July 21, 1936. C. ZULVER 2,048,312

SHIP FOR CARRYING FLUIDS IN BULK

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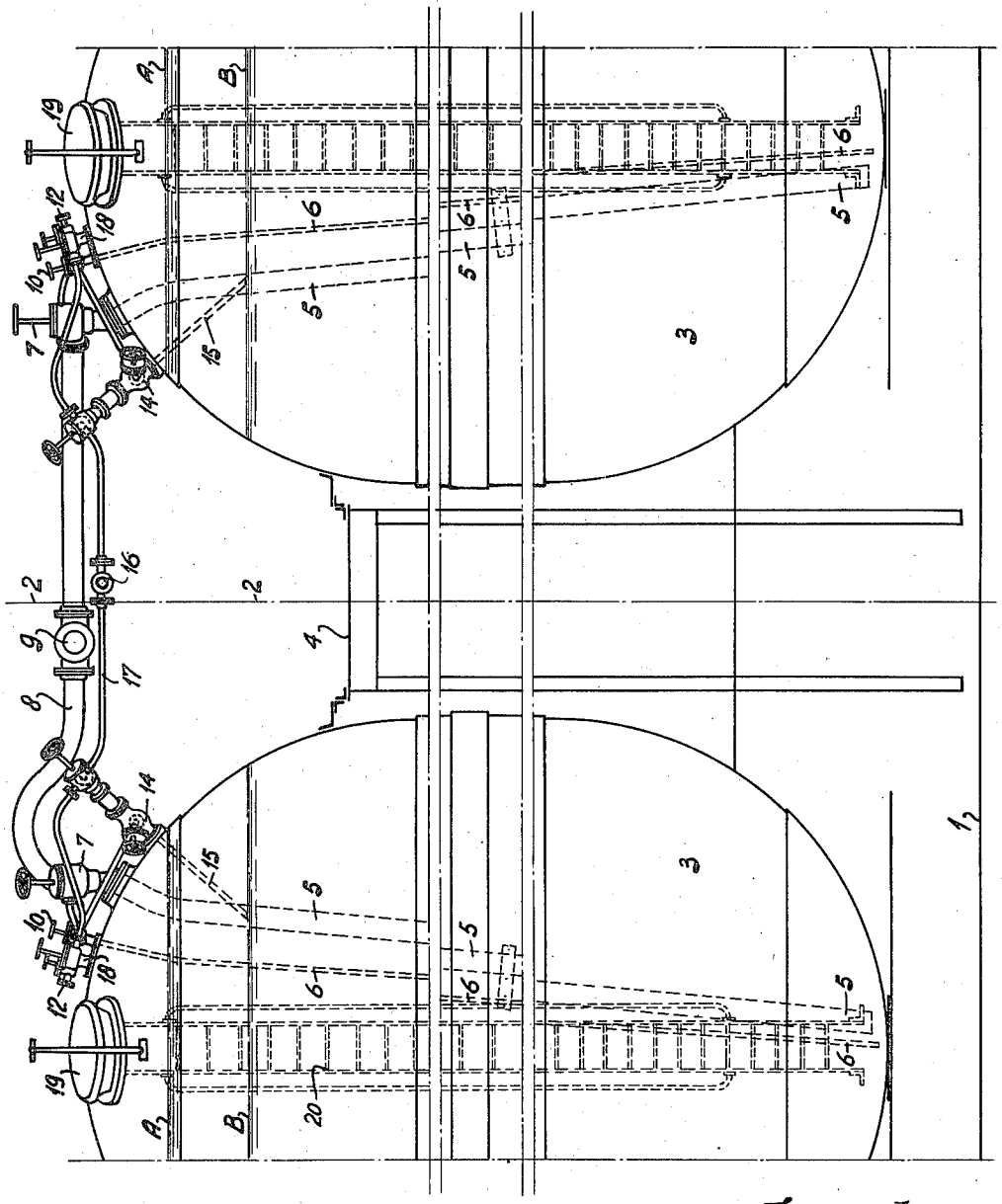


