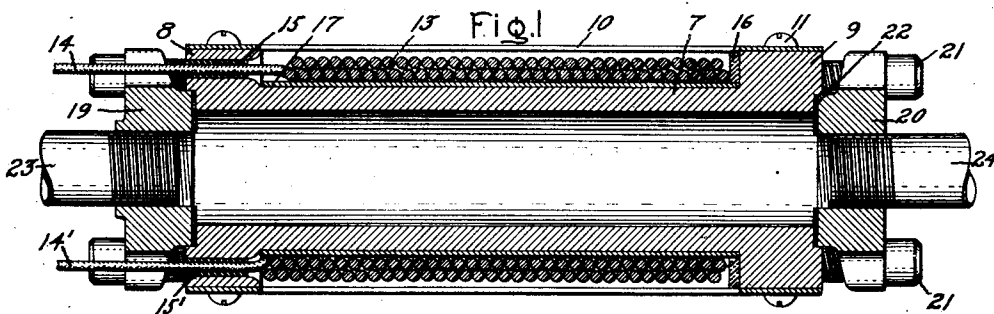
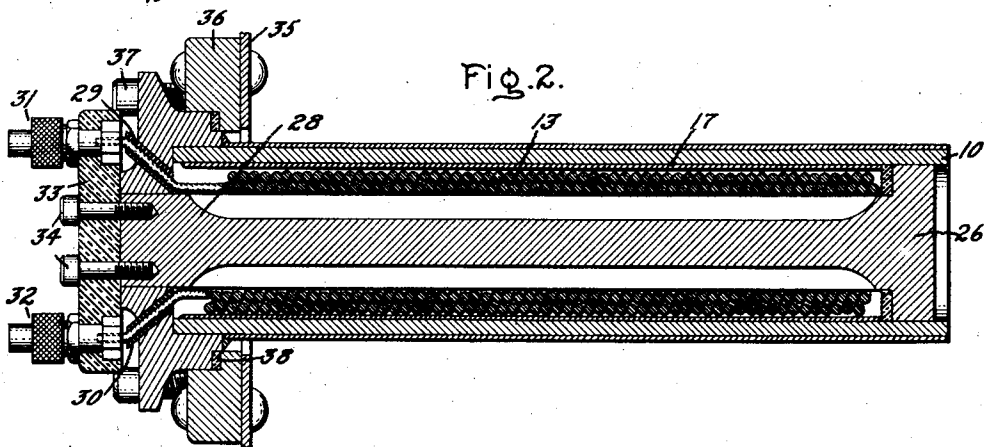
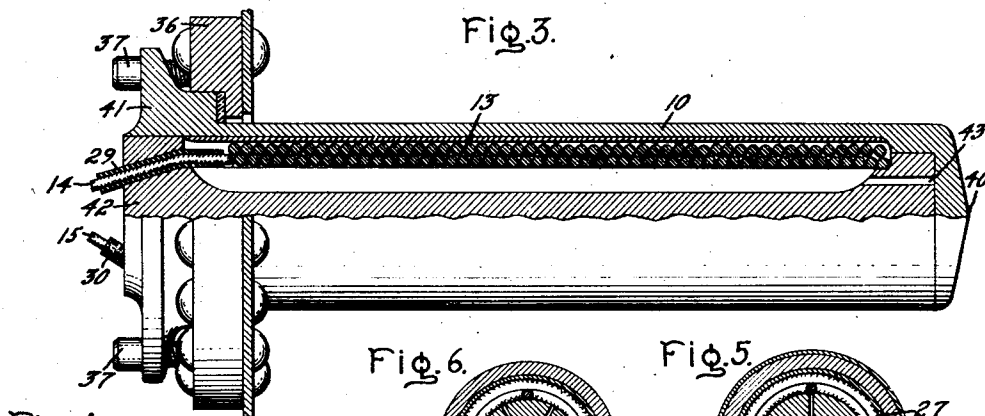
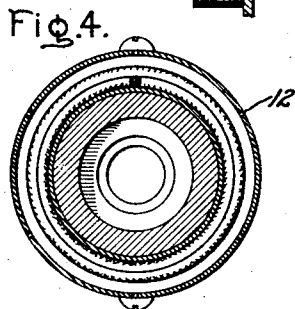
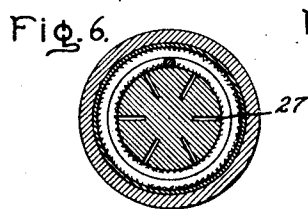
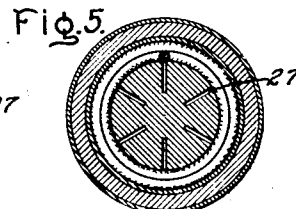


