Dec. 24, 1957 F. G. WEIS 2,817,299

PACKAGE SINGLE EJECTOR LIFT STATION FOR SEWAGE

Filed Aug. 29, 1955 2 Sheets-Sheet 1

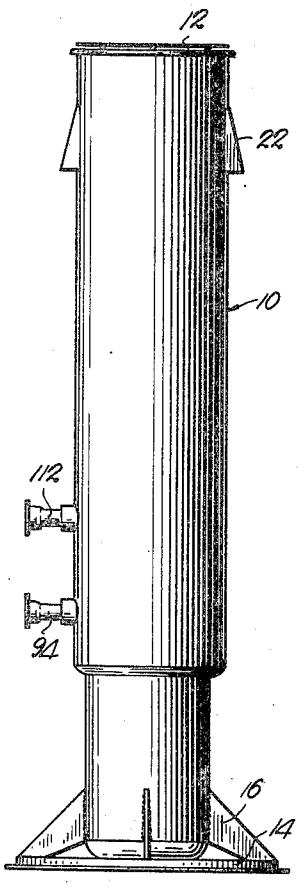


Fig. 1.

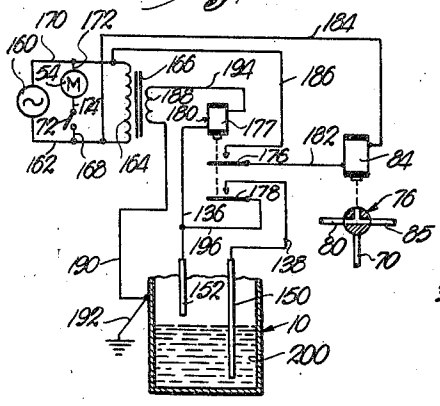


Fig. 3.

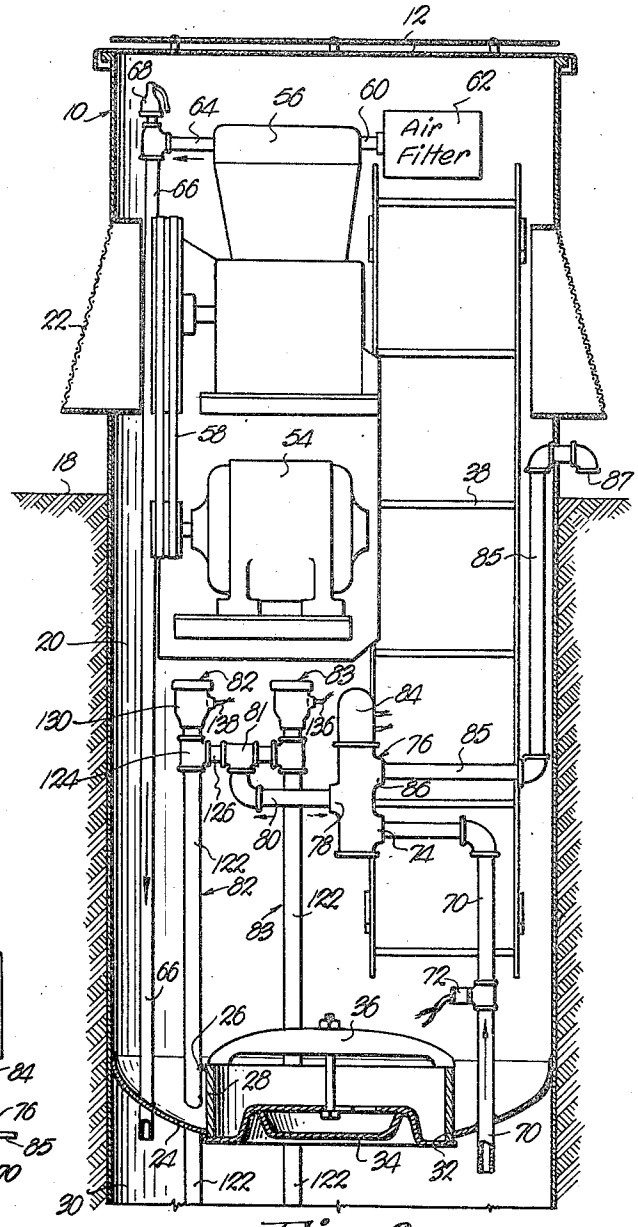


Fig. 2a.