FIG. 1

Inventor

CORNELIS ZULVER

By

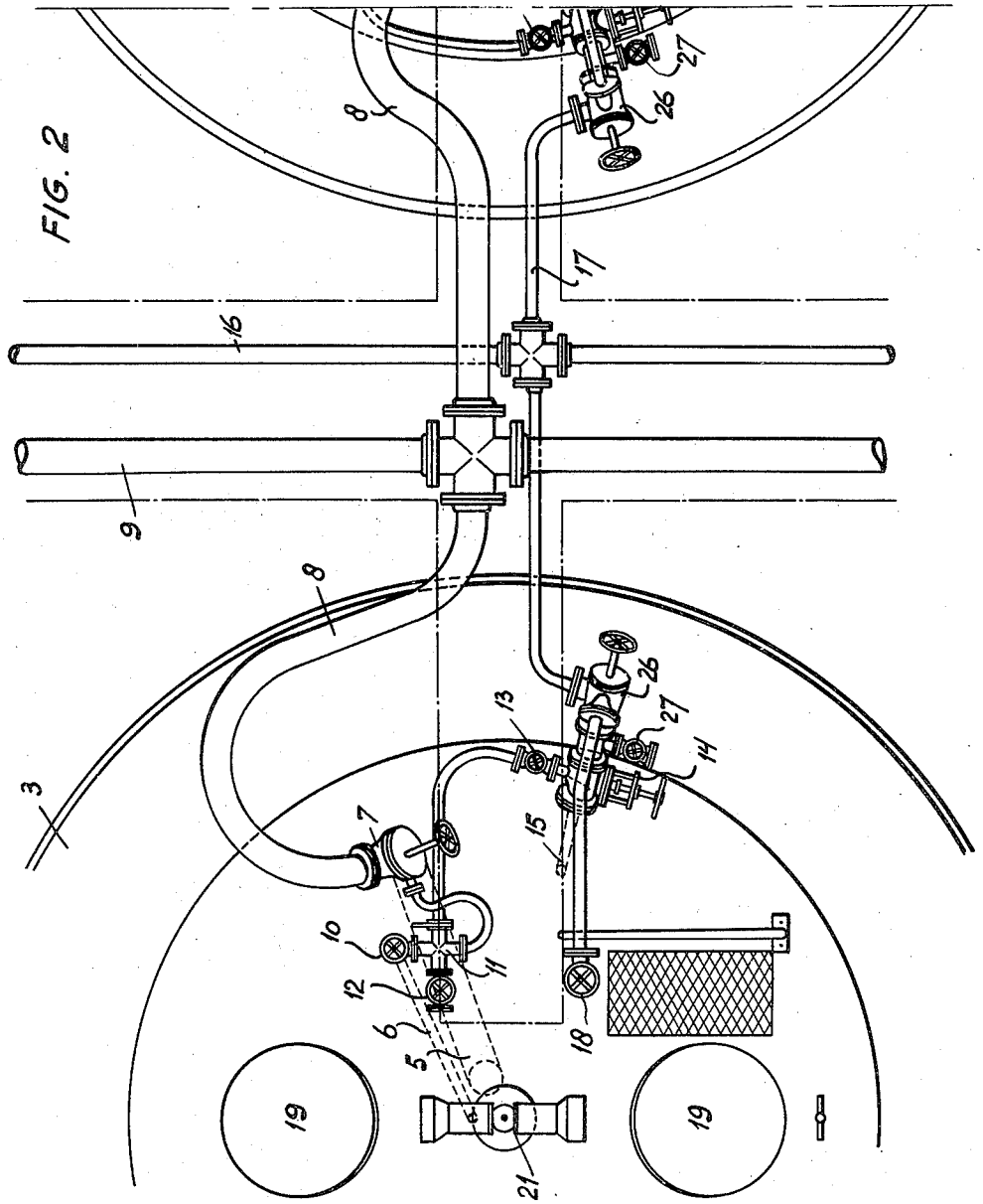
Attorney.

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SHIP FOR CARRYING FLUIDS IN BULK

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FIG. 2



Inventor

CORNELIS ZULVER

By

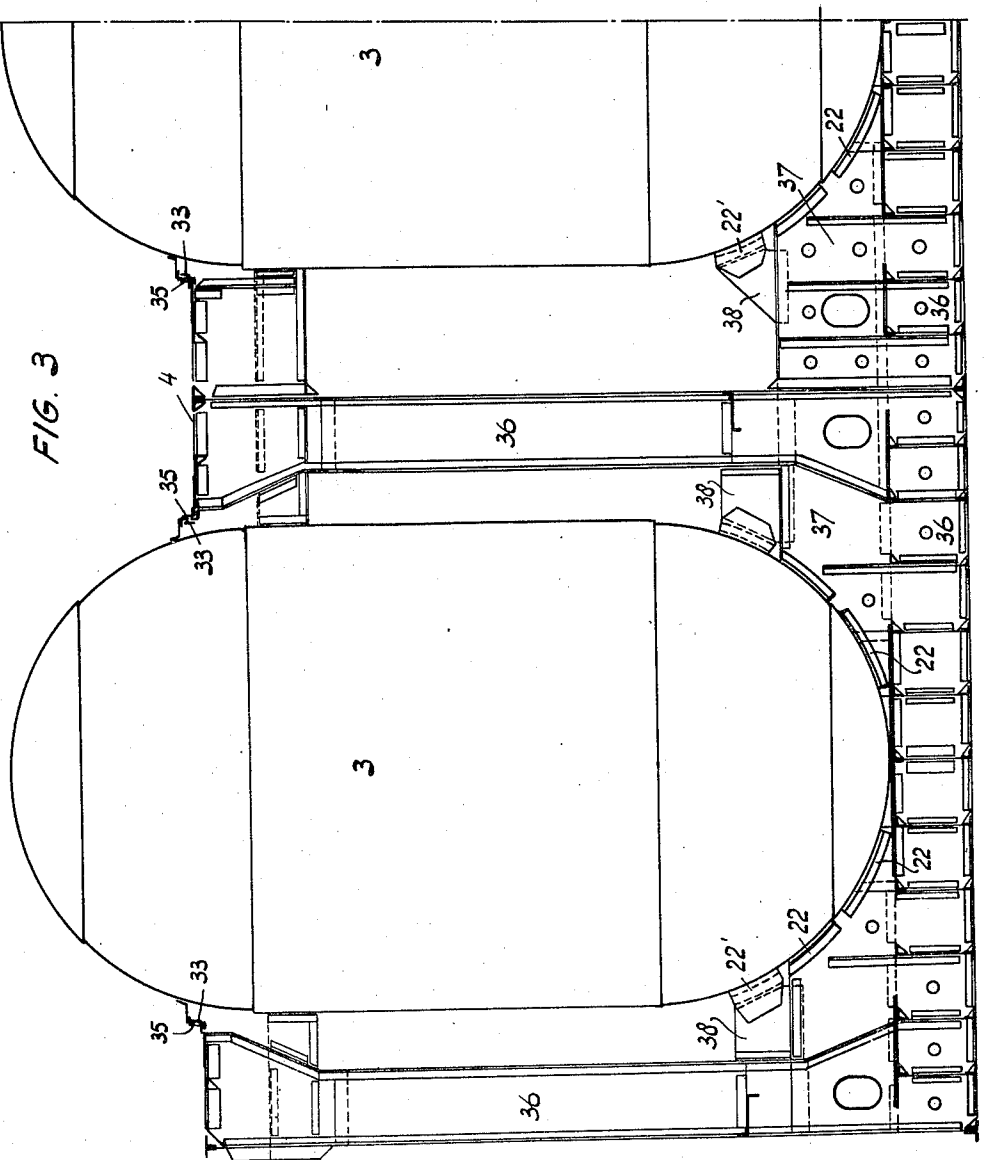
Attorney.

