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(54) **Electrically operated water heating device.**

(57) The invention comprises in a preferred form, an electrically operated water heating unit (10) integral with a shower rose (18) and is primarily characterized by the successful use of a "bare" element (22) for heating the water and by the novel switching arrangment, comprising a first set of contact points (28) mounted through a flexible diaphragm (32), the diaphragm forming the roof of the heating chamber (20), and a second set of contacts (36) aligned so as to engage the first contacts (28) when same are moved upwards by water pressure exerting on the diaphragm (32) during use.

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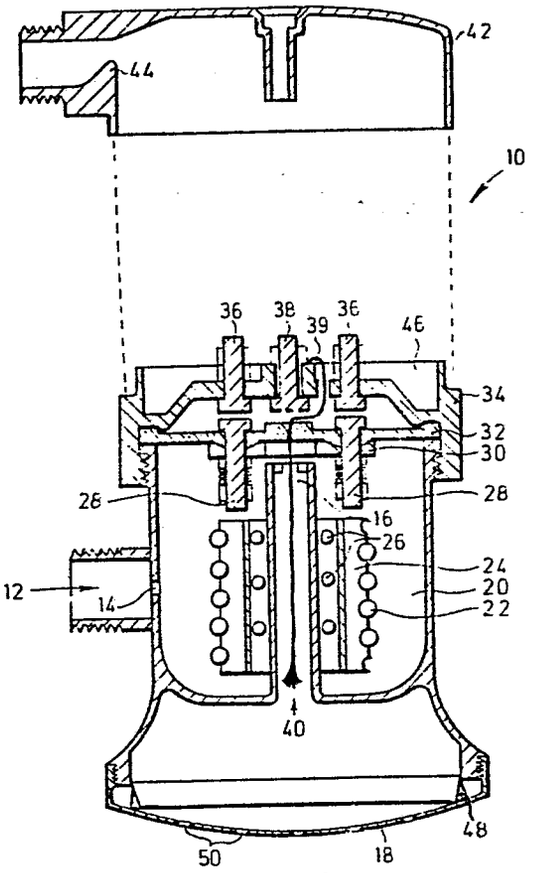

FIG 2

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'ELECTRICALLY OPERATED WATER HEATING DEVICE'

This invention is concerned with a water heating device which gives substantially instantaneous hot water without the need for pre-heating and storage.

Devices of the kind in question are known in several forms but more commonly they comprise an integral water heater/shower head with an immersion type element placed within the unit in such a way that cold water under pressure must pass over the coils of the element before passing to the shower head or outlet. It is common to have a switching arrangement such that once the tap is opened, the flow of water actuates a contact thus energizing the heating element although it is not unknown to have a remote manual switching arrangement.

Presently known devices do unfortunately suffer from a number of disadvantages, some more serious than others. One of the major and more serious disadvantages is in the area of current leakage to the water as well as the unit casing. There are a number of known electrocutions which have occurred as a result of this problem. Research has shown that the commonly used heater element of the "closed" type, used extensively in kettles, geysers and the like have a comparatively high current leakage and in the event of failure for one reason or another of the earth leakage system, this current leakage is potentially lethal, especially in the confines of a shower cubicle.

To obtain adequate heating, most known units use an element with a power rating of between 5 and 7kw and while this may seem a very high consumption, they generally do save on electricity in view of the fact that power is only used during operation. The present invention has arrived at a unit with a number of substantially improved features which largely overcome the drawbacks as aforementioned.

Therefore, according to the invention, an electrically operated water heating device comprises in working combination, a housing, said housing including water inlet and outlet means; a heating chamber containing an electrical element and adapted such that water from the inlet must pass through the chamber before passing to the outlet, means adapted to engage when the unit is in an operative mode, a set of electrical contacts which in turn energize the element and additionally adapted so as to disengage the contacts when the unit is not in use; and means adapted to supply electric current to the unit, characterised firstly in that the electrical element is of the "bare" or open type and secondly by the novel switching mechanism comprising a first set of contact points attached to a flexible diaphragm, said diaphragm forming preferably the roof portion of the heating chamber, such that under the influence of incoming water under pressure, the first contact points will be forced up into contact with a second rigidly mounted set of contact points thus closing the electrical circuit and energizing the electrical element.

