United States Patent

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[54] HYDRAULIC TRANSPORTATION SYSTEM

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[52] U.S. Cl. 302/15

[51] Int. Cl. B65g 53/30

[58] Field of Search 302/14, 15, 16; 222/193

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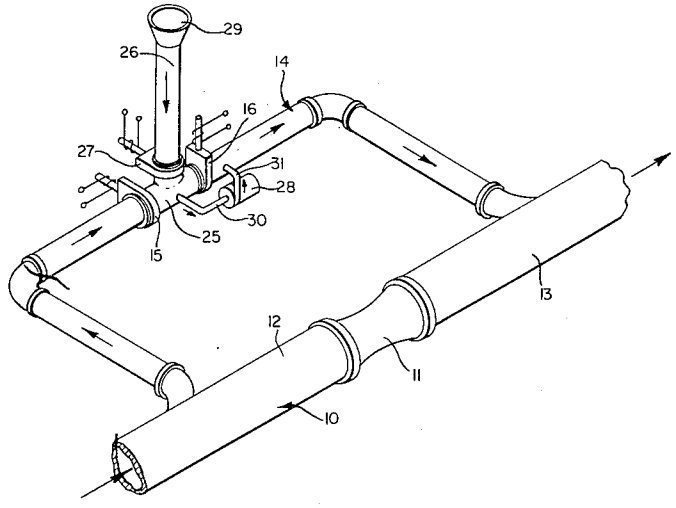
[57] ABSTRACT

A system is provided for hydraulic transportation of waste solids, whereby the solids may be introduced into a by-pass line off a main duct, whereby the solids are introduced into a chamber after discontinuing the flow of water through the by-pass line, with the solids either being introduced into a chamber directly in the by-pass line, or into a chamber connected thereto for subsequent introduction into the by-pass line. In the latter situation, a pusher of the piston type may be utilized. Valves are used to discontinue the flow to the chamber, and to open a solids inlet to the chamber, with the valves then being actuated to close the solids inlet and to open the chamber to the flow of water. In those instances wherein the chamber forms a part of the by-pass line, the water may then carry off the waste. In those instances wherein the chamber does not form a part of the by-pass line but communicates therewith, the pusher is then utilized to push the solids into the by-pass line. This procedure is then followed by the extraction of water from the chamber.

