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REPLACED SHEETS SG

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☒ Claim(s) : paged 16 to paged 20
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☒ Abstract : paged 21 to paged 2

TITLE

"FLUID STORAGE TANK"

DESCRIPTION

The present invention relates to a fluid storage tank.

The fluid storage tank is used to store fluid which is under pressure.

The fluid storage tank of the present invention may be used as the hot water storage tank in a hot water system. The hot water system may, for example, be a solar, gas or electric hot water system. The fluid storage tank of the present invention may be used in other applications in which fluid is stored under pressure in a tank or similar container, eg water filters, fire extinguishes, and gas cylinders.

FIELD OF THE INVENTION

Fluid storage tanks used to store fluid under pressure may deteriorate over time.

In fluid storage tanks used in hot water systems, deterioration generally occurs to the lining inside such tanks which is in contact with the fluid stored in the tank. However, due to the structure of conventional tanks when this deterioration occurs to the lining, the entire tank must be replaced.

In contrast the present invention provides a fluid storage tank in which only the liner needs to be replaced if it deteriorates. In this way the fluid storage tank of the present invention is recyclable or renewable.

The present invention provides a fluid storage tank



which may also be used in other applications in which fluid is stored under pressure to provide a fluid storage tank which is recyclable or renewable.

SUMMARY OF THE PRESENT INVENTION

In accordance with one aspect of the present invention there is provided a fluid storage tank characterized in that it comprises a main body having at least one opening, cover means to close off said opening of said main body, and seal means, said cover means and said main body having a respective inside surface arranged to be, in use, in contact with fluid stored in said fluid storage tank, said main body comprising casing means and liner means, said liner means provided inside said casing means, wherein said cover means is releasably retained in place and seals with said inside surface of said main body via said seal means such that said fluid is storable in said fluid storage tank.

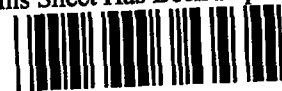
BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a partly cross-sectional elevation view of a first embodiment of a fluid storage tank in accordance with the present invention;

Figure 2 is a partly cross-sectional elevation view of the cover region of the fluid storage tank shown in Figure 1;

Figure 3 is a perspective view of the outside of the cover region of the fluid storage tank shown in Figure 1;

Figure 4 is a partly cross-sectional elevation view of the cover region of a second embodiment of a fluid



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DESCRIPTION OF THE INVENTION

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storage tank in accordance with the present invention;
Figure 5 is a partly cross-sectional elevation view of a
third embodiment of a fluid storage tank in accordance
with the present invention;
Figure 6 is a partly cross-sectional elevation view of a
fourth embodiment of a fluid storage tank in accordance
with the present invention;
Figure 7 is a cross-sectional elevation view of the
cover region of a fifth embodiment of a fluid storage
tank in accordance with the present invention; and,
Figure 8 shows a particular embodiment of the casing and
liner of a fluid storage tank in accordance with the
present invention.

Figures 1 to 8 and the description of the preferred
embodiments use the same reference numerals to denote
the same parts. The description of such parts is not
repeated for subsequent embodiments, but it is to be
understood that it applies in like manner to such
subsequent embodiments.

In Figure 1 there is shown a fluid storage tank 10
comprising a main body 12 and covers 14 to close off
respective openings of the main body 12. The openings
are located at respective ends of the main body 12. The
main body 12 has an inside surface 15a. The covers 14
each have an inside surface 15b. (The inside surfaces
15b of the covers 14 cannot be seen in Figures 1 to 3 of
the first embodiment of the fluid storage tank 10 since
the covers 14 are not shown in cross-section in those



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Figures. However, the inside surface 15b of a cover 14 of the fifth embodiment of the fluid storage tank 60 can be seen in Figure 7). The inside surfaces 15a and 15b are, in use, in contact with the fluid stored in the fluid storage tank 10.

The covers 14 seal with the inside surface 15a of the main body 12.

The main body 12 is substantially tubular.

The main body 12 comprises a casing 16 and a liner 18.

The liner 18 is provided inside the casing 16. The liner 18 is provided adjacent the inside surface of the casing 16. The liner 18 substantially conforms to the inside surface of the casing 16.

Each cover 14 is provided with a seal at its outside surface 19. This seal may be in the form of an O-ring 20 which is positioned in a groove 22 provided on the outside surface 19 of each cover 14. The O-ring seals 20 of the covers 14 seal with the inside surface 15a of the main body 12.

The O-ring seals 20 and grooves 22 are provided on respective portions 24 of the covers 14 which lie adjacent the inside surface 15a of the main body 12.

Preferably, the liner 18 extends sufficiently far to the openings of the main body 12 that the O-ring seals 20 of the covers 14 seal with the liner 18. In this case the inside surface 15a of the main body 12 is defined by the inside surface of the liner 18. This is shown in Figure 2. Whilst the covers 14 could seal with the casing 16 instead (in which case the inside surface 15a of the



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2 main body 12 is defined by the inside surface of the
3 casing 16) this arrangement is not preferred.

4 Each cover 14 comprises a portion 24 and a dome like
5 portion 26. The portion 24 is drum like, or tubular.

6 Retaining means is provided to retain each cover 14
7 releasably in position to close off the respective
8 openings of the main body 12.

9 The retaining means enable the covers 14 to be
10 releasably retained in position without connecting the
11 covers 14 to the main body 12.. The only "interaction"
12 between the main body 12 and the covers 14 is the
13 sealing contact between the O-ring seals 20 and the
14 portions 24 of the covers 14 with the inside surface 15a
15 of the main body 12. This is a pressure induced sealing
16 contact as will be later herein described.

17 The retaining means is shown in more detail in Figures 2
18 and 3.

19 In Figures 2 and 3, the retaining means is shown as
20 comprising respective cover retention members 28 which
21 are fixedly secured to the main body 12 at respective
22 ends thereof adjacent the covers 14. The cover
23 retention members 28 are fixedly secured to the main
24 body 12 by nuts and bolts shown at 30.

25 Each cover retention member 28 comprises a plate like
26 portion 32, a peripheral strip like portion 33 and
27 strengthening ribs 34. At least the inside surface 35
28 of the plate like portion 32 is shaped to conform to the
29 shape of the outer surface 19 of the dome like portion
30 26 of a cover 14. The plate like portion 32 may itself



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2 be dome like. The peripheral strip like portion 33
3 extends around the periphery of the plate like portion
4 32 and projects therefrom away from cover 14. The strip
5 like portion 33 conforms with the shape of the inner
6 surface 15a of the main body 12. The strengthening ribs
7 34 extend between the plate like portion 32 and the
8 peripheral strip like portion 33, at spaced intervals,
9 as best seen in Figure 3. The bolts 30 pass through the
10 strip like portions 33 and the main body 12 to secure
11 the cover retention members 28 to the main body 12. In
12 Figure 2 a gap is shown between the outside surface 19
13 of the dome like portion 26 of the cover 14 and the
14 inside surface 35 of the plate like portion 32.
15 However, this is only for clarity of representation. In
16 practice, no such gap would exist.

17 Figure 4 shows a second embodiment of a fluid storage
18 tank 38 in accordance with the present invention.
19 The fluid storage tank 38 is the same as the fluid
20 storage tank 10 of the first embodiment except that it
21 employs an alternative arrangement for securing the
22 cover retention members 28 to the main body 12.

23 In the fluid storage tank 38, the nuts and bolts 30 are
24 not used. Instead, the end portions of the casing 16
25 are turned over the edges of the strip like portions 33
26 of the cover retention members 28 to form a turned lip
27 39. The cover retention members 28 are in this way
28 fixedly secured to the casing 16 of the main body 12 by
29 a clamping type action of the turned lip 39.

30 The remainder of the fluid storage tank 38 is the same



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as the fluid storage tank 10.

Figure 5 shows a third embodiment of a fluid storage tank 40 in accordance with the present invention.

The fluid storage tank 40 is similar to the fluid storage tank 10 of the first embodiment except that it employs a different arrangement of the retaining means to retain the covers 14 in position.

In the fluid storage tank 40, the retaining means comprises the cover retention members 28 of the fluid storage tank 10, but these are not secured to the main body 12.

Instead, there is provided an elongate bolt 42 which extends through the main body portion 12 between the covers 14. The covers 14 and cover retention members 28 are provided with appropriate holes for the bolt 42 to pass therethrough and nuts 44 are provided outside the tank 40 to keep the bolt 42 in position. The bolts 44 are provided on the outside of each pair of covers 14 and cover retention members 28.

The remainder of the fluid storage tank 40 is the same as the fluid storage tank 10.

Figure 6 shows a fourth embodiment of a fluid storage tank 50 in accordance with the present invention.

The fluid storage tank 50 is similar to the fluid storage tank 10, except that it employs a different arrangement of the retaining means to retain the covers 14 in position.

Once again, the retaining means comprises the cover retention members 28 of the fluid storage tank 10, but



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these are not secured to the main body 12.

The fluid storage tank 50 is provided with a flue-way 52 extending through the main body 12 between the covers 14. Securing means (not shown) are provided outside the fluid storage tank 50 adjacent the cover retention members 28 in a similar manner to the bolts 44 of the fluid storage tank 40.

Thus, the fluid storage tank 50 is of a similar structure to the fluid storage tank 40, except that the bolt 42 of the fluid storage tank 40 is replaced by a flue-way 52 and the bolts 44 are replaced by an alternative, but analogous, form of securing means.

The remainder of the fluid storage tank 60 is the same as the fluid storage tank 10.

Figure 7 shows the cover region of a fifth embodiment of a fluid storage tank 60.

Whilst in Figure 7 only one end of the fluid storage tank 60 is shown, it will be understood that the other end is of a similar form.

The fluid storage tank 60 is similar to the fluid storage tank 10 except that it employs an alternative sealing arrangement of the covers 14' with the inside surface 15a of the main body 12.

The covers 14' of the fluid storage tank 60 do not use the O-ring seal 20 and groove 22 of the covers 14 of the previously described embodiments.

In the fluid storage tank 60, each covers 14' is formed with an outwardly extending sealing flange or lip like portion 62 at the outside surface 19 at the peripheral



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edge of the portion 24. This portion 62 is tapered, as can be seen in Figure 5. The portion 62 seals with the inside surface 15a of the main body 12.

The fluid storage tank 60 may employ retaining means of the same type as any of the fluid storage tanks 10, 38, 40 and 50.

The remainder of the fluid storage tank 60 is the same as the fluid storage tank 10.

In the fluid storage tank of the present invention, the liner 18 may be in the form of a membrane, coating, ceramics material, or a tubular insert which fits into the casing 16.

The liner 18 may be made of material which is non-corrodable since the contents of the fluid storage tank will be in contact with the liner 18. Depending upon the application of the fluid storage tank of the present invention, the liner 18 may need to be made of material which is also high temperature resistant, e.g. when the fluid storage tank is used as the storage tank in a hot water system.

The liner 18 may be made of a plastics polymer. The use of a plastics polymer is particularly suitable when the liner 18 is in the form of a tubular insert.

The covers 14, 14' are also preferably made of a material which is non-corrodable (and high temperature resistant if required) since the contents of the fluid storage tank will also be in contact with the inside surfaces 15b of the covers 14, 14'.

The covers 14, 14' may be made from a plastics material,



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e.g. plastics polymer.

If the covers 14, 14' are not made from a non-corrodable (and high temperature resistant) material, then their inside surfaces 15b are provided with a non-corrodable (and high temperature resistant) coating or lining.

The casing 16 may be made from metal, e.g. steel.

The casing 16 surrounds and encloses the liner 18.

Similarly, the cover retention members 28 retain the covers 14, 14' in position. In this way, the casing 16 and the cover retention members 28 supports the liner 18 and the covers 14, 14', respectively, and carry the structural stress from the fluid stored by the fluid storage tank of the present invention.

The embodiments of the fluid storage tank that have been described herein incorporate retaining means which comprise cover retention members 28 having plate like portions 32 conforming to the shape of the outer surface 19 of the dome like portions 26 of the covers 14, 14'.

It is these plate like portions 32 which carry the structural stress from the fluid pressing against the covers 14, 14'. However, if the covers 14, 14' are made of a material of sufficiently high strength, the cover retention members 28 may be omitted, or modified.

Accordingly, in the embodiments shown in Figures 5 and 6, the cover retention members 28 may, in such cases, be omitted. In the embodiments shown in Figures 1 to 4, the cover retention members 28 may, in such cases, be modified so that the plate like portions 32 are omitted. This then leaves only the strip like portions



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33 which are secured to the casing 16 and which are modified to engage with the covers 14, 14'. In this way, the covers 14, 14' will still be retained in position.

Depending upon its application, appropriate holes (not shown) for fittings and the like (not shown) may be provided in the covers 14, 14' and cover retention members 28. In the case of the fluid storage tank being used in a hot water system, such holes accommodate fittings such as the fluid inlet and outlet pipes.

The casing 16 may be formed from a strip material which is wound into a helix structure and has its abutting edges butt-welded together.

A casing of this type is shown in Figure 8 and is identified by reference numeral 16'.

The casing 16' is formed from strip material 72 whose butt-welded helical edges are shown by the helical line 74.

A casing 16' formed in this way is particularly suitable when the fluid storage tank is used for a hot water system. However, it may also be used for other applications of the fluid storage tank.

The use of a casing 16' in the form shown in Figure 8 is particularly suitable when the liner 18 is in the form of a tubular insert. This is also shown in Figure 8.

A liner in the form of a tubular insert is identified in Figure 8 by reference numeral 18'. The liner 18' is fitted into a casing 16' made of strip material 72 and may have an outer diameter that is very slightly greater



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2 than the inner diameter of the casing 16' such that the
3 liner 18' cannot readily be inserted into the casing 16.
4 This liner 18' is first placed into a freezer to reduce
5 its temperature. The temperature of the liner 18' is
6 reduced sufficiently such that it shrinks in its radial
7 direction, i.e. the diameter of the liner 18' is
8 reduced. This reduction of its diameter needs to be
9 only a few millimetres. Subjecting the liner 18' to a
10 temperature of minus 20°C for approximately 24 hours
11 results in sufficient reduction.

12 After the appropriate time, the liner 18' is removed
13 from the freezer and is then pushed into the casing 16'.
14 This temperature reduction of the liner 18' also results
15 in the liner 18' being inwardly pre-loaded.

16 As the liner 18' returns to ambient temperature, it
17 expands. In so doing, the outer surface of the liner
18 18' tightly bears against the inner surface of the
19 casing 16'.

20 The casing 16, 16' of the present invention carries the
21 structural stress from the fluid contents inside the
22 fluid storage tank. Even in the case of the liner 18
23 being in the form of a tubular insert, this is also the
24 case.

25 The fluid storage tank of the present invention is
26 recyclable or renewable. This means that if defects
27 occur in the liner 18, 18' it can be replaced.

28 This can be done by draining the contents of the fluid
29 storage tank and releasing the retaining means which
30 retains the covers 14, 14' in position. Depending upon



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2 the form of the liner 18, 18', the liner 18, 18' can be
3 then removed from the casing 16, 16' and replaced. This
4 is particularly suitably in the case of the liner 18'
5 being in the form of an insert.

6 If the liner 18 is in the form of a coating, or the
7 like, on the inside surface of the casing 16, 16' then a
8 new coating can be applied or the casing 16, 16' and
9 lining 18 are both removed and replaced as a unit.

10 In another alternative embodiment, the main body 12 may
11 further comprise a (tubular) sleeve (not shown).

12 This sleeve is inserted into the casing 16, 16' to lie
13 adjacent the inside surface of the casing 16, 16'. The
14 liner 18, 18' is then provided adjacent the inside
15 surface of the sleeve.

16 The sleeve can be used with any form of liner 18, 18'
17 and is particularly suitable when the liner 18 is in the
18 form of a coating or the like.

19 The sleeve may be made of an insulating material, e.g.
20 urethane.

21 When the liner 18, 18' becomes defective, the sleeve
22 along with the liner 18, 18' may be removed as a unit
23 from the casing 16 and replaced.

24 Thus, the form of the main body 12 and releasably
25 retained covers 14, 14' (which are not connected to the
26 main body 12) of the fluid storage tank of the present
27 invention allow the fluid storage tank of the present
28 invention to be recyclable or renewable.

29 Whilst the embodiments of the fluid storage tank of the
30 present invention have been described with reference to



particular forms of the sealing arrangement (viz. O-ring seals 20 and flange or lip like portions 62), covers 14 and retaining means of any suitable form may be used.

The fluid storage tank of the present invention can be used to store fluid under pressure.

The pressure exerted by the fluid contents of the fluid storage tank of the present invention exerts outwardly directed radial and longitudinal forces on the fluid storage tank.

The longitudinal forces are countered by the retaining means, or covers 14, 14'. The retaining means prevent the covers 14, 14' from moving in the outward direction, i.e. away from one another. At the same time, the radial forces exerted by the contents of the fluid storage tank push the drum like portions 24 of the covers 14, 14' in a radial direction to bear against the inside surface 15a of the main body 12. This pushes the seal means, e.g. the O-ring seals 20 or the sealing flange or lip like portions 62, into closer contact with the inside surface 15a (e.g. the liner 18) of the main body 12 thus providing a stronger seal with increasing pressure of the fluid in the fluid storage tank.

Whilst in the embodiments hereindescribed, the fluid storage tank of the embodiments is shown as having a pair of covers 14, 14' which are releasably positioned to cover a respective opening, it is possible that only one of the covers 14, 14' is releasably retained and the other cover 14, 14' is fixedly retained at one end, i.e. fixed to the main body 12. This may be done by directly



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2 connecting the cover 14, 14' to the casing 16, e.g., by
3 a metal strap or by fixedly connecting a securing means
4 of the retaining means to the casing 16.

5 In the case of the fluid storage tank of the present
6 invention being used in a hot water system, e.g. a
7 solar, gas, or electric hot water system, the fluid
8 storage tank encloses a space which is suitable to
9 contain potable water, e.g. drinking water.

