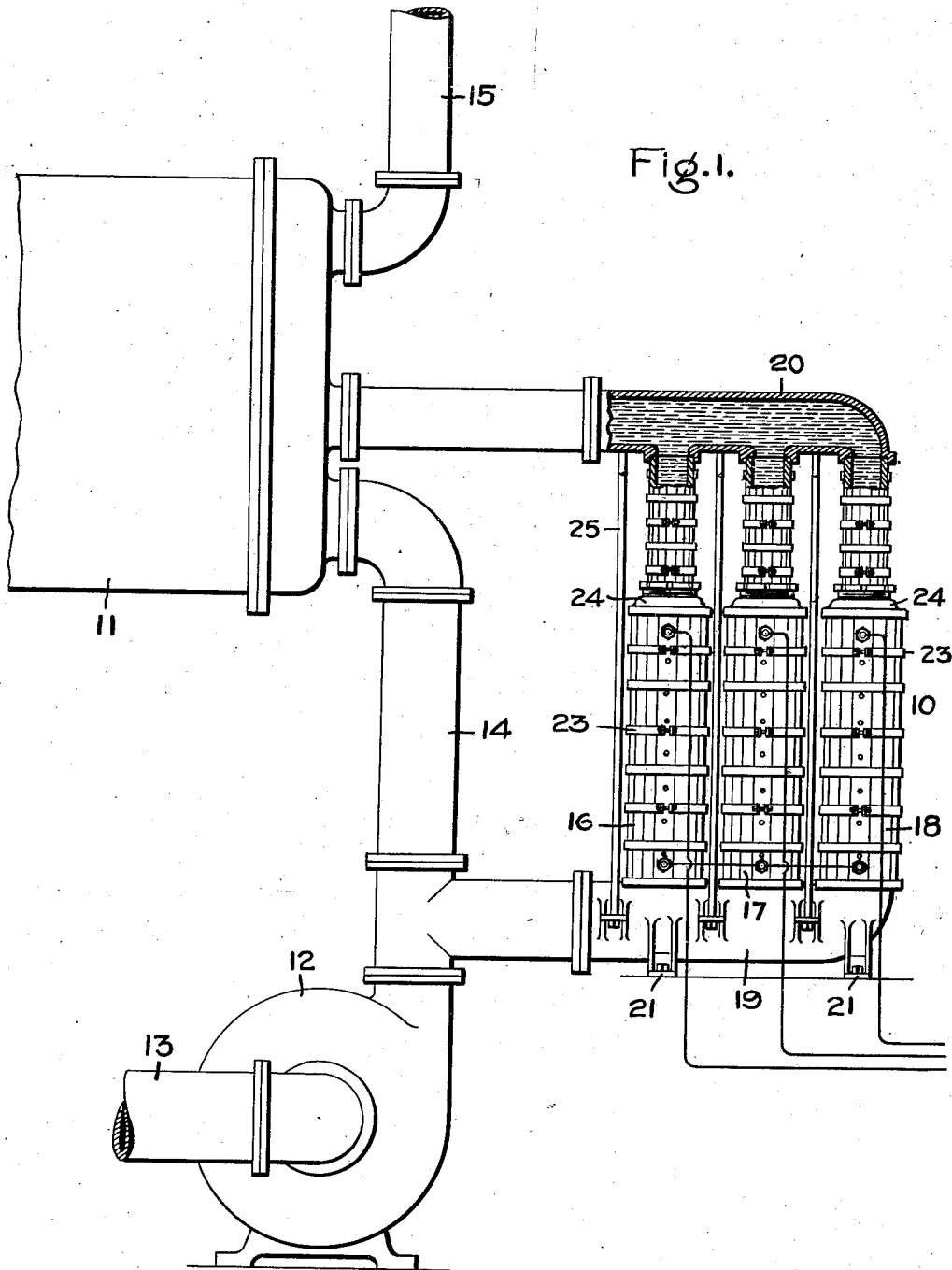


W. L. R. EMMET.
WATER COOLED RESISTANCE.
APPLICATION FILED NOV. 7, 1910.

1,062,900.

Patented May 27, 1913.

2 SHEETS—SHEET 1.



Witnesses:

Marcus L. Byng,
J. Ellis Elen.