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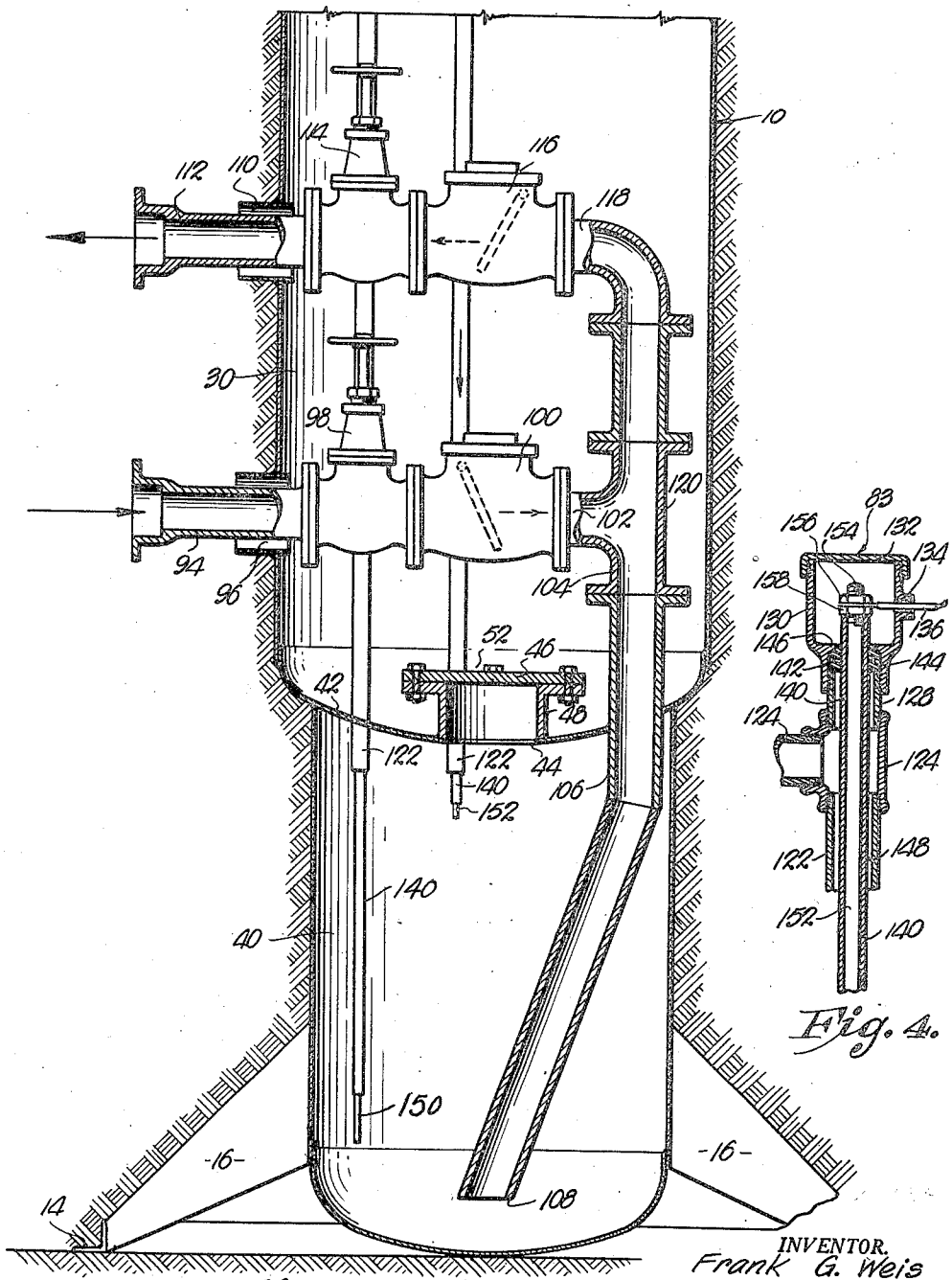


Fig. 2b.

Fig. 4.

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PACKAGE SINGLE EJECTOR LIFT STATION FOR SEWAGE

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This invention relates generally to apparatus for lifting sewage and, more particularly, to apparatus of such general class especially adapted for receiving sewage fed to the apparatus by gravity and forcing the same by means of air pressure to a higher level or elevation.

Prior devices for accomplishing the same general purposes as the apparatus of the present invention have all been subject to various objections and disadvantages. Notable among these deficiencies of prior devices are their complexity, which results in increased manufacturing costs and greater maintenance requirements, their relative inefficiency, which results in unnecessary power costs, and their bulky nature, which often results in the necessity of installation above ground level and the provision of suitable housing or camouflaging means therefor.

