May 14, 1957 T. VEITCH, SR., ET AL 2,792,158

PRESSURE EVACUATING MEANS FOR STORAGE VESSELS

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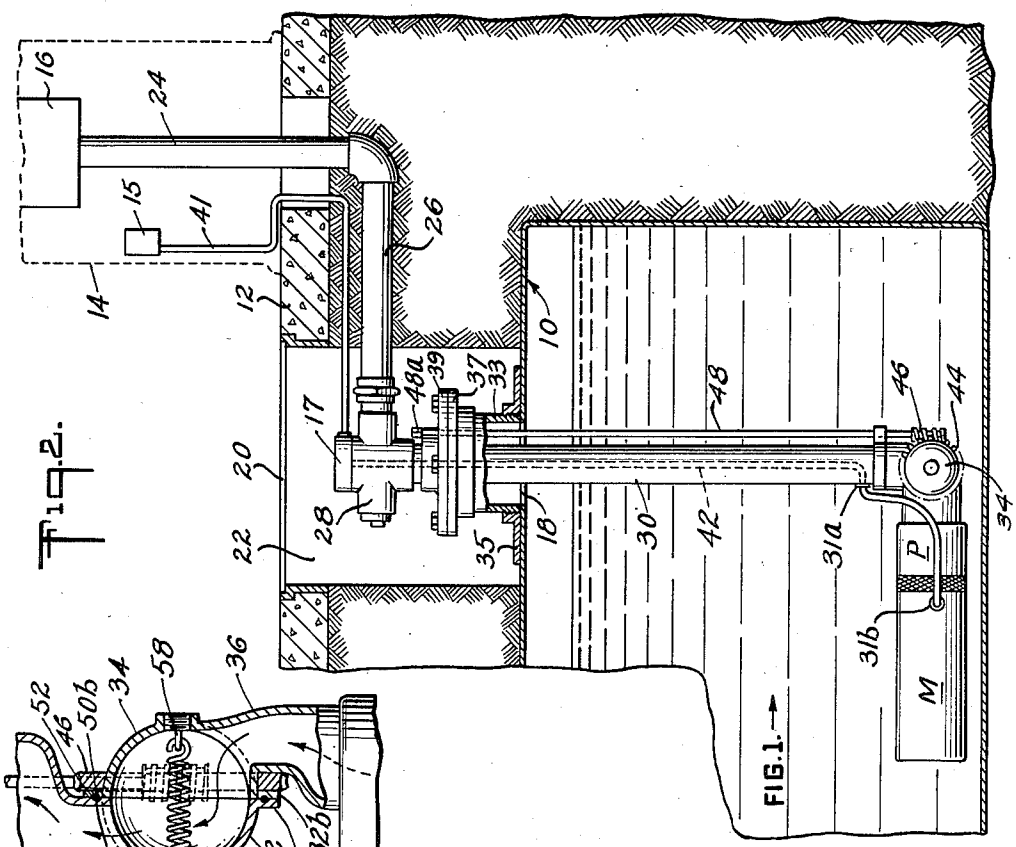


FIG. 1.

Fig. 2.

Fig. 3.

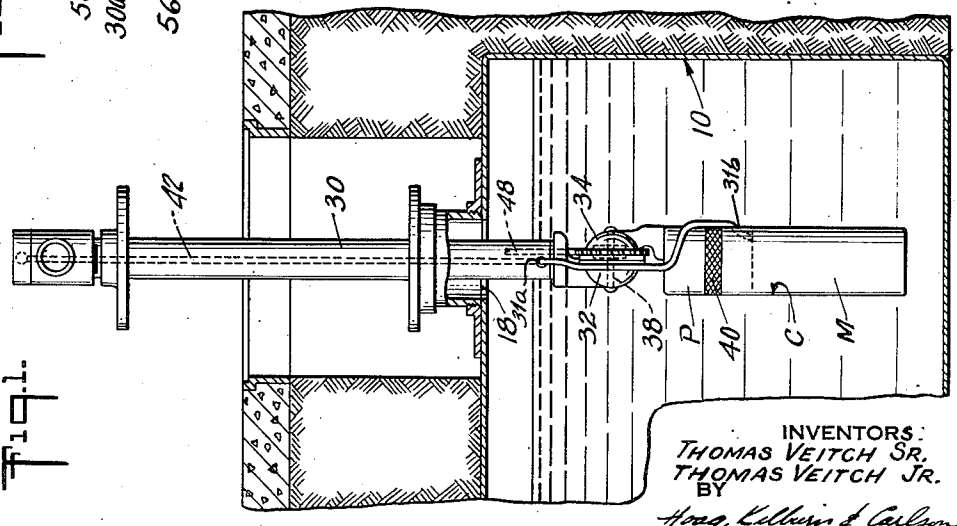


Fig. 1.