A. B. HENDRICKS, JR.
ELECTRIC HEATER.
APPLICATION FILED APR. 26, 1920.

1,362,622.

Patented Dec. 21, 1920.



Inventor:
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UNITED STATES PATENT OFFICE.

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ELECTRIC HEATER.

1,362,622.

Specification of Letters Patent. Patented Dec. 21, 1920.

Application filed April 26, 1920. Serial No. 376,466.

To all whom it may concern:

Be it known that I, ALLAN B. HENDRICKS, Jr., a citizen of the United States, residing at Pittsfield, county of Berkshire, State of Massachusetts, have invented certain new and useful Improvements in Electric Heaters, of which the following is a specification.

The present invention comprises an electric heater of the induction type.

10 It is the object of my invention to produce a simple, rugged device which can be manufactured at relatively low cost and which will have substantially unity power factor.

My invention in its preferred embodiment 15 comprises a closed magnetic core, and a short-circuited secondary winding of one turn which is in thermally good conducting relation to the medium to be heated. The novel features of my invention will be 20 pointed out with particularity in the appended claims.

In the accompanying drawing, Figure 1 shows a sectional view of an induction heater embodying my invention which is 25 adapted to be made part of a circulating system; Figs. 2 and 3 are longitudinal sections of different forms of electric heaters of the immersion type embodying my invention; and Figs. 4, 5 and 6 are cross-sectional views respectively of the devices 30 shown in Figs. 1, 2 and 3.

The device shown in Fig. 1 comprises a tube 7 consisting preferably of cast iron provided at its ends with flanges 8 and 9. 35 Inclosing this tube 7 is a second tube 10 consisting of iron or steel attached to the inner cylinder by screws 11 entering the flanges 8 and 9. This outer tube preferably is slotted as indicated at 12, Fig. 4, when the induced 40 heat is desired in the central tube. In the annular space or recess between the two concentric tubes 7 and 10 is located a primary winding 13, suitably insulated. The terminals 14, 14' are passed through the flange 8 45 and suitably insulated therefrom by sleeves 15. Insulating asbestos washers 16 may be provided to hold the winding 13 in place.

On the outer surface of the cylinder 7 is a coating 17 of non-magnetic conducting material, preferably copper, which may be conveniently deposited by electrolysis, and may have a thickness of about $\frac{3}{8}$ of an inch. This coating 17 constitutes a low resistance secondary winding of one turn. Because of 55 the location of the secondary winding 17

closely adjacent to the primary winding 13, and in close proximity to the magnetic core, leakage fluxes between the primary and secondary windings are so reduced that the power factor of the device closely approximates unity. The location of the copper layer on the inner tube concentrates the heat generated by induction where it is desired, namely, at the inner tube which is in contact with the fluid to be heated. 60 65

Detachable couplings 19, 20, are provided at each end of the device which may be connected to the flanges 8, 9 by screws 21, suitable gaskets 22 being provided to make a tight joint. These couplings are threaded 70 to receive threaded ends of pipes 23, 24, which may convey water, gas, or other fluid to be heated to the hollow interior of the heater.