It is the primary object of this invention to overcome all of the mentioned and other disadvantages of prior devices by the provision of improved apparatus of simple and efficient construction and of unitary nature adapting the same for convenient installation in a small space enclosed by a single vertical housing with a major portion of the apparatus disposed below ground level.

It is another important object of this invention to provide such a single or package unit station wherein a single vertical housing is divided to present three superimposed chambers of which two are closed to provide an air storage tank and a sewage receiving and ejecting compartment while the third accommodates various mechanisms forming a part of the apparatus included in the complete system.

It is another important object of this invention to provide such apparatus which will operate automatically and require maintenance or attention only at infrequent intervals.

It is another important object of this invention to provide such apparatus utilizing stored air pressure for the raising of sewage material to a higher elevation.

It is another important object of this invention to provide control electrode mounting means adapted to serve as a conduit for air under pressure, whereby air passing through the mounting means will maintain the electrode structure in a clean condition deterring corrosion.

Broadly, the invention contemplates and utilizes compressor means for maintaining air under pressure in a storage chamber, the operation of the compressor means being automatically responsive to the pressure within such air storage chamber, and a sewage chamber into which the sewage material is fed by gravity through a check valve which automatically closes when the sewage reaches a predetermined level closing an electrical circuit to operate a solenoid valve which places the air under pressure within the storage chamber in communication with the sewage chamber to force the sewage up through the same conduit through which it entered and through a second check valve into the elevating conduit.

Still other important objects of this invention will be made clear or become apparent as the following description of the invention progresses.

In the accompanying drawings:

Fig. 1 is an external, side elevational view of the apparatus of this invention before installation in the ground;

Fig. 2*a* is an essentially diagrammatic view of the upper portion of the apparatus, showing some parts in cross section and others in elevation, as appears most appropriate for clarity;

Fig. 2*b* is an essentially diagrammatic view of the lower portion of the apparatus, showing some parts in cross section and others in elevation, as appears most appropriate for clarity;

Fig. 3 is a schematic view illustrating the essential aspects of the electrical control circuitry forming a part of the apparatus; and

Fig. 4 is an enlarged, fragmentary, cross-sectional view through a portion of one of the control electrodes and the mounting means therefor which also serves as a conduit for air under pressure.

Referring now to the drawings, the numeral 10 generally designates an elongated, upright, substantially cylindrical, hollow housing having a removable top cover 12 and a base plate 14 secured to the lower portion of housing 10 by fins 16 and adapted for supporting and anchoring the housing 10 within the ground.

Housing 10 is divided into three superimposed chambers, as follows: an uppermost elongated mechanism accommodating chamber 20, a central air storage chamber 30, and a lowermost sewage-receiving chamber 40. As will be clear in Fig. 2*a*, the housing 10 is normally emplaced in the ground so that ground level 18 is disposed slightly above the center of chamber 20 and slightly below one or more screened vents 22 provided in the housing 10 for placing the uppermost chamber 20 in communication with the atmosphere. Chamber 20 is separated from chamber 30 by a partition 24 having an airtight manhole assembly generally designated 26 provided therein. Assembly 26 may be of any conventional character, but as illustrated, includes a relatively short seat-forming tube 28 within an aperture 32 of partition 24 and preferably is welded to the latter, a cover 34 adapted to seat upon the lowermost extremity of tube 28 for closing the latter, and a releasable clamping mechanism 36 for drawing the cover 34 into air tight seated engagement upon tube 28, a suitable gasket (not shown) preferably being provided between cover 34 and tube 28. A ladder 38 is preferably provided within the chamber 20 to permit maintenance personnel to reach the manhole assembly 26 after removal of the cover 12 from the housing 10 to enter the chamber 20.

The chamber 30 is separated from the chamber 40 by a partition 42 having an access aperture 44 therein, which is normally closed by an airtight and liquidtight seal between a cover plate 46 and a tubular seat-forming member 48, the plate 46 being held upon member 48 by bolt and nut means 52 or the like. Normally, access to chamber 40 will not be necessary, although such access means is preferably provided for use in the event that maintenance operations within the chamber 40 should be required.