In order to further illustrate the many advantages of the invention, one preferred embodiment will now be described in detail by way of example with reference to the accompanying drawings.

Fig.1 is a side elevation - external view of a unit in accordance with the invention;

Fig.2 is a cross-sectioned side elevation of the unit shown in Fig.1.

In this description, like reference numerals will refer to the same parts throughout.

Reference numeral 10 indicates generally an integral water heating unit with combined shower head in accordance with one preferred embodiment. The water inlet 12 includes a restriction 14 which ensures that the volume of water entering the unit 10 can not exceed the volume escaping from the unit. Water passes via a nozzle 16 which atomizes the water (not shown) before leaving the unit via the shower rose head 18. This process of atomizing the water through nozzle 16 is a vital factor in the safe operation of the unit 10 since current leakage to the water is dissipated almost entirely.

In Fig.2 the heating chamber 20 can be seen with the coiled element 22 in position on the element support assembly 24. The element 22 is a coiled non-ferrous open or bare element which is wound around the support assembly 24 which is preferably moulded from a heat resistant thermo plastics material which is light weight, extremely strong and able to withstand temperatures up to 400 degrees centigrade. The support assembly 24 is further composed of four separate identical segments which interlock on assembly. The individual segments themselves have holes 26 to enable free passage of the water and thus enable the water to come into contact with over 90 percent of the surface area of the element. Because of the novel design of this component, combined with the open element 22, greater thermal efficiency is achieved thereby allowing the element 22 to be of a relatively low resistance type which results in longer life expectancy and lower current consumption. The non-ferrous element 22 is corrosion resistant which should further enhance the life expectancy of this component.

The electrical switching mechanism of the invention is a further novel arrangement and is clearly illustrated in Fig.2. A primary pair of contacts 28 are mounted in a watertight manner through a rigid support washer 30 to a flexible diaphragm 32, which diaphragm forms the roof portion of the heating chamber 20. The lower portions of the terminals 28 fasten to the free ends of the element 22 and a semi-rigid wire support (not shown) serves to secure the elements support assembly 24 to the flexible diaphragm 32 in spaced apart relationship but such that the element 22 and support 24 move up and down in sympathy with the diaphragm 32.

The contact cap assembly 34 is securely screwed on to the body of the unit by means of corresponding screw threads during assembly. The diaphragm 32 is thus clamped between the contact cap 34 and the body in sealing abutment. The contact cap assembly 34 includes secondary contacts 36, aligned so as to correspond with the primary contacts 28. As seen in Fig.2 the unit is in an inoperative mode where, under the influence of gravity, the element and support assembly 22 and 24 respectively, pull the diaphragm 32 downwards thus holding contacts 28 and 36 apart. Under the influence of water pressure in the heating chamber 20, the diaphragm 32 is forced upwards causing the contacts 28 and 36 to engage and thereby energize the element 22.

The contact cap 34 further includes an earth terminal 38 to which is attached a wire 39 which passes through the diaphragm 32 and is free floating in the area 40. This earth wire is an additional safety feature intended to minimize current leakage even further.

The upper portions of contacts 36 and 38 are adapted to receive the incoming wires being earth, neutral and line respectively. The cable passes through a terminal cover 42 which includes a threaded coupling to receive a cable gland. The cover 42 is rotatable relative to the unit thus

allowing greater freedom in cable positioning during installation. The inlet to the cover 42 includes a restriction 44 which will tend to minimize the possibility of water entering the area of the electrical contacts from this source. However, in the event that some water should gain access to this area, the contact cap 34 includes a recessed well 46 into which such water can flow to keep it away from the contacts.

So as to avoid the contacts 36 and 38 turning in the contact cap 34 while securing the incoming wires, the shafts of the terminals are knurled vertically where they pass through the contact cap, thus locking them in position.