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SHIP FOR CARRYING FLUIDS IN BULK

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FIG. 3



Inventor:
CORNELIS ZULVER
By
Attorney.

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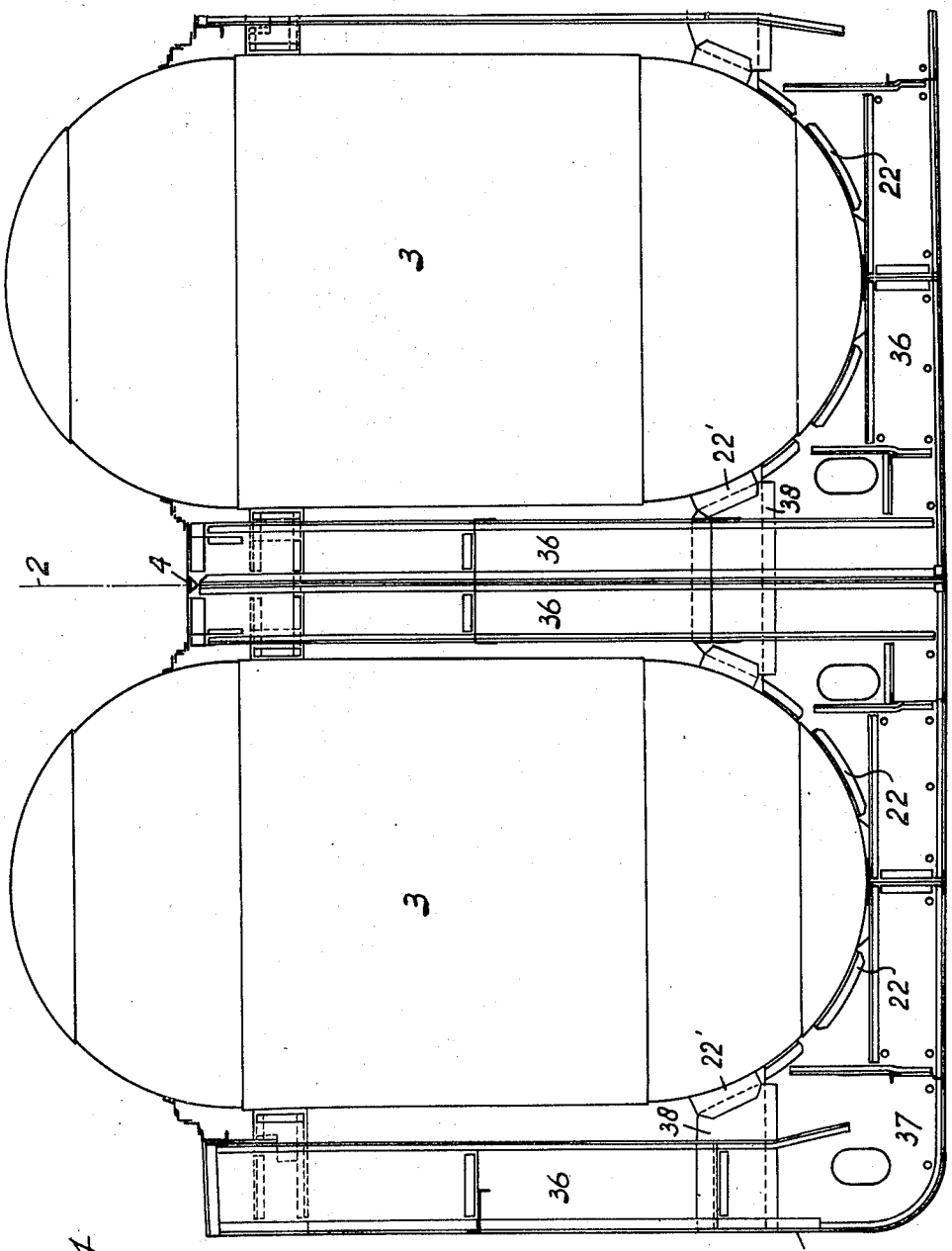