Mounted within the chamber 20 by any suitable means are an electric motor 54 and an air compressor 56, the motor 54 being operably coupled with compressor 56 by belt means 58. The compressor 56 is provided with an inlet 60 preferably having an air filter 62 attached thereto, while the discharge outlet 64 of compressor 56 is coupled through a conduit 66 preferably having a pressure relief valve 68 therein with the chamber 30, it being understood that the conduit 66 passes through partition 30 in airtight relationship therewith and terminates within chamber 30 to place the outlet 64 of compressor 56 in communication with chamber 30. An air delivery pipe 70 also passes through partition 24 in airtight relationship thereto and has its lowermost open extremity in communication with chamber 30. Pipe 70 is preferably provided with a pressure responsive electrical switching device 72 coupled therein

for purposes hereinafter to be more fully explained. Pipe 70 leads from chamber 30 to the inlet port 74 of a solenoid valve assembly broadly designated 76 and having an outlet port 78 to which is connected an ejecting air carrying pipe 80, which pipe 80 is connected through a T-coupling 81 with a pair of electrode mounting assemblies generally designated 82 and 83.

Solencid valve 76 also includes an electrically responsive solenoid portion 84 which is adapted, when energized, for actuating valve 76 to place the air delivery pipe 70 in communication with the air carrying pipe 80 and, when deenergized, for closing the delivery pipe 70 and placing the pipe 80 in communication with an air vent pipe 85 coupled with a third port 86 of valve 76 and extending through housing 10 above ground level 18 into communication with the atmosphere as at 87. The valve 76 is thus a three-way, solenoid operated valve which may be of conventional character.

A sewage inlet port 94 enters chamber 30 through housing 10 below ground level 18 and is adapted for coupling with a gravity feed sewage conduit (not shown). The port or connection 94 is externally sealed in airtight relationship to the housing 10 by any suitable means as at 96. Coupled with connection 94 within chamber 30 is a manual control valve 98, which will normally be open, valve 98 in turn being coupled with a check valve designated 100 and adapted to pass sewage material only in the direction of the arrow shown thereon. Check valve 100 in turn is coupled with a T-connection 102 having a downwardly directed arm 104 coupled with the uppermost extremity of a conduit 106 passing through partition 42 in airtight and watertight relationship thereto into the chamber 40 and terminating with an open end 108 at its lowermost extremity within chamber 40 adjacent the bottom of the latter.

Also passing into chamber 30 through housing 10 in airtight relationship to the latter by virtue of conventional sealing means 110 is a sewage outlet port or connection 112 adapted for coupling with a line (not shown) leading to an elevated position of discharge into a sewage main (not shown) or the like. Within chamber 30, connection 112 is coupled with a normally open manual control valve 114 which is in turn coupled with a check valve 116 adapted to pass sewage material only in the direction of the arrow shown thereon. Check valve 116 is in turn coupled with the upper extremity of a pipe 118 leading downwardly and connected with an upper arm 120 of T-joint 102.

Referring next particularly to Fig. 4, wherein is illustrated one of the substantially identical electrode holding assemblies, 83 (and 82), the numeral 122 designates an elongated, tubular pipe, which it will be seen from Figs. 2*a* and 2*b* extends downwardly from an open end within chamber 20, through partition 24, chamber 30 and partition 42 into chamber 40, terminating with an open end in chamber 40 slightly below partition 42. The pipes 122 of assemblies 82 and 83 obviously pass through partitions 24 and 42 in airtight and liquidtight relationship to the latter. A T-connector 124 is coupled with the upper end of each pipe 122. Laterally coupled with each connector 124 is a pipe 126 leading to T-coupler 81, and a stub pipe 128 is connected to each connector 124 in opposed alignment with the pipe 122. Connected atop each pipe 128 is an electrode connection housing cup 130 having a top cap 132 and a lateral port 134 to permit ingress of a lead wire 136 (or 138 in the case of assembly 82).

An elongated tube 140 of plastic or other suitable insulating material has its uppermost end within each cup 130 and extends downwardly through an opeinng 142 in the bottom of such cup 130 and the corresponding stub pipe 128, T-connector 124 and pipe 122, emerging within chamber 40 below the lowermost end of the corresponding pipe 122. Tube 140 is held in place by any suitable means such as the packing ring 144 illustrated in opening 142 of cup 130, which serves the dual purpose of holding tube 140 and effecting an airtight seal between the latter and cup 30 within opening 142. As will be clear in Fig. 4, packing ring 144, which may be of rubber or the like, is squeezed into tight engagement between tube 140 and cup 130 by the opposite engagement therewith of the top of stub pipe 128 and an inturned shoulder 146 of cup 130 defining the upper extremity of opening 142.