A further novel aspect of the invention is seen in the removable shower head or rose cap 18 which has a quick release thread such that it will release from the unit in approximately a quarter turn. The rose cap 18 includes an integrally moulded sealing formation 48 which removes the necessity for a rubber sealing ring or the like which can become detached and lost. The sealing is automatic as the rose head 18 is screwed on to the unit 10.

The rose cap 18 is further novel in that the outlet holes 50 when seen in cross section are tapered in a manner similar to a funnel. It has been found that this arrangement allows easy cleaning of the shower rose 18 since dirt lodges in the tapered holes and can be removed merely by releasing the rose 18 from the unit and banging lightly in an inverted position against a firm surface. This contrasts favourably with presently known units where it is normally necessary to clean each hole individually with a pin or similar object.

It can be seen from the above that the unit has numerous features which combine to make it a significant improvement over the prior art. Not so obvious advantages have been revealed as a result of extensive testing where for example it has been established that, not withstanding the

use of the bare element, the maximum current leakage without any earthing arrangement is in the region of .001 to .007 milli-amps. This leakage could never lead to accidental electrocution as has been known to happen with some existing similar units. To the best knowledge of the inventor, this is the first time an arrangement using a bare element has been safely used for the heating of water, with the above earth leakage results.

The novel switching method although simple is extremely robust and in operation it is expected the contacts will not need attention during the lifetime of the unit. This aspect again contrasts extremely favourably with presently used switching methods which by and large use micro switches which do not adequately cope with the 5 to 7 kw current passing through them and the contacts tend to burn and require early replacement.

In its preferred form, the unit is primarily made from moulded durable plastics material which is of course non-conductive or corrosive and can therefore be considered a further safety feature.

As mentioned previously, the use of the bare element and the novel element support have allowed greater thermal efficiency. This is highlighted when it is appreciated that the present unit will operate satisfactorily using only 2 to 3 kw while all known units to achieve the same degree of heating are using in the order of 5 to 7 kw. Water temperature is governed by the volume of water passing through the heating chamber, such that the more water that is allowed to pass the cooler it will become. Calibration is such that at minimum flow, the temperature can not exceed 60 degrees which means that one cannot be accidentally scalded, while the restriction in the water inlet ensures that the volume of water passing through will never be such that water will not be "hot". An unexpected benefit which has been discovered lies in the field of general health/hygiene, since most known bacteria in the water are destroyed by a combination of the action of heat

and low voltage electrocution. This combination renders water passing through the unit of the invention semi-sterilized. This combined with the many other advantages of the invention make it eminently suitable for use in hospitals and such like institutions.

In spite of the fact the current leakage without an earth system is extremely low, the unit of the invention would normally include an earth arrangement in the form of a length of wire bared at one end and located in the zone of the water outlet and taken separately to earth. This arrangement could be advantageous in areas prone to frequent electrical thunder storms.

It is felt that the present invention offers numerous advantages over the present state of the art and these advantages would be readily apparent to any persons skilled in this particular field of the art.

CLAIMS

1) An electrically operated water heating device comprising in working combination, a housing, said housing including water inlet and outlet means; a heating chamber containing an electrical element and adapted such that water from the inlet must pass through the chamber before passing to the outlet, means adapted to engage when the unit is in an operative mode, a set of electrical contacts which in turn energize the element and additionally, adapted so as to disengage the contacts when the unit is not in use; and means adapted to supply electric current to the unit, characterized firstly in that the electrical element is of the "bare" or open type and secondly by the novel switching mechanism comprising a first set of contact points attached to a flexible diaphragm, said diaphragm forming preferably the roof portion of the heating chamber, such that under the influence of incoming water under pressure, the first contact points will be forced up into contact with a second rigidly mounted set of contact points thus closing the electrical circuit and energizing the electrical element.

2) An electrically operated water heating device as claimed in Claim 1 integral with a shower rose.

3) An electrically operated water heating device as claimed in Claim 1 or 2 incorporating restrictions in both the inlet and the outlet means to limit the volume of water passing through the unit.

4) An electrically operated water heating device as claimed in Claim 3 wherein the restriction in the outlet means is a nozzle which atomizes water passing through.

