

United States Patent

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[56]

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[54] **WASTE LIFT SYSTEM**
4 Claims, 5 Drawing Figs.

[52] U.S. Cl..... **137/13,**

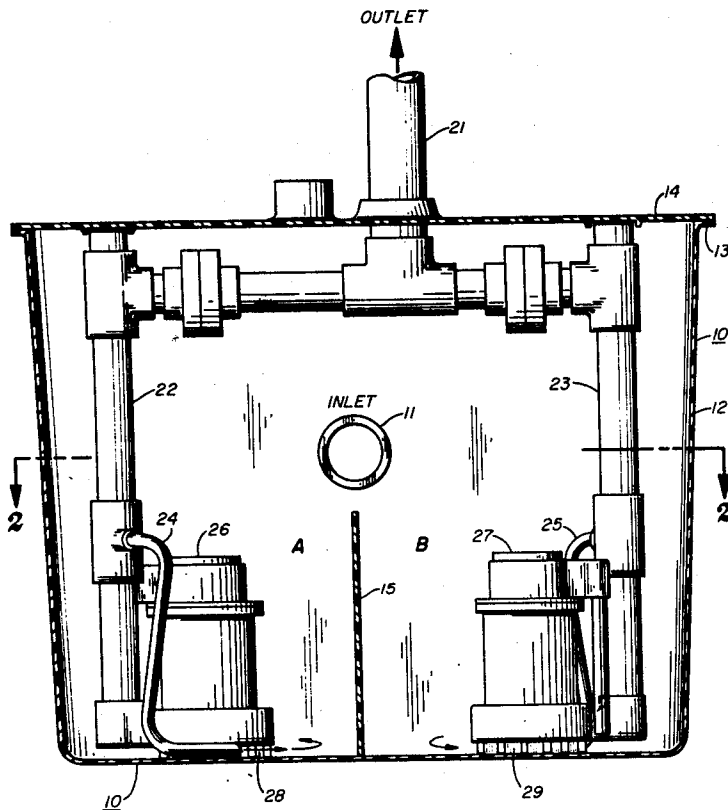
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[51] Int. Cl..... **F17d 1/14**

[50] Field of Search..... **4/10, 115,**

35, 34, 39, 40; 137/13, 608

ABSTRACT: A container is connected to a source of waste. Two pumps are mounted in separate compartments within the container and supplied from the source in parallel. The pumps are connected together to discharge waste through a common outlet.



