United States Patent

Thillet

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[45] **Sept. 26, 1972**

[54] **RECEPTACLE DESIGNED TO WITHSTAND AN INTERNAL PRESSURE**

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[52] **U.S. Cl.** **220/3,** 220/46

[51] **Int. Cl.** **B65d 53/02**

[58] **Field of Search** 220/3, 46

[56] **References Cited**

UNITED STATES PATENTS

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Primary Examiner—Allen N. Knowles
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Attorney—Cameron, Kerkam & Sutton

[57] **ABSTRACT**

A receptacle for withstanding internal pressure and including a barrel, tie bars outside the barrel, end-plates for the barrel secured by the tie bars and external hoops restraining the tie bars against radial outward displacement.

8 Claims, 5 Drawing Figures

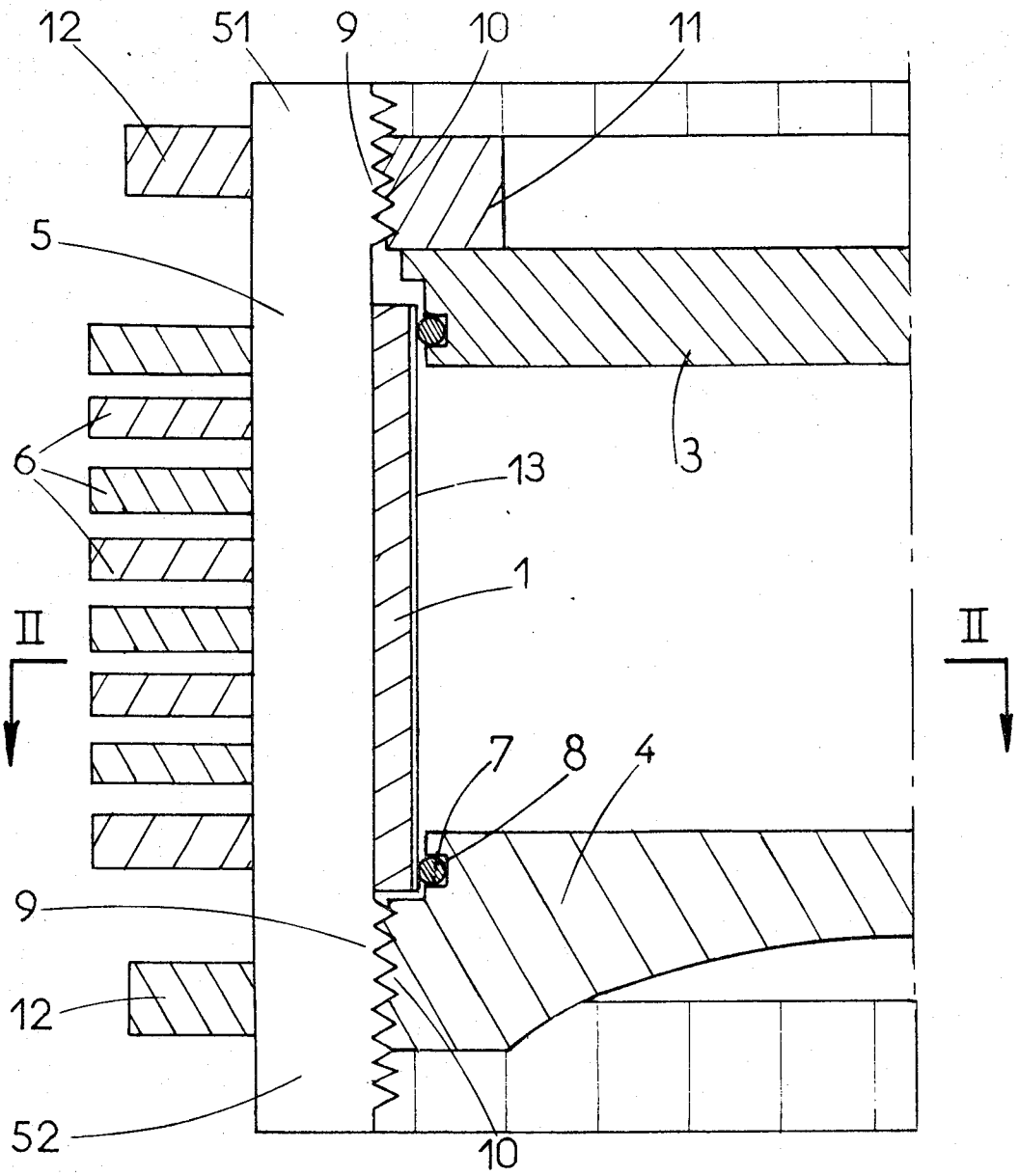


FIG. 2

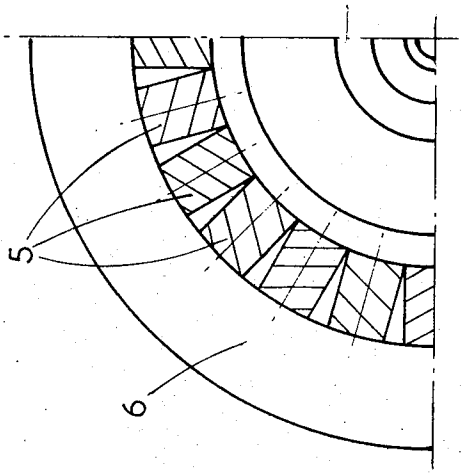


FIG. 1

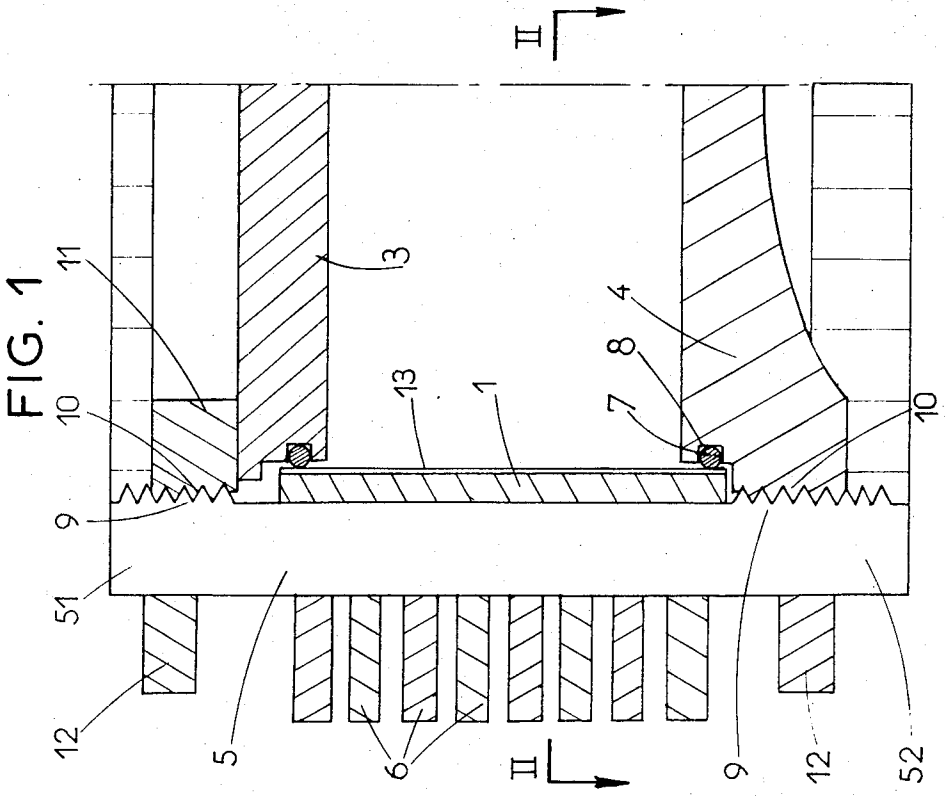


FIG. 4

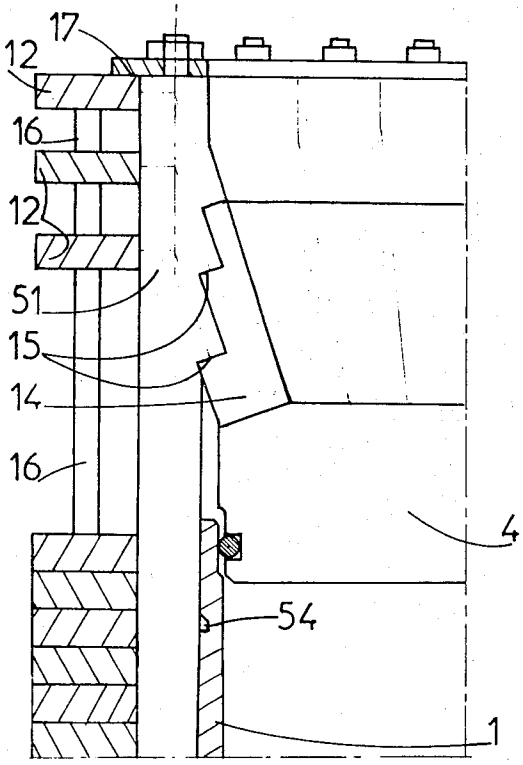


FIG. 5

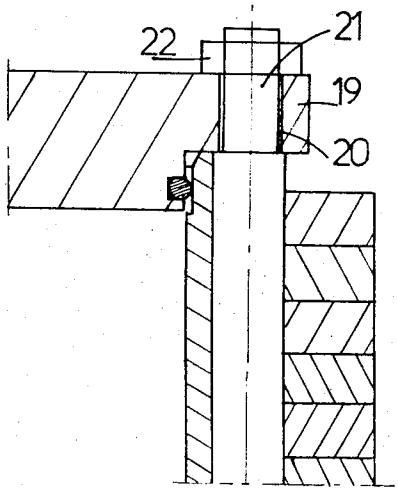
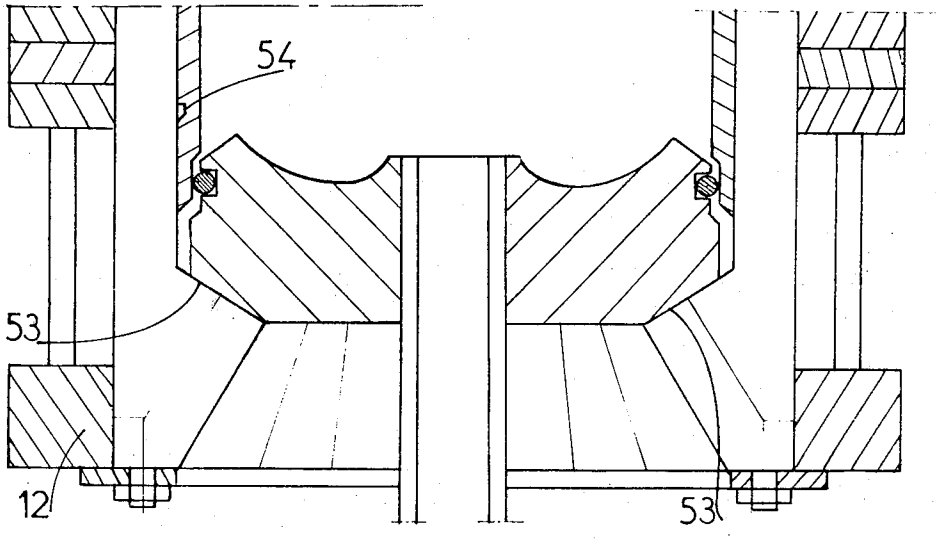


FIG. 3



RECEPTACLE DESIGNED TO WITHSTAND AN INTERNAL PRESSURE

The invention relates to a receptacle designed to withstand an internal pressure. More particularly, it relates to large receptacles, particularly where these are highly elongated.

Large receptacles subject to high pressures must have very thick walls, for which it is hard to obtain the required qualities. In particular, very thick steel walls are very difficult to weld. As a result, most receptacles of this type have multiple walls, possibly adjacent to one another and possibly pre-stressed by one method or another.

When the receptacles are large, heat treatment, machining, handling and transport also present very difficult problems. Lastly, where the making of a plant with a very large opening is concerned, restrictions are imposed by forging.

An object of the invention is to provide a receptacle made from elements which can be constructed, treated and transported separately and then assembled on site to form a fluid-tight closed envelope capable of withstanding high pressures, the requirements of fluid-tightness, tightness, resistance to circular stresses and resistance to longitudinal stresses being fulfilled by separate elements.

