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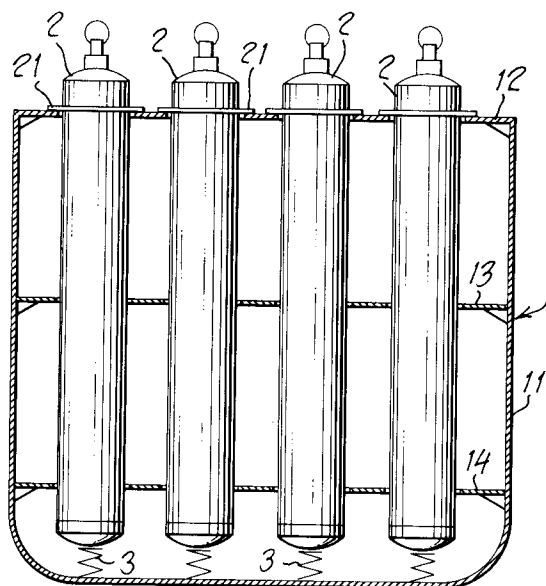
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I-16124 Genova (IT)(54) **Method for transporting cargoes of petroleum by ship and tanks for performing said method.**

(57) Method for transporting by ship materials that are flammable, polluting and highly hazardous to transport, comprising: subdivision of the cargo into a plurality of basically cylindrical tanks (2) of relatively small dimensions; and insertion of said tanks (2), such that their longitudinal axis is vertical, into special housings formed in the decks (12, 13, 14) of a ship (1), said tanks (2) not being fastened to the ship (1) itself in any way.

*Fig. 2***EP 0 611 692 A1**

The present invention relates to maritime transport and in particular to methods for transporting cargoes of liquids that are flammable and potentially polluting, and hence dangerous to transport, such as crude oil and its derivatives.

Crude oil is commonly transported in special ships known as oil tankers, constructed to provide a series of voluminous tanks that can be filled with the fluid in question. Today such ships are the principal means of transporting petroleum, and although widely used they present a whole series of disadvantages.

In the first place, such ships are quite unequipped, should a serious shipping accident or shipwreck occur, to prevent heavy loss of material which will mean financial loss and, more importantly, massive environmental damage. Such accidents as have occurred to date, though fortunately low in number, have nevertheless left an indelible mark on the environment. This is to be attributed to the fact that in reality, such ships do not provide sufficient means to prevent the dispersal of their contents into the sea.

Also to be considered are defects relating to the maintenance of said ships, which is often very difficult because of the enormous size of their tanks; which leads to increased costs and exposes maintenance workers to substantial risks, caused in large part by the presence of gases which are released inside the tanks and stagnate therein.

Besides this, as already noted, the virtual impossibility of recovering oil lost in such accidents must be considered, along with the resulting obvious financial loss and the already mentioned environmental damage.

A variety of solutions have been put forward to solve this kind of problem; for example, that ships be built with twin hulls in order to avert the dangers of accidents. This system has very little bearing on maintenance, however, except for the fact that it provides a limited guarantee - limited because the second hull too may under certain circumstances become damaged, and we are left with the original problem.

To overcome this and other problems, the present invention provides a method for transporting flammable and polluting materials by sea such that safety on these cargo ships is greatly enhanced both in the event of accidents and during ordinary maintenance and loading and unloading operations.

According to the method of the invention, the polluting cargo is subdivided into a plurality of cylindrical tanks of relatively small dimensions, which are inserted vertically into housings consisting of holes passing through the decks of said ships, said tanks not being fastened to the ship itself, in order that in the event of shipwreck said

tanks will not be trapped inside the ship but can be separated from it.

To this end the tanks are provided with air chambers in order that at full load the apparent specific weight is less than that of water, so as to give them buoyancy in water.

Advantageously, these tanks will be installed without fastenings on dampers located at the bottom of the ship.

