June 26, 1934. R. V. COOK 1,964,033

UNDERGROUND PUMPING SYSTEM

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Fig. 2.

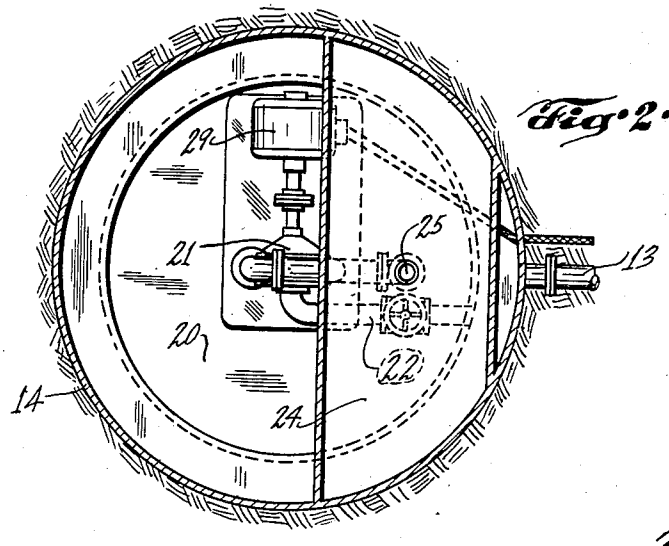
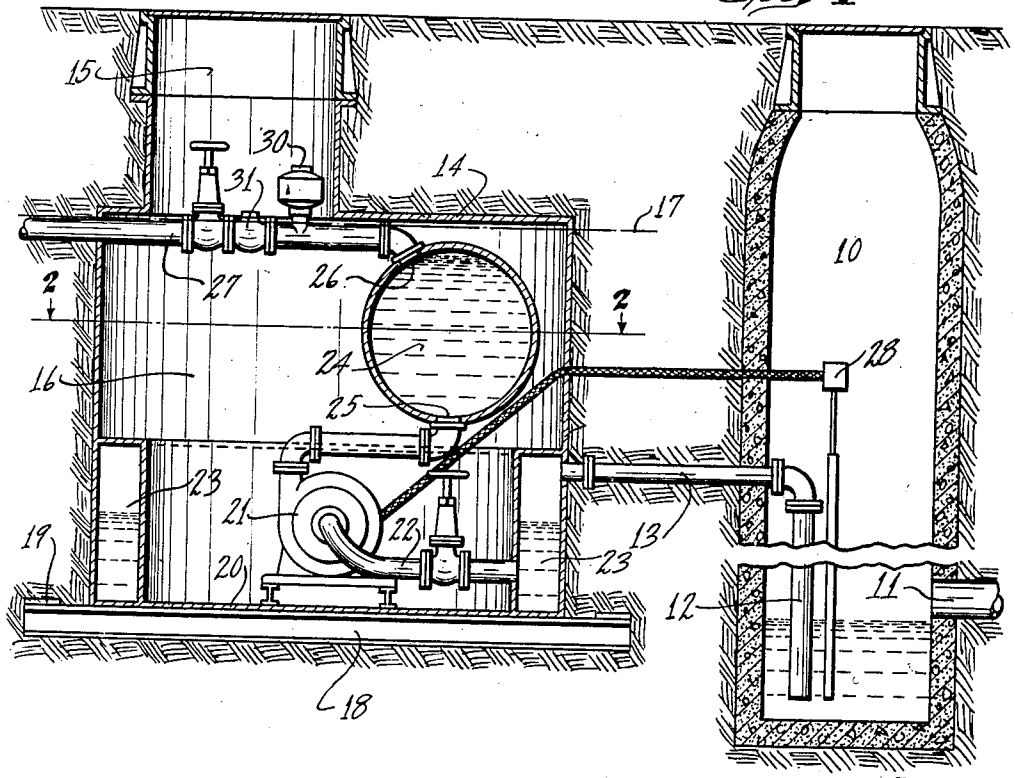


Fig. 1.



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UNDERGROUND PUMPING SYSTEM

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4 Claims. (Cl. 103—113)

This invention relates to improvements in underground pumping systems, and more particularly to an improved combination of pumping apparatus for automatic underground pumping installations.

