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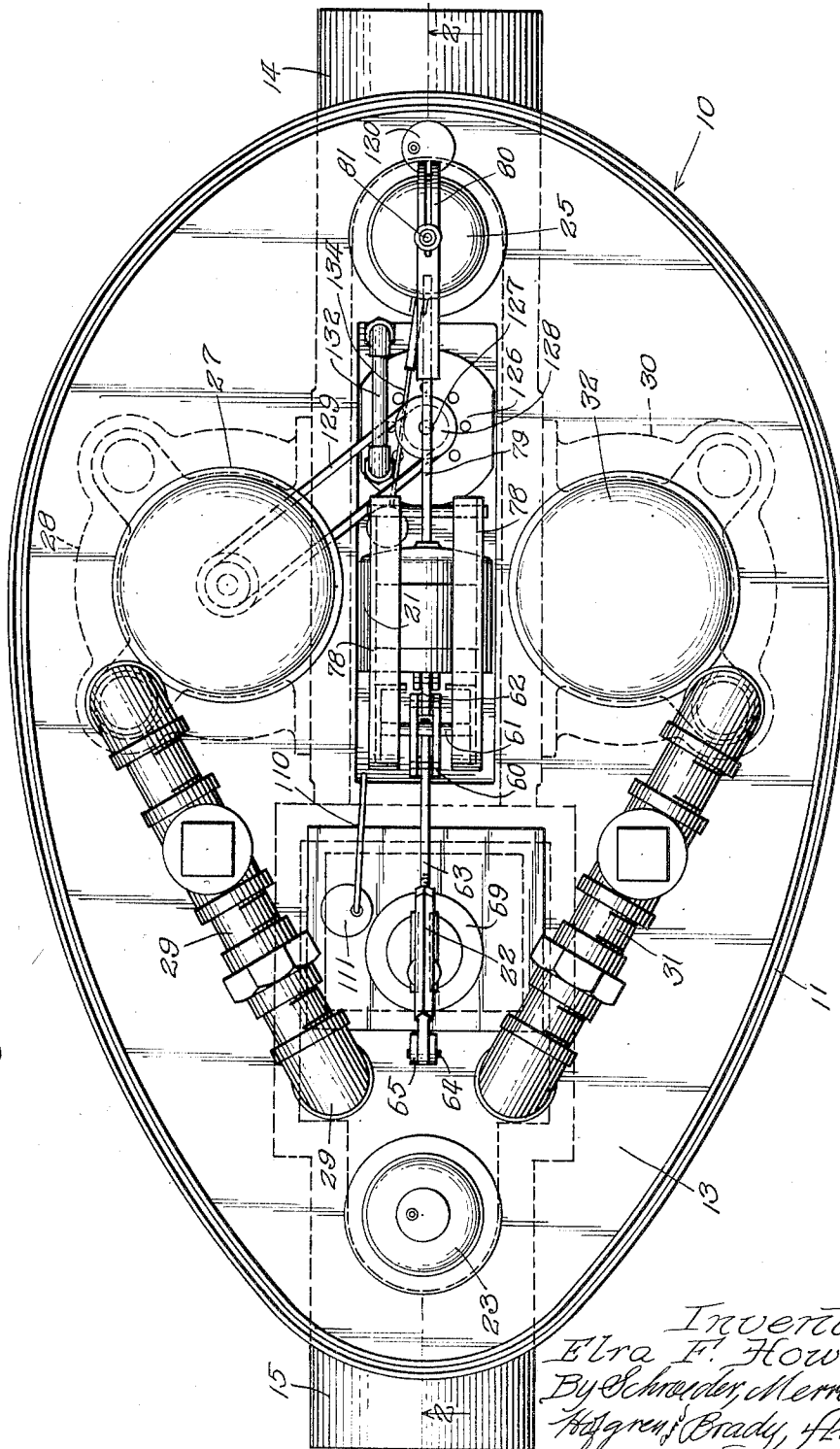
E. F. HOWE
FLOOD CONTROL SYSTEM

2,701,026

Filed July 31, 1951

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Fig. 1.



