

A VESSEL, AN APPARATUS FOR MANUFACTURING THE VESSEL AND A METHOD OF MANUFACTURING THE VESSEL

FIELD OF INVENTION

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This invention relates to a vessel, an apparatus for manufacturing the vessel and a method of manufacturing the vessel. The vessel refers particularly, though not exclusively, to a vessel used to contain fluids subjected to high pressures. The apparatus refers particularly to a type of drill bit used to create holes with neck protrusions around the holes on at least one surface of a panel. The method of manufacturing the vessel refers particularly to the drilling of holes with neck protrusions around the holes on at least one surface of a panel.

BACKGROUND

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Transportation of items to every corner of the world is required to meet the needs of people. Frequently, the items to be transported are perishable and require storage at a lowered temperature.

20 Containers have had incorporated refrigeration systems for the transport of such items for a long time. However, the components of such incorporated refrigeration systems are usually exposed to the elements and these exposed components fail often due to factors like, for example, environmental degradation, wear-and-tear at joints and the like. When such components fail, the damages payable for the spoilt perishable items in a twenty-foot container are significant.

One such component which fails regularly is the receiver-drier vessel that is part of the refrigeration system. This is the storage tank for the liquid refrigerant, and also where moisture is removed from the refrigerant. Besides the problems mentioned earlier, a common problem in relation to the receiver-drier vessel stems from the serviceability of the inlets and outlets of the vessel.

Existing receiver-drier vessels utilise welds at the inlets and outlets to fix the positions of necks to which relevant pipings are attached. The regular removal and re-attachment of the pipings from the vessel for maintenance weakens the welds and causes leakage of refrigerant from cracks in the welds at the inlets and outlets.

- 5 This would affect the cooling capability of the refrigeration system and may jeopardize all the items being stored in the container.

Thus far, there are only drill bits and methods of drilling that enables the boring of a hole with an extruded neck portion for thin sheets of material, such as, for example, metal and plastic. Currently, neck portions on circumferences of holes are separate
10 pieces welded to surfaces. This means that the welding joints are lines of weaknesses. These lines of weakness are more pronounced when the surface to which the neck portions are welded is not flat.

15 SUMMARY OF INVENTION

There is provided an elongated vessel for the containment of fluid, including: at least one inlet for the ingress of the fluid to the vessel; and at least one outlet for the egress of the fluid from the vessel. The vessel may be sealed at a first end and
20 a second end with the fluid in the vessel maintained at a predetermined pressure, and the inlet and the outlet may be annular conduits extruded from the vessel forming neck portions that add structural strength and rigidity. The vessel may be formed from a ductile metal sheet of a predetermined thickness such as, for example, copper, mild steel, aluminum, lead and stainless steel. The thickness of
25 the ductile metal sheet may be at least 1 mm.

Preferably, a first end of the inlet protrudes from an outer surface of the vessel, and a second end of the inlet protrudes from an inner surface of the vessel. It is also preferable that a first end of the outlet protrudes from an outer surface of the vessel,
30 and a second end of the outlet protrudes from an inner surface of the vessel.

Preferably, an edge of the first and second ends of the inlet may be bent at an angle of between 70° to 100° forming an overhang. The edge of the first and

second ends of the outlet may also be bent at an angle of between 70° to 100° forming an overhang. It is most preferable that the angle of bend is 90° . It should preferable be angled so that the brazing/welding material flows into the hole.

- 5 Preferably, the fluid in the vessel is maintained at a maximum pressure of 2400 psi. The maximum pressure of storage depends on the material yield strength of the vessel. The fluid to be stored in the vessel is preferably a refrigerant.

10 There is also provided an apparatus for boring an opening in a metal panel including: a cylindrical extension to enable the apparatus to be gripped in a housing of a drill; and a plurality of sections with tapered first ends positioned sequentially with each other and the cylindrical extension. It is preferable that the diameters of second ends of each section coincide with the diameter of the tapered first ends of each previous section and the diameter of a section subsequent to the cylindrical
15 extension is larger than the diameter of the cylindrical extension. The number of sections may be between 2 and 6 inclusive. Preferably, the number of sections of the apparatus is 4. Preferably, the apparatus is made from carbide.

