

[54] **METHOD AND APPARATUS FOR CARGO TRANSFER SYSTEM**

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[51] Int. Cl. **B67c 3/34**

[58] Field of Search **141/346-352, 279, 284, 387, 388; 114/0.5, 235 R, 235 B; 61/46.5**

[56] **References Cited**

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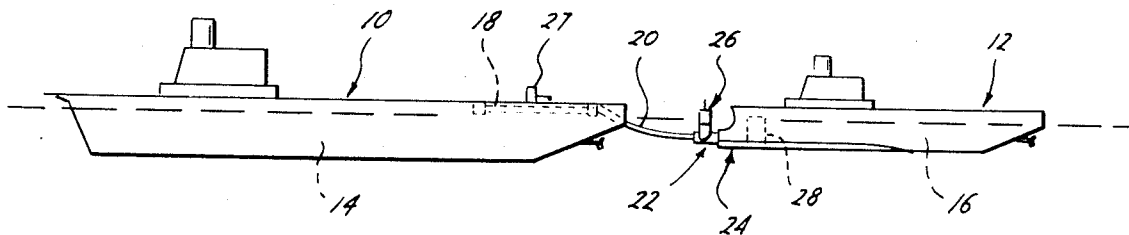
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[57] **ABSTRACT**

The present invention is directed to method and apparatus for the transfer of flowable cargo from ship to ship without the necessity of docking. It utilizes on one ship a transfer hose that, in the preferred embodiment, is trailed out behind the first ship as it moves through the water. The hose is equipped with a probe end that is received in an opening in the bow of the second ship moving along behind the first ship. Locking means secures the hose in the second ship while the transfer takes place. The probe end is provided with sealing means that may be opened and closed, depending upon the direction of the pumping action. Pumps are provided on both ships, and in the second ship the pump is in the chamber that receives the transferred cargo. The probe end is provided with float, ballast and trim means to maintain it properly in the water as it is received and held by the second ship.

26 Claims, 8 Drawing Figures



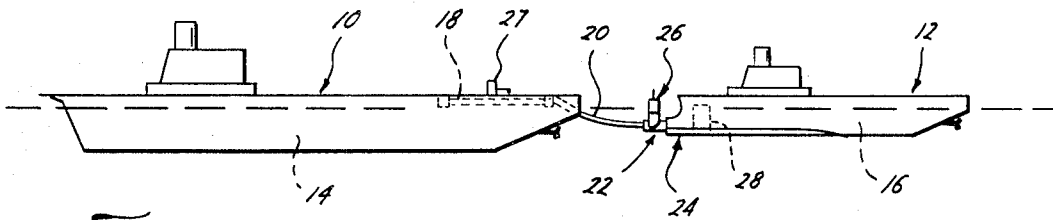


Fig. 1

Fig. 2

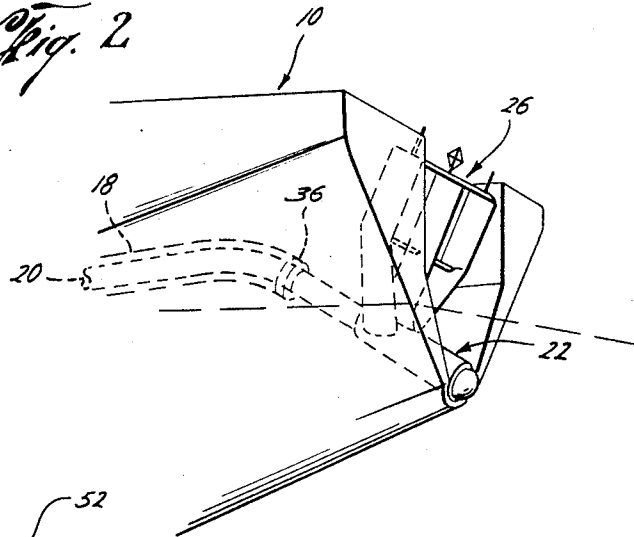
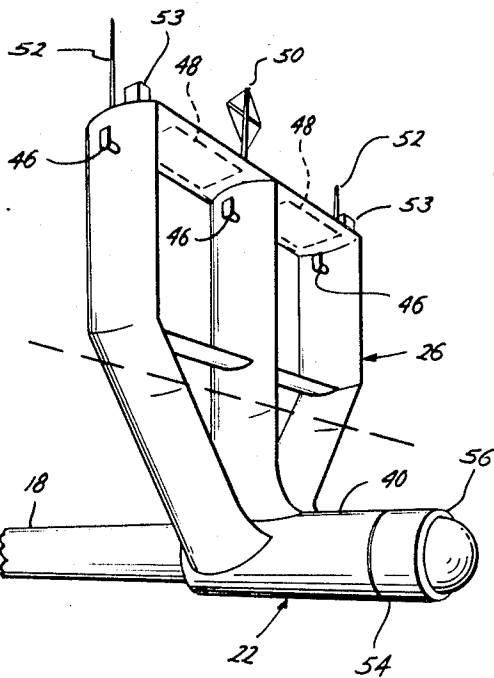