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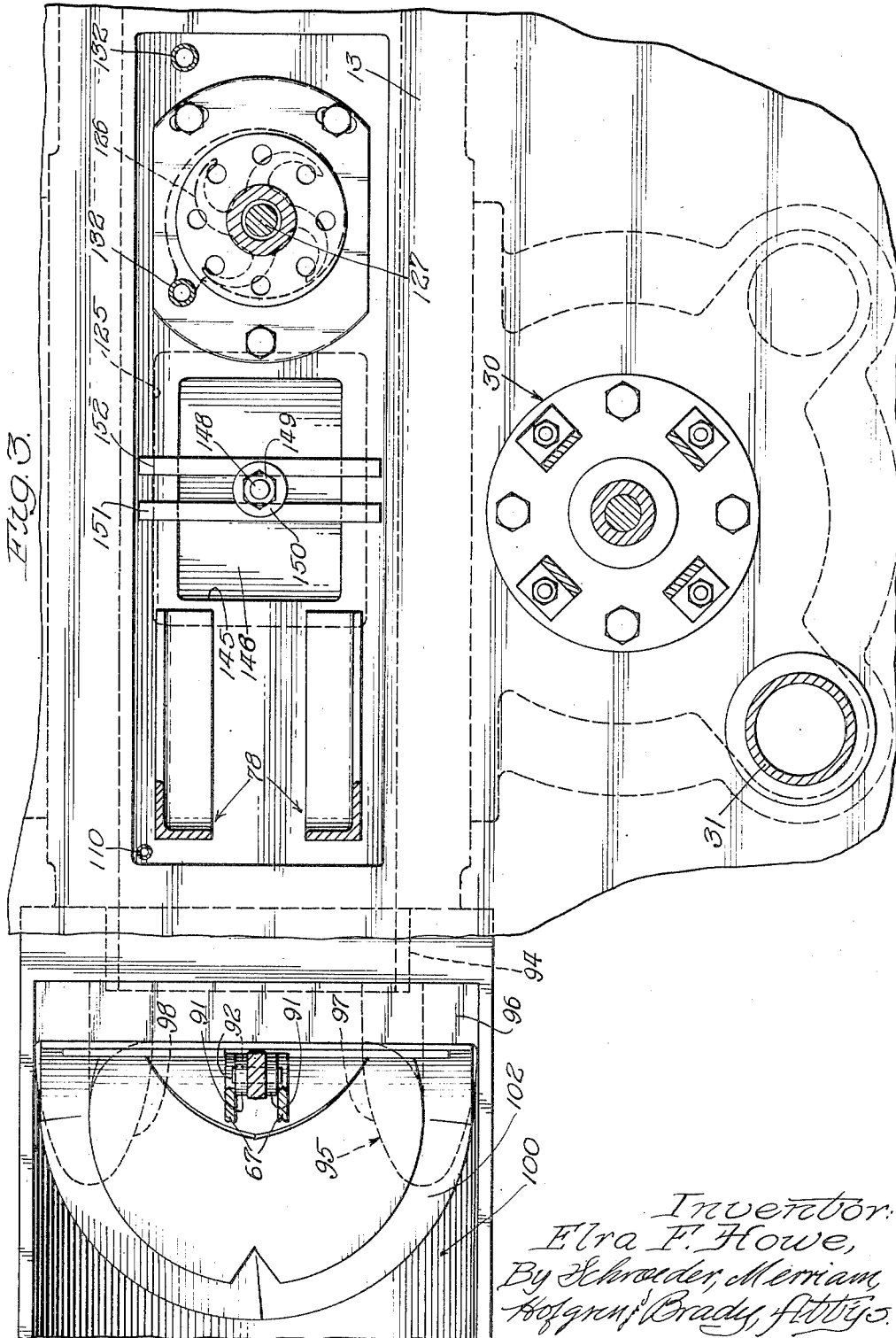
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Filed July 31, 1951