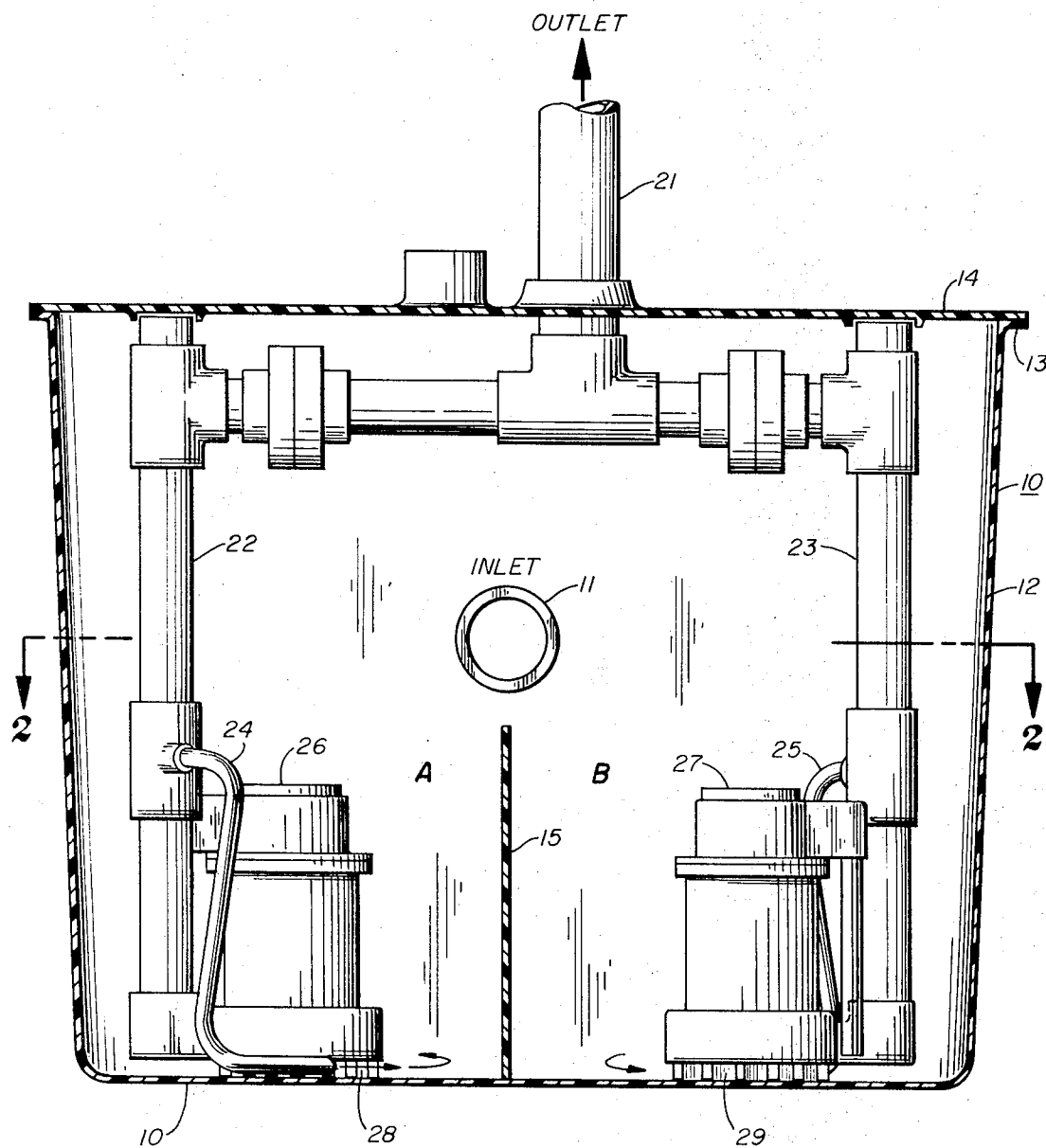


Fig. 1.

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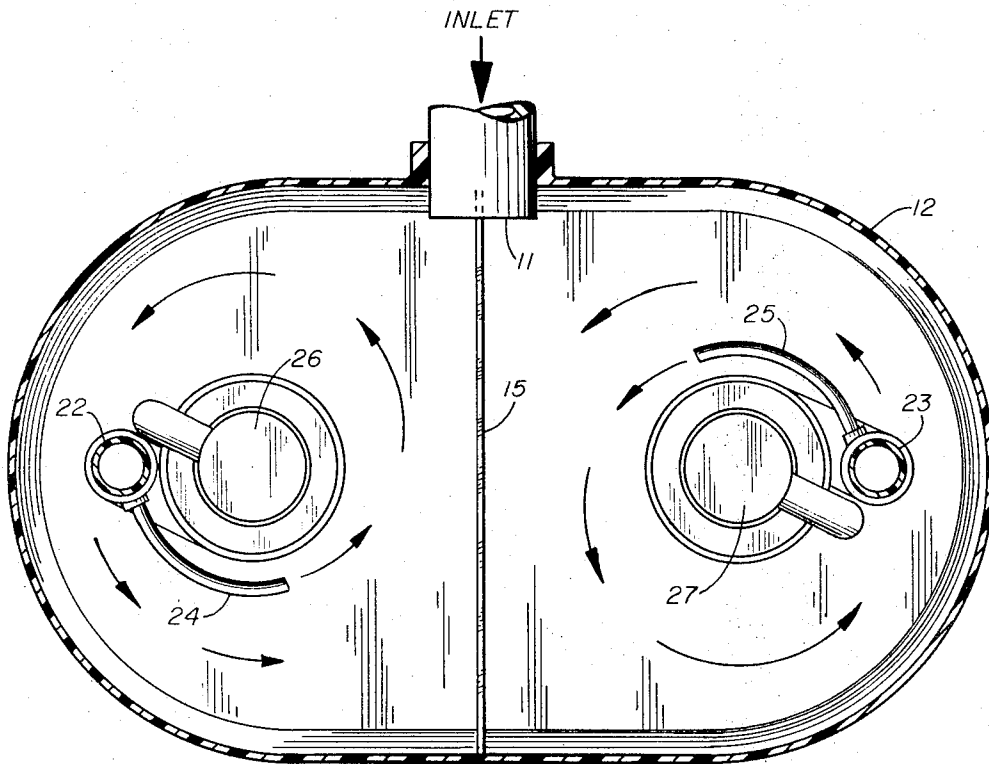


Fig. 2.