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Fig. 6.

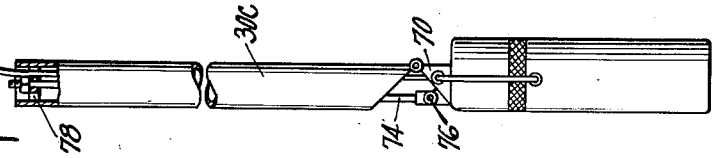


Fig. 5.

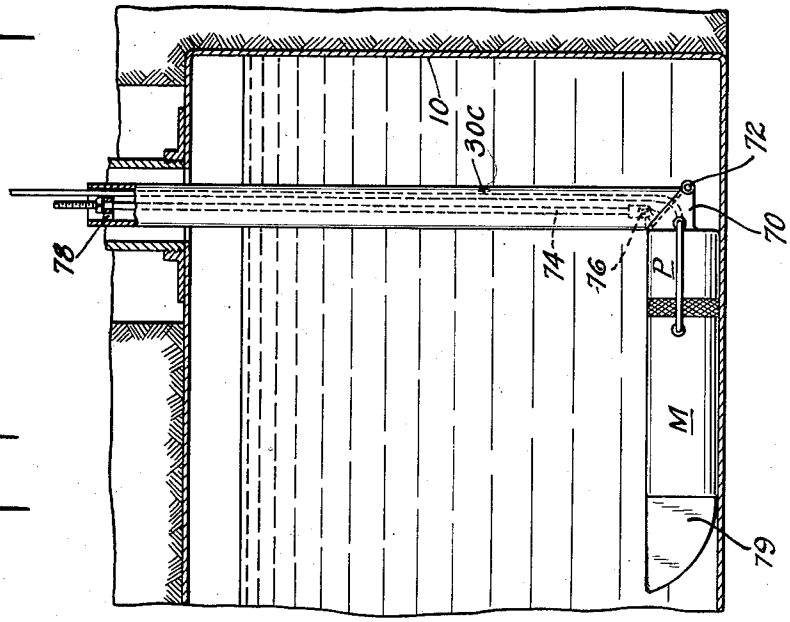
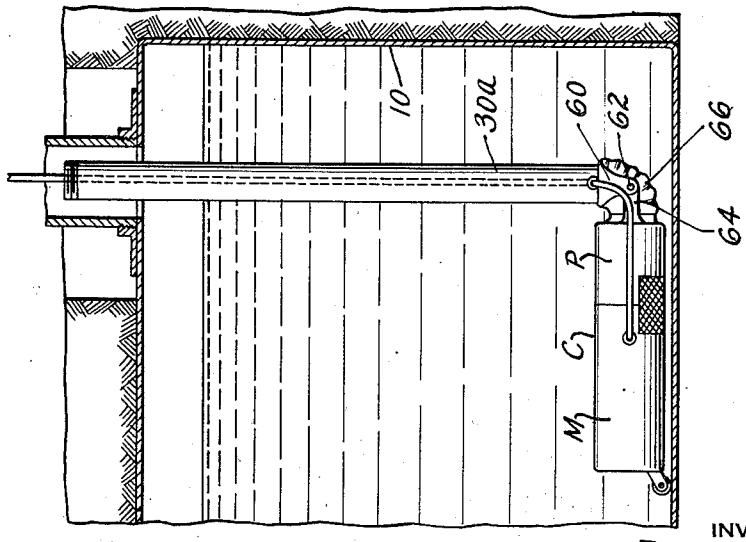


Fig. 4.



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Fig. 8.

