

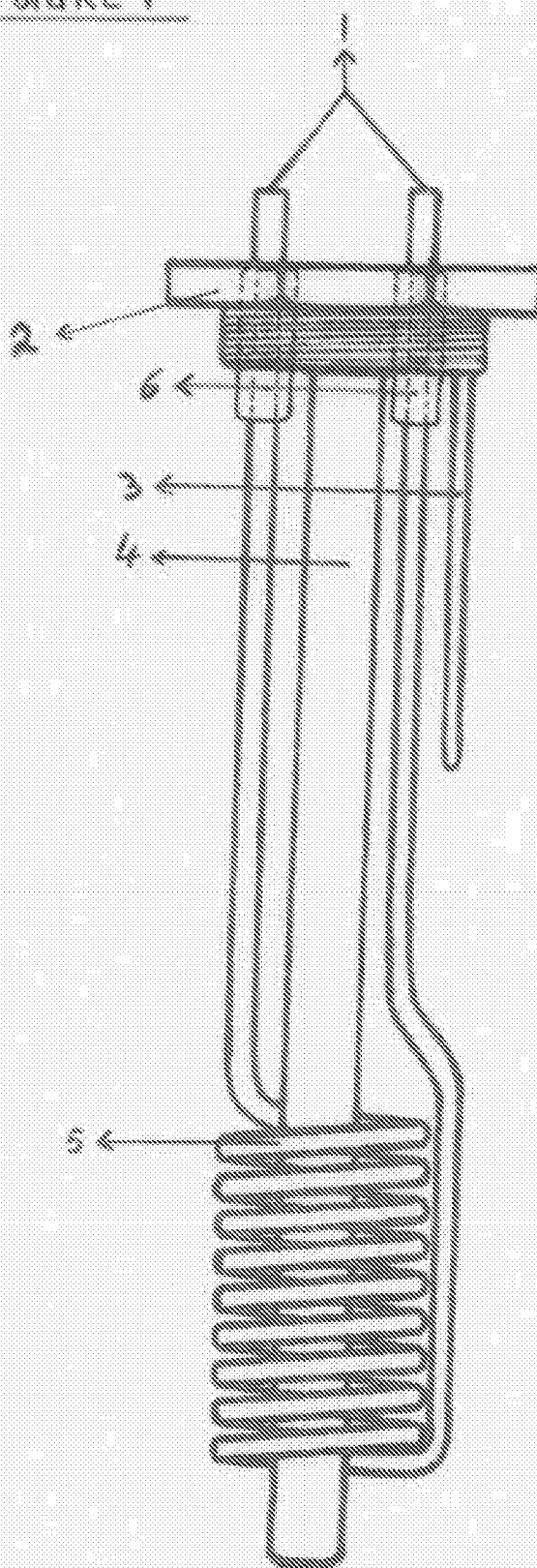
(54) Title of the Invention: Water heater element

(51) INT CL: F24H 7/02 (2022.01) F24H 9/20 (2022.01)

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(56) Documents Cited:	CN 212253134 U US 20160195301 A1 US 20220046767 A1		
(58) Field of Search:	As for published application 2629558 A viz: INT CL F24H, H05B Other: SEARCH-PATENT updated as appropriate Additional Fields Other: None		

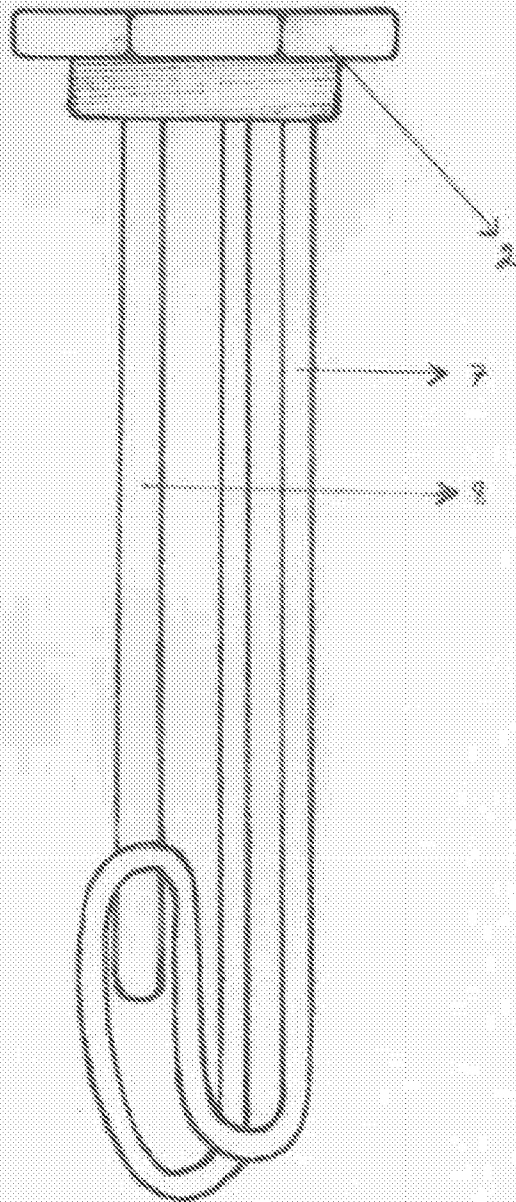
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FIGURE 1