FIG 4

Inventor
CORNELIS ZULVER
By
Attorney

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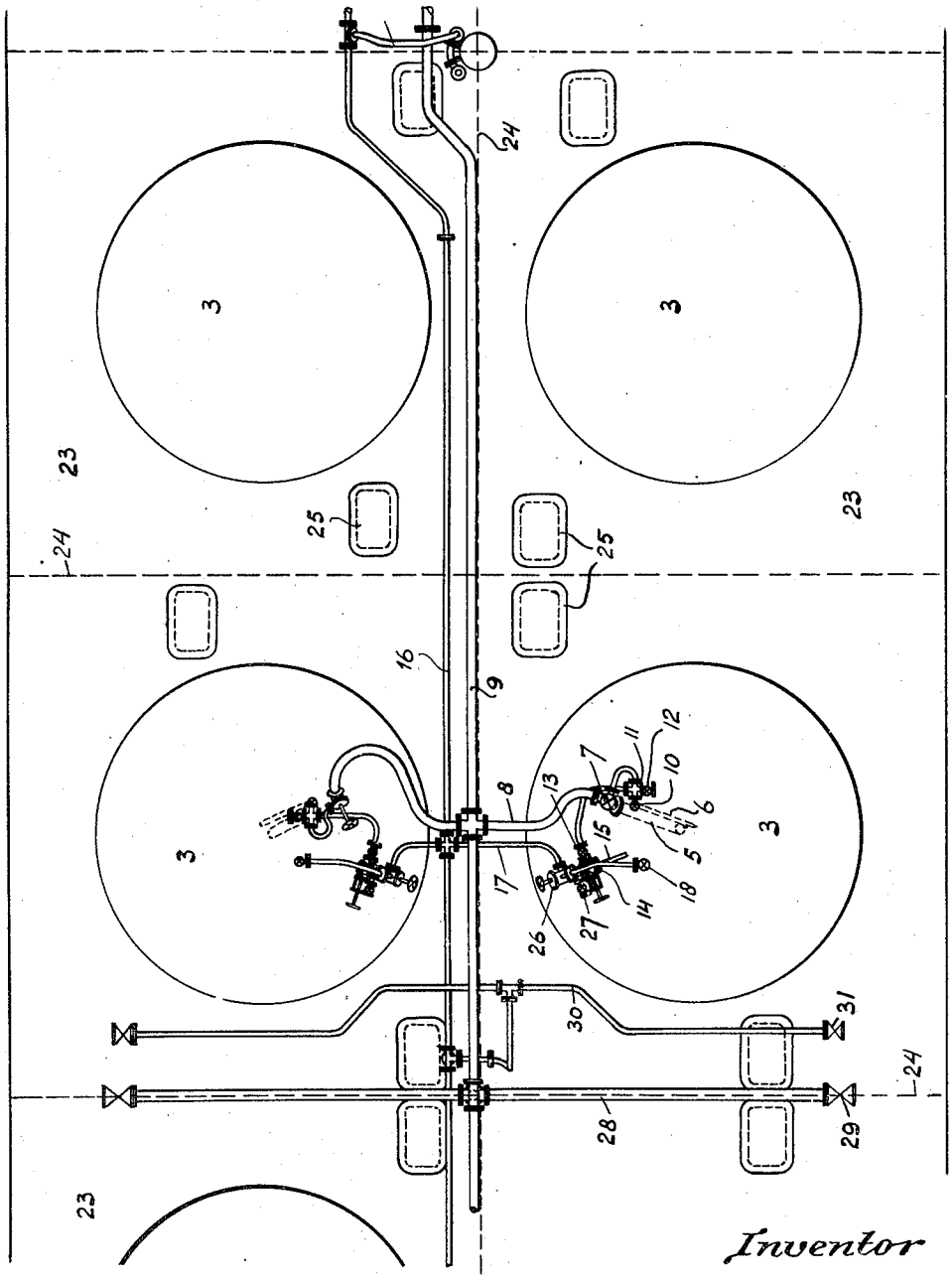