10 In other applications, the fluid storage tank would
11 store the appropriate fluid, e.g. gas in a gas cylinder
12 application, etc...

13 Modifications and variations such as would be apparent
14 to a skilled addressee are deemed within the scope of
15 the present invention.

CLAIMS

1. A fluid storage tank characterized in that it comprises a main body having at least one opening, cover means to close off said opening of said main body, and seal means, said cover means and said main body having a respective inside surface arranged to be, in use, in contact with fluid stored in said fluid storage tank, said main body comprising casing means and liner means, said liner means provided inside said casing means, wherein said cover means is releasably retained in place and seals with said inside surface of said main body via said seal means such that said fluid is storable in said fluid storage tank.

2. A fluid storage tank according to Claim 1, characterised in that said cover means has an outside surface and said seal means is provided substantially at said outside surface.

3. A fluid storage tank according to Claim 2, characterized in that a portion of said outside surface of said cover means lies substantially adjacent said inside surface of said main body and said seal means is provided substantially at said portion of said outside surface of said cover means.

4. A fluid storage tank according to Claim 3, characterized in that said seal means comprises a sealing ring member which is located in a groove formed in said cover means at said portion of said outside surface of said cover means.

5. A fluid storage tank according to Claim 3,





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characterized in that said seal means comprises a sealing flange substantially at a peripheral edge of said portion of said cover means.

6. A fluid storage tank according to any one of Claims 1 to 5, characterized in that retaining means is provided to retain said cover means in place.

7. A fluid storage tank according to Claim 6, characterized in that said retaining means comprises at least one cover retention member and securing means, said cover retention member having at least a first portion and said securing means engaging with said first portion to secure said cover retention member to said main body.

8. A fluid storage tank according to Claim 7, characterized in that said securing means comprises nuts and bolts which extend through said first portion of said cover retention member and said main body.

9. A fluid storage tank according to Claim 7, characterized in that said securing means comprises the end portion of said casing means turned over an edge of said first portion of said cover retention member.

10. A fluid storage tank according to any one of Claims 7 to 9, characterized in that said securing means secures said cover retention member to said casing means of said main body.

11. A fluid storage tank according to any one of claims 7 to 10, characterised in that said first portion of said cover retention member engages with said cover means to retain said cover means in place.



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12. A fluid storage tank according to any one of claims 7 to 10, characterised in that said cover retention member has a second portion which contacts said cover means to retain said cover means in place.

13. A fluid storage tank according to Claim 6, characterized in that said retaining means comprises at least one cover retention member and elongate member means, said cover retention member having a first portion and a second portion, said elongate member means extending through said fluid storage tank said cover means and said second portion of said cover retention member and secured outside said fluid storage tank.

14. A fluid storage tank according to claim 6, characterised in that said retaining means comprises elongate member means extending through said fluid storage tank and said cover means, and secured outside said fluid storage tank.

15. A fluid storage tank according to Claim 13 or 14, characterized in that said elongate member means comprises bolt means which is secured by nut means outside said fluid storage tank.

16. A fluid storage tank according to Claim 13 or 14, characterised in that said elongate member means comprises flue-way means which is secured outside said fluid storage tank.

17. A fluid storage tank according to any one of Claims 7 to 13, 15 or 16, characterised in that said first portion of said cover retention member comprises strip material.





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2 18. A fluid storage tank according to claim 12,
3 characterised in that said second portion comprises a
4 plate portion which has an inside surface shaped to
5 confirm with said cover means.

6 19. A fluid storage tank according to any one of Claims
7 1 to 18, characterized in that said main body further
8 comprises a sleeve positioned adjacent said casing
9 means, and said liner means is provided adjacent said
10 sleeve.

11 20. A fluid storage tank according to any one of Claims
12 1 to 18, characterized in that said liner means is
13 provided adjacent said casing means.

14 21. A fluid storage tank according to any one of Claims
15 1 to 20, characterized in that said liner means
16 comprises a membrane, coating, ceramics material, or a
17 tubular insert.

18 22. A fluid storage tank according to any one of Claims
19 1 to 21, characterized in that said main body comprises
20 two openings, one at each end thereof and a said cover
21 means is provided at a respective said end.

22 23. A fluid storage tank according to any one of Claims
23 1 to 22, characterized in that said casing means is made
24 of metal and said inside surfaces of said main body and
25 said cover means are made of non-corrodable material.

26 24. A fluid storage tank according to any one of Claims
27 1 to 23, characterized in that said liner means is made
28 of non-corrodable material.

29 25. A fluid storage tank according to any one of claims
30 1 to 24, characterised in that said casing means



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- 2 comprises strip material wound into a helix with its
- 3 abutting edges connected.

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"FLUID STORAGE TANK"**ABSTRACT**

A fluid storage tank (38) comprising a main body (12) and covers (14) to close off openings of the main body (12). The main body (12) and covers (14) have inside surfaces (15a, 15b) which are, in use, in contact with fluid stored in the tank (38). The main body (12) is made up of a casing (16) and a liner (18) which is provided inside the casing (16). The covers (14) are releasably retained in place and seal with the inside surface (15a) of the main body (12) so that fluid can be stored in the tank (10).

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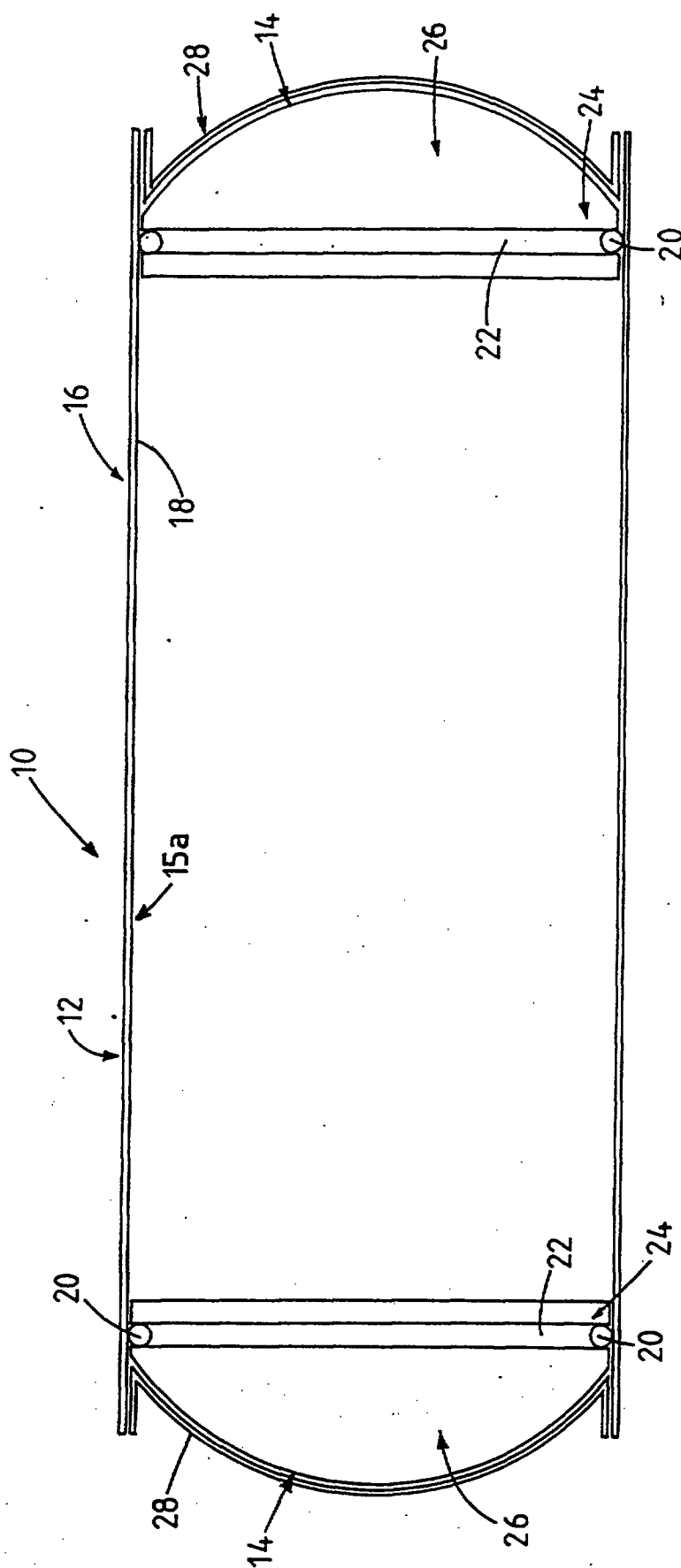


FIG. 1

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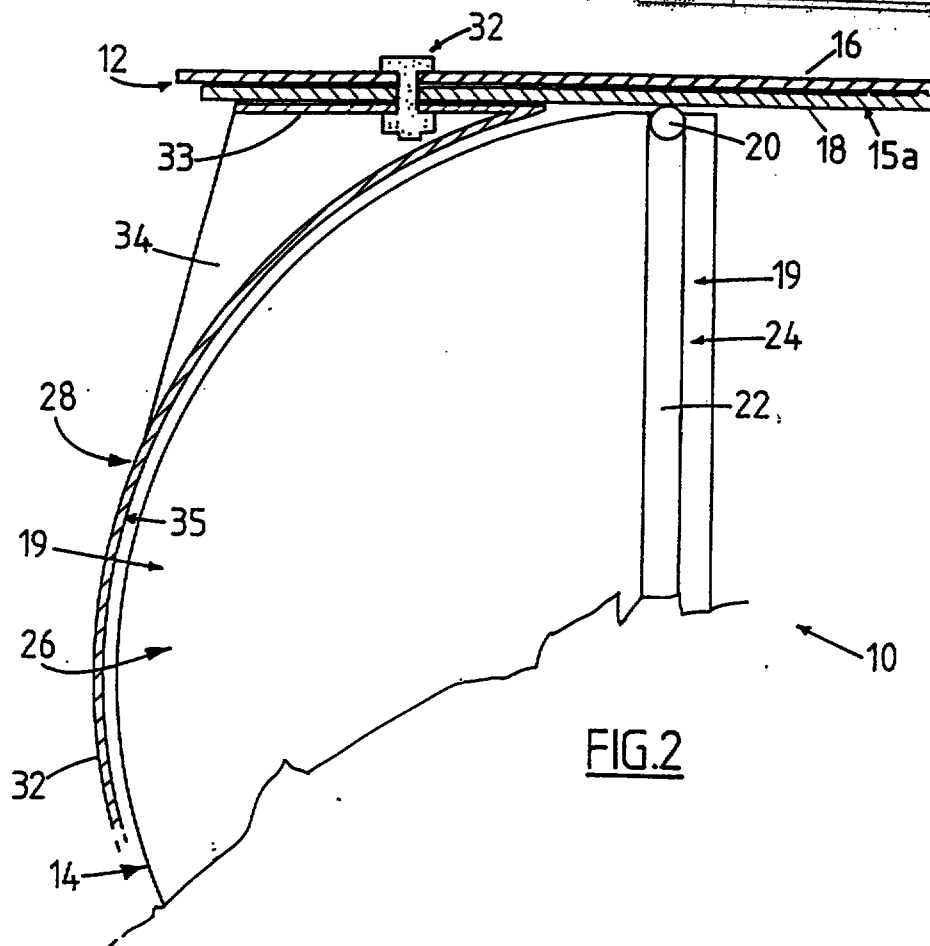


FIG. 2

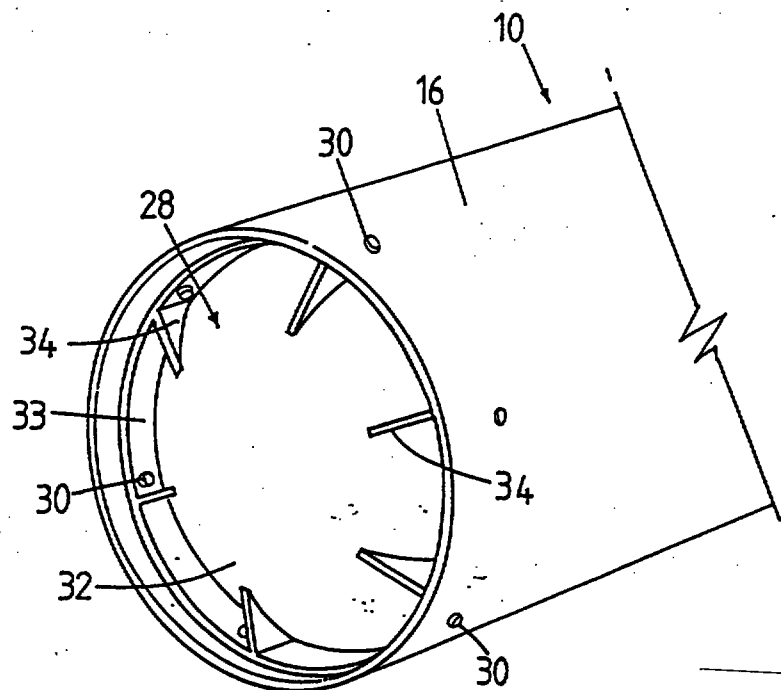


FIG. 3



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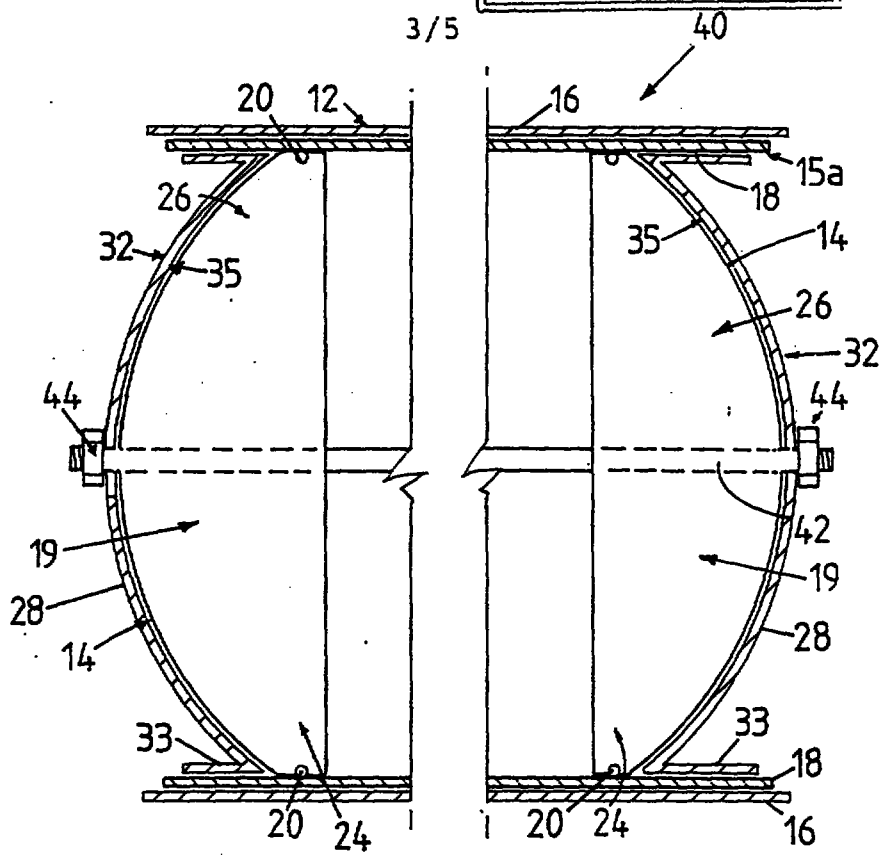