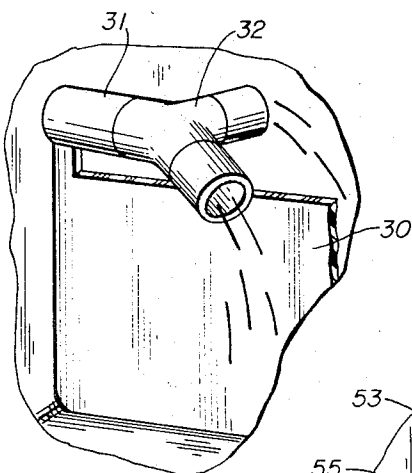


Fig. 3.

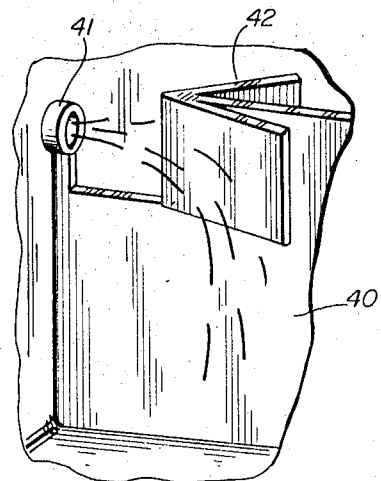


Fig. 4.

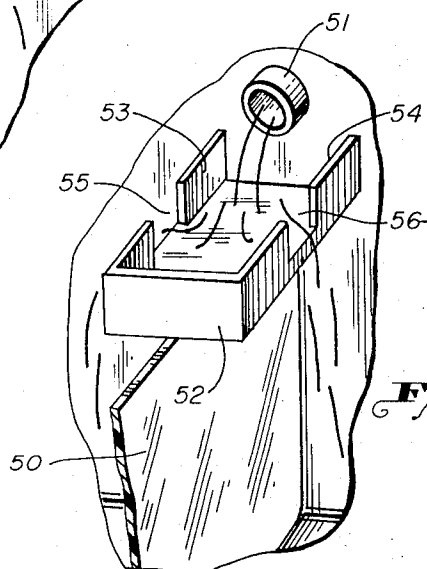


Fig. 5.

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WASTE LIFT SYSTEM

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to the distribution of waste material deposited in a container between a plurality of pump units. More particularly, the invention relates to supplying a plurality of pumps within a container between in parallel so if one pump stops pumping, the load will be diverted to the operative pump, or pumps.

2. Description of the Prior Art

When the demand for pumping from low locations has been frequent, or continuous, it has been customary to provide a plurality of pumping units. The use of a plurality of pumps is based on the requirement that if there is a malfunction of one unit the pumping will not be interrupted. It has been the practice to size the pumping units so that if one unit stops the load can be carried by the remaining unit, or units.

The past practice has usually provided sequential and cyclic application of power to the plurality of pumping units. When one pump malfunctions, or clogs, the control system switches the power to the next unit in the cycle. Service, repair or replacement of the malfunctioning units can then take place without interruption of the pumping. Also, a cycle is usually established to provide even wear on all the pumps of the system. A further complication is generated by the requirement of operation of more than one pump at a time if the load exceeds capacity of one pump for a period of time.

In theory, the system of power switching on the pumps employed is practical. However, the system is inherently complex. If the load itself can be shifted between the pumps, simplification can be expected. If clogging can be eliminated in many instances by shifting the load, this advantage will be additive to that of simplification.

SUMMARY OF THE INVENTION

A principal object of the invention is to continuously divide the load automatically between a plurality of pumping units and shift the load automatically from a unit which becomes inoperative.

Another object is to automatically increase the back flow to a pumping unit which becomes at least partially clogged to raise the possibility of unclogging the unit with the increased back flow.