In certain localities, due to geographical conditions, it is necessary, as is known in the art, to make provision for a periodic removal of sewage or other liquid from sumps, cisterns, or basins into which the sewage accumulates. To this end there is customarily provided an underground pumping station in which is located a centrifugal pump, together with automatic fluid pressure actuated switch suitably connected to prime movers by which the pumps are actuated, in order to lift the sewage from the sump to the municipal sewer mains.

Heretofore the greater number of pumping installations of this type have necessarily been located below the level of the sewage or other liquid, in the basins or cisterns supplying such pumps, in which case the column of liquid in the sump will keep the pump flooded, due to the fact that the pump intake is disposed below the level of the liquid in the sump. In other installations the pumping station has been built over the sump, and the centrifugal pumps have been submerged in the liquid in the sump, and therefore would be primed or flooded by the surrounding liquid. An obvious disadvantage is at once noted in the latter type of installation, in that a pump that is submerged at all time is inaccessible in case repairs are necessary, and further, a comparatively long vertical driving shaft from the pump to the prime mover must be provided.

In the present arrangement, the pumps, prime movers, pump control means, and primer device, are all disposed within a fluid-tight compartment. The compartment may be disposed relatively close to the ground level, due to the fact that an automatic pump primer or flooding device is incorporated within the station.

An object of the present invention is to provide, in connection with a cistern or sump, such as is employed in connection with sewage disposal systems, an underground casing or housing containing centrifugal pumps, which pumps are in communication with the sump, and provision being made within the casing for automatically keeping the pumps primed and ready for service at any time in the absence of an attendant.

A further object of the invention is attained in the provision of a built-in device in connection with an underground sewage disposal station, for automatically keeping one or more pumps primed and ready for service at all times.

A still further object is to provide in connection with an underground station or housing, a built-in priming device which is constructed as a part of the housing, and which is of such location and relation with respect to the pumps in the housing that the pumps will always be kept in prime, irrespective of the relative depths, or vertical disposition of the pumping station proper and the sump or system by which the pumps are supplied.

Further objects and advantages will appear from the following detailed description of parts and the accompanying drawing, in which:

Fig. 1 is a vertical sectional elevation of a preferred form of shallow pit underground sewage station, to which the present improvements are applied; and Fig. 2 is a sectional elevation taken along line 2—2 in Fig. 1.

Referring by numerals to the drawing, a sump or cistern 10 appears at the right of Fig. 1, it being understood that the sump serves as a central receiver for sewage discharge, for example, from local sewer mains, the sewage or other liquid being directed into the sump through conduits 11. This sump may be of any suitable water-tight construction, and may be extended vertically downward from the ground level to any desired depth. It will, of course, be understood that a portion of the sump is usually disposed below the flow-off level of the sewer mains. Disposed within the sump is a vertical suction or riser conduit 12, which is connected to a suitable length of suction piping 13, which is connected to an underground housing or casing 14. This housing is disposed, preferably, underground and is substantially of fluid-tight construction, being constructed of steel plates, or the like. The housing 14 constituting the enclosure for the station as a whole, is provided with an upwardly projecting tubular or manhole portion 15, terminating preferably at the ground level, and provided with a suitable cover or closure. This housing is provided with an enlarged portion 16 which is disposed substantially close to the ground level, the depth below the ground level being controlled by the fluid connection to the housing which necessarily must be disposed beneath the frost line 17. The housing as a whole is positioned at a fixed depth below the ground level and is, by preference, supported upon a plurality of structural steel members, such as I-beams 18 which are interconnected at their ends by cross or brace members 19. It will be readily seen that these members serve as ground anchors to prevent any

tendency for the station to be displaced upwardly.

