(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
27 December 2012 (27.12.2012)

WIPO | PCT

(10) International Publication Number
WO 2012/175961 A2

(51) International Patent Classification: Not classified

(21) International Application Number:
PCT/GB2012/051425

(22) International Filing Date:
20 June 2012 (20.06.2012)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
1110840.4 24 June 2011 (24.06.2011) GB

(71) Applicant *(for all designated States except US)*: **COPPER INDUSTRIES (IRELAND) LIMITED** [GB/GB]; Toome Business Park, 21 Hillhead Road, Toomebridge, Antrim BT41 3SF (GB).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: **SHIVERS, Charles Laurence** [GB/GB]; Toome Business Park, 21 Hillhead Road, Toomebridge, Antrim BT41 3SF (GB).

(74) Agent: **NOVAGRAAF UK**; 12 Meridian Way, Meridian Business Park, Norwich NR7 0TA (GB).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

Published:

— *without international search report and to be republished upon receipt of that report (Rule 48.2(g))*

WO 2012/175961 A2

(54) Title: AN IMPROVED WATER HEATER

(57) Abstract: A water heater, having a tank with a water inlet and outlet, and a heater element to heat water within the tank. The heater element is surrounded by a heat exchanger having an inlet towards its lower end and a tube extending from it upper end to direct heated water towards the top of the tank.

AN IMPROVED WATER HEATER

Field of the Invention

The present invention relates to a water heater. In particular, a water heater suitable for both domestic and larger industrial uses, which utilises heat energy more efficiently through the use of a heat exchanger.

Background to the Invention

There is within the water heating industry a continued and increasing requirement for heaters to utilise energy more effectively and efficiently. This requirement is mainly driven at present by increasing fuel costs and the desire to reduce consumption of fossil fuels of limited availability.

To achieve this end a large number of improvements to many aspects of water heaters has been made. So, improved insulation to cut loss, more efficient heaters and so-called smart heaters, which time the energy utilisation using information on the building and users in which the heater is installed have all been included either alone or in combination with each other.

One type of water heater which is widely used, commonly known as a combi-heater, has the heat source activated only when hot water is drawn, for example to provide heat for wash water or a central heating system. Such systems have the benefit of utilising energy to heat water only when required.

The disadvantage of combi-heaters are however that they tend to be of increased complexity compared to conventional tank heaters. In the latter, a tank of water is kept at a required temperature and is available when needed. The disadvantage of a tank heater is of course that if water is not drawn off then the body of water gradually cools, thus wasting the heat energy imported to the water.

The present invention seeks to address the disadvantages of tank heaters and to provide a heater which, although itself a tank heater, can in certain circumstances function in a similar manner to a combi-heater.

Summary of the Invention

According to a first aspect of the invention there is provided a water heater, comprising:

a tank to retain a volume of water to be heated,

a water inlet and a water outlet,

a heater element to heat water in the tank,

a heat exchanger located around the heater element, the heat exchanger having an aperture in the heat exchanger's base or lower regions, allowing water to flow into the heat exchanger and to the heater element,

the in-use upper region of the heat exchanger being in fluid communication with a connection tube, the tube co-operating with the heat exchanger to direct heated water from the heater element to the upper regions of the tank.

Heated water is thus led in a smooth manner to the upper regions of the tank, drawing cooler water to the heater element to be heated and allowing the heated water to form a layer which can be used more directly by the user.

The tube is preferably 15-65mm in diameter to allow sufficient water to flow in a smooth manner and not introduce turbulence at the upper region of the tank.

The material from which the heat exchanger and/or tube is formed preferably includes a heat insulator. Further preferably a heat insulator is present in the form of a lining about or on the inside layer of the tube. Optionally, the heat exchanger and/or tube are formed completely from a heat insulation material such as a plastics material or a ceramics material.

Advantageously, one or more further heater elements are located within the tube

to enable a higher temperature of water to be reached.

According to a second aspect of the invention, there is provided a heat exchanger and tube as defined above.

Brief Description of the Drawings

The invention is described with reference to the accompanying drawings which show, by way of example only, two embodiments of a water heater. In the drawings:

Figure 1 illustrates a first embodiment of a water heater; and
Figure 2 illustrates a second embodiment of a water heater.