Fig. 3



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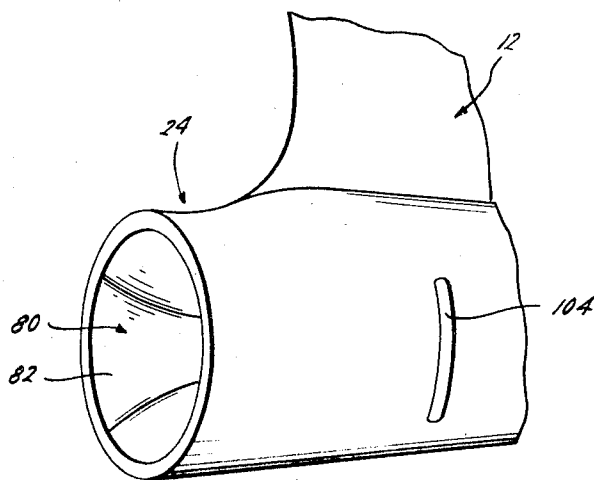


Fig. 4

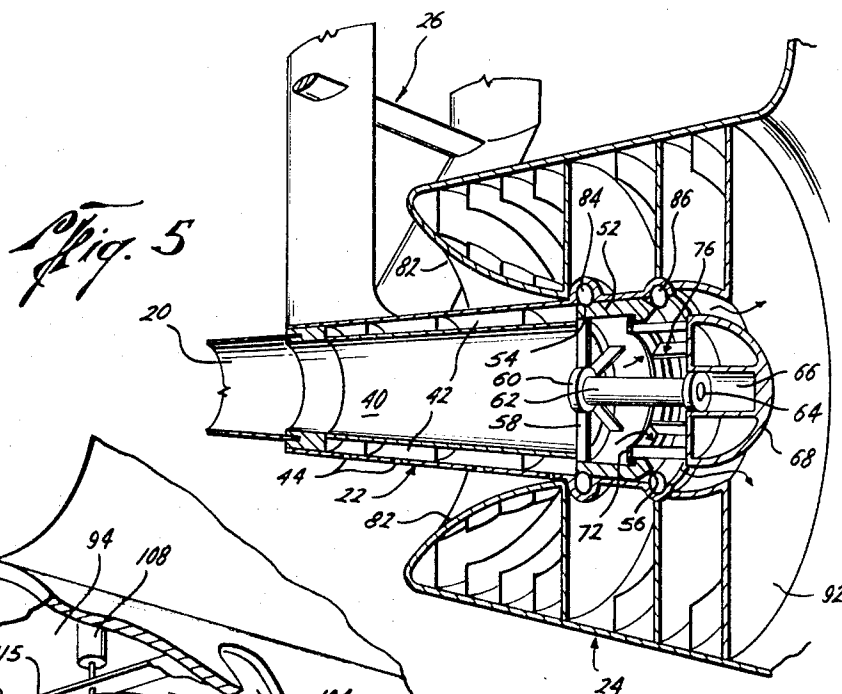


Fig. 5

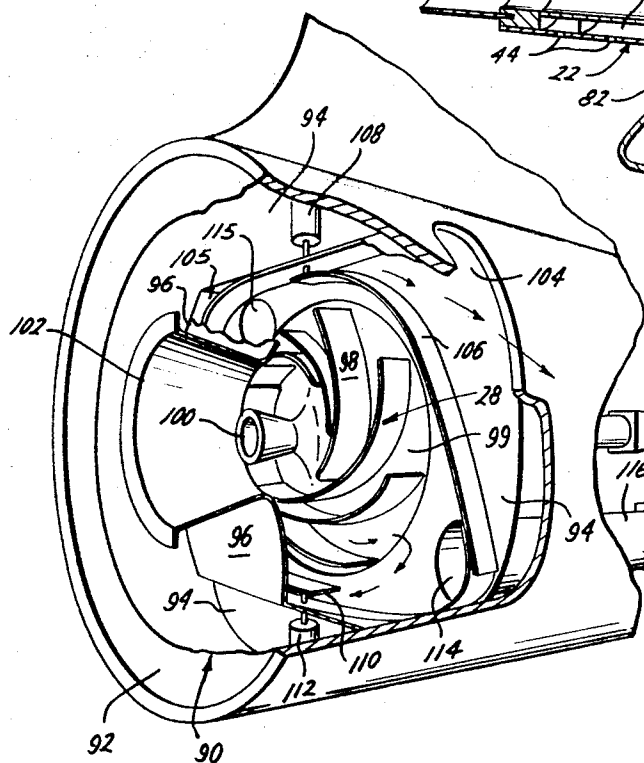


Fig. 6

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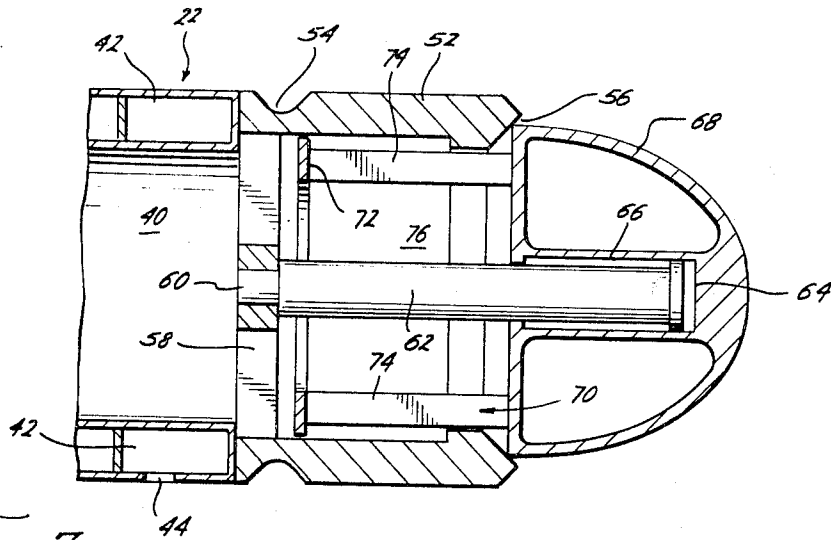


Fig. 7

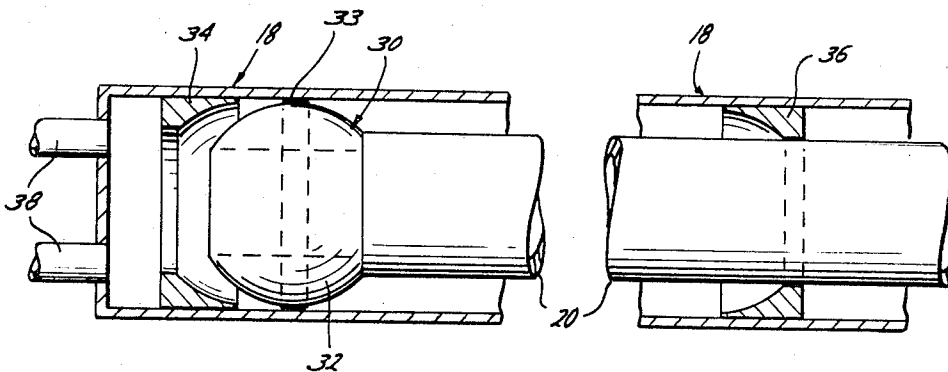


Fig. 8

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METHOD AND APPARATUS FOR CARGO TRANSFER SYSTEM

BACKGROUND OF THE PRESENT INVENTION

The present invention relates to the field of shipping, and more specifically, to the area of transferring a flowable cargo from one ship to another without the necessity of entering a harbor or of docking.

As commerce between nations increases, the shipping industry will bear an even greater load than it does today. One inevitable result of this will be a greater strain placed on the world's ports and the already overcrowded docking facilities available. In addition, the size of transport tankers is increasing to provide a greater payload. The use of such "supertankers" places a greater strain on port facilities.

Further problems that are faced by the shipping industry deal with the ability to transfer cargo quickly and efficiently from tankers to other vessels. Needless to say, the tying up of a large transport tanker in port for long periods of time is undesirable from an economic standpoint. The same is true of ships having to wait off shore to enter ports filled to capacity. Furthermore, entering and leaving certain ports has become a time-consuming and, in certain areas, a hazardous undertaking. With the advent of the supertanker, this is increased manifold.

The problem of water pollution is much evident today and has been caused to a significant extent by materials intentionally or unintentionally released from ships. Any transfer at sea of a cargo such as oil would certainly have to overcome the problem of possible spillage with the resultant pollution that would occur.

Another problem existing in the shipping industry is that ocean-going tankers cannot be accommodated in many harbors and ports. Accordingly, it is necessary to unload the tanker at some central distribution point. The cargo is then loaded into smaller vessels for delivery to the ports and harbors having smaller demands. Certainly with the coming of the supertanker, even more ports will be inaccessible to these tankers and some type of transfer system will be required that does not necessitate the entering of the harbor by the large tanker.

SUMMARY OF THE PRESENT INVENTION

The present invention is designed to provide a cargo transfer system which will overcome, at least to a significant extent, the problems mentioned above. The present invention is designed to be used with any type of liquid cargo such as oil, as well as other types of flowable cargoes such as grain.

In one embodiment, the present invention envisions a large, ocean-going transport tanker which is unloaded by smaller, shuttle tankers. This takes place at sea, and preferably while the vessels are underway. The shuttle tankers then enter the port for unloading of the cargo onto land while the larger tanker continues on its way.

The preferred embodiment disclosed herein illustrates this last mentioned example and comprises generally a transfer hose extending from the stern of the transport tanker and engaged in an opening located in the bow of the shuttle tanker. Appropriate opening and closing means are found in the end of the hose which extends into the shuttle tanker and which is called the probe end. In addition appropriate flotation and ballast means are attached to the probe end and may be con-

trolled remotely from either ship in order to insure that the probe is at the proper depth to be received and held by the shuttle tanker.

The cargo is transferred by pump means which may be located on either vessel, or preferably, on both vessels. The pump means also function to open and close the probe end of the transfer hose and to help connect and disconnect it. Appropriate controls and discharges are located on the smaller vessel to insure that the cargo is not contaminated with sea water or that the sea is not contaminated with spilled or discharged cargo.

It is, therefore, an object of the present invention to provide a complete system for transferring large quantities of flowable cargo between two vessels while at sea.

It is another object of the present invention to disclose such a system which will provide efficient and economical transfer means, which due to its simplicity, will function in a reliable and dependable manner.

Still another object of the present invention is to provide means for transferring a ship's cargo while at the same time alleviating congestion of port and dock facilities and to increase the types and numbers of ports which may be served by large ocean-going vessels.

Still another object of the present invention is to provide such transfer system which utilizes a transfer hose extending between the two tankers and which may be connected, the cargo transferred, and the hose disconnected all while the tankers are underway.

These and other objects, features and advantages will be apparent from the following description of a presently preferred embodiment of the invention, given for the purpose of disclosure, when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

In the following drawings, like character references designate like parts throughout the several views, which are as follows:

FIG. 1 is a side view of a transport tanker connected for cargo transfer to a shuttle tanker,

FIG. 2 is a partial, perspective view of the stern of the transport tanker with the transfer hose retracted into its storage position,

FIG. 3 is a perspective view of the probe end of the transfer hose with the hose partially shown,

FIG. 4 is a perspective view of the probe receiver on the shuttle tanker's bow which is partially shown,

FIG. 5 is a partial perspective view, in section, showing the probe engaged in the probe receiver,

FIG. 6 is a partial perspective view, in section, showing the receiving chamber of the probe receiver,

FIG. 7 is a partial side view, in section, of the probe end of the transfer hose, and

FIG. 8 is a partial side view, in section, of the transfer hose received within the storage tunnel and showing the sealing unit at the forward end of the hose.

BRIEF DESCRIPTION OF THE PREFERRED EMBODIMENT

Turning now to the drawings, a preferred embodiment of the present invention will be disclosed. For purposes of explanation only, the example given herein will discuss oil as the cargo, which is being transferred from a large ocean-going tanker (herein called, the "transport" or "transport tanker") to a smaller tanker (herein called the "shuttle" or "shuttle tanker"). It is

understood, of course, that variations to this arrangement may be made such as a reversal of the parts, having the smaller shuttle tanker load a larger transport tanker with appropriate modifications.

Turning now to FIG. 1, the basic system is comprised of the transport tanker 10 and the shuttle tanker 12. Each tanker has a hold 14 and 16, respectively, for cargo storage as is well known in the art. The transport tanker has a tunnel 18, within which is stored, and from which extends in FIG. 1, a transfer hose 20. The transfer hose 20 has a probe or outermost end 22 which is engaged with a probe receiver 24 on the shuttle tanker. Appropriate flotation and ballast means 26 are provided on the probe end. Pump means 27 and 28 (see FIG. 6) are provided to move the cargo from one vessel to another.

Discussing the invention in greater detail, and referring to FIGS. 2 and 8, the tunnel 18 provides a housing for the transfer hose 20 when it is to be stored while not in use. The tunnel is generally cylindrical and extends longitudinally on the centerline of the ship, terminating at the stern of the transport. As can be seen, the stern must be modified to provide for storage of the probe 22, float struts 26 and the transfer hose.

Appropriate seal means will, of course, be required to prevent the cargo from escaping into the sea and the basic sealing unit is illustrated by the numeral 30. This sealing unit 30 is located on the forward-most end of the hose 20 and may be of any conventional arrangement which will provide a sliding seal with the tunnel 18. In one embodiment, the sealing unit 30 may be a somewhat flexible spherical member 32 resembling a pigging ball. A hole extends through the ball 32 having a diameter equal to the inside diameter of the hose 20. The outside diameter of the ball 32 would approximate the inside diameter of the tunnel 18, so that it could function as a sliding seal as the hose is extended or retracted. Conventional seal means 33 may be used if desired or necessary. The pigging ball 32 or means 33 should also function to wipe or clean the walls of the tunnel 18.

At the forward and after termini of the hose travel are annular flanges 34 and 36. As the hose reaches either limit of its travel, the sphere 32 would seat in the appropriate flange 34 or 36 to provide a seal. Of course, passageways 38 are located in the tunnel leading from the hold 14 and are operatively connected to the pump means 27 for conveying the cargo from the hold into the tunnel and hose, or alternately, of pulling suction on the tunnel and hose.

Turning now to the probe end of the hose and referring to FIGS. 3, 5 and 7, the probe end 22 is comprised of a cylindrical casing 40 which connects to the end of the hose 20 in any conventional manner that will form a watertight seal. Due to the construction of this particular probe cylinder 40, a portion 42 of it functions as a buoyancy chamber. This buoyancy chamber 42 is also connected to the float struts 26, the interiors of which may also function as buoyancy chambers. Holes 44 are located in the bottom of the buoyancy chamber 42 to allow the entry and/or exit of water into the chamber. Appropriate relief valves 46 are located on the float struts for the release of pressure from the buoyancy chambers and remotely controlled compressed air storage chambers 48 are also located in the float struts. The float struts also carry a sighting mast 50, and radio antenna 52 for determining the degree of

cylinder submergence as well as its alignment and for receiving signals for operating the depth control system.

Returning now to the probe itself, a probe housing 52 extends from the probe cylinder 40. This housing 52 has a peripheral ring 54 for locking purposes and a leading edge 56.

Within the housing, radially extending reinforcing struts 58 support a hub 60 from which extends a shaft 62. The outermost end of this shaft 62 carries a guide 64 which is received within a cylindrical passageway 66 formed in a closure member or cap 68. This cap 68 is a portion of a probe piston 70 which is made up of the cap 68, a rear bracing ring 72 and support guides 74. The probe piston is shown in FIG. 5, in its extended or open position and is shown retracted to its closed or sealed position in FIG. 7. When in its retracted position, the cap 68 contacts the leading edge 56 and forms a fluid tight seal with this edge. When in its open position, cargo being transferred can flow through the openings 76 formed between the support members 74.

Turning now to the shuttle tanker 12, and more specifically to the receiver means that it carries in its bow for receiving the probe 22, FIG. 4 discloses the external configuration of this portion of the ship. An opening 80 receives the probe and has a tapered throat 82 which acts as a guide for the probe. An inflatable seal and locking means 84 is carried in the probe receiver, as is an inflatable or resilient stop 86.

The probe stops just short of a receiving or pump chamber 90 which is shown in FIG. 6. This chamber 90 is defined generally by a forward pump chamber bulkhead 92, which is shown in both FIGS. 5 and 6, and by an after pump chamber bulkhead 94, which is seen only in FIG. 6. A housing 96 extends outwardly from the after bulkhead 94 to form an enclosure for a centrifugal pump 28. The pump comprises the curved vanes 98 mounted for rotation on the plate 99 about an axis which extends generally parallel to the longitudinal axis of the ship. A pressurizing duct 100 extends from the center of the centrifugal pump. A funnel shaped inlet 102 forms the opening to the enclosure formed by the housing 96, and it is through this inlet 102 that the cargo moves from the hose.

There are basically two outlets to sea from the pump or receiving chamber and these comprise the port thruster discharge outlet 104. The port discharge outlet 104 is shown in both FIGS. 4 and 6. It is controlled by the port and a similar outlet 105 on the starboard side discharge guide vane 106, which in turn is controlled by the cylinder 108. In the same manner, the starboard thruster discharge outlet 105 is controlled by the starboard discharge guide vane 110 which is actuated by the cylinder 112. The vanes 106 and 110 can be operated independently of each other.

Thus, when the guide vanes are opened as they are in FIG. 6, material being pumped by the pump 28 will flow (in accordance with the arrows) out the port and starboard thruster discharge outlets 104 and 105. Should the cylinders 108 and 112 retract their piston rods, the guide vanes 106 and 110 will be moved until they contact the top and bottom, respectively, of the previously mentioned pump housing, thereby shutting off the flow to the thruster discharge outlets 104 and 105. Independent control is exercised over the pump discharge to port and to starboard. As will be readily understood, a fluid-tight seal is formed between the

guide vanes 106 and 110, the after bulkhead 94 and the housing 96. It is only by raising the guide vanes out of contact with the top and bottom of the housing 96 that the pump chamber is open to discharge into the sea.

A second pair of outlets 114 and 115 are located in the after bulkhead 94. The port outlet 114 and connections to it are shown in FIG. 6, and it is understood that similar valve and tank arrangements connect to the starboard outlet 115. For purpose of explanation, therefore, only outlet 114 and its connecting structure will be discussed. This outlet 114 connects with a pipe or passageway 116 which leads to valve means 118. Extending from valve means 118 is a first line 120 which connects with the storage hold 16, and a second line 122 which connects with the settling tank 124. This latter discussed subject matter is only schematically shown in FIG. 6.

Turning now to the operation of the preferred embodiment of the present invention, while the transport tanker 10 is in the process of transporting the cargo from one port to another, the transfer hose and probe are stored in the position shown in FIG. 2. While underway, the hose would normally be filled with cargo oil under atmospheric pressure. A seal would be effected between the sealing unit 30 and the forward flange 34 to prevent seawater from entering the transfer pipe 20. The length of the tunnel and hose would be determined by the length of hose required for safe fore and aft separation of the two tankers during the mating and cargo transfer operation.

When readying for the transfer operation, the probe end 22 and float 26 would be released from the stern of the transport. This release may be effected by releasing means that have secured the elements in place and by allowing the weight of the float struts and probe to move the hose 20 out of the stern of the ship or by mechanical assistance if needed. The hose is then streamed out astern of the transport. With the transport under way, the drag on the probe 22 and float struts 26 should be sufficient to draw the hose out of the tunnel until the spherical seal 30 reaches the rear or terminal flange 36. During this period, cargo oil would be pumped or flooded into the forward section of the tunnel, with sea water discharged from the terminal end of the tunnel abaft the rear seal 36. When the hose is fully extended, the sealing unit 30 would seat within the flange 36 to form a water tight seal. The hose would remain extended due to the drag created by the transport's being under way.

In the design of the system, the hose may, of course, vary in size, depending upon the size of transport, cargo to be transferred, etc. The hose should preferably be designed, however, with approximately neutral buoyancy when filled with the cargo being transferred. The probe end 22 and float struts 26 should be of such a design that the entire probe end assembly would float with the probe end submerged at a controllable depth and could be towed through the water without trim. The outboard float struts should be sufficiently, widely separated at the normal water line to provide good transverse stability with minimum roll response to wave action. The float assembly 26 and the probe 22 must be designed so that when the assembly is streamed out behind the transport, it will trail directly astern and have dynamic stability of route. Furthermore, the vertical center of resistance must be such that no trimming moment is applied to the assembly. Obviously, different

designs and configurations of the probe and associated gear may be resorted to to achieve the desired results. If desired, controllable elements such as rudders, elevators and the like may be employed.

The shuttle tanker is now moved into position to the rear of the probe 22 which is now being towed through the water. In making the connection with the probe end, the sighting mast 50 is used by the captain of the shuttle to obtain proper alignment of the probe laterally and to maintain the probe at the proper depth. The depth is controlled remotely by radio signal. In addition, radar transponders 53 may be mounted on the outboard struts to permit automatic alignment of the shuttle's bow receiver 24 with the probe 22.

The depth control apparatus disclosed is a relatively simple system powered by compressed air stored in tanks 48. For decreasing the probe's submergence, compressed air would be released from the tanks 48 by radio signal from one of the tankers to force ballast water through the flooding openings 44 in the bottom of the probe cylinder 40. For increasing submergence, the air pressure may be reduced by the remotely controlled relief valves 46, thereby allowing water to enter the buoyancy chamber 42 until the desired depth is attained. Thus, the radio control signals required would be only those needed to open and/or shut the air valve on the compressed air tanks 48 and the relief valves 46.

When the shuttle is underway, and particularly when it approaches the probe, the large centrifugal pump 28 is running continuously. For straight-ahead operation, the pump discharge is usually equally divided between the port and starboard discharge outlets 104 and 105. By running the centrifugal pump 28, and by utilizing the proper design on the inverted bulb or probe receiver section 24, a forward thrust will develop as the flow is accelerated through the throat 82 of the receiver bulb 24. Thus the propulsive efficiency lost due to this particular bow configuration will be minimal.

As will be understood, by altering the position of the discharge guide vanes 106 and 110, the discharge through the port and starboard outlets 104 and 105 can also be varied so that close maneuvering control can be exercised. If desired, this proportioning can be controlled automatically in response to radar or radio signals received from the transponders on the probe and float assembly. Thus, as the shuttle tanker 12 pulls up astern of the transport 10, its bow can be automatically controlled to home in on the probe 22. In like manner, the depth of the probe can be automatically adjusted to match that of the probe receiver throat.

The entry of the probe 22 into the probe receiver throat 82 will be aided further by the suction created by the action of the centrifugal pump 28. As clearance between the probe and the throat 82 is reduced, the flow velocity will increase, and the accompanying pressure reduction will draw the probe tightly into the receiver 24.

As the probe 22 moves into the receiver, the leading edge 56 will contact the stop 86, which is a flexible toroidal ring. Upon this contact being made, the inflatable seal 84 is pressurized and locks into the matching groove 54 in the probe cylinder 52.

When the probe is securely locked into position, a signal is sent to the transport from the shuttle tanker. The transport's pumps 27 are then started to apply pressure to the hose. At the same time, pressure is reduced in the pump chamber 90 by the action of the

centrifugal pump 28. The increased pressurization in the hose and probe coupled with the reduced pressure in the receiver pump chamber 90 causes the probe piston 70 to extend, thereby breaking the seal formed between the cap 68 and edge 56. The oil thus flows into the pump chamber 90.

Until the probe piston is extended, only sea water is being pumped by the pump 28. This is discharged back into the sea through the outlets 104 and 105, as valve means 118 is normally closed to prevent seawater from flowing into either the settling tanks 124 or the hold 16. When oil is first introduced into the chamber, it will not be a pure oil but an oil-water mixture. It is, of course, desirable to separate this from the pure oil that will soon flow through the hose, while at the same time, not discharging the mixture into the sea to avoid pollution problems.

Accordingly, the cylinders 108 and 112 are activated to close the thruster discharge outlets 104 and 105, and the valve means 118 are activated to open the outlets 114 and 115 to the lines 122 and settling tanks 124. The oil and water emulsion will be fed into the settling tanks 124, and the oil may later be extracted by conventional procedures.

When there is no further danger of contamination by seawater, the valve means 118 are again switched to allow the discharges 114 and 115 to feed through lines 120 to the storage hold 16. In this way, the cargo is transferred to the shuttle.

During the transfer operation, the suction of the centrifugal pump plus the seal 84 should be sufficient to hold the probe 22 in place. The two tankers can be operated so as to maintain a tension in the hose, and therefore, the bow thruster action will not be required for maneuvering during the cargo transfer operation.

Upon completion of the cargo transfer, the pump 28 can be shut down, the oil discharge valve means 118 closed, and the transport tanker pumps 27 rigged to apply suction to the forward end of the hose. Through the pressurizing duct 100, conventional pump means 101 can pump seawater into the pump chamber. The pressure difference thus created will force the probe piston 70 to retract into the probe cylinder 52 thereby closing the probe end. In addition, by operation of the valve means 118, the remaining oil-water mixture in the pump chamber can be forced into the settling tanks 124. Thus the pump chamber will be flushed of residual oil cargo. At this point, the seal 84 can be deflated, and the lesser speed of the shuttle 12 will cause the probe 22 to be withdrawn from the receiver 24.

Retraction of the transfer hose 20 into the transport tanker 10 may be accomplished by continuing to apply suction with the pumps 27 at the forward end of the hose tunnel 18. As the residual oil in the tunnel is returned to the cargo hold 15, seawater will flood into the tunnel behind the spherical seal 30. It will not flow past this seal means 30, however, due to the fact that the unit 30 forms a sliding seal with the sidewalls of the tunnel 18. The result, however, is a pressure differential existing on either side of this seal means 30 which will move the seal forward in the transport tanker until it seats in the forward tunnel flange 34. For this means of hose retraction to be successful, the design must be such that the cross-sectional area of the tunnel, multiplied by the suction pressure of the pumps 26, is a force greater than the hydrodynamic drag of the hose 20, probe 22 and float assembly 26. If this is not sufficient,

a cable and winch retraction system can be resorted to to supplement the pump's suction. In addition, the transport 10 can be halted to decrease the resistance to the retraction.

As the pigging ball 32 retracts into the tunnel 18, it wipes clean the sidewalls of the tunnel. To assist the ball 32 in its sealing and cleaning operations, appropriate, conventional sealing and wiping means 33 may be incorporated. Such wiping action aids in the prevention of water pollution.

As is seen, therefore, the objects of the invention have been accomplished by the embodiment disclosed herein. Means have been provided to efficiently and reliably transfer a flowable cargo from one tanker to another without the necessity of docking or entering a port. Furthermore, such transfer operation may take place while the vessels are underway.

In addition, problems that would normally be faced such as pollution of the sea by the cargo or intermixing of seawater with the cargo, have been minimized. Means have been provided to make the operation as simple and easy as possible. A pump is employed to provide suction through a bow nozzle or receiver with a controllable port and starboard discharge to act as a bow thruster for maneuvering control. This concept enables the tanker to provide maneuvering control while underway at full ships speed, and at the same time provide a compensating forward thrust to reduce drag. In addition, the pump 28 is also utilized as a means to center and lock the probe end of the transfer hose. In a similar manner, the transfer pumps 27 on the transport tanker 10 are used to retract or assist in the retraction of the hose.

It is understood that the preferred embodiment disclosed herein shows the transfer of material from a transport tanker 10 to a smaller shuttle tanker 12. The reverse may also be true, with the process being used to load an ocean-going tanker. In fact, it is possible to include both the stern discharge hose arrangement and bow probe receiving arrangement on the same vessel so that it may be loaded and unloaded in accordance with the invention disclosed herein.

The present invention, therefore, is well adapted to carry out the objects and attain the ends and advantages mentioned, as well as others inherent therein. While the presently preferred embodiment of the invention has been given for the purpose of disclosure, numerous changes in the details of construction and combination, size, shape and arrangement of parts may be resorted to without departing from the spirit and scope of the invention as herein claimed.

I claim:

1. A cargo transfer system for transferring flowable cargo between vessels while on water and comprised of,

means for unloading flowable cargo from a first vessel to a second vessel while said vessels are afloat, including,
a storage hold on each vessel for said cargo,
a cargo transfer hose connected to the first vessel, said hose having a floatable probe on one end of the hose,
means for extending the probe end of the hose away from the first vessel,
receiving means on the second vessel for receiving the probe end of the hose, and

pump means on one of said vessels to pump said cargo through the hose to the second vessel.

2. The invention of claim 1 and further including, a first chamber in the second vessel, said probe end discharging into said first chamber when received in the receiving means, said first chamber having first discharge outlet means to the water, second discharge outlet means to the storage hold of the second vessel, and control means for opening and closing the first and second discharge outlet means as desired.

3. The invention of claim 2 and further including a settling tank in the second vessel, third discharge outlet means from the first chamber to the settling tank, said control means being further defined as means for opening and closing the first, second and third discharge outlet means as desired.

4. The invention of claim 2 wherein said first chamber further includes, second pump means.

5. The invention of claim 1 and further including, a pressurizing duct directed against the transfer hose when it is in the receiving means to assist in disconnecting the hose from the receiving means.

6. The invention of claim 4 and further including, pressurizing duct means in said first chamber for the introduction of pressurizing fluid into the first chamber.

7. The invention of claim 1 and including, individually controlled port and starboard thruster discharge means for assisting in the maneuvering of the vessel.

8. The invention of claim 2 and further including, a pump in the first chamber, the first discharge outlet means being further defined as including, port and starboard bow thruster discharges which may be opened and closed independently of each other to assist in maneuvering the vessel.

9. The invention of claim 1 and including means for retracting into, and storing in the first vessel the hose and probe end.

10. The invention of claim 9 wherein said retracting and storing means includes, a tunnel in said first vessel to receive said hose, sealing means on the hose for forming a sliding seal with the tunnel, pressure reducing means operatively connected to the tunnel for reducing the pressure in the tunnel on the inboard side of said sealing means, whereby the pressure exerted on the sealing means, hose and probe end by the water will urge the hose into said tunnel.

11. The invention of claim 10 wherein said pump means is further defined as pump means located on said first vessel and having means for reversing pumping action to form the pressure reducing means.

12. The invention of claim 9 wherein said retracting means includes, a tunnel in said first vessel to receive said hose, sealing means on one of said hose and tunnel to form a sliding seal between the hose and tunnel.

13. The invention of claim 1 wherein said hose is defined as, a hose extendable from, and retractable into, a tunnel in the first vessel,

sealing means at the end of the hose opposite the probe end for forming a sliding seal with the tunnel side wall,

a first flange near the innermost end of the tunnel for mating with the sealing means when the hose is fully retracted, and

a second flange near the outermost end of the tunnel for mating with the sealing means when the hose is fully extended,

said sealing means forming fluid-tight seals with the respective first and second flanges when said sealing means is mated therewith.

14. The invention of claim 1 wherein the sealing means includes,

valve means for opening and closing the innermost end of the hose.

15. The invention of claim 1 wherein the probe is further defined as including,

buoyancy means for maintaining the probe at the desired level in the water.

16. The invention of claim 1 wherein the buoyancy means is further defined as including,

ballast means, and

ballast control means for adjusting the level of the probe in the water.

17. The invention of claim 1 and further including, trim control means for providing trim to the probe as it is moved through the water.

18. The invention of claim 17 wherein the probe and buoyancy means are constructed to provide trim for the probe as it is moved through the water.

19. The invention of claim 1 wherein the probe is further defined as including,

a housing attached to the hose,

a passageway through the housing for the passage of said cargo,

a discharge outlet in the housing,

closure means for opening and closing the discharge outlet.

20. The invention of claim 19 wherein the closure means is further defined as,

a piston slidably mounted in the housing,

a cap on said piston that mates with the discharge outlet to form a fluid-tight seal therewith,

flange means on the piston and discharge outlet to limit the sliding movement of the piston.

21. The invention of claim 1 wherein the probe is further defined as including,

a discharge outlet,

means for opening and closing the discharge outlet as desired,

buoyancy means,

ballast means, and

buoyancy and ballast control means for maintaining the probe at the desired level in the water,

trim means for maintaining the probe in trim as it is moved through the water.

22. The invention of claim 21 wherein the buoyancy and trim means are further defined as,

float struts attached to the probe and including buoyancy chambers therein and being constructed so as to provide trim as the probe is moved through the water, the ballast control means being incorporated in the float struts.

23. The invention of claim 22 wherein the probe is further defined as,

a housing attached to the hose,

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a passageway through said housing connected to the discharge outlet,
 said opening and closing means being further defined as including,
 a piston slidably mounted in the housing,
 a portion of the piston extending through the discharge outlet,
 cap means attached to said piston portion for forming a fluid-tight seal with the discharge outlet when the piston is retracted, whereby cargo moving through the hose may pass through the passageway and out the discharge outlet when the piston is extended.

24. The invention of claim 1 and further including, a pump in the first chamber.

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25. The invention of claim 8 wherein, the pump is a centrifugal pump mounted for rotation about an axis that extends generally longitudinally of the vessel, the discharge of the pump being directed to said port and starboard bow thruster discharges.

26. The invention of claim 8 wherein the control means is further defined as including, discharge vanes at the port and starboard bow thruster discharges, and means for opening and closing these vanes independently of each other.

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