FIG. 5

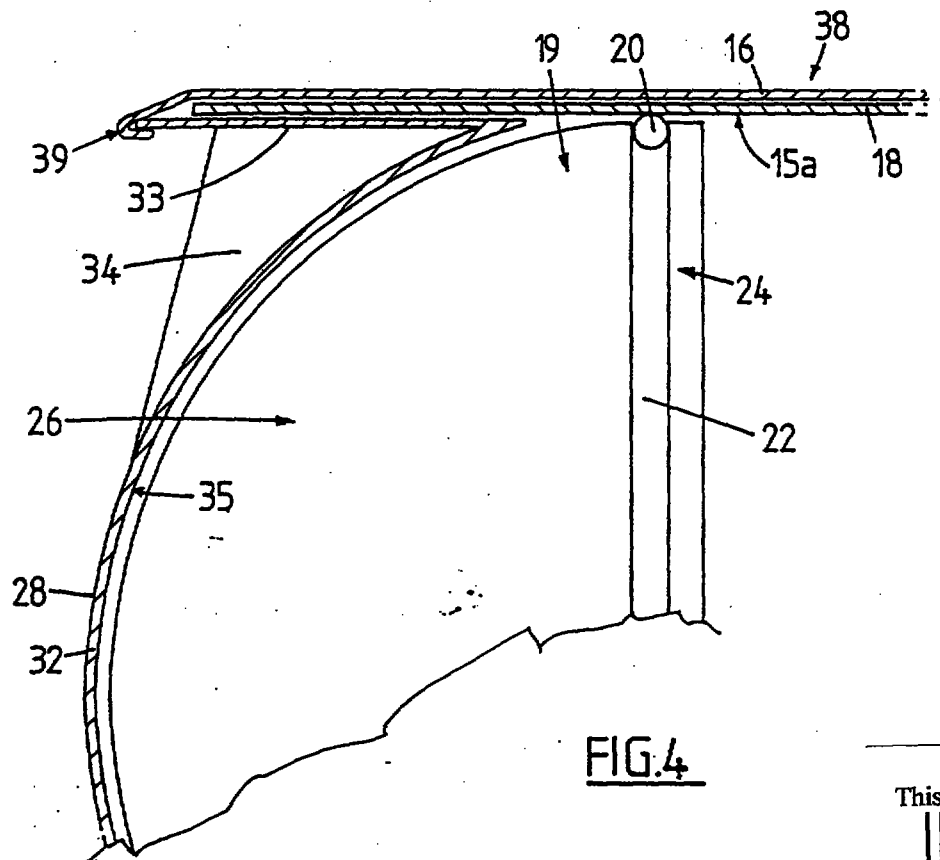


FIG. 4

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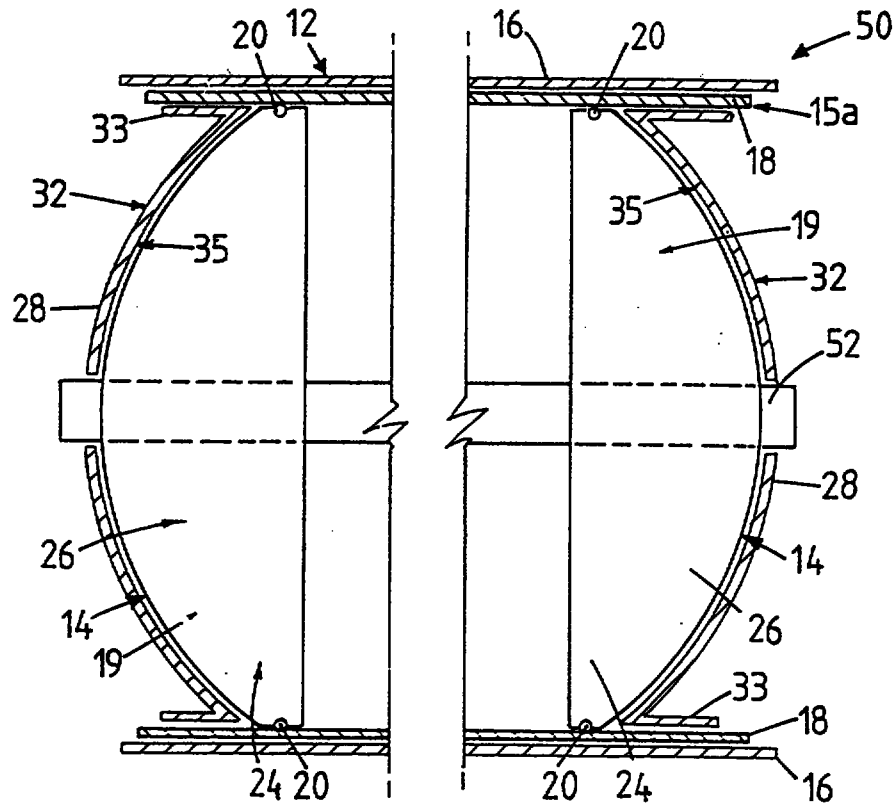


FIG. 6

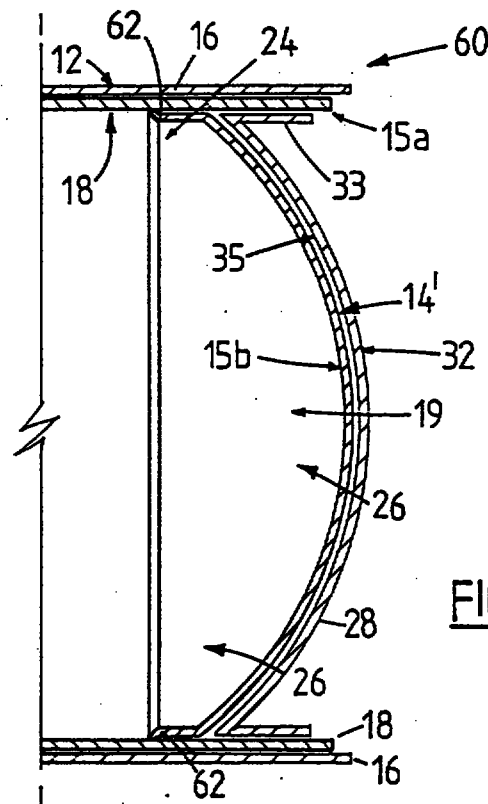


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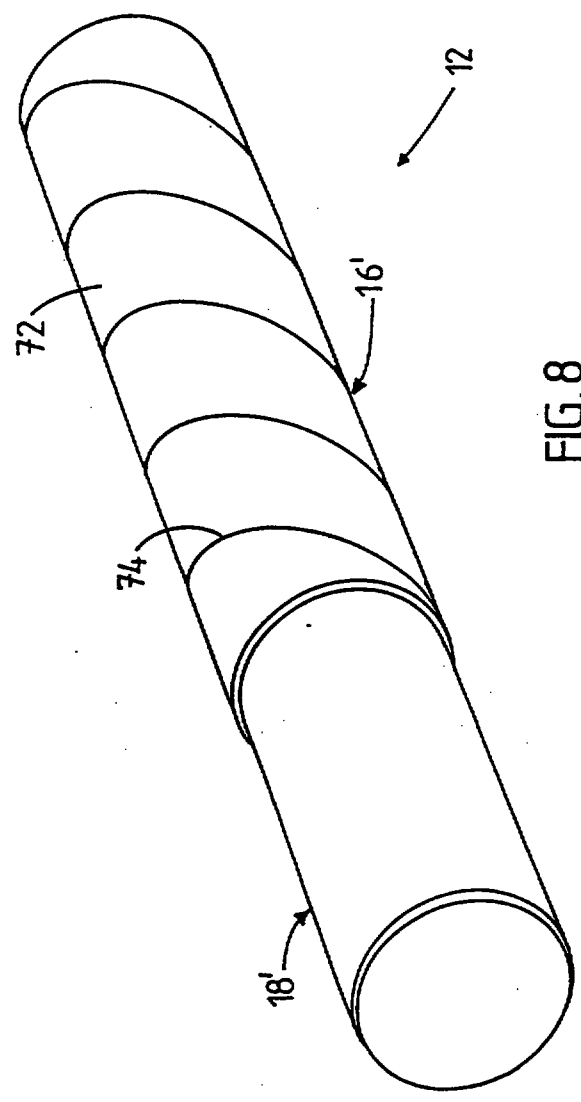


FIG. 8

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TITLE

"FLUID STORAGE TANK"

DESCRIPTION

The present invention relates to a fluid storage tank.

The fluid storage tank is used to store fluid which is under pressure.

The fluid storage tank of the present invention may be used as the hot water storage tank in a hot water system. The hot water system may, for example, be a solar, gas or electric hot water system. The fluid storage tank of the present invention may be used in other applications in which fluid is stored under pressure in a tank or similar container, eg water filters, fire extinguishes, and gas cylinders.

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FIELD OF THE INVENTION

Fluid storage tanks used to store fluid under pressure may deteriorate over time.

In fluid storage tanks used in hot water systems, deterioration generally occurs to the lining inside such tanks which is in contact with the fluid stored in the tank. However, due to the structure of conventional tanks when this deterioration occurs to the lining, the entire tank must be replaced.

In contrast the present invention provides a fluid storage tank in which only the liner needs to be replaced if it deteriorates. In this way the fluid storage tank of the present invention is recyclable or renewable.

The present invention provides a fluid storage tank

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which may also be used in other applications in which fluid is stored under pressure to provide a fluid storage tank which is recyclable or renewable.

SUMMARY OF THE PRESENT INVENTION

In accordance with one aspect of the present invention there is provided a fluid storage tank characterized in that it comprises a main body having at least one opening, cover means to close off said opening of said main body, and seal means, said cover means and said main body having a respective inside surface arranged to be, in use, in contact with fluid stored in said fluid storage tank, said main body comprising casing means and liner means, said liner means provided inside said casing means, wherein said cover means is releasably retained in place and seals with said inside surface of said main body via said seal means such that said fluid is storable in said fluid storage tank.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a partly cross-sectional elevation view of a first embodiment of a fluid storage tank in accordance with the present invention;

Figure 2 is a partly cross-sectional elevation view of the cover region of the fluid storage tank shown in Figure 1;

Figure 3 is a perspective view of the outside of the cover region of the fluid storage tank shown in Figure 1;

Figure 4 is a partly cross-sectional elevation view of the cover region of a second embodiment of a fluid



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storage tank in accordance with the present invention; Figure 5 is a partly cross-sectional elevation view of a third embodiment of a fluid storage tank in accordance with the present invention; Figure 6 is a partly cross-sectional elevation view of a fourth embodiment of a fluid storage tank in accordance with the present invention; Figure 7 is a cross-sectional elevation view of the cover region of a fifth embodiment of a fluid storage tank in accordance with the present invention; and, Figure 8 shows a particular embodiment of the casing and liner of a fluid storage tank in accordance with the present invention.

DESCRIPTION OF THE INVENTION

Figures 1 to 8 and the description of the preferred embodiments use the same reference numerals to denote the same parts. The description of such parts is not repeated for subsequent embodiments, but it is to be understood that it applies in like manner to such subsequent embodiments.

In Figure 1 there is shown a fluid storage tank 10 comprising a main body 12 and covers 14 to close off respective openings of the main body 12. The openings are located at respective ends of the main body 12. The main body 12 has an inside surface 15a. The covers 14 each have an inside surface 15b. (The inside surfaces 15b of the covers 14 cannot be seen in Figures 1 to 3 of the first embodiment of the fluid storage tank 10 since the covers 14 are not shown in cross-section in those



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Figures. However, the inside surface 15b of a cover 14' of the fifth embodiment of the fluid storage tank 60 can be seen in Figure 7). The inside surfaces 15a and 15b are, in use, in contact with the fluid stored in the fluid storage tank 10.

The covers 14 seal with the inside surface 15a of the main body 12.

The main body 12 is substantially tubular.

The main body 12 comprises a casing 16 and a liner 18.

The liner 18 is provided inside the casing 16. The liner 18 is provided adjacent the inside surface of the casing 16. The liner 18 substantially conforms to the inside surface of the casing 16.

Each cover 14 is provided with a seal at its outside surface 19. This seal may be in the form of an O-ring 20 which is positioned in a groove 22 provided on the outside surface 19 of each cover 14. The O-ring seals 20 of the covers 14 seal with the inside surface 15a of the main body 12.

The O-ring seals 20 and grooves 22 are provided on respective portions 24 of the covers 14 which lie adjacent the inside surface 15a of the main body 12.

Preferably, the liner 18 extends sufficiently far to the openings of the main body 12 that the O-ring seals 20 of the covers 14 seal with the liner 18. In this case the inside surface 15a of the main body 12 is defined by the inside surface of the liner 18. This is shown in Figure 2. Whilst the covers 14 could seal with the casing 16 instead (in which case the inside surface 15a of the



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main body 12 is defined by the inside surface of the casing 16) this arrangement is not preferred.

Each cover 14 comprises a portion 24 and a dome like portion 26. The portion 24 is drum like, or tubular. Retaining means is provided to retain each cover 14 releasably in position to close off the respective openings of the main body 12.

The retaining means enable the covers 14 to be releasably retained in position without connecting the covers 14 to the main body 12. The only "interaction" between the main body 12 and the covers 14 is the sealing contact between the O-ring seals 20 and the portions 24 of the covers 14 with the inside surface 15a of the main body 12. This is a pressure induced sealing contact as will be later herein described.

The retaining means is shown in more detail in Figures 2 and 3.

In Figures 2 and 3, the retaining means is shown as comprising respective cover retention members 28 which are fixedly secured to the main body 12 at respective ends thereof adjacent the covers 14. The cover retention members 28 are fixedly secured to the main body 12 by nuts and bolts shown at 30.

Each cover retention member 28 comprises a plate like portion 32, a peripheral strip like portion 33 and strengthening ribs 34. At least the inside surface 35 of the plate like portion 32 is shaped to conform to the shape of the outer surface 19 of the dome like portion 26 of a cover 14. The plate like portion 32 may itself



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be dome like. The peripheral strip like portion 33 extends around the periphery of the plate like portion 32 and projects therefrom away from cover 14. The strip like portion 33 conforms with the shape of the inner surface 15a of the main body 12. The strengthening ribs 34 extend between the plate like portion 32 and the peripheral strip like portion 33, at spaced intervals, as best seen in Figure 3. The bolts 30 pass through the strip like portions 33 and the main body 12 to secure the cover retention members 28 to the main body 12. In Figure 2 a gap is shown between the outside surface 19 of the dome like portion 26 of the cover 14 and the inside surface 35 of the plate like portion 32. However, this is only for clarity of representation. In practice, no such gap would exist.

Figure 4 shows a second embodiment of a fluid storage tank 38 in accordance with the present invention.

The fluid storage tank 38 is the same as the fluid storage tank 10 of the first embodiment except that it employs an alternative arrangement for securing the cover retention members 28 to the main body 12.

In the fluid storage tank 38, the nuts and bolts 30 are not used. Instead, the end portions of the casing 16 are turned over the edges of the strip like portions 33 of the cover retention members 28 to form a turned lip 39. The cover retention members 28 are in this way fixedly secured to the casing 16 of the main body 12 by a clamping type action of the turned lip 39.

The remainder of the fluid storage tank 38 is the same



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as the fluid storage tank 10.

Figure 5 shows a third embodiment of a fluid storage tank 40 in accordance with the present invention.

The fluid storage tank 40 is similar to the fluid storage tank 10 of the first embodiment except that it employs a different arrangement of the retaining means to retain the covers 14 in position.

In the fluid storage tank 40, the retaining means comprises the cover retention members 28 of the fluid storage tank 10, but these are not secured to the main body 12.

Instead, there is provided an elongate bolt 42 which extends through the main body portion 12 between the covers 14. The covers 14 and cover retention members 28 are provided with appropriate holes for the bolt 42 to pass therethrough and nuts 44 are provided outside the tank 40 to keep the bolt 42 in position. The bolts 44 are provided on the outside of each pair of covers 14 and cover retention members 28.

The remainder of the fluid storage tank 40 is the same as the fluid storage tank 10.

Figure 6 shows a fourth embodiment of a fluid storage tank 50 in accordance with the present invention.

The fluid storage tank 50 is similar to the fluid storage tank 10, except that it employs a different arrangement of the retaining means to retain the covers 14 in position.

Once again, the retaining means comprises the cover retention members 28 of the fluid storage tank 10, but



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these are not secured to the main body 12.

The fluid storage tank 50 is provided with a flue-way 52 extending through the main body 12 between the covers 14. Securing means (not shown) are provided outside the fluid storage tank 50 adjacent the cover retention members 28 in a similar manner to the bolts 44 of the fluid storage tank 40.

Thus, the fluid storage tank 50 is of a similar structure to the fluid storage tank 40, except that the bolt 42 of the fluid storage tank 40 is replaced by a flue-way 52 and the bolts 44 are replaced by an alternative, but analogous, form of securing means.

The remainder of the fluid storage tank 60 is the same as the fluid storage tank 10.

Figure 7 shows the cover region of a fifth embodiment of a fluid storage tank 60.

Whilst in Figure 7 only one end of the fluid storage tank 60 is shown, it will be understood that the other end is of a similar form.

The fluid storage tank 60 is similar to the fluid storage tank 10 except that it employs an alternative sealing arrangement of the covers 14' with the inside surface 15a of the main body 12.

The covers 14' of the fluid storage tank 60 do not use the O-ring seal 20 and groove 22 of the covers 14 of the previously described embodiments.

In the fluid storage tank 60, each covers 14' is formed with an outwardly extending sealing flange or lip like portion 62 at the outside surface 19 at the peripheral



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edge of the portion 24. This portion 62 is tapered, as can be seen in Figure 5. The portion 62 seals with the inside surface 15a of the main body 12.

The fluid storage tank 60 may employ retaining means of the same type as any of the fluid storage tanks 10, 38, 40 and 50.

The remainder of the fluid storage tank 60 is the same as the fluid storage tank 10.

In the fluid storage tank of the present invention, the liner 18 may be in the form of a membrane, coating, ceramics material, or a tubular insert which fits into the casing 16.

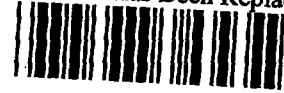
The liner 18 may be made of material which is non-corrodable since the contents of the fluid storage tank will be in contact with the liner 18. Depending upon the application of the fluid storage tank of the present invention, the liner 18 may need to be made of material which is also high temperature resistant, e.g. when the fluid storage tank is used as the storage tank in a hot water system.

The liner 18 may be made of a plastics polymer. The use of a plastics polymer is particularly suitable when the liner 18 is in the form of a tubular insert.

The covers 14, 14' are also preferably made of a material which is non-corrodable (and high temperature resistant if required) since the contents of the fluid storage tank will also be in contact with the inside surfaces 15b of the covers 14, 14'.

The covers 14, 14' may be made from a plastics material,

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e.g. plastics polymer.

If the covers 14, 14' are not made from a non-corrodable (and high temperature resistant) material, then their inside surfaces 15b are provided with a non-corrodable (and high temperature resistant) coating or lining.

The casing 16 may be made from metal, e.g. steel.

The casing 16 surrounds and encloses the liner 18.

Similarly, the cover retention members 28 retain the covers 14, 14' in position. In this way, the casing 16 and the cover retention members 28 supports the liner 18 and the covers 14, 14', respectively, and carry the structural stress from the fluid stored by the fluid storage tank of the present invention.

The embodiments of the fluid storage tank that have been described herein incorporate retaining means which comprise cover retention members 28 having plate like portions 32 conforming to the shape of the outer surface 19 of the dome like portions 26 of the covers 14, 14'.

It is these plate like portions 32 which carry the structural stress from the fluid pressing against the covers 14, 14'. However, if the covers 14, 14' are made of a material of sufficiently high strength, the cover retention members 28 may be omitted, or modified.

Accordingly, in the embodiments shown in Figures 5 and 6, the cover retention members 28 may, in such cases, be omitted. In the embodiments shown in Figures 1 to 4, the cover retention members 28 may, in such cases, be modified so that the plate like portions 32 are omitted. This then leaves only the strip like portions



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33 which are secured to the casing 16 and which are modified to engage with the covers 14, 14'. In this way, the covers 14, 14' will still be retained in position.