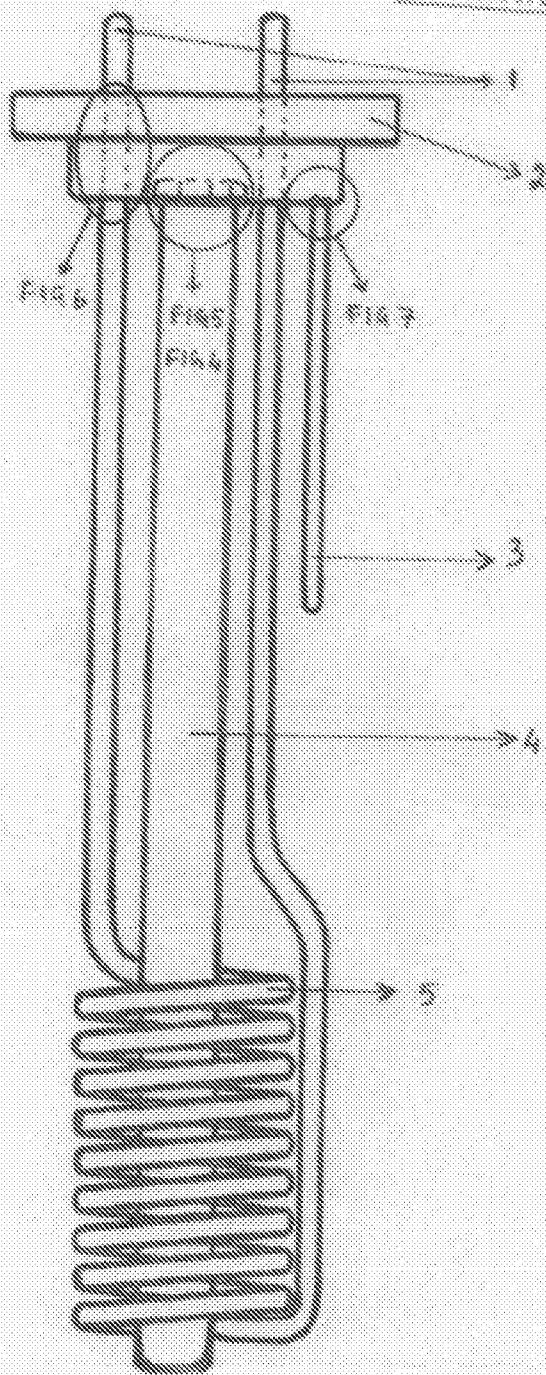
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FIGURE 2



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FIGURE 3



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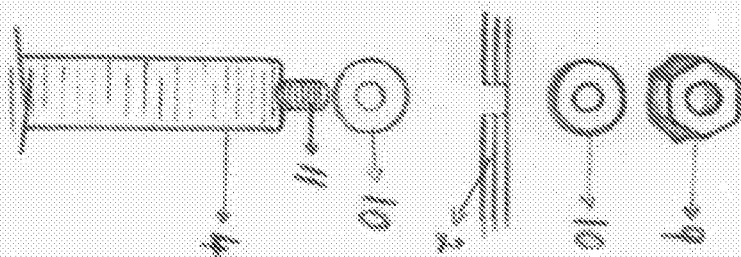