20 Preferably, the tapered edges are cutting edges. The edges may be tapered at an angle of between 10° to 20° . The edges may also be tapered at an angle of between 14° to 16° . The edges may be tapered at an angle of between 14.8° to 15.2° . It is preferable when the edges are tapered at an angle of 15° .

25 It is preferable that the metal to be bored is ductile. The ductile metal may be, for example, copper, mild steel, aluminum, lead and stainless steel. The metal panel to be bored may be flat or curved.

30 A method to bore an opening in a metal panel is also disclosed. The method includes the steps of: boring a pre-hole to mark the position of the opening in the metal panel; attaching an apparatus for boring in a housing of a drill; running the drill at a pre-determined speed of rotation; and pushing the apparatus through a

mark made by the pre-hole. Preferably, the drill is run at a pre-determined speed of rotation for a conduit to be extruded from the metal panel.

5 Preferably, the opening has neck protrusions on a first surface and a second surface of the metal panel. An edge of the neck protrusion on the first and second surfaces of the metal panel may be bent at an angle of between 70° to 100° . Preferably, the angle of bend is 90° .

10 It is preferable that the size of the pre-hole determines the height of the neck protrusions. The metal panel to be bored may be flat, or curved. Preferably, the metal to be bored is ductile. The metal to be bored may be such as, for example, copper, mild steel, aluminum, lead and stainless steel.

It is preferable that the pre-determined speed of rotation is at least 3000 rpm.

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DESCRIPTION OF DRAWINGS

In order that the invention may be better understood and readily put into practical effect, there shall now be described by way of non-limitative example only preferred
20 embodiments of the present invention, the description being in reference to the accompanying illustrative drawings in which:

Figure 1 shows a cross-sectional view of a preferred embodiment of the present invention;

25 Figure 2 shows a magnified cross-sectional view of an inlet/outlet of a preferred embodiment of the present invention;

Figure 3 shows a top view of a preferred embodiment of the present invention;

Figure 4 shows a perspective view of a preferred embodiment of the present invention;

30 Figure 5 shows an apparatus used to manufacture a preferred embodiment of the present invention;

Figure 6 shows a front view of an apparatus used to manufacture a preferred embodiment of the present invention; and

Figure 7 is a flow chart showing a method of manufacturing a preferred embodiment of the present invention.

DESCRIPTION OF PREFERRED EMBODIMENTS

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Referring to figure 1, there is provided an elongated vessel 20 that may be used as a receiver-drier in a refrigeration system for containers. There is an inlet 22 for the ingress of fluid to the vessel 20 and there is an outlet 24 for the egress of fluid from the vessel 20. The inlet 22 and the outlet 24 may be annular conduits formed from
10 the body of the vessel 20. The conduits may form neck portions that add structural strength and rigidity.

The vessel is sealed at a first end 26 and a second end 28 of the vessel 20. The first and second ends 26, 28 may be curved, or flat. The shape of the ends may be
15 determined by size and shape constraints placed on the vessel 20. Fluid that passes into the vessel 20 may be a refrigerant and may be maintained at a predetermined pressure, such as, for example, 500 psi. The vessel 20 may be able to withstand a pressure of 2400 psi prior to rupturing. The maximum pressure of storage depends on the material yield strength of the vessel.

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The vessel 20 may be manufactured from a ductile metal, such as, for example, copper, mild steel, aluminum, lead or stainless steel. The thickness of the ductile metal panel may depend on the rupture limit required of the vessel 20. The higher the rupture limit, the thicker the sheet that is required. In a preferred embodiment of
25 the present invention, a copper sheet of thickness 2.54mm is used to form the vessel 20. The copper may be of grade C1220.