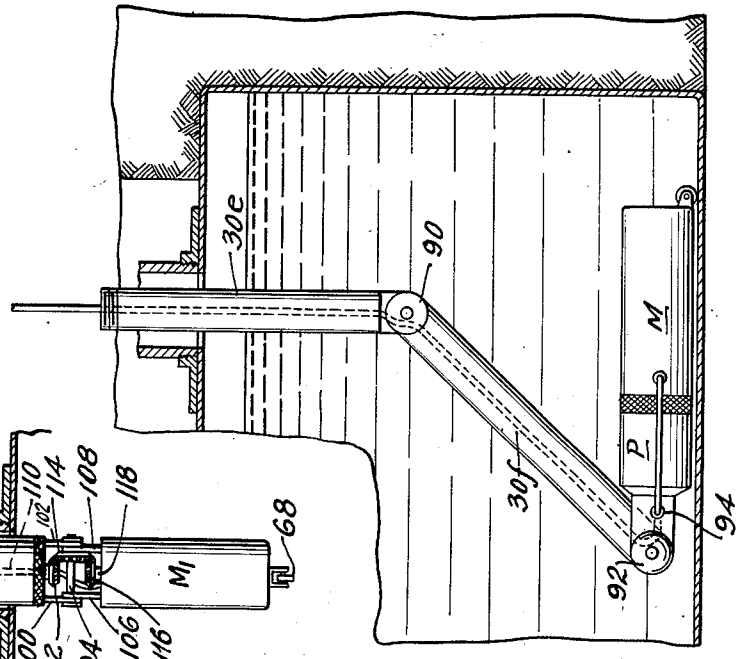
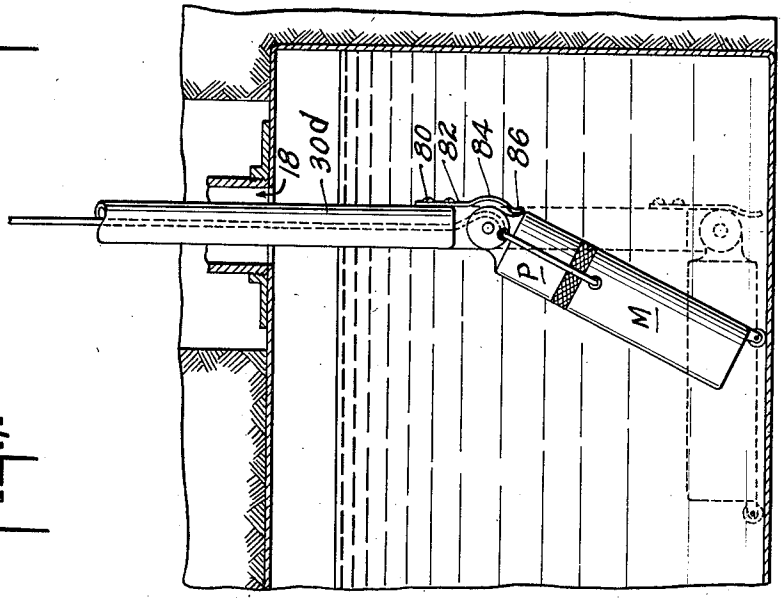


Fig. 9.

Fig. 7.



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PRESSURE EVACUATING MEANS FOR STORAGE VESSELS

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Application January 19, 1954, Serial No. 404,942

14 Claims. (Cl. 222—333)

Our invention relates to apparatus insertable even into tanks having a very small access opening, by which even the liquid at the bottom of a tank may be evacuated under pressure.

The means disclosed are such that both a motor and a pump may be inserted into a tank through a small access opening and then disposed within the tank to position the liquid intake of the pump at the bottom of the tank, or at a desired level within the tank, and to position the motor so that it will not reduce the effective area of the discharge conduit.

It has been customary to withdraw liquids from tanks by means of suction, the suction producing means being external to the tank. For example, in the case of service stations supplying gasoline it has been customary to position both a motor and a pump in a cabinet above ground, along with means for measuring and dispensing the gasoline, and to raise the gasoline to the dispensing point from a storage tank disposed underground by using a suction pump to create suction within a pipe or conduit leading from the pump into the storage tank. However, this procedure is not satisfactory where the liquids are highly volatile and may vaporize in the pipe leading to the pump. It will be understood that vapor accumulating in the piping will interfere with the supply and measuring of the liquid and may cause vapor lock rendering the pump action entirely ineffective.

In recent years many liquids of high volatility have come into general use such for example as petroleum products, cleaning fluids, and chemical solvents. It is well known that in the art of producing liquid fuels, notably gasoline, there is an increasing trend toward providing liquids of high octane rating and increased volatility. The problem of vapor forming in piping leading from a storage tank to a suction pump located above ground becomes acute for service stations exposed to prolonged high temperatures, and especially when located at higher altitudes where the lessened atmospheric pressure causes vapor to form more readily in the piping. In gasoline dispensing stations where the underground storage tanks are located some distance from the pumping units the long "draw" combined with the vertical "lift" further increases the chance of vapor forming in the piping.

