

IMPROVEMENTS IN OUTER GLASS PIPES FOR SOLAR HEAT COLLECTORS

The present invention relates to improvements in outer glass pipes for use with solar heat collectors.

Solar heat collector units of the type in which the outer surfaces of heat receptor pipes are enclosed within closed straight glass pipes are now widely used for solar heat collector equipment. For example, solar heat collector pipes of vacuum double structure or vacuum single structure have been proposed in the art. The former type collector typically comprises an inner pipe of smaller diameter, having one end closed by rounding and the other end left open, and an outer pipe of larger diameter, having one end closed by rounding and the other end left open, the outer pipe having the inner pipe inserted concentrically within it. A space between the outer and inner pipes is then maintained in an air-tight condition under reduced pressure. The latter type collector typically comprises a straight glass pipe having one end closed by rounding, within which a heat medium-filled tube assembly is placed, such as various tubes inclusive of a U-shaped or hair-pin tube. A space between the outer pipe and the tube assembly is similarly maintained in an air-tight condition under reduced pressure. In either case, a glass exhaust tube of small diameter is attached to the closed end of the outer pipe so as to facilitate evacuation and air-tight sealing of said space. However, mounting such an exhaust tube requires, in addition to rounding and other ordinary

glass works, drawing, boring which has to be performed by skilled workmen, welding, etc., leading to a considerable rise in the price of the product. Exhaust tubes are either formed integrally in the rounding step in the production of
5 the outer glass pipes, or separate exhaust tubes are attached to the bottoms of the rounded outer pipes as by welding. If mishandling occurs in the step of providing the exhaust tubes on the outer pipes, then the outer pipes frequently must be entirely disposed of, resulting in considerable economic loss.

10 Thus, the prior art outer glass pipes for solar heat collector units of vacuum single or double struction leave much to be desired in regard to production techniques and cost. Furthermore, the least mishandling in production is not tolerable for the foregoing reason.

15 An object of the invention is therefore to provide an outer glass pipe, designed for use with solar heat collector equipment, which is both relatively easy and inexpensive to manufacture, and which allows a degree of mishandling in production to be tolerated.

20 According to the present invention, an outer glass pipe for a solar heat collector unit comprises an outer glass pipe body formed of a straight glass pipe initially open at both ends, and an end plate provided with a small diameter exhaust opening, to which end plate an exhaust tube of small
25 diameter is attached at said opening to form a closure member,

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the end plate of said closure member being air-tightly fixed to one open end of said outer glass pipe body at its peripheral edge, thereby closing said one open end.

Thus, the outer glass pipe can be manufactured merely by 5 air-tightly fixing to an open end of a straight pipe a closure member which is easily fabricated with no special skill.

Arrangements according to the invention will now be described by way of example and with reference to the accom- 10 panying drawings, in which:

Fig. 1 is a side view, partly in longitudinal section, of a solar heat collector equipped with an outer pipe according to the present invention,

Fig. 2 is a side view, partly in section, of the bottom 15 of a solar heat collector pipe equipped with an outer pipe according to the invention, shown prior to sealing under reduced pressure,

Fig. 3 is an end view of the bottom of the outer pipe as viewed from the left in Fig. 2,

20 Fig. 4 is a side view, in half section, of part of a straight glass pipe assembled with a bottom closure member and prior to uniting of the parts to form the collector outer pipe of Figures 2 and 3,

Fig. 5 is an end view of the assembly of Figure 4,

25 Fig. 6 is a side view, in half section, of an alternative closure member,

Fig. 7 is an end view of the closure member of Figure 6, and

Fig. 8 is a view similar to Fig. 4, showing a modified form of assembly of the closure member and the glass pipe.

5 As illustrated in Fig. 4, a straight glass pipe 1 is used for the formation of an outer pipe for a solar heat collector, the pipe 1 being initially open at both ends. One end 3 of the pipe 1 is closed with a circular glass closure member 2 shown also in Fig. 5. The closure member 2
10 consists of an end plate 7 provided at its center with a small exhaust opening, and having a glass exhaust tube 5 of small diameter welded to it centrally at right angles so as to be coaxial with the exhaust opening and form a small bore exhaust passage 4 communicating with said opening.
15 The exhaust tube can have its outside diameter substantially equal to the diameter of the exhaust opening so that its end can be fitted into and welded inside said opening; or it can have its inside diameter equal to the diameter of the exhaust opening and be butt-welded to the end plate 7. The
20 end plate 7 is welded at its peripheral edge 6 into the end 3 of the pipe 1.

As shown in Figs. 4 and 5, the circular end plate 7, forming a main part of said closure member 2, has one surface, i.e., the surface facing into the end of the pipe 1, which
25 is flat. The opposite surface of plate 7 is provided with

an annular rib 9 of a given width positioned concentrically with respect to the central opening and the exhaust tube 5 and surrounding an annular channel 8, of a given width, which is disposed adjacent to and concentric with said tube 5.