FIG 5

Inventor

CORNELIS ZULVER

By

Attorney

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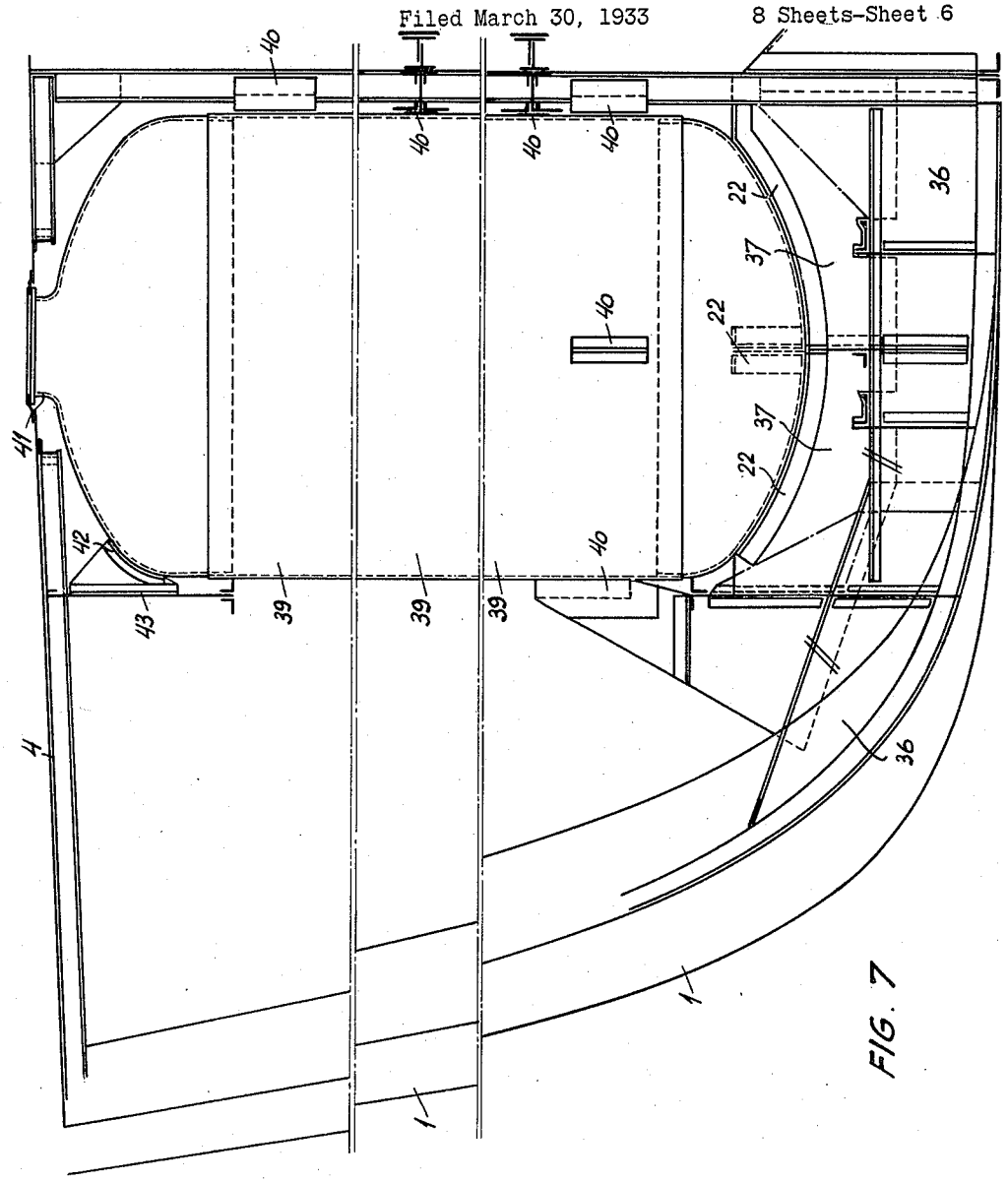


FIG. 7

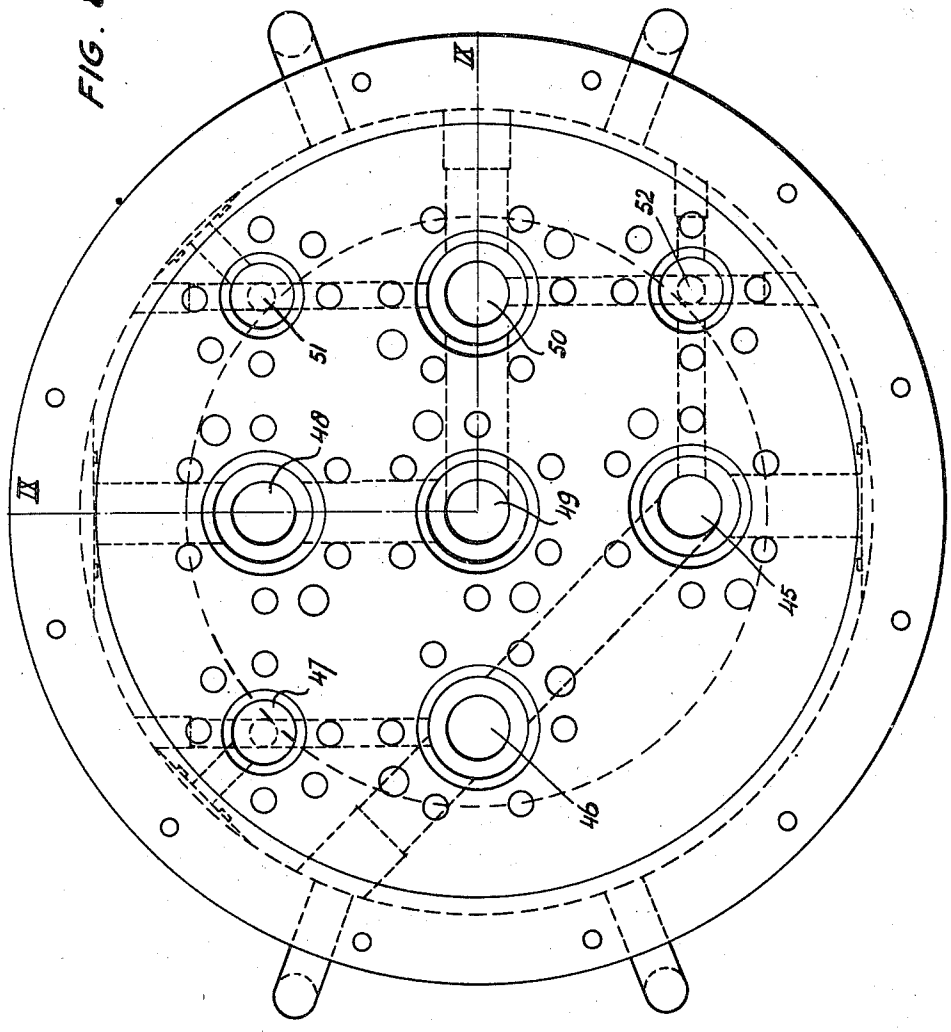
Inventor:
CORNELIS ZULVER
By
Attorney.