17 Claims, 4 Drawing Figures



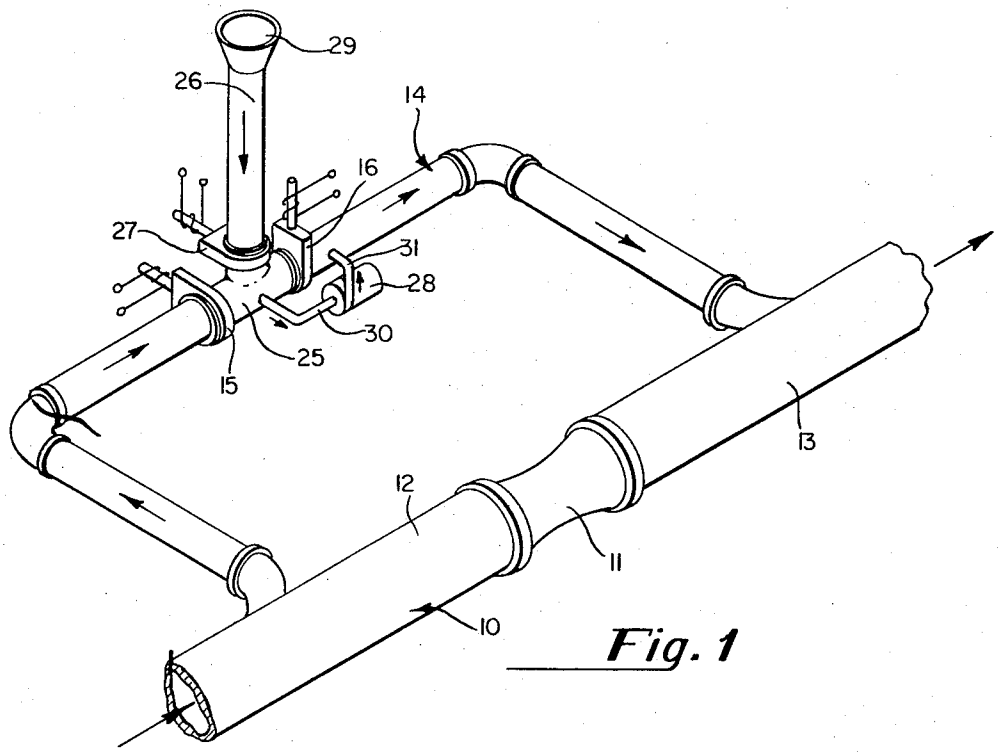


Fig. 1

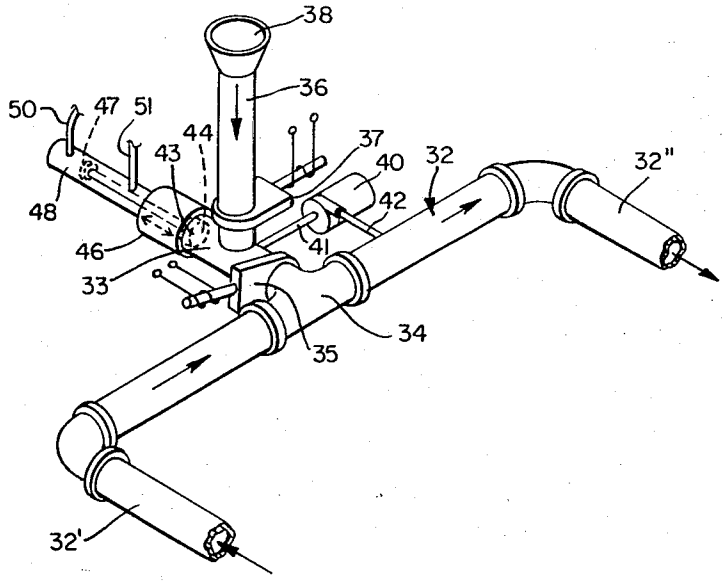


Fig. 2

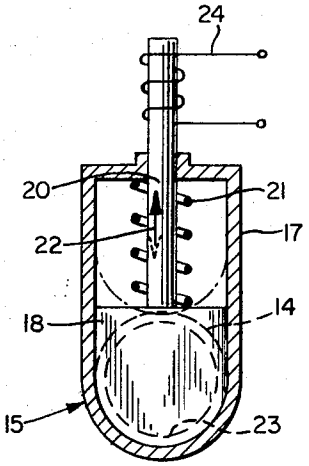


Fig. 3

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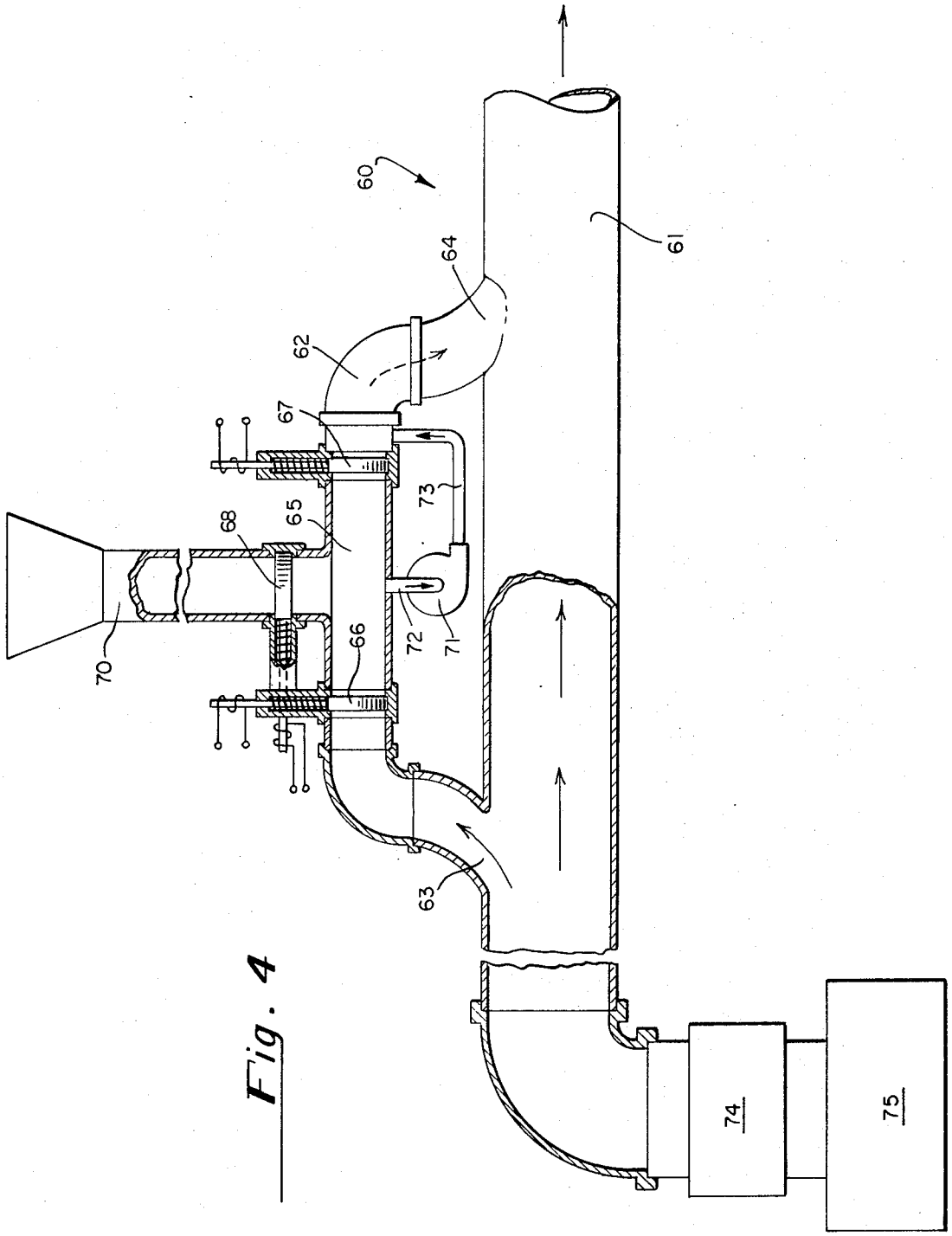

Fig. 4

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HYDRAULIC TRANSPORTATION SYSTEM

BACKGROUND OF THE INVENTION

In the present day household, more and more items such as food stuffs, commodities and the like are purchased in packaged form, thereby creating increased waste material in households, which must be disposed of.

Present day waste disposal techniques, for the most part, include the door-to-door collection of trash which is becoming increasingly expensive, with increased labor and other costs. Also, the problem of bacteria formation with garbage, trash and the like remains present, and in fact increases with the quantity of trash and garbage that need be collected from households and the like in any given community. This problem is particularly true in urban areas wherein a greater population density magnifies the trash accumulation problem and consequently magnifies the trash pick-up problem.

It has been recognized that it would be desirable to have some automatic disposal system for use at individual households, or other places of trash generation. However, localized trash pulping and grinding in individual households and the like for the most part becomes prohibitively expensive, for most households having normal trash accumulation problems. Even so, should a given site of trash generation have a sufficient quantity of trash generated as to warrant a pulping or trash compacting apparatus on the premises, there still remains the problem of collecting such condensed trash, even on a less frequent basis.

SUMMARY OF THE INVENTION

The present invention is directed toward overcoming the above, and other problems, in providing a hydraulic transportation system for waste conveying, that is adaptable to an entire community, wherein a main trash disposal duct is utilized by numerous households, or other locations of trash accumulation, and wherein each such situs of trash accumulation is provided with an apparatus for introducing trash into a pipe line, for carrying off the trash. A by-pass line is utilized, with valves for terminating the flow of water in such by-pass line under an arrangement that permits introduction of trash into the by-pass line, with such valves then being opened to permit flow of water and trash thus introduced into the by-pass line, into the main disposal duct or conduit.