The present invention divides a hydraulic load between a plurality of pumping units. All units normally carry their individual proportion of the load continuously. If one unit malfunctions, or clogs, its load is automatically shifted to the operable unit, or units. The inoperable pump in then service, repaired or replaced while the entire load is carried by the operable unit, or units. Additionally, the feedback of a portion of the pumped fluid is automatically increased to a clogged unit to possibly sweep the clogging material from the entrance of the clogged pump.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a sectioned elevation of two pumps in a container with conduits, all embodying the present invention;

FIG. 2 is a sectioned plan view along lines 2-2 of FIG. 1; and FIGS. 3, 4 and 5 are isometric elevations of flow dividing structure useful in the container of FIGS. 1 and 2.

DESCRIPTION OF THE PREFERRED EMBODIMENT

FIGS. 1 and 2 disclose the overall arrangement of the preferred embodiment. FIG. 1 discloses a container 10 connected to inlet 11 from which liquid and solid waste are received. The container is usually placed at a level low enough to receive the liquid and solid material as it gravitates from multiple sources not indicated in this disclosure.

Container 10 is disclosed in a form molded from a plastic material which will withstand the corrosive nature of the waste collected. Under present day technology, the basic housing 12

of container 10 can be shaped in one piece with a flange 13 on which can be mounted a cover 14. Suitable fittings are readily molded in place to form connections with the conduits communicating with the interior of the container. There is a wide range of materials including plastic which are suitable for container 10.

The cover 14 is mounted on flange 13 and attached in one of a number of suitable ways. Access openings are provided as may be convenient for any manual cleaning and inspection of the interior of the container.

The form of the container housing 12 is disclosed as generally oblong as can be more fully appreciated with FIG. 2. A center baffle, or partition, 15 divides the lower portion of the interior into compartments A and B, each roughly cylindrical in form. Inlet 11 is arranged to discharge the waste material on the bottoms of the compartments for removal through a common discharge conduit 21.

Conduit 21 is a manifold in that it receives waste material from branch conduit 22 in compartment A and waste material from branch conduit 23 in compartment B. A pressure drop is generated across each inlet of branch conduits 22 and 23, so liquid and properly sized solid waste material will flow from the container through the discharge manifold 21 and up to a predetermined level above the container.

The inlets of conduits 22, 23 are swept of solid material some of which may be so large that it tends to bridge over the inlets and block discharge from the container. A backflow of stream of the material which has passed through each inlet is directed across the inlet to provide the sweeping function. More specifically, a bypass conduit is connected to each branch conduit 22, 23 downstream of the inlet to the branch conduit and extended back down to branch conduit inlet. The force of the differential pressure generated across the inlet of the branch conduit ejects a portion of the material passed through the inlet back down to the bottom of the compartment and across the inlet. The size of this relatively high velocity stream is determined by the size of the bypass conduit relative to that of its branch conduit.

The outlet end of each bypass conduit 24, 25 is directed across the inlet of its branch conduit. Also, the direction of the sweeping flow is made generally tangential to the walls of the compartment. This arrangement provides for the liquid and solid material to be formed into a vortex about the inlet of each branch conduit in its compartment. The vortex is made intense enough by this arrangement that solid waste material is digested by fluid agitation and attrition.

The swirling vortex of waste in the lower portion of each container compartment not only reduces the larger of the pieces of waste into smaller pieces but keeps the large material which will not reduce in size isolated against the wall of the compartment. The material which does digest (reduce in size) eventually is drawn into the inlet of the branch conduit in that compartment. Therefore, this grading process separates the solids within the compartment and keeps the solids which cannot be reduced isolated by centrifugal force until removed through an opening in cover 14.

Up to this point, in connection with FIGS. 1 and 2, the differential pressures across the inlets of branch conduits 24 and 25 have been discussed as generated by some general structure. The embodiment of FIGS. 1 and 2 discloses electric-driven, vane-type, pumps 26 and 27 as specific structures to provide the differential pressures.

Pumps of this general type are well-known as sump pumps. The motors of the pumps have liquidtight housings while immersed in mixtures being pumped. Each pump unit is mounted on the end of a discharge conduit, such as branch conduits 22 and 23, the inlet of each branch conduit in its respective compartment becoming the inlet of its pump.