The access openings of underground storage tanks of the type now in use in gasoline filling stations are very narrow, usually from 3" to 3½" in diameter. While it has long been realized that the problem of vapor lock could be overcome if a submerged motor driven pressure pump could be substituted for the suction pump equipment now in use, the practical problems involved in making such substitution have remained unsolved. It is impractical to mount a motor outside of the storage tank and drive it through a shaft as in many cases there is insufficient room between the tank access opening and the surface of the ground. Furthermore, the shaft projecting from a motor outside of the storage tank would be too long. If a pump and motor are inserted into a tank through its access opening and hung from and supported by the lower end of a discharge pipe leading from the tank the space within the pipe, which must be small enough to pass through the access opening, will be substantially taken up by the motor if the motor is positioned above the pump. Or if the pump is positioned above the motor, to avoid the difficulty of pumping the liquid past the motor, the pump will be suspended above the bottom of the tank a distance depending upon the height of the motor, leaving a volume of liquid in the tank which will not be evacuated by the pump.

An object of the invention is to provide a motor, pump and conduit combination in which said elements are interrelated and interconnected in such a way that they can be inserted into tanks, including those having the very small access openings referred to above, and disposed within the tank in such a way as to position the pump intake at the bottom of the tank without having the motor blocking the conduit leading from the discharge end of the pump.

Another object of our invention is to make it possible to insert a motor, pressure pump and conduit into a tank including tanks of existing dispensing systems having very restricted access openings, and thereafter dispose the motor, or a motor and pump assembly, substantially at right angles to the axis of the access opening so that the pump intake will be at, or as near to the bottom of the tank as is desired, and can evacuate the liquid stored in the tank by subjecting the liquid to pressure at the point where it enters the piping leading from the tank, thus preventing vaporizing of the liquid.

Another object of our invention is to provide pressure evacuating means for liquid which may be substituted for suction pumping means in existing installations without major structural changes in the station equipment and piping and no change whatever in measuring and computing equipment.

Other objects of the invention will be in part obvious or in part pointed out hereinafter.

The invention accordingly consists in the features of construction, combinations of elements, arrangements of parts, and in the several steps and relation and order of each of said steps to one or more of the others thereof, all as will be pointed out in the following description, and the scope of the application of which will be indicated in the following claims.

The invention will best be understood if the following description is read in connection with the drawings, in which,

Figure 1 is a side elevation, partly in section, of a storage tank showing an assembly of motor, pump and fluid discharge conduit being lowered into the storage tank;

Figure 2 is a view similar to Figure 1 but showing the elements of the assembly after being disposed within the storage tank in a manner made possible by the invention;

Figure 3 is a detail vertical view in cross section taken through the flexible joint interconnecting the pump and the main body of the discharge conduit;

Figure 4 is a view similar to Figure 2 and shows a modification of flexible joint and means interconnecting the pump and the main body of the discharge conduit;

Figure 5 is a side elevational view, partly in section, showing a modification of means for interconnecting the motor and pump assembly with said assembly disposed substantially at right angles to the discharge conduit;

Figure 6 is a side elevational view, partly in section, showing the motor, pump and discharge conduit elements of Figure 5 when axially aligned as for insertion through the access opening of a tank;

Figure 7 is a view similar to Figure 2 showing a modification of means for angularly displacing a motor and pump assembly relative to the discharge conduit and the access opening of a tank;

Figure 8 is a view similar to Figure 2 but showing a modification comprising a plurality of flexible joints interconnecting a motor and pump assembly with the main body of the discharge conduit; and

Figure 9 is a view similar to Figure 2 but showing a modification in which a motor is angularly displaceable relative to a pump and discharge conduit which are in axial alignment.

In Figures 1 and 2 a storage tank **10** is shown located below the ground level indicated by a pavement **12** such as is usually provided in gasoline filling stations for example, and above the ground level is a cabinet **14** having therein measuring and dispensing equipment of known kind, not shown. Storage tank **10** has the small access opening **18** to which access may be had by removing the cover **20** of the manhole **22** extending from the top of pavement **12** to the top of tank **10** around said access opening.