A further object of the invention is to provide the special tanks for the application of the above method. These tanks consist of long, essentially cylindrical shafts comprising a central chamber for containing the material to be transported and also comprising two compensating chambers, one upper and one lower, full of air to assist floating in the event of an accident and subsequent shipwreck.

In addition said tank is provided with an air piston system for loading and unloading, comprising a piston, fitted inside the central transporting chamber, and means for admitting and discharging air into and from the chamber containing the material to be transported; when the piston is raised, air enters the part of the chamber under the piston, enabling the piston to rise and lift the material contained in said chamber.

More particularly, said means for admitting and discharging air into and from the containing chamber may be formed by the piston rod itself, the said rod being hollow and communicating with the exterior at its top end, which has a plug. When said plug is unscrewed, air will pass into the piston rod and from there into the bottom part of the containing chamber as the piston is raised, operating in the same manner as is described above, and likewise when the air is being discharged.

Moreover, said tank also comprises a system consisting of an expansion vessel for controlling the thermal expansion of the transported material. Said expansion vessel involves the presence inside one of the compensating air chambers, and communicating with the material transporting chamber, of a container made of a flexible material and filled with a gas such as air or nitrogen; whenever the transported material expands under the influence of heat, the gas contained inside the flexible container undergoes compression, thereby preventing excessive pressure build-up in the interior of the tank.

Advantageously, the tank loading and unloading pipe communicating with the material transporting chamber has a safety valve and a shut-off valve for shutting off the expansion chamber during the operation of loading and unloading in order to avoid damage to the flexible membrane.

In addition, the central transporting chamber has a discharge pipe at its bottom end to facilitate cleaning of said central chamber.

Further advantages and features will be clear from the following detailed description of one way of carrying out the present invention: this description, which is not intended restrictively, refers to the appended drawings in which:

Figure 1 is a schematic elevation of a ship which transports materials by the method of the invention;

Figure 2 is a transverse section through the ship shown in Figure 1;

Figure 3 is a longitudinal section through one of the tanks shown in Figure 2; and

Figure 4 is a section taken through the line IV-IV indicated in Figure 3.

Figure 1 shows a ship that carries flammable and/or polluting material by the method of the invention; rising visibly above the sides 11 are the tops of the tanks 2, shown in greater detail in Fig. 2 et seqq. The section drawn in Fig. 2 shows one of the tanks 2 which extend through holes formed in the various decks 12, 13, 14 of the ship 1 and rest on dampers 3 located at the bottom of the hull and not fastened to said tanks 2, while at the top end the tanks are supported by a flange 21. By thus locating the cargo, small quantities of crude or similar material can be held separately from each other; in the event of an accident, therefore, the tanks 2, which are not fastened to the ship's structure, can escape and consequently be recovered since, as will be explained later, they will float.

Said tanks 2 are preferably arranged in the decks of the abovementioned ship 1 in staggered rows, partly so that the ship can be filled better and partly to facilitate a more balanced distribution of the cargo.

In order to guarantee the operation of the method according to the invention, a tank 2 as depicted in Figure 3 must comprise: a materials loading chamber 22, and two chambers 23 and 24 separated from the first by two walls 25 and 26, respectively. Inside the chamber 22 is a piston 5 whose hollow rod 51 passes up the pipe 6 which passes through the chamber 24 and emerges at the top of said tank 2; at this top, the hollow rod 51 terminates in a screw plug 54 and a ring 53 hinged to said hollow rod 51 for purposes which will be explained below.

The bottom chamber 23 rests on the stop piece 31 of the damper 3 via its bottom wall 28 and the pipe 15, whose function will be illustrated below, runs through it. In contrast the top chamber 24 is located over the flange 21 on top of the deck 12 and is formed by the cap 29 which joins the walls of the chamber 22 and the diaphragm 26 at the flange 21, which is clamped by bolts 27. Passing through the chamber 24, as stated above, are the pipe 6 and the hollow rod 51 which slides inside the latter; this pipe is sealed by a seal 61. Further-

more, said chamber has a compartment 240 generated by a C-shaped bulkhead 110 through which passes the pipe 6 referred to above. Also housed inside the compartment 240 is the loading and unloading pipe 7 fitted with closure means 71, with the safety valve 73 and with the manometer 72.