Detailed Description of the Invention

Tank heaters of the type described herein are in general well known and normally share a number of features in common. The tank body itself is typically made of a corrosion-resistant material such as steel or copper and tends to have a generally cylindrical shape, which eases manufacture, gives reduction of the surface area of wall to volume ratio, and also minimises the presence of any edges within the tank which would increase corrosion of the tank. The tank is provided with a cold water inlet to replenish water drawn off and a hot water outlet so that water can be drawn off by the user. One or more heating elements provide energy for the heating process. Often the or each heating element is located towards the base of the tank. Hot water produced by the heater rises to the top of the volume of water, with more cold water then replacing this heated water around the elements, which cold water can then be brought up to the correct temperature. In this way the temperature of the water in the tank is gradually brought to equilibrium.

The present invention utilises the above described lower density of hot water

compared to cold water as well as a further property where flow of water within a volume is low: namely thermal stratification. When there is relatively little flow, layers of water can develop in which each layer is at a different temperature, the lowest temperature naturally being at the bottom and the warmest at the top. Such stratification is remarkably stable and certainly over time periods required in domestic water heating installations.

Referring initially to Figure 1, this illustrates a water heater according to a first embodiment of the invention. The water heater comprises a tank 10 of conventional construction, having a water inlet (not illustrated) towards the base of the tank 10, and a water outlet 11. The water outlet 11, may extend several inches into the body of the tank 10 to ensure that one end of the outlet 11 lies within the body of the water. The length is not however too great as the end of the water outlet 11 then lies in the cooler regions with water then being drawn from those regions.

A heating element 12 extends through the walls of the tank 10 and into the volume of water. The heating element 12 is normally located towards the base of the tank 12 to enable heating of the coldest water. The heating element 12 can be a conventional resistive element or it can also provide heat from a source such as solar hot water heater, located externally on the building, a geo-thermal hot water heater or other source.

In the present invention, the element 12 is located within a heat exchanger 13. The heat exchanger 13 is generally cylindrical, open at one end 14, and is so mounted that the open end 14 opens downwardly with the edge below the level of the element 12. The heat exchanger 13, although it does not have to be completely open at the lower end does have to include apertures to allow cooler water to flow to the element.

The upper end of the heat exchanger 13 is closed. There is however an aperture 15 in the otherwise closed end which allows heated water within the heat exchanger 13 to exit. An open tube 16 is joined at its first end about the aperture

15 with a second end opening into the upper region of the tank 10. Hot water therefore produced by the element 12, which rises and exits through the aperture 15, is led by the tube 16 to the upper region of the volume of water within the tank 10. Typically the tube 16 has an internal diameter of around 15-65mm, although the value is chosen to suit the size of the tank 10.

Because flow of water out of the tube 16 is relatively slow and smooth, the heated water exiting the tube tends to accumulate and form a stable layer of water above the cooler body of water by the above mentioned process of stratification.

This provides advantages to the user as follows. Firstly, if most of the hot water within a tank has been drawn off only a short time previously, the heated water subsequently produced by the element 12 builds up relatively quickly in the region from which the water is drawn off. Hot water therefore becomes available more rapidly than would be the case with a conventional tank heater. In a conventional heater, the hot water produced by an element rises through the whole body of cooler water, losing heat quite rapidly as it does so. The time required to produced usable hot water is therefore greater than in the present invention.

Given the above, the invention allows a conventional tank heater to have some of the features of a combi-heater without having the disadvantages thereof.

The heat exchanger 13 and the tube 16 can be formed of conventional materials such as copper or steel. Alternatively, these can be formed, either partially or completely of a plastics or ceramics material. In order to decrease the thermal conductivity, a heat insulating layer can be applied to the heat exchanger 13 and/or the tube 16. This reduces heat loss from the heated water as it rises through the tank.

In use therefore the system functions as follows. The heating element 12 is activated by conventional means. The action may be under control of a timer or

of a thermostat, combination of these or other means in the art. The heated water, due to its lower density rises to the top of the heat exchanger 13 and thence via the aperture 15 into the tube 16. The water then rises until it exits the tube 16 into the upper regions of the tank 10 where it is available for use. If water is not being drawn off at the time then it accumulates into a layer of heated water.