The piping interconnecting storage tank **10** with the measuring and dispensing means comprises the vertical riser **24**, the horizontally extending section **26**, and the cross head **28** to which is connected the pipe or conduit portion **30** which extends down into the tank through its access opening **18**.

The invention comprises means for interconnecting the elements of an assembly of a motor, pump and discharge conduit in such a way that the elements may be inserted into a tank through a narrow access opening, which requires that they be inserted in axial alignment, and thereafter disposed within the tank to position the inlet of the pump at the bottom of the tank so that all of the fluid in the tank may be evacuated, and without restricting the size of the discharge conduit except as is required by the size of the tank access opening. Figures 1 to 8 inclusive show combinations with a fluid conduit of a motor and pump assembly which is angularly displaceable relative to said conduit after said elements are inserted within a tank. Figure 9 illustrates an assembly in which the motor is angularly displaceable relative to a pump disposed in axial alignment with the discharge conduit.

In the embodiment of the invention shown in Figures 1–3 a flexible joint is shown comprising the two opposed semi-spherical members **32** and **34** the peripheries of which are slidingly interengaged at their interface permitting one member to be rotated with respect to the other. One member, **32**, is secured to and in communication with the lower end **30***a* of conduit **30** and the other member, **34**, is connected to, and in communication with, the short pipe **36** leading from the discharge end of pump P. In Figure 1 the two opposed semi-spherical members **32** and **34** are shown positively joined together by a cross bolt **38** extending diametrically through said members and constituting a pivot on which said members may rotate through the desired angle, relative to one another.

The motor and pump are of a diameter which is small enough to permit said members to be inserted through said access opening **18**, and they are joined together within a common casing *c* having the screened opening **40** between the motor and pump and on a level with the pump inlet. The motor M is connected to a source of power as for example switch **15** in cabinet **14**, by cable **41** extending from switch **15** to the connection box **17**, and by flexible cable **42** extending from connection box **17** through access opening **18**, and desirably through the conduit **30** to the sealed opening **31***a* and over the flexible coupling to the sealed opening **31***b* in the casing *c*.

In Figure 1 the assembly, comprising motor M and pump P and conduit **30** including the flexible joint members **32** and **34**, is shown being lowered into tank **10** through its access opening **18**. At this stage the motor and pump and conduit are all in vertical alignment. If allowed to remain in this position, even with the motor touching the bottom of the tank, the pump inlet **40** would be spaced by the motor a substantial distance above the bottom of the tank, and there would be a large amount of liquid in the lower portion of tank **10** (all of the liquid below the level of the pump inlet indicated by screened port **40**), which could not be evacuated.

On the outer surface of the spherical flexible joint member **34** is the worm gear **44** which is engaged by worm **46** supported at the lower end of a shaft **48** which extends up through the access opening **18** of tank **10** and through the short nipple **33** screwed into the collar **35** surrounding the access opening **18** and through the flange **39** secured to discharge conduit **30** and screwed to the top of flange **37** projecting from the top of nipple **33**. Said rod **48** has an enlarged head portion **48***a* to facilitate rotating said rod to cause worm **46** to rotate worm wheel **44** and thereby swing said motor and pump assembly angularly with relation to conduit **30**, such action preferably taking place while the assembly of motor, pump and conduit are being inserted into tank **10**, and while about in the position shown in Figure 1, before the motor and pump unit has been lowered into contact with the bottom of the tank, as shown in Figure 2.

After being swung angularly, preferably through substantially 90°, the lowering of motor, pump and conduit may be completed to cause the motor and pump to be disposed horizontally along the bottom of the tank and substantially at right angles to the main portion of conduit **30** which extends through the access opening **18**. It will be seen that in this position the inlet opening **40** will be substantially at the bottom of tank **10**. Of course the inlet **40** may be spaced above the bottom of the tank if desired, the important thing being that the level of the inlet is not controlled by the height or size of the motor.

In Figure 3 the opposed flanges **32***a* and **32***b* of said semi-spherical members **32** and **34** are shown provided with opposed semi-cylindrical surface grooves **50***a* and **50***b* and an O-washer **52** is seated in the groove thus provided by the opposed members **32** and **34**. In Figure 3 a spring **54** is shown interconnected between flexible joint member **32** and **34** to yieldingly hold them together. The spring is formed with hook ends for engagement with the eyes **56** and **58** respectively, detachably secured to members **32** and **34**.

