Aug. 17, 1971 B. R. PARMELEE 3,600,225

PIPE CLEANING

Filed Sept. 19, 1968 2 Sheets-Sheet 1

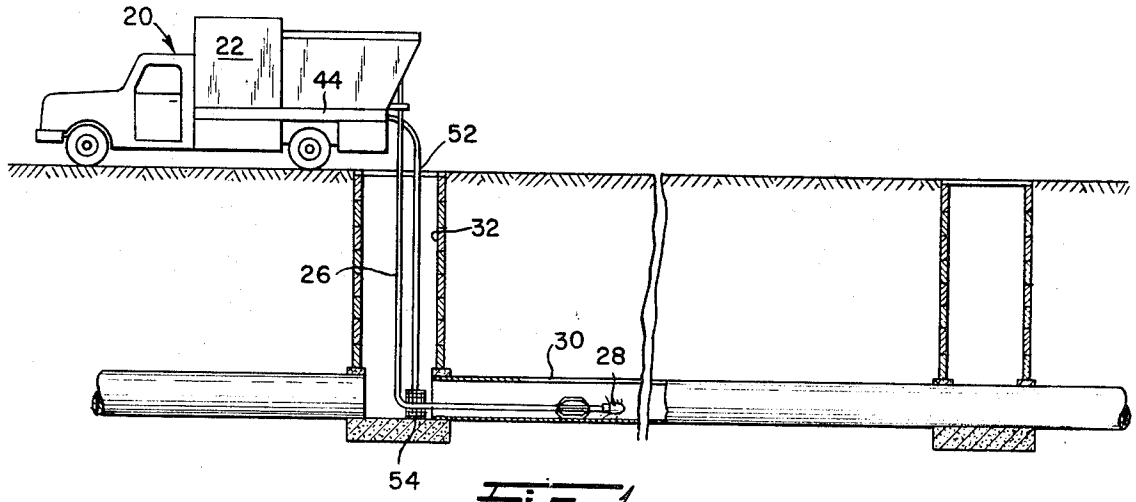


Fig. 1

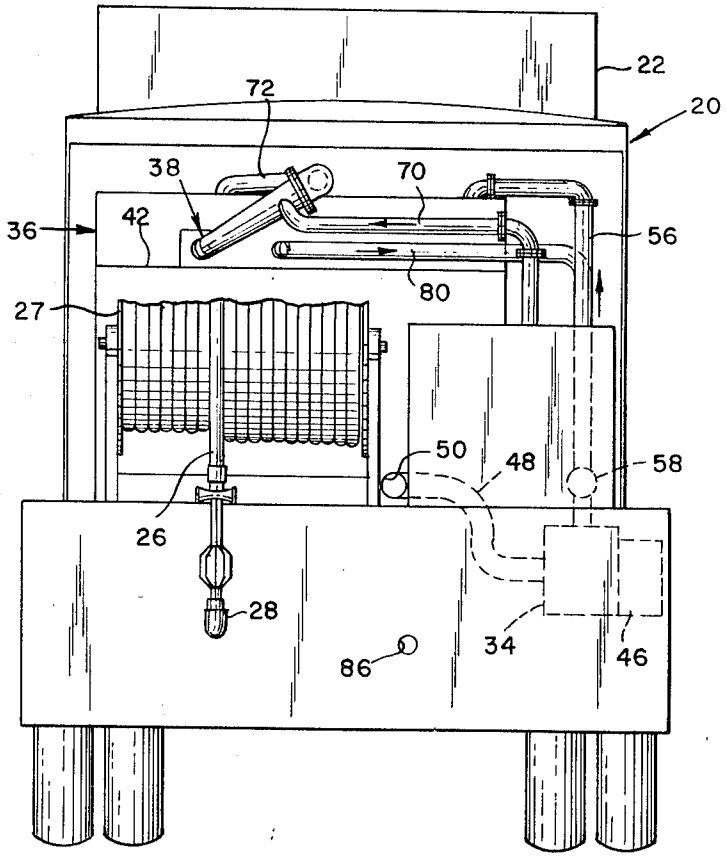


Fig. 2

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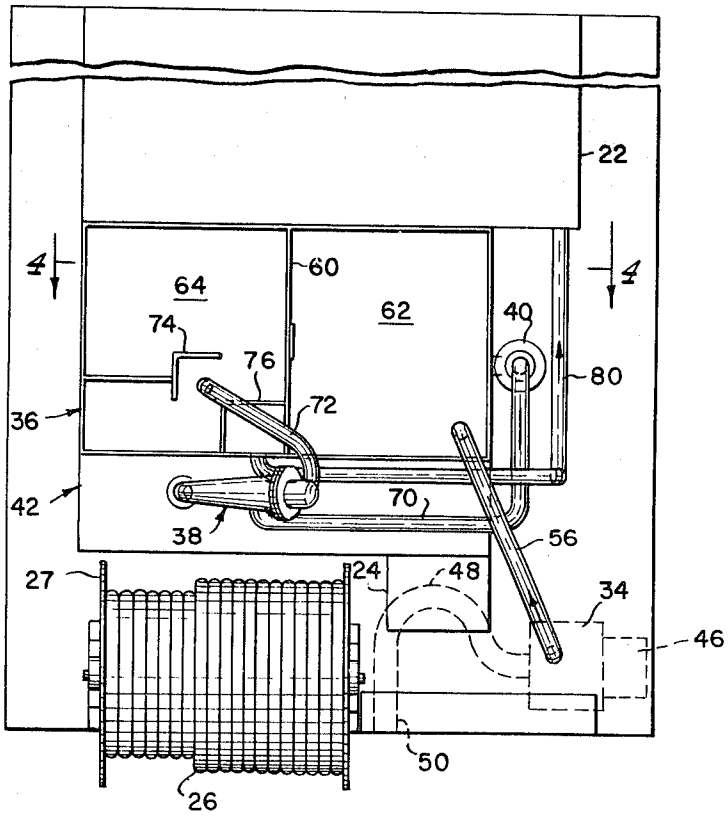
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Fig. 3



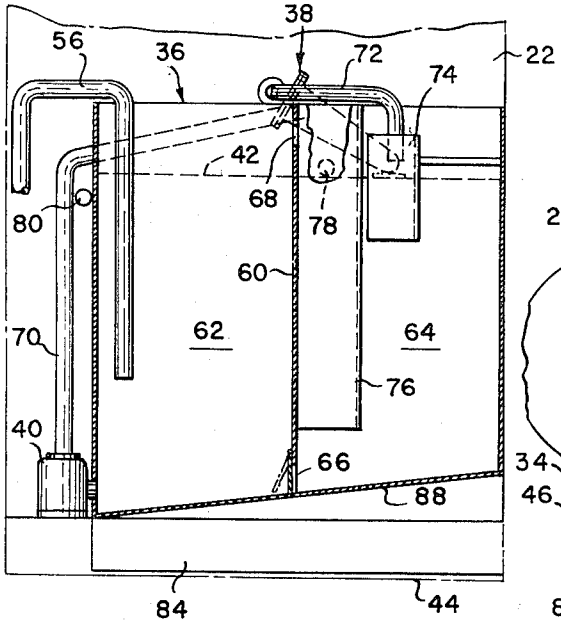


Fig. 4

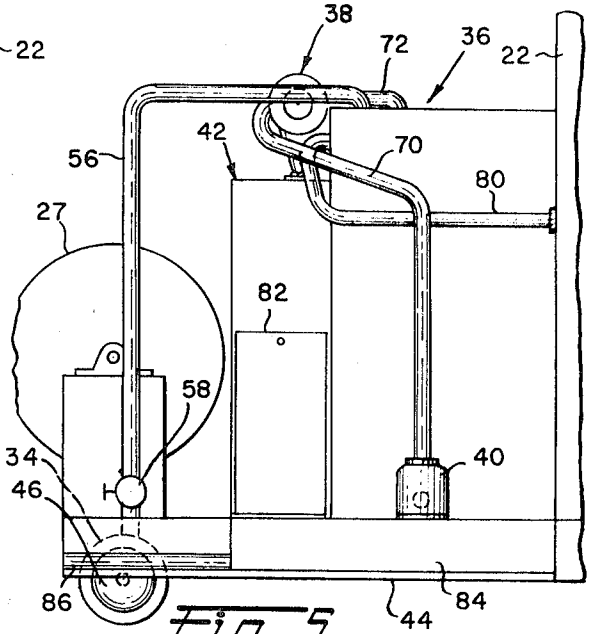


Fig. 5

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PIPE CLEANING

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U.S. Cl. 134—10 10 Claims

ABSTRACT OF THE DISCLOSURE

Equipment and method for cleaning pipes, particularly sewer lines, in which the cleaning action is effected by jets of water issuing from a self-propelled nozzle. The water for supplying the jets is taken from the sewer and pumped under high pressure to the nozzle after the removal and collection of grits and other fines.

BACKGROUND OF THE INVENTION

Two basic methods of cleaning sewers are now practiced. One method involves essentially mechanical apparatus by which obstructions and debris are mechanically cut-away or dislodged and may be removed from the sewer lines by means of a conveyer system, such as a series of material handling buckets.