Figure 4

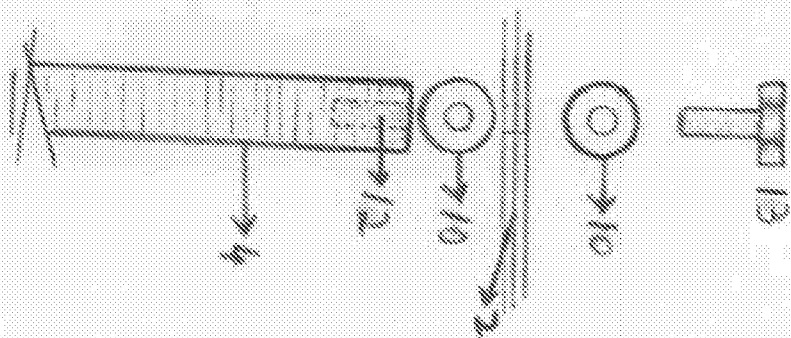


Figure 5

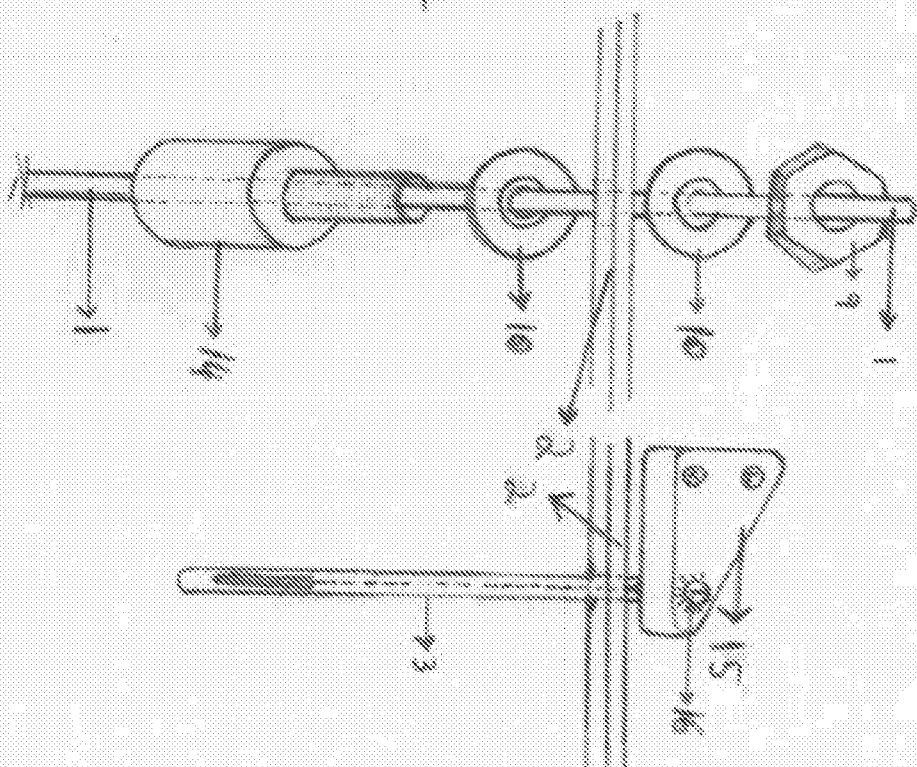


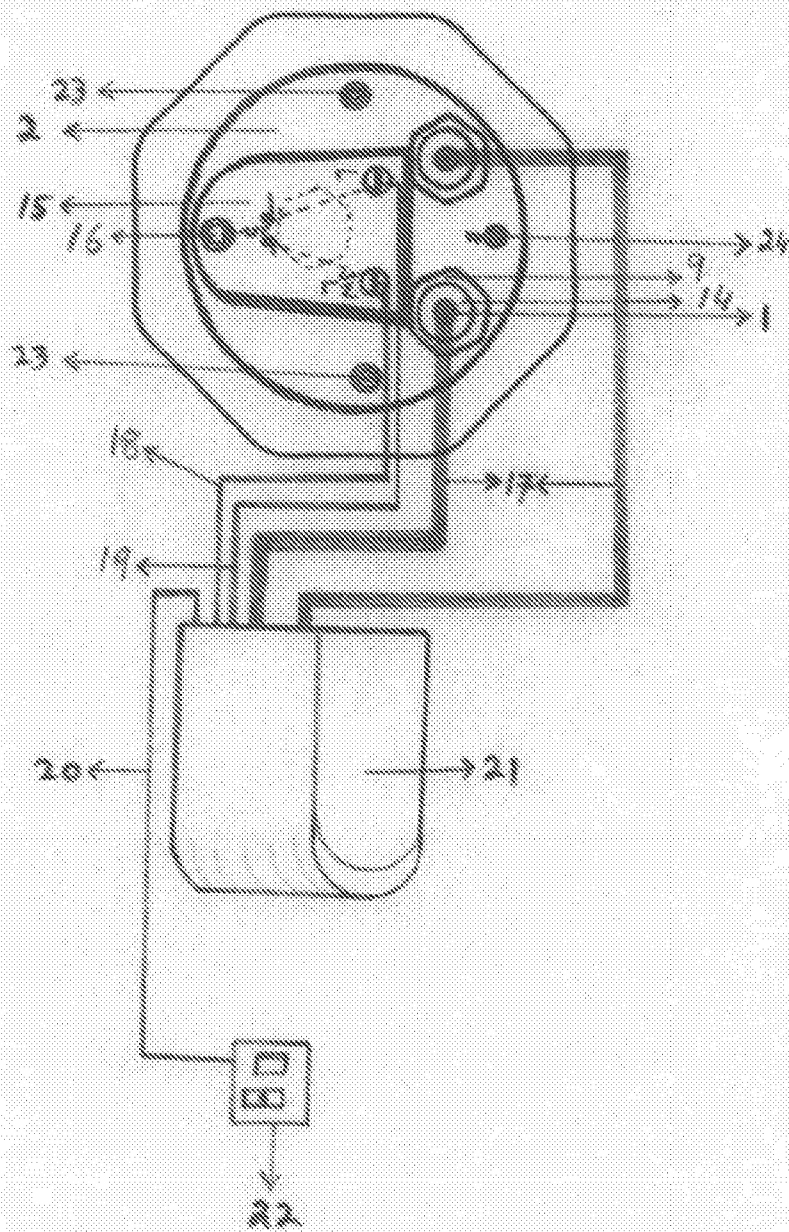
Figure 6



Figure 7

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FIGURE 8



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FIGURE 9

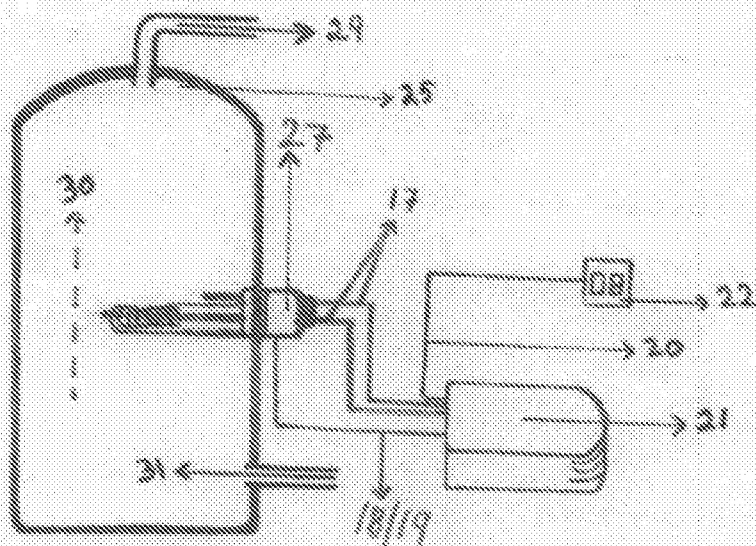
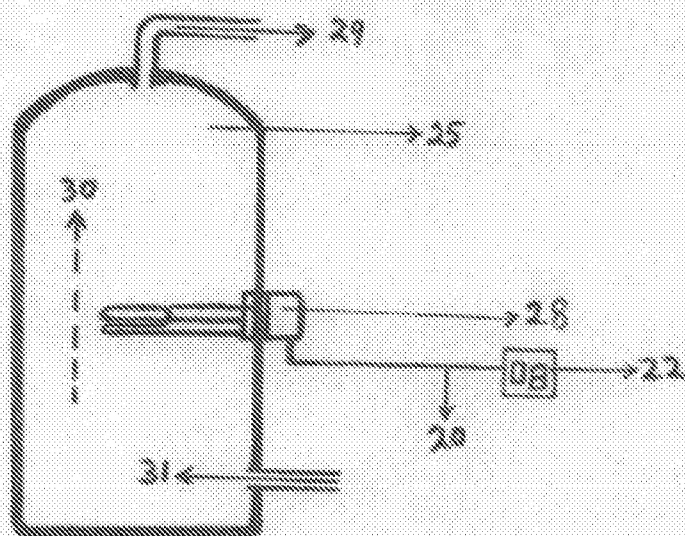
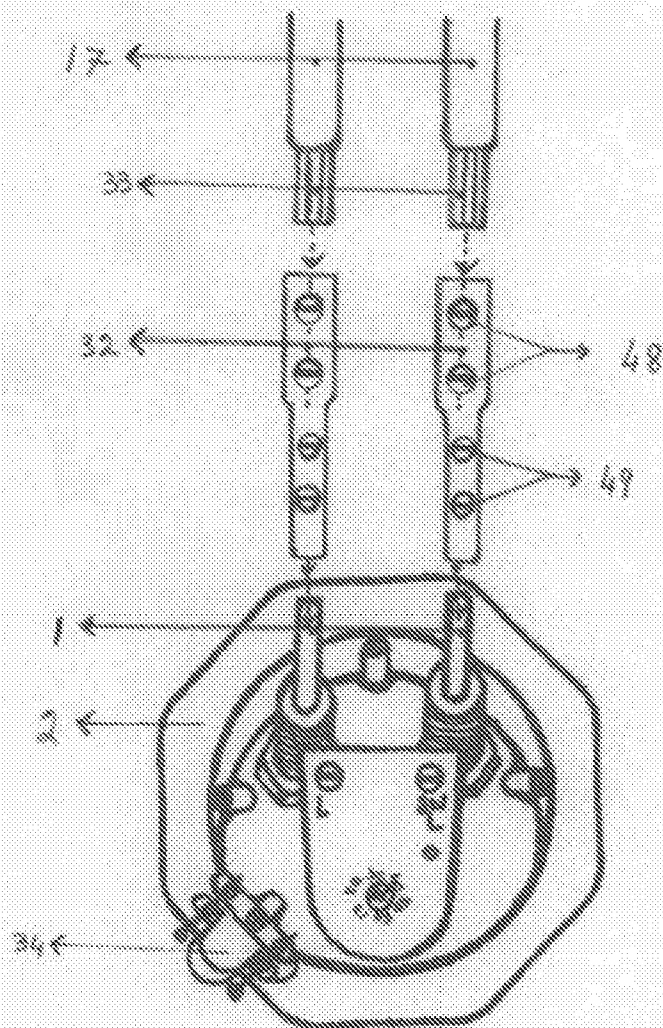