As the heated water rises, cooler water is drawn into the heat exchanger 13 via the open end 14 and, if heating is maintained, is itself heated and flows out of the heat exchanger 13. If hot water is drawn from the tank 10 then the cold water is admitted into the tank through the inlet.

In Figure 2, a second embodiment of water heater is shown with features common to both embodiments being allocated the same number. The second embodiment includes an additional heating source 22 whose element is located within the tube 16 to boost the temperature of the water produced as it rises upwards. A hotter temperature can therefore be obtained on a first pass through the heat exchanger 13 and the tube 16.

An important feature of the tube 16 is that no water can enter the tube along its length. The temperature of the water exiting the tube 16 can therefore be controlled more efficiently allowing a sufficient amount of energy to be provided by the heating element 12 or additional heating source 22.

It will of course be understood that the invention is not limited to the specific details described herein, which are given by way of example only, and that various modifications and alterations are possible within the scope of the invention.

CLAIMS

1. A water heater, comprising:

a tank to retain a volume of water to be heated,

a water inlet and a water outlet,

a heater element to heat water in the tank,

a heat exchanger located around the heater element, the heat exchanger having an aperture in the heat exchanger's base or lower regions, allowing water to flow into the heat exchanger and to the heater element,

the in-use upper region of the heat exchanger being in fluid communication with a connection tube, the tube co-operating with the heat exchanger to direct heated water from the heater element to the upper regions of the tank.

2. A water heater according to Claim 1 wherein said connection tube has an internal diameter of between 15 and 65mm.

3. A water heater according to Claim 1or Claim 2 wherein said heat exchanger is formed from a material that includes a heat insulator.

4. A water heater according to any preceding claim wherein said connection tube is formed from a material that includes a heat insulator.

5. A water heater according to Claim 4 said heat insulator comprises a lining about, or on the inside of, said connection tube.

6. A water heater according to Claim 1 or Claim 2 wherein said heat exchanger is formed completely from a heat insulation material such as a plastics material or a ceramics material.

7. A water heater according to any of Claims 1, 2 or 6 wherein said connection tube is formed completely from a heat insulation material such as a plastics material or a ceramics material.

8. A heat exchanger according to any preceding claim comprising one or more further heater elements located within said connection tube.

9. A heat exchanger and tube suitable for use in a water heater according to any preceding claim, comprising a heat exchanger for surrounding a heater element, said heat exchanger having an aperture in its base or lower, in-use, region to allow water to flow into said heat exchanger and a connection tube in fluid communication with said heat exchanger at its upper, in-use, region.

