W. D. LUDWICK.

ELECTRIC WATER HEATER.

APPLICATION FILED OCT. 21, 1914.

1,273,389.

Patented July 23, 1918.

2 SHEETS—SHEET 1.

Fig. 1.

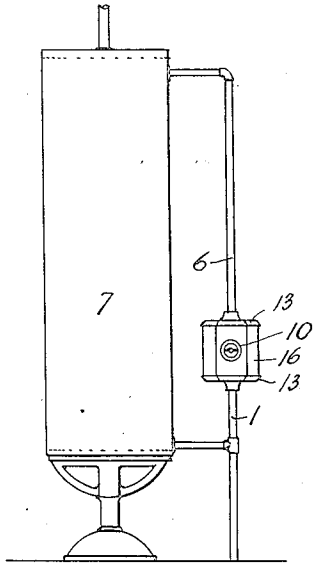
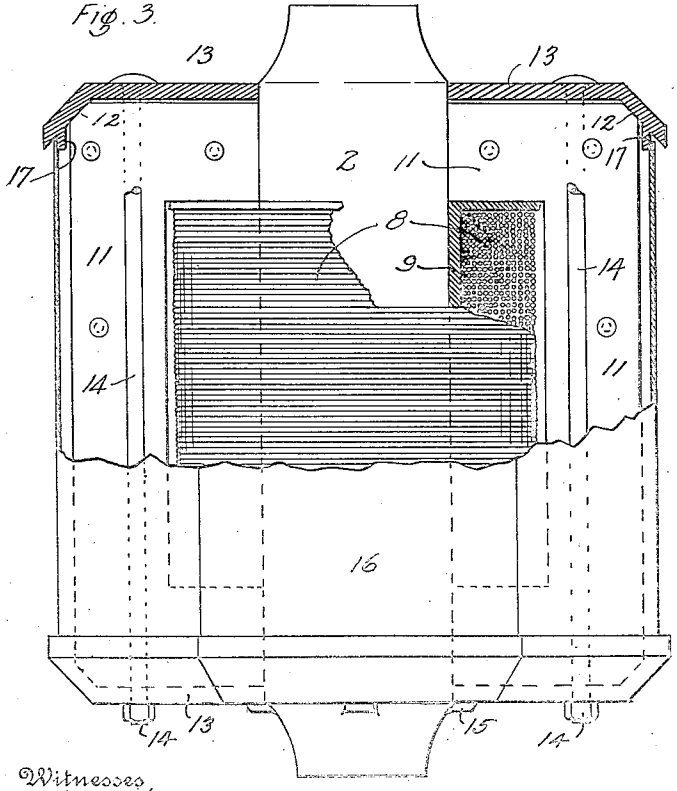


Fig. 3.



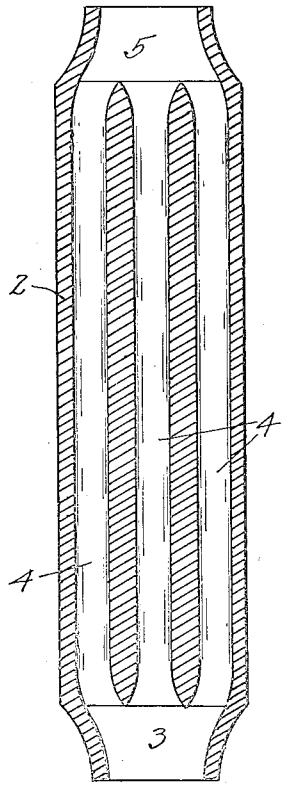


Fig. 2.

Witnesses

Carl Field

A. E. Allen

Inventor

Wayne D. Ludwick

By

T. A. Elliott

Attorney

W. D. LUDWICK.

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2 SHEETS—SHEET 2.