Inventor:

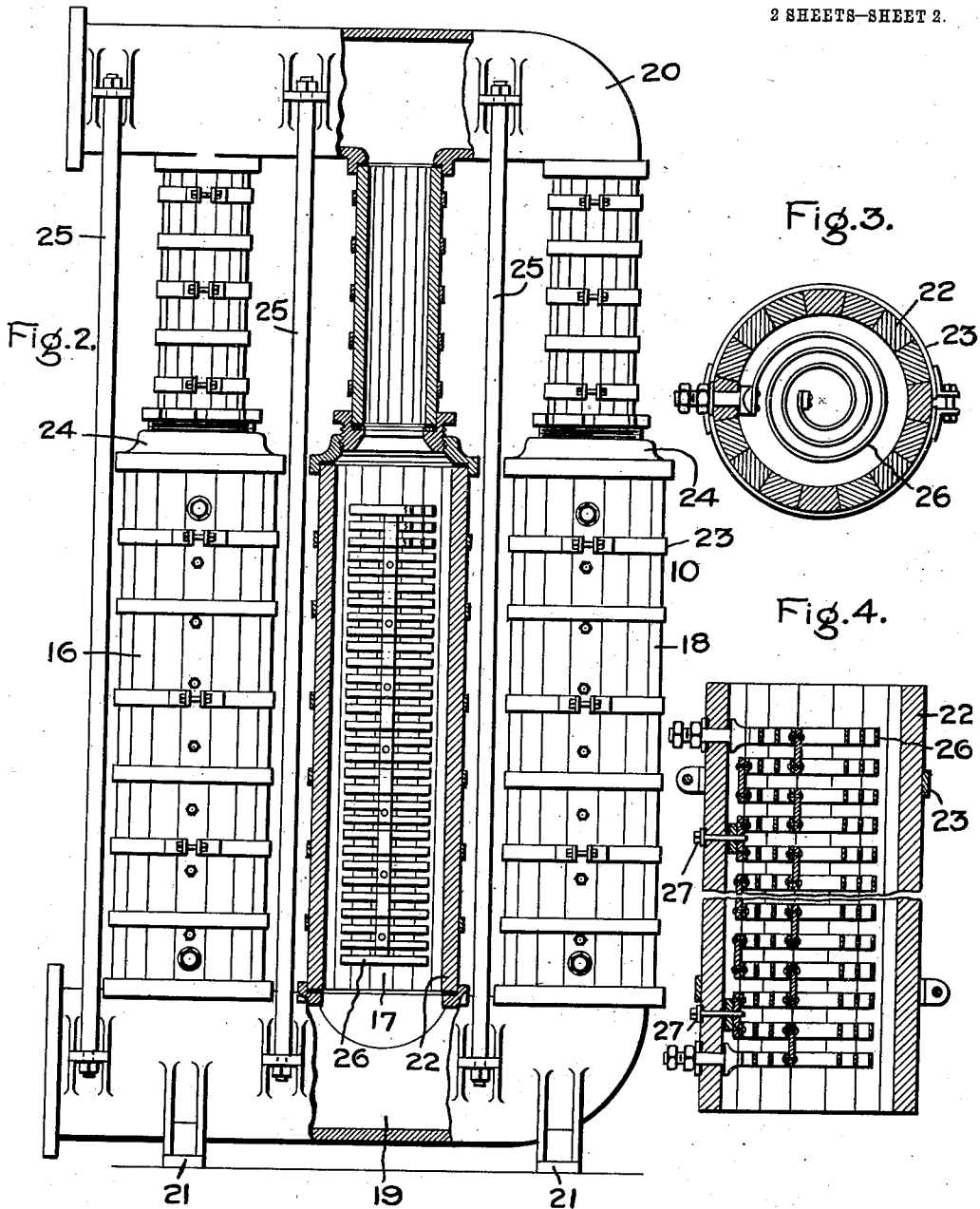
William L. R. Emmet,
by *Abner S. Davis*
His Attorney.

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Marcus L. Byng.
J. Ellis Allen

Inventor:

William L. R. Emmet,
by *Alfred S. Davis*
His Attorney.

UNITED STATES PATENT OFFICE.

WILLIAM L. R. EMMET, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL
ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

WATER-COOLED RESISTANCE.

1,062,900.

Specification of Letters Patent.

Patented May 27, 1913.

Application filed November 7, 1910. Serial No. 591,001.

To all whom it may concern:

Be it known that I, WILLIAM L. R. EMMET, a citizen of the United States, residing at Schenectady, in the county of Schenectady, State of New York, have invented certain new and useful Improvements in Water-Cooled Resistances, of which the following is a specification.

My invention relates to electrical resistance devices and has for its object the provision of means whereby a large amount of electrical energy may be dissipated in a relatively small space.

In certain cases, as for instance, on board a ship equipped for electric propulsion, it is oftentimes necessary to dissipate a large amount of electrical energy in the circuit of the propelling motors. The space which is available for resistance devices is necessarily small and the ordinary forms of resistance are unsatisfactory and inadequate for this purpose.