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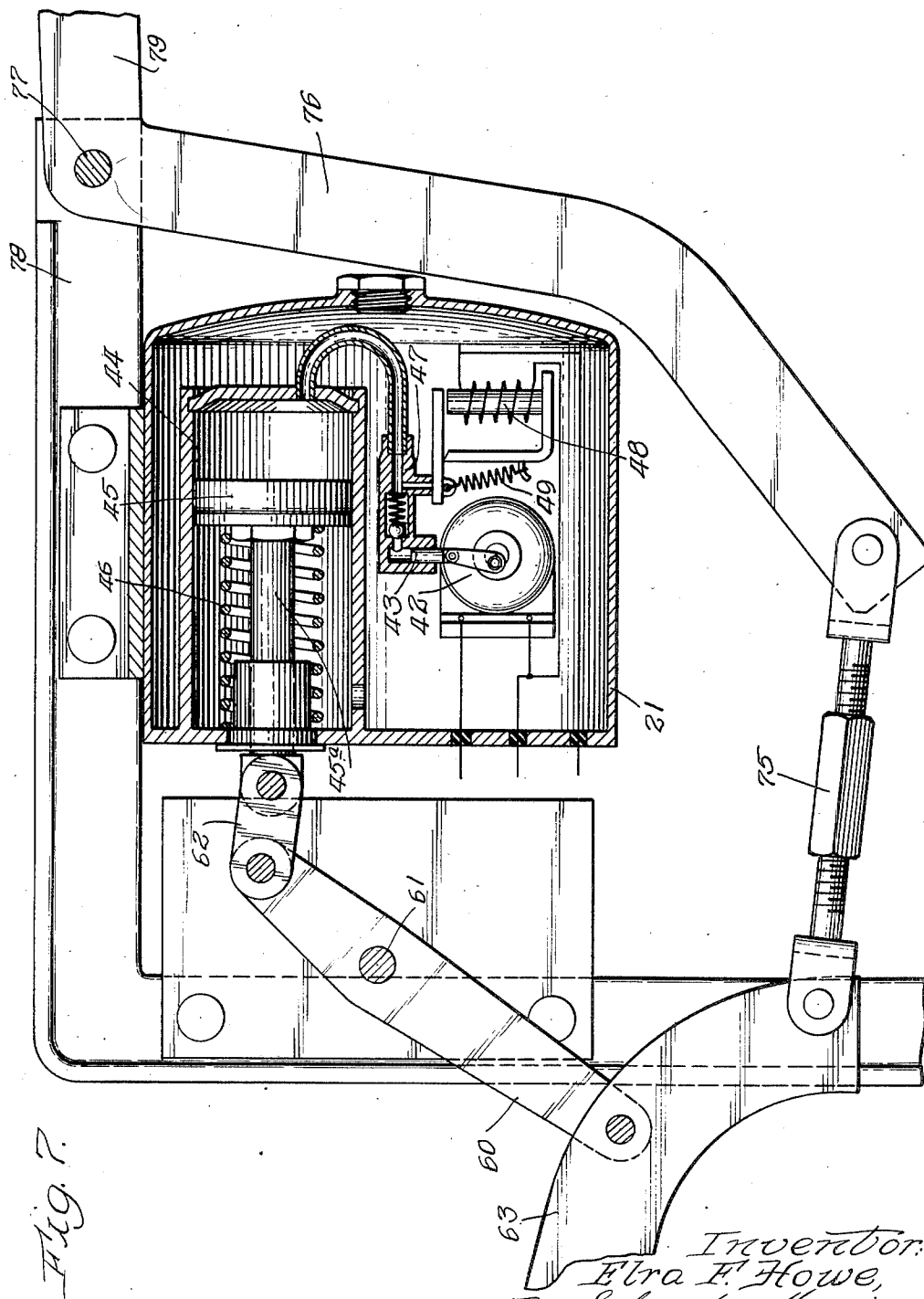
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5 Sheets-Sheet 5



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2,701,026

FLOOD CONTROL SYSTEM

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Application July 31, 1951, Serial No. 239,611

5 Claims. (Cl. 182—1)

This invention relates to flood control systems and more particularly to a flood control system particularly adapted to be associated with a drainage or disposal pipe leading from a building to a sewer connection.

It is the principal object of this invention to produce a new and improved flood control system.

In my Patent No. 2,421,066 and in my copending application Serial No. 112,587 filed on August 26, 1949, (now Patent No. 2,569,102) there is shown a flood control system which includes a disposal pipe connecting the drainage facilities of a house or building with a sewer. In the disclosed systems there is provided a main valve means adapted to close when flood conditions prevail in the sewer to prevent sewage from backing up into the house system. There is also included in such system a by-pass passage connected to opposite sides of the main valve means and provided with a pump for moving wastes discharged during periods when the main valve means is closed from the upstream side of the valve to the downstream or sewer side of the main valve, with the pump operating against whatever hydrostatic pressure may exist in the downstream side of the disposal pipe due to the flood conditions. Disintegrator means may be provided in the by-pass passage to reduce to a finely divided state any solid matter discharged during periods when the valve means is closed.

The purpose of the flood control system shown in my patent and copending application and briefly described above is, of course, to prevent sewage from backing up into the house or building disposal system during periods of heavy precipitation or under conditions which overload the sewage system. The apparatus is so designed as to permit continued use of the toilet and other facilities of the house during times when the main valve is closed.

It has been discovered that occasionally conditions exist which tend to prevent the flood control system described from performing its function. There have occurred conditions where a large solid object became lodged on the valve seat for the main valve means and prevented the valve from closing, thus permitting flooding conditions to occur in the house. In addition, heavy precipitation is often accompanied by violent electrical storms which may interrupt the electrical supply to the house, and thus a system which relies upon electrical power to close the valve will fail because of failure of the power at the time when it is needed most.

Therefore, one of the principal features of this invention is the provision of a flood control system having main valve means effective positively to close the disposal pipe even in the presence of solid objects lodged on the valve seat. Another feature of the invention is the provision of closing means for the valve which will operate even though electrical current has been interrupted.