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FIG. 8



Inventor:
CORNELIS ZULVER
By
Attorney

July 21, 1936. C. ZULVER 2,048,312

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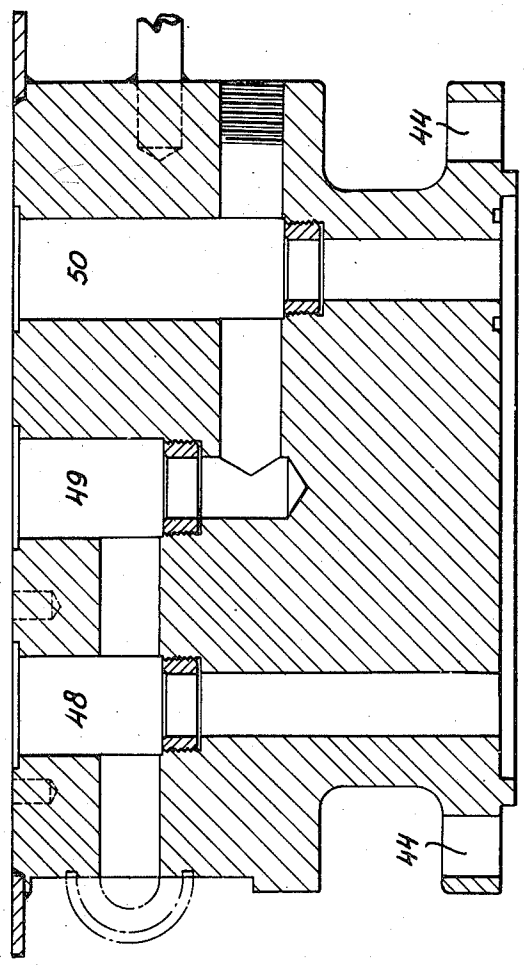


FIG. 9

Inventor:
CORNELIS ZULVER
By
Attorney

Patented July 21, 1936 2,048,312

UNITED STATES PATENT OFFICE

2,048,312

SHIP FOR CARRYING FLUIDS IN BULK

Cornelis Zulver, London, England, assignor to Shell Development Company, San Francisco, Calif., a corporation of Delaware

Application March 30, 1933, Serial No. 663,506
In Great Britain April 6, 1932

4 Claims. (Cl. 220—85)

The invention relates to ships for carrying fluids in bulk and provides improved means by which fluids under pressure may be conveyed. Such a problem is met with for example in the case of butane and propane which are gaseous at normal atmospheric pressure and temperature but can be liquefied at ordinary temperatures by a suitable high pressure.

Hitherto the general practice of transporting by sea bulk cargoes under pressure and particularly those of petroleum products has only been by means of small steel flasks which is a very costly arrangement.

According to the present invention the ship incorporates as part of its structure egg-ended cylindrical pressure tanks adapted to contain fluid under substantial pressure and fixed to the hull by saddles at the bottom and by suitably placed intermediate ties at the sides. The tanks are fitted vertically or in any other suitable position and in the case of smaller tanks, they may be arranged with a neck and bolted, riveted or welded to the deck plating. The tanks occupy as much of the hold space as is necessary, and they may be as large as desired within the limits of the space available in the hold of the ship. Other liquid cargoes of various grades not under pressure are advantageously carried in bulk around the vertical tanks, and for these liquids the usual bulkheads and hatches will be provided.

In the preferred construction with vertical tanks the upper parts of the tanks protrude through the deck. In the larger sizes an expansion joint is then fitted at the point of connection between the tank and the deck. The saddles or seatings, intermediate ties and expansion joints are adapted to take up the strains which result from the buoyancy of the tanks, having regard to their contents and the surrounding medium, and also the strains due to the difference in the specific gravity of the various liquid cargoes carried. In the case of smaller tanks they are bolted, riveted or welded direct to the deck plating.

One feature of the system of construction used according to the invention in anchoring the tanks to the structure of the ship is that a combination of suitably shaped brackets, frames and girders is used, which when assembled forms a safe structure providing ample strength and flexibility against the stresses set up by the cargoes in and outside the tanks, and also the stresses due to wave action and the buoyancy of the ship in bad weather.

The valves for loading, discharging, ascertaining the ullage, testing valves and other fittings, both suitable for the use, say, of concentrated sulphuric acid and similar corrosive cargoes, and for the conveyance of petroleum products liquid under pressure are advantageously accommodated on or in the upper dome or head above the deck level, the whole arrangement being such that there is a minimum risk of contamination of one cargo by another through the leakage of valves, stuffing boxes, joints or pipes.

This arrangement also avoids the necessity of leading suction and discharge connections into the holds. Further, all valve, testing and other connections are placed in a situation where they are readily accessible for examination and overhauling.

Loading and discharging of the cylindrical tanks is accomplished under the closed system, thus avoiding loss of cargo or vapour, the tanks being all interconnected with a vapour line fitted with a safety valve and pressure gauges.

An internal pipe as a main loading and discharging connection is provided in each cylindrical tank and terminates near the bottom; also a small auxiliary pipe terminating as close as possible to the lowest point of the tank is provided for the purpose of thoroughly draining the tank. A test valve is attached to the external portion of the auxiliary pipe (or with the smaller type of tanks is arranged in the valve head) for testing to determine whether all liquid has been discharged.

As with certain cargoes the contents of each tank are under pressure, it is impossible to remove any plug, cap or other fitting for the purpose of ascertaining the actual height of the liquid contained therein. In the carriage of liquid cargoes in bulk it is necessary to allow sufficient space for a safe ullage to permit the liquid to expand due to an increase in atmospheric temperature or other causes, without overflowing or causing the pressure to rise excessively.

