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Burkholder

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[54] **PRESSURE SEWAGE SYSTEM AND MEANS**

[75] Inventor: **Jack Burkholder**, Tulsa, Okla.

[73] Assignee: **Robintech, Incorporated**, Fort Worth, Tex.

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Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 162,838, July 15, 1971, abandoned.

[52] **U.S. Cl.** ..... **4/10**; 210/15; 241/185 A

[51] **Int. Cl.** .. **E03d 11/02**; E03d 11/00; B60r 16/04

[58] **Field of Search** ..... 4/1, 10, 77, 81, 90; 137/12; 210/15; 241/185 A

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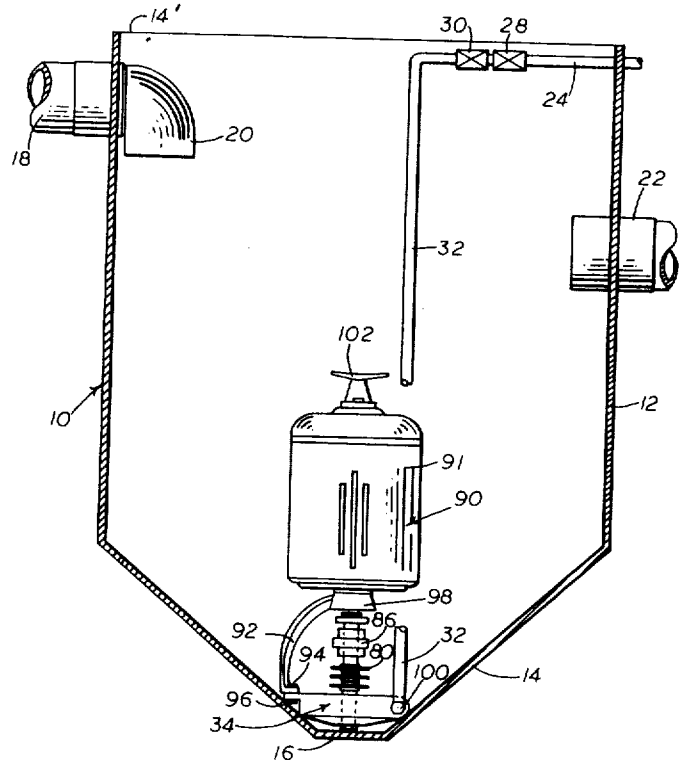
Primary Examiner—Henry K. Artis

Attorney, Agent, or Firm—Wilbur J. Kupfrian

[57] **ABSTRACT**

A method and means of directing sewage from a holding tank, septic tank, or the like, into a pressure sewage system which comprises providing a receptacle or storage area for receiving sewage by gravity from a residential or similar source, which receptacle has a downwardly converging or conical bottom region, whereby heavier solid matter in the sewage fluids will be directed into a relatively confined area at the bottom of the reservoir. A sewage-treating unit comprising a macerator and pump is disposed in the apex portion of the bottom of the receptacle or storage area for comminuting the solids, agitating the sewage mixture and transferring the effluent into a relatively small discharge conduit and moving the fluid through the conduit for discharge under a predetermined hydraulic head into the pressure sewage system.

