ABSTRACT OF THE DISCLOSURE

A prefabricated underground pumping station formed in two sections including a lower section defining a pump chamber and a wet well and an upper section defining an access chamber of smaller cross sectional area than the first section. The pump chamber houses mechanical suction pumps and other equipment.

Background of the invention

This invention relates to an underground pumping station and more particularly to sewage pumping apparatus to lift sewage from a low level to a higher elevation.

Sewage handling systems are designed to convey sewage, waste, storm and surface water from a given area, such as a serviced community, to a sewage treating or disposal area. Where the topography permits, the sewer system enjoys natural drainage. However, where the topography is too level it becomes necessary to incline the sewer lines to impose a gravitational flow on the sewage. At the end of the incline the sewage is lifted at an underground pumping station to a sufficiently high discharge elevation to allow it to continue its flow by gravity to a final sewage disposal area.

Underground pumping stations of this type generally include an equipment chamber containing pumping equipment including pumps, motors, piping, valves and liquid level controls as well as atmospheric control equipment including ventilating blowers and dehumidifiers. These stations also include an adjacent wet well chamber for receiving the sewage and suitable piping connecting the wet well to the pumps. In order to install the equipment properly within the pumping chamber skilled technicians are required and therefore such assembly is best done at the manufacturing plant. For this reason these pumping stations have been constructed as prefabricated units in recent years requiring only excavation of a site, shipment thereto and connection of influent and effluent pipes and electrical service.

It should be noted that the wet well chamber is only to be used for control purposes to receive the sewage and to retain it between pumping cycles. It is not to be used for storage since any prolonged retention of sewage may result in septic action producing noxious gases. Two pumps are usually used alternatively to minimize pump cycling time and minimize sewage retention.

One type of common prior art station utilizes pneumatic pressure for lifting the sewage and thus necessitating the housing of air compressors and the provision of an air pressure chamber. Another type of station known to the prior art comprises submersible pumps located at the bottom of the wet well chamber.

A major disadvantage of the pneumatic pumping stations is their small capacity which is limited by (1) the volume of compressed air which may be collected in storage tanks and (2) the speed with which the compressed air may be collected. During the lifting of sewage no air is collected and during the collection of air no sewage is pumped. This would increase the sewage retention time for large quantities of sewage contrary to the laws of many states. Furthermore, pneumatic pumping stations require at least three chambers, one of equipment, one for sewage, and one for receiving sewage. This necessitates expensive heavy duty welded construction increasing the cost of the station.

The submersible pump stations are unsatisfactory for the obvious reason that they are substantially inaccessible for repair especially under peak load conditions such as heavy storms and flooding. It is just during these emergency situations that failures are most likely to occur due to the overloading and possible clogging of the submerged impellers. Furthermore, electrical wiring for the pumps must be submerged and present a potential shock hazard.

As regards both of the above described types of pumping stations the usual liquid level sensors in the wet well which control actuation of the pumping means comprise either mechanical float devices or electrical probes, the former being easily disturbed especially in turbulent flow conditions at peak loads and the latter presenting an electric shock hazard. Furthermore, factory assembled, prefabricated pumping stations of both prior art types are formed in a generally elongated cylindrical shape having an over-and-under construction regarding the positioning of the equipment chamber and wet well. The equipment secured in place in the narrow elongated equipment chamber is necessarily positioned at various levels therein. This stratification of the equipment complicates its maintenance and repair and complicates the initial shipping of the prefabricated units. These elongated pumping stations are generally shipped horizontally on the flat bed of a truck requiring special bracing for the equipment. This is both time consuming and expensive.

Summary of the invention

Accordingly, it is an object of my invention to provide a prefabricated underground pumping station in two sections for ease of shipping, one section comprising a unitary wet well and pump chamber having a relatively large cross-sectional area and the other section comprising an elongated entrance chamber having a substantially smaller cross sectional area, and wherein mechanical suction pumps are housed within the pump chamber.

Other objects of my invention are to provide a safe, foolproof liquid level sensor comprising a bubbled air device and to provide a high capacity prefabricated pumping station of side-by-side arrangement.

To accomplish these objects, in one form, I have provided a prefabricated pumping station including a lower section and an upper section, the lower section defining a pump chamber and a wet well separated by a watertight interior wall and the upper section defining means of access to the lower section. An influent pipe is positioned to enter the wet well, a discharge pipe is positioned to exit the pump chamber at a height substantially above the influent pipe and a suction pipe communicates the wet well with the pump chamber. Mechanical suction pumping means positioned within the pump chamber receives the liquid through the suction pipe and passes it through the discharge pipe.