It is important that the outer diameter of tube 140 is substantially smaller than inner diameter of pipe 122 and connector 124, so that an air conduit space 148 is provided within pipe 122 between the latter and tube 140.

Extending through the tubes 140 of assemblies 82 and 83 respectively are elongated, electrode rods 150 and 152, rod 150 being substantially longer than rod 152. The upper ends of each of rods 150 and 152 are within the cups 130 of corresponding assemblies 82 and 83 and are threaded as at 154 to receive a pair of nuts 156 and 158 between which are held in electrically contacting relationship with the rod 150 or 152 the conductive portion of the corresponding wire 138 or 136. The lower nut 158 rests on the upper end of the tube 140 so as to support the rod 150 or 152 within the tube 140 and also so as to provide a limited adjustment of the lowermost end of the rod 150 or 152 through shifting of nut 158 upon threads 154.

As will be apparent in Fig. 2*b*, the lowermost end of rod 150 should be adjacent the bottom of chamber 40, while the lowermost end of rod 152 should be disposed higher in the chamber 40. As will hereinafter be made clear, the positioning of the lowermost end of rod 152 controls the level of liquid sewage material within chamber 40 at which the ejecting part of the cycle of operation will be automatically commenced, while the disposition of the lowermost end of rod 150 determines the level to which sewage will be ejected before the system automatically shifts to the filling portion of its operating cycle during which additional sewage material may be received within chamber 40.

Referring now to Fig. 3, a source of power generally designated 160 is coupled by a conductor 162 with one terminal of the primary 164 of an isolation transformer 166 and through a conductor 168 with one terminal of normally open, pressure responsive switch 72. The other side of electrical power source 160 is coupled through a conductor 170 with the other terminal of primary 164 through a conductor 172 with one terminal of motor 54. The other terminal of motor 54 is coupled through a conductor 174 with the other terminal of switch 72. The operating coil 84 of solenoid valve 76 is coupled in series with one normally open switch 176 of a relay generally designated 180 and having a coil 177 and another normally open switch 178 by a conductor 182. Coil 84, conductor 182 and coil 177 are coupled between power lines 162 and 170 by conductors 184 and 186.

One side of the secondary 188, which preferably is a relatively low voltage winding, of transformer 166 is connected with the metallic body of housing 10 by a conductor 190 and grounded as at 192. The other side of secondary 188 is coupled through a conductor 194, coil 177 and conductor 136 with electrode 152, and through conductor 194, coil 177, conductor 136, a conductor 196, the other relay switch 178 and conductor 138 with electrode 150.

A quantity of liquid sewage material is illustrated within chamber 40 and designated 200, it being understood that the material 200 is of conductive nature adapted for completing an electrical circuit between the housing 10 and either or both of electrodes 150 and 152 when its level brings it into contact with the latter.

In operation, the pressure responsive switch 72 remains in its normally open condition until the pressure of air

stored within chamber 30 falls below a predetermined level, whereupon switch 72 automatically closes to energize motor 54 through a circuit traceable from power source 160 through conductors 162 and 168, switch 72, conductor 174, motor 54 and conductors 172 and 170 back to source 160. Energization of motor 54 operates the same to actuate compressor 56 which takes in air through filter 62 and forces the same through conduit 66 into chamber 30 until the pressure of air stored within the latter has risen to the desired predetermined level, whereupon the switch 72 will again open to de-energize motor 54 and deactivate compressor 56.

The sewage 200 flows by gravity or its own head through connection 94, normally open valve 98, and check valve 100 into T-connection 102 and thence by gravity downwardly through conduit 106 into chamber 40 until such sewage material has reached a predetermined level within chamber 40 in contact with the electrode rod 152. As soon as material 200 contacts the rod 152, the electrical circuit between housing 10 and electrode 152 is closed by virtue of liquid nature of material 200. Thereupon, coil 177 of relay 180 is energized through a circuit traceable from secondary 188 of transformer 166 through conductor 190, housing 10, liquid sewage material 200, electrode rod 152, conductor 136, coil 177 and conductor 194 back to secondary 188.

Energization of coil 177 closes switches 176 and 178. Closure of switch 178 completes a holding circuit for relay 180 from secondary 188 through conductor 190, housing 10, material 200, electrode 150, conductor 138, switch 178, conductor 196, conductor 136, coil 177 and conductor 194 back to secondary 188. Closure of switch 176 completes an energizing circuit for coil 84 of valve 76 from source 160 through conductor 162, conductor 184, coil 84, conductor 182, switch 176, conductor 186 and conductor 170 back to source 160.

