PROCESS AND APPARATUS FOR CLEANING WASTE-DISPOSAL SYSTEMS

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Fig. 1

Fig. 2

Fig. 3

Inventor:
WOLFGANG MAASBERG

BY KARL F. RUS
AGENT
My present invention relates to a process for cleaning and clearing disposal systems for sewage and other wastes adapted to be conveyed in a liquid flow, and to apparatus for carrying out such process.

The underground waste-conducting networks of metropolitan areas frequently are obstructed by deposits of sludge, sediment and objects which, owing to the relatively slight grade of the waste conduits, cannot be successfully flushed free by the slow-moving liquid carrier flowing therethrough. Although many methods of cleaning and clearing sewage systems have been proposed and employed heretofore, substantially all such methods require some tedious and noxious hand labor while several necessitate expensive and complicated machinery. The aforementioned methods include mechanical removal of obstructions along the walls of waste conduits by brushes, scrapers, scoops and the like drawn through the pipes by flexible cables, the hydraulic removal of sediment by washing with water and the removal of sludge by suctioning apparatus. The washing nozzles, suction heads and scraping devices were generally propelled through the pipes at the ends of rotating flexible shafts, driven by a complicated mechanism at the street level and fed through manholes into the sewage networks, which frequently were halted by sharp bends in the pipe. Manual labor and considerable time often were required to release the cleaning apparatus.

It is an object of the present invention to provide an improved process for cleaning and clearing waste-disposal systems, adapted to obviate the disadvantages of earlier processes. It is another object of my invention to provide an improved process for washing the walls of waste conduits of different diameters with a minimum of manual labor. Another object of the invention is to provide a relatively simple and inexpensive apparatus for cleaning sewage networks.

A more specific object of the present invention is to provide a self-propelled device for flushing waste-disposal conduits, adapted to pass relatively freely through the conduit network. According to a feature of the invention, a washing nozzle at the extremity of a flexible high-pressure hose is provided with outlet-forming means adapted to emit at least one high-velocity jet of wash fluid in a generally rearward direction, thereby imparting forward motion to the washing nozzle to propel the latter through the network of waste-disposal conduits. The wash fluid, preferably water, is fed to the nozzle with a pressure preferably in excess of about 60 atmospheres gauge from a high-pressure pump at street level which communicates with the hose. The latter is introduced into the conduit network via the usual manholes spaced therealong. I have found that the optimum flow of fluid from the nozzle exceeds about 90 liters per minute.

The nozzle, according to a more specific feature of the invention, is provided with a central channel communicating with the high-pressure hose and with a plurality of angularly equi-spaced outlet bores. The latter are directed generally rearwardly to impart forward motion to the nozzle as a high-velocity fluid is ejected therefrom, and are inclined at an acute angle to the axis of the nozzle. The velocity of the fluid ejected from each bore thus comprises an axial component which serves to urge the nozzle forwardly, and a component transverse to the axis which maintains a spacing between the nozzle and the walls of the conduits. As the nozzle automatically propels itself through the waste piping it is carried on a cushion of ejected water around or over immovable obstructions while the water jets loosen and dislodge accumulated sediment and sludge.

The aforesaid nozzle with rearwardly directed water jets may also be employed as the propelling means for conventional cleaning devices (e.g., brushes and scrapers) and/or for flushing nozzles. Thus, according to another specific feature of the invention, the propelling nozzle is accompanied by a flushing nozzle, rigidly affixed thereto, which is provided with a source of wash fluid under pressure and means for dispensing the fluid in a generally forwardly directed flow to wash away the sludge and/or a plurality of radially directed streams to clean the walls of the conduits. The flushing nozzle may be supplied from the high-pressure hose which is connected to the propelling nozzle or from a second, independent hose which may terminate at a pressure.

The ejection pressure of water from the flushing nozzle is also, preferably, greater than about 60 atmospheres.

The propelling nozzle is inserted into the waste-disposal channels, via access manholes, at the end of its high-pressure conduit (normally a flexible hose) which is, advantageously, of a small caliber and in a preferred embodiment has an inner diameter between substantially 10 and 20 mm., and is displaced along these conduits over a distance determined by the length of the hose. The rearwardly directed propelling jets of the nozzle simultaneously loosen sediment and sludge lining the walls of the conduits. Upon reaching the extension limit of the hose, the nozzle is drawn rearwardly against the force of the jets whereby the rearward force of the latter, reinforced by the withdrawal force, undercut and dislodges heavier concentrations of sediment which are either washed away or carried to the vicinity of the manhole whence they may be scooped out. The flushing nozzle which may accompany the propelling nozzle into the conduits serves, upon the withdrawal thereof, to provide a final washing of the conduit wall and to dispense additional quantities of water to carry off any residual waste.

The water jets from the nozzles, as the latter are withdrawn from the conduits via the manholes, scour the manhole shaft and its appurtenances (i.e., steps, ladder rungs and the like).