It has heretofore been proposed to immerse a resistance conductor in a body of water so as to increase the rate at which the heat of the conductor will be dissipated, but I have found that this simple arrangement is objectionable in practice because the water surrounding the conductor furnishes a path of very low resistance in parallel therewith and tends to cause a bubbling and the formation of steam at the conductor terminals which both tends to eat away the conductor at the points where the current flows into the surrounding water and also gives a continually varying resistance due to the formation of air bubbles and steam at these points.

It is the object of my invention to overcome the difficulties above mentioned by materially increasing the resistance of the parallel water path and in accordance with my invention I surround the resistance conductor with a relatively long conduit or duct of insulating material, the resistance conductor being located along only a portion of the length of the conduit and the whole being submerged in or connected to a body of cooling liquid. The surrounding of the resistance conductor by an insulating conduit reduces the cross-section of the leakage path from one terminal of the conductor to the other through the water adjacent to the conductor and the extension of the conduit beyond the conductor increases the length of

the leakage path through the body of liquid in which the conduit is submerged or to which it is connected. I preferably reduce the cross-section of that portion of the conduit which is not occupied by the resistance conductor by such an amount that the total cross-sectional area of this portion of the conduit will be equal to the effective cross-sectional area of that portion of the conduit in which the resistance conductor is located. By so doing I am enabled to make the extended portion of the conduit shorter for a given resistance. The circulation of the cooling fluid may be produced wholly by the heat in the resistance conductor, or the natural circulation due to the above effect may be supplemented by other means.

For use on shipboard, I naturally employ the salt water of the ocean for the cooling fluid and to this end I connect the conduit containing the resistance conductor to suitable outlet and inlet pipes extending through the sides of the vessel. Since on shipboard it is generally customary to employ a salt water circulating system for cooling the condensers for the engine, I preferably connect the conduits containing the resistance in circuit with the condenser pump, so that the natural circulation due to the heat dissipated by the resistance is supplemented by artificial circulation produced by the pump.

For the resistance conductor, I prefer to employ a metal which is non-corrosive, which will be practically unaffected by long submersion in salt water and which is but slightly affected by electrolysis. I have found that by the resistance material described and claimed in the patent to Dempster, No. 901,428, is particularly adapted for this purpose.

My invention comprises further features and combinations of elements hereinafter set forth and particularly pointed out in the claims annexed hereto.

For a better understanding of my invention, reference may be made to the following specification, taken in connection with the accompanying drawings, in which—

Figure 1 shows the preferred embodiment of my invention connected to the water circulating system of a condenser; Fig. 2 is a view of the rheostat proper, showing the headers to which the conduits inclosing the resistance conductor are connected, and Figs. 3 and 4 are respectively a cross-section

and a longitudinal-section of the conduit, showing the manner of mounting the resistance conductor therein.

In the drawings, 10 represents the rheostat proper adapted to be connected with a source of circulating water. In the present instance I have shown a condenser system as furnishing the water supply. On board ship the condenser system forms the most available supply of water for such a purpose, but it is obvious that this is not an essential feature of my invention. The condenser is therefore indicated at 11. A pump 12 having an intake 13 is connected with the condenser through pipe 14, while the condenser discharges overboard through pipe 15. The water flows through the rheostat in shunt with the pipe 14, thereby always furnishing an ample supply of circulating water. In the present instance I have shown my rheostat arranged for a three-phase system, although it is obvious that my invention is in no sense limited to this particular application. As thus constructed for three-phase work, the rheostat consists of three casings 16, 17 and 18, which are in the form of elongated conduits or ducts connected between the headers or manifolds 19 and 20. These headers are similar in construction, although the header 19 is provided with feet 21 for supporting the rheostat in the vertical position. The construction of all three of the ducts is the same. Each has a lower portion of suitable cross section and an upper contracted portion or extension. The lower portion is shown in section in Fig. 3, and may consist of sections of insulating material 22 arranged in the form of a circular pipe and held together by bands or hoops 23. One end of this lower part fits into the header 19, while the other end is provided with a threaded ring 24 into which the upper contracted portion of the pipe is screwed. This upper portion is made in a similar manner, as shown in the drawings, and has its upper end fitting into the header 20. Tie rods 25 connect the two headers and hold the parts securely in place.