2 Claims, 3 Drawing Figures



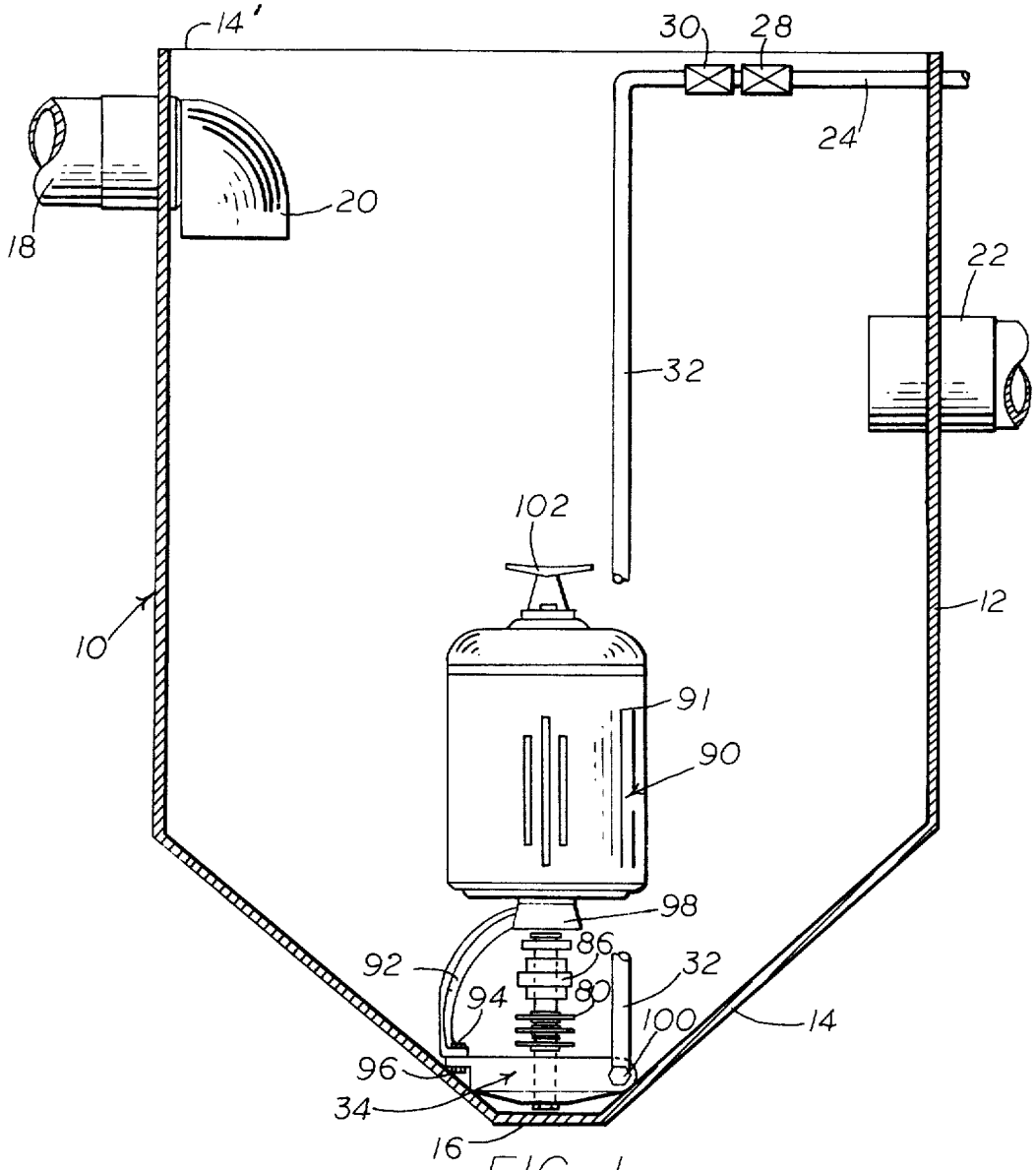


FIG. 1

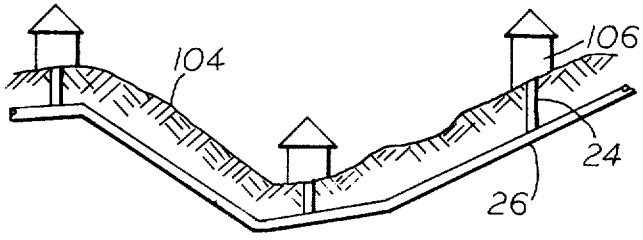


FIG. 3

INVENTOR.
Jack Burkholder
BY
William S. Dorman
ATTORNEY

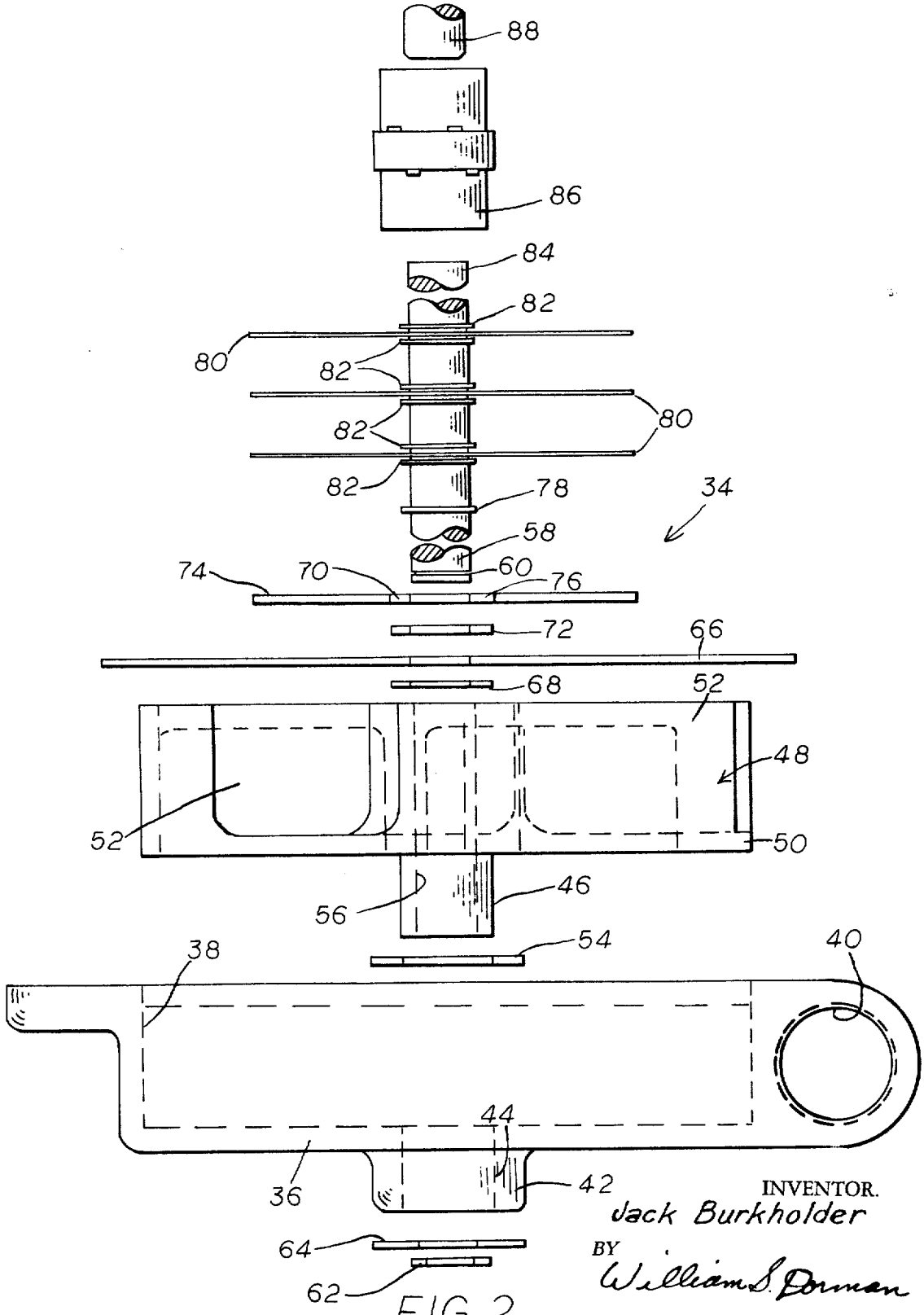


FIG. 2

INVENTOR.
Jack Burkholder
BY
William S. Dorman
ATTORNEY

PRESSURE SEWAGE SYSTEM AND MEANS

This application is a continuation-in-part of my previously-filed pending application U.S. Ser. No. **162,838,** filed July **15, 1971** now abandoned.

This invention relates to improvements in sewage handling systems and means and more particularly, but not by way of limitation, to a method and means for directing sewage from a reservoir into a pressurized sewer system.