FIGURE 10



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FIGURE 11



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FIGURE 14

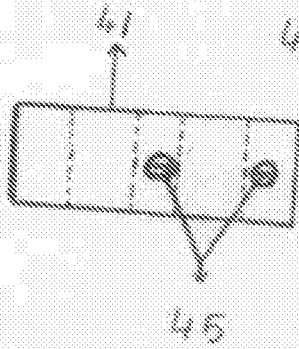


FIGURE 13

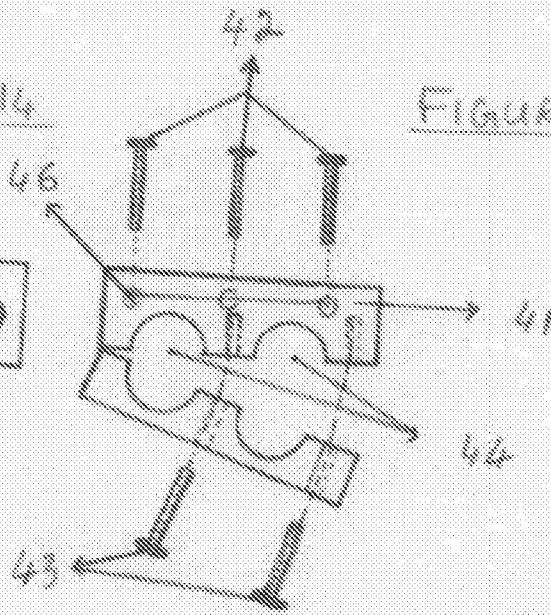
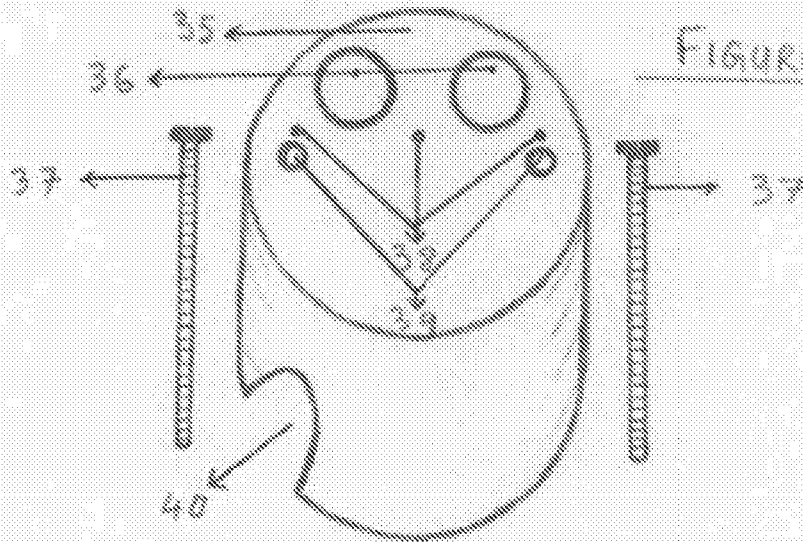