Leading off from the pipe 7 is the take-off pipe 74 which passes through the valve 81 and ends in the pipe 8; this pipe 8 leads out of the C-shaped bulkhead 110 and into the chamber 24. Inside said chamber is a flexible container 10 to which there is connected, through the bulkhead 110, a pipe 9 with a valve 91. The function of this chamber 24, of the container 10 and of the pipes connected to it will be described below.

In Figure 3, the chamber 22, with the piston 5 at the bottom of its down stroke, is full of material to be transported, such as crude oil or derivatives thereof of an equally hazardous nature and environmental impact. When the tank is to be emptied, the ring 53 connected to the rod 51 of the piston 5 is coupled to the hook of a crane (not shown), the plug 54 having first been removed. In this way air passing from the hollow rod 51 into the part of the chamber underneath the piston 5, which latter is sealed by the piston ring 52 or other similar sealing means, allows said piston to rise up the chamber 22, emptying it of its contents, which pass out through the material loading and unloading pipe 7. Said pipe 7 will be connected up in some appropriate way to a collecting system (not shown). In reverse, during filling, the piston will be at the other end of its stroke and the weight of the petroleum introduced via the pipe 7 will cause said piston 5 to descend to the position depicted in Figure 3, driving out the air from under the piston 5 through the hollow rod 51.

The chamber 23 below the chamber 22 has two functions: on the one hand it is a weight compensating chamber, being full of air to enable the tank 2 to float; while on the other, it is a shock absorbing chamber, since the damper 3 acts on its bottom wall 28, and therefore is not in direct contact with the chamber 22 containing the crude oil. The discharge pipe 15 fitted with a valve 151 also passes through this chamber.

The top chamber 24, defined at its top and around its exterior by the metal cap 29 and at its bottom by the diaphragm 26 and internally by the C-shaped bulkhead 110 has a similar weight compensating function to enable the tank 2 to float. Moreover it contains a device, of the type known as an expansion vessel, which prevents damage caused by thermal expansion of the material contained in the chamber 22. This device, whose components have already been illustrated, works as follows (cf Figure 4): when the material contained within the chamber 22 expands under the effect of heat, it

risks up the pipe 7 located inside the compartment 240 but finds it to be closed by the closure means 71. At this point the material can only pass along the take-off pipe 74 which leads away from the pipe 7 to the pipe 8 communicating with the chamber 24 through the bulkhead 110, the valve 81 being open to allow it to pass through. Inside said chamber is a deformable container 10 containing a gas such as nitrogen or air, fed into said container 10 through the feed pipe 9, which is also inside the compartment 240 and has closure means 91. Because the liquid is incompressible while the gas is compressible, the increased pressure of the crude oil is transferred to the gas contained inside the deformable container 10. By this means a dangerous build-up of pressure inside the materials transporting chamber 22 is avoided.

For safety's sake, the tank 22 is fitted with a safety valve 73 on the line of the loading and unloading pipe 7 in order to avert emergencies more serious than those described in relation to the device whose operation was dealt with above.

Advantageously, the chamber 22 can be washed, once it has been emptied, by making use of the hollow piston rod 51, the discharge pipe 15 and the loading and unloading pipe 7, as well as the action of the piston itself, giving an efficient cleaning and degassing action that greatly simplifies the job of the operators and minimizes the risks associated with this operation.