Accordingly, it is a primary object of this invention to provide a novel hydraulic transportation system for waste conveyance, utilizing a main duct, having one or more by-pass conduit lines, each with means for introducing solids into such by-pass conduit line.

It is a further object of this invention to accomplish the above object, utilizing novel trash introduction means, particularly valve devices for opening an inlet into such by-pass conduit line and for closing off the water supply through such by-pass conduit line.

It is a further object of this invention to provide trash inlet means as set forth in the objects immediately above, wherein the trash is introduced directly in the by-pass line.

It is yet another object of this invention to provide a novel hydraulic transportation system, wherein, in addition to utilizing valves which selectively permit entry of trash into a chamber, or water into the chamber, utilizing novel pusher type means for introducing trash from the chamber into a by-pass line of a central trash disposal duct, to be carried off by water running through the by-pass line into the central duct.

Other object and advantages of the present invention will be readily apparent to those skilled in the art from a reading of the following brief description of the drawing figures, detailed descriptions of the preferred embodiments, and the appended claims.

IN THE DRAWINGS

FIG. 1 is a diagrammatic perspective view of a portion of a hydraulic transportation system in accordance with this invention, wherein a single trash inlet location is illustrated, along with basic operational components therefor.

FIG. 2 is a view generally similar to portions of FIG. 1, but wherein an alternative means is utilized for introducing trash into a by-pass line of the main duct.

FIG. 3 is a vertical sectional view through a typical valve utilized in accordance with the embodiments of FIGS. 1 and 2.

FIG. 4 is a vertical sectional view taken through a portion of a modified form of a hydraulic transportation system.

Referring now to the drawings in detail, reference is first made to FIG. 1, wherein there is illustrated a main water duct generally designated by the numeral **10**, that would comprise the main duct for a community or the like, for conveying waste solids from a plurality of residences, stores or the like thereof. The main duct **10** would comprise a large pressure tight pipe, for example, of 3 feet or greater in diameter, that would normally run down the center of the street in a given community. The duct **10** is pressurized for carrying water therethrough at a pressure of approximately 50 pounds per square inch. This duct **10** would normally be running full of water at all times.

A reduced diameter pipe section **11** would be provided, as a means for creating a pressure drop between upstream and downstream pipe sections **12** and **13** respectively.

The reduced diameter section **11** may comprise a zone of reduced interior pipe cross-section, or a throat, which would restrict the passage of water through the pipe **10**, to create the high pressure in the upstream end **12** of the pipe, which high pressure would prevail in water conveyed through a by-pass conduit **14**, to facilitate introduction of the high pressure water into the lower pressure section **13** of the pipe **11**, at a point located at predetermined distance from the throat **11** that would facilitate the re-entry of high pressure water into the pipe **13**.

The by-pass conduit **14** may comprise piping for example of 18 inch diameter.

A pair of valves **15** and **16** are located in the conduit **14**, each such valve being constructed in any desired manner, but preferably along the lines of one illustrated in FIG. 3. In FIG. 3, a gate valve is illustrated, comprising a housing **17** to which is connected the conduit **14**, on opposite sides thereof, with the housing also having a gate **18** slidable therein, to completely close off a section of the conduit **14**, when in the position illustrated in FIG. 3. The gate **18** is carried on a rod **20** and is spring-biased by means of a spring **21** in the downward position illustrated in FIG. 3. The gate **18** is movable upwardly, as indicated by the arrow **22** of FIG. 2, against the force of the spring **21**, to open the passageway **23** of the conduit **14** through the valve **15**, when actuated by means of a solenoid **24**, or the like.