The resistance element of my device consists of a plurality of spirals of resistance conductor 26 so formed that the element has a small cross section relative to its length mounted in each of the lower enlarged portions so that the wall of each duct closely surrounds its resistance element. The particular material which I employ for this purpose has a high resistance, may be run at a very high temperature, and will not oxidize or corrode. For this purpose the resistance material described and claimed in the patent to Dempster, No. 901,428, is satisfactory. I have found this material to be almost entirely non-corrosive and to successfully withstand long submersion in salt solution. It is, furthermore, very slightly

affected by electrolysis. This resistance material is preferably made in the form of a flat ribbon and wound into a spiral, as shown. The spirals are arranged transversely of the duct so that the flat conductor is parallel with the sides of the duct. This arrangement reduces the resistance to the flow of water and leaves no place for the accumulation of bubbles. These consecutive spirals are arranged parallel with each other in the duct and connected alternately at their inner and outer ends so as to make the windings non-inductive. Taps are taken off at various points, such as at 27, in the duct, so that the resistance may be varied as desired. The resisting element extends only through the larger portion of the duct and the upper portion is provided in order to increase the length of the path by which electric current can leak through the water. In order to further increase the resistance of the path, the upper part of the duct is reduced in size as above described. The upper portion is reduced in size by an amount approximately sufficient to compensate for the space in the lower portion occupied by the resistance element, so that the reduction causes no great impediment to flow of water. By this arrangement a large amount of electric energy can be dissipated in a very small space. The parts are arranged for easy disassembling and the floor space occupied thereby is very small.

While I have described my invention as embodied in concrete form for purposes of illustration, it should be understood that I do not limit my invention thereto, since various modifications thereof will suggest themselves to those skilled in the art without departing from the spirit of my invention, the scope of which is set forth in the annexed claims.

What I claim as new, and desire to secure by Letters Patent of the United States, is,—

1. A rheostat comprising a duct of insulating material, a resistance conductor occupying a part of the length of said duct and a body of liquid connected to said duct so as to circulate therethrough, the cross sections of the occupied and unoccupied portions of the duct being each such that the resistance to the flow of current therein is materially greater than the resistance of the conductor.

2. A rheostat comprising a resistance element of small cross section relative to its length, a duct of insulating material closely surrounding said resistance element, and an extension duct of insulating material connected with the main duct the cross section and length of the extension duct being such that the resistance to the flow of current therethrough is materially greater than the resistance of the said element.

3. A rheostat comprising a duct of insulating material, a resistance occupying a part of the length of said duct, and connections for circulating a continuous supply of water through said duct to cool the resistance.

4. A rheostat comprising a duct of insulating material, a resistance of non-corrosive material occupying a part of the length of said duct, and connections for circulating a continuous supply of water through said duct to cool the resistance.

5. A rheostat comprising an insulating duct, a resistance conductor located therein, and an extension duct of insulating material connected with the main duct.

6. A rheostat comprising a duct, a resistance therein, and an insulating tube for conveying water from the duct.

7. A rheostat comprising a pair of headers, a plurality of parallel insulating ducts extending between said headers, means for circulating water from one header to the other through said ducts, and a resistance conductor mounted at the intake end of each duct.

8. A rheostat comprising an elongated duct consisting of two insulating sections of different diameter secured together, a resistance in the larger section and means for circulating water through the duct.

9. A rheostat comprising a pair of headers, an insulating duct extending between said headers and a resistance located in one end of said duct.

10. A rheostat comprising a pair of headers, a plurality of insulating ducts extending between said headers in parallel, and a resistance occupying a portion of the length of each of said ducts.

11. A rheostat for polyphase circuits comprising an exposed resistance conductor in each phase, an insulating duct surrounding each of said conductors, and means for continuously circulating water through said ducts in multiple.

12. A rheostat for polyphase circuits comprising a plurality of elongated insulating ducts having a contracted portion at one end opening into a common chamber at each end, an exposed resistance conductor mounted in the larger portion of each duct, and means for circulating water through said ducts from the larger to the smaller end.

13. A rheostat for polyphase circuits comprising a plurality of elongated insulating ducts, an exposed resistance element mounted in each of said ducts, each element consisting of a plurality of parallel spirals formed of a flat resistance conductor arranged transversely of said duct, and means for continuously circulating water through said ducts in multiple.

14. A rheostat comprising a resistance, a duct inclosing the same, and a condenser system connected with said rheostat so as to circulate water through the duct to cool the resistance.

15. A rheostat comprising a resistance, a duct inclosing the same, and a condenser system, said duct being connected in shunt with said system to circulate water through the duct and cool the resistance.

In witness whereof I have hereunto set my hand this 4th day of November, 1910.

WILLIAM L. R. EMMET.

Witnesses:

BENJAMIN B. HULL,
HELEN ORFORD.