In the example shown the housing forming the enclosure for the station is of circular form, being economically constructed in this shape. It may, however, be of any suitable or polygonal form and proportioned other than as shown according to the present example. The underground station 14 is by preference provided with an imperforate floor portion 20 upon which is supported a valveless or centrifugal pump 21, the suction side of this pump being connected to a pipe or conduit 22. It will, of course, be understood that the suction side of the pump 21 is disposed substantially above the level of fluid in the sump 10. A concentric suction chamber 23 is built into the underground station 14, and is supported, preferably, upon the floor 20 of the station. This chamber may be formed integrally with the side walls of the housing 14, or may be formed so as to encircle the outer wall of the housing, in the latter case the chamber would be supported upon the beams 18. It will be seen that in either construction, the outer wall of the station forms a side wall of the chamber. The suction side of the pump is, preferably, connected by means of the pipe 22 into the lower portion of the suction chamber 23. The suction line from the sump constituted by the pipes 12 and 13 is connected to the chamber 23 near the upper end thereof. A pressure chamber 24 is disposed transversely of the station and the suction chamber 23 and is, by preference, built into the casing. This chamber is provided with inlet and discharge openings 25 and 26, respectively. The chamber 24 is formed of substantially fluid-tight construction. The discharge side of the pump 21 is connected to the inlet opening 25 of the pressure chamber 24, the inlet opening being disposed substantially at the lowest point of the chamber. A discharge conduit 27 is connected to the discharge opening 26 of the pressure chamber, the disharge opening being disposed substantially at the highest point of the chamber.

The operation of the pumping station will be apparent by reference to Fig. 1, from which it will appear that when the fluid in the sump 10 reaches a predetermined level, a suitable float arrangement in the sump will actuate a suitable Mercoid switch 28, or the equivalent, to energize a prime mover 29 such as an electric motor, which is operatively connected to the pump. It will be readily understood that a valveless or centrifugal pump must be flooded or primed with liquid during pump starting period. Therefore, it is essential in shallow pit underground pumping stations to provide some suitable form of automatic priming apparatus. In the present arrangement when the pump is not operating, the suction pipes 12 and 13, the pressure chamber 24, and the discharge pipe 27 are empty, but the suction chamber 23 is filled with liquid to substantially the level of the suction pipe 13, and therefore the pump is completely flooded. When the pump is started, the liquid is drawn from the suction chamber 23 and is forced by the pump into the pressure chamber. The withdrawal of liquid from the chamber 23 necessarily reduces the pressure within the chamber. This reduction in pressure in the suction chamber is sufficient to draw liquid up through the suction pipings 12 and 13, and replace that which has been removed by the pump, thus maintaining the liquid in the suction chamber constant. With continued pumping operation the liquid fills the pressure chambers 24 and is discharged through the discharge pipe 27. When the sewage in the sump reaches a predetermined low level, the switch operates to break the power circuit to stop the prime mover. At this time the discharge pipe 27, pressure chamber 24 and pump 21 are substantially flooded with liquid. An air valve 30 provided in the discharge line 27 permits the liquid in the pressure chamber 24 to return, by gravity, through the pump to the suction chamber to a height substantially level with the suction pipe 13, while the water in the suction line drops back into the sump, and the pump is in flooded or primed condition for subsequent operation.

It will be apparent that the capacity afforded by the concentric construction of the chamber 23 permits a shallower construction of the station housing, which thereby results in a saving in the pit excavation. The chamber 23 may be formed either interiorly or externally of the housing. It is preferred to provide a check valve 31 somewhere along the discharge line 27 beyond the air valve 30, to prevent fluid that has passed the valve from draining back into the pressure chamber, during the pump priming operation.

It will be readily understood that in certain instances the pressure chamber 24 may be entirely eliminated from the present arrangement, in which case the check valve 31 and air vent 30 may then be disposed in the discharge line at some distance from the station. With such an arrangement the discharge line 27 would be directly connected to the pump discharge. The fluid in the discharge pipe between the check valve and the pump is sufficient to refill the suction chamber for priming action. By this arrangement the station or housing 14 may be made shallower than an underground station with a pressure chamber and the station may, therefore, be disposed closer to the ground level, for it will be readily seen that the top of the suction chamber may be disposed just below the frost line 17.