The zone **25** of the conduit **14** as located between the valves **15** and **16**, comprises a chamber in its interior, that communicates with an inlet line or duct **26**, across the valve **27**, which valve **27** is also constructed generally in the manner illustrated in FIG. 3. The duct **26** may have a conical inlet **29** or the like, as desired, and would normally be located with a residence to be served by the system illustrated. A pump **28** is provided, for clearing water out of the chamber **25**, through a line **30**, and for interjecting the same into the conduit line **14**, on the downstream side of the chamber **25**, through a line **31**.

Waste would be placed into the top of the vertical duct **26**, in a condition of the system such that all of the valves **15**, **16**, and **27** are closed. The homeowner would then actuate the horizontal valve **27**, allowing the waste to drop directly into the chamber **25**, which would at this point contain no water. Then, the valve **27** would be closed, and both lower valves **15** and **16** would be opened, to allow water from the duct **10**, which would then have passed into the upstream end of the conduit **14**, to flood the chamber **25**, thereby washing solid waste into the downstream side of the conduit **14**, and then into the downstream portion **13** of the duct **10**, because of the difference between the pressure of water conveyed through the conduit **14**, relative to the lower pressure in the downstream side **13** of the duct **10**, as is effected by the use of a pressure reducing means such as the constriction **11**. After the waste has been washed by the water from the chamber **25**,

the valves 15 and 16 would be actuated by their solenoids to close, trapping water within the chamber 25. The pump 28 would then be actuated to extract the water from the chamber 25, through the line 30, and to interject such water through the line 31, back into the downstream side of the by-pass conduit 14. The upper valve 27 may then be opened to receive additional waste into the chamber 25.

This system permits entry of waste into a chamber that does not already have water in the chamber. If the waste that were to be carried away was sufficiently dense that it would immerse itself in water, and did not contain other items that were lighter in weight than water, such as paper particles and the like, then there would normally be no problem of introducing waste directly into the by-pass duct 14, without the use of the valves 15, 16 and 27. However, most waste comprises a heterogeneous mixture of metal, plastics, paper and cardboard components, some of which are lighter than water, and which would not readily be carried off, without the use of the arrangement discussed above.

At certain locations along the length of the main duct 10, there may be disposed various comminuting apparatus, such a pulping tanks as disclosed in application Ser. No. 580,445, filed Sept. 20th 1966, now U.S. Pat. No. 3,489,356 which may pulp the solid carried by the main duct 10 into the slurry form, which slurry may then be subsequently ground, if desired, or may be compressed at some stage, by the use of a press such as that disclosed in U.S. Pat. No. 3,426,677, if desired. In other instances, it may be desirable to dispose of the solids carried within the main duct 10, directly into a sewage system or the like, if desired. However, in most instances, it may be desirable to pulp and compress the solids carried within the duct 10, at one or more locations throughout the community having such a system as that disclosed herein.

WIth particular reference to FIG. 2, there is illustrated a system generally similar to that of FIG. 1, but wherein an alternative method is provided for introducing solids into a by-pass conduit 32. The conduit is provided with an upstream portion 32' which is connectable to a high pressure side of a main duct (not shown) and a downstream section 32'' which is connected to a low pressure section of a main duct (not shown).

A pipe section 33 is connected in communicating relation with the conduit 32 by means of a piping "T" 34, with a valve 35, constructed generally along the lines of the valve illustrated in FIG. 3, being disposed between the "T" 34 and the chamber 33. A vertical duct 36 is provided, which passed through another valve 37, which also is constructed along the lines of that illustrated in FIG. 3, for inlet of particles received into a conical hopper 38 or the like, for passing through the valve 37 when the same is in an open condition, and vertically downwardly into the chamber 33, as illustrated in FIG. 2.

In the embodiment in FIG. 2, a pump 40 is provided for evacuating water from the chamber 33 through a line 41, and for interjecting the same through a line 42, into the downstream section 32'' of the by-pass conduit 32. A pusher 43 is provided, in the form of a piston 44 connected to a rod 45, with the piston 44 being carried within a cylinder 46, and with the rod 45 having another piston 47 connected at its opposite end, with the piston 47 being disposed within a cylinder 48, and with drive means in a form of pneumatic lines 50 and 51 being provided, for receiving a fluid for driving the piston 47 back and forth, as desired, which in turn, will cause the pusher 43 to be actuated such that the piston 42 may traverse the chamber 33, for pushing solids and water disposed therein through the valve 35, and directly into the "T" section 34 of the by-pass conduit 32.