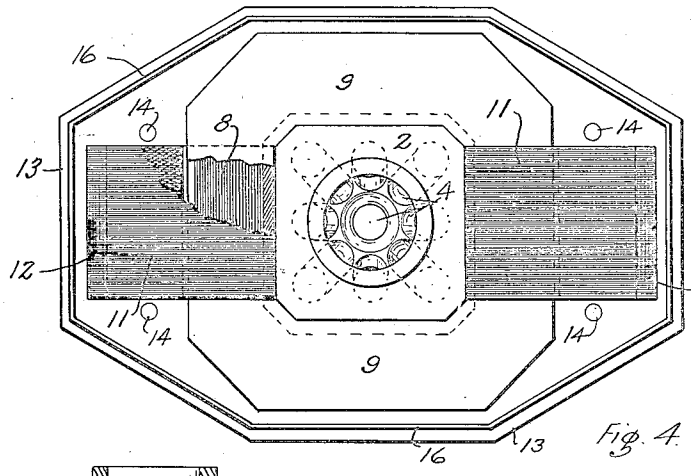


Fig. 4

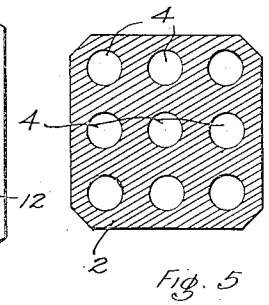


Fig. 5

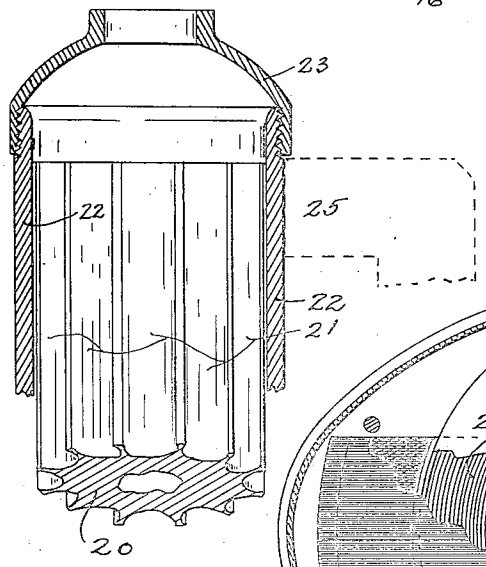


Fig. 6

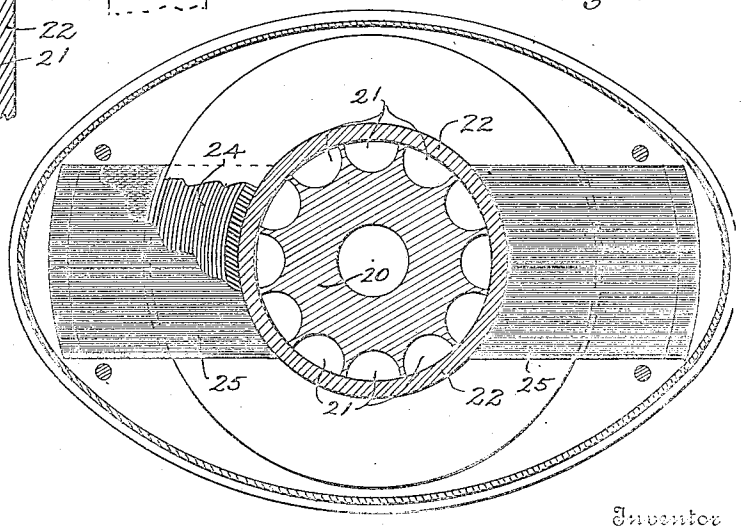


Fig. 7

Inventor

Witnesses

Earl Eitel

A. E. Allen

Wayne D. Ludwick

By

P. A. Elliott

Attorney

UNITED STATES PATENT OFFICE.

WAYNE D. LUDWICK, OF NEAR TACOMA, WASHINGTON, ASSIGNOR TO ELECTRIC HEATING COMPANY, A CORPORATION OF WASHINGTON.

ELECTRIC WATER-HEATER.

1,273,389. Specification of Letters Patent. Patented July 23, 1918.

Application filed October 21, 1914. Serial No. 867,302.

To all whom it may concern:

Be it known that I, WAYNE D. LUDWICK, a citizen of the United States, residing near Tacoma, in the county of Pierce, State of Washington, have invented certain new and useful Improvements in Electric Water-Heaters, of which the following is a specification.

This invention relates to devices for heating water by electric means and has special reference to such devices as are adapted for domestic and similar uses. The objects of my invention are to produce a device which will be of sufficient electrical efficiency to enable it to enter into competition with water heaters in which a gaseous fuel is used as the heating agent; which is substantially indestructible; which is simple and cheap to make; and which requires no care or attention on the part of the user.