According to the invention, the receptacle comprises a fluid-tight envelope composed of a cylindrical side wall closed with an end-plate at each end, an assembly of tie bars which are distributed around the side wall, and parallel to its axis, and which are provided at each end with a device for retaining each endplate, and an external belt for reinforcing the side wall.

The invention will now be described with reference to particular embodiments, given by way of example and illustrated in the accompanying drawings.

FIG. 1 is a half-section in elevation of a receptacle embodying the invention;

FIG. 2 is a partial section along a plane II—II in FIG. 1; and

FIG. 3, 4 and 5 represent partial sections through three different embodiments of the invention.

In the embodiment illustrated in FIGS. 1 and 2, the receptacle comprises an envelope made up of a cylindrical side wall 1 closed by two end-plates 3 and 4. Each end-plate is a solid element capable of withstanding the stresses due to the internal pressure.

The side wall 1 is enclosed in a plurality of tie bars 5 which, as FIG. 2 shows, are rectangular in cross-section and are placed edge-to-edge to form a continuous envelope. These tie bars 5 are surrounded by a plurality of hoops 6 forming a reinforcing belt in contact with the tie bars, at the level of the side wall.

Each end-plate can be displaced axially and is provided with a seal to ensure a fluid-tight join between the end-plate and the side wall. This seal may, for example, be a resilient cord 7 placed in a groove 8 in the outer edge of the end-plate.

Each of the ends 51 and 52 has a threaded portion 9. The portions 9 on all the tie bars combine to form a continuous thread co-operating with a corresponding thread 10 on the outer edge of a ring 11, which retains the end-plate. The ring 11 may, of course, be integral with the end-plate, in which case the thread is formed on the outer edge of the end-plate as shown on end-plate 4.

The end 51, 52 of all the tie bars are enclosed in reinforcing hoops 12, placed in contact with the tie bars.

When the receptacle is pressurized, the end-plates 3 and 4 tend to move away from one another, and they support themselves on the retaining rings 11, retained in turn by the tie bars 5. The hoops 12 are carefully sited so that they absorb the stress which the thrust applied to the end-plate produces to push away the ends 51,52 of the tie bars. The tie bars are therefore subject only to tensile stress, and their ends are not subjected to any bending stress.

Similarly, the stresses applied to the side wall 1 are taken up by the hoops 10, so that the central portions of the tie bars are not subject to bending stress.

If the tie bars and hoops are adjacent, no bending stress will be applied to the wall 1 itself. The tie bars could of course be moved away, however, in which case the thickness of the barrel plate forming the wall 1 will be determined according to the local bending stresses.

The wall 1 and end-plates 3,4 may be made from a type of steel which resists corrosion by the fluid contained under operating conditions. This may not be economical, however, for example in the case of a very large elongated reservoir. If not, the side wall and possibly the end-plates can be covered with a corrosion-resistant skin 13, which may also provide a seal along this wall. This skin should cover the bottom of the groove 8 so that no part of the end-plate 3 or 4 is exposed to corrosion (the resilient cord itself being capable of resisting the corrosion).

In the embodiment shown in FIG. 3, the means for locking the end-plate consists of a plurality of projections 53, which are formed on the ends of each tie bar and together form a ring bearing on the end-plate as illustrated for end-plate 3. An external hoop 12 runs round the ends 51 of the tie bars and absorbs the stresses transmitted by the end-plate. This hoop 12 is centered at the level of the point of intersection between the resultant of the forces applied to each projection 53 and the neutral axis of the associated tie bar. For this reason the ends of the tie bars are not subjected to any bending stress.

A variant of this embodiment is shown in FIG. 4.

The outside surface of the end-plate 4 supports itself against a plurality of wedges 14, each associated with one or more tie bars. Each wedge 14 is provided with steps 15 bearing on corresponding projections formed on the ends 51 of the tie bars. The steps therefore form a plurality of rings bearing on the end-plate. The stresses separating the tie bars and transmitted by the steps are absorbed by a plurality of hoops 12, one for each bearing ring, placed at the level of the point of intersection between the line of application of the stress transmitted to each projection and the neutral axis of the associated tie bar. The tie bar, therefore, is subjected only to tensile stresses.

The stepped wedges 14 may, in a known manner, be connected to a handling device capable of causing rapid withdrawal of the wedges for removal of the end-plate 4.

Lugs 54 may be provided on the tie bars in order to hold the barrel plate 1 forming the lateral wall, to prevent any displacement of the barrel plate due to vibrations.