In the operation of the system illustrated in FIG. 2, all of the valves 37 and 35 would normally be closed, when waste is discharged into the vertical duct 36.

The homeowner would then actuate the valve 37, in order to allow waste to drop into the trash discharge chamber 33. The valve 37 would then be closed by actuation of its solenoid by any suitable switching device located nearby the point of inlet of trash by the householder, such as the inlet point 38, and the valve 35 would then be opened. All this time, water is being conveyed freely through the by-pass conduit 32. Thus, upon opening of the valve 35, water is free to flood the chamber 33, and to mix with the solids disposed therein. The ram or pusher 43 is then actuated by the pneumatic means illustrated, such that the piston 44 traverses the chamber 33, and passes through the valve 35, to force waste and water from the chamber 33, into the "T" 34. The ram is then actuated in a reverse manner such that the piston 44 is then withdrawn. As soon as the piston 44 passes backwardly clear of the valve 35, the valve 35 is closed and the pump 40 is then actuated by the householder or the like, for evacuating water from the chamber 33 through the line 41, and for interjecting the same into the downstream section 32'' of the duct 32 through the line 42. The trash discharge chamber is then ready to receive trash once again, upon actuation of the valve 37.

Referring now to FOG. 4 in detail, it will be seen that an alternative system generally designated by the numeral 60 is provided, with the system 60 including a main duct 61 that does not have a pressure reducing throat such as that 11 of FIG. 1. A by-pass conduit 62 is provided, that is disposed vertically above the main duct 61, approximately at an elevation of two feet thereabove, and with the by-pass conduit 62 being approximately eight feet in length, between its upstream point of communication 63 with the main duct and its downstream point of communication 64 with the main duct.

The by-pass conduit 62 includes a central portion or a chamber 65 that is disposed substantially parallel to and above the main duct 61, that is provided with valves 66 and 67, constructed in accordance with the construction of FIG. 3, as are the other embodiments of this invention. Also, a valve 68 is provided, for opening and closing a waste inlet chute 70 into and out of communication with the chamber 65.

A pump 71 is also provided, having a line 72 for withdrawing water within the chamber 65, when the valves 66 and 67 are closed, and for delivering water through a line 73, back into a downstream portion of the conduit 62, for introduction into the main duct 61. The operation of the valves 66, 67, 68 and the pump 71, as well as the general operation of the system 60 by a householder, for introducing waste to be discarded into the chute 70, is identical with that set forth above with respect to the system of FIG. 1, so the same will not be repeated in detail here.

The system 60 of FIG. 4 is constructed to eliminate the need for a pressure reducing means of the throat type, for causing water to be introduced into the by-pass conduit 62. The by-pass conduit 62 is located close the main duct 61, and although the same is illustrated as being disposed vertically above the duct 61, such is for exemplary purposes only, such disposition of the conduit 62 being not necessary. However, such disposition is preferable, and the distance of the main portion of the conduit 62, and especially that portion comprising the chamber 65, would be located within a predetermined distance from the main duct 61, so that the head (approximately ten to forty feet of pressure) in the main duct 61, at the point 63 of inlet communication with the by-pass conduit 62 will be sufficient to provide flow through the conduit 62, and back into the main duct 61, at the desired velocity. It is conceivable, that should the distance between the major central portion of the conduit 62 and the main duct 61 become too great, there would be a great pressure drop in the conduit 62 on the downstream side of the chamber 65, that may create some difficulty in reinjecting the waste and water back into the main duct 61 through the conduit outlet 64. However, by maintaining the distance between the main duct 61 and the chamber 65 of the conduit 62 to a minimum, and in any event, less than the maximum distance that would permit the minimum velocity flow through the conduit 62, for purposes of waste removal from the chamber 65, for a given preselected capacity of the pump or other means which supplies the pressure at the point of inlet 63, it is possible to rely upon the head pressure within the main duct 61, for sweeping the by-pass conduit 62, and waste disposed therein, such head also

facilitating the re-entry of water and any waste back into the main duct **61**, without reliance upon a pressure reducing means, such as a throat.