Brief description of the drawings

Other objects and further details of that which I believe to be novel and my invention will be clear from the following description and claims taken with the accompanying drawings, wherein:

FIG. 1 is a sectional side elevational view of one form of my invention showing the high capacity side-by-side arrangement of the pump chamber and the wet well;

FIG. 2 is a top plan view of the FIG. 1 form of my invention with the top wall partially broken away to show the pumping equipment;
FIG. 3 is a sectional view taken substantially along line 3–3 of FIG. 1 showing the improved high capacity wet well construction;

FIG. 4 is a sectional side elevation view of a prefabricated low capacity pumping station; and

FIG. 5 is a top plan view of the FIG. 4 embodiment with a portion of the top wall broken away to show the pumping equipment.

Description of the preferred embodiments

With reference to the drawings I have illustrated in FIGS. 1–3 one form of a prefabricated pumping station capable of handling large volumes of sewage, indicated generally by the numeral 10. The station includes a lower section 12 comprising a wet well 14 and pump chamber 16 combined in side-by-side relationship and having a large cross-sectional area and an upper section comprising access chambers 18, 20 of substantially smaller cross-sectional area. In this manner, besides increasing the capacity of the wet well 14, I have overcome several of the disadvantages of the prior art constructions—namely, the equipment may be positioned in such a manner as to simplify maintenance and repairs and the entire lower section 12 may be transported separately from the access chambers 18, 20 allowing it to be shipped in an upright position and on completion of the prefabricated equipment. The pumping station 10 is shown in position under the grade G, seated upon a suitable concrete supporting bed C.

The lower section 12 comprises an outer shell 22 enclosing the side-by-side wet well 14 and pump chamber 16, an interior wall 24 defining the pumping chamber, interior wall sections 26 with the central portion of interior wall 24 defining the wet well, a bottom wall 28 and a top wall 30. The entire lower section is mounted upon rigidifying support beams 32 and is further supported by rigidifying beams 34 secured to the top wall 30. The wet well 14 includes an inclined bottom wall section 36 located below an influent pipe 38, which extends through the outer shell 22 in order to direct the sewage to suction pipes 40. The portion of the top wall 30 which overlies the wet well defines a flanged opening 42 therein to which the inclined access chamber 18 is secured by welding. A usual counterbalanced hinged cover 44 closes the access chamber 18. In order to gain entrance to the wet well for maintenance purposes, a ladder 46 extends through the access chamber to a grate 48 which serves as a floor at about the midpoint of the wet well. A bar rack 50 includes inclined rods 52 and vertical rod 54 serving as a rough filler immediately in front of the influent pipe 38 to screen inordinately large objects which may pass through the pipe 38, the rods 52 and 54 being spaced approximately two inches apart. Proper ventilation within the wet well is provided by an exhaust blower 56 connected to an exhaust tube 58 which passes through the wall of the access chamber 18 venting the wet well to the atmosphere. It should be noted that while the grate 48 acts as the interior top wall of the wet well under normal conditions, the wet well can hold substantially more sewage under emergency conditions thus preventing back-up in the influent sewage line.

The top wall portion 60 of the pump chamber is inclined towards a sump pit 62 which is covered by a grading 64 to keep out debris. A submersible sump pump 66 is located in the sump pit 62 and discharges back into the wet well through a pipe 68 terminating in a flapper valve 70 within the wet well. The top wall portion overlying the pump chamber also defines a flanged opening 72 for receiving the access chamber 20. As in the wet well access chamber 18, the access chamber 20 includes a hinged counterbalanced cover 74, a ladder 76 terminating in an exhaust tube 78, an exhaust tube 82 vented to the atmosphere. The suction pipes 40 which are horizontally disposed adjacent the bottom of the wet well pass through the interior wall 24 into the pump chamber 16 to impeller pumps 84 driven by motors 86. Sewage is discharged to a central vertical discharge pipe 88. The discharge pipe elevates the sewage and terminates in a flanged connection for discharge to a sewer line. Suitable valves are positioned in the described piping including gate valves 92 located in the suction lines and check valves 94 and gate valves 96 located in the discharge line between the pumps 84 and the central vertical discharge pipe 88.

The actuation of the pumps 84 is controlled by a wet well level sensor device operating on the bubbled air purge principle. An air bubbler line 98 constantly bubbles compressed air into the liquid in the wet well 14 and a suitable sensor device (not shown) senses the back pressure of the compressed air thus determining the "head" or level of the liquid above the line. The low and high water levels are indicated by the letters LWL and HWL (FIG.1). The control mechanism will actuate the pumps 84 alternatively as required and will also allow actuation of both pumps simultaneously if the incoming sewage exceeds the capacity of the lead pump.

Spaced anodes 100 made of magnesium or other suitable material may be buried in the ground surrounding the pumping station 10 and are connected thereto by wires 102 so as to minimize the corrosion of the housing by electrolytic action. Although a dehumidifier and a control panel as well as a complete electric assembly equipment 110 is standard in my underground pumping station they have not been illustrated. However, it would be pointed out that where there is a great deal of available space within the pump chamber 16 so that all housed equipment may be positioned for easy access by maintenance personnel.