Depending upon its application, appropriate holes (not shown) for fittings and the like (not shown) may be provided in the covers 14, 14' and cover retention members 28. In the case of the fluid storage tank being used in a hot water system, such holes accommodate fittings such as the fluid inlet and outlet pipes.

The casing 16 may be formed from a strip material which is wound into a helix structure and has its abutting edges butt-welded together.

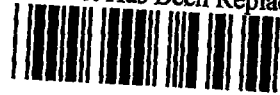
A casing of this type is shown in Figure 8 and is identified by reference numeral 16'.

The casing 16' is formed from strip material 72 whose butt-welded helical edges are shown by the helical line 74.

A casing 16' formed in this way is particularly suitable when the fluid storage tank is used for a hot water system. However, it may also be used for other applications of the fluid storage tank.

The use of a casing 16' in the form shown in Figure 8 is particularly suitable when the liner 18 is in the form of a tubular insert. This is also shown in Figure 8.

A liner in the form of a tubular insert is identified in Figure 8 by reference numeral 18'. The liner 18' is fitted into a casing 16' made of strip material 72 and may have an outer diameter that is very slightly greater



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than the inner diameter of the casing 16' such that the liner 18' cannot readily be inserted into the casing 16'. This liner 18' is first placed into a freezer to reduce its temperature. The temperature of the liner 18' is reduced sufficiently such that it shrinks in its radial direction, i.e. the diameter of the liner 18' is reduced. This reduction of its diameter needs to be only a few millimetres. Subjecting the liner 18' to a temperature of minus 20°C for approximately 24 hours results in sufficient reduction.

After the appropriate time, the liner 18' is removed from the freezer and is then pushed into the casing 16'. This temperature reduction of the liner 18' also results in the liner 18' being inwardly pre-loaded.

As the liner 18' returns to ambient temperature, it expands. In so doing, the outer surface of the liner 18' tightly bears against the inner surface of the casing 16'.

The casing 16, 16' of the present invention carries the structural stress from the fluid contents inside the fluid storage tank. Even in the case of the liner 18 being in the form of a tubular insert, this is also the case.

The fluid storage tank of the present invention is recyclable or renewable. This means that if defects occur in the liner 18, 18' it can be replaced.

This can be done by draining the contents of the fluid storage tank and releasing the retaining means which maintains the covers 14, 14' in position. Depending upon



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the form of the liner 18, 18', the liner 18, 18' can be then removed from the casing 16, 16' and replaced. This is particularly suitable in the case of the liner 18' being in the form of an insert.

If the liner 18 is in the form of a coating, or the like, on the inside surface of the casing 16, 16' then a new coating can be applied or the casing 16, 16' and lining 18 are both removed and replaced as a unit.

In another alternative embodiment, the main body 12 may further comprise a (tubular) sleeve (not shown).

This sleeve is inserted into the casing 16, 16' to lie adjacent the inside surface of the casing 16, 16'. The liner 18, 18' is then provided adjacent the inside surface of the sleeve.

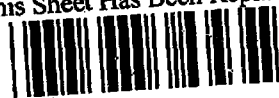
The sleeve can be used with any form of liner 18, 18' and is particularly suitable when the liner 18 is in the form of a coating or the like.

The sleeve may be made of an insulating material, e.g. urethane.

When the liner 18, 18' becomes defective, the sleeve along with the liner 18, 18' may be removed as a unit from the casing 16 and replaced.

Thus, the form of the main body 12 and releasably retained covers 14, 14' (which are not connected to the main body 12) of the fluid storage tank of the present invention allow the fluid storage tank of the present invention to be recyclable or renewable.

Whilst the embodiments of the fluid storage tank of the present invention have been described with reference to



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particular forms of the sealing arrangement (viz. O-ring seals 20 and flange, or lip like portions 62), covers 14 and retaining means of any suitable form may be used. The fluid storage tank of the present invention can be used to store fluid under pressure.

The pressure exerted by the fluid contents of the fluid storage tank of the present invention exerts outwardly directed radial and longitudinal forces on the fluid storage tank.

The longitudinal forces are countered by the retaining means, or covers 14, 14'. The retaining means prevent the covers 14, 14' from moving in the outward direction, i.e. away from one another. At the same time, the radial forces exerted by the contents of the fluid storage tank push the drum like portions 24 of the covers 14, 14' in a radial direction to bear against the inside surface 15a of the main body 12. This pushes the seal means, e.g. the O-ring seals 20 or the sealing flange or lip like portions 62, into closer contact with the inside surface 15a (e.g. the liner 18) of the main body 12 thus providing a stronger seal with increasing pressure of the fluid in the fluid storage tank.

Whilst in the embodiments hereindescribed, the fluid storage tank of the embodiments is shown as having a pair of covers 14, 14' which are releasably positioned to cover a respective opening, it is possible that only one of the covers 14, 14' is releasably retained and the other cover 14, 14' is fixedly retained at one end, i.e. fixed to the main body 12. This may be done by directly



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connecting the cover 14, 14' to the casing 16, e.g., by a metal strap or by fixedly connecting a securing means of the retaining means to the casing 16.

In the case of the fluid storage tank of the present invention being used in a hot water system, e.g. a solar, gas, or electric hot water system, the fluid storage tank encloses a space which is suitable to contain potable water, e.g. drinking water.

In other applications, the fluid storage tank would store the appropriate fluid, e.g. gas in a gas cylinder application, etc.

Modifications and variations such as would be apparent to a skilled addressee are deemed within the scope of the present invention.



CLAIMS

1. A fluid storage tank characterized in that it comprises a main body having at least one opening, cover means to close off said opening of said main body, and seal means, said cover means and said main body having a respective inside surface arranged to be, in use, in contact with fluid stored in said fluid storage tank, said main body comprising casing means and liner means, said liner means provided inside said casing means, wherein said cover means is releasably retained in place and seals with said inside surface of said main body via said seal means such that said fluid is storable in said fluid storage tank.

2. A fluid storage tank according to Claim 1, characterised in that said cover means has an outside surface and said seal means is provided substantially at said outside surface.

3. A fluid storage tank according to Claim 2, characterized in that a portion of said outside surface of said cover means lies substantially adjacent said inside surface of said main body and said seal means is provided substantially at said portion of said outside surface of said cover means.

4. A fluid storage tank according to Claim 3, characterized in that said seal means comprises a sealing ring member which is located in a groove formed in said cover means at said portion of said outside surface of said cover means.

5. A fluid storage tank according to Claim 3, This is the replacement sh



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characterized in that said seal means comprises a sealing flange substantially at a peripheral edge of said portion of said cover means.

6. A fluid storage tank according to any one of Claims 1 to 5, characterized in that retaining means is provided to retain said cover means in place.

7. A fluid storage tank according to Claim 6, characterized in that said retaining means comprises at least one cover retention member and securing means, said cover retention member having at least a first portion and said securing means engaging with said first portion to secure said cover retention member to said main body.

8. A fluid storage tank according to Claim 7, characterized in that said securing means comprises nuts and bolts which extend through said first portion of said cover retention member and said main body.

9. A fluid storage tank according to Claim 7, characterized in that said securing means comprises the end portion of said casing means turned over an edge of said first portion of said cover retention member.

10. A fluid storage tank according to any one of Claims 7 to 9, characterized in that said securing means secures said cover retention member to said casing means of said main body.

11. A fluid storage tank according to any one of claims 7 to 10, characterised in that said first portion of said cover retention member engages with said cover means to retain said cover means in place.



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12. A fluid storage tank according to any one of claims 7 to 10, characterised in that said cover retention member has a second portion which contacts said cover means to retain said cover means in place.

13. A fluid storage tank according to Claim 6, characterized in that said retaining means comprises at least one cover retention member and elongate member means, said cover retention member having a first portion and a second portion, said elongate member means extending through said fluid storage tank said cover means and said second portion of said cover retention member and secured outside said fluid storage tank.

14. A fluid storage tank according to claim 6, characterised in that said retaining means comprises elongate member means extending through said fluid storage tank and said cover means, and secured outside said fluid storage tank.

15. A fluid storage tank according to Claim 13 or 14, characterized in that said elongate member means comprises bolt means which is secured by nut means outside said fluid storage tank.

16. A fluid storage tank according to Claim 13 or 14, characterised in that said elongate member means comprises flue-way means which is secured outside said fluid storage tank.

17. A fluid storage tank according to any one of Claims 7 to 13, 15 or 16, characterised in that said first portion of said cover retention member comprises strip material.



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18. A fluid storage tank according to claim 12, characterised in that said second portion comprises a plate portion which has an inside surface shaped to confirm with said cover means.
19. A fluid storage tank according to any one of Claims 1 to 18, characterized in that said main body further comprises a sleeve positioned adjacent said casing means, and said liner means is provided adjacent said sleeve.
20. A fluid storage tank according to any one of Claims 1 to 18, characterized in that said liner means is provided adjacent said casing means.
21. A fluid storage tank according to any one of Claims 1 to 20, characterized in that said liner means comprises a membrane, coating, ceramics material, or a tubular insert.
22. A fluid storage tank according to any one of Claims 1 to 21, characterized in that said main body comprises two openings, one at each end thereof and a said cover means is provided at a respective said end.
23. A fluid storage tank according to any one of Claims 1 to 22, characterized in that said casing means is made of metal and said inside surfaces of said main body and said cover means are made of non-corrodable material.
24. A fluid storage tank according to any one of Claims 1 to 23, characterized in that said liner means is made of non-corrodable material.
25. A fluid storage tank according to any one of claims 1 to 24, characterised in that said casing means



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comprises strip material wound into a helix with its
abutting edges connected.

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ABSTRACT**"Fluid Storage Tank".**

A fluid storage tank (38) comprising a main body (12) and covers (14) to close off openings of the main body (12). The main body (12) and covers (14) have inside surfaces (15a, 15b) which are, in use, in contact with fluid stored in the tank (38). The main body (12) is made up of a casing (16) and a liner (18) which is provided inside the casing (16). The covers (14) are releasably retained in place and seal with the inside surface (15a) of the main body (12) so that fluid can be stored in the tank (10).

FIGURE 2

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TITLE

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"FLUID STORAGE TANK"

DESCRIPTION

The present invention relates to a fluid storage tank.

The fluid storage tank is used to store fluid which is under pressure.

The fluid storage tank of the present invention may be used as the hot water storage tank in a hot water system. The hot water system may, for example, be a solar, gas or electric hot water system. The fluid storage tank of the present invention may be used in other applications in which fluid is stored under pressure in a tank or similar container, eg water filters, fire extinguishers, and gas cylinders.

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FIELD OF THE INVENTION

Fluid storage tanks used to store fluid under pressure may deteriorate over time.

In fluid storage tanks used in hot water systems, deterioration generally occurs to the lining inside such tanks which is in contact with the fluid stored in the tank. However, due to the structure of conventional tanks when this deterioration occurs to the lining, the entire tank must be replaced.

In contrast the present invention provides a fluid storage tank in which only the liner needs to be replaced if it deteriorates. In this way the fluid storage tank of the present invention is recyclable or renewable.

The present invention provides a fluid storage tank

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which may also be used in other applications in which fluid is stored under pressure to provide a fluid storage tank which is recyclable or renewable.

SUMMARY OF THE PRESENT INVENTION

In accordance with one aspect of the present invention there is provided a fluid storage tank characterized in that it comprises a main body having at least one opening, cover means to close off said opening of said main body, and seal means, said cover means and said main body having a respective inside surface arranged to be, in use, in contact with fluid stored in said fluid storage tank, said main body comprising casing means and liner means, said liner means provided inside said casing means, wherein said cover means is releasably retained in place and seals with said inside surface of said main body via said seal means such that said fluid is storable in said fluid storage tank.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a partly cross-sectional elevation view of a first embodiment of a fluid storage tank in accordance with the present invention;

Figure 2 is a partly cross-sectional elevation view of the cover region of the fluid storage tank shown in Figure 1;

Figure 3 is a perspective view of the outside of the cover region of the fluid storage tank shown in Figure 1;

Figure 4 is a partly cross-sectional elevation view of the cover region of a second embodiment of a fluid



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storage tank in accordance with the present invention;

Figure 5 is a partly cross-sectional elevation view of a third embodiment of a fluid storage tank in accordance with the present invention;

Figure 6 is a partly cross-sectional elevation view of a fourth embodiment of a fluid storage tank in accordance with the present invention;

Figure 7 is a cross-sectional elevation view of the cover region of a fifth embodiment of a fluid storage tank in accordance with the present invention; and,

Figure 8 shows a particular embodiment of the casing and liner of a fluid storage tank in accordance with the present invention.

DESCRIPTION OF THE INVENTION

Figures 1 to 8 and the description of the preferred embodiments use the same reference numerals to denote the same parts. The description of such parts is not repeated for subsequent embodiments, but it is to be understood that it applies in like manner to such subsequent embodiments.

In Figure 1 there is shown a fluid storage tank 10 comprising a main body 12 and covers 14 to close off respective openings of the main body 12. The openings are located at respective ends of the main body 12. The main body 12 has an inside surface 15a. The covers 14 each have an inside surface 15b. (The inside surfaces 15b of the covers 14 cannot be seen in Figures 1 to 3 of the first embodiment of the fluid storage tank 10 since the covers 14 are not shown in cross-section in those

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Figures. However, the inside surface 15b of a cover 14' of the fifth embodiment of the fluid storage tank 60 can be seen in Figure 7). The inside surfaces 15a and 15b are, in use, in contact with the fluid stored in the fluid storage tank 10.

The covers 14 seal with the inside surface 15a of the main body 12.

The main body 12 is substantially tubular.

The main body 12 comprises a casing 16 and a liner 18.

The liner 18 is provided inside the casing 16. The liner 18 is provided adjacent the inside surface of the casing 16. The liner 18 substantially conforms to the inside surface of the casing 16.

Each cover 14 is provided with a seal at its outside surface 19. This seal may be in the form of an O-ring 20 which is positioned in a groove 22 provided on the outside surface 19 of each cover 14. The O-ring seals 20 of the covers 14 seal with the inside surface 15a of the main body 12.

The O-ring seals 20 and grooves 22 are provided on respective portions 24 of the covers 14 which lie adjacent the inside surface 15a of the main body 12.

Preferably, the liner 18 extends sufficiently far to the openings of the main body 12 that the O-ring seals 20 of the covers 14 seal with the liner 18. In this case the inside surface 15a of the main body 12 is defined by the inside surface of the liner 18. This is shown in Figure 2. Whilst the covers 14 could seal with the casing 16 instead (in which case the inside surface 15a of the

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main body 12 is defined by the inside surface of the casing 16) this arrangement is not preferred.

Each cover 14 comprises a portion 24 and a dome like portion 26. The portion 24 is drum like, or tubular. Retaining means is provided to retain each cover 14 releasably in position to close off the respective openings of the main body 12.

The retaining means enable the covers 14 to be releasably retained in position without connecting the covers 14 to the main body 12. The only "interaction" between the main body 12 and the covers 14 is the sealing contact between the O-ring seals 20 and the portions 24 of the covers 14 with the inside surface 15a of the main body 12. This is a pressure induced sealing contact as will be later herein described.

The retaining means is shown in more detail in Figures 2 and 3.

In Figures 2 and 3, the retaining means is shown as comprising respective cover retention members 28 which are fixedly secured to the main body 12 at respective ends thereof adjacent the covers 14. The cover retention members 28 are fixedly secured to the main body 12 by nuts and bolts shown at 30.

Each cover retention member 28 comprises a plate like portion 32, a peripheral strip like portion 33 and strengthening ribs 34. At least the inside surface 35 of the plate like portion 32 is shaped to conform to the shape of the outer surface 19 of the dome like portion 26 of a cover 14. The plate like portion 32 may itself

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be dome like. The peripheral strip like portion 33 extends around the periphery of the plate like portion 32 and projects therefrom away from cover 14. The strip like portion 33 conforms with the shape of the inner surface 15a of the main body 12. The strengthening ribs 34 extend between the plate like portion 32 and the peripheral strip like portion 33, at spaced intervals, as best seen in Figure 3. The bolts 30 pass through the strip like portions 33 and the main body 12 to secure the cover retention members 28 to the main body 12. In Figure 2 a gap is shown between the outside surface 19 of the dome like portion 26 of the cover 14 and the inside surface 35 of the plate like portion 32. However, this is only for clarity of representation. In practice, no such gap would exist.

Figure 4 shows a second embodiment of a fluid storage tank 38 in accordance with the present invention.

The fluid storage tank 38 is the same as the fluid storage tank 10 of the first embodiment except that it employs an alternative arrangement for securing the cover retention members 28 to the main body 12.

In the fluid storage tank 38, the nuts and bolts 30 are not used. Instead, the end portions of the casing 16 are turned over the edges of the strip like portions 33 of the cover retention members 28 to form a turned lip 39. The cover retention members 28 are in this way fixedly secured to the casing 16 of the main body 12 by a clamping type action of the turned lip 39.

The remainder of the fluid storage tank 38 is the same

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as the fluid storage tank 10.

Figure 5 shows a third embodiment of a fluid storage tank 40 in accordance with the present invention.

The fluid storage tank 40 is similar to the fluid storage tank 10 of the first embodiment except that it employs a different arrangement of the retaining means to retain the covers 14 in position.

In the fluid storage tank 40, the retaining means comprises the cover retention members 28 of the fluid storage tank 10, but these are not secured to the main body 12.

Instead, there is provided an elongate bolt 42 which extends through the main body portion 12 between the covers 14. The covers 14 and cover retention members 28 are provided with appropriate holes for the bolt 42 to pass therethrough and nuts 44 are provided outside the tank 40 to keep the bolt 42 in position. The bolts 44 are provided on the outside of each pair of covers 14 and cover retention members 28.