In the modification shown in Figure 4 the main discharge conduit **30***a* has the rigid ears **60** projecting from its lower end and these ears are pivotally connected as by pivot **62** to the ears **64** projecting from the pump P or more exactly from the periphery of the casing *c* which encloses both the motor and the pump. Intercommunicating between conduit **30***a* and the inlet of pump P and partly encompassed by said pivoted pairs of ears is a length of flexible conduit **66**. It will be understood that the motor and pump unit may be suspended from conduit **30***a* in axial alignment therewith or may be swung on pivot **62** for rotation relative to main conduit **30***a* while fluid connection between the pump and said conduit **30***a* is maintained at all times.

In Figure 4 a caster-like projection **68** is shown projecting from the periphery of the casing *c* at a point laterally displaced from the axis of the motor and pump unit to facilitate angular movement of the motor longitudinally of the tank and into angular displacement relative to the axis of the access opening **18** of the tank. Obviously member **68** may be employed in any of the illustrated embodiments of the invention. When positioned at a point radially spaced from the axis of casing *c* a portion of the weight of the assembly acts as a force urging the pump and motor unit to move out of axial alignment with the tank access opening.

In Figures 5 and 6 the pump P has a short pipe **70** communicating with its discharge side and projecting from one end of the pump, said pipe being cut off at an angle, and the lower end of discharge pipe or conduit **30***c* is

cut off at the bottom at an angle complementary to the angle of the end of pipe 70 and the high points of said pipes 70 and 30*c* are hinged together as by the pivot 72. The opposed edges of said pipes 70 and 30*c* meet causing said pipes to intercommunicate when the motor and pump unit is angularly displaced in relation to conduit 30*c* as illustrated in Figure 5. Pivoted to the motor and pump unit, as for example to the inner surface of pipe 70 by pivot 76 is a rod 74, which as shown extends up through conduit 30*c* and its threaded upper end extends through the internally threaded nut 78, provided within conduit 30*c* above tank 10. By rotating nut 78 rod 74 is caused to move up or down thereby swinging the motor and pump unit. By rotation of nut 78 the pump and motor unit may be moved from a position of alignment with the axis of conduit 30*c* to a position in which it is disposed substantially at right angles to said axis.

Projecting from the end of motor M remote from pump P is a skid 79, which serves to facilitate angular displacement of the motor and pump unit and like the castor-like projection 68 could of course be employed by the motor shown in Figure 9 or the motor and pump unit of any of Figures 1–8.

In Figure 7 discharge conduit 30*d* is shown connected to a motor and pump unit through a flexible coupling, which may for example be of the kind shown in Figures 1–3, and secured to the lower end of conduit 30*d* as by screws 80 is a leaf spring 82 an intermediate portion 84 of which may be bent outwardly to conform to the shape of the flexible coupling interconnecting conduit 30*d* with the outlet of the pump, and the lower extremity 86 of which is free and presses against the surface of the pump and motor unit to yieldingly urge it into a position of lateral displacement relative to conduit 30*d*. Preferably spring 84 is of sufficient strength to initiate displacement of the motor and pump unit relative to the axis of access opening 18 and conduit 30*d* without preventing the motor and pump from being held in axial alignment with said conduit 30*d* while the motor and pump of said unit are being inserted through said opening.

In Figure 8 two flexible or rotatable couplings indicated generally by the numerals 90 and 92 respectively are shown, coupling 90 interconnects discharge conduit portions 30*e* and 30*f* and coupling 92 interconnects conduit 30*f* with the short pipe 94 projecting from the discharge end of pump P.

It will be understood that this conduit structure is self-adjusting in length and so is adapted for use in storage tanks of different sizes. In tanks of small diameter the members 30*e* and 30*f* adjust themselves angularly and similarly in tanks of greater height or diameter the members 30*e* and 30*f* tend to move into axial alignment thus tending to increase their length to the extent required to position the lower end of conduit 30*f* as may be desired.

In Figure 9 a pump P^1 is shown positioned at the lower end of a conduit 30*g*. Projecting from the lower end of pump P^1 are the brackets 100 and 102 which are pivotally connected by means of pivot 104 with the brackets 106 and 108 projecting from one end of the motor M^1. Also projecting from the lower end of pump P^1 is the power shaft 110 having at its extremity the bevel gear 112 which meshes with the bevel gear 114, which may be mounted for rotation on pivot 104, which also meshes with the bevel gear 116 mounted on the end of the power shaft 118 projecting out of the motor toward the pump. Power from motor M^1 is transmitted from power shaft 118 through gears 116, 114 and 112 to the driven shaft 110 of the pump, the interior mechanism of which is not shown since it may be of known kind utilizing the power transmitted to shaft 110.