The inlet of each pump is formed into a series of openings 28 and 29 between legs arranged about the impeller of each pump. As a series of openings 28 and 29, this structure becomes a coarse strainer through which solid material of large size cannot pass to jam, or injure, the impellers of the pumps.

Additionally, it is emphasized that the two-compartment container of the disclosure is not a limitation of the invention in any way. The compartments could be in completely separate containers and utilize the invention. There could be more than two compartments. Further, the compartments, and their respective pump units, need not be of the equal size disclosed to utilize the invention. The same principle of automatic, continuous division of the pumped load with automatic shift of the load from a malfunctioning unit is not limited in any way by the size and number of pumps and compartments disclosed.

DIVIDING INPUT BETWEEN COMPARTMENTS A AND B

The load of waste material flowing into the container 12 is divided between compartments A and B. The preferred simple embodiment of a dividing arrangement is disclosed in FIGS. 1 and 2. Inlet 11 discharges the load of waste into the side of container 12. Vertical baffle partition 15 is extended up from the bottom of the container directly beneath the center of inlet 11. The waste is, therefore, divided by upper edge of structure as it descends upon the upper edge. Substantially equal amounts of waste material fall into compartments A and B.

Obviously, there are other arrangements which will also divide the waste material between a plurality of compartments. FIGS. 3, 4 and 5 are examples of such alternate arrangements.

In FIG. 3 a fragment of a vessel-dividing baffle 30 is disclosed. An inlet 31 is provided with a Y-connection 32. Each of the legs of the Y-connection deposits its waste load in one of the compartments formed by baffle 30.

In FIG. 4 a fragment of a vessel-dividing baffle 40 is disclosed. An inlet 41 is arranged in a manner similar to that provided for inlet 11 of FIGS. 1 and 2. A V-shaped baffle portion 42 is mounted as a part of baffle 40 to present its apex to the middle of inlet 41 and provide more positive diversion to the waste flowing from inlet 41. The diverted portions of the waste fall directly into their respective compartments formed by baffle 40.

In FIG. 5 a fragment of a vessel-dividing baffle 50 is disclosed. An inlet 51 is arranged in a manner similar to that provided for inlet 11 of FIGS. 1 and 2. A tray 52 is mounted on the top edge of baffle 50 and beneath inlet 51 to receive the waste upon the flat bottom of the tray. Opposite sides 53 and 54 of the tray 52 have identical slots 55 and 56. Obviously the waste material of inlet 51 will flow into the tray 52 and flow out through both slots 55 and 56 in a substantially equal division of the input. Each slot 55 and 56 is positioned to divert its output into a compartment of the vessel formed by baffle 50.

OPERATION

The operation of the embodiment of FIGS. 1 and 2 is only representative of the operation many different embodiments which have been indicated as falling within the scope of the invention. The waste input to container 12 is divided between its compartments. In FIGS. 1 and 2 baffle partition 15 divides the waste into substantially equal portions, each portion collecting in one of compartments A and B.

As the level of waste in each compartment reaches a predetermined height, a control system responds to the waste at that level to switch on the pump motor. Normally, the predetermined level is below the upper edge of baffle partition 15. The pump is sized with the capacity of to evacuate its compartment and lower the level of the waste to a predetermined lower height. The pump will be automatically turned off at the low level and not turned on again until the upper level is reached. This cycle will repeat so long as the rate at which the waste is introduced into the compartment is less than the rate at which the pump can remove the waste through outlet 21.

Each compartment operates on its individual cycle. The pump of each compartment may have a slightly different capacity from the other pump, or pumps. One of the pumps may clog slightly with solids in the waste. Many such factors

establish an individual cycle time for filling and evacuating each compartment. Therefore, one compartment may be filling while another compartment is being pumped down. So long as the input of waste to each compartment is at a rate less than the capacity of its pump, the system functions smoothly, although the pumps are not turned off and turned on at the same time.

If there is a temporary increase in the waste input rate and one compartment overflows into another, the system will function smoothly if all pumps are operative. Once a compartment overflows, its waste level reaches the upper edge of partition baffle 15, the level of waste in the compartment receiving the overflow will reach the level which will bring its pump into action. All pumps will then be on at the same time, their total capacity brought to bear on the load of the temporarily increased input rate. Whether all pumps can meet this load is, of course, dependent upon the magnitude of the input rate increase and its duration. However, the invention provides this switch from individual cyclic operation of each pump to continuous operation of all pumps during the period of excessive input rate. Once the input rate decreases to the original range, cyclic operation on an individual basis is automatically resumed.