Accordingly, a pump **74** is provided, for supplying water from a suitable source **75**, and being selected to have a capacity to deliver the desired head or pressure at any and each by-pass conduit inlet location **63**.

It will be apparent that a single main duct **61** would ordinarily be utilized to provide flow at the desired pressure for a plurality of by-pass conduits, as for example, under a residential community, wherein the main duct **61** may be run beneath the houses at a given depth, with the by-pass conduits **62** being disposed above the main duct **61**, but located also beneath the houses, thereby eliminating the necessity for extensive piping, as for example, inwardly from a street to the location of a residence.

It will also be apparent, that if there is noticeable pressure drop within the loop or by-pass conduit **62**, the re-entry of water from the conduit **62** into the main duct **61** may be facilitated by a partial venturi effect, or partial vacuum caused by the passage of water across the opening **64**, through the main duct **61**, that has not been reduced noticeable in pressure, with the resultant partial vacuum or venturi assisting the inflow of water from the conduit **62**, through the opening **64**, into the main duct **61**. However, the venturi effect is generally insignificant in the arrangement of FIG. **4**, relative to the velocity impact of water within the conduit **62**, which is at a sufficiently high velocity due to the relatively short distance separating the conduit **62** and the main duct **61**, to move dense material out of the chamber **65**, and into the main duct **61**.

It will be apparent from the foregoing that various modifications may be made in the details of construction, and in the details of operation of the various components of the system illustrated herein. Also, various modifications may be made in the manner of utilization of the system set forth herein, all within the spirit and scope of the invention as defined in the appended claims.

What is claimed is:

1. A hydraulic transportation system for waste conveyance comprising a main duct for conveying solids therethrough in a pressurized water medium with means for creating a pressure drop in the main duct from a high pressure at a first location to a lower pressure at a second location downstream of said first location, a by-pass conduit having an inlet communicating with said main duct at said first location and an outlet communicating with said duct at said second location and being coextensive between said locations, and means for introducing solids into said by-pass conduit from outside thereof, wherein said by-pass conduit includes a chamber located in line therewith between said inlet and said outlet, for receiving waste solids therein and means for flooding said chamber with high pressure water carried in said by-pass conduit, with said introducing means also including delivery means being provided for delivering waste solids into said chamber, and valve means as part of said flooding means, actuatable to maintain in shut-off condition the supply of water into said chamber from said by-pass conduit while said delivery means to said chamber is open for introduction of solids into said chamber and to maintain shut said delivery means after passage of solids into said chamber and while water from said by-pass conduit is permitted to flood said chamber and carry off solids through said by-pass conduit to said main duct, wherein said chamber is provided with pump type evacuation means for evacuating water trapped therein after closing of said valve means in such a manner as to shut off water flow through said by-pass conduit, and for delivering the water thus evacuated into the by-pass conduit, on the downstream side of the chamber.

2. A hydraulic transportation system for waste conveyance comprising a main duct for conveying solids therethrough in a pressurized water medium with means for creating a pressure drop in the main duct from a high pressure at a first location to a lower pressure at a second location downstream of said first location, a by-pass conduit having an inlet communicating with said main duct at said first location and an outlet communicating with said duct at said second location and being coextensive between said locations, and means for introducing solids into said by-pass conduit from outside thereof, wherein said introducing means includes a chamber for receiving waste solids therein and means for flooding said chamber with high pressure water carried in said by-pass conduit, wherein said introducing means includes delivery means being provided for delivering waste solids into said chamber, and valve means as part of said flooding means actuatable to maintain said chamber closed to the water passing through said by-pass conduit while said delivery means to said chamber is open for introduction of solids into said chamber, and to maintain shut said delivery means when said chamber is open to said by-pass conduit and while water from said by-pass conduit is permitted to flood said chamber, said introducing means also including pusher means in said chamber for pushing solids and water from said chamber into said by-pass conduit while said chamber is open to said by-pass conduit.