FIGURE 12



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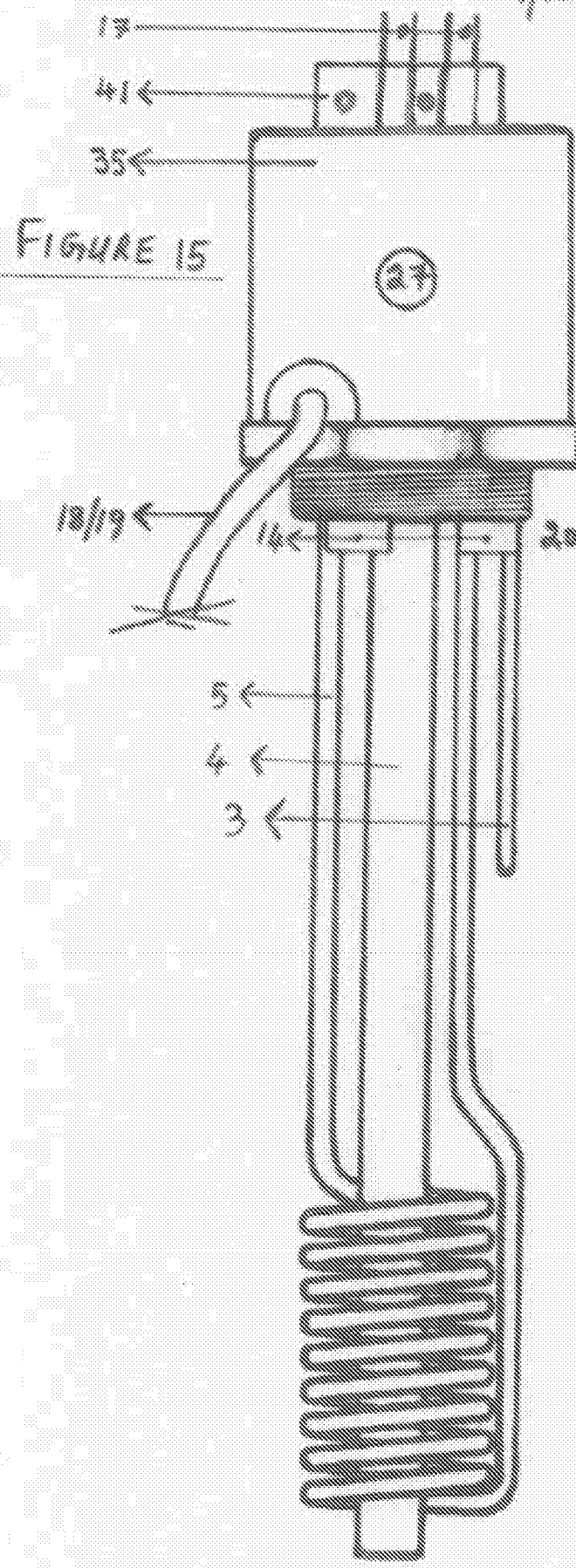
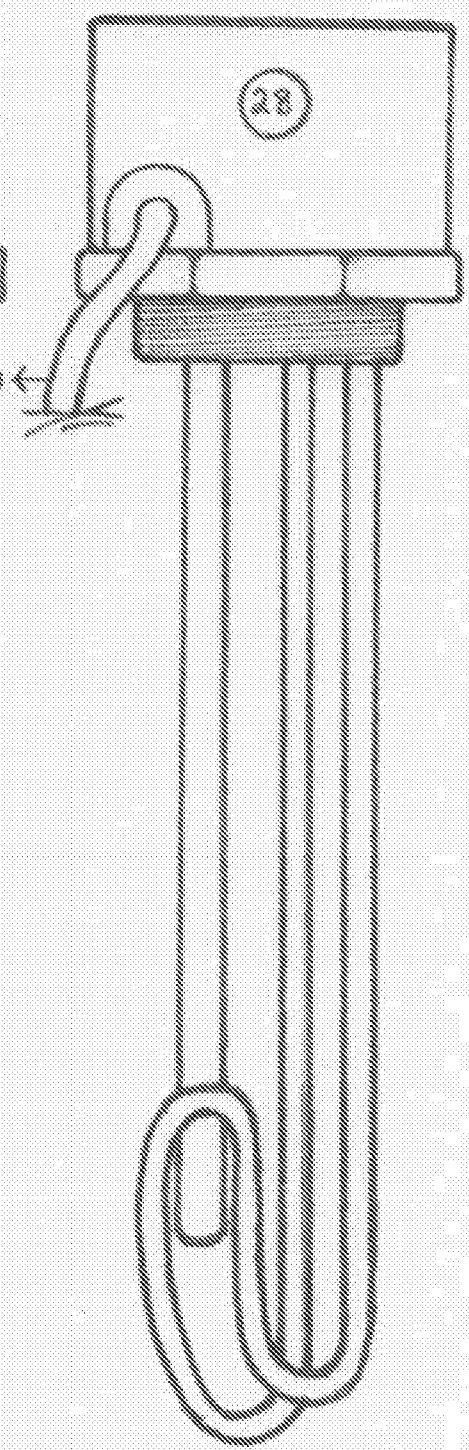
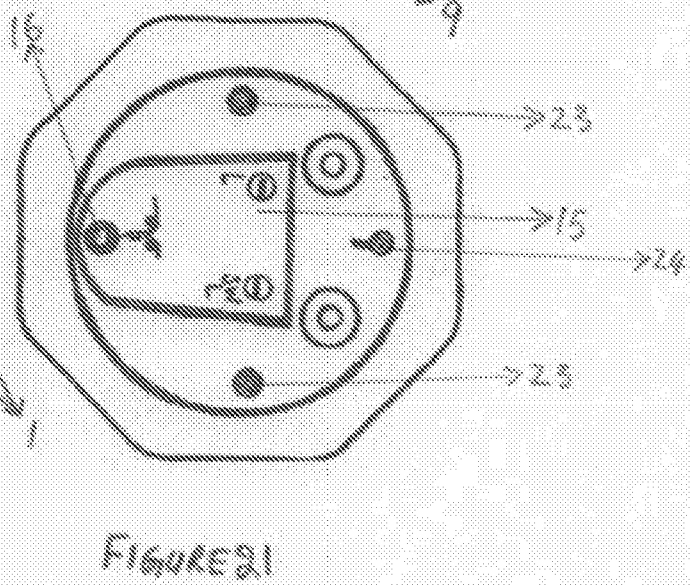
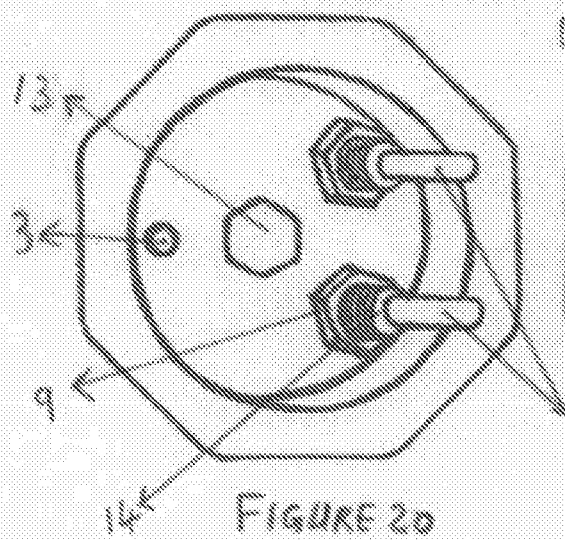
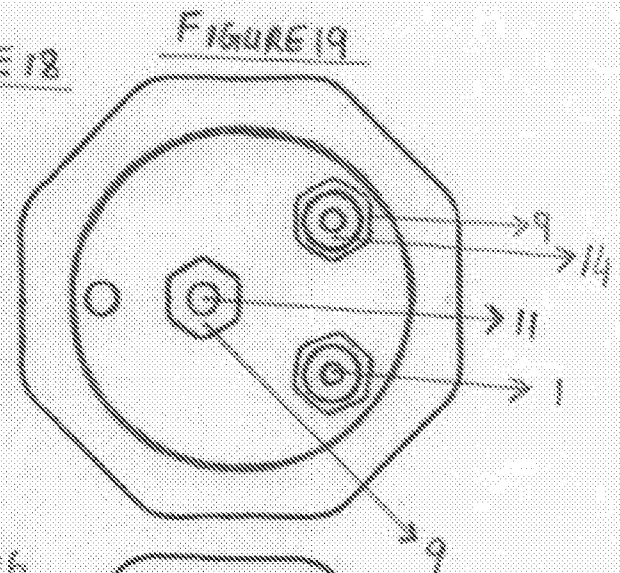
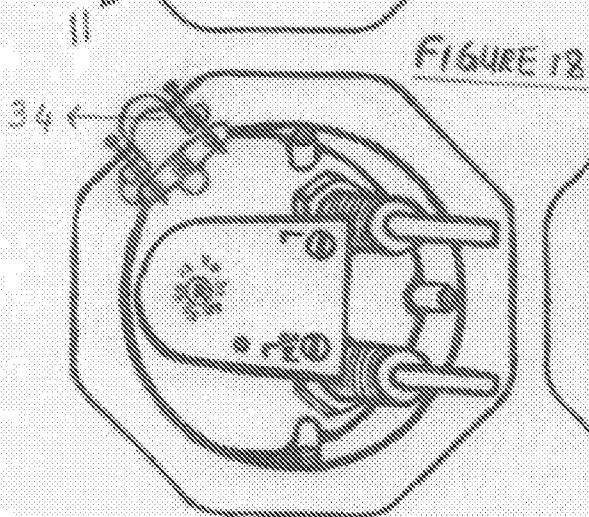
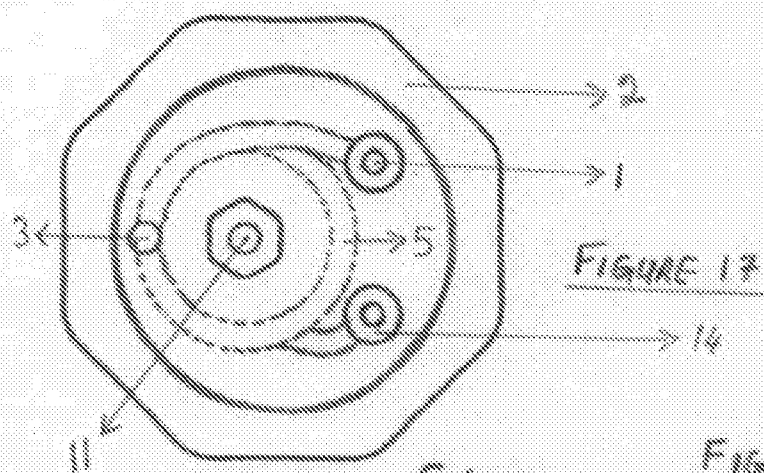