5) An electrically operated water heating device as claimed in any one of claims 1 to 4 wherein the electrical element is made from a non-ferrous material.

6) An electrically operated water heating device as claimed in any one of Claims 1 to 5 including an element support assembly made from heat resistant thermo plastics material and composed of four substantially identical segments which interlock on assembly and which support the element in a manner allowing water to come into contact with over 90 percent of the surface area of the element.

7) An electrically operated water heating device as claimed in any one of Claims 2 to 6 wherein the shower rose includes a self-sealing arrangement in combination with quick release threads.

8) An electrically operated water heating device as claimed in any one of Claims 2 to 7 wherein the holes in the shower rose are tapered.

9) An electrically operated water heating device as claimed in any of the proceeding claims including an earthing device situated in the zone of the water outlet.

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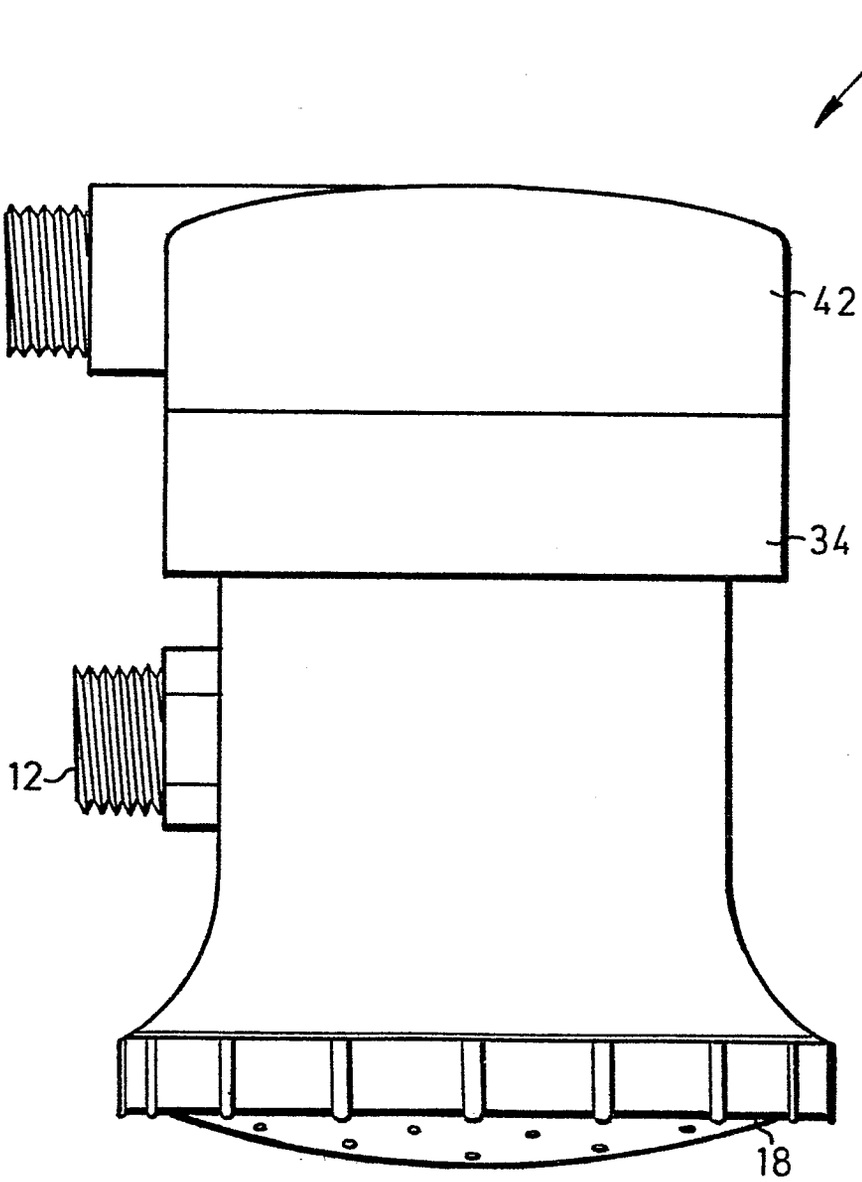