3. The system of claim **2** wherein said delivery means comprises a vertically extending duct adapted for gravity feed of solids into said chamber from a location of trash disposal.

4. The system of claim **2** wherein said valve means comprises two separate valves provided with actuation means operable from a point located remote from said valve means, near the inlet to said delivery means.

5. The system of claim **2** wherein said pusher means comprises a piston and means for actuating the piston for traversing said chamber.

6. The system of claim **2** wherein said chamber is provided with pump type evacuation means for evacuating water trapped therein after closing said valve means to shut off communication of said chamber with said by-pass conduit, and for delivering the water thus evacuated into said by-pass conduit.

7. A hydraulic transportation system for waste conveyance comprising a discharge main, a conduit communicatively connected to said main for carrying waste thereinto and with means for supplying water to said conduit, a portion of said conduit being a chamber for receipt of waste therein through a waste-receiving inlet thereof and with said chamber being of substantially the same cross-sectional area as adjacent portions of the conduit at upstream and downstream ends of the chamber with said conduit being of substantially uniform cross-sectional area throughout its length, and of lesser cross-sectional area than that of the main, and means for shutting off the flow of water in the conduit and opening said waste-receiving opening prior to placement of waste in the chamber through said waste-receiving opening and for resuming the flow of water in the conduit through the chamber and closing said waste-receiving opening after placement of waste in the conduit, for sweeping of waste into the main.

8. The system of claim **7** wherein said means for shutting off and resuming water flow and for opening and closing said waste-receiving opening comprise valve means for isolating said chamber from the remainder of said conduit.

9. The system of claim **8**, wherein said valve means comprise three separate valves provided with actuation means operable from a point located remote from said valve means.

10. The hydraulic transportation system of claim **7**, wherein said conduit comprises a by-pass conduit, with said means for supplying water to said conduit comprising another communicative connection with said conduit and said main located upstream of said main from said aforementioned connection of said conduit and said main.

11. The system of claim **10** wherein said by-pass conduit is disposed at a greater vertical elevation than the elevation level of said main and wherein said by-pass conduit has a water-carrying portion that is disposed in spaced relation to, and substantially parallel to, said duct a predetermined amount that is less than the maximum distance that will permit minimum velocity flow in both of said main duct and said by-pass conduit, for a given preselected capacity of said supplying means.

12. The system of claim 10, including pump means for clearing water from said chamber prior to reception of waste therein.

13. The system of claim 10, including a waste chute connected to said waste-receiving opening for facilitating the input of waste thereto.

14. The system of claim 10, including means for creating a pressure drop between locations of connection of said by-pass conduit to said main.

15. The system of claim 14, wherein said means for creating a pressure drop comprise a zone of restricted cross-section of said main.

16. A hydraulic transportation system for waste conveyance comprising a waste discharge main, a conduit communicatively connected to said main for carrying waste thereto, a waste-receiving chamber associated with said conduit for supplying waste thereto, means for supplying water to said chamber, means for shutting off the water supply to the chamber during placement of waste therein and for resuming the supply of water to the chamber after placement of waste therein for washing of waste through the conduit to the main, and pusher means carried in the chamber for pushing waste disposed therein into said conduit.

17. A hydraulic transportation system for waste conveyance comprising a longitudinal conduit for carrying liquid therethrough, a chamber opening into said conduit, a closable waste inlet duct opening into said chamber for delivery of solid waste thereto, pusher means within said chamber for traversing said chamber and pushing solid waste into said conduit, means for actuating said pusher means, and means selectively operable for shutting off liquid communication between said conduit and said chamber when said duct opening is opened for receipt of waste and for closing said opening and for permitting liquid communication between said conduit and said chamber for flooding said chamber for facilitating transfer of solids from said chamber to said conduit, with the transverse cross-sectional interior size of said conduit being at least as great as the cross-sectional interior size of said chamber, as measured transverse to the path of movement of said pushing means.

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