The above and other objects, features and advantages of my present invention will become more readily apparent from the following description, reference being made to the accompanying drawings in which:

FIG. 1 is an axial cross-sectional view of a portion of a waste-disposal network illustrating a cleaning device, according to the invention.

FIG. 2 is a cross-sectional view of the propelling nozzle of the device shown in FIG. 1; and

FIG. 3 is a view similar to FIG. 2 of the propelling nozzle joined to a flushing nozzle.

In FIG. 1, I show a manhole shaft 10 communicating with a waste-disposal channel 11 of a sewage system below the street level 13. The manhole shaft 10 is provided with ladder rungs 12 adapted to afford access to the channel 11. Through a hole 15 in the usual manhole cover 14, a propelling head or nozzle 2a (described in greater detail hereinafter and shown at FIG. 2) is inserted at one extremity of a relatively long flexible high-pressure hose 1 which, according to the present invention, at a distance of 13.8 feet has a cross-sectional area of 0.97 square inches.

The pump, in FIG. 1, is at 17, and is connected to a source of fluid, preferably water, not shown.
As illustrated in FIG. 2, the nozzle 2a is provided with a central chamber 6, which communicates with the inner cavity of the hose 1, and with a plurality of angularly equispaced outlet bores 7 which are inclined rearwardly at an acute angle to the axis of the nozzle 2a and open at the external surface thereof.

In operation, the nozzle 2a and its hose 1, which may be assumed to have an internal diameter of substantially 10 to 20 mm., is inserted into the channel 11 via manhole 10. Pump 13 maintains a water flow of about 90 liters per minute or greater through the hose 1 and from the outlets 7 at a pressure in excess of approximately 60 atmospheres. The high-pressure water jets ejected from the outlet bores 7 in the directions of arrows 4 propel the nozzle 2a and its hose along the channel 11, thereby loosening and dislodging sediment and sludge. When the limit of the length of the hose 1 has been reached and the nozzle 2a is no longer able to propel itself through the sewer 11, the hose 1 is drawn from the manhole 10 (e.g., by a windlass at the street level) whereupon the jets 4 of water undercut and dislodge additional accumulations of sediment to clear the sewer. As the nozzle 2a is drawn out of the manhole shaft 10, the latter and its rungs 12 are thoroughly cleaned by the water jets.

The nozzle 2a may also be used to propel hydraulic cleaning accessories such as the flushing nozzle 2b, shown in FIG. 3, through the channel 11. Nozzle 2b is provided with a hose 1b which terminates in a pressure pump similar to that shown at 3 in FIG. 1 and is affixed to the hose 1 of the nozzle 2a by a clamp 8. Flushing nozzle 2b is provided with a plurality of radial outlet bores 9 and with a forwardly directed bore 9' which communicates with the inner channel 17 of the nozzle. As nozzle 2b is carried along with the propelling nozzle 2a into the channel 11, it serves to wash the walls of the conduit and to flush dislodged sediment away from the cleaned area.

The invention as described and illustrated is believed to admit of many modifications and variations deemed to be within the ability of persons skilled in the art and intended to be included within the spirit and scope of the appended claims.

I claim:

1. An apparatus for cleaning a waste-disposal channel, comprising a generally cylindrical nozzle adapted to be inserted into said channel, flexible-hose means attached to the rear of said nozzle for supplying a fluid under pressure thereto, said nozzle being provided with a central chamber communicating with said flexible-hose means and with a plurality of angularly spaced rearwardly and outwardly directed bores opening into said chamber and terminating at the outer surface of said nozzle, each of said bores being adapted to eject a jet of said fluid in a generally rearward direction whereby said nozzle is displaced within said conduit in a generally forward direction, a flushing nozzle operatively connected to said cylindrical nozzle and displaceable therewithin said conduit for dislodging obstructive matter therein, and a source of fluid for saidflushing nozzle, said flushing nozzle being provided with outlet means for emitting a generally forwardly directed stream of fluid.

2. An apparatus according to claim 1 wherein said bores are inclined at an acute angle to the axis of said nozzle.

3. An apparatus according to claim 1 wherein said flexible-hose means is connected to a source of fluid adapted to maintain the pressure of said fluid at said nozzle at a magnitude of at least 60 atm.

4. An apparatus according to claim 1 wherein said flushing nozzle is provided with a central inlet for fluid and a plurality of radial outlet bores communicating with said inlet and angularly spaced about the axis of said flushing nozzle.

5. A process for cleaning a waste-disposal channel, comprising the steps of inserting a flexible high-pressure hose terminating in a nozzle into said channel, pumping a fluid under pressure through said hose to said nozzle, ejecting at least one jet of fluid from said nozzle in a generally rearward direction within said channel, thereby displacing said nozzle in a generally forward direction, ejecting an additional stream of fluid in a forward direction, and subsequently withdrawing said hose and said nozzle in said rearward direction while continuing to pump fluid through said hose.

6. A process according to claim 5 wherein said fluid is pumped at a pressure of at least 60 atmospheres.

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