FIGURE 16



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WATER HEATER ELEMENT

The present invention relates to an apparatus which heats water in a water storage tank or container.

5 At present, natural gas is the most common energy source for heating water in domestic, commercial and industrial environments. Natural gas is a fossil fuel with a high carbon footprint, endangering the environment.

10 A second option is electricity. Devices and apparatus which heat water using electricity are very cost effective, easy to replace and almost maintenance free. But the operational cost is very high, their electricity demand is very high and the energy source for producing electricity is mostly fossil fuels.

15 Conventional water heating devices largely depend on electricity produced from fossil fuel, which is unsuitable for the environment. To overcome these basic environmental problems and high operational cost, the proposed invention does not depend on natural gas and is economical compared to commonly used electric water heating devices.

The present invention, provides a water heater element as set out in appended claim 1.

20 The impact on environment of the present water heater element is less than that of the conventional electric water heating element and its operational cost is very low. The present water heater element is very easy to install and maintain and will replace existing electric immersion heating elements.

25 Specific embodiments of the present invention will now be described, by way of example only, with reference to the accompanying drawings, in which:-

Figure 1 shows a submersible induction water heating element embodying the present invention.

Figure 2 shows a conventional immersion water heating element for comparison purpose only.

Figure 3 shows the water heating element of Figure 1 and indicates where further detail is to be found in separate figures.

30 Figure 4 shows a first option for attachment of a ferric steel rod/tube to a baseplate.

Figure 5 shows a second option for attachment of the ferric steel rod/tube to the baseplate.

Figure 6 shows the attachment of a standoff bush spacer assembly and hex nut for separating the baseplate from a heating coil stem.

Figure 7 shows the attachment of a thermostat tube to the baseplate.

35 Figure 8 shows connections between a supply, an induction generating device, and the induction water heating element.

Figure 9 shows the submersible induction heating element installed in a water storage tank.

Figure 10 shows a conventional immersion heating element installed in a water storage tank, for comparison purpose only.

40 Figure 11 shows attachment of an induction cable to the baseplate of the induction heating element

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by means of metal boot connectors.

Figure 12 shows a protective cover of the baseplate of the induction heating element baseplate.

Figure 13 shows a top view of a cable-supporting connector for the induction cable.

Figure 14 shows a front view of the cable-supporting connector 41 for the induction cable.

Figure 15 shows the submersible induction heating element ready to install.

Figure 16 shows a conventional immersion water heating element for comparison purpose only.

Figure 17 shows a top view of a coil and rod arrangement on the baseplate.

Figure 18 shows a top view of a cable supply and the cable-supporting connector.

Figure 19 shows top view of a coil stem, a bush assembly, and a holding hex nut to standoff the rod/tube.

Figure 20 shows a top view of the coil stem, the bush spacer assembly, the hex nut and a temperature tube.

Figure 21 shows a top view of a thermostat, a fixing point for the protective cover, an earth terminal and a thermostat, positioned on the baseplate.

The present invention relates to an apparatus which heats water in a water storage tank or container, otherwise commonly known as a hot-water storage tank. Apparatus used to heat water in a water storage tank is commonly known as an immersion water-heating element.

A submersible induction water-heating element as depicted in Figure 1 has a power/electricity requirement almost half that of a conventional water-heating element as depicted in Figure 2 and is as economical as gas-powered heating devices and equipment.

An induction heater requires three parts:

1. an induction coil;
2. a ferritic metal object; and
3. an induction-generating controller

The induction-generating controller generates induction in the induction coil and when the ferritic metal object is inserted inside the coil, or the apparatus comes in near contact to the ferritic metal object, the ferritic metal object is heated up and attains an extremely high temperature. Also the induction coil itself gets heated up during the process.

In using heat energy generated by induction to heat water, the challenge is to construct an apparatus that will put the first two parts of the induction heater in a permanently fixed position, and then to energise the apparatus as and when the hot-water demand arises. According to the invention, the first two parts of the induction heater are attached to a housing/baseplate 2.

When submerged in water in the water storage tank, they form a submersible induction water-heating element, thus combining the two functions and the two parts of an induction heater in one apparatus able

to be installed in water in a water-storage tank to heat the water as demand arises.

In developing a functional submersible induction water heating element, there are two further obstacles:

1. separating and attaching the induction heating coil stem 1 from the element baseplate 2, and
2. permanently attaching a ferrite steel rod/tube 4 to the baseplate 2.

Obstacle 1 is overcome by introducing a non-conductive or insulated standoff bush spacer assembly in a hex nut-and-bolt arrangement as in Figures 1, 3, 6, 15, 19, 20. An induction coil stem 1 and the baseplate 2 both are made up of conductive material and can conduct electricity or induction produced by the induction controller to a coil 5 as well as to the baseplate 2 and any other conductive parts either attached or in contact. To avoid the induction spreading across objects other than the induction coil 5, a separation mechanism is necessary and this is achieved by introducing a standoff bush spacer assembly 6, 14 between the stem 1 of the induction coil 5 and the baseplate 2.

