherical impelling element fitting over the inlet end of said tube, said element having openings leading to spiral shaped grooves adjacent said resistance coating at one end of the tube, whereby liquid may be directed in substantially spiral paths along said resistant coating throughout the length of said tube.

6. In a resistor construction, in combination, a tube formed from dielectric material having a resistance coating on its inner surface, means forming highly conductive coatings extending over the opposite ends of said resistance coating and extending around the ends of the tube and along a portion of the outer surface thereof, cup-shaped members fitting over the ends of said tubes and forming mechanical and electrical connections with said coatings, said cup-shaped members being shaped to direct a stream of water through the interior of said tube, and means at one end of said tube connected with the inlet of the water supply, shaped to direct a stream of water over said resistance coating in curved paths at an angular velocity sufficient to force air and vapor bubbles in said water away from said resistance coating.

7. In a resistor construction, in combination, a tube formed from dielectric material having a resistance coating on its inner surface, means forming highly conductive coatings extending over the opposite ends of said resistance coating and extending around the ends of the tube and along a portion of the outer surface thereof, cup-shaped members fitting over the ends of said tubes and forming mechanical and electrical connections with said coatings, said cup-shaped members being shaped to conduct a stream of water through the interior of said tube, and an impeller fitting over one end of said tube adjacent one of said cup-shaped members adapted to be attached to the inlet of a fluid supply, said impeller including openings into the interior of the tube and grooves shaped to direct a stream of fluid along the resistance coating substantially in spiral paths.

8. The method of cooling a resistance coating

on the interior of a tube forming a water path which comprises imparting to the stream of water at the inlet end of said tube a spiral motion of sufficient angular velocity to force air and vapor bubbles in said water toward the center of said tube and away from said resistance coating.

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