In order to determine the correct level of the liquid in the tanks, a short internal pipe is fitted in each tank and connected to the dome or valve head, the length being fixed by the expansion allowance required. A test valve is also attached to the external portion of each of these pipes (or with smaller type tanks it is arranged in the valve head) so that when liquid reaches the orifice of the internal pipe, the test valve on being opened will indicate whether the tank has been filled to the desired height.

The object of this arrangement is to prevent the neutral gas, which has been trapped in the upper

part of the tank, from escaping; it thus forms a cushion, so that immediately the level of the liquid rises to the lower point of the test pipe, the test cock on being opened will permit a small quantity to escape, indicating that the tank has been filled to the desired extent, there being at the same time sufficient ullage as a provision for expansion.

The foregoing arrangement renders unnecessary gauge glasses and their fittings, which are liable to become broken or troublesome during the voyage. In some cases, however, these may be fitted, but with certain liquid cargoes they would be a source of danger.

Another feature in connection with the arrangement for providing sufficient space for expansion of the cargo is a by-pass valve and piping connections fitted on the dome of each tank, or formed in the valve head with smaller type tanks. This is arranged so that when under certain conditions an excess of liquid has been put into any tank, the surplus can be allowed to escape into any other compartment or returned to the shore delivery line, or if under certain conditions the excess will not discharge itself automatically on the valve being opened, gas of a higher pressure than that contained in the tank can be connected to the piping system and employed to force out all liquid above the level of the orifice of the internal pipe in each tank. This arrangement, therefore, positively provides the required space for expansion, a very essential feature in the carriage of liquids under high pressure.

The drawings illustrate by way of example some typical constructions of tankers according to the invention.

In these drawings:

Figure 1 is a part transverse section of a tank ship looking forward, partly showing two tanks.

Figure 2 is a part plan mainly corresponding thereto.

Figures 3 and 4 are a part longitudinal and a transverse sectional elevation respectively showing the constructional work surrounding the tanks.

Figure 5 is a deck plan, and

Figure 6 is a section of the coaming at the deck.

Figure 7 is a part sectional elevation of a tank ship with a smaller type tank in place.

Figure 8 is a plan of a top fitting for such a tank and

Figure 9 is an elevation of Figure 8 in section on the line IX—IX.

The arrangement shown in the Figures 1–6 is that of two tanks abreast and a suitable number in a fore and aft direction arranged in two groups, one forward and one aft. This grouping yields certain advantages over others, but it is clear that other arrangements will come within the scope of the invention.

Referring to Figures 1 and 2, the outline of the hull is shown at 1, the centre line at 2. The tank 3 is cylindrical with round ends, having no openings of any kind below the level of the deck 4. A main pipe 5 serves for loading and discharging and an auxiliary pipe 6 serves to evacuate the residue of liquid cargo not accessible to the pipe 5. The main pipe 5 communicates by valve 7 and pipe 8 with a main loading and discharge line 9. The auxiliary pipe 6 communicates by valve 10 with the side of valve 7 towards the pipe line 9 and by an X connection 11 a discharge test valve 12 and bye-pass 13. An ullage valve 14 and pipe 15 provide for testing the level of the liquid. The level to which sulphuric acid may be filled is marked A and the level for butane is marked B. The ullage pipe 15 terminates at the level B with an open end. A master ullage valve 26 and a loading test valve 27 are provided on each tank. A main air and vapour line 16 communicates by branch pipe 17 and valve 18 with the space at the top of the tank. Manholes 19 give access to a ladder 20 for inspection purposes, and a sounding plug 21 is provided at the top of the tank. It will be seen that all openings in the tank are in the upper domed surface above the deck level.

The same figures further show the connections permitting excess liquid to escape or be forced from any tank. Valve 14 (ullage valve) and valve 13 (bye-pass valve) must be opened and the liquid will pass through the bye-pass pipe to above valve 7 and thence to any tank desired or direct to the shore line 9. In the event of the pressure in the tank or tanks containing excess liquid being less than that of the other tanks or of the shore line so that the excess cannot escape, gas of a higher pressure from other sources, such as carbon dioxide in the usual flasks, can be employed. These would be connected to line 16 or at any suitable connection, and the high pressure gas would be delivered to above the surface of the liquid B through pipe 17 above the top of valve 26 which is kept closed and through to valve 18 (vapour valve). The excess liquid will then be forced out through pipe 15, valves 14 and 13, to above valve 7 and to the desired tank or to shore line. To make certain that an equilibrium of pressure does not occur due to high pressure gas leaking past valve 14 and finding its way into the tank whilst also being admitted to the tank through valve 18, valve 27 placed between valve 14 and valve 26 has been specially fitted for the purpose of releasing to the atmosphere any leakage past valve 14 of high pressure gas.

Figures 3 and 4 show the modifications from the normal construction to be made to the ship to accommodate the lower ends of the tanks already described. The girders and webs 36 forming part of the usual ship's structure are extended towards the centre line of the tanks by plates 37 riveted or welded to them. These plates take the place of the gusset plates usually applied at these places. At their edges the plates are shaped to fit the tanks and are attached to the bottom ends of the tanks by saddles 22. An extension 38 of the plate 37 provides support for a saddle 22' engaging a higher part of the tank end and forms an anchoring arrangement for the tank. It will be clear from the drawings that the plates 37 are provided both in the longitudinal direction and in the athwart direction.