The remainder of the fluid storage tank 40 is the same as the fluid storage tank 10.

Figure 6 shows a fourth embodiment of a fluid storage tank 50 in accordance with the present invention.

The fluid storage tank 50 is similar to the fluid storage tank 10, except that it employs a different arrangement of the retaining means to retain the covers 14 in position.

Once again, the retaining means comprises the cover retention members 28 of the fluid storage tank 10, but

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these are not secured to the main body 12.

The fluid storage tank 50 is provided with a flue-way 52 extending through the main body 12 between the covers 14. Securing means (not shown) are provided outside the fluid storage tank 50 adjacent the cover retention members 28 in a similar manner to the bolts 44 of the fluid storage tank 40.

Thus, the fluid storage tank 50 is of a similar structure to the fluid storage tank 40, except that the bolt 42 of the fluid storage tank 40 is replaced by a flue-way 52 and the bolts 44 are replaced by an alternative, but analogous, form of securing means.

The remainder of the fluid storage tank 60 is the same as the fluid storage tank 10.

Figure 7 shows the cover region of a fifth embodiment of a fluid storage tank 60.

Whilst in Figure 7 only one end of the fluid storage tank 60 is shown, it will be understood that the other end is of a similar form.

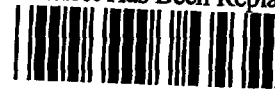
The fluid storage tank 60 is similar to the fluid storage tank 10 except that it employs an alternative sealing arrangement of the covers 14' with the inside surface 15a of the main body 12.

The covers 14' of the fluid storage tank 60 do not use the O-ring seal 20 and groove 22 of the covers 14 of the previously described embodiments.

In the fluid storage tank 60, each covers 14' is formed with an outwardly extending sealing flange or lip like portion 62 at the outside surface 19 at the peripheral

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edge of the portion 24. This portion 62 is tapered, as can be seen in Figure 5. The portion 62 seals with the inside surface 15a of the main body 12.

The fluid storage tank 60 may employ retaining means of the same type as any of the fluid storage tanks 10, 38, 40 and 50.

The remainder of the fluid storage tank 60 is the same as the fluid storage tank 10.

In the fluid storage tank of the present invention, the liner 18 may be in the form of a membrane, coating, ceramics material, or a tubular insert which fits into the casing 16.

The liner 18 may be made of material which is non-corrodable since the contents of the fluid storage tank will be in contact with the liner 18. Depending upon the application of the fluid storage tank of the present invention, the liner 18 may need to be made of material which is also high temperature resistant, e.g. when the fluid storage tank is used as the storage tank in a hot water system.

The liner 18 may be made of a plastics polymer. The use of a plastics polymer is particularly suitable when the liner 18 is in the form of a tubular insert.

The covers 14, 14' are also preferably made of a material which is non-corrodable (and high temperature resistant if required) since the contents of the fluid storage tank will also be in contact with the inside surfaces 15b of the covers 14, 14'.

The covers 14, 14' may be made from a plastics material,

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e.g. plastics polymer.

If the covers 14, 14' are not made from a non-corrodable (and high temperature resistant) material, then their inside surfaces 15b are provided with a non-corrodable (and high temperature resistant) coating or lining.

The casing 16 may be made from metal, e.g. steel.

The casing 16 surrounds and encloses the liner 18.

Similarly, the cover retention members 28 retain the covers 14, 14' in position. In this way, the casing 16 and the cover retention members 28 supports the liner 18 and the covers 14, 14', respectively, and carry the structural stress from the fluid stored by the fluid storage tank of the present invention.

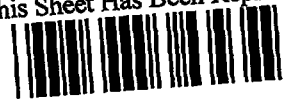
The embodiments of the fluid storage tank that have been described herein incorporate retaining means which comprise cover retention members 28 having plate like portions 32 conforming to the shape of the outer surface 19 of the dome like portions 26 of the covers 14, 14'.

It is these plate like portions 32 which carry the structural stress from the fluid pressing against the covers 14, 14'. However, if the covers 14, 14' are made of a material of sufficiently high strength, the cover retention members 28 may be omitted, or modified.

Accordingly, in the embodiments shown in Figures 5 and 6, the cover retention members 28 may, in such cases, be omitted. In the embodiments shown in Figures 1 to 4, the cover retention members 28 may, in such cases, be modified so that the plate like portions 32 are omitted. This then leaves only the strip like portions

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33 which are secured to the casing 16 and which are modified to engage with the covers 14, 14'. In this way, the covers 14, 14' will still be retained in position.

Depending upon its application, appropriate holes (not shown) for fittings and the like (not shown) may be provided in the covers 14, 14' and cover retention members 28. In the case of the fluid storage tank being used in a hot water system, such holes accommodate fittings such as the fluid inlet and outlet pipes.

The casing 16 may be formed from a strip material which is wound into a helix structure and has its abutting edges butt-welded together.

A casing of this type is shown in Figure 8 and is identified by reference numeral 16'.

The casing 16' is formed from strip material 72 whose butt-welded helical edges are shown by the helical line 74.

A casing 16' formed in this way is particularly suitable when the fluid storage tank is used for a hot water system. However, it may also be used for other applications of the fluid storage tank.

The use of a casing 16' in the form shown in Figure 8 is particularly suitable when the liner 18 is in the form of a tubular insert. This is also shown in Figure 8.

A liner in the form of a tubular insert is identified in Figure 8 by reference numeral 18'. The liner 18' is fitted into a casing 16' made of strip material 72 and may have an outer diameter that is very slightly greater

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than the inner diameter of the casing 16' such that the liner 18' cannot readily be inserted into the casing 16. This liner 18' is first placed into a freezer to reduce its temperature. The temperature of the liner 18' is reduced sufficiently such that it shrinks in its radial direction, i.e. the diameter of the liner 18' is reduced. This reduction of its diameter needs to be only a few millimetres. Subjecting the liner 18' to a temperature of minus 20°C for approximately 24 hours results in sufficient reduction.

After the appropriate time, the liner 18' is removed from the freezer and is then pushed into the casing 16'. This temperature reduction of the liner 18' also results in the liner 18' being inwardly pre-loaded.

As the liner 18' returns to ambient temperature, it expands. In so doing, the outer surface of the liner 18' tightly bears against the inner surface of the casing 16'.

The casing 16, 16' of the present invention carries the structural stress from the fluid contents inside the fluid storage tank. Even in the case of the liner 18 being in the form of a tubular insert, this is also the case.

The fluid storage tank of the present invention is recyclable or renewable. This means that if defects occur in the liner 18, 18' it can be replaced.

This can be done by draining the contents of the fluid storage tank and releasing the retaining means which retains the covers 14, 14' in position. Depending upon

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the form of the liner 18, 18', the liner 18, 18' can be then removed from the casing 16, 16' and replaced. This is particularly suitable in the case of the liner 18' being in the form of an insert.

If the liner 18 is in the form of a coating, or the like, on the inside surface of the casing 16, 16' then a new coating can be applied or the casing 16, 16' and lining 18 are both removed and replaced as a unit.

In another alternative embodiment, the main body 12 may further comprise a (tubular) sleeve (not shown).

This sleeve is inserted into the casing 16, 16' to lie adjacent the inside surface of the casing 16, 16'. The liner 18, 18' is then provided adjacent the inside surface of the sleeve.

The sleeve can be used with any form of liner 18, 18' and is particularly suitable when the liner 18 is in the form of a coating or the like.

The sleeve may be made of an insulating material, e.g. urethane.

When the liner 18, 18' becomes defective, the sleeve along with the liner 18, 18' may be removed as a unit from the casing 16 and replaced.

Thus, the form of the main body 12 and releasably retained covers 14, 14' (which are not connected to the main body 12) of the fluid storage tank of the present invention allow the fluid storage tank of the present invention to be recyclable or renewable.

Whilst the embodiments of the fluid storage tank of the present invention have been described with reference to

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particular forms of the sealing arrangement (viz. O-ring seals 20 and flange or lip like portions 62), covers 14 and retaining means of any suitable form may be used. The fluid storage tank of the present invention can be used to store fluid under pressure.

The pressure exerted by the fluid contents of the fluid storage tank of the present invention exerts outwardly directed radial and longitudinal forces on the fluid storage tank.

The longitudinal forces are countered by the retaining means, or covers 14, 14'. The retaining means prevent the covers 14, 14' from moving in the outward direction, i.e. away from one another. At the same time, the radial forces exerted by the contents of the fluid storage tank push the drum like portions 24 of the covers 14, 14' in a radial direction to bear against the inside surface 15a of the main body 12. This pushes the seal means, e.g. the O-ring seals 20 or the sealing flange or lip like portions 62, into closer contact with the inside surface 15a (e.g. the liner 18) of the main body 12 thus providing a stronger seal with increasing pressure of the fluid in the fluid storage tank.

Whilst in the embodiments hereindescribed, the fluid storage tank of the embodiments is shown as having a pair of covers 14, 14' which are releasably positioned to cover a respective opening, it is possible that only one of the covers 14, 14' is releasably retained and the other cover 14, 14' is fixedly retained at one end, i.e. fixed to the main body 12. This may be done by directly

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connecting the cover 14, 14' to the casing 16, e.g., by a metal strap or by fixedly connecting a securing means of the retaining means to the casing 16.

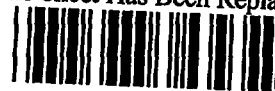
In the case of the fluid storage tank of the present invention being used in a hot water system, e.g. a solar, gas, or electric hot water system, the fluid storage tank encloses a space which is suitable to contain potable water, e.g. drinking water.

In other applications, the fluid storage tank would store the appropriate fluid, e.g. gas in a gas cylinder application, etc.

Modifications and variations such as would be apparent to a skilled addressee are deemed within the scope of the present invention.

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CLAIMS

1. A fluid storage tank characterized in that it comprises a main body having at least one opening, cover means to close off said opening of said main body, and seal means, said cover means and said main body having a respective inside surface arranged to be, in use, in contact with fluid stored in said fluid storage tank, said main body comprising casing means and liner means, said liner means provided inside said casing means, wherein said cover means is releasably retained in place and seals with said inside surface of said main body via said seal means such that said fluid is storable in said fluid storage tank.

2. A fluid storage tank according to Claim 1, characterised in that said cover means has an outside surface and said seal means is provided substantially at said outside surface.

3. A fluid storage tank according to Claim 2, characterized in that a portion of said outside surface of said cover means lies substantially adjacent said inside surface of said main body and said seal means is provided substantially at said portion of said outside surface of said cover means.

4. A fluid storage tank according to Claim 3, characterized in that said seal means comprises a sealing ring member which is located in a groove formed in said cover means at said portion of said outside surface of said cover means.

5. A fluid storage tank according to Claim 3,

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characterized in that said seal means comprises a sealing flange substantially at a peripheral edge of said portion of said cover means.

6. A fluid storage tank according to any one of Claims 1 to 5, characterized in that retaining means is provided to retain said cover means in place.

7. A fluid storage tank according to Claim 6, characterized in that said retaining means comprises at least one cover retention member and securing means, said cover retention member having at least a first portion and said securing means engaging with said first portion to secure said cover retention member to said main body.

8. A fluid storage tank according to Claim 7, characterized in that said securing means comprises nuts and bolts which extend through said first portion of said cover retention member and said main body.

9. A fluid storage tank according to Claim 7, characterized in that said securing means comprises the end portion of said casing means turned over an edge of said first portion of said cover retention member.

10. A fluid storage tank according to any one of Claims 7 to 9, characterized in that said securing means secures said cover retention member to said casing means of said main body.

11. A fluid storage tank according to any one of claims 7 to 10, characterised in that said first portion of said cover retention member engages with said cover means to retain said cover means in place.

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12. A fluid storage tank according to any one of claims 7 to 10, characterised in that said cover retention member has a second portion which contacts said cover means to retain said cover means in place.

13. A fluid storage tank according to Claim 6, characterized in that said retaining means comprises at least one cover retention member and elongate member means, said cover retention member having a first portion and a second portion, said elongate member means extending through said fluid storage tank said cover means and said second portion of said cover retention member and secured outside said fluid storage tank.

14. A fluid storage tank according to claim 6, characterised in that said retaining means comprises elongate member means extending through said fluid storage tank and said cover means, and secured outside said fluid storage tank.

15. A fluid storage tank according to Claim 13 or 14, characterized in that said elongate member means comprises bolt means which is secured by nut means outside said fluid storage tank.

16. A fluid storage tank according to Claim 13 or 14, characterised in that said elongate member means comprises flue-way means which is secured outside said fluid storage tank.

17. A fluid storage tank according to any one of Claims 7 to 13, 15 or 16, characterised in that said first portion of said cover retention member comprises strip material.

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18. A fluid storage tank according to claim 12, characterised in that said second portion comprises a plate portion which has an inside surface shaped to confirm with said cover means.

19. A fluid storage tank according to any one of Claims 1 to 18, characterized in that said main body further comprises a sleeve positioned adjacent said casing means, and said liner means is provided adjacent said sleeve.

20. A fluid storage tank according to any one of Claims 1 to 18, characterized in that said liner means is provided adjacent said casing means.

21. A fluid storage tank according to any one of Claims 1 to 20, characterized in that said liner means comprises a membrane, coating, ceramics material, or a tubular insert.

22. A fluid storage tank according to any one of Claims 1 to 21, characterized in that said main body comprises two openings, one at each end thereof and a said cover means is provided at a respective said end.

23. A fluid storage tank according to any one of Claims 1 to 22, characterized in that said casing means is made of metal and said inside surfaces of said main body and said cover means are made of non-corrodable material.

24. A fluid storage tank according to any one of Claims 1 to 23, characterized in that said liner means is made of non-corrodable material.

25. A fluid storage tank according to any one of claims 1 to 24, characterised in that said casing means

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comprises strip material wound into a helix with its
abutting edges connected.

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ABSTRACT

"Fluid Storage Tank".

A fluid storage tank (38) comprising a main body (12) and covers (14) to close off openings of the main body (12). The main body (12) and covers (14) have inside surfaces (15a, 15b) which are, in use, in contact with fluid stored in the tank (38). The main body (12) is made up of a casing (16) and a liner (18) which is provided inside the casing (16). The covers (14) are releasably retained in place and seal with the inside surface (15a) of the main body (12) so that fluid can be stored in the tank (10).

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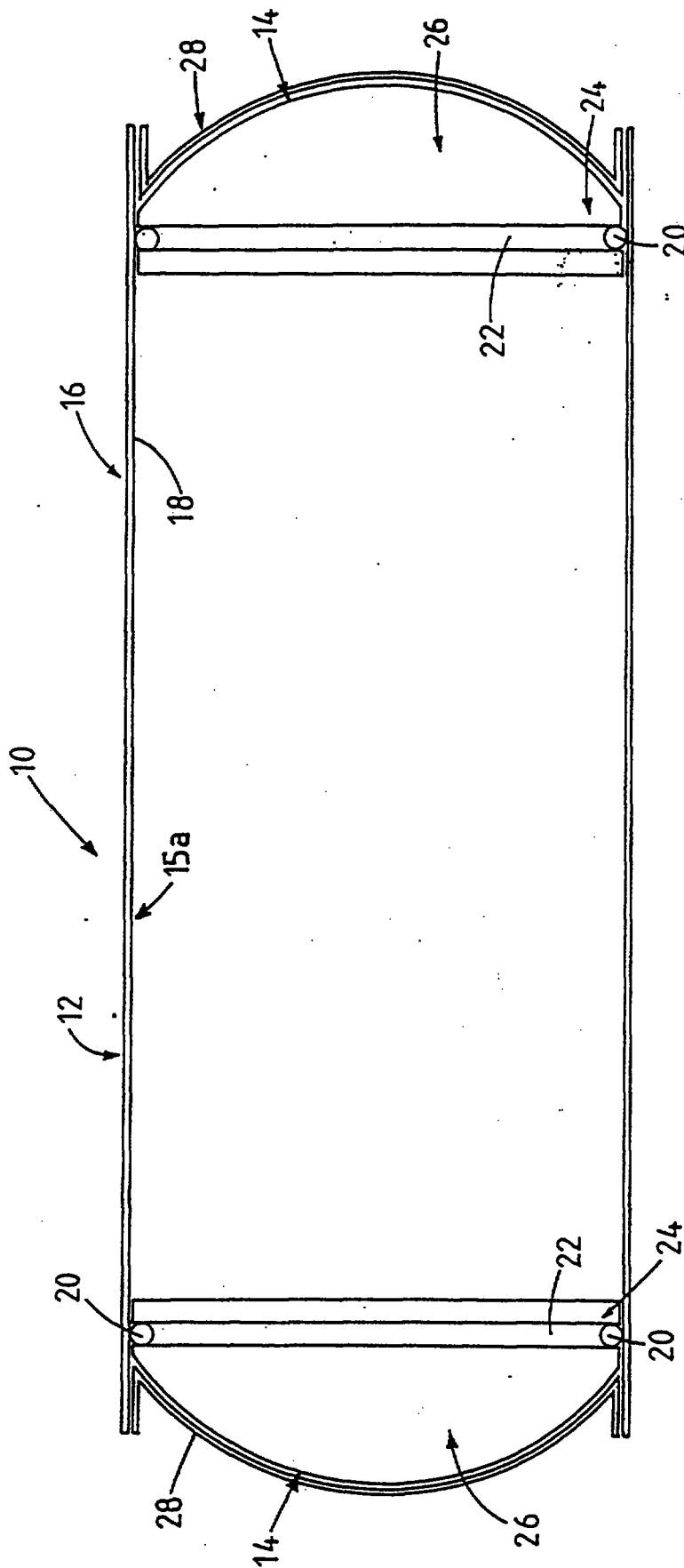