The device shown in Fig. 2 is particularly adapted for developing heat upon its external surface and therefore the internal leg 26 of the magnetic core is made solid but is provided with a plurality of slots 27, as shown in Fig. 5. The secondary winding 17, which in this case also preferably consists of electrolytically deposited copper, is located on the outer inclosing magnetic shell 10, and adjacent the primary winding 13. The terminals of the primary winding are 85 carried through a flange 28 through suitable insulating sleeves 29, 30, and carried to binding posts 31, 32, which are mounted upon a plate 33 fastened by screws 34 to the inner core member 26. The heater support, for 90 example, the wall 35 of a water tank, is connected to a ring 36 which in turn is fastened to the flange 28 by detachable screws 37. A washer 38 may be interposed to make a water-tight connection. 95

Both of the devices illustrated are adapted for ready machining and assembling of component parts, and provide a compact, rugged heating unit of high efficiency. The copper sheath 17, which in both modifications shown in Figs. 1 and 2 constitutes a secondary winding of one turn, is advantageous in raising the power factor of the device nearly to 100%. When a copper sheath is employed practically all of the 105 secondary current flows through the same rather than in the iron core because of the greatly superior electrical conductivity of the copper as compared to iron. There is then but a very slight leakage flux between 110

the secondary and primary currents and hence a high power factor. On the other hand, when the sheath is omitted, the secondary current will circulate throughout the iron core. The current density will increase in a radial direction in the parts of the core more remote from the primary, hence the portion of the iron core will constitute a magnetic shunt between the more remote section of the secondary circuit and the primary circuit and produce a lower power factor.

In the modification of my invention illustrated in Fig. 3, a particularly simple and rugged construction is illustrated. The outer leg 10 of the magnetic core is constituted by a cast iron tube with a closed end 40 and having the opposite end open and bearing a shoulder 41. This iron tube may be machined as a single piece, the inner surface being recessed, as shown in the drawing, for the reception of the primary winding 13. The inner leg of the magnetic core 42 is introduced into the closed end of the tube by pressure. When the slotting 27 of the inner core 42 does not extend clear to the end a passage way 43 is preferably bored from one of the slots to the outer end for the escape of air when the press fit of the inner core into the outer tube is made. The ends 14, 15 of the primary winding are brought through holes in the end of the inner core 42 suitably insulated by sleeves 29, 30. Flange 41 may be connected by screws 37 to a ring 36 in the same manner as the device shown in Fig. 2.

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

1. An induction heater comprising a cylindrical closed magnetic core consisting of a plurality of concentric members, a coating of non-magnetic conducting material on one of said members constituting a secondary winding and a primary winding located between said members and closely adjacent said secondary winding.

2. An induction heater comprising an elongated body of magnetic material having a flange at each end, a tube of magnetic material inclosing said cylinder and constituting therewith a closed magnetic core, a primary winding located between said body and said tube, and a layer of conductive,

non-magnetic material on one of the members of said core.

3. An induction heater consisting of a magnetic core comprising a tubular shell and a cylinder within said shell separated from said shell intermediate the ends thereof by an annular space, a primary winding located in said space and a single turn secondary winding closed upon itself located between said primary winding and one of the elements of said core.

4. In an induction heater, the combination of a magnetic core comprising concentric tubes, the inner tube being spaced away from the outer tube by a flange at each end thereof, a primary winding in the annular space between said tubes, a coating of copper constituting a secondary winding located between said primary winding and said inner tube, and detachable threaded closures for the ends of said inner tube adapted to receive pipe connections.

5. An electric heater of the induction type comprising a closed magnetic core consisting of a cast iron tube having flanges at opposite ends and a surrounding slotted iron tube engaging with said flanges, a primary winding in the annular space between said tubes, a plating of non-magnetic metal on said inner tube adjacent said primary winding and detachable coupling at each end of said heater adapted to connect the same to conduits for delivering a fluid to be heated.

6. An electric induction heater comprising a tube of magnetic material having a closed end, a core of magnetic material therein having a plurality of radial slots and being spaced away from said tube, a magnetic winding in said space, and means for conveying current to said winding.

7. An induction heater comprising a cast iron tube having a recess, a magnetic winding in said recess, a magnetic member closely adjacent said winding and connecting the parts of said tube adjacent the ends of said winding to complete the magnetic circuit of said winding, means for conveying current to said winding, and means for mounting said tube in a desired relation to a medium to be heated.

In witness whereof I have hereunto set my hand this 23 day of Apr., 1920.

ALLAN B. HENDRICKS, JR.