It will be understood that the drive from the motor to the pump is effective whether the pump and motor are aligned axially or angularly disposed one to the other. It will also be understood that any means such as the spring 84 shown in Figure 7, or the rod 74 shown in Figure 5, or the rod, worm and gear combination shown in Figures 1 and 2, may be applied to the motor M^1 instead of to the pump, or a unitary casing enclosing both pump and motor, and employed to dispose the motor in angular relation to the pump P^1 and conduit 30*g*, thus making it possible to lower the pump substantially to the bottom of a storage tank, the motor being disposed out of the way and in angular relation to the pump.

If desired the castor-like member 68*a*, shown in the center of the lower end of the motor M^1, may be positioned off center to cause angular movement of the motor relative to the pump to be facilitated by the weight of the assembly acting through a laterally extending force vector when the eccentrically positioned member 68*a* strikes the bottom of a storage tank.

The construction shown in Figure 9 like the constructions shown in Figures 1 to 8 has the advantage that the pump intake may be brought down to the very bottom of the storage tank and thus be in a position to exhaust all of the liquid from the tank and in so doing to exert pressure on it at all times thereby preventing the formation of vapor within the discharge conduit or the piping with which it connects and thus avoiding the danger of vapor-lock.

It will thus be seen that there has been provided by this invention an apparatus in which the various objects hereinabove set forth together with many thoroughly practical advantages are successfully achieved. As various possible embodiments might be made of the mechanical features of the above invention and as the art herein described might be varied in various parts, all without departing from the scope of the invention, it is to be understood that all matter hereinbefore set forth or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

What we claim is:

1. Apparatus for insertion into a tank through its access opening which comprises a combination of, a pump, a conduit connected to the output side of said pump, a motor on the opposite side of the pump from said conduit, and a power shaft interconnecting said motor and pump for driving said pump, said combination being characterized in that said conduit, pump and motor are axially aligned when suspended for insertion into a tank through its access opening, said pump and motor being enclosed in a common casing for movement together as a unit, said unit being movable from a position of axial alignment with the axis of said access opening into a position in which it is angularly disposed with respect to the axis of said access opening, and said conduit comprising a portion interconnected with said pump in such a manner that said unit is movable from axial alignment with the axis of said access opening to a position in which it is angularly disposed with respect to the axis of said access opening, and means connected to said casing and extending to a point outside of said tank for swinging said casing from a position of axial alignment with the axis of said access opening into a position in which it is angularly disposed with respect to the axis of said access opening.

2. The apparatus claimed in claim 1 including means pivotally interconnecting said casing and said conduit.

3. Apparatus for insertion into a tank through its access opening which comprises, a combination of a pump, a motor, a power shaft interconnecting said motor and pump for driving said pump, an outlet conduit connected to said pump at a point remote from said motor, and joint means interconnecting said outlet conduit and pump and permitting relative movement between them, the assembly comprising said combination being movable from a position of axial alignment into a position in which said motor and pump are disposed substantially at right angles to the axis of said access opening with the inlet of said pump disposed substantially at the bottom of said tank.

4. The apparatus claimed in claim 3 in which said outlet conduit comprises a rigid portion and a second portion including said joint means interconnected with said pump and movable from axial alignment with said pump and motor to a position in which it is substantially augularly disposed with respect to said pump and motor.

5. The apparatus claimed in claim 3 including a power cable extending from said motor past said pump and through said outlet conduit to a source of power.

6. The apparatus claimed in claim 3 in which said pump and motor are enclosed in a unitary casing, said casing having a fluid inlet intermediate its ends communicating with said pump.

7. The apparatus claimed in claim 6 in combination with means extending from the unit comprising said motor and pump to a point outside said tank and operative to swing said unit from a position of alignment with the axis of the tank opening to a position substantially at right angles to the axis of the tank opening.

8. Apparatus for insertion into a tank through its access opening which comprises a pump, a motor, a power shaft interconnecting said motor and pump for driving said pump, an outlet conduit connected to the output side of said pump and adapted to extend through said access opening to a point outside the tank, joint means interconnecting the conduit and pump and permitting relative movement between the motor and pump sub-assembly and the conduit, a rod extending axially of said conduit and pivot means connecting said rod to said pump, said rod constituting control means for causing the sub-assembly of the pump and motor to be displaced angularly relative to said discharge conduit.