A further feature of the invention is the provision of motor means for opening the main valve means wherein opening movement of the valve tensions or potentiates an independent biasing means. The valve is held in open position by an electrical device which releases, when deenergized, to permit the biasing means to move the valve means to closed position. The electrical device may be deenergized through the operation of a float in the disposal pipe which moves in response to the existence of flood conditions or may be deenergized upon the failure of electrical current, in either event the biasing means thereupon serves to move the valve to closed position.

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A further feature of the invention is the provision of a hydraulic motor for opening the main valve means including a piston and cylinder device having an electrically operated valve for opening and closing the cylinder. Movement of the piston to move the valve to open position tensions a spring, and the valve is held in open position by the electrically operated valve means. The deenergization of the electrically operated valve opens the cylinder to permit the spring to move the valve to closed position. A further feature of the invention is the provision of a float controlled switch for deenergizing said electrical valve means to move the main valve means to closed position, it being understood that the deenergization of the electrical valve means may also occur through failure of electrical current, again to effect the closing of the main valve means.

A further feature of the invention is the provision of main valve means which includes a main valve pivotally mounted in the disposal pipe and adapted to seat against a main valve seat in the pipe, the main valve being provided with a secondary valve attached thereto adapted to seat against a secondary valve seat. A further feature of the invention is the provision of a secondary valve seat which is slanted with respect to the pipe so that a closure of the pipe is effected between the secondary valve seat and the secondary valve before the main valve is seated on the main valve seat. The secondary valve and seat are designed so as to effect a closure of the disposal pipe even though complete closure of the main valve is prevented by an obstruction on the main valve seat. A further feature of the invention is the provision of a secondary valve of the type just described which is provided with a flexible feather edge to seat on the secondary valve seat and a flexible center attached to the main valve to permit the main valve to move to completely closed position even after the secondary valve has seated, together with stiffening means for the secondary valve located intermediate the center portion and the edge to hold the secondary valve in the form of a flexible cup.

A further feature of the invention is the provision of venting means to establish equal air pressure on opposite sides of the main valve means when the valve means is in closed position, with such means being so constructed as to permit only the passage of air therethrough and being provided with means for draining liquid from the vent. Another feature of the invention is the provision, in combination with an air vent, of means for draining liquid from the vent including an elongated chamber opening at one end to the upper side of the disposal pipe and at its other end to the bottom of the vent, and including a vent pipe extending through and spaced from the openings in the chamber with the vent pipe opening at one end to the disposal pipe on one side of the main valve means and below the chamber opening so that water accumulated in the vent proper may drain through the chamber and be replaced with air, such replaced air being then vented to the opposite side of the main valve means to equalize the pressure therein. Other and further features of the invention will be readily apparent from the following description and drawings, in which:

Fig. 1 is a top plan view of a flood control apparatus embodying the invention of this application;

Fig. 2 is a vertical section taken along line 2—2 of Fig. 1;

Fig. 3 is a horizontal section taken along line 3—3 of Fig. 2;

Fig. 4 is a vertical section taken along line 4—4 of Fig. 2;

Fig. 5 is a vertical section through the venting means of the invention;

Fig. 6 is a side elevation, partially broken away for clarity of illustration, showing the electrical means for actuating certain of the motor devices of the apparatus; and

Fig. 7 is a sectional view showing the details of the motor for operating the main valve means.

While this invention is susceptible of embodiment in many different forms, there is shown in the drawings and will herein be described in detail one specific embodiment,

with the understanding that the present disclosure is to be considered as an exemplification of the principles of the invention and is not intended to limit the invention to the embodiment illustrated. The scope of the invention will be pointed out in the appended claims.

Referring now to Figs. 1, 2 and 3, the flood control unit is housed within a pit structure generally designated 10 which includes somewhat egg-shaped sidewalls 11 adapted to support a cover 12. The sidewalls or jacket 11 are removable to allow ample work space around the flood control unit while installation is being made and may be of any desired height so as to bring the cover 12 substantially flush with the basement flooring. Reinforcing rims (not shown) may be provided in the jacket, and the jacket and cover are preferably made of cast aluminum to provide an anti-corrosion housing.

The pit structure includes a cast aluminum bottom 13 upon which is mounted a number of the devices forming the invention. Secured to the underside of the bottom 13 are two pipe sections 14 and 15 which are to be connected into and form a part of the disposal pipe leading from the house or building in which the unit is installed to an outside sewer. Preferably, the pipe unit 14 is equipped with a hub 16 of the usual six inch diameter to fit tile or iron sewer pipe of that diameter. If the preexisting disposal pipe is of a different diameter, suitable adapters may be used to effect the connection.