Obstacle 2 is overcome by permanently attaching the ferritic steel rod/tube 4 through the heating coil 5 to the baseplate 2 without contacting the coil 5 and in the centre of the coil 5 as shown in Figures 3,4 and 17.

As a result, when submerged, the ferritic metal rod 4 and the induction coil 5 both heat the water in the water storage tank or container, without wasting heat energy.

The submersible induction water-heating element system seen Figures 9 and 15 can be installed by simply replacing the existing immersion water-heating element, see Figures 10 and 16. It is constructed on the same size and dimensions of baseplate as the existing immersion water-heating element - see Figures 1 and 2.

Operational control is provided by an automatic mechanical heating thermostat switch (see Figures 7, 8, 9 and 21) which will turn the heating ON as the water temperature drops from a preset temperature and turn OFF when the temperature reaches a desired heating level. Operation can also be controlled by an external tank-state thermostat.

The submersible induction water-heating element must be fully submerged in water, in the water storage tank or container, before energising the induction-generating controller. Otherwise, since the ferritic rod/tube 4 is attached to the baseplate 2 permanently, it will start heating up and attain very high temperature in a very short time which could damage the coil 5.

Numbering of components in the drawings is as follows.

1. Coil stem
2. Baseplate
3. Temperature sensor probe tube
4. Ferric steel/metal rod or tube
5. Induction coil
6. Bush spacer assembly for holding and separating the induction coil 5 from the baseplate 2
7. Conventional immersion heating element
8. Conventional immersion heating element temperature probe tube
9. Hex nut to attach the ferric steel rod/tube 4 to the baseplate 2
10. Washer
11. Outward standoff screw thread for nut on the ferric steel rod/tube 4
12. Inwardly tapered screw thread for screwing on ferric steel rod/tube 4
13. Standoff long spacer screw to attach the ferric steel rod/ tube 4 to the baseplate 2
14. Bush spacer nut bolt standoff type assembly for separation of the coil stem 1 from the baseplate 2
15. Temperature sensor thermostat device
16. Temperature controlling knob
17. Induction heating cables
18. Switch live cable
19. Live cable to thermostat
20. Main power cable
21. Induction generating device
22. Supply isolator

23. Protective cover holding blind hole taped nut point on the baseplate 2
24. Earth connection holding blind hole tapered nut point on the baseplate 2
25. Water storage tank
26. Not applicable
27. submersible induction water-heating element
28. Conventional immersion water-heating element
29. Hot water outlet
30. Heated water flow upward
31. Cold water inlet
32. Boot connector for connecting coil stem and induction cable
33. Stranded cable strap
34. Supply cable holding connector
35. Element Protective cover
36. Induction cable insertion holes
37. Protective cover holding screws
38. Cable support block installation points
39. Screws holes for protective cover
40. Electric supply cable location cavity space on protective cover
41. Induction cable support block
42. Screws to attach cable support block on protective cover

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43. Screws to fasten the induction cable with cable support block
44. Position for induction cable to pass through the cable support block
45. Screw positioned to fasten the induction cable with the cable support block
46. Position of screws to attached the cable support block on the protective cover.

Figure 1 shows a submersible induction water heating element with all three parts (the induction coil 5, the ferrite steel rod/tube 4 and the temperature sensor probe tube 3) permanently attached to the baseplate 2. On an outer side of the heating element, the induction coil stem 1 is ready for connection, and the bush spacer assembly 6, 14, separates the conductive parts (baseplate 2 and induction coil 5), preventing them from contacting each other.

Figure 2 shows a conventional immersion water heating element for comparison purpose only. Parts include baseplate 2, heating element 7 and temperature probe tube 8.

Figures 5, 6 and 7 show detail of arrangements highlighted in Figure 3.

Figure 4 shows one option for attaching the ferric steel rod/tube 4 to the baseplate 2, by attaching a long standoff spacer rod/ tube 11 and fixing it with a hex nut 9 on the baseplate 2 on its top side. The ferric steel rod/ tube 4 should be installed permanently in the centre of the induction coil 5 by means of a nut-and-screw arrangement. Washer 9 is used to provide water leakage tightness. Since the ferric steel rod/tube 4 is submerged, temperature remains around the preset level and does not attain a higher level which might burn the washers or compromise the air tightness. Once the ferric steel rod/tube 4 is permanently attached to the baseplate 2, the device is ready to heat up the ferric steel rod/tube 4, which in turn heats the water through simple heat exchange.

Figure 5 shows a second option for attachment of the ferric steel rod/ tube 4 to the baseplate 2, achieved by making a blind hole arrangement 12 in the centre of the ferric steel rod/tube 4 or through a hole in a casing of the ferric steel rod/tube 4 and attaching it on the baseplate 2 by means of a hex screw 13. The ferric steel rod/ tube 4 is thereby permanently attached to the baseplate 2.

Figure 6 shows attachment of a bush spacer assembly 6, 14 for separating the baseplate 2 and the stem 1 of the heating coil 5, while the coil stem 1 emerges out of the baseplate 2 to serve as a connection point for induction cable 17. The bush spacer assembly 6, 14 is made with insulated material which will act as an insulator and will not allow the coil stem 1 and baseplate 2 to establish contact with each other. A hole is made through the bush spacer assembly 6,14 where the coil stem 1 passes through, to emerge at the top side of baseplate 2, where it serves as a connection point for the induction cable 17. Further, a hex

nut fitted to the top side of the baseplate 2 keeps the bush spacer assembly 6, 14 firmly attached with the baseplate 2. Without the bush spacer 6, 14 assembly, induction generated by the device 21 would spread across all the connected conductive parts and the required result would not be achieved.

Figure 7 shows the attachment of temperature sensor probe tube 3 to the baseplate 2 by means of solder to permanently bond them. The temperature sensor probe tube 3 holds the temperature probe of a thermostat 15 which also provides automatic switching for the induction heating element. It will control heating of water by pre-setting the water temperature on the thermostat. Once the desired temperature is reached, the thermostat 15 switches off, and turns on when temperature falls below a desired level.