I attain these and other objects by the devices and arrangements illustrated in the accompanying drawings, in which—

Figure 1 is a front elevation of my device in use; Fig. 2 is a vertical section of the central core thereof; Fig. 3 is a front elevation of my device, parts thereof being broken away to reveal the interior arrangement and construction; Fig. 4 is a plan thereof, the upper plate having been removed; Fig. 5 is a cross-section of the central core; Fig. 6 is a partial vertical section showing a different form of core; and Fig. 7 is a cross-section of a heater constructed with such a core.

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

Referring to the drawings, the cold water is conducted by the pipe 1 to the lower orifice of the core 2. This core 2 is made of metallic and magnetic substance, such as iron or steel. This pipe 1 communicates with a distributing chamber 3 in the lower end of the core 2. A plurality of passages 4 lead upward from the chamber 3 to another similar chamber 5 at the upper end of the core. The water is heated while passing through these passages 4. The hot water is collected from the passages 4 in the chamber 5 and passes therefrom through the pipe 6 to the storage tank 7 or other container or pipe. The upper and lower orifices extend beyond the casing of the device so that the pipes 1 and 6 may be inserted therein without dismounting the parts of the heater.

A primary coil 8, consisting of insulated wire of suitable qualities, properly wound on a spool 9, extends entirely around the core 2 in close contact therewith, and the terminals of said coil 8 are secured to the controlling switch (indicated at 10, Fig. 1) through which it is connected to a proper source of alternating current (not shown in the drawings).

The magnetic circuit comprises the said core 2 extending through the coil 8 and a pair of return circuits 11, each of which is built up of a plurality of thin sheets of soft iron, said sheets secured together and forming a laminated body having high magnetic conductivity but of such form as to be substantially free from eddy currents of electricity. The said magnetic bodies 11 are formed so that their two ends engage the sides of the core 2, substantially in line with the ends of the heating water passages 4 therein, and pass therefrom outside of the electric coil 8, thus forming a pair of continuous magnetic loops passing through the center of the generating coil 8 and returning outside thereof, said loops comprising a solid part within the coil and a laminated part outside thereof.

The bodies 11 must be kept in very close contact with the core 2, for otherwise the magnetic resistance is largely increased by the gaps between the said parts. This may be accomplished by simply fastening the two bodies 11 by means of straps to the core 2, but I prefer to clamp them together as follows:—The outer corners of the bodies 11 are beveled as at 12. An upper and a lower cover or plate 13 are slipped over the ends of the core 2 and are provided with complementary beveled interior surfaces adapted to engage the beveled corners 12 of the parts 11 and to exert an inward thrust thereon. Tension rods 14 connect the two plates 13 and draw them toward each other. As these plates are thus moved they each force the said bodies 11 laterally inward into intimate contact with the core 2. One of the plates 13 may be supported from vertical movement by a lug or lugs 15 formed on the core, or by other means.

A casing 16 of suitable shape and material surrounds the parts 8 and 11 between

the plates 13, being held thereby by means of the flanges 17, as shown, and the controlling switch 10 may be mounted thereon.

Referring now to the variation shown in Figs. 6 and 7 it will be seen that the core is built up of a central part 20 having flutes or channels 21 formed in its outer surface, and positioned within a cylindrical tube 22, and a pair of end pieces 23 at the ends of the tube 22. Thus it will be seen that the flutes 21 form water passages between the tube 22 and the core 20, and the end pieces 23 inclose the distributing and collecting chambers at the ends of the core 20. In this case the electric coil 24 may be circular and the laminated pieces 25 shaped to conform to the general shape of the device.

In the preferred form of the heater, the heating channel or core of the coil is an integral casting having a body of considerable area in cross section and is proportioned to secure the greatest heating effect due to hyteresis eddy and secondary currents in the metal, while the fluid passage is of reduced cross section, with large surface area in proportion to its cross section area, whereby the whole body of water flowing through the heater is brought into intimate relation to the metal surface. The core extends beyond the ends of the coil and is provided with plane faces as shown in Fig. 2 to secure intimate contact of the ends of the laminated returns for the magnetic circuit and thereby reduce magnetic resistance.

In operation, the alternating current flowing in the coil causes rapid reversals in the magnetic condition of the core or heating duct and owing to eddy and secondary currents and hysteresis in the metal, rapid heating results. Owing to the employment of magnetic metal as the body of the heating duct and the provision of a return for the magnetic circuit, which return is practically without magnetic resistance, the heating effect is localized in the duct and the attenuated body of water is brought directly into contact with the heated metal.

To protect the coil, it may conveniently be wound on a spool of heat insulating material, as indicated at 9, adapted to fit the heating duct, this construction being especially convenient for manufacturing economy.