Figure 2 shows a magnified cross-sectional view of the outlet 24. The inlet 22 also has the same cross-sectional view. A first end 30 of the outlet 24 protrudes from the outer surface 32 of the vessel 20. A second end 34 of the outlet 24 also protrudes
30 from the inner surface 36 of the vessel 20. The ends 30, 34 are formed (extruded) from the body of the vessel 20. An edge 38 of the first end 30 may be bent at an angle of between 70° to 100° and may form an overhang. The angle of bend of the

edge 38 may be 90° or substantially perpendicular as shown in Figure 2. An edge 40 of the second end 34 of the outlet 24 may also be bent at an angle of between 70° to 100° and may form an overhang. The angle of bend of the edge 40 may be 90° or substantially perpendicular as shown in Figure 2. The overhangs on the ends
5 30, 34 may be used as anchorage points for the connection of pipings or hoses. Accordingly, the inlet 22 also has the same structure as described for the outlet 24 and the overhangs for the inlet 22 may be used in a similar manner as well.

Referring to Figure 3, an overhang 42 of the inlet 22 may also be used as an
10 anchorage point for the connection of pipings or hoses. Figure 4 shows a first end 44 of the inlet 22. As the ends 44, 30 of the inlet 22 and outlet 24 respectively are formed (extruded) from the body of the vessel 20, the inherent strength of the ends is high and consequently, the occurrence of failure at such regions may be minimised. There are no joints and corresponding lines of weakness. This is
15 advantageous when pipings or hoses are regularly connected and removed from the inlet 22 and outlet 24.

Figure 5 shows an apparatus used to manufacture a portion of a preferred embodiment of the present invention, specifically the inlet 22 and outlet 24 of the
20 vessel 20. There is shown an apparatus 60 for boring an opening in a metal panel. The metal panel may be a ductile metal, such as, for example, copper, mild steel, aluminum, lead or stainless steel. The metal panel may be flat or may even be curved.

25 The apparatus 60 includes a cylindrical extension 62 of constant diameter to enable the apparatus 60 to be gripped in a housing of a drill. There is a plurality of sections on the apparatus 60. The number of sections may be between 2 and 6 inclusive. The number of sections in a preferred embodiment is 4. Each section is fixedly positioned sequentially with each other and the cylindrical extension 62. Each
30 section may be separate carbide components that combine to form the apparatus 60 or the apparatus 60 may be formed from a single block of carbide.

A first section 64 of the apparatus 60 has the largest diameter of all the other sections and the cylindrical extension 62. A first end 66 of the first section 64 is tapered. The tapered first end 66 of the first section 64 may be a cutting edge. A second end 72 of the first section 64 continues from the cylindrical extension 62.

5 The diameter of the tapered first end 66 of the first section 64 is substantially the same as the diameter of a second end 68 of a second section 70. A first end 74 of the second section 70 is also tapered. The tapered first end 74 of the second section 70 may also be a cutting edge. The diameter of the tapered first end 74 of the second section 70 is substantially the same as the diameter of a second end 76

10 of a third section 78. A first end 80 of the third section 78 is also tapered. The tapered first end 80 of the third section 78 may also be a cutting edge. The diameter of the tapered first end 80 of the third section 78 is substantially the same as the diameter of a second end 82 of a fourth section 84. A first end 86 of the fourth section 84 is also tapered. The tapered first end 86 of the fourth section 78

15 may also be a cutting edge.

The first ends 66, 74, 80, 86 of all four sections may be tapered at angles of between 10° to 20° . The first ends 66, 74, 80, 86 of all four sections may be tapered at angles of between 10° to 20° . The range of taper angles may also fall within 14°

20 to 16° . The range of taper angles may even fall within 14.8° to 15.2° . The edges may also be tapered at an angle of 15° .

The apparatus 60 is shaped as such to allow for the apparatus 60 to bore through a ductile metal panel at a predetermined rpm of at least 3000 rpm without burrs forming from the metal panel. Instead, neck sections are formed (extruded) from the metal panels. The predetermined speed is material and thickness dependent and the extrusion effect can be effected properly only with a minimum speed of rotation. If the rotational speed is less than the predetermined speed, there will be no extrusion effect or just very poor extrusion. Figure 6 shows portions of the first ends

25 66, 74, 80 and the whole first end 86 when the apparatus 60 is viewed from the front.

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Referring to Figure 7, there is provided a method to bore an opening with an extruded conduit in a metal panel using the apparatus 60 described earlier. Firstly, a pre-hole is bored in the metal panel to mark the position where the hole is supposed to be made (100). The apparatus 60 for boring is then attached in a housing of a drill (102). The boring of the opening starts with the running of the drill at a pre-determined speed of rotation (104). The apparatus 60 is then pushed through the position in the metal panel where a mark made by the pre-hole was made (106).