MALFUNCTION OF ONE PUMP

The basic problem anticipated by the invention is the malfunction of one of the pumps. A pump motor may become partially or completely inoperative. Eventually normal wear will cause this to happen. The pump impeller may partially, or completely, clog with solid waste despite the backflow provided to sweep the pump input clean. In any event, a reduction in the designed pumping rate may cause the level of waste in that compartment to rise to the upper edge of the baffle partition 15 and waste overflow into the neighboring compartment. Specifically, pump 26 of FIGS. 1 and 2 may malfunction and the waste of compartment A overflow into compartment B.

The invention anticipates that pump 27 will have the capacity to pump the total waste load placed upon it from inlet 11. The cycle of operation will increase because the predetermined upper level will be reached in a shorter period of time, but the pump 27 will continue to pump the waste of inlet 11 to outlet 21.

A signal system is readily conceived which will manifest that compartment A has overflowed. Remedial action can then be taken to repair, clean or replace pump 26.

BACKFLOW

Certainly, the pumping of one pump should be controlled in how much backflow will result into the inoperative pump. The branch conduits are connected together, and if no flow control action is provided, a substantial amount of the pumped flow may be routed down the other branch conduit as backflow. Therefore, a control device should be provided in each branch conduit which will limit the amount of backflow from the actuated pumping unit.

The backflow from a pumping unit into the inactive unit could be positively eliminated. However, if the malfunction is due to some clogging at the inactive unit, a measure of backflow could clean the unit. The waste back flowing could simply enter into raising the level in the inactive compartment. If the sweeping action of the backflow was ineffective to unclog the pump, the waste would merely overflow into the compartment of the active pump.

CONCLUSION

The invention thus obviates any complex level detection system which electrically switches the power between the motors of plural pumping units. The problem of malfunction and unbalance is solved by this automatic shift of the hydraulic load among the pumping units.

From the foregoing, it will be seen that this invention is one well adapted to attain all of the ends and objects hereinabove

set forth, together with other advantages which are obvious and which are inherent to the method and apparatus.

It will be understood that certain features and subcombinations are of utility and may be employed without reference to other features and subcombinations. This is contemplated by and is within the scope of the claims.

As many possible embodiments may be made of the invention without departing from the scope thereof, it is to be understood that all matter herein set forth or shown in the accompanying drawing is to be interpreted as illustrative and not in a limiting sense.

We claim:

1. A lift system, including:

a container;

a partition mounted in the container to divide the container into a plurality of compartments which communicate with each other above the partition;

an inlet system connected into the container above the partition for introducing waste into the container and dividing the waste over the upper edge of the partition into the compartments in predetermined proportions;

a pump unit connected to each compartment with its inlet arranged below the height at which the compartments communicate; and

means for actuating each pump unit when the level of waste in the pump compartment is at and above a predetermined height, below the height at which communication takes place between compartments, whereby inoperation of any one pump will cause the level of waste to rise to the predetermined height of communication and pass the waste to a compartment whose pump is operable for discharge of the waste to a point of disposal outside the

container.

2. The lift system of claim 1, including:

an output manifold connected to all the pumps of the container compartments; and

a means connected to each pump discharge to direct a portion of the pumped waste in a sweeping action across the pump inlet; whereby at least partial inoperativeness of any one pump will result in at least part of the output of an operative pump to the output manifold to be directed in a sweeping action across the inlet of the inoperative pump.

3. A method of pumping waste material from a low location to a higher location, including:

dividing the waste into portions of predetermined size;

collecting each of the predetermined portions so the height of each portion can vary between two levels for each portion;

normally pumping waste from each collected portion to a higher location to cycle the height of each portion between the two levels for the portion; and

passing waste from a first of the collected portions to a second of the collected portions when the pumping rate from the first portion becomes too low to maintain the height of the first portion between the two levels for the first portion.

4. The method of claim 3, including directing a part of the waste of the second of the collected portions over the entrance to the pumping unit for the first of the collected portions in a sweeping action to promote cleaning the entrance of any solid material which has at least partially blocked the entrance.

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