Turning now to FIGS. 4, 4 and 5 I have illustrated an alternative form of my unique underground pumping station designed for use where there are relatively small flows of sewage. The basic elements of this form are similar to those illustrated in the high capacity pumping station described above with reference to FIGS. 1–3 and therefore similar elements will be identified by similar numerals with a prime (') added.

The pumping station 10' shown positioned below the grade G' upon a concrete support slab C' includes a lower section 12' comprising a wet well 14' and pump chamber 16' positioned under the other and an upper access chamber 20'. The lower and upper sections are formed separately and are assembled, as by welding, at the site of the excavation. Thus, as explained above with reference to the FIG. 1 form, the lower section may be transported in its proper attitude to protect the equipment therein. The inclined rods 52 and vertical rod 54 serving as a rough filler and screen inordinately large objects passing through the pipe 38, the rods 52 and 54 being spaced approximately two inches apart. A bar rack 50 includes an exhaust blower 56 connected to an exhaust tube 58 which separates the access chamber 18 venting the wet well to the atmosphere. It should be noted that while the grate 48' acts as the interior top wall of the wet well under normal conditions, the wet well can hold substantially more sewage under emergency conditions thus preventing back-up in the influent sewage line.

The bottom wall portion 60' of the pump chamber is inclined towards a sump pit 62 which is covered by a grading 64 to keep out debris. A submersible sump pump 66 is located in the sump pit 62 and discharges back into the wet well through a pipe 68 terminating in a flapper valve 70 within the wet well. The top wall portion overlying the pump chamber also defines a flanged opening 72 for receiving the access chamber 20. As in the wet well access chamber 18, the access chamber 20 includes a hinged counterbalanced cover 74, a ladder 76 terminating in an exhaust tube 78, an exhaust tube 82 vented to the atmosphere. The suction pipes 40 which are horizontally disposed adjacent the bottom of the wet well pass through the interior wall 24 into the pump chamber 16 to impeller pumps 84 driven by motors 86. Sewage is discharged to a central vertical discharge pipe 88. The discharge pipe elevates the sewage and terminates in a flanged connection for discharge to a sewer line. Suitable valves are positioned in the described piping including gate valves 92 located in the suction lines and check valves 94 and gate valves 96 located in the discharge line between the pumps 84 and the central vertical discharge pipe 88.

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suitable circuit breakers for each motor 114, motor starters, a lighting panel, and controls for a dehumidifier, a sump pump (not shown), the exhaust blower 89' and a liquid level sensor. The liquid level sensor comprises an air bubbler line 98' fully described in the discussion of the FIC. 1 embodiment.

Having described my invention of an underground pumping station it will be noted that by means of the present invention the objectives set forth above have been attained. For example, I have provided such a station incorporating both mechanical impeller pumps located in the pump chamber and an air bubbler liquid level sensor for safety of operation, the station being constructed for easy and inexpensive transporting and simplicity of servicing.

What is claimed is:

1. A prefabricated pumping station for use in an underground sewer system comprising: a lower housing section defining a pump chamber and a wet well, said chamber and well being separated by a watertight interior wall; a removable upper section defining an access chamber, the cross-sectional area of which is substantially smaller than the cross-sectional area of said lower section; an influent pipe positioned through a wall of said wet well for supplying sewage to said wet well; a discharge pipe positioned through a wall of said pump chamber and being substantially higher than said influent pipe; a section pipe communicating the interior of said wet well with said pump chamber; and mechanical suction pumping means positioned within said pump chamber, said pumping means connecting said suction pipe and said discharge pipe.

2. The pumping station defined in claim 1 further including a liquid level sensor for actuating said pumping means, said sensor comprising a bubbled air pipe positioned in said wet well.

3. The pumping station defined in claim 1 wherein said pumping means comprises an impeller pump.

4. The pumping station defined in claim 1 wherein said pump chamber and said wet well are of substantially the same height and are positioned in a side-by-side relationship and said suction pipe is substantially horizontally disposed.

5. The pumping station defined in claim 4 wherein: said access chamber comprises two access tubes, a first removably secured to the top wall of said pump chamber and a second removably secured to the top wall of said wet well further includes a rough filtering device positioned in each of said access tubes.

6. The pumping station defined in claim 5 wherein said wet well further includes: a rough filtering device positioned adjacent said influent pipe in the path of influent material, said device including a rack formed of spaced substantially parallel rods; and a liquid level sensor for actuating said pumping means, said sensor comprising an air bubbler pipe positioned in said wet well.

7. The pumping station defined in claim 4 wherein said wet well further includes a rough filterig device positioned adjacent said influent pipe in the path of influent material, said device including a rack formed of spaced substantially parallel rods.

8. The pumping station defined in claim 4 further including a liquid level sensor for actuating said pumping means, said sensor comprising an air bubbler pipe positioned in said wet well.

9. The pumping station defined in claim 2 wherein said pump chamber and said wet well are positioned in an over-and-under relationship, said suction pipe is substantially vertically disposed and said pumping means comprises a self-priming impeller pump.

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