It will be readily understood that the present improvements result in the provision of an inexpensive automatic pumping station, in that such an assembly or unit may be placed in a much shallower pit, than is required for installations wherein the pumps are flooded, by gravity flow, directly from the sump. By combining the improved automatic primer of the present arrangement with an underground fluid-tight compartment, there is eliminated the necessity of keeping the pump intake below the level of the sewage in the sump. The comparative shallow underground pumping station is readily accessible at all times, for the purpose of repair, cleaning, or the like. It will be readily seen that the station serves as a support common to all the apparatus housed therein, and that all of the pipe connections to the various devices are short and therefore, inexpensive. With the present arrangement of pumps, prime movers, control means and primers within a housing, a neat and compact arrangement of equipment is provided.

It will be readily understood that the concentric arrangement of the suction chamber 23, which completely surrounds the centrifugal pumps affords the possibility of connecting the suction sides of several pumps to the same chamber. Since by correctly proportioning the diameter and height of this chamber, it is possible to insure sufficient suction capacity in this chamber to take care of a plurality of pumps. It will, of course, be apparent that when employing a pressure chamber, such as 24, it must necessarily be disposed above the suction chamber 23.

For convenience of illustration and description, and as illustrating the practical application of the invention, it has been described by reference to a sewage disposal system. It will, however, be understood that the present arrangement is applicable to automatic pumping installations, generally, and that substantial changes may be made in the described arrangement and construction of parts without departing from the spirit and full intended scope of the invention.

I claim as my invention:

1. In combination with an underground tank constituting a housing for use with sewage disposal systems, a sewage receiving sump, a vertical partition within the tank, coacting with the tank walls and provided with closure elements to form a suction chamber disposed substantially concentrically with respect to said housing, extended along the inner periphery of the housing, and formed as a structural unit therewith, a conduit connecting said chamber and sump, a centrifugal pump and pump-operating means within said housing and inside the vertical partition, a pressure chamber disposed transversely within said housing and overlying portions of said suction chamber, pump and operating means, a discharge conduit connecting said pressure chamber and the discharge side of said pump, the pressure chamber constituting a distinct enlargement or reservoir in the discharge line or conduit, and a conduit from the lower portion of said suction chamber, to the pump intake.

2. In combination with an underground sewage pumping station, an underground housing, a sewage receiving sump, an annular chamber for a pump priming fluid, carried by said housing, a conduit extending from said sump to said chamber, a pump and pump-operating means in said housing, the inlet side of said pump being connected to said priming chamber, a pressure chamber mounted transversely within said housing, and above the pumping mechanism and priming chamber, a conduit extending from the discharge side of said pump to said pressure chamber, a discharge conduit extending from said pressure chamber, said pump and connections adapted to permit liquid in said pressure chamber and portions of the discharge line to flow back through said pump and into said annular priming chamber, when said pump is inoperative.

3. In an automatic sewage disposal system, the combination of an underground housing of cylindrical form, a sump separate from said housing, a partition in the housing, forming therewith a priming fluid or suction chamber disposed concentrically with respect to said housing, a conduit connecting said sump and chamber, a pump and pump-operating means within said housing, a tubular structure disposed transversely of the housing, and forming with the housing wall a pressure chamber within said housing, said pressure chamber being disposed substantially above said suction chamber, a conduit connecting the lower portion of said pressure chamber to the discharge side of said pump, and a connection from the inlet of the pump to said suction chamber, coacting with said conduit, for permitting liquid to return to said suction chamber when said pump is stopped.

4. As a structural unit, a pumping organization for use with a separate supply sump, including a substantially fluid tight housing of cylindrical form, partitions within the lower portion of said housing, secured to the walls thereof, to form a closed annular priming chamber, a conduit from the upper portion of said priming chamber, to the lower portion of said sump, the housing being disposed substantially above the normal level of liquid in said sump, a centrifugal pump and a prime mover connected therewith, disposed within the housing and surrounded by the annular priming chamber, a connection from the lower portion of said priming chamber to the intake of said pump, an elongated tank disposed crosswise, within the housing, and having its ends closed by the wall of said housing, said tank constituting a pressure chamber above the priming chamber and overlying portions of the pump and prime mover, a connection from the pump discharge to the lower portion of said pressure tank, and a discharge connection from the upper portion of said pressure tank to a point without said housing, a control device located in the sump, and control connections from said device, to said prime mover.

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