Energization of solenoid 84 operates the solenoid controlled air valve 76 to place inlet 74 in communication with outlet 78. Thereupon, air under pressure from chamber 30 will flow through pipe 70, valve 76, pipe 80, connection 81, pipes 126 and pipes 122 into the upper portion of chamber 40 above the level of sewage material 200, thereby exerting a downward air pressure upon the material 200 to force the same back upwardly through conduit 106. When the sewage material 200 being thus raised through conduit 106 reaches the T-connection 102 and check valve 100, the latter will close and the material 200 will be forced on upwardly through pipe 118, check valve 116, open valve 114 and connection 112 to the elevating line (not shown). As soon as the material 200 has been exhausted from chamber 40 to an extent lowering the level thereof below the lowermost end of electrode rod 150, the holding circuit for relay coil 177 through switch 178, and accordingly the energizing circuit for solenoid 84, will be broken, and valve 76 will close cutting off the supply of air under pressure to chamber 40. When the pressure behind the sewage material 200 in conduit 118 is cut off, the check valve 116 will close to prevent retrograde movement of sewage which has been elevated to connection 112 and the line (not shown) coupled therewith.

As valve 76 closes inlet 74 thereof, it simultaneously places port 86 and vent pipe 85 in communication with port 78 and, ultimately, pipes 122 leading to chamber 40. The necessity of vent pipe 85 for venting chamber 40 to the atmosphere during filling will be obvious in that some means for the exhausting of air from the upper portion of the chamber 40 must be provided to allow for displacement within the chamber 40 as additional sewage material 200 enters through conduit 106.

The system is thus restored to a condition for receiving further sewage 200 until the level thereof contacts electrode 152 closing the energizing circuit for relay coil 177 to commence the ejection portion of the operating cycle again. It will be apparent that the two electrodes 150 and 152 of differing lengths are used to provide for commencing the ejection action only when material 200 has reached a relatively high level in chamber 40 contacting electrode 152 and continuing such ejection until the material has reached a relatively low level clearing electrode 150.

It is believed that the structure hereinabove described for purposes of illustration will render the invention readily understandable to those skilled in the art. It is also believed manifest that various minor changes and modifications could be made to the exact structure shown for purposes of illustration without materially departing from the true spirit or intention of the invention. Accordingly, it is to be understood that the invention shall be deemed limited only by the scope of the appended claims.

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent is:

1. In a pneumatic pumping installation for liquid sewage material, a unitary, upright, elongated, hollow housing closed at its bottom, open at its top and adapted to have a major, lower length thereof disposed underground with the remaining, upper length thereof above the ground; a pair of spaced, generally horizontal partitions in the housing intermediate its ends and dividing the same into a lowermost, fluid-tight, displacement pumping chamber, an intermediate, fluid-tight, compressed air storage chamber and an uppermost, equipment receiving chamber; an air compressor in the uppermost chamber; a prime mover in the upper chamber operably coupled with the compressor; first air pipe means coupling the compressor with the intermediate chamber; second air pipe means coupling the intermediate chamber with the lowermost chamber adjacent the upper extremity of the latter, air control valve means in the second air pipe means; venting pipe means oppositely communicating with the lowermost chamber adjacent the upper extremity of the latter and the atmosphere outside said upper length of the housing; venting control valve means in the venting pipe means; liquid inlet pipe means communicating with the lowermost chamber adjacent the lower extremity thereof and disposed for flow of liquid sewage material therethrough and into the lowermost chamber by gravity; a check valve in the inlet pipe means; and liquid outlet pipe means communicating with the lowermost chamber adjacent the lower extremity thereof and extending upwardly therefrom for receiving liquid sewage material from the lowermost chamber when the air control valve means is opened and the venting control valve means is closed.

2. In an installation as set forth in claim 1, wherein is provided an actuating solenoid for each of said valve means respectively; electrode structure within the lowermost chamber; and electrical control circuit means coupling the electrode structure with each of said valve means for actuating the latter alternately and automatically responsive to the level of liquid material within the lowermost chamber.

3. In an installation as set forth in claim 2, wherein is provided a pressure responsive switch having a pneumatic connection with the intermediate chamber; and electrical control circuitry coupling the switch with the prime mover, the latter being electrically operable, for automatically operating the compressor whenever the pressure of air stored within the intermediate chamber falls below a predetermined level.

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