

PATENT SPECIFICATION (11)

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(54) SOLAR WATER HEATER

(71) We, SHELL OIL SOUTH AFRICA (PROPRIETARY) LIMITED, of Shell House, Greenmarket Square, Cape Town, Cape Province, Republic of South Africa, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a solar water heater.

According to the invention, there is provided a solar water heater which includes a base member, an upper member adapted to absorb radiant heat and removably attached to the base member to define a chamber for liquid therebetween, an inlet and an outlet for filling and drawing liquid into and from the chamber, and an intermediate member of an insulative material dividing the chamber into upper and lower compartments, the intermediate member having passages therein providing communication between the upper and lower compartments.

The intermediate member is conveniently located closer to the upper member than to the base member so that the upper compartment is smaller than the lower compartment. The intermediate member is intended to minimise outward radiation of heat via the upper member from the major portion of liquid in the chamber during periods when radiant heat is not being applied to the upper member.

When the solar water heater is inclined at an angle to the horizontal to present as much as possible of the surface of the upper member to direct rays from the sun, at least one of the passages in the intermediate member is conveniently controlled by a non-return valve, thereby to permit flow of liquid from the upper compartment to the lower compartment via the non-return valve in the passage or passages located at a high level. If desired, a further non-return valve may be provided in the passages located at a low level in the intermediate member to prevent flow of liquid from the upper compartment to the lower compartment at such low level.

The chamber may be substantially elliptical in cross-section with a varying radius of curvature, the inner walls of the upper member and base member being smoothly curved. The upper member, intermediate member and base member may be of saucer shape, each having peripheral outwardly extending flanges. The flanges of the upper and base members then clamp the flange of the intermediate member between them and permit removable attachment of the upper and base members. One or more gaskets may be provided intermediate the flanges of the upper member, intermediate member and/or base member.

A protective cover of transparent or translucent material is conveniently provided above the upper member to afford protection against physical damage, e.g. from hail stones. The base member may be covered on its outside by an insulative material, e.g. of polyurethane foam.

The base member may have a downwardly depending skirt at its outer edge for supporting the solar water heater.

The or each non-return valve in the passages may be formed by two sheets of flat resilient material, e.g. rubber sheeting, joined along their longitudinal edges, e.g. by vulcanising, but not along their ends or lateral edges. One end of the pair of rubber sheets may then be fitted over a pipe protruding from the passage in the intermediate member. By reason of the resilience of the pair of rubber sheets, and by reason of their close proximity along a major portion of their length, fluid flow from this other end through the pipe is minimised.

The solar water heater may be mounted on a stand which may be adjustable to permit adjustment of the angle of inclination of the heater at different latitudes or during different seasons of the year. In another embodiment, the heater may be mounted on a surface by means of one or more wedge shaped mounting members to provide a suitable angle of inclination.

The inlet to the chamber may include a pipe forming a blind passage and having a plurality of transversely extending outlet

apertures in the pipe to minimise disturbance of the liquid during filling of the chamber. In another embodiment, the inlet to the chamber may have a deflector plate near its mouth. The outlet to the chamber may have a stand pipe or pressure operated release valve to cater for expansion of the liquid contained in the chamber.

The base member and/or upper member may be formed by a metal pressing process.

Various embodiments of the invention are now described by way of example with reference to the accompanying drawings, in which:—

Figure 1 shows a side elevation of a solar water heater in accordance with the invention;

Figure 2 shows a plan view of the solar water heater of Figure 1;

Figure 3 shows a sectional view of portion of the solar water heater;

Figure 4 shows a three-dimensional view of a non-return valve used in the solar water heater;

Figure 5 shows a sectional view of portion of the solar water heater mounted on a pair of wedge shaped members;

Figures 6 to 10 show schematic side elevations of various configurations of wedge shaped mounting members used in combination with the solar water heater; and

Figure 11 shows a plan view of still a further configuration of wedge shaped mounting members used with the solar water heater.

Referring to Figures 1 to 3, reference numeral 20 generally indicates a solar water heater which includes a base member 22 having a smoothly curved inner wall 24, an upper member 26 which is also smoothly curved and which is adapted to absorb radiant heat, and an intermediate member 28 of an insulative material. Conveniently, the intermediate member 28 is formed from two layers of fibreglass sandwiching a layer of polyurethane foam therebetween.

The intermediate member 28 divides the solar water heater into an upper compartment 30 and a lower compartment 32, the lower compartment 32 being much larger than the upper compartment 30.

The area defined between the outer surface of the inner wall 24 of the base member 22 and a peripheral skirt 34 of the base member 22 is filled with an insulative material, e.g. of polyurethane foam or the like. The upper member 26 is conveniently formed as a metal pressing from copper, stainless steel, galvanized steel, or the like and covered on its outer surface with a matte black coating. The inner wall 24 of the base member 22 may be moulded from a glass reinforced plastics material.

The upper member 26, intermediate mem-

ber 28 and base member 22 each have outwardly extending peripheral flanges 26-1, 28-1 and 22-1 respectively to permit removable attachment of the upper and base members and sandwiching of the flange 28-1 of the intermediate member 28 between the flanges of the upper and base members.

The upper surface of the solar water heater is protected by a dome-shaped protective covering 36 of a translucent or transparent material which is hail resistant, e.g. perspex (Registered Trade Mark), acrylic cabulite, or the like.

The solar water heater is filled with liquid via an inlet connection 38 and liquid can be drawn off from the heater via an outlet connection 40. A further outlet is provided at 42 to permit connection to an expansion pipe.

As shown in Figure 2, a plurality of passages 44 are provided at a high level in the intermediate member 28 and a further set of passages 46 are provided at a low level in the intermediate member 28.

At least those passages 44 at a high level are, as shown in Figure 3, controlled by a non-return valve 48, details of which are shown in Figures 3 and 4. As shown in Figure 3, the passage 44 is defined by a pipe 50 extending through and protruding from the intermediate member 28. The non-return valve 48 comprises a pair of rubber sheets joined together along their longitudinal edges at 52 (see Figure 4). One end of the pair of rubber sheets is fitted over the pipe 50 while the rubber sheets at the other end, by reason of their resilience, are in close proximity. It has been found that this arrangement allows flow of liquid from the pipe 50 into the lower compartment 32 but reverse flow is minimised. If non-return valves are provided in the passages 46 at a low level, they would be reversed and extend into the upper compartment to minimise flow of liquid from the upper compartment to the lower compartment.

As shown in Figures 1 and 3, the inner walls of the solar water heater are smoothly curved having a varying radius of curvature so that the chamber in which liquid is held, is substantially elliptical in cross-section. In plan view, the chamber can be circular as shown in Figure 2 or square or rectangular as described.

As shown in Figure 3, the flange 28-1 of the intermediate member 28 is clamped between the flanges 26-1 and 22-1 of the upper member 26 and the base member 22 by means of a plurality of bolts and nuts 54. O-ring type gaskets 56 prevent leakage of the liquid from the upper and lower compartments 30 and 32.

As shown in Figures 1 and 2, the solar water heater can be mounted on an adjustable stand 58 so that as much as possible of

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the surface area of the upper member 26 is presented to the direct rays of the sun.

In another arrangement shown in Figures 5 to 11, one or more wedge shaped mounting members 60 may be provided for mounting the solar water heater 20 on a surface 62. Thus, in Figure 6, where the surface 62, e.g. a roof of a dwelling, is inclined at an angle of, say, 30°, a single mounting member 60 is used so that the heater 20 is arranged at an angle of 45°. In the Figure 7 embodiment, the surface 62 is at an angle of 15°, and, accordingly two mounting members 60 are used.

In Figure 8, three mounting members 60 are used on a flat horizontally extending surface 62.

In Figure 9, four mounting members 60 are used when the surface 62 slopes downwardly away from the sun.

In Figure 10, three mounting members 60 are used to mount the heater 20 on a vertical surface 62, which may, for example, be the side wall of a building.

In Figure 11, the mounting members 60 are furthermore rotated relative to each other to provide a tortuous mounting for a surface 62 which does not run substantially east west.

Details of the mounting members 60 are shown in Figure 5. As shown, the mounting members 60 have lower and upper inwardly turned flanges 64 which are bolted together. The lowermost flange 64 is fixed to the surface 62 via a flange 65 while the base of the solar water heater has an inwardly directed lip 66 attached to its skirt 34 whereby the base of the solar water heater is fitted onto the uppermost flange of the mounting member 60. When the solar water heater is fixed directly to a surface, a flange similar to the flange 65 is provided attached to its base via a countersunk screw (not shown).

In use, while the solar water heater is exposed to sunlight, water contained therein will be heated in the upper compartment 30 and, by convection, will pass through the passages 44 into the lower compartment while water in the lower compartment will circulate into the upper compartment via the passages 46. While the solar water heater is not exposed to sunlight, the major portion of the liquid contained therein is insulated by the intermediate member 28 to prevent radiation of heat outwardly therefrom. Only the liquid contained in the upper compartment 30 will lose heat during such periods.

The invention provides a neat, compact solar water heater which can be relatively inexpensively manufactured and which minimises heat loss during periods when it is not exposed to sunlight. A variety of configurations of mountings are provided

for the solar water heater to facilitate its mounting on different surfaces. The construction of the solar water heater is simple as the upper and base members can be formed from metal pressings and/or moulded forms. The solar water heater can be readily disassembled for inspection and cleaning. It will be noted that the surfaces of the solar water heater which in use will be in contact with water are weld-free thereby minimising the risk of corrosion of welded joints. The non-return valves are also of simple yet, it is believed, effective construction and not readily susceptible to furring.

Attention is drawn to our copending application No. 5889/78 (Serial No. 1,564,886) which describes and claims features of the above solar water heater.

WHAT WE CLAIM IS:—

1. A solar water heater which includes a base member, an upper member adapted to absorb radiant heat and removably attached to the base member to define a chamber for liquid therebetween, an inlet and an outlet for filling and drawing liquid into and from the chamber, and an intermediate member of an insulative material dividing the chamber into upper and lower compartments, the intermediate member having passages therein providing communication between the upper and lower compartments.

2. A solar water heater as claimed in claim 1, in which the intermediate member is located closer to the upper member than to the base member so that the upper compartment is smaller than the lower compartment.

3. A solar water heater as claimed in claim 1 or claim 2, in which at least one of the passages in the intermediate member is controlled by a non-return valve.

4. A solar water heater as claimed in claim 3, in which the non-return valve is formed by two sheets of flat resilient material joined along their longitudinal edges and openable along their lateral edges, the sheets, by reason of their resilience, lying in close abutting relationship along a major portion of their length.

5. A solar water heater as claimed in any one of the preceding claims, in which the chamber is substantially elliptical in cross section with a varying radius of curvature.

6. A solar water heater as claimed in any one of the preceding claims, in which the upper member, the intermediate member and base member are of saucer shape having outwardly extending peripheral flanges, the flanges of the intermediate member being clamped between the flanges of the base member and upper member.

7. A solar water heater as claimed in 130

the surface area of the upper member 26 is presented to the direct rays of the sun.

In another arrangement shown in Figures 5 to 11, one or more wedge shaped mounting members 60 may be provided for mounting the solar water heater 20 on a surface 62. Thus, in Figure 6, where the surface 62, e.g. a roof of a dwelling, is inclined at an angle of, say, 30°, a single mounting member 60 is used so that the heater 20 is arranged at an angle of 45°. In the Figure 7 embodiment, the surface 62 is at an angle of 15°, and, accordingly two mounting members 60 are used.

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In Figure 11, the mounting members 60 are furthermore rotated relative to each other to provide a tortuous mounting for a surface 62 which does not run substantially east west.

Details of the mounting members 60 are shown in Figure 5. As shown, the mounting members 60 have lower and upper inwardly turned flanges 64 which are bolted together. The lowermost flange 64 is fixed to the surface 62 via a flange 65 while the base of the solar water heater has an inwardly directed lip 66 attached to its skirt 34 whereby the base of the solar water heater is fitted onto the uppermost flange of the mounting member 60. When the solar water heater is fixed directly to a surface, a flange similar to the flange 65 is provided attached to its base via a countersunk screw (not shown).

In use, while the solar water heater is exposed to sunlight, water contained therein will be heated in the upper compartment 30 and, by convection, will pass through the passages 44 into the lower compartment while water in the lower compartment will circulate into the upper compartment via the passages 46. While the solar water heater is not exposed to sunlight, the major portion of the liquid contained therein is insulated by the intermediate member 28 to prevent radiation of heat outwardly therefrom. Only the liquid contained in the upper compartment 30 will lose heat during such periods.

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for the solar water heater to facilitate its mounting on different surfaces. The construction of the solar water heater is simple as the upper and base members can be formed from metal pressings and/or moulded forms. The solar water heater can be readily disassembled for inspection and cleaning. It will be noted that the surfaces of the solar water heater which in use will be in contact with water are weld-free thereby minimising the risk of corrosion of welded joints. The non-return valves are also of simple yet, it is believed, effective construction and not readily susceptible to furring.

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2. A solar water heater as claimed in claim 1, in which the intermediate member is located closer to the upper member than to the base member so that the upper compartment is smaller than the lower compartment.

3. A solar water heater as claimed in claim 1 or claim 2, in which at least one of the passages in the intermediate member is controlled by a non-return valve.

4. A solar water heater as claimed in claim 3, in which the non-return valve is formed by two sheets of flat resilient material joined along their longitudinal edges and openable along their lateral edges, the sheets, by reason of their resilience, lying in close abutting relationship along a major portion of their length.

5. A solar water heater as claimed in any one of the preceding claims, in which the chamber is substantially elliptical in cross section with a varying radius of curvature.

6. A solar water heater as claimed in any one of the preceding claims, in which the upper member, the intermediate member and base member are of saucer shape having outwardly extending peripheral flanges, the flanges of the intermediate member being clamped between the flanges of the base member and upper member.

7. A solar water heater as claimed in 130



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- claim 6, in which at least one gasket is provided intermediate the flanges of the upper member, intermediate member or base member.
- 5 8. A solar water heater as claimed in any one of the preceding claims, which includes a protective cover of a transparent or translucent material fitted over the upper member to afford protection against physical damage.
- 10 9. A solar water heater as claimed in any one of the preceding claims, in which the base member is covered exteriorly by an insulative material.
- 15 10. A solar water heater as claimed in any one of the preceding claims, which includes a stand which is adjustable to permit adjustment of the angle of inclination of the solar water heater.
- 20 11. A solar water heater as claimed in any one of the preceding claims 1 to 9, which includes at least one wedge shaped mounting member for mounting it on a surface at a suitable angle of inclination.
- 25 12. A solar water heater as claimed in any one of the preceding claims, in which the base member or upper member are formed by a metal pressing process.
- 30 13. A solar water heater substantially as described and as illustrated herein.
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