The flood control system includes a main valve means 20 mounted for pivotal movement within the pipe section 15 and actuated by motor means generally designated 21 through a linkage mechanism 22 which serves to move the valve means between open and closed positions. The motor means 21 is actuated through an electrical switch assembly generally designated 23 which in turn is actuated by a float 24 within the downstream side of the pipe section 15.

Accumulation of waste matter in the upstream section 14 when the main valve means is closed operates an electrical switch means 25 through a second float 26 located in the upstream section 14 to operate a motor 27 connected to a pump 28 to pump liquid within the section 14 through a by-pass passage 29 and into the disposal pipe on the opposite side of the valve means. A second pump 30 is also provided to pump such waste matter through a second by-pass passage 31 into the downstream side of the disposal pipe. Preferably, the two pumps 28 and 30 operate in sequence, that is, as waste matter accumulates within the upstream section 14 the motor associated with either of the pumps, for example the pump 28, is first actuated, and unless waste matter accumulates beyond the capacity of this pump 28 the second pump 30 remains idle. Should the accumulation of waste matter in the upstream section behind the closed valve be beyond the capacity of the pump 28, further upward movement of the float 26 actuates a motor 32 associated with the pump 30 so that both pumps operate in parallel to by-pass waste matter around the valve means 20.

In order to dispose of solid matter which may be located within the pipe section 14, disintegrator means located behind a grating 33 are provided for each pump and serve to reduce to a finely divided condition any solids within the upstream section 14 so that the same may pass freely through the pumps and through the by-pass passages 29 and 31. Because of the action of the disintegrators, the by-pass passages may be of considerably smaller diameter than the disposal pipe.

Preferably, the floats 24 and 26 are of copper and provided with stainless steel rods 34 and 35 respectively, and the disintegrator blades and pump shafts are also preferably made of stainless steel to provide a unit which is extremely resistant to corrosion.

The foregoing general description is believed to be sufficient for an appraisal of the principal units of the flood disposal system and reference is made to the aforementioned patent and application for a more complete and detailed description of the various elements just described.

The float 24 is, as previously noted, provided with a copper float portion 40 secured to the rod 34. To prevent waste material, such as paper, string and the like, from collecting around the float rod which would interfere with operation of the float, there is provided a flexible guard in the form of a boot 41 which is collapsible in the nature of a bellows, as the float rises and falls in response to the rise and fall of the level of liquid within the pipe

section 15. The float rod 34 is connected to a mercury contact switch (not shown) within the switch unit 23, which in turn is connected to suitable wiring to the motor 21.

As best seen in Fig. 7, the motor 21 is hydraulic (of the type commonly known as a "hydramotor") and includes an electric motor 42 operating to drive a fluid pump 43 which may be of the usual gear type. Fluid pumped by the pump 43 is directed to a cylinder 44 in which there is reciprocally mounted a piston 45 having a piston rod 45a extending outwardly from the cylinder and connected to the linkage mechanism 22. A spring 46 located within the cylinder 44 is connected to the linkage mechanism, as shown, and is so arranged as to constantly bias the valve means 20 towards closed position. Movement of the piston within the cylinder in response to the introduction of hydraulic fluid therein from the pump serves to move the main valve means to open position and simultaneously to tension the spring 46. Valve means 47 are provided on the cylinder for maintaining the cylinder closed after the main valve means has been moved to open position, the valve means 47 being so constructed as to be held in closed position by the solenoid device 48 when the latter is energized and moves to open position by a spring 49 when the solenoid 48 is deenergized. The electrical system is such that when the float 24 is raised through the accumulation of water in the downstream section 14, it serves to deenergize the solenoid 48, opening the valve 47 and permitting the spring 46 to move the main valve means 20 to the closed position shown in Fig. 2. This closing movement is accomplished even though electrical failure may occur contemporaneously with flood conditions. In the event that an electrical failure occurs without the existence of flood conditions, the main valve 20 may be opened manually by operating the linkage mechanism 22 and held in open position by a catch (not shown) until such time as the electrical current is restored.

The linkage mechanism 22 includes a lever arm 60 pivoted to a rod 61 and connected at one end to a link 62 connected to the piston rod 45a and at the other end to a second link 63 intermediate the ends thereof. One end of the link 63 is pivotally connected at 64 to a downwardly extending arm 65 attached at its lower end to an actuating rod 66 connected through a link 67 to the main valve means 20. The actuating rod extends through an opening 68 in a box-like housing 69 fixed to the bottom 13 of the pit and positioned over a suitable opening 70 in the disposal pipe section 15. The rod 66 is rockably held in the opening 68 through the provision of a ball joint 71 suitably sealed to the edges of the housing 69 by a flexible diaphragm 72.