To conclude, the method according to the present invention enables polluting and flammable materials such as petroleum or its derivatives to be transported safely, both from the point of view of the operators on board the ship and, more especially, from the point of view of damage that would be caused to the environment in the event of accident or shipwreck, inasmuch as the tanks described above according to the method of the invention are capable of floating and are also capable, since they are not fastened down, of escaping from their housings in the decks of the aforesaid ship: they require no pump rooms for loading and unloading operations, but simply motorized cranes.

To summarize, the advantages of the method according to the invention are as follows:

1. The contents of the tanks are made practically unsinkable and consequently recoverable, even in the event of the tanker ship's being rammed and then sunk.
2. A system is provided such that present-day tanker ships can be adapted to the new system of transport.
3. Payload capacity unchanged.
4. Maintenance of ship reduced by some 90%.
5. Gas pockets fully eliminated.
6. Pump room eliminated.

7. Loading and unloading times reduced by a factor of between 2 and 10.

8. Although reference has been made in the course of the description to the use of cranes for lifting or lowering the pistons 5, the same operation can be effected by injecting compressed air through the piston rods 51 in order to bring about the lifting.

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Claims

1. Method for transporting by ship fluid materials that are flammable, polluting and highly hazardous to transport, characterized by the fact of comprising the steps of: subdividing the fluid cargo into a plurality of cylindrical tanks (2) of comparatively small dimensions; forming a plurality of housings in the deck (12, 13, 14) of a ship (1) for individually accommodating said tanks (2), and inserting said tanks (2) into said housing in the number of one tank (2) for each housing with their longitudinal axis oriented vertically.
2. Method according to claim 1, in which said tanks (2) are inserted onto the decks (12, 13, 14) of the ship (1) in staggered rows.
3. Method according to Claims 1 and 2, in which said tanks (2) rest on dampers (3) located in the bottom of the ship (1).
4. A tank for performing the method of claims 1 to 3, characterized by the fact that it comprises a long, cylindrical metal drum having a central chamber (22) for containing the fluid material to be transported and at least one second chamber (24; 23) full of air or other gas, the said second chamber or chambers (24, 23) having a volume such as to render the fully laden tank buoyant.
5. Tank according to claim 4, further comprising an air piston system for loading and unloading said tank, said air piston system consisting of a piston (5) fitted inside the central transporting chamber (22), and of means for admitting and discharging air into and from the transporting chamber (22).
6. Tank according to Claims 4 and 5, in which said means for admitting and discharging air are two valves, one for admission and one for discharging, located on the bottom wall (25) of the chamber (22) containing the material to be transported.

7. Tank according to claims 4 and 5, in which said means for admitting and discharging air are the rod (51) of the piston (5), said piston rod (51) being hollow and open at its top end which emerges outside the pipe (6). 5
8. Tank according to claims 4 to 7, comprising a system for controlling the thermal expansion of the transported material in the form of an expansion vessel comprising a first chamber (24) 10 communicating with the underlying transported fluid containing chamber (22), and a container (10) made of deformable material and filled with a gas such as air or nitrogen. 15
9. Tank according to claims 4 to 8, in which the pipe (7) through which the material being transported is unloaded and loaded is provided with a safety valve (73). 20
10. Tank according to claims 4 to 9, in which said chamber (22) containing the material to be transported is provided at its bottom (25) with a discharge pipe (15) communicating with the exterior through a closure valve. 25

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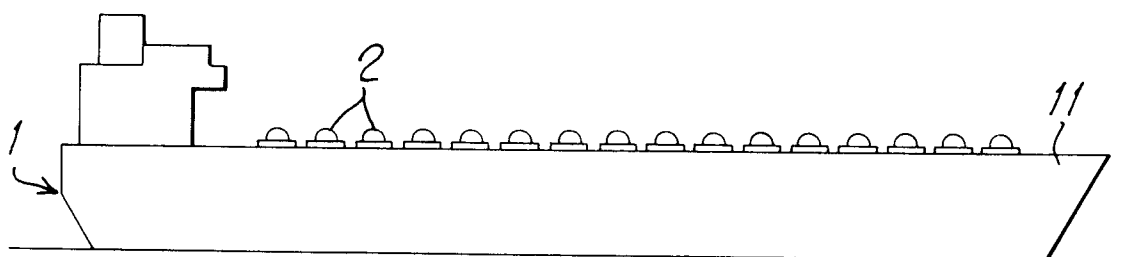