5 The end of the exhaust tube 5 is welded to the plate 7 within the channel 8 enclosed by the rib 9.

Figs. 6 and 7 show an alternative closure member 16 which is generally similar to the first closure member 2 except that the channel 8 is recessed into the outer surface 10 of the plate 7 and, in a concentric ring around the channel, the plate bears a plurality of projections 19, four in the example shown. Figure 8 shows an alternative method of assembly in which the end plate 7 of the closure member 2 overlies the annular end edge of the pipe 1, instead of 15 being fitted inside the pipe end as in Figure 4.

Referring to Figure 1, an inner glass collector pipe 11, through which a heating medium flows, is installed within the outer pipe 1 and united thereto at the end remote from the closure member 2. The whole assembly of solar heat 20 collector equipment is mounted in a frame 12.

Reference will now be made to the reasons for provision of the annular channel 8 in the end plate 7 of the closure member 2, to which is attached the exhaust tube 5. The exhaust tube 5 has to be sealed off and parted close to 25 the plate 7 by electrical fusion using a heater or like means,

after an amount of air present in between the outer pipe 1 and the inner collector pipe inserted therethrough has been exhausted. The heat from the heater is applied substantially entirely to the tube 5 to be sealed off, and is not significantly applied to the end plate 7, since during sealing the heater is spaced away from the surface of the plate 7 by at least a distance corresponding to the depth D of the channel 8 (Fig. 2). In other words, the exhaust tube 5 can be sealed off and parted in a very short period of time with no fear of melting of the plate 7. In addition, since the exhaust tube 5 can be sealed off at a position (as indicated by the arrow A in Fig. 1) close to the end plate 7, the length of the tube tail 10, i.e., the portion of tube 5 which has not been parted off, can be reduced as much as possible. It is thus possible to reduce the risk of an accident which might otherwise happen due to an impact on the tube tail, viz. a breakage of the outer pipe 1 in the vicinity of the junction of the outer and inner pipes, as indicated by the arrow B in Fig. 1.

20 The annular rib 9 or the plurality of projections 19 is provided on the glass end plate 7 for the following reason. When a solar heat collector pipe is mounted on the frame 12, the rib 9 or projections 19 serve to provide a seat for a spring 13 for pressing the assembled collector and outer

25 pipe 1 in the axial direction, so that its bottom end is held in a stable state.

With the arrangement as described, an accident associated with mishandling of parts is much less likely to happen during preparation of the closure member 2 or air-tight fitting thereof. In addition, the extent of damage due to mishandling, if any, will in general be limited to the end plate 7 forming the bottom end of the pipe 1, or the exhaust tube 5. Thus, it is not necessary in the present instance to dispose of the entire outer pipe 1.

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**CLAIMS:-**

1. An outer glass pipe for a solar heat collector unit, comprising an outer glass pipe body formed of a straight glass pipe initially open at both ends, and an end plate provided with a small diameter exhaust opening, to which
5 end plate an exhaust tube of small diameter is attached at said opening to form a closure member, the end plate of said closure member being air-tightly fixed to one open end of said outer glass pipe body at its peripheral edge, thereby closing said one open end.
- 10 2. An outer glass pipe for a solar heat collector unit, comprising an outer glass pipe body formed of a straight glass pipe initially open at both ends, an end plate provided with a small exhaust opening and an annular rib therearound, and an exhaust tube of small diameter attached
15 to said end plate at said opening within said annular rib to form a closure member, the end plate of said closure member being air-tightly fixed to one open end of said outer glass pipe body at its peripheral edge, thereby closing said one open end.
- 20 3. An outer glass pipe according to claim 1 or claim 2, wherein said closure member is formed of glass.
4. An outer glass pipe according to claim 1 or claim 2 or claim 3, wherein said end plate is air-tightly fixed to the end of the outer glass pipe by heat welding.
- 25 5. An outer glass pipe according to any one of the preceding



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claims, wherein said end plate is fixed with its peripheral edge fitted within the end of the outer glass pipe body.

6. An outer glass pipe according to any one of claims 1 to 4, wherein said end plate is fixed with its peripheral

5 edge overlying the annular end edge of the outer glass pipe body.

7. An outer glass pipe according to claim 1, wherein said end plate is formed with an annular channel around the exhaust tube and a plurality of projections disposed

10 around said channel.

8. An outer glass pipe according to claim 2, wherein said end plate has an annular channel around the exhaust tube concentrically arranged within said annular rib.

9. An outer glass pipe according to any one of the
15 preceding claims, wherein said end plate has a flat surface facing into said outer glass pipe body.

10. An outer glass pipe according to any one of the preceding claims, wherein said exhaust tube is coaxially mounted with respect to said outer glass pipe.

20 11. An outer glass pipe according to any one of the preceding claims, wherein said exhaust tube has an outer diameter substantially equal to the diameter of said exhaust opening.

12. An outer glass pipe according to any one of claims 1 to 10, wherein said exhaust tube has an inner diameter equal
25 to the diameter of said exhaust opening.



13. An outer glass pipe for a solar heat collector unit, substantially as described with reference to Figures 1 to 5 of the accompanying drawings, or as modified according to Figures 6 and 7, or Figure 8.

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