Figure 5 shows the after tanks 3 in plan with the spaces 23 surrounding them, which are available for ordinary liquid cargo in bulk, such as oil. The usual longitudinal and transverse bulkheads 24 are then provided, as also oil-tight hatches 25.

This figure also shows the external connections to the pipe-work. The piping at the tank heads is shown in Figures 1 and 2 and has already been described; these figures should be referred to for the details of that pipe-work, which is shown on a rather small scale in Figure 5 to indicate its relationship to the external piping. The main loading and discharge line 9 is connected by pipe 28 and valve 29 to a loading and discharge connection from the shore. The vapour line 16 is similarly connected by pipe 30 and valve 31 to the shore. The connections and valves 28, 29, 30, 31 are duplicated on the other side of the ship so that loading and discharging may take place from

either side. The lines 9 and 16 are continued at 9' and 16' to the forward tanks and the vapour line 16 has a branch 32 passing through a spring-loaded relief valve in parallel with a stop valve to a relief connection taken to the mast top.

Figure 6 shows on a larger scale the coaming at the deck level. An angle bar 33 planed to suit the camber of the deck is attached on one flange to an angle bar 34, riveted to the tank, and on the other flange to an angle bar 35 riveted to the deck. These form an expansion joint providing the necessary flexibility between the tank and deck.

The tanks are thus detachably secured to the framing and/or plating of the ship and on it being necessary to remove any of them for repairs or for other purposes, they are made free of the deck plating and are ready for removal merely by removing the rivets in one flange of the deck expansion joint and the rivets connecting the upper portion of the saddles 22 to the extension plate 38.

Figure 7 shows a smaller cylindrical tank fixed into the ship, the hull of the ship is shown at 1 and the cylindrical tank at 39. The lower end of the tank is egg-shaped and is fixed as before to saddles 22 attached to extensions 37 of the frame plating 36. As will be seen from the drawings the saddles 22 form in plan the shape of a cross supporting the bottom of the tank in two directions at right angles to each other.

The cylindrical part of the tank 39 is attached by means of angle pieces 40, somewhat similar to the saddles 22, to the framework of the ship. Four sets of angle pieces 40 are shown towards the bottom of the cylindrical part of the tank, and these provide means for anchoring the tank. Two also are indicated at an intermediate position in the height and one near the top and these form a steadying means for the tank. The upper end of the tank 39 is domed, but is provided with a flanged opening adapted to receive a top fitting. This top fitting is shown in Figures 8 and 9 and will subsequently be described. The top flange is fixed to the deck 4 by bolting, welding or riveting and a further saddle piece 42 uniting the upper part of the tank 39 to the plate 43 forming part of the ship's structure gives added rigidity. The fixing of the tank is only shown by way of example; the precise arrangement to be adopted in any case will be determined by calculations based on the anticipated stresses to which the various parts are to be subjected. On account of the smaller size of these tanks the expansion joint previously described will not generally be found necessary.

The top of the tank 39 is closed by the cover shown in Figures 8 and 9. This cover may conveniently be constructed as a casting or forging. The cover is bolted to the flange of the tank by means of the bolt holes 44 indicated in Figure 9. Facings are provided for the attachment of the various pipes or valve flanges and are indicated as follows:—45 master-valve, 46 discharge, 47 test for discharge, 48 vapour, 49 master ullage, 50 ullage, 51 test for ullage, 52 bye-pass. By means of this cover all the connections are concentrated in one place and the body of the tank has no holes at all below the deck level.

What I claim is:

1. An oil storage system for fluid under substantial pressure comprising spheroidal pressure tanks; inside each of said tanks a loading and discharging pipe extending nearly to the bottom, an ullage pipe extending to the desired top level and a vapor opening communicating with the space above the liquid level and a container for storing liquid under substantially atmospheric pressure surrounding said spheroidal pressure tanks.

2. An oil storage system for fluid under substantial pressure comprising spheroidal pressure tanks; inside each of said tanks a loading and discharging pipe extending nearly to the bottom, an ullage pipe extending to the desired top level, a vapor opening communicating with the space above the liquid level and an auxiliary drainage pipe extending almost into contact with the lowest point of the tank and a container for storing liquid under substantially atmospheric pressure surrounding said spheroidal pressure tanks.

3. An oil storage system for fluid under substantial pressure comprising a plurality of spheroidal pressure tanks, each tank containing a loading and discharging pipe extending to the lower part of the tank, a drainage pipe extending nearly in contact with the lowest point of the tank, and an ullage pipe extending to the desired top liquid level, all said pipes entering the tank through its head; a vapor opening in each tank communicating with the space above the liquid level; piping means connecting the several tanks and cooperating with the ullage pipes to discharge any excess of liquid from one tank into the other tanks, and a container for storing liquid under substantially atmospheric pressure surrounding said spheroidal pressure tanks.

4. An oil storage system for fluid under substantial pressure comprising a plurality of spheroidal pressure tanks, each tank containing a loading and discharging pipe extending to the lower part of the tank, a drainage pipe extending nearly in contact with the lowest point of the tank, and an ullage pipe extending to the desired top liquid level, all said pipes entering the tank through its head; a vapor opening in each tank communicating with the space above the liquid level; means to force gases under pressure into the tank through said opening; piping means connecting the several tanks and cooperating with the ullage pipes to discharge any excess of liquid from one tank into the other tanks, and a container for storing liquid under substantially atmospheric pressure surrounding said spheroidal pressure tanks.

CORNELIS ZULVER.