Fig. 1

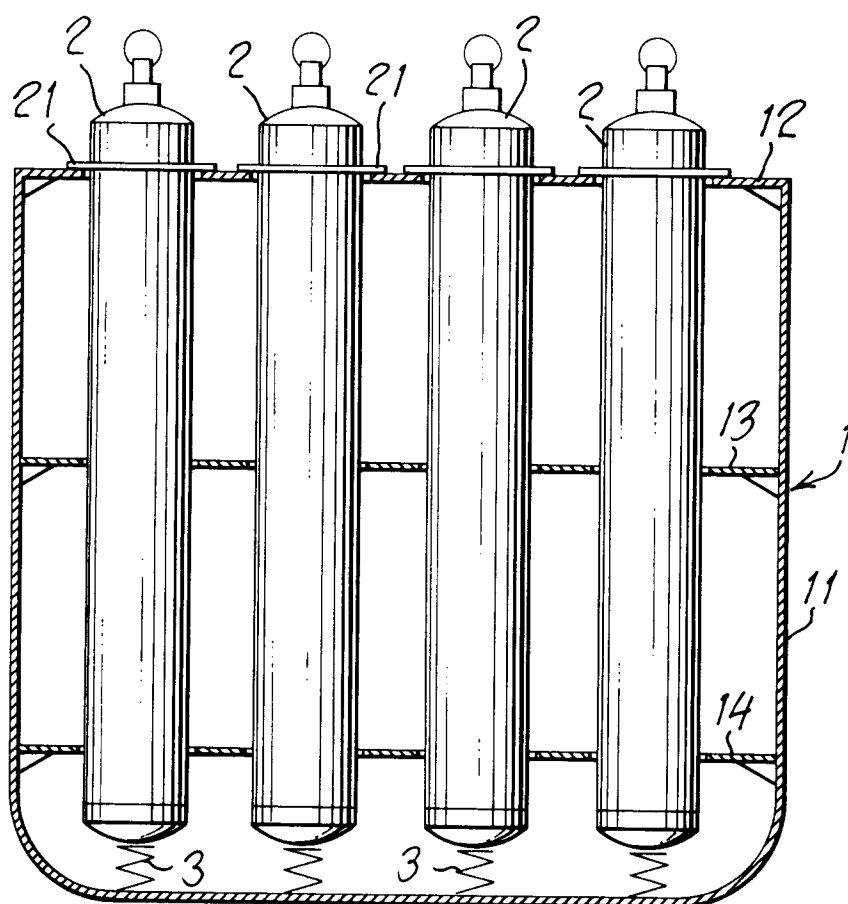