The other end of the lever arm 63 is pivoted to an adjustable link mechanism 75 connected to an upwardly extending leg 76 of a crank arm mechanism, which is pivoted at 77 to a frame member 78, and whose other leg 79 carries a bifurcated arm 80 embracing the upper end 81 of a switch operating mechanism for the switch device 25. The purpose of the crank arm and the bifurcated arm 80 is to normally maintain the float 26 in the upper position shown so as not to interfere with the passage of sewage through the disposal pipe section 14 under normal conditions. Only when flood conditions occur in the section 15 is the float 26 lowered and rendered operative to start either of the motors 27 and 32. The particular switch arrangement is more fully shown and described in my said copending application Serial No. 112,587 (now Patent No. 2,569,102).

From the foregoing description it can be seen that movement of the piston 45 in one direction under the influence of the fluid moved by the pump 43 serves through the linkage mechanism 22 to pivot the valve means 20 to open position while movement of the piston in the opposite direction under the influence of the spring 46 serves to bring the valve means to the closed position shown in Fig. 2.

The main valve means 20 includes a main body member in the form of a circular plate 90 to the back of which is secured an arm 91 pivoted at its upper end to a pin 92 secured adjacent the upper portion of the disposal pipe section 15. The body member 90 carries on its upstream face an annular valve member 93 preferably of rubber or other similar material adapted to seat against an annular brass valve seat 94 fixed to the end of the section 14. The valve portion 93 and seat 94 constitute the main closure means for the disposal pipe

and under the usually encountered conditions effectively seal off the two sections from each other when flooding conditions occur. It can be seen, however, that should a large solid object happen to be located on the valve seat 94 at the time the main valve is moved to closed position such solid object would serve to hold the valve in open position and thus permit flooding of the premises. To prevent such failure of the main valve means, secondary valve means are provided which will serve effectively to close off communication between two pipe sections 14 and 15 even should the main valve be unable to close because of the presence of obstructing solids.

As best seen in Figs. 2, 3 and 4, the secondary valve includes a secondary valve seat 95, which is preferably made of rubber, in somewhat the shape of a horseshoe. The toe portion 96 of the shoe is located adjacent the top of the pipe section 15 while the heels 97 and 98 of the shoe are located adjacent the bottom of the pipe section and extend away from the valve seat 94 so as to provide a secondary valve seat 99 which is slanted with respect to the axis of the pipe 15 and with respect to the plane of the valve seat 94.

Secured to the back or downstream side of the body member 90 is a secondary valve 100 of resilient material which is adapted to seat on the secondary valve seat 99. The secondary valve 100 includes a central portion 101 secured to the body member 90 and made of flexible material, such as rubber. The outer edge 102 is feathered, that is tapered off to a very fine edge, and provided with slits 103 to permit the edge portions intermediate the slits to overlap when the valve is moved to seated position. Stiffening means 104 is provided on the secondary valve intermediate the central portion 101 and the edge portion 102 which serves to hold the entire secondary valve 100 in a cup shape. The stiffening means, therefore, provide a means for maintaining the secondary valve in the desired shape without the necessity of molding the same to that shape which molding, of course, would entail an operation of some expense. The edge portion 102 is made flexible in order that it may seat properly on the face 99 of the secondary valve seat while the central portion 101 is made flexible so that the main valve means may move to fully closed position. Thus, as the main valve means is moved toward closed position the secondary valve seats on the secondary valve seat and is effective to seal off communication between the two pipe sections. Should some solid matter prevent complete closure of the main valve means, fluid is prevented from entering the upstream section 14 by the secondary valve. In the event no solid matter is present on the main valve seat, the valve continues its closing movement until it reaches fully closed position, and the secondary valve offers little resistance to such further closing movement because of the resilient character of the central portion 101 of the secondary valve.

It will be noted that the portion of the pipe section 15 lying between the two heel portions 98 of the secondary valve seat forms a part of that valve seat in that the lower portion of the edge 102 of the secondary valve contacts and sealingly engages that portion of the pipe section as the valve means is moved toward closed position.

It will, of course, be understood that when flood conditions occur such condition is sensed by the float 24 which, upon being raised, deenergizes the solenoid 48 to move the main valve means 20 to closed position. When the flood conditions subside, the float 40 is lowered as the water level within the pipe section 15 lowers and upon reaching a predetermined position actuates the hydramotor 21 to open the main valve.