FIG 1

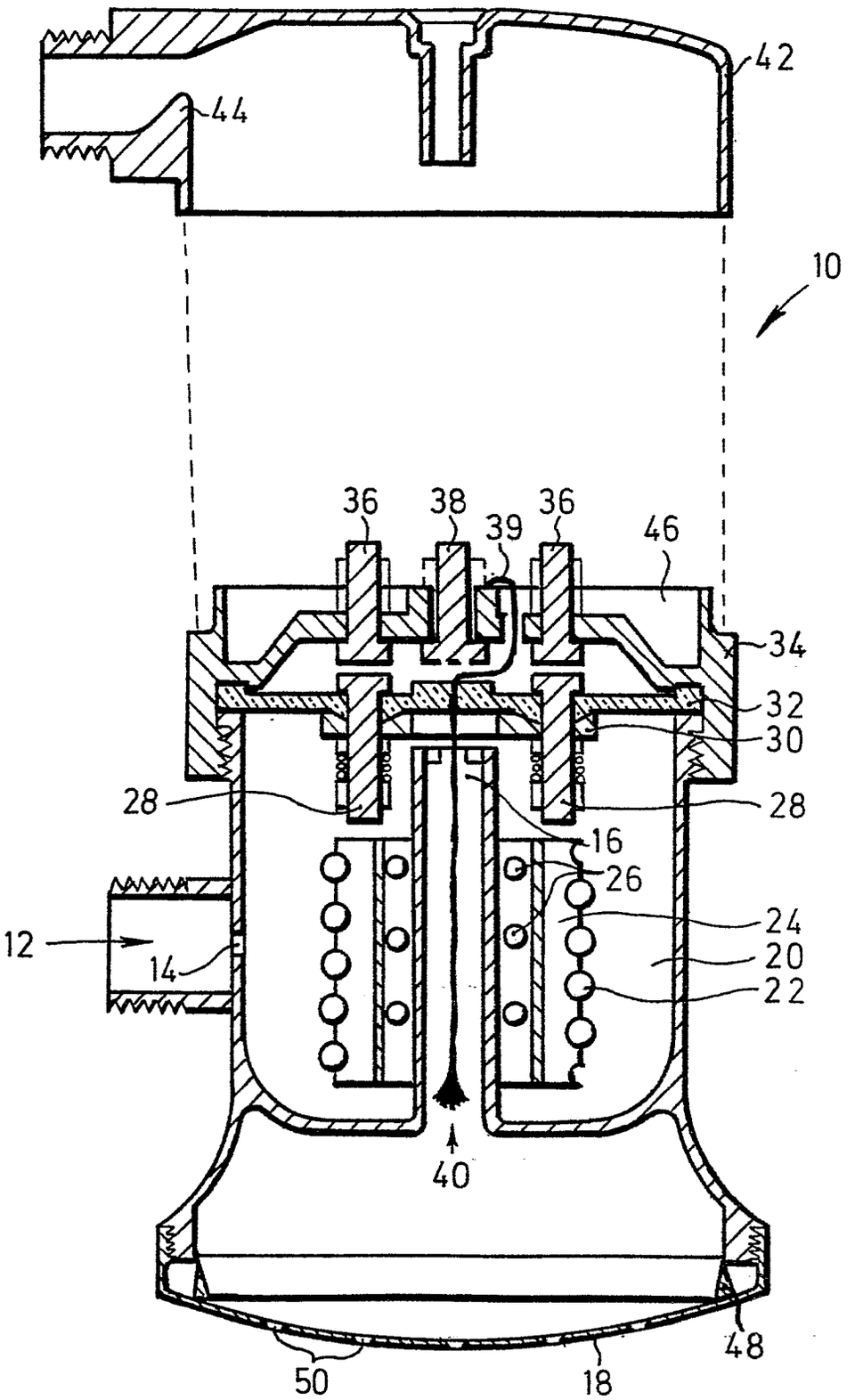

FIG 2