Figure 8 shows electrical connections and is a top view of the induction-generating device 21, the induction coil stem 1 and the heating element's baseplate 2, showing where connection is made for supply to the thermostat 15, the induction cable 17 and to the stem 1 of the induction heating coil 5. Figure 8 also shows the positioning of the thermostat 15, a protective cover holding position 23, an earth protection point 24, and connection of a supply cable 18 and 19 to the thermostat 15 as well as a further supply cable 20 leading to the induction-generating device 21 and a supply isolator 22.

Figure 9 is a schematic depiction of the induction submersible heating element 27 installed in a water storage tank 25, also showing the induction-generating device 21 with the electric supply cable 20 and the electric isolator 22. Induction cable 17 is connected from the induction-generating device 21 to the submersible heating element 27, which is submerged in water in the water-storage tank 25. The water-storage tank 25 is filled up with water through a water inlet 31, the water being heated up and flowing upward (see arrow 30) to the outlet 29.

Figure 10 shows installation of the conventional immersion heating element 28 in a water storage tank for comparison purpose only.

Figure 11 shows attachment of the induction cable 17 to the coil stem 1 at the baseplate 2 by means of metallic boot connectors 32. Bootlace cord end ferrule terminals 33 of the induction cable strap 17 are inserted into metallic boot connectors 32 and tightened by means of screws 48. Opposite ends of the boot connectors 32 are inserted in the coil stem 1 and tightened up by means of screws 49. The supply cable 20 shall be inserted and secured by a cable support connector 34 to a terminal of the thermostat 15. The metallic boot connectors 32 are specially designed for this purpose as the induction cable 17 is stranded, flexible and of heavy gauge.

Figure 12 shows a protective cover 35 of the submersible heating element 27, made up of insulated material with insertion holes 36 for the induction cable 17, holes 39 for holding screw 37 to the baseplate 2 at point 23, see figure 8, semi holes 38 to attach an induction cable support block 41 on the protective cover 35 and cavity hole 40 to insert the supply cable 20 for the electric connection.

Figure 13 shows a top view of the induction cable supporting block 41 on the protective cover 35. As the induction cable 17 is stranded, of heavy gauge and needs to be run apart to each other, the induction cable supporting block 41 serves the purpose. The induction cable supporting block 41 is made of insulating material and needs to be placed 10cm apart on the cable for the full length of the induction cable 17 as well. It will provide the separation between the induction cable 17 and the induction-generating device 21 to induction heating element 27. It has three holes 46 and should be attached on the induction heating element cover 35 by means of screws 42. The induction cable is inserted through holes 44 and cable supporting block 41 is closed and secured by means of screws 43. This arrangement keeps the induction cable 17 in place and the cable's connection with the boot connectors 32 will not be affected by movement of the induction cable 17.

The induction cable supporting block 41 is especially designed for the submersible heating element 27 to serve the purpose of supporting and strengthening the induction cable 17 and avoiding cable weight being exerted on the boot connectors 32.

Figure 14 shows the front view of cable-supporting connector 41. Holes 45 are provided for securing the induction cable 17 in the cable-supporting connector 41 by means of the screws 43.

Figure 15 shows the submersible heating element 27 ready to install. The induction cable 17 passes through the induction cable connector block 41. The temperature sensor probe tube 3, the ferric steel/metal rod or tube 4 and the induction coil 5. are attached to the baseplate 2, whose size and dimensions are of universal standard and will replace the existing heating element 7 conveniently.

Figure 16 shows a conventional immersion water heating element 28 for comparison purposes only.

Figure 17 shows a top view of the heating coil 5 and the ferric steel rod/tube 4 standoff screw 11, the hex nut attachment and the temperature sensor probe tube 3 arrangement on the baseplate 2.

Figure 18 shows a top view of the supply cable connection support 34.

Figure 19 shows a top view of the coil stem 1, the bush spacer assembly 6, 14 and the hex nut 9 on the base plate 2. it also shows the long standoff spacer rod/tube 11 attached by means of the hex nut 9.

Figure 20 shows a top/side view of the coil stem 1, the bush spacer assembly 6, 14, the hex nut 9, temperature sensor probe tube 3 and the ferric steel/ rod hex screw 13 for attaching the blind hole arrangement on the ferrite steel rod/tube 4.

Figure 21 shows a top view of the base plate 2 and position of the thermostat 15, the fixing point 23 for the protective cover, the earth terminal 24 and a thermostat temperature control knob 16. The thermostat 15 provides the option to preset the temperature by means of the knob 16 .

The submersible water heating element 27 is a very simple device that will heat the water in the water storage tank 25. The complete induction water heating system is made up of two items: the induction-generating device 21 and the submersible water heating element 27.

5

The submersible water heating element 27, assembled on the baseplate of induction submersible water heating element, makes the submersible water heating element very convenient to install, replace and maintain. Heat energy produced by induction is utilised to heat the water in the water storage tank 25. Induction heating is thermostatically controlled to achieve a desired temperature.

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Claims

5 1. An inductive water heater element comprising a baseplate receivable through an opening in a wall of a water tank, an induction coil upstanding from the baseplate, a ferritic steel rod or tube upstanding from the baseplate and disposed within the induction coil, and a temperature sensor probe upstanding from the baseplate, so that in use the induction coil, the ferritic steel rod or tube and the temperature sensor probe are installable as a unit, and in use are submerged in water in the water tank.

10 2. A water heater element as claimed in claim 1 in which the induction coil has a pair of stems through which it is mounted to the baseplate.

15 3. A water heater element as claimed in claim 2 in which the stems of the induction coil pass through the baseplate.

20 4. A water heater element as claimed in claim 3, in which the stems of the induction coil pass through the baseplate via respective insulating bushes which isolate the stems from the baseplate.

25 5. A water heater element as claimed in claim 3 or claim 4 in which the stems are electrically connected to an induction cable through respective boot connectors engaging with ends of the stems projecting from the baseplate.

30 6. A water heater element as claimed in any preceding claim in which the ferritic steel rod or tube is attached to the baseplate through a standoff spacer passing through a hole in the centre of the baseplate and secured by a nut on an outer side of the baseplate.

35 7. A water heater element as claimed in any of claims 1 to 5 in which the ferritic steel rod or tube is attached to the baseplate through a screw received in a blind hole in the ferritic steel rod or tube.

40 8. A water heater element as claimed in any preceding claim, in which a housing of the temperature sensor probe is attached permanently to the baseplate by means of solder.

45 9. A water heater element as claimed in any preceding claim further comprising a protective cover.