In most cities or urban areas today, the sanitary sewer system is of the gravity type, wherein individual service conduits drain sewage by gravity into a main sewer conduit, which in turn moves the collecting sewage by gravity to a disposal plant, or the like. Of course, it is common practice to provide sewer lifts or boosters in the system strategically located to raise sewage from a relatively low area into a higher main conduit for gravity flow or transport to the disposal site. The gravity sewer system has many disadvantages in that uneven terrain frequently requires extremely deep trenches to maintain adequate grade for the conduit to insure proper gravity flow of fluid through the entire system.

In order to overcome the disadvantages of gravity type systems, pressure sewage systems have been developed wherein pumping pressure is provided at each individual collecting site for pressurizing the main line to move the fluids through the main conduits to the ultimate disposal site. With a pressurized system, the sewer conduits may substantially conform to the cross-sectional configuration of the terrain, thus eliminating the need for progressively deeper trenches as required in the gravity flow system. In the pressure or force sewer system, it is necessary to provide individual grinders, mixers and pumping devices usually of substantial and expensive design, located at isolated stations between the existing homes or buildings and the main sewer conduit or between the existing septic tanks and the main conduit for forcing the sewage into the main sewer system. The usual grinding, mixing and pumping devices utilized at the present time for moving the sewage into the main sewer system are so arranged as to be submerged in fluids and usually have a relatively short useful life, and it is common practice to provide a float arrangement to indicate when the pumping system is malfunctioning. Of course, the disadvantages of a malfunctioning pump in the line between the house or septic tank and the main sewer system will be apparent.

The present invention contemplates a novel sewage system and means for admitting or directing sewage fluids into a main pressure sewage system which is particularly designed and constructed for overcoming the above disadvantages. The main sewer conduit normally is open at the discharge end for delivering the sewage to a preselected accumulation or treatment area. The novel system and means comprises a holding tank, or septic tank, for receiving the raw effluents therein. The tank is provided with a substantially frustoconical or downwardly-tapered bottom section whereby the solids in the fluid will collect by gravity in the central constricted area of the bottom of the tank. A macerating type pump is disposed near and preferably rests upon the bottom of the tank for pulling the fluid mixture therethrough, for grinding and mixing the solids and liquid and for passing them through a relatively small discharge conduit from which the resulting effluent is forced into the main pressure sewage system. The pump motor is of the submersible type and provides pressure at the individual tank for pressurizing the remote main sewer line. Of course, suitable valves are interposed in the discharge conduit for precluding backflow of fluids from the main sewer line into the holding tank, as is well known. The conical contour of the bottom of the holding tank, the central placement of the pump, and the relatively small discharge conduit provide an efficient transfer of the sewage from the holding tank to the main sewer system in a manner not heretofore employed.

Similar systems are known, typically as shown in E. F. Howe U.S. Pat. No. **2,676,666** dated Apr. **27, 1954,** wherein unitary macerating and pumping devices are associated with collecting chambers, gravity fed from a sewage source. By the present invention, however, a number of novel features typically relating to the location and mounting of the unit, the type of agitation obtainable, and the discharging of the material at high presssure into an already pressurized line, offer distinct advantages.

It is an important object of this invention to provide a novel method and means for directing sewage into a pressure sewage system.

It is another object of this inventiion to provide a method and means for directing sewage into a pressure sewage system wherein the solids in the sewage are efficiently macerated and mixed with the liquid components for facilitating handling of the sewage.

Another object of this invention is to provide a novel method and means for directing fluids into a pressure sewage system wherein the solids in the fluid are accumulated in the proximity of a macerating type pump for increasing the efficiency of grinding and mixing of the solids.

Still another object of this invention is to provide a novel method and means for directing fluids into a pressure sewage system which is simple and efficient in operation and economical and durable in construction.

Other and further objects and advantageous features of the present invention will hereinafter more fully appear in connection with a detailed description of the drawings in which:

FIG. **1** is an elevational view partly in section of a holding tank and pump unit embodying the invention.

FIG. **2** is an enlarged exploded side elevational view of a pump embodying the invention.

FIG. **3** is a sectional schematic view of a pressure sewage system.