FIG. 1

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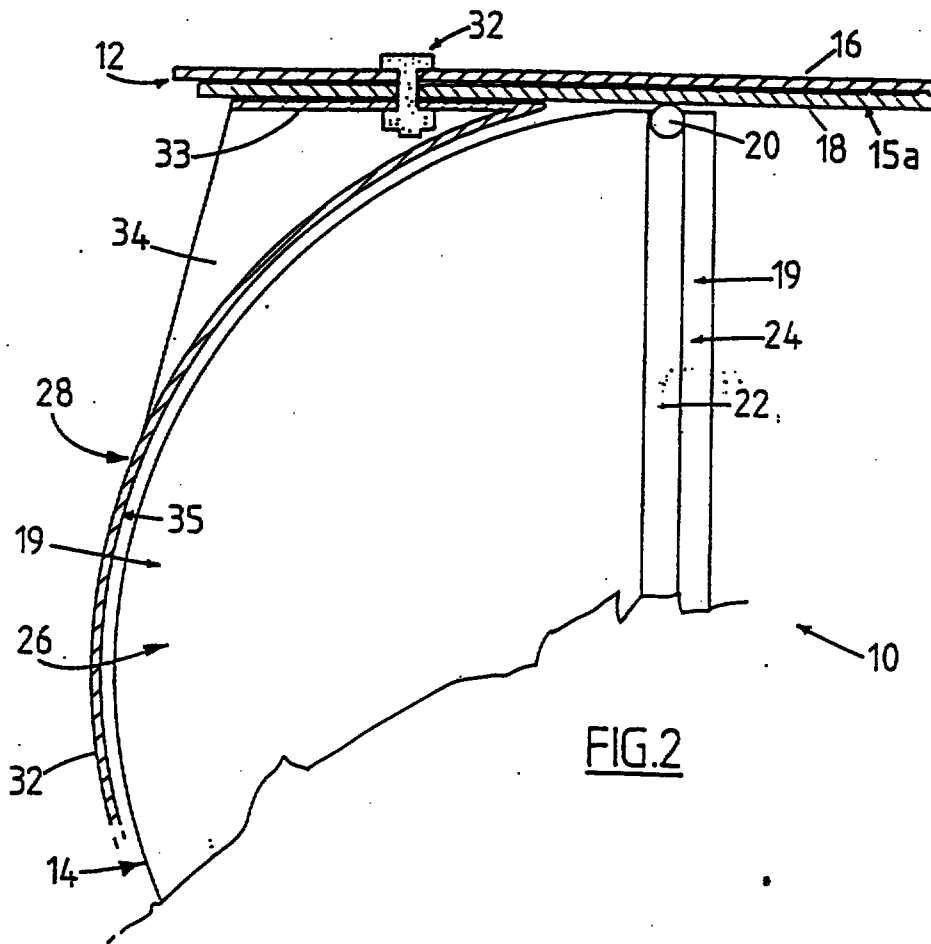


FIG. 2

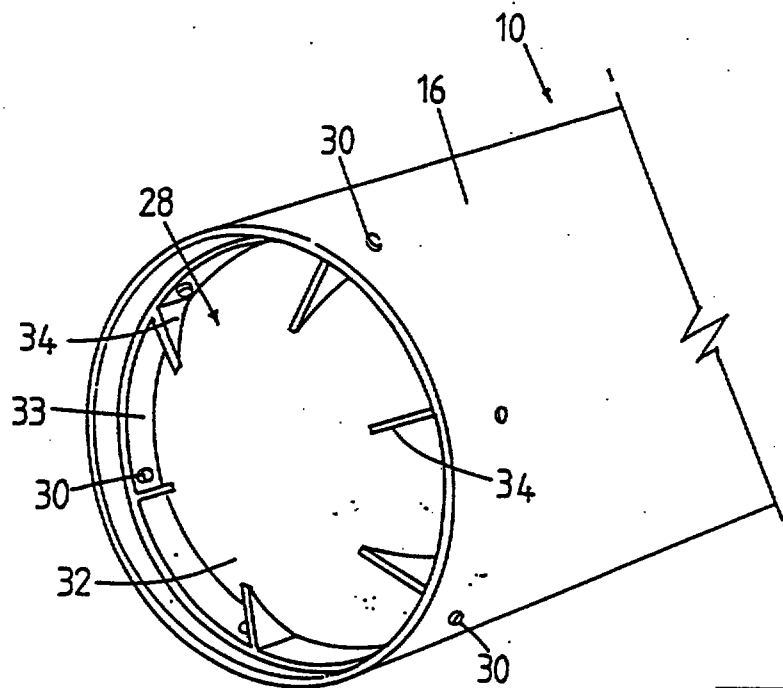


FIG. 3

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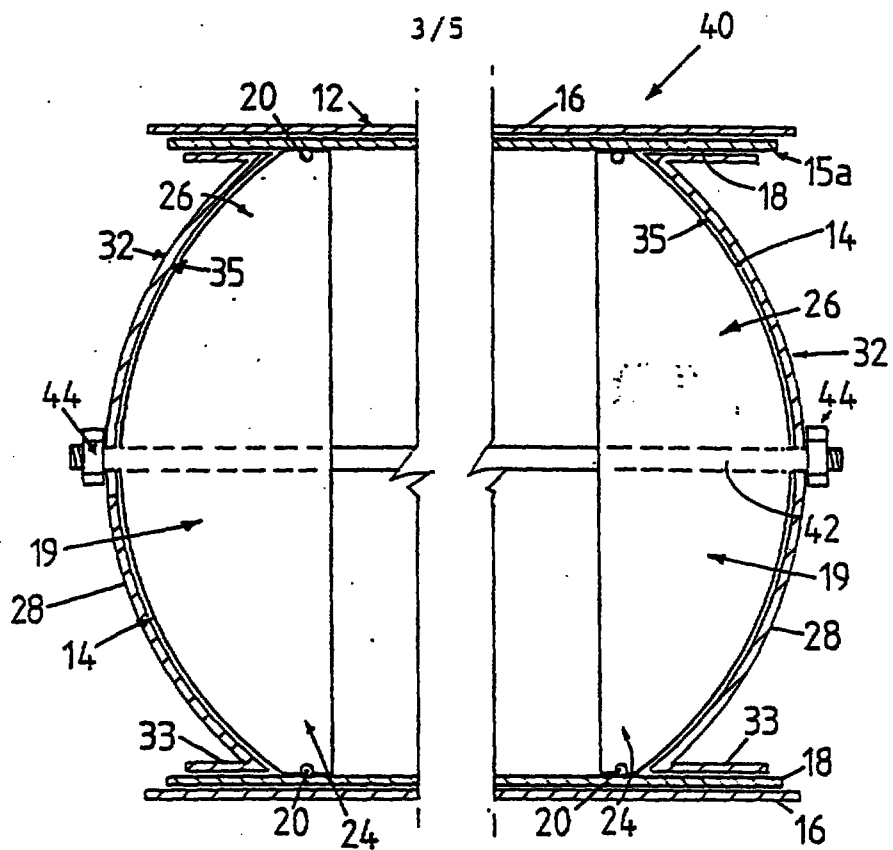


FIG. 5

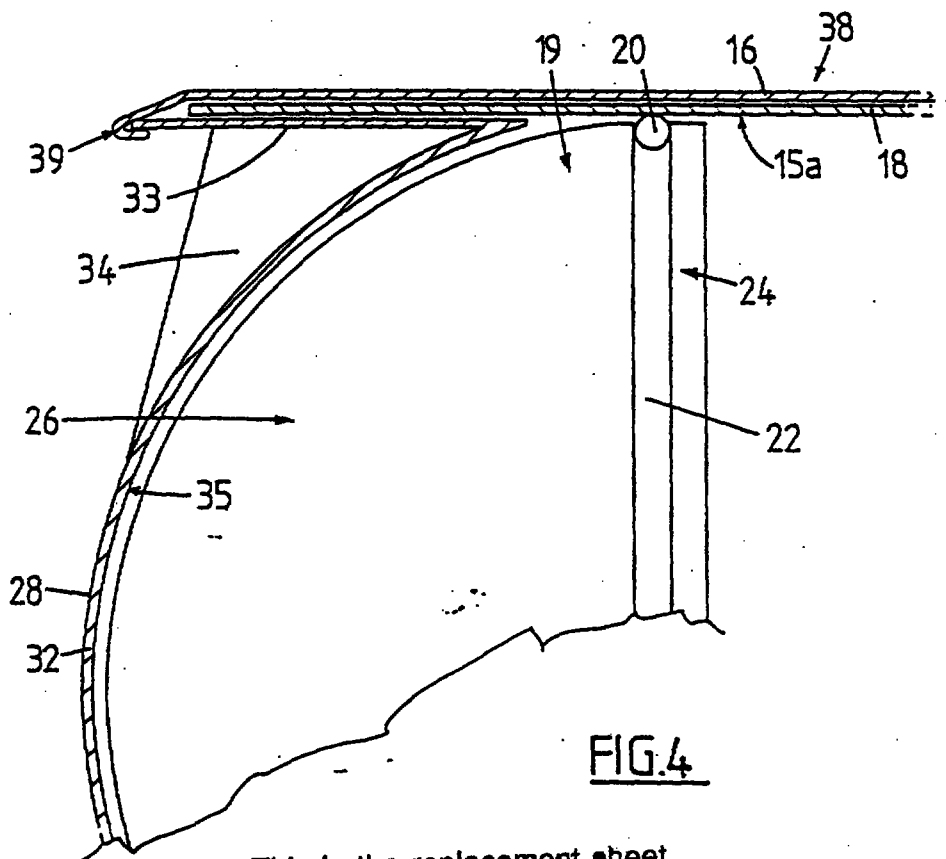


FIG. 4

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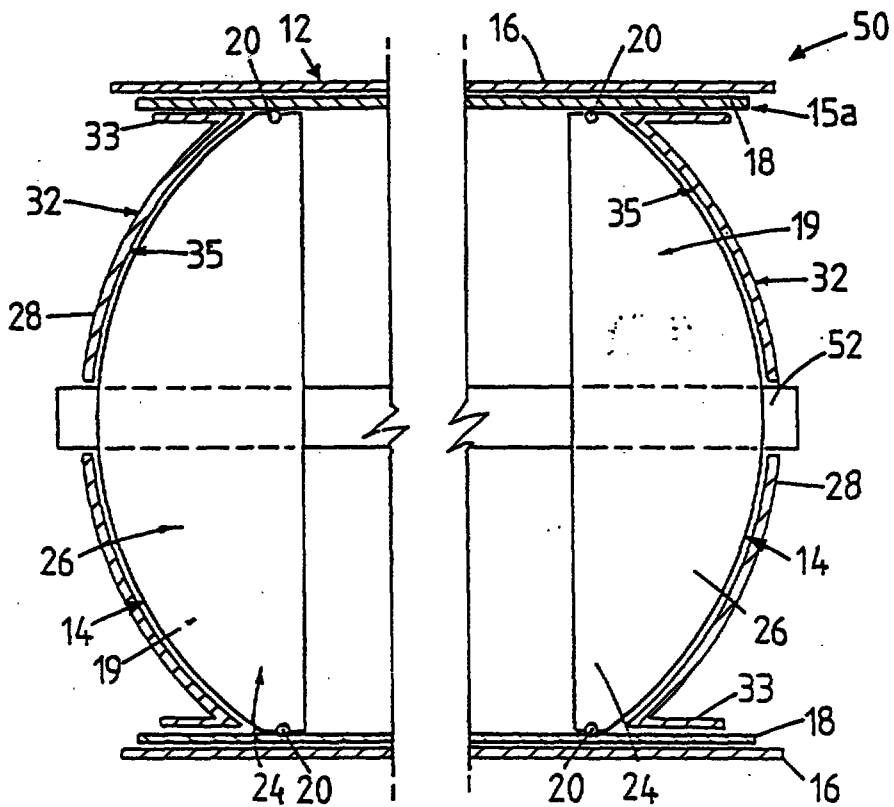


FIG. 6.

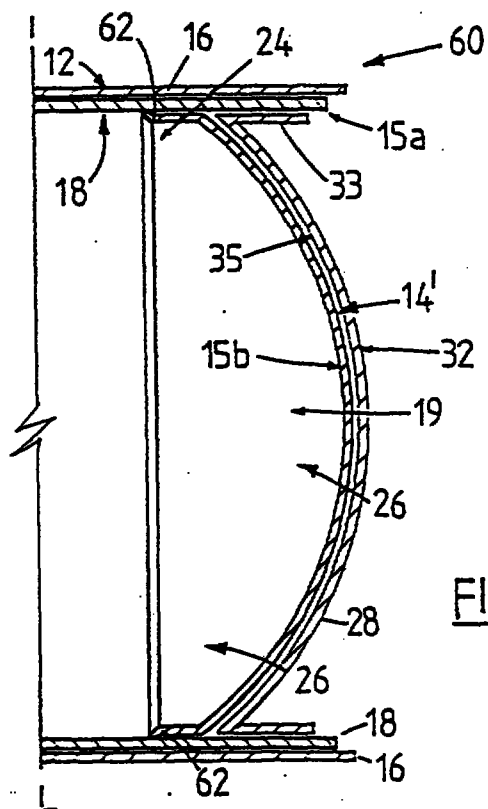


FIG.7

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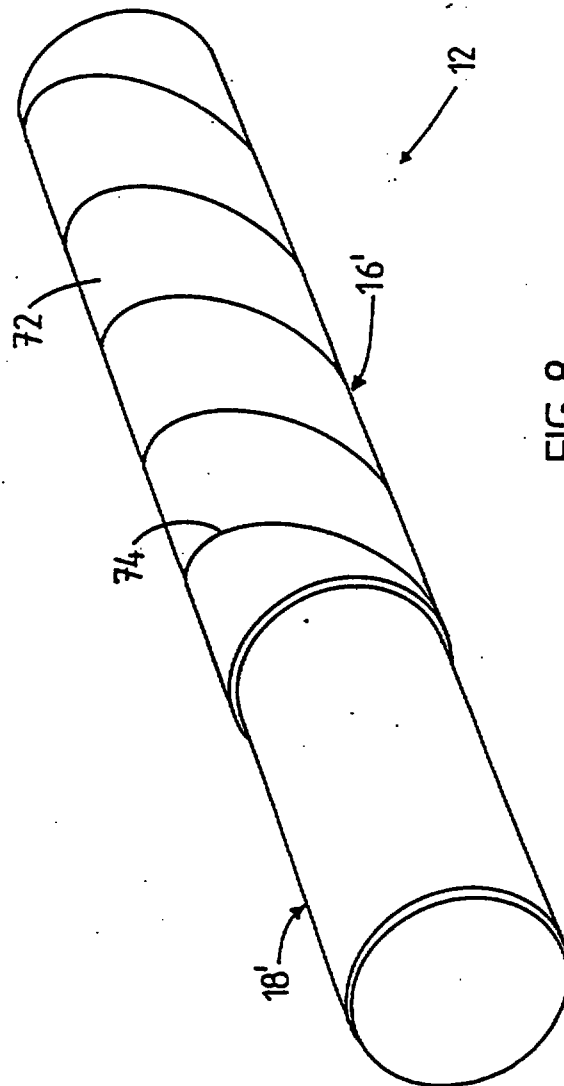


FIG. 8

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TITLE

"FLUID STORAGE TANK"

DESCRIPTION

The present invention relates to a fluid storage tank. The fluid storage tank is used to store fluid which is under pressure.

The fluid storage tank of the present invention may be used as the hot water storage tank in a hot water system. The hot water system may, for example, be a solar, gas or electric hot water system. The fluid storage tank of the present invention may be used in other applications in which fluid is stored under pressure in a tank or similar container, eg water filters, fire extinguishes, and gas cylinders.

FIELD OF THE INVENTION

Fluid storage tanks used to store fluid under pressure may deteriorate over time.

In fluid storage tanks used in hot water systems, deterioration generally occurs to the lining inside such tanks which is in contact with the fluid stored in the tank. However, due to the structure of conventional tanks when this deterioration occurs to the lining, the entire tank must be replaced.

In contrast the present invention provides a fluid storage tank in which only the liner needs to be replaced if it deteriorates. In this way the fluid storage tank of the present invention is recyclable or renewable.

The present invention provides a fluid storage tank

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REPLACEMENT SHEETS		SG
☒ Description	: paged 1 to paged 15	
☒ Claim(s)	: paged 16 to paged 20	
☒ Drawing(s)	: paged 15 to paged 55	
☒ Abstract	: paged 21 to paged	
DATE OF RECEIPT		28/2/97

which may also be used in other applications in which fluid is stored under pressure to provide a fluid storage tank which is recyclable or renewable.

SUMMARY OF THE PRESENT INVENTION

In accordance with one aspect of the present invention there is provided a fluid storage tank characterized in that it comprises a main body having at least one opening, cover means to close off said opening of said main body, and seal means, said cover means and said main body having a respective inside surface arranged to be, in use, in contact with fluid stored in said fluid storage tank, said main body comprising casing means and liner means, said liner means provided inside said casing means, wherein said cover means is releasably retained in place and seals with said inside surface of said main body via said seal means such that said fluid is storable in said fluid storage tank.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a partly cross-sectional elevation view of a first embodiment of a fluid storage tank in accordance with the present invention;

Figure 2 is a partly cross-sectional elevation view of the cover region of the fluid storage tank shown in Figure 1;

Figure 3 is a perspective view of the outside of the cover region of the fluid storage tank shown in Figure 1;

Figure 4 is a partly cross-sectional elevation view of the cover region of a second embodiment of a fluid

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storage tank in accordance with the present invention;

Figure 5 is a partly cross-sectional elevation view of a third embodiment of a fluid storage tank in accordance with the present invention;

Figure 6 is a partly cross-sectional elevation view of a fourth embodiment of a fluid storage tank in accordance with the present invention;

Figure 7 is a cross-sectional elevation view of the cover region of a fifth embodiment of a fluid storage tank in accordance with the present invention; and,

Figure 8 shows a particular embodiment of the casing and liner of a fluid storage tank in accordance with the present invention.