9. Apparatus for insertion into a tank through its access opening which comprises a pump, a motor, a power shaft interconnecting said motor and pump for driving said pump, an outlet conduit connected to the output side of said pump and adapted to extend through said access opening to a point outside the tank, joint means interconnecting the conduit and pump and permitting relative movement between the motor and pump sub-assembly and the conduit, said pump and motor comprising a sub-assembly movable in unison, a rod extending axially of said discharge conduit, a pivot means interconnecting said rod to said sub-assembly, said rod constituting control means for causing said sub-assembly to be displaced angularly relative to said discharge conduit.

10. Apparatus for insertion into a tank through its access opening which comprises a combination of a pump, a motor, a power shaft interconnecting said motor and pump for driving said pump and means projecting from the free end of said casing off center to facilitate angular movement of said casing and the motor and pump contained therein relative to said discharge conduit.

11. Apparatus for insertion into a tank through its access opening which comprises a combination of, a pump, a conduit connected to the output side of said pump, a motor on the opposite side of the pump from said conduit, and a power shaft interconnecting said motor and pump for driving said pump, said combination being characterized in that said conduit, pump and motor are axially aligned when suspended for insertion into a tank through its access opening, said pump and motor being enclosed in a common casing for movement together as a unit, said unit being movable from a position of axial alignment with the axis of said access opening into a position in which it is angularly disposed with respect to the axis of said access opening, and said conduit comprising a portion interconnected with said pump in such a manner that said unit is movable from axial alignment with the axis of said access opening to a position in which it is angularly disposed with respect to the axis of said access opening, said conduit comprising two members with opposed circular peripheries relatively rotatable in the plane of their interface, means holding said members together in all angular positions relative to one another, a worm wheel mounted on one of said members, a worm meshing with said worm wheel, and a rod connected to said worm to rotate it and thereby provide remote control for swinging said member and the means connected to it into a position of angular displacement relative to the axis of said access opening.

12. Apparatus for insertion into a tank through its access opening which comprises a combination of, a pump, a conduit connected to the output side of said pump, a motor on the opposite side of the pump from said conduit, and a power shaft interconnecting said motor and pump for driving said pump, said combination being characterized in that said conduit, pump and motor are axially aligned when suspended for insertion into a tank through its access opening, said pump and motor being enclosed in a common casing for movement together as a unit, said unit being movable from a position of axial alignment with the axis of said access opening into a position in which it is angularly disposed with respect to the axis of said access opening, and said conduit comprising a portion interconnected with said pump in such a manner that said unit is movable from axial alignment with the axis of said access opening to a position in which it is angularly disposed with respect to the axis of said access opening, a short pipe connected to the discharge side of the pump, the end of said pipe which is furthest from the pump being cut at an angle, and the opposed end of said conduit being cut at a substantially complementary angle, said pipe and conduit being hinged together at their extremities permitting movement of said motor and pump from axial alignment with said conduit to a position in which it is angularly disposed relative to said conduit, said angularly disposed ends being adapted to seat one against the other when the motor and pump assembly is angularly disposed relative to said conduit.

13. Apparatus for insertion into a tank through its access opening which comprises a combination of, a pump, a conduit including a flexible portion, connected to the output side of said pump, a motor on the opposite side of the pump from said conduit, and a power shaft interconnecting said motor and pump for driving said pump, said combination being characterized in that said conduit, pump and motor are axially aligned when suspended for insertion into a tank through its access opening, and means operative after the motor and pump combination have been inserted into the tank to displace the motor and pump combination angularly with respect to the access opening of the tank to lie along the bottom of the tank with the pump inlet substantially at the bottom of the tank.

14. Apparatus for insertion into a tank through its access opening which comprises a combination of, a pump, a conduit including a bendable portion connected to the output side of said pump, a motor on the opposite side of the pump from said conduit, and a power shaft interconnecting said motor and pump for driving said pump, said combination being characterized in that said conduit, pump and motor are axially aligned when suspended for insertion into a tank through its access opening, and means operative after the motor and pump combination have been inserted into the tank to facilitate movement of the pump and motor in a direction substantially at right angles to the access opening of the tank.

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