Referring to the drawings in detail, a fluid receiving tank **10** has outer sidewalls **12** which may be of substantially any configuration, such as cylindrical, square, rectangular, or the like, which tank is normally at least partially buried beneath the surface of the earth. The upper end **14** of the tank **10** is open and may be provided with a suitable manhole extension member (not shown) complementary to the configuration of the sidewalls **12** and extending upwardly therefrom for receiving a suitable manhole cover member and lid, thus providing access to the interior of the buried tank **10** from the surface of the ground, as is well known. The bottom **14** of the tank **10** preferably is downwardly and inwardly tapered as particularly shown in FIG. **1,** and preferably is provided with a relatively flat or horizontal floor portion **16** at the central converging point of the bottom for a purpose as will be hereinafter set forth.

An inlet pipe or conduit **18** of conventional size (typically 4-inch nominal diameter) is provided in the upper portion of the tank **10** spaced downwardly from the open upper end thereof, and extends through an aperture (not shown) in the sidewall **12** to an elbow or angled conduit **20** for directing effluent into the tank **10** and discharging the fluid in a downward direction therein. An overflow conduit **22** extends through a second aperture (not shown) provided in the sidewalls **12** to provide communication between the interior of the tank **10** and the exterior thereof. The overflow conduit **22** is spaced below the inlet conduit **18** in order to permit emergency discharge of any accumulating fluids in the tank **10** and to forestall any inadvertent back-up of the fluids through the inlet conduit **18**, as will be hereinafter set forth. In addition, a discharge conduit or line **24**, which as shown is quite small in diameter relative to the size of the inlet pipe **18**, extends through the sidewalls **12** in any well-known manner for providing communication between the interior of the tank **10** and the main sewer system **16** (FIG. 3). The discharge line **24** is provided with a plurality of suitable valves, such as schematically shown check valve **28**, and a suitable compression end valve **30**, as is well known, which may be threaded or otherwise attached to a vertically-disposed portion **32** extending downwardly into the proximity of the bottom **16** of the tank **10**, as particularly shown in FIG. **1**. As small as practicable diameter discharge pipes may be employed. In practice 1-inch diameter discharge conduits **24** and **32** have been found entirely satisfactory for use with this system. The economic advantages in furnishing and burying such a small pipe in preference to the much larger tile or cast-iron pipe of conventional size are manifest.

A macerator type impeller pump generally indicated at **34** is disposed in the proximity of the lower portion **16** of the tank **10** and as shown in FIG. **1** is secured to the lower end of the immediately-adjoining, generally centrally located and vertically disposed pipe portion **32** in a manner and for a purpose to be hereinafter set forth. As best seen in FIG. **2**, the pump **34** comprises a body portion **36** having an interiorly disposed convulate type recess **38** terminating in a discharge port **40**, as is well known. A centrally disposed boss **42** extends axially from the body **36** and is provided with a central bore **44** for journalling one end of a hub **46** of an impeller **48**.

The impeller **48** comprises a substantially circular plate **50** intergral with or secured around the hub **46** and axially spaced from one end thereof. A plurality of circumferentially spaced fins or blades **52** are secured to or integral with the plate **50** and are disposed substantially perpendicular with respect thereto. The blades **52** are preferably of a substantially spiral configuration and are integral with or secured around the hub and extend radially outwardly therefrom as is well known. The hub **46** is rotatably disposed or journaled in the bore **44**, and a shim member **54** is preferably disposed between the plate **50** and the body **36** for facilitating rotation of the impeller member **48** with respect to the body **36**. A central bore **56** extends through the hub **46** for receiving a shaft **58** therethrough. The shaft **58** may be keyed or otherwise secured within the bore **56** for transmitting rotation to the impeller **48**, and an annular groove **60** is provided on the outer end of the shaft **58** for receiving a retainer ring **62** therein for locking the shaft **58** against longitudinal movement in one direction with respect to the hub **46**. In addition, it is preferable to interpose an annular shim member **64** between the retainer ring **62** and the body **36** for facilitating rotation of the shaft **58** with respect thereto.

A stationary grinder plate or disc **66** is suitably secured around the shaft **58** and is disposed on the upper surface of the blades **52**. It is preferable however to provide a suitable annular shim member **68** between the plate **66** and the fins **52**. The grinder plate **66** may be of any suitable type, such as perforate plate, or the like which screens the sewage material that flows through the holes of the plate enroute to the pump, as is well known. In addition, a grinder blade **70** is secured around the shaft **58** in any suitable manner for rotation therewith and is spaced from the grinder plate by a suitable annular shim member **72**. The grinder blade **70** may be of any suitable type, and comprises one or more radially extending blades **74** (preferably three) integral with or secured to a central disc member **76** which in turn is secured to the shaft **58** in any well-known manner (not shown). An annular retainer ring **78** may be suitably secured to the shaft **58** for cooperating with the shim **72** to retain the grinder blade **70** thereon, as is well known.

A plurality of suitable macerator blades **80** are secured on the shaft **58** in any well-known manner (not shown)) for rotation simultaneously therewith and are spaced longitudinally therealong by suitable retainer rings **82**.

The upper end of the shaft **58** is adapted for connection preferably through suitable flexible type coupling **86** to the drive shaft **88** of an electric motor **90**. The motor **90** may be of any suitable type and as shown herein typically is a Franklin Submatic Motor manufactured by Franklin Electric Co., Inc. and as shown in their brochure No. **310.501**. This motor is built to operate in an underwater environment and is adapted for connection with a suitable power supply as is well known. The drive shaft **88** of the motor **90** is suitably keyed or otherwise connected with the coupling **86** for transmitting rotation thereto. The outer housing or casing **91** of the motor **90** is reciprocally supported on the motor for limitied vertical movement in much limited same manner as a float member for actuation of a float switch (not shown) provided in the motor **90** for a purpose and in a manner as will be hereinafter set forth.

The motor housing **91** is secured to the pump **34** by means of an arcuate arm member **92** which has one end thereof secured to the body **36** by a bolt **94** and lock nut **96**. The opposite end of the arm **92** is provided with a flared sleeve member **98** adapted for receiving and supporting the mounting hub and associated parts (not shown) of the motor **90**. The motor **90** is provided with a float switch (not shown) whereby the motor is inoperative while the housing **91** is in a lowered position, and operative when the housing becomes buoyant and assumes a raised position. In addition, the port **40** of the pump **34** is secured to the lower end of the pipe portion **32** by a suitable fitting member **100** in such a manner as to secure the body **36** to the pipe **32**, and provide open communication between the port **40** and the interior of the pipe **32**.

A suitable handle member **102** is provided on the uppermost end of the motor **90** for facilitating installation in and removal from the interior of the tank **10**, as will be hereinafter set forth.

In a pressure sewer system, such as schematically depicted in FIG. 3, the main sewer conduit 26 is normally buried beneath the surface of the ground 104 at a substantially uniform depth, so it generally follows the contour of the ground or earth. The individual buildings 106, or the like, feed sewage into their respective tanks and are independently connected with the main sewer conduit 26 by the lines 24, as hereinbefore set forth, and the pump 34 of each tank 10 provides adequate pressure for operation of the main sewer system. The line 24 is provided with the valves 30 and 28 in order that fluid may be pumpted from the line 24 into the line 26, but back flow of the fluids from the line 26 into the pipe portion 32 is precluded. Raw sewage from the building 106 is directed to the tank 10 by gravity through the usual tile conduit or pipe 18, and is discharged into the interior of the tank 10 through the elbow member 20 for accumulation in the lower portion thereof.

Assuming motor 90 and pump 34 are in a non-operative condition following a pumping cycle, sewage fluid routinely accumulates in the tank 10, and the motor casing 91 floats or rises slightly to actuate the float switch, thereby activating the entire sewage treating and pumping unit, comprising motor 90, macerator blades 80, grinder blades 74, and impeller 48. When the pump is operating, the agitated sewage is swirled into a vortex, as might be expected, particularly when the adjoining tank walls are conical and convergent, and the exposed macerator blades 80 above the pump apparently assist in producing a substantial degree of aeration indicated by extensive bubbling when viewed through an observation window in test units, which undoubtedly encourages chemical action through oxidation. This reduces odor, and in fact field reports consistently indicate that the unit is odorless.

The solids in the sewage are accumulated in the proximity of the bottom 16 of the tank 10 by gravity, and are thus efficiently directed to the pump 34 and macerator blades and grinding blades thereof; thus, the solids are efficiently macerated and mixed with the liquids as they descend and are drawn into the pump cavity 38. The pump action forces the mixture centrifugally upward through the discharge pipe 32, valves 30 and 28, and the relatively small line 24 replacing the usual large tile conduit and leading up and down with the terrain into the main sewer conduit 26, under sufficient hydraulic head to pressurize the main sewer conduit 26. After a predetermined quantity of the sewage has been pumped from the tank 10, the motor casing 91 will have moved downwardly to its lowermost position, and the operation of the motor 90 and pump ceases, so the liquid level in the tank is maintained within predetermined limits.

In the event of any pump or motor failure, the sewage accumulating in the tank 10 will flow through the discharge pipe 22 prior to any back-up of the sewage into the pipe 18 since the discharge pipe 22 is disposed at a lower elevation than the inlet pipe 18. Of course, if desired, a suitable alarm system (not shown) may be provided for indicating any pump failure in order to preclude damage from overflow of the sewage.

Removal of the entire treating and pumping unit for servicing or cleaning is readily accomplished by disconnecting a union, conventional ground joint, or similar threaded connection (not shown) normally associated with valves of the type of valve 30, whereby, if the handle 102 is submerged, the pipe 32 may serve as a convenient handle means located well above any normal fluid level for lifting the entire operating assembly from the tank. Likewise on reassembly, the unit may be lowered by gravity to its operating position, the pump being automatically located and concentrically aligned by the convergent side walls of the tank, and the unit resting on the frustoconical floor section, all as shown in FIG. 1.

From the foregoing it will be apparent that the present invention provides a novel method and means of transferring raw sewage from a local site, such as a building, or the like, through a tube of a size not hitherto realized and often a substantial distance, just below the surface of the terrain, to a main pressure sewage system. The novel method comprises providing a septic tank or holding tank having a tapered bottom for accumulating solids in the sewage fluids in one area of the tank. A macerating type pump is disposed above the pump in the proximity of the bottom of the tank for assuring an efficient grinding of the solids and mixing thereof with the liquids for facilitating pumping of the fluid through a relatively small discharge line into the main pressure sewage system. The pump is actuated by an electric motor which is particularly designed and constructed for operation in and under water, thus assuring an efficient and prolonged useful life for the pump. In addition, the motor housing functions in much the manner of a float for providing intermittent operation of the pump whereby the pump is activated only when a sufficient quantity oof sewage is present in the holding tank to require the pump action.

Whereas the present invention has been described in particular relation to the drawings attached hereto, it should be understood that other and further modifications, apart from those shown or suggested herein, may be made within the spirit and scope of this invention.

I claim:

1. A sewage accumulating and treating unit for receiving gravity-fed sewage through an inlet pipe from a local source, for macerating solids in said sewage and for discharging the resulting effluent under a predetermined pressure into a pressurized sewer main, said unit comprising:

a. an accumulation tank having downwardly converging walls, with a frustoconical bottom section for receiving said sewage;

b. a centrally-disposed sewage-treating unit for comminuting solids in said sewage and discharging effluent from said tank, said treating unit normally being submerged below the sewage level in said tank and resting upon and being located by said converging walls adjacent to said frustoconical bottom section; and

c. a relatively small diameter discharge pipe extending upwardly from said treating unit for connection to said pressurized sewer main;

d. said treating unit including a pump and including a pump and including exposed macerating blades located above said pump but nevertheless close to said bottom section, said blades being rotatable about the central axis of said frustoconical section, to agitate said sewage and swirl it into a vortex while said treating unit operates.

2. A sewage accumulating and treating unit as claimed in claim 1, wherein said discharge pipe is the sole structural member extending vertically upward in a region directly adjacent to said treating unit and continues vertically upward from said pump to a point above the uppermost sewage level in said tank, whereby when said upper end is disconnected said discharge pipe is operative for lifting said treating unit from said tank.

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