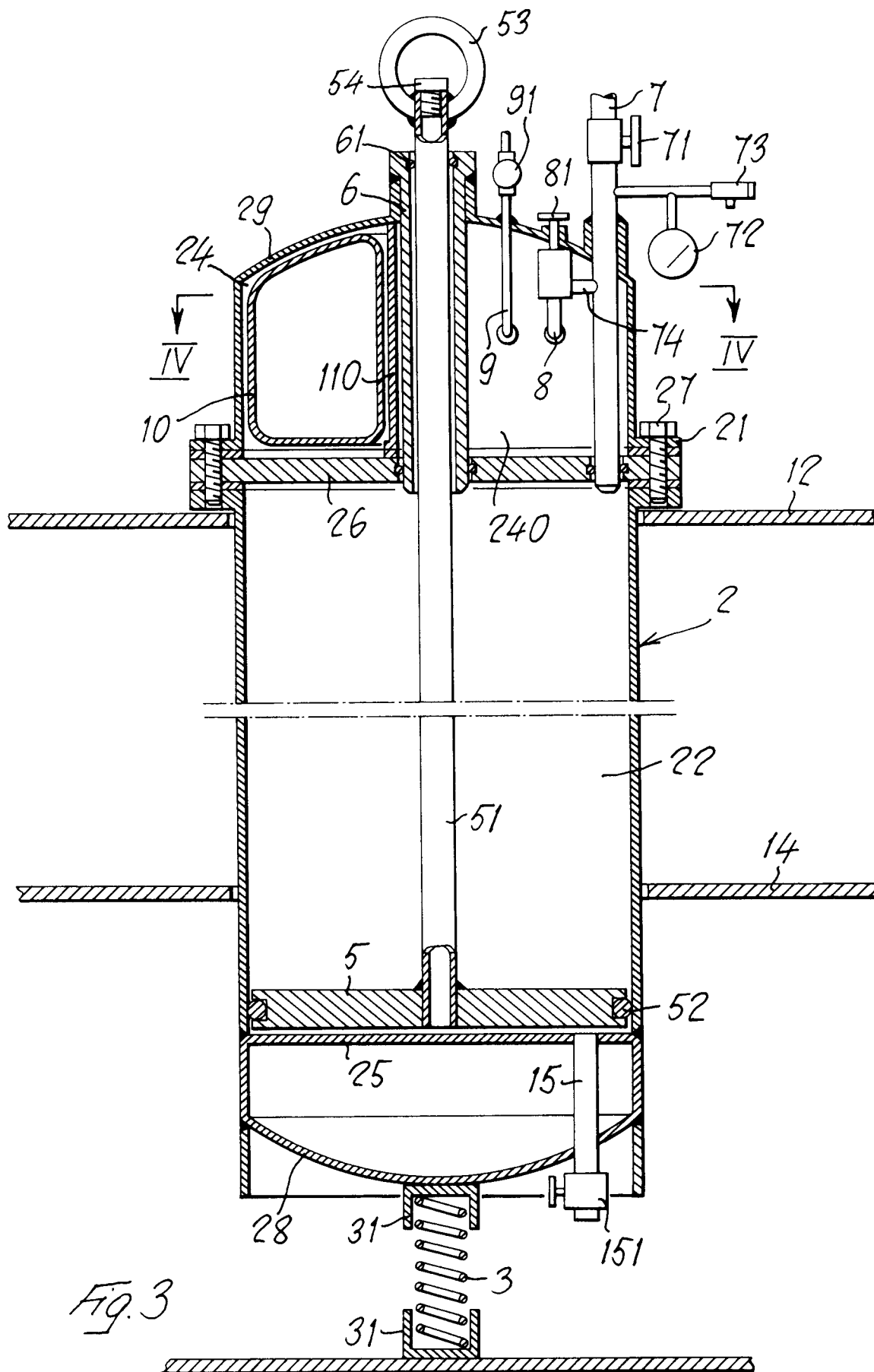
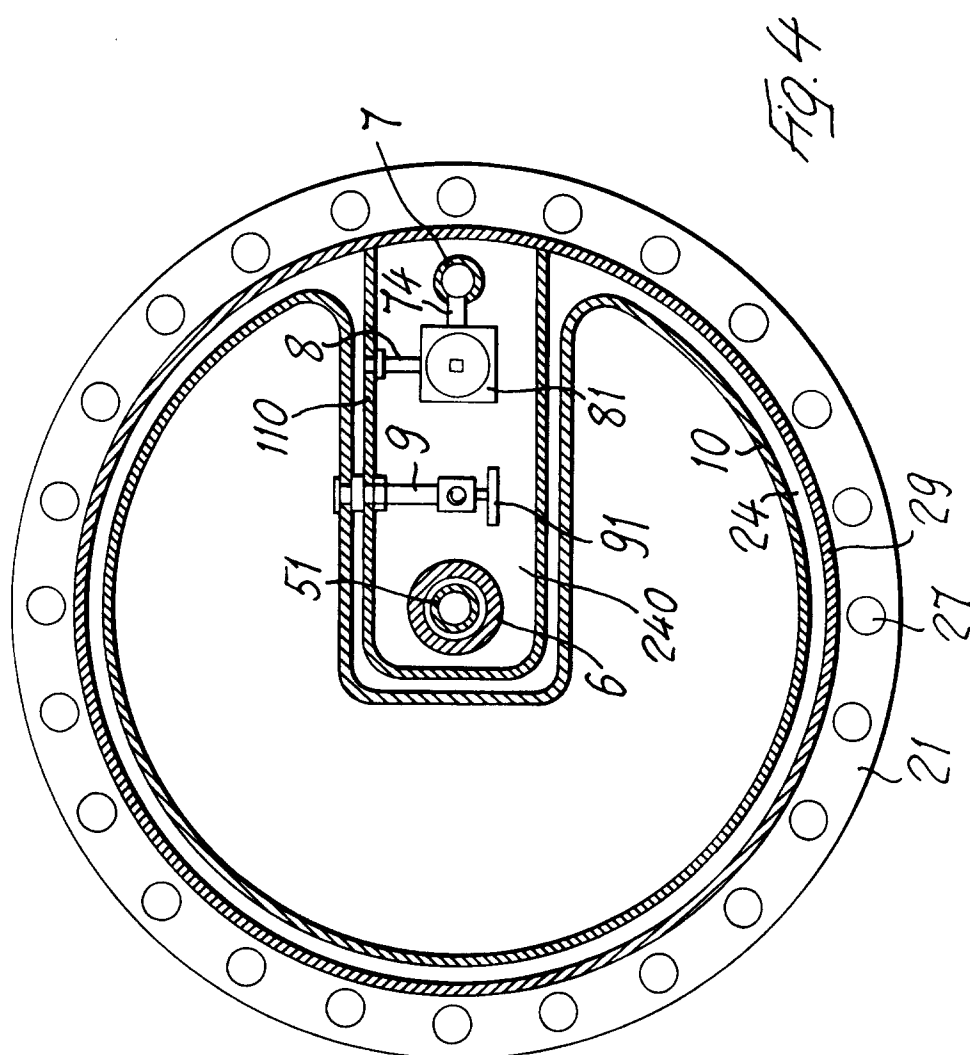