Openings in a metal panel formed using the method have neck protrusions on a first surface and a second surface of the metal panel. An edge of the neck protrusion on the first and second surfaces of the metal panel may bend at an angle of between 70° to 100° . The angle of bend may also be substantially perpendicular or 90° . The size of the pre-hole made in during one of the intermediate stages of the method determines the height of the neck protrusions. The method may be used for flat or curved metal panels. The method is used for ductile metals such as, for example, copper, mild steel, aluminum, lead and stainless steel.

Whilst there has been described in the foregoing description preferred embodiments of the present invention, it will be understood by those skilled in the technology concerned that many variations or modifications may be made to details of design or construction without departing from the present invention.

The present invention extends to all features disclosed either individually, or in all possible permutations and combinations.

CLAIMS

1. An apparatus for boring an opening with an extruded conduit in a metal panel including:
a cylindrical extension to enable the apparatus to be gripped in a housing of a drill; and a plurality of sections with tapered first ends positioned sequentially with each other and the cylindrical extension, the tapered first end of each section is a cutting edge;
wherein diameters of second ends of each section coincide with the diameter of the tapered first ends of each previous section and wherein the diameter of a section subsequent to the cylindrical extension is larger than the diameter of the cylindrical extension.
2. An apparatus as claimed in claim 1, wherein the number of sections is between 2 and 6 inclusive.
3. An apparatus as claimed in claim 2, wherein the number of sections is 4.
4. An apparatus as claimed in any one of claims 1 to 3, wherein the edges are tapered at an angle of between 10° to 20° .
5. An apparatus as claimed in claim 4, wherein the edges are tapered at an angle of between 14° to 16° .
6. An apparatus as claimed in claim 5, wherein the edges are tapered at an angle of between 14.8° to 15.2° .
7. An apparatus as claimed in claim 6, wherein the edges are tapered at an angle of 15° .
8. An apparatus as claimed in any one of claims 1 to 7, wherein the metal to be bored is ductile.

9. An apparatus as claimed in claim 8, wherein the ductile metal is selected from the group of metals comprising: copper, mild steel, aluminum, lead and stainless steel.
10. An apparatus as claimed in any one of claims 1 to 9, wherein the apparatus is made from carbide.
11. An apparatus as claimed in any one of claims 1 to 10, wherein the metal panel is flat.
12. An apparatus as claimed in any one of claims 1 to 10, wherein the metal panel is curved.
13. A method to bore an opening with an extruded conduit in a metal panel, including the steps of:
boring a pre-hole to mark the position of the opening in the metal panel;
attaching an apparatus for boring in a housing of a drill;
running the drill at a pre-determined speed of rotation;
boring the apparatus through a mark made by the pre-hole at the pre-determined speed of rotation of the drill so as to extrude a conduit from the metal panel.
14. A method as claimed in claim 13, wherein the opening has neck protrusions on a first surface and a second surface of the metal panel.
15. A method as claimed in claim 14, wherein an edge of the neck protrusion on the first surface of the metal panel is bent at an angle of between 70° to 100° .
16. A method as claimed in claim 14, wherein an edge of the neck protrusion on the second surface of the metal panel is bent at an angle of between 70° to 100° .
17. A method as claimed in either one of claims 15 or 16, wherein the angle is 90° .
18. A method as claimed in any one of claims 14 to 17, wherein the size of the pre-hole determines the height of the neck protrusions.

19. A method as claimed in any one of claims 13 to 17, wherein the metal panel is flat.
20. A method as claimed in any one of claims 13 to 17, wherein the metal panel is curved.
21. A method as claimed in any one of claims 13 to 20, wherein the metal to be bored is ductile.
22. A method as claimed in claim 21, wherein the ductile metal is selected from the group of metals comprising: copper, mild steel, aluminum, lead and stainless steel.
23. A method as claimed in any one of claims 13 to 22, wherein the pre-determined speed of rotation is at least 3000 rpm.