Spacers **16** placed between the hoops make it possible to position the hoops precisely during assembly if they are not placed edge-to-edge.

All the tie bars **5** are fixed together by distributing rings **17**, attached by nuts **18** screwed onto the threaded rods fixed to the ends of the tie bars.

In the embodiment shown in FIG. **5**, each end-plate is extended by a retaining ring **19** containing apertures **20**, through which pass threaded ends **21** or the tie bars. Fixing nuts **22** are screwed onto these ends **21**. The retaining rings **19**, therefore, fulfill the two functions of locking on the end-plates and of preventing stresses other than tensile stresses from being transmitted to the tie bars.

The receptacle just described is therefore formed of separate elements which respectively fulfil the functions of ensuring fluid-tightness, providing circumferential resistance to pressures, and providing longitudinal resistance to the depth effect. The resistance to circumferential stresses is provided by the circular external hoops and possibly partly by the side wall; and the resistance to longitudinal stresses due to the depth effect is provided by the tie bars which are subjected only to tensile stresses, the radial stresses being absorbed by the end hoops.

The invention is not, of course, restricted to the details of the various embodiments which have been described and which may be modified without exceeding the scope of the invention.

The sealing skin may be formed by a chemical coating or a synthetic plastic or metal material applied by spraying or any other method, a metal lining, metal plating, an elastomeric diaphragm, etc.

The hoops which absorb the circumferential stresses may be comprised of rolled rings, cut, welded or twisted, of welded collars or wound cables or strips.

Similarly, the tie bars may be formed of forged, rolled or drawn steel or of cables whose ends are provided with means for locking on the end-plates.

Any equivalent means may be substituted for the seal between the end-plate and the side wall.

As FIG. **3** shows, the ends may be provided with any operating pipe required, for example pressurizing or blow-off pipes, or with fluid-tight connections for electric cables.

A pressure receptacle embodying the invention is therefore formed of elements, each of which has a unit weight relatively small compared with the total weight, so that the receptacle can be transported in the form of separate elements and assembled on site. Each of its relatively small constituent elements can be efficiently monitored, and if one of them is rejected, the cost price of the whole is not greatly affected.

Also, the receptacle can be assembled without welding any of its elements except for the inside side wall, which is relatively thin. Lastly, the tie bars and hoops can be made from high-strength, even non-weldable, steel.

I claim:

1. A receptacle withstanding internal pressure comprising a fluid-tight envelope, a cylindrical sidewall for said envelope, end plates closing said cylindrical sidewall and parallel to the long axis of said sidewall, means at each end of said tie bars for retaining each of said end plates, an external belt reinforcing said sidewall, said belt engaging the outside surfaces of said tie bars at the level of said sidewall, said tie bars having an elongated prismatic shape, inside surfaces for said tie bars bearing against said sidewall, said retaining means including a plurality of locking means engaging the inside surface of each end of each of said tie bars and projections for said locking means bearing on the outside surface of the adjacent one of said end plates and an external hoop supporting the ends of said tie bars at the level of said locking means.

2. A receptacle as claimed in claim **1**, said locking means including wedges bearing on the outside surface of said end-plate and engaging steps on said tie bars.

3. A receptacle as claimed in claim **1**, said locking means including threaded portions on the inside surfaces of the ends of said tie bars receiving corresponding thread on said end-plate.

4. A receptacle as claimed in claim **1**, said side wall being a barrel plate retained between projections on the inside surfaces of said tie bars.

5. A receptacle as claimed in claim **1**, said reinforcing belt including a plurality of hoops spaced along said side wall.

6. A receptacle as claimed in claim **5**, said hoops being separated by spacers.

7. A receptacle as claimed in claim **1**, said end-plate being detachable and a seal between said end-plate and said side wall.

8. A receptacle as claimed in claim **1**, including a distributing ring connected to the ends of said tie bars.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,693,822 Dated September 26, 1972

Inventor(s) Georges Thillet

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

[73] Assignee: B.V.S., Grenoble, France, is omitted; [30] Foreign Application Priority data France No. PV 70,02444, filed January 23, 1970, is omitted; Col. 1, line 42, "Fig." should be--Figs.--.

Signed and sealed this 13th day of March 1973.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents