April 12, 1960 M. F. KOBLISH 2,932,310

APPARATUS FOR LIQUEFIED GAS TRANSFER

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FIG.1.

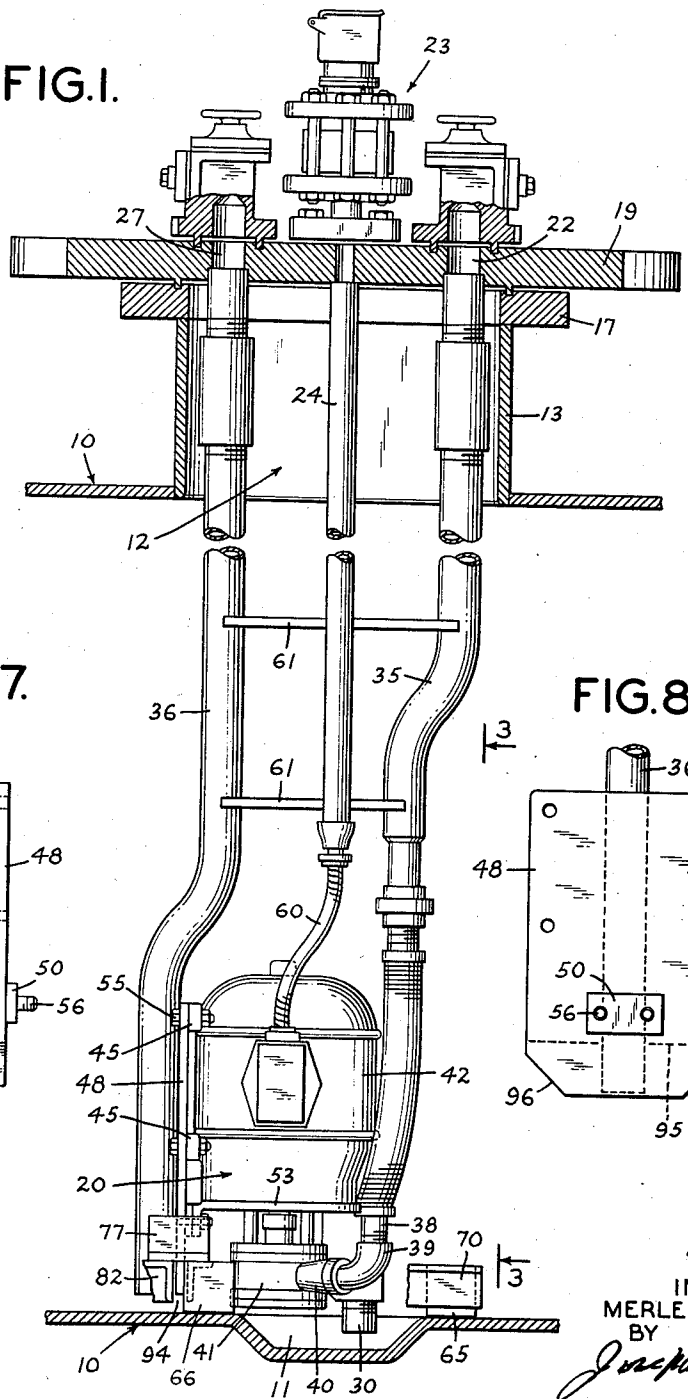


FIG.7.

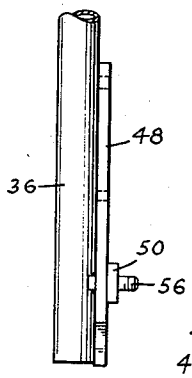


FIG.8.

INVENTOR
MERLE F. KOBLISH
BY
Joseph A. Ryan
ATTORNEY

April 12, 1960 M. F. KOBLISH 2,932,310

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FIG.2.

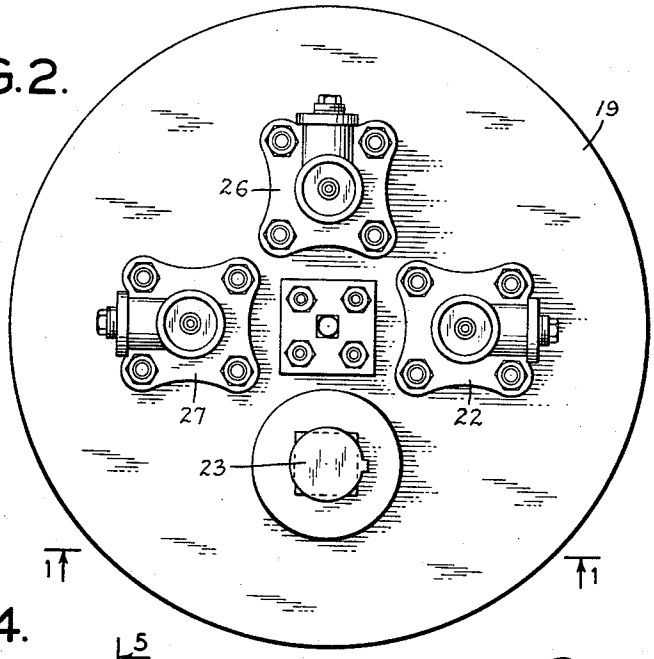


FIG.4.

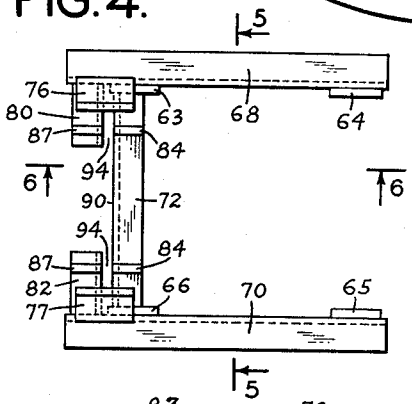


FIG.5.

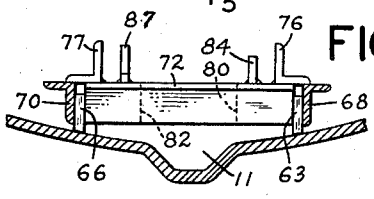


FIG.6.

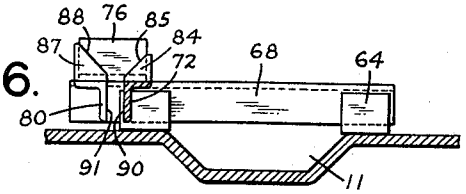
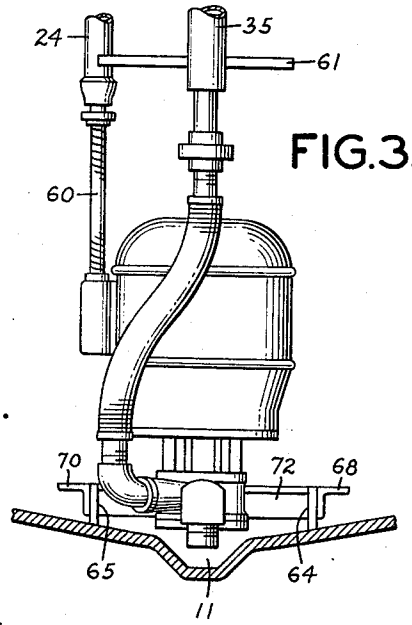


FIG.3.



INVENTOR
MERLE F. KOBLISH
BY
Joseph A. Ryan
ATTORNEY

April 12, 1960 M. F. KOBLISH 2,932,310

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FIG.9.

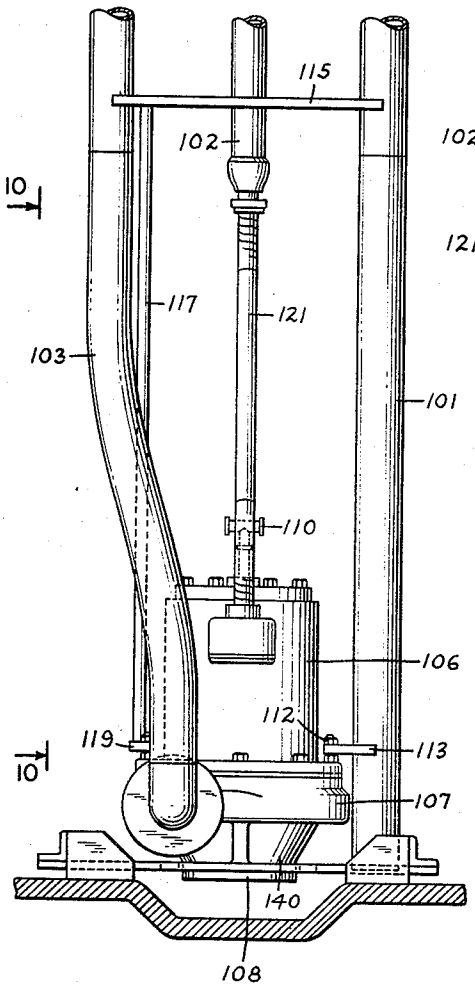
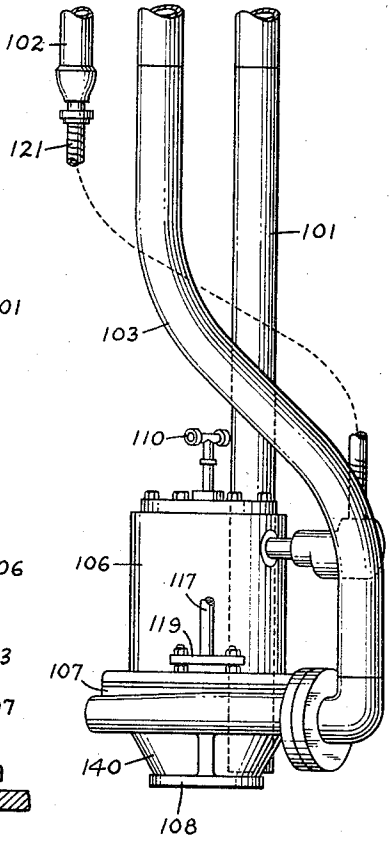


FIG.10.



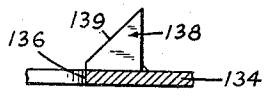


FIG.12.

INVENTOR
MERLE F. KOBLISH
BY
Joseph A. Regan
ATTORNEY

April 12, 1960 M. F. KOBLISH 2,932,310

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FIG.11.

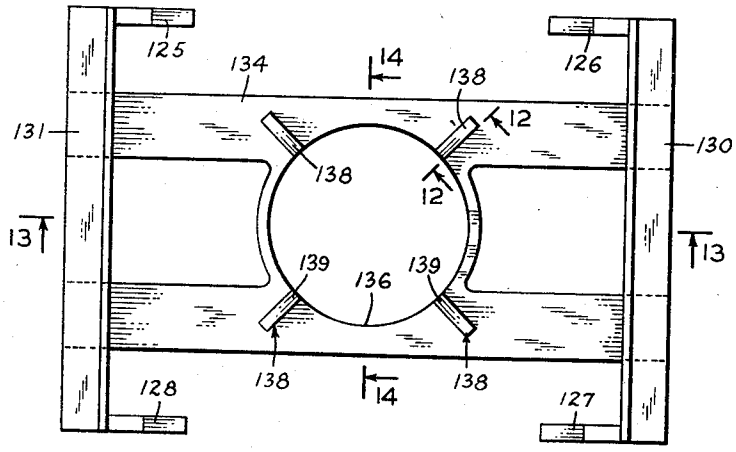
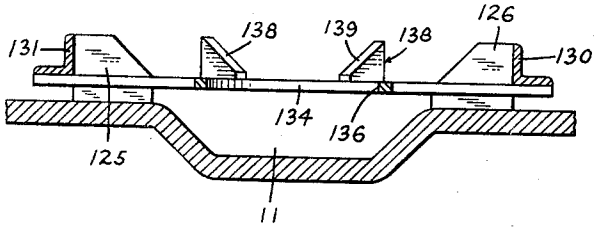


FIG.13.



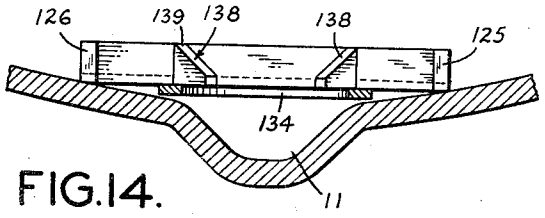


FIG.14.

INVENTOR
MERLE F. KOBLISH
BY
Charles A. Ryan
ATTORNEY

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2,932,310

APPARATUS FOR LIQUEFIED GAS TRANSFER

Merle F. Koblish, Morristown, N.J., assignor to Allied Chemical Corporation, a corporation of New York

Application September 16, 1957, Serial No. 684,270

2 Claims. (Cl. 137—212)

This invention relates to apparatus for the transportation, transfer, or storage of materials which are gases at normal temperature and pressure but which are handled, at least prior to ultimate use, as liquids maintained under pressure. An example of these materials is a 50/50 mixture of CCl_2F_2 and CCl_3F. This mixture, an important commercial chlorofluorocarbon commodity, is normally a gas and is customarily shipped and stored in bulk in liquid phase under suitable pressure. This invention relates more particularly to apparatus for discharging bulk quantities of such materials from a container. While the apparatus of the invention is of equal utility for transferring such materials from one stationary storage tank to another or from a storage tank to a point of process use, for convenience, the invention is described in connection with the unloading of tank cars into wayside storage tanks at customers' locations.

In general practice regarding tank car shipment of liquids, unloading is effected by gravity flow thru outlet valves in the tank car sump or by putting the liquid in the tank under sufficient air pressure to force the liquid out thru an eduction pipe having its lower inlet end opening into the car sump and its upper end exiting the car thru the manhole cover. However, as to tank car shipment of materials such as above noted, use of bottom discharge tank cars is prohibited, and compressed air for top unloading cannot be employed because of product contamination by air. Hence, prior to the present improvements, tank car unloading of materials of the characteristics above indicated has been effected by one or the other of two specialized methods.

According to one procedure, at least a heel of the product material to be unloaded from the tank car is maintained in the customer's storage tank. A portion of this heel is withdrawn as vapor, relatively highly compressed in a refrigeration type compressor, and then fed into the top of the tank car to create sufficient pressure therein to discharge the liquid content of the car tank thru the sump-manhole eduction pipe and thru suitable pipe connections to the customer's storage tank, i.e. unloading is about the same as with compressed air, except that the pressurizing medium is vapor of the material being unloaded. In another procedure, in which a pump at the customer's location is employed, the suction side of the pump is connected to both the heel in the customer's storage tank and to the liquid in the tank car, and the pressure side of the pump is connected with the customer's tank and via a vaporizing heater with the gas space in the car tank. The pump is primed by withdrawing heel from the customer's tank, passing the same thru the pump and heater to vaporize enough material to create sufficient gas pressure in the top of the tank car to force liquid to the suction side of the pump. Thereafter, throughout the unloading operation, part of the liquid discharged from the tank car is by-passed thru the heater, vaporized, and returned to the gas space in the car to maintain therein a sufficiently high pressure in the gas space of the car tank to supplementally force-feed the

suction side of the pump, this combination of pressure-suction feed to the pump being necessary to prevent gas locking and resultant loss of pump prime. With regard to each of the two foregoing procedures, high installation, maintenance and operating costs of the equipment at the customer's location are obvious.

The object of this invention is to provide tank unloading apparatus which eliminates the maintenance of all the above-described compressors, pumps, and heaters and elaborate piping at the customer's location, and which necessitates no customer maintained equipment other than a source of electric current, and a simple pressure equalizing conduit adapted to connect the top of the customer's storage tank with the gas space in the top of the car tank. Another object of the invention is to provide apparatus which effects the foregoing improvements and which requires a minimum of modification of existing tank cars.

The invention and the objects and advantages thereof will be apparent from the following description taken in connection with the accompanying drawings, in which

Fig. 1 is an elevation of one form of the unitary manhole cover-submerged pump assembly of the invention as adapted for use in conjunction with a tank car, Fig. 1 being taken approximately on the line **1—1** of Fig. 2;

Fig. 2 is a plan of Fig. 1;

Fig. 3 is a side view of the lower portion of Fig. 1 taken approximately on line **3—3** of Fig. 1;

Fig. 4 is a plan view of socket arrangement located on the bottom of the car, substantially concentrically with the vertical center line of the manhole, and adapted to receive, center and rigidly secure the lower end of the assembly in place but in non-fixed relation with the bottom of the tank car;

Fig. 5 is a vertical section taken transversely thru the bottom of the car and on the line **5—5** of Fig. 4;

Fig. 6 is a vertical section taken longitudinally thru the bottom of the car and on the line **6—6** of Fig. 4;

Fig. 7 is an elevational detail of a lower portion of Fig. 1 showing partially a mode of connecting a motor casing to a supporting member;

Fig. 8 is a side view of Fig. 7;

Fig. 9 is an elevation, similar to Fig. 1, of another form of the invention; a plan view of the embodiment of Fig. 9 being the same as the plan view of Fig. 2 if the plan of Fig. 2 were rotated 180° in the plane of the paper;

Fig. 10 is a side view of Fig. 9 taken approximately on the line **10—10** of Fig. 9;

Fig. 11 is a plan view of a modified socket arrangement located in the bottom of the tank car and functioning similarly to the arrangement of Fig. 4;

Fig. 12 is an elevation of a detail taken on the line **12—12** of Fig. 11;

Fig. 13 is a vertical section taken longitudinally thru the bottom of the car and on the line **13—13** of Fig. 11; and

Fig. 14 is a vertical section taken transversely thru the bottom of the car and on a line **14—14** of Fig. 11.

Referring to Fig. 1 of the drawing, **10** indicates a tank car (in vertical longitudinal section) having a sump **11** and a manhole opening **12** defined by a cylindrical sleeve **13** terminating in an outwardly projecting flange **17** to which a manhole cover may be securely attached in gas-tight relation by suitable bolts not shown. The center of sump **11** is approximately in vertical alignment with the vertical center line of the manhole **12**.

The unitary manhole cover-pump assembly of the invention comprises, as major elements, a manhole cover **19** and a dependently attached motor-pump unit indicated generally by **20**. As shown in Figs. 1 and 2, the manhole cover is provided with a valved liquid discharge

port 22, a receptacle 23 for electrical energy input and an associated tubular conduit 24 for an electric cable, and a valved inlet port 26 affording means for introduction of vapor into the gas space in the top of the tank. In the preferred embodiment, the cover 19 also includes a supplemental valved liquid discharge port 27. Receptacle 23 and the valves associated with discharge ports 22 and 27 and with the vapor inlet 26 may be secured in gas-tight relation to the manhole cover by conventional means.

In accordance with the invention, the motor-pump unit 20 is connected to and rigidly supported from the underside of the manhole cover. As indicated in Fig. 1, a motor-pump unit is placed, with respect to the manhole cover and the manhole, so that the pump inlet 30 is maintained substantially contiguous with the bottom of the car and projects somewhat into sump 11. Another feature of the invention is that the unitary assembly, below the under face of the cover, has cross-sectional dimensions less than those of the manhole. Considering this feature and the vertical position of the motor-pump unit with regard to the car bottom, while any suitably constructed and arranged connecting and supporting elements may be employed to rigidly attach the motor-pump unit to the cover 19, aspects of the invention include simplification of design and minimization of the number of parts employed. To this end, the invention affords substantially total support of the motor-pump unit and rigid connection thereof to the manhole cover by means of rigid conduits 35 and 36, each of which serves a double function. Conduit 35 constitutes the primary liquid discharge conduit of the car tank, and is rigidly connected at its upper end to cover 19 and opens into valved discharge port 22, while the lower end of conduit 35, via a nipple 38 and an elbow 39, is rigidly connected to the discharge outlet 40 of a turbine-type rotary pump 41. Supplemental discharge conduit 36 is rigidly attached at its upper end to cover 19 and opens into valved discharge port 27.

Motor 42 and pump 41, close-coupled thru a common shaft, constitute the motor-pump unit which is constructed for liquid-submerged operation as known in the art. The casing of motor 42 is provided, in the embodiment shown, with four attaching ears 45 which are integral parts of the casing. As shown particularly in Figs. 7 and 8, a rugged plate 48, generally rectangular in elevation, is attached to the lower end of supplemental discharge pipe 36 as by welding along the line of contact between the contiguous face of plate 48 and the circumference of conduit 36. A rectangular shim 50, Figs. 7 and 8, affords another double bolt connection between plate 48 and a pair of ears integral with and depending from the lower rim 53 of the motor casing. Thus, by bolts 55 and 56 and plate 48, the motor-pump unit is rigidly secured to the lower end of discharge pipe 36. Receptacle 23, tubular conduit 24 and flexible cable 60 afford means for supplying electrical energy to the motor 42. Additional rigidity as between the motor-pump unit, conduits 36, 24 and 35, and manhole cover 19, may be effected by spider plates 61 which at their edges are recessed semicircularly and are welded to each of the three conduits at points of contact.

Because of the rough usage to which tank cars and trucks are subjected, it is necessary to stabilize the position of the motor-pump unit in the bottom of the car. The invention provides adequate stabilization but in a way such that there is no fixed connection between the lower end of the unitary manhole cover-pump assembly and the bottom of the tank car. For this purpose, a suitable socket is fixed to the bottom of the tank car substantially in coaxial alignment with the center line of the manhole. A socket particularly adaptable to cooperate with conduit 36 and plate 48 is exemplified in Figs. 4–6, and to some extent in Fig. 1 which show four upstanding studs 63, 64, 65 and 66 welded at their lower edges to the bottom of the tank car and symmetrically spaced about sump 11. To

the outer vertical faces of studs 63 and 64 is welded a horizontally disposed angle iron 68, a similar angle iron 70 being welded to the outer faces of studs 65 and 66. As shown particularly in Figs. 4 and 6, the opposite ends of an angle iron 72 are welded to the inner faces of studs 63 and 66 in such position that the upper horizontal flange of angle iron 72 lies in the same plane as the horizontal flanges of angle irons 68 and 70. The lower horizontal flanges of two short angle irons 76 and 77 are welded to the upper faces of angle irons 68, 70 and 72, Figs. 4 and 5. One end of a short angle iron 80, Figs. 4 and 6, is welded to the vertical flange of angle iron 68, and part of one end of the upper face of angle iron 80 is welded to the underside of short angle iron 76. A corresponding angle iron 82 is similarly welded at one end to the vertical flange of angle iron 70 and to the under face of short angle iron 77. The horizontal face of angle iron 72 is provided with two relatively short upstanding studs 84 each having a sloping edge 85 as seen in elevation in Fig. 6. The upper faces of angle irons 80 and 82 are provided with similar upstanding studs 87 each having sloping edges 88 as seen in Fig. 6.

The inner vertical faces of short angle irons 76 and 77, the vertical face 90 of angle iron 72, and the inner vertical faces 91 of short angle irons 80 and 82 all together form a slot 94 which is adapted to receive, as a tongue-like projection, that portion of plate 48, Fig. 8, below dotted line 95. When the entire assembly is being put in position in the car by lowering the manhole cover 19 into contact with flange 17, the converging sloping faces 85 and 88, Fig. 6, of studs 84 and 87, in conjunction with the tapers 96 of plate 48 (Fig. 8) on contacting the inner edges of the vertical flanges of short angle irons 76 and 77 (Figs. 4 and 6), all cooperate to guide the lower end of plate 48 into the slot 94. Hence, after insertion of the lower end of plate 48 into slot 94 all lateral movement of the motor-pump unit is prevented, although at the same time the lower end of the assembly is non-fixed with respect to the tank car bottom. As above described, overall cross-sectional dimensions of the assembly are less than those of the manhole, and the overall longitudinal dimensions of the assembly as a whole are such that the pump inlet is maintained substantially contiguous with the bottom of the tank. Accordingly, it will be apparent that the assembly is readily insertable in and removable from the tank car, and that the socket arrangement provided at the bottom of the tank car is such that existing cars need be modified to only a minor degree to afford a socket facility which functions to space the pump inlet sufficiently from the bottom of the tank to permit liquor inflow, and at the same time prevent any lateral movement of the motor-pump unit.

The invention is such that, with relatively minor structural modification, the apparatus may be adopted for use of several styles and types of commercially available close-coupled motor-rotary pump units designed for operation when submerged in a liquid. A modification of this nature is illustrated in Figs. 9–14.

In Fig. 9, conduits 101, 102 and 103 correspond structurally and functionally with conduits 36, 24 and 35 of Fig. 1 respectively. The motor-pump unit of Fig. 9 comprises a motor casing 106 the lower end of which is attached directly to the casing 107 of a close-coupled centrifugal type pump having a liquid inlet 108. This unit is of known type in which moving parts of the motor are lubricated by the liquid being pumped, construction being such that a relatively small amount of the liquid being pumped is pressured upwardly thru the rotor of the motor and is discharged back into the tank thru jets 110.

As in Fig. 1, the motor-pump unit of Fig. 9 is rigidly suspended from the manhole cover through conduits 101, 102 and 103. The lower end of supplemental liquid discharge conduit 101 is rigidly attached to the motor casing by bolt 112 and a plate 113, the outer edge of which

is semi-circularly indented to fit snugly against the circumference of conduit **101**, the plate and conduit being welded at the point of contact. Spider plate **115** is welded to conduits **101**, **102** and **103** similarly as spider plates **61** of Fig. 1. To provide additional rigidity and vertical support, the upper end of a rod **117** is welded to spider plate **115**, and the lower end of the rod carries a T **119** the ends of which are bolted to the flange of the motor casing particularly as shown in Fig. 10. Current is supplied to motor **106** through cable **121**.

It will be noted that the configuration of the lower extremity of the motor-pump unit differs substantially from that of the lower end of the motor-pump unit of Fig. 1. As plainly seen in Figs. 9 and 10, the lower end of pump casing **107** is frusto-conical in form and terminates in the open liquid inlet **108**. In view of the different design of the lower part of the motor-pump unit, the socket built into the bottom of the tank car and surrounding the sump differs to some extent from the socket of Fig. 1.

Referring to Figs. 11, 13 and 14 the lower edges of upstanding studs **125**, **126**, **127** and **128** are welded to the tank car bottom, and these studs correspond to studs **63**, **64**, **65** and **66** of Fig. 4. The vertical inner faces of angle irons **130** and **131**, Fig. 13, are welded to the outer vertical edges of the adjacent studs. The upper faces of the four extremities of an H-shaped plate **134** are welded to the under horizontal faces of angle irons **130** and **131**. In the center of plate **134** is a circular opening **136** of diameter sufficient to permit the insertion of the lowermost end of the pump casing. Spaced about the circumference of opening **136** and welded to the upper face of plate **134** are upstanding studs **138** having inwardly and downwardly sloping edges **139**, Fig. 12. It will be seen that opening **136** in conjunction with studs **138** form a partially funnel-shaped socket adapted to receive the frusto-conical lower end **140** of the pump casing. When the assembly of the Figs. 9 and 10 modification is being placed in the tank car, sloping edges **139** of studs **138** cooperate with the conical bottom **140** of the pump casing, and function to direct the lower end of the pump casing into opening **136**, the circumference of which thereafter holds the lower end of the assembly rigidly as to lateral movement but non-fixed with regard to the tank car bottom.

On arrival at a customer's location, the outlet of the valve associated with liquid discharge port **22**, Fig. 1, is connected by a suitable conduit to the liquid inlet of the customer's storage tank. The only other connection between the tank car and the customer's storage tank is a conduit attached at one end to the valve of the tank car vapor inlet **26**, Fig. 2, and at the other end to the gas space in the customer's storage tank, the function of this conduit being to equalize pressures in the gas spaces in the top of the car tank and in the top of the customer's tank. When using the submerged pump of the present development, the valve associated with the supplemental liquid discharge port **27** of Fig. 1 is kept closed and inoperative. The motor-pump unit is then put in operation, and discharge of liquid from the car tank proceeds via liquid discharge conduit **35**, port **22** and the pipe connection between the valve of the latter and the customer's tank. The pump-motor unit, being submerged in the tank liquid, is self-priming, pump prime is never lost because of gas lock, and the tank may be emptied down to the sump level without any operation difficulties.

The simplicity and low installation, operating and maintenance costs of the described apparatus, as compared with the related prior art as outlined at the head of this specification, are self-evident.

A further important feature of the invention involves the dual function of supplemental discharge pipes **36** and **101**. As stated above, these supplemental discharge pipes primarily constitute partial supports for the motor-pump units. It will be noted, however, that the lower open ends of pipes **36** and **101** are in approximately the same horizontal plane as the pump inlets. If the customer's location is already provided with one or the other of prior art unloading equipment and it is desired to use the same, or for any reason it is undesirable, e.g. a temporary breakdown, to employ the motor-pump unit of the invention, the prior art unloading equipment may be utilized by simple expedient of valve manipulation. For example, if the customer's equipment is of the compressor type, the vapor line of the compressor may be connected to the valve of vapor inlet port **26**, Fig. 2, and the liquid conduit opening at one end into the top of the customer's storage tank may be connected at its other end to the valve associated with liquid discharge port **27**, Fig. 1, and supplemental discharge pipe **36**. On the other hand, if the customer's equipment comprises the described suction pump-heater arrangement, the suction side of the customer's pump may be connected to the valve of liquid discharge port **27**, Fig. 1, and the vapor line communicating with the outlet side of the customer's heater may be connected at its other end to the vapor inlet port **26**, Fig. 2. In both these instances, liquid discharge is thru supplemental discharge pipes **36** or **101**, and the valve associated with outlet port **22** is kept closed. Accordingly, the invention provides apparatus which affords minimum simplicity and cost, minimum modification of existing tank cars, elimination of the necessity of installing expensive equipment at a customer's location, and at the same time permits use of already existing loading equipment if desired.

I claim:

1. A gas-tight container having a manhole in the top wall and a sump in the bottom wall substantially in coaxial alignment with the center line of said manhole, a unitary manhole cover-pump assembly comprising a cover; means for attaching said cover to the manhole periphery in gas-tight, cover supporting relation; said cover having a pair of valved liquid discharge ports, a valved vapor inlet port communicating with the interior of the container and a receptacle for electrical energy input; an encased motor-pump unit; means for rigidly supporting said unit from the underside of said cover comprising a liquid discharge conduit fixed at the upper end to one of said discharge ports and at the lower end to the pump discharge, a second liquid discharge conduit fixed at the upper end to the other of said discharge ports and having the lower open liquid inlet end contiguous with the bottom of the container, the lower end of said second discharge conduit being fixed to the casing of said unit; and an electrical conductor between the motor of said motor-pump unit and said receptacle, a socket upstandingly fixed to the bottom of said container at said sump and substantially in coaxial alignment with the center line of said manhole, means carried by the lower end of the assembly for registering with said socket to laterally rigidly secure the lower end of said assembly in readily removable manner with said bottom; said assembly below said cover having cross-sectional dimensions less than those of said manhole whereby said assembly is readily insertable in and removable from said container, and longitudinal dimensions sufficient so that the pump inlet is maintained substantially contiguous with the bottom of said container.

2. The apparatus of claim 1 in which the said means for rigidly supporting said unit from the underside of the cover includes a tubular conduit adapted to house said electrical conductor and being fixed at the upper end to the underside of said cover and extending downwardly a substantial distance toward said unit, and a rigid tie member fixed to each of said tubular conduit and said liquid discharge conduits.

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