While there would be but slight loss in efficiency due to convection and radiation, such losses are largely prevented by the casing which tightly incloses all of the parts and makes a compact and practically indestructible unit which may be conveniently coupled in the ordinary piping systems now in use as a substitute for or supplementary to the usual gas water heater.

Having described my invention, what I claim is:—

1. In an electric water heater, the combination of a primary coil adapted to conduct an alternating electric current; a non-laminated magnetic core centrally positioned within said coil and adapted to permit the formation of secondary eddy currents therein; passages extending through said core and adapted to hold the water to be heated; magnetic bodies each engaging the core at each end and forming a loop therewith around and through the coil; beveled surfaces formed on the edges of said bodies; a pair of upper and lower plates each provided with beveled surfaces complementary to and engaging the similar surfaces on the magnetic bodies, whereby when said plates are drawn toward each other said magnetic bodies are forced inward against said core; and tension rods joining said plates.

2. In an electric heater, the combination with a duct formed of integral cast magnetizable metal of sufficient cross sectional area to properly conduct all the lines of force generated by the coil with a cavity therein having small cross sectional area in proportion to its walls, a coil surrounding the duct intermediate its ends, and a return for the magnetic circuit in contact with the duct at opposite ends of the coil, said return having less magnetic resistance than the duct and being substantially free from eddy currents, whereby heating is localized in the walls of the duct.

3. In an electric heater, the combination with a core of magnetizable material having a duct extending therethrough for the passage of the material to be heated, said core being surrounded by a magnet coil adapted to conduct an alternating current, and constituting the sole heating unit, and a return for the magnetic circuit in contact with the core at opposite ends of the coil, said return being of less magnetic resistance than the core, whereby heating is localized in the walls of the duct.

4. In an electric heater, the combination with a duct formed of integral cast hysteretic magnetizable metal with a passage extending therethrough, the cross sectional area of the passage being small as compared with the cross sectional area of the metal of the duct, a coil for alternating current surrounding the duct intermediate its ends, and a return for the magnetic circuit in contact with the duct at opposite ends of the coil, said return having less magnetic resistance than the duct and being substantially free from eddy currents, whereby heating is localized in the walls of the duct.

5. In an electric heater, the combination with a duct formed of integral hysteretic magnetizable metal with a passage extending therethrough, the cross sectional area of the passage being small as compared with the cross sectional area of the metal of the duct, a coil for alternating current sur-

rounding the duct intermediate its ends and a return for the magnetic circuit formed of a section of laminated magnetic metal in contact with the duct at opposite ends of the coil, whereby heating is localized in the walls of the duct.

6. In an electric heater, the combination with a substantially straight duct formed of integral hysteretic magnetizable metal with a passage extending therethrough, the cross sectional area of the passage being small as compared with the cross sectional area of the metal of the duct, a coil for alternating current surrounding the duct intermediate its ends, a branched return for the magnetic circuit formed of U-shaped sections of laminated magnetic metal with the ends of the sections in contact with the duct above and below the coil, and means for separably retaining the elements in their assembled position.

7. In an electric heater for liquids, the combination with a substantially straight duct formed of integral hysteretic magnetizable metal with plane exterior faces at the ends and a passage for the liquid extending through the duct, the cross sectional area of the passage being small as compared with the cross sectional area of the metal of the duct, a coil for alternating current surrounding the duct intermediate its ends, a return for the magnetic circuit formed of a U-shaped laminated metal section having plane faces at the ends, and means for clamping the plane faces of the duct and laminated metal sections permanently together at points above and below the coil.

8. An electric heating apparatus, comprising a non-laminated magnetic core, a primary winding thereon; adapted to conduct an alternating electric current, said magnetic core having a distributing chamber at or near each end and a plurality of passages leading through said core and connecting said chambers, one or more laminated magnetic return circuits engaging said core at or near each end and forming a continuous magnetic circuit therewith around and through said coil.

9. In an electric heater, the combination of a primary coil adapted to conduct an alternating electric current, an integral cast magnetizable core positioned within said coil and adapted to permit the formation of eddy-currents and hysteresis therein, passages extending through said core and adapted to hold the material to be heated, the cross sectional area of each of the passages being small as compared with the area of their walls; and laminated magnetic return circuits in contact with said core near the ends of said coil and passing outside of said coil.

WAYNE D. LUDWICK.

Witnesses:
M. M. MURRAY,
S. E. ALLEN.