DESCRIPTION OF THE INVENTION

Figures 1 to 8 and the description of the preferred embodiments use the same reference numerals to denote the same parts. The description of such parts is not repeated for subsequent embodiments, but it is to be understood that it applies in like manner to such subsequent embodiments.

In Figure 1 there is shown a fluid storage tank 10 comprising a main body 12 and covers 14 to close off respective openings of the main body 12. The openings are located at respective ends of the main body 12. The main body 12 has an inside surface 15a. The covers 14 each have an inside surface 15b. (The inside surfaces 15b of the covers 14 cannot be seen in Figures 1 to 3 of the first embodiment of the fluid storage tank 10 since the covers 14 are not shown in cross-section in those

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Figures. However, the inside surface 15b of a cover 14' of the fifth embodiment of the fluid storage tank 60 can be seen in Figure 7). The inside surfaces 15a and 15b are, in use, in contact with the fluid stored in the fluid storage tank 10.

The covers 14 seal with the inside surface 15a of the main body 12.

The main body 12 is substantially tubular.

The main body 12 comprises a casing 16 and a liner 18.

The liner 18 is provided inside the casing 16. The liner 18 is provided adjacent the inside surface of the casing 16. The liner 18 substantially conforms to the inside surface of the casing 16.

Each cover 14 is provided with a seal at its outside surface 19. This seal may be in the form of an O-ring 20 which is positioned in a groove 22 provided on the outside surface 19 of each cover 14. The O-ring seals 20 of the covers 14 seal with the inside surface 15a of the main body 12.

The O-ring seals 20 and grooves 22 are provided on respective portions 24 of the covers 14 which lie adjacent the inside surface 15a of the main body 12.

Preferably, the liner 18 extends sufficiently far to the openings of the main body 12 that the O-ring seals 20 of the covers 14 seal with the liner 18. In this case the inside surface 15a of the main body 12 is defined by the inside surface of the liner 18. This is shown in Figure 2. Whilst the covers 14 could seal with the casing 16 instead (in which case the inside surface 15a of the

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main body 12 is defined by the inside surface of the casing 16) this arrangement is not preferred.

Each cover 14 comprises a portion 24 and a dome like portion 26. The portion 24 is drum like, or tubular. Retaining means is provided to retain each cover 14 releasably in position to close off the respective openings of the main body 12.

The retaining means enable the covers 14 to be releasably retained in position without connecting the covers 14 to the main body 12.. The only "interaction" between the main body 12 and the covers 14 is the sealing contact between the O-ring seals 20 and the portions 24 of the covers 14 with the inside surface 15a of the main body 12. This is a pressure induced sealing contact as will be later herein described.

The retaining means is shown in more detail in Figures 2 and 3.

In Figures 2 and 3, the retaining means is shown as comprising respective cover retention members 28 which are fixedly secured to the main body 12 at respective ends thereof adjacent the covers 14. The cover retention members 28 are fixedly secured to the main body 12 by nuts and bolts shown at 30.

Each cover retention member 28 comprises a plate like portion 32, a peripheral strip like portion 33 and strengthening ribs 34. At least the inside surface 35 of the plate like portion 32 is shaped to conform to the shape of the outer surface 19 of the dome like portion 26 of a cover 14. The plate like portion 32 may itself

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be dome like. The peripheral strip like portion 33 extends around the periphery of the plate like portion 32 and projects therefrom away from cover 14. The strip like portion 33 conforms with the shape of the inner surface 15a of the main body 12. The strengthening ribs 34 extend between the plate like portion 32 and the peripheral strip like portion 33, at spaced intervals, as best seen in Figure 3. The bolts 30 pass through the strip like portions 33 and the main body 12 to secure the cover retention members 28 to the main body 12. In Figure 2 a gap is shown between the outside surface 19 of the dome like portion 26 of the cover 14 and the inside surface 35 of the plate like portion 32. However, this is only for clarity of representation. In practice, no such gap would exist.

Figure 4 shows a second embodiment of a fluid storage tank 38 in accordance with the present invention.

The fluid storage tank 38 is the same as the fluid storage tank 10 of the first embodiment except that it employs an alternative arrangement for securing the cover retention members 28 to the main body 12.

In the fluid storage tank 38, the nuts and bolts 30 are not used. Instead, the end portions of the casing 16 are turned over the edges of the strip like portions 33 of the cover retention members 28 to form a turned lip 39. The cover retention members 28 are in this way fixedly secured to the casing 16 of the main body 12 by a clamping type action of the turned lip 39.

The remainder of the fluid storage tank 38 is the same

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as the fluid storage tank 10.

Figure 5 shows a third embodiment of a fluid storage tank 40 in accordance with the present invention.

The fluid storage tank 40 is similar to the fluid storage tank 10 of the first embodiment except that it employs a different arrangement of the retaining means to retain the covers 14 in position.

In the fluid storage tank 40, the retaining means comprises the cover retention members 28 of the fluid storage tank 10, but these are not secured to the main body 12.

Instead, there is provided an elongate bolt 42 which extends through the main body portion 12 between the covers 14. The covers 14 and cover retention members 28 are provided with appropriate holes for the bolt 42 to pass therethrough and nuts 44 are provided outside the tank 40 to keep the bolt 42 in position. The bolts 44 are provided on the outside of each pair of covers 14 and cover retention members 28.

The remainder of the fluid storage tank 40 is the same as the fluid storage tank 10.

Figure 6 shows a fourth embodiment of a fluid storage tank 50 in accordance with the present invention.

The fluid storage tank 50 is similar to the fluid storage tank 10, except that it employs a different arrangement of the retaining means to retain the covers 14 in position.

Once again, the retaining means comprises the cover retention members 28 of the fluid storage tank 10, but

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these are not secured to the main body 12.

The fluid storage tank 50 is provided with a flue-way 52 extending through the main body 12 between the covers 14. Securing means (not shown) are provided outside the fluid storage tank 50 adjacent the cover retention members 28 in a similar manner to the bolts 44 of the fluid storage tank 40.

Thus, the fluid storage tank 50 is of a similar structure to the fluid storage tank 40, except that the bolt 42 of the fluid storage tank 40 is replaced by a flue-way 52 and the bolts 44 are replaced by an alternative, but analogous, form of securing means.

The remainder of the fluid storage tank 60 is the same as the fluid storage tank 10.

Figure 7 shows the cover region of a fifth embodiment of a fluid storage tank 60.

Whilst in Figure 7 only one end of the fluid storage tank 60 is shown, it will be understood that the other end is of a similar form.

The fluid storage tank 60 is similar to the fluid storage tank 10 except that it employs an alternative sealing arrangement of the covers 14' with the inside surface 15a of the main body 12.

The covers 14' of the fluid storage tank 60 do not use the O-ring seal 20 and groove 22 of the covers 14 of the previously described embodiments.

In the fluid storage tank 60, each covers 14' is formed with an outwardly extending sealing flange or lip like portion 62 at the outside surface 19 at the peripheral

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edge of the portion 24. This portion 62 is tapered, as can be seen in Figure 5. The portion 62 seals with the inside surface 15a of the main body 12.

The fluid storage tank 60 may employ retaining means of the same type as any of the fluid storage tanks 10, 38, 40 and 50.

The remainder of the fluid storage tank 60 is the same as the fluid storage tank 10.

In the fluid storage tank of the present invention, the liner 18 may be in the form of a membrane, coating, ceramics material, or a tubular insert which fits into the casing 16.

The liner 18 may be made of material which is non-corrodable since the contents of the fluid storage tank will be in contact with the liner 18. Depending upon the application of the fluid storage tank of the present invention, the liner 18 may need to be made of material which is also high temperature resistant, e.g. when the fluid storage tank is used as the storage tank in a hot water system.

The liner 18 may be made of a plastics polymer. The use of a plastics polymer is particularly suitable when the liner 18 is in the form of a tubular insert.

The covers 14, 14' are also preferably made of a material which is non-corrodable (and high temperature resistant if required) since the contents of the fluid storage tank will also be in contact with the inside surfaces 15b of the covers 14, 14'.

The covers 14, 14' may be made from a plastics material,

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e.g. plastics polymer.

If the covers 14, 14' are not made from a non-corrodable (and high temperature resistant) material, then their inside surfaces 15b are provided with a non-corrodable (and high temperature resistant) coating or lining.

The casing 16 may be made from metal, e.g. steel.

The casing 16 surrounds and encloses the liner 18.

Similarly, the cover retention members 28 retain the covers 14, 14' in position. In this way, the casing 16 and the cover retention members 28 supports the liner 18 and the covers 14, 14', respectively, and carry the structural stress from the fluid stored by the fluid storage tank of the present invention.

The embodiments of the fluid storage tank that have been described herein incorporate retaining means which comprise cover retention members 28 having plate like portions 32 conforming to the shape of the outer surface 19 of the dome like portions 26 of the covers 14, 14'.

It is these plate like portions 32 which carry the structural stress from the fluid pressing against the covers 14, 14'. However, if the covers 14, 14' are made of a material of sufficiently high strength, the cover retention members 28 may be omitted, or modified.

Accordingly, in the embodiments shown in Figures 5 and 6, the cover retention members 28 may, in such cases, be omitted. In the embodiments shown in Figures 1 to 4, the cover retention members 28 may, in such cases, be modified so that the plate like portions 32 are omitted. This then leaves only the strip like portions

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33 which are secured to the casing 16 and which are modified to engage with the covers 14, 14'. In this way, the covers 14, 14' will still be retained in position.

Depending upon its application, appropriate holes (not shown) for fittings and the like (not shown) may be provided in the covers 14, 14' and cover retention members 28. In the case of the fluid storage tank being used in a hot water system, such holes accommodate fittings such as the fluid inlet and outlet pipes. The casing 16 may be formed from a strip material which is wound into a helix structure and has its abutting edges butt-welded together.

A casing of this type is shown in Figure 8 and is identified by reference numeral 16'.

The casing 16' is formed from strip material 72 whose butt-welded helical edges are shown by the helical line 74.

A casing 16' formed in this way is particularly suitable when the fluid storage tank is used for a hot water system. However, it may also be used for other applications of the fluid storage tank.

The use of a casing 16' in the form shown in Figure 8 is particularly suitable when the liner 18 is in the form of a tubular insert. This is also shown in Figure 8.

A liner in the form of a tubular insert is identified in Figure 8 by reference numeral 18'. The liner 18' is fitted into a casing 16' made of strip material 72 and may have an outer diameter that is very slightly greater

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than the inner diameter of the casing 16' such that the liner 18' cannot readily be inserted into the casing 16. This liner 18' is first placed into a freezer to reduce its temperature. The temperature of the liner 18' is reduced sufficiently such that it shrinks in its radial direction, i.e. the diameter of the liner 18' is reduced. This reduction of its diameter needs to be only a few millimetres. Subjecting the liner 18' to a temperature of minus 20°C for approximately 24 hours results in sufficient reduction.

After the appropriate time, the liner 18' is removed from the freezer and is then pushed into the casing 16'. This temperature reduction of the liner 18' also results in the liner 18' being inwardly pre-loaded.

As the liner 18' returns to ambient temperature, it expands. In so doing, the outer surface of the liner 18' tightly bears against the inner surface of the casing 16'.

The casing 16, 16' of the present invention carries the structural stress from the fluid contents inside the fluid storage tank. Even in the case of the liner 18 being in the form of a tubular insert, this is also the case.

The fluid storage tank of the present invention is recyclable or renewable. This means that if defects occur in the liner 18, 18' it can be replaced.

This can be done by draining the contents of the fluid storage tank and releasing the retaining means which retains the covers 14, 14' in position. Depending upon

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the form of the liner 18, 18', the liner 18, 18' can be then removed from the casing 16, 16' and replaced. This is particularly suitably in the case of the liner 18' being in the form of an insert.

If the liner 18 is in the form of a coating, or the like, on the inside surface of the casing 16, 16' then a new coating can be applied or the casing 16, 16' and lining 18 are both removed and replaced as a unit.

In another alternative embodiment, the main body 12 may further comprise a (tubular) sleeve (not shown).

This sleeve is inserted into the casing 16, 16' to lie adjacent the inside surface of the casing 16, 16'. The liner 18, 18' is then provided adjacent the inside surface of the sleeve.

The sleeve can be used with any form of liner 18, 18' and is particularly suitable when the liner 18 is in the form of a coating or the like.

The sleeve may be made of an insulating material, e.g. urethane.

When the liner 18, 18' becomes defective, the sleeve along with the liner 18, 18' may be removed as a unit from the casing 16 and replaced.

Thus, the form of the main body 12 and releasably retained covers 14, 14' (which are not connected to the main body 12) of the fluid storage tank of the present invention allow the fluid storage tank of the present invention to be recyclable or renewable.

Whilst the embodiments of the fluid storage tank of the present invention have been described with reference to

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particular forms of the sealing arrangement (viz. O-ring seals 20 and flange or lip like portions 62), covers 14 and retaining means of any suitable form may be used.

The fluid storage tank of the present invention can be used to store fluid under pressure.

The pressure exerted by the fluid contents of the fluid storage tank of the present invention exerts outwardly directed radial and longitudinal forces on the fluid storage tank.

The longitudinal forces are countered by the retaining means, or covers 14, 14'. The retaining means prevent the covers 14, 14' from moving in the outward direction, i.e. away from one another. At the same time, the radial forces exerted by the contents of the fluid storage tank push the drum like portions 24 of the covers 14, 14' in a radial direction to bear against the inside surface 15a of the main body 12. This pushes the seal means, e.g. the O-ring seals 20 or the sealing flange or lip like portions 62, into closer contact with the inside surface 15a (e.g. the liner 18) of the main body 12 thus providing a stronger seal with increasing pressure of the fluid in the fluid storage tank.

Whilst in the embodiments hereindescribed, the fluid storage tank of the embodiments is shown as having a pair of covers 14, 14' which are releasably positioned to cover a respective opening, it is possible that only one of the covers 14, 14' is releasably retained and the other cover 14, 14' is fixedly retained at one end, i.e. fixed to the main body 12. This may be done by directly

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connecting the cover 14, 14' to the casing 16, e.g., by a metal strap or by fixedly connecting a securing means of the retaining means to the casing 16.

In the case of the fluid storage tank of the present invention being used in a hot water system, e.g. a solar, gas, or electric hot water system, the fluid storage tank encloses a space which is suitable to contain potable water, e.g. drinking water.

In other applications, the fluid storage tank would store the appropriate fluid, e.g. gas in a gas cylinder application, etc..

Modifications and variations such as would be apparent to a skilled addressee are deemed within the scope of the present invention.

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CLAIMS

1. A fluid storage tank characterized in that it comprises a main body having at least one opening, cover means to close off said opening of said main body, and seal means, said cover means and said main body having a respective inside surface arranged to be, in use, in contact with fluid stored in said fluid storage tank, said main body comprising casing means and liner means, said liner means provided inside said casing means, wherein said cover means is releasably retained in place and seals with said inside surface of said main body via said seal means such that said fluid is storable in said fluid storage tank.

2. A fluid storage tank according to Claim 1, characterised in that said cover means has an outside surface and said seal means is provided substantially at said outside surface.

3. A fluid storage tank according to Claim 2, characterized in that a portion of said outside surface of said cover means lies substantially adjacent said inside surface of said main body and said seal means is provided substantially at said portion of said outside surface of said cover means.

4. A fluid storage tank according to Claim 3, characterized in that said seal means comprises a sealing ring member which is located in a groove formed in said cover means at said portion of said outside surface of said cover means.

5. A fluid storage tank according to Claim 3,

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characterized in that said seal means comprises a sealing flange substantially at a peripheral edge of said portion of said cover means.

6. A fluid storage tank according to any one of Claims 1 to 5, characterized in that retaining means is provided to retain said cover means in place.

7. A fluid storage tank according to Claim 6, characterized in that said retaining means comprises at least one cover retention member and securing means, said cover retention member having at least a first portion and said securing means engaging with said first portion to secure said cover retention member to said main body.

8. A fluid storage tank according to Claim 7, characterized in that said securing means comprises nuts and bolts which extend through said first portion of said cover retention member and said main body.

9. A fluid storage tank according to Claim 7, characterized in that said securing means comprises the end portion of said casing means turned over an edge of said first portion of said cover retention member.

10. A fluid storage tank according to any one of Claims 7 to 9, characterized in that said securing means secures said cover retention member to said casing means of said main body.

11. A fluid storage tank according to any one of claims 7 to 10, characterised in that said first portion of said cover retention member engages with said cover means to retain said cover means in place.

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12. A fluid storage tank according to any one of claims 7 to 10, characterised in that said cover retention member has a second portion which contacts said cover means to retain said cover means in place.

13. A fluid storage tank according to Claim 6, characterized in that said retaining means comprises at least one cover retention member and elongate member means, said cover retention member having a first portion and a second portion, said elongate member means extending through said fluid storage tank said cover means and said second portion of said cover retention member and secured outside said fluid storage tank.

14. A fluid storage tank according to claim 6, characterised in that said retaining means comprises elongate member means extending through said fluid storage tank and said cover means, and secured outside said fluid storage tank.

15. A fluid storage tank according to Claim 13 or 14, characterized in that said elongate member means comprises bolt means which is secured by nut means outside said fluid storage tank.

16. A fluid storage tank according to Claim 13 or 14, characterised in that said elongate member means comprises flue-way means which is secured outside said fluid storage tank.

17. A fluid storage tank according to any one of Claims 7 to 13, 15 or 16, characterised in that said first portion of said cover retention member comprises strip material.

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18. A fluid storage tank according to claim 12, characterised in that said second portion comprises a plate portion which has an inside surface shaped to conform with said cover means.

19. A fluid storage tank according to any one of Claims 1 to 18, characterized in that said main body further comprises a sleeve positioned adjacent said casing means, and said liner means is provided adjacent said sleeve.