Under certain conditions air may enter the pipe section 15 while a flood situation still prevails, the air, of course, being under some pressure due to the hydrostatic head in the street sewage system. Air in the pipe section 15 replaces the liquid and if permitted to remain would allow the float 40 to move downwardly and thus would serve to open the valve means 20 while flooding conditions still existed. In order to prevent such an occurrence, means are provided for venting any air present on the street side of the main valve means when it is closed. To this end there is provided an air pipe 110 opening at one end to the interior of the pipe section 14 and connected at its other end to a float controlled air vent 111 which is connected in a manner

hereinafter to be described to the interior of the pipe section 15.

The air vent 111 is of usual construction and includes a valve so constructed as to permit the passage only of air into the pipe 110. Any such vent may be used in this flood control system, the most common being known as the Auto-Vent, which includes a venting valve normally open and adapted to be closed by a float contained within the vent. Thus, as long as air only passes through the vent the venting valve remains open, but should liquid enter the vent valve chamber the float is raised to close off the venting valve. When the venting valve has been closed in response to accumulation of liquid within the vent, it has been found on occasion that further air may accumulate within the pipe section 15. The presence of liquid in the vent 111 prevents such air from venting, giving rise to conditions under which the main valve 20 may open prematurely.

For this reason, drainage means for the vent 111 is provided with the apparatus shown and is best illustrated in Fig. 5. As shown in that figure, there is provided a vertical cylinder 112 defining an elongated vertical chamber 113 provided with an opening 114 at its lower end opening into the upper portion of the pipe section 15. A second opening 115, somewhat smaller in diameter than the opening 114, is provided at the top of the chamber 113 with the opening 115 opening to the bottom of the vent 111. Extending through but spaced from each of the openings 114 and 115 is a vent pipe 116 whose lower end 117 opens within the pipe section 15 below the opening 114 and whose upper end 118 opens into the interior of the vent 111. The vent pipe 116 is provided with an orifice or opening 119 located adjacent the upper end of the chamber 113. When flooding conditions first occur to cause closure of the main valve means 20, water is forced upwardly by hydrostatic pressure through the opening 114 to fill the chamber 113 and subsequently to fill the vent 111 until the level of the liquid within the vent 111 operates the float therein to close the valve. Should air accumulate in the section 15 it may pass upwardly through the opening 114 into the chamber 113 allowing the water therein to spill back into the pipe 15. When the liquid within the chamber 113 has been substantially completely replaced with air, such air may enter the orifice 119 and pass upwardly through the vent pipe into the vent 111 while simultaneously permitting liquid therein to drain down in the space between the vent pipe and the sides of the opening 115. A strainer screen 113a is provided in the chamber 113 and surrounds the pipe 116 to prevent solid matter from reaching and possibly blocking the orifice 119. As air enters the vent 111, the valve therein is opened and such air, under whatever pressure it may be, is conducted to the pipe section 14 so as to equalize the air pressure therein with the air pressure existing on the opposite side of the main valve means.

An additional air vent 120, similar in construction to the air vent 111, is provided adjacent the float 26 in the pipe section 14 although as can be seen this latter air vent vents directly to the exterior.

It will be noted that the bottom 13 of the pit structure is provided with a sump 125 which is adapted to collect water which may seep into the housing. Such seepage may occur through the cover plate 12 or may arise from various other causes, but all such seepage is collected in the sump from which it may be removed by the means about to be described.

Located within the sump 125 is a centrifugal sump pump 126 provided with a drive shaft 127 which carries a pulley 128 adjacent its upper end. A V-belt 129 rides on the pulley 128 and a second pulley 130 mounted on the shaft 131 of the pump motor 27. The sump pump discharges through a pipe 132 into the pipe section 14. Thus, it can be seen that operation of the motor 27 not only operates the pump 28 but also the centrifugal sump pump 126.

Inasmuch as condensation may frequently cause accumulation of water in the top part of the unit, or seepage from the basement might do the same, and in the absence of a flooding condition within the disposal pipe, separate means are provided for actuating the motor 27 to drain the sump of liquid which may have accumulated therein. To this end there is provided a ball float 133 located within the sump and connected to a float

rod 134 which, as best seen in Fig. 6, is pivoted at 135 to an arm 136 secured to the electrical switch means 25. The arm 134 is provided with a curved portion 137 which extends through a suitable opening 138 in the housing for the switch means and is adapted to bear against a pivotally mounted switch assembly 139 which carries a mercury switch 140 adapted to energize the motor 27. A coil spring 141 has one end secured to the switch assembly 139 and its other end secured to a portion 142 of the assembly which is fixed within the electrical switch means 25 in order to hold the mercury switch in the open position shown in Fig. 6. Upward movement of the ball float 133 in response to the accumulation of liquid within the sump 125 serves to pivot the portion 139 and hence the mercury switch 140 to close the same to operate the motor 27. The fact that the pump 28 and disintegrator means associated therewith are operated incidentally during the operation of the sump pump 125 is of no consequence, and such incidental operation will, of course, be of short duration sufficient only to empty the sump 125 and to lower the ball float 133. The switch assembly 139 is operated through a permanent magnet 143 in response to movement of the float 26 in a manner described in my said copending application Serial No. 112,587 (now Patent No. 2,569,102).