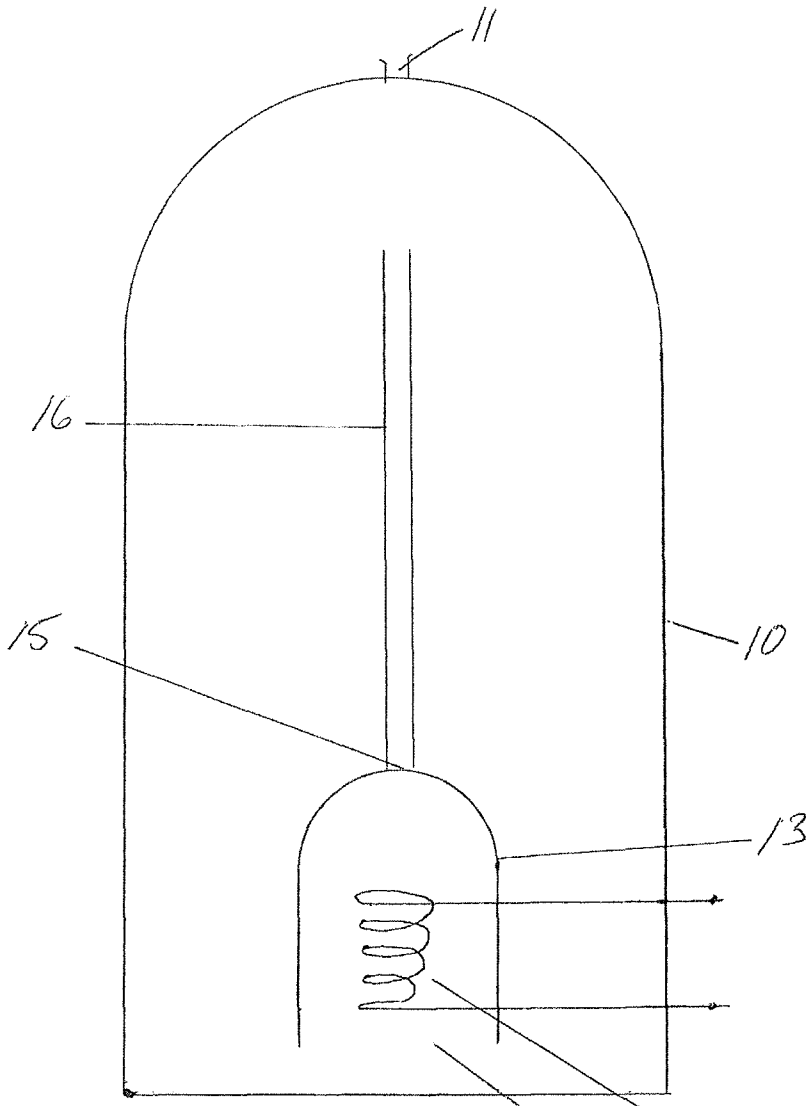

FIGURE 1

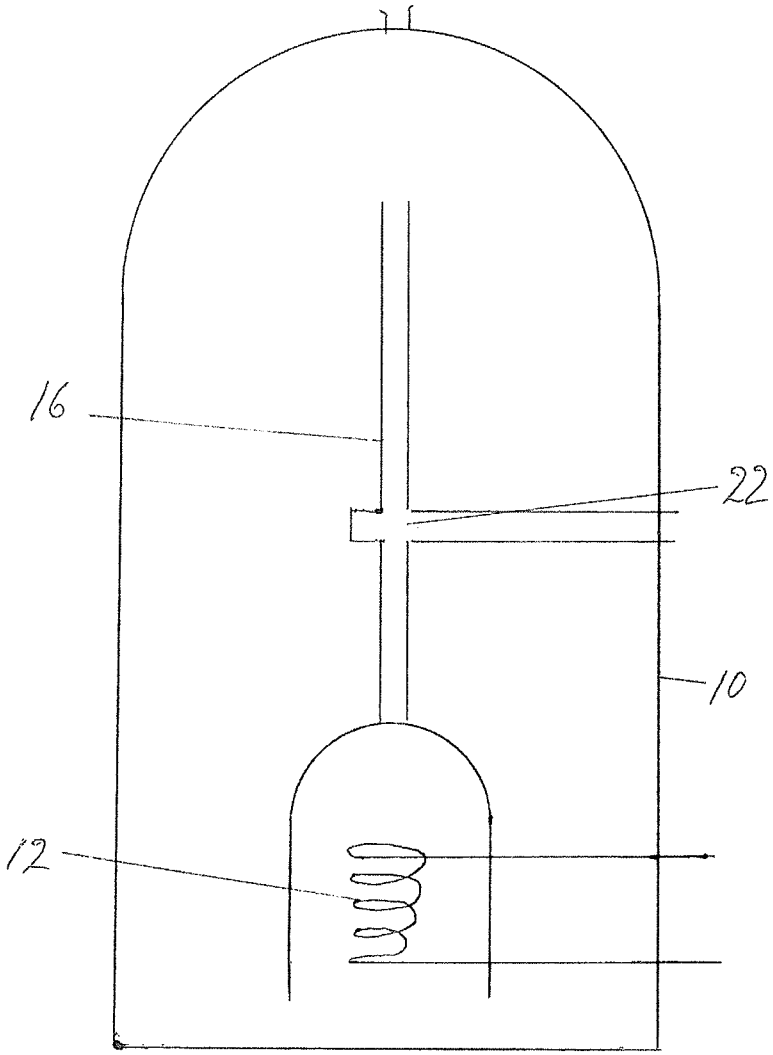

FIGURE 2