20. A fluid storage tank according to any one of Claims 1 to 18, characterized in that said liner means is provided adjacent said casing means.

21. A fluid storage tank according to any one of Claims 1 to 20, characterized in that said liner means comprises a membrane, coating, ceramics material, or a tubular insert.

22. A fluid storage tank according to any one of Claims 1 to 21, characterized in that said main body comprises two openings, one at each end thereof and a said cover means is provided at a respective said end.

23. A fluid storage tank according to any one of Claims 1 to 22, characterized in that said casing means is made of metal and said inside surfaces of said main body and said cover means are made of non-corrodable material.

24. A fluid storage tank according to any one of Claims 1 to 23, characterized in that said liner means is made of non-corrodable material.

25. A fluid storage tank according to any one of claims 1 to 24, characterised in that said casing means

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comprises strip material wound into a helix with its
abutting edges connected.

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THIS SHEET HAS BEEN
REPLACED

ABSTRACT

"Fluid Storage Tank".

A fluid storage tank (38) comprising a main body (12) and covers (14) to close off openings of the main body (12). The main body (12) and covers (14) have inside surfaces (15a, 15b) which are, in use, in contact with fluid stored in the tank (38). The main body (12) is made up of a casing (16) and a liner (18) which is provided inside the casing (16). The covers (14) are releasably retained in place and seal with the inside surface (15a) of the main body (12) so that fluid can be stored in the tank (10).

FIGURE 2

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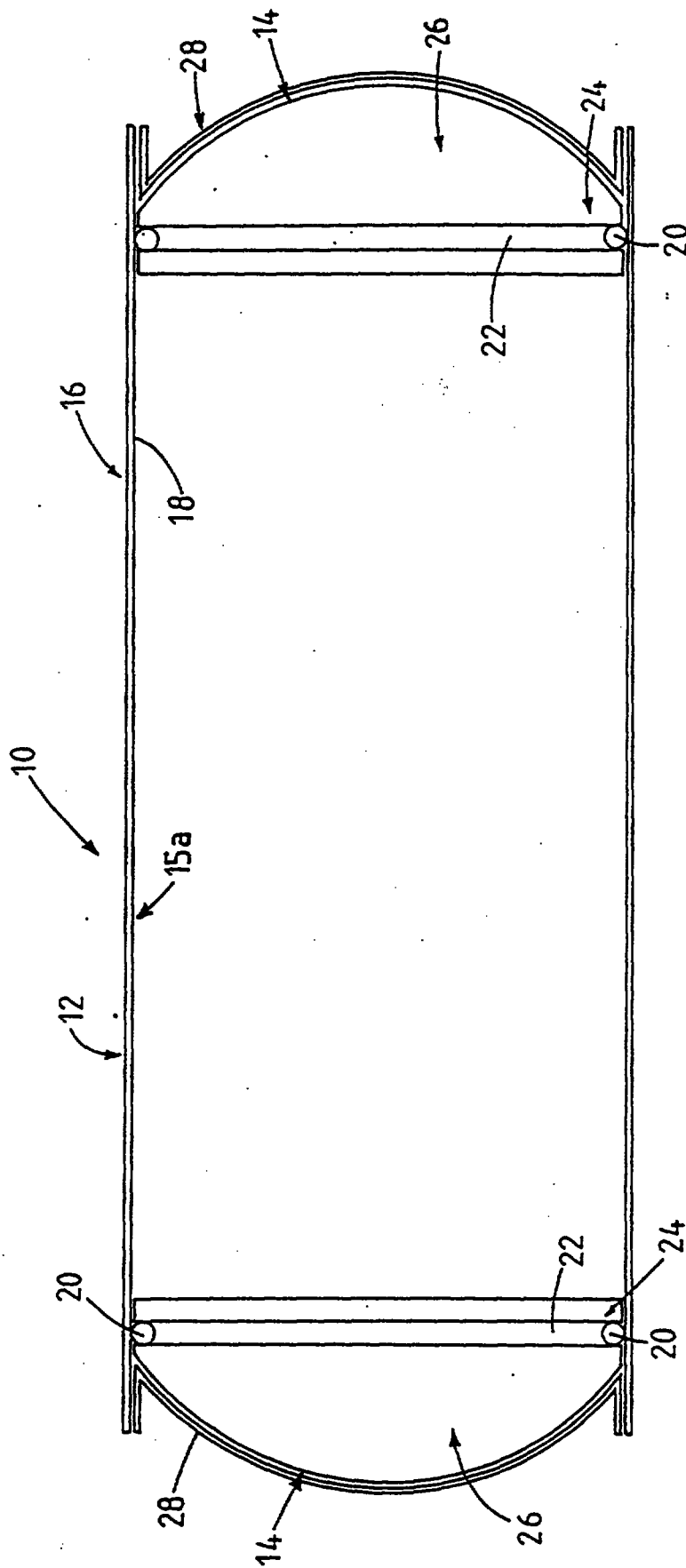
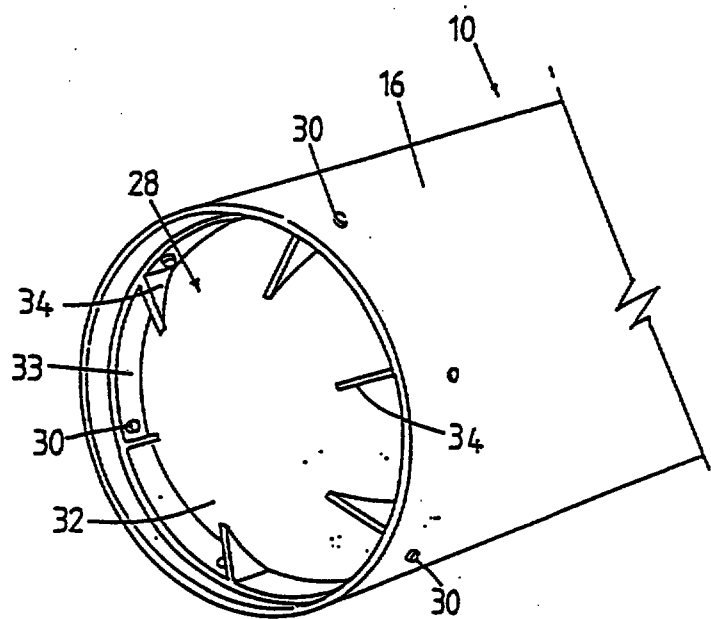


FIG. 1

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FIG.2



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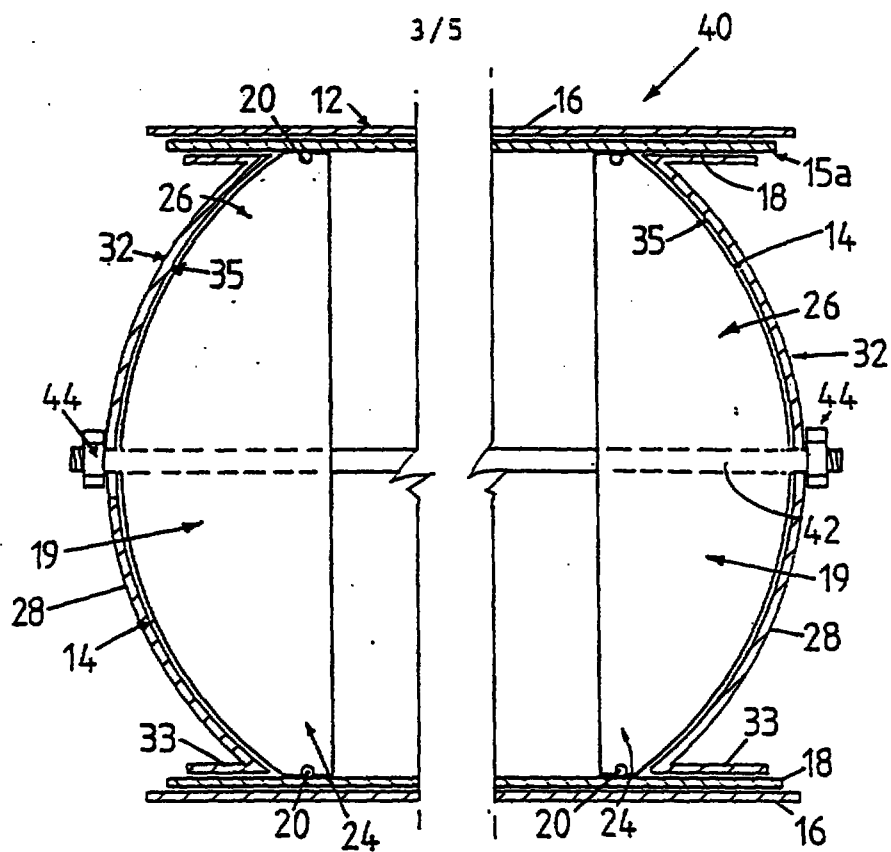


FIG. 5

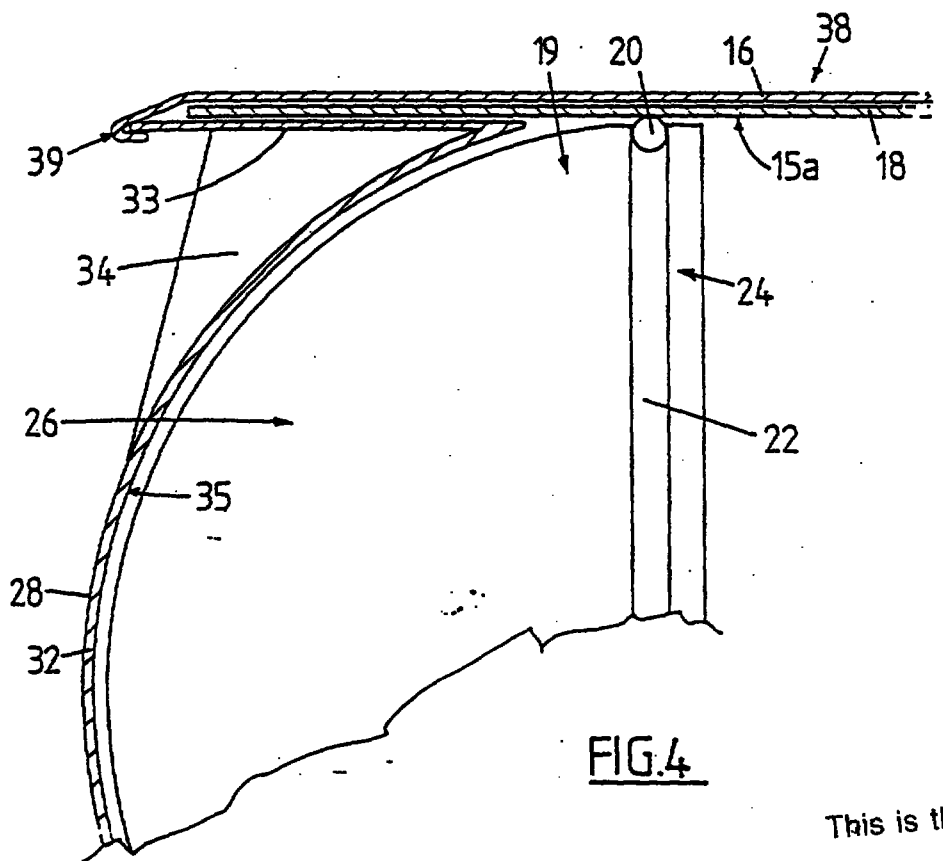


FIG. 4

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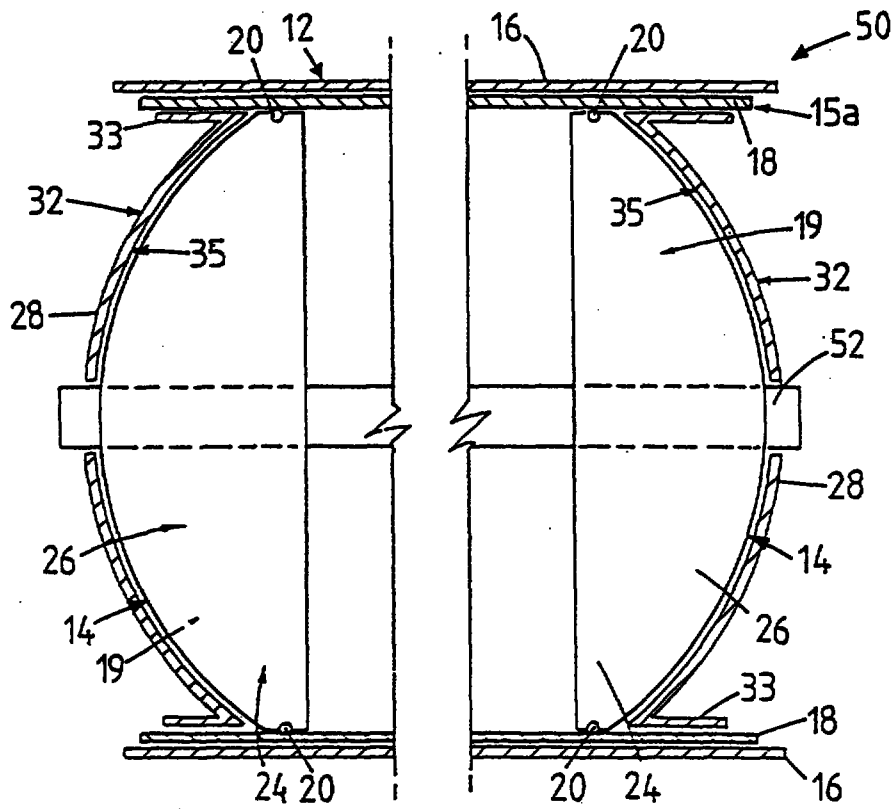


FIG. 6

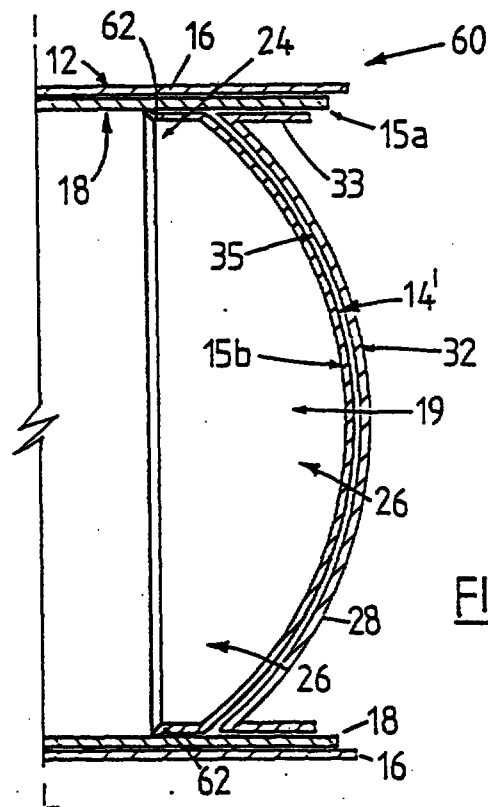


FIG. 7

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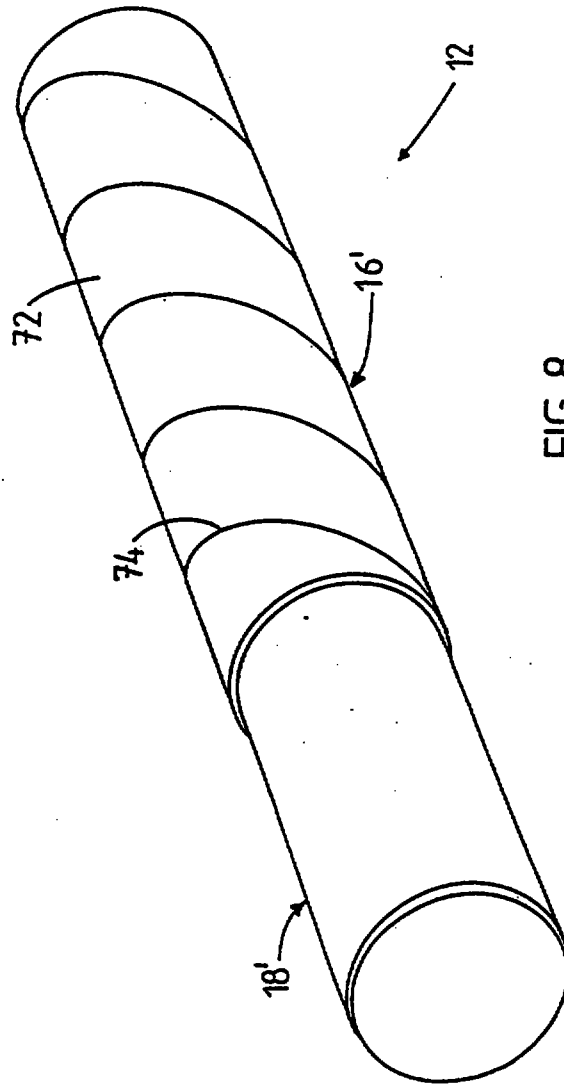
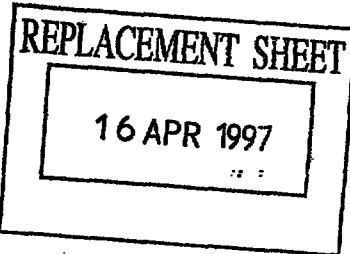


FIG. 8

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**ABSTRACT****FLUID STORAGE TANK**

A fluid storage tank (38) comprising a main body (12) and covers (14) to close off openings of the main body (12). The main body (12) and covers (14) have inside surfaces (15a, 15b) which are, in use, in contact with fluid stored in the tank (38). The main body (12) is made up of a casing (16) and a liner (18) which is provided inside the casing (16). The covers (14) are releasably retained in place and seal with the inside surface (15a) of the main body (12) so that fluid can be stored in the tank (10).

FIGURE 2