A clean-out opening 145 is provided in the bottom of the sump and is normally closed by a rectangular closure 146 provided with a gasket 147 to be compressed between the edges of the opening 145 and the closure 146 by a bolt 148 as shown. The upper end of the bolt 148 is provided with a nut 149 bearing against a washer 150 which in turn bears against two spaced supports 151 and 152 extending across the sump 125.

I claim:

1. In a flood control system associated with a disposal pipe and including main valve means in said pipe, means for operating said valve means, a by-pass passageway communicating with said pipe on opposite sides of the main valve means, a pump in said passageway for forcing material in the pipe behind the main valve means through said passageway, an electrical motor for operating the by-pass pump, a float in the pipe behind the main valve means and connected to a switch for energizing the motor upon the accumulation of liquid in the pipe behind the main valve means, and a pit structure adjacent said pipe and housing said by-pass passageway, apparatus of the character described for disposing of seepage into the pit comprising means defining a sump in the bottom of the pit, a sump pump having an inlet communicating with the sump and an outlet communicating with the pipe behind the main valve means, means providing a driving connection between the sump pump and said motor, and a second float in the sump and connected to the switch for energizing the motor in response to the accumulation of liquid in the sump.

2. In a flood control system associated with a disposal pipe and including main valve means in said pipe, a by-pass passageway communicating with said pipe on opposite sides of the main valve means, and a pump in said passageway for forcing material in the pipe behind the main valve means through said passageway, means for operating the main valve means comprising an electric motor, means operated by the motor for opening the valve means, electrical means operating when energized to hold the main valve means in open position, a spring for closing the main valve means when the electrical means is de-energized, a float in the pipe on the downstream side of the main valve means, and means connected to the float for de-energizing the electrical means in response to upward movement of the float under flood conditions in the pipe.

3. In a flood control system associated with a dis-

posal pipe and including main valve means in said pipe, a by-pass passageway communicating with said pipe on opposite sides of the main valve means, and a pump in said passageway for forcing material in the pipe behind the main valve means through said passageway, means for operating the main valve comprising an electric motor, a hydraulic pump operated by the motor, a hydraulic piston and cylinder device connected to the pump, means connecting the piston to the main valve means adapted to move the valve means to open position when hydraulic fluid is pumped into the cylinder, a spring tensioned by movement of the valve means to open position to bias the valve means to closed position, a valve for the cylinder adapted when closed to prevent discharge of fluid from the cylinder, electrical means controlling the cylinder valve and operating when energized to close the cylinder valve to hold the main valve means in open position and when deenergized to open the cylinder valve to permit the spring to close the main valve means, and means operating in response to the existence of flood conditions in said pipe downstream of the valve means to de-energize the electrical means.

4. In a flood control system associated with a disposal pipe and including main valve means, a float in the pipe on the downstream side of the main valve means adapted under flood conditions to cause the valve means to close and upon subsidence of the flood conditions to cause the valve means to open, a vent provided with float controlled means for venting only air and a passage for conducting vented air to the disposal pipe on the upstream side of the valve means, means for draining liquid from the vent comprising means defining a chamber opening at its bottom to the disposal pipe on the downstream side of the main valve means and opening at its top to the vent, a vent pipe extending upwardly through the openings in the chamber and spaced from the sides of the openings with the lower end of the vent pipe opening into the downstream side of the disposal pipe below the bottom chamber opening and with the upper end of the vent pipe opening into the vent, and an opening in the vent pipe adjacent the top of the chamber.

5. In a flood control system associated with a disposal pipe and including main valve means, a float in the pipe on the downstream side of the main valve means adapted under flood conditions to cause the valve means to close and upon subsidence of the flood conditions to cause the valve means to open, a vent provided with float controlled means for venting only air and a passage for conducting vented air to the disposal pipe in the upstream side of the valve means, means for draining liquid from the vent comprising means defining an elongated vertical chamber having an opening in its bottom to the top of the disposal pipe on the downstream side of the valve means, said chamber having an opening at its top to the vent, a vent pipe extending vertically upwardly through the openings in the chamber and spaced from the sides of the openings with the lower end of the vent pipe opening into the downstream side of the disposal pipe below the bottom chamber opening and with the upper end of the vent pipe opening into the vent, an opening in the vent pipe adjacent the top of the chamber, and a strainer in the chamber surrounding the vent pipe.

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