Fig. 2







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EUROPEAN SEARCH REPORT

Application Number
EP 94 10 1527

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.5)
X Y	DE-A-31 28 822 (HIRSCH) * the whole document * ---	1,2 3-7,9,10	B63B25/08 B63B25/12
X	GB-A-399 518 (THE ANGLO-SAXON PETROLEUM COMPANY,LTD) * the whole document * ---	1	
Y	FR-A-1 330 876 (LEROUX & S.A. DES ANCIENS CHANTIERES DUBIGEON) * page 2, right column, line 2; figures 1,2 * ---	3	
Y A	US-A-3 672 320 (MIKK) * column 1, line 47 - column 2, line 7; figures 1-3 * ---	4,10 1,2	
Y	US-A-4 117 796 (STRAIN) * column 6, line 33 - line 40; figures 4,7 * ---	5-7	
Y	US-A-3 927 702 (INGLE ET AL) * abstract; figure 1 * ---	9	TECHNICAL FIELDS SEARCHED (Int.Cl.5)
A	US-A-4 384 704 (WOLFF) * abstract; figure 1 * ---	5-7	B63B
A	US-A-2 931 409 (UNTHANK) * the whole document * -----	5-7	
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 29 April 1994	Examiner DE SENA, A
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ----- & : member of the same patent family, corresponding document			