The second primary method, hydraulic cleaning of sewer lines, has long been practiced although on a somewhat restricted scale. This type of equipment includes a cleaning nozzle carried by a flexible hose through which water is pumped at high pressure. The nozzle is usually provided with a forwardly directed jet and one or more rearwardly directed jets, the latter performing the dual function of cleaning and scouring the interior of the sewer line and propelling the nozzle through the line. Usually the flexible hose is carried on a power operated reel mounted on a truck or a trailer which also carries a high pressure pump, the associated motor or engine and related controls which constitute a self-contained mobile unit.

This type of equipment, which has been known and used on a limited scale for many years, has recently become increasingly popular primarily because of the availability of compact, lightweight and reliable equipment for pumping water to the nozzle at the relatively high pressure and flow rates necessary for effective cleaning action. It is now common for example, to pump water to the nozzle at a pressure of 1000 lbs. per square inch at a rate of 50–75 gallons per minute. While the use of high pressure water at relatively high flow rates has had the expected and obvious effect of improving cleaning efficiency it also materially increases the water requirements. In the past, the supply of water has been carried by a truck-mounted tank. Because of thick bulk and weight, the capacity of the tanks is limited, as a practical matter, to approximately 1200 gallons, which provides, under normal circumstances, sufficient capacity for about 15 minutes of operation after which the cleaning operation must be discontinued and the tanks refilled. Frequently, refilling the tank may interrupt the cleaning operation for a half an hour or more since the cleaninz nozzle, hose, and associated guide equipment must be removed from the sewer lines and the truck must be moved, often a considerable distance, to an available water source such as a fire hydrant.

In many areas of the country, the use of city water for this purpose is objectionable, particularly during the summer months when water shortages may reach critical proportions.

Accordingly, the use of hydraulic sewer cleaning equipment has continued to be restricted despite its efficiency and the relative mechanical simplicity of the equipment.

Another limitation of such equipment is its inability to physically remove material such as sand and debris from the sewer lines. As presently used, it is effective only to dislodge such material and flush it from one location in a line to another relatively accessible location where it can be collected and removed by other apparatus. Presently available equipment for this purpose is effective to remove the larger bulk material from the lines. However, the sand, abrasive grit and other fines invariably found in sewer lines, becomes entrained in the water and is delivered ultimately to the sewage treatment plant. Such grit and abrasive material has long been a major source of damage and wear to the pumps, valves and fluid lines in such plants. In this respect, the deficiency of the hydraulic sewer cleaning equipment is shared with the existing mechanical equipment.

SUMMARY OF INVENTION

With the foregoing considerations in mind, it is a principal purpose and object of the present invention to provide novel hydraulic sewer cleaning equipment which eliminates the above stated disadvantages of prior equipment and in which the water used for cleaning is taken from the sewer line thus making possible essentially continuous operation and eliminating the dependence of the equipment on a source of clean water from city mains.

It is also an important object of the present invention to provide, in hydraulic sewer cleaning equipment, apparatus for recovering and collecting from the sewer lines a substantial portion of the sand, grit and other abrasive fines heretofore permitted to remain in the lines for passage to sewerage treatment plants. Preferably, the fines removal mechanism is incorporated as an integral component of the water recovery and recirculation system.

It is a further important object of the invention to materially reduce the present requirement for placing personnel and equipment into the sewer line for removal of solids thus reducing costs and eliminating safety hazards.

In attaining these and other objects, the present invention provides novel hydraulic pipe cleaning equipment which includes in addition to the components previously used in such equipment, a pump and conduit system for removing water from the sewer lines, delivering the water to a temporary storage point, a cleaner for removing the grit and other fines from the water, delivering the grit to a convenient point of collection and delivering the grit-free water to a second storage point from which it passes to the main supply tank, to thereafter be pumped to the cleaning nozzle and thus returned to the sewer line.

Additional objects and advantages will become apparent as the description proceeds.

DESCRIPTION OF DRAWINGS

FIG. 1 is a side elevation of a mobile sewer cleaning unit constructed in accordance with the present invention;

FIG. 2 is a rear view of the unit of FIG. 1;

FIG. 3 is a fragmentary top plan view of the unit of FIG. 1;

FIG. 4 is a vertical section taken along line 4—4 of FIG. 3; and

FIG. 5 is a fragmentary side elevation of a portion of the unit shown in FIG. 3.

DESCRIPTION OF PREFERRED EMBODIMENT

Referring now more particularly to the drawings, FIG. 1 illustrates a mobile sewer unit, indicated generally at **20**, of the type with which the present invention has particular utility. Essentially the unit comprises a water storage tank **22** from which water is delivered by a high pressure pump **24** to a hose **26** normally carried on a reel **27** reversibly driven by a suitable motor, not shown. The end of the hose carries a nozzle **28** having forwardly and rearwardly directed openings, not shown.

In the normal operation of the unit as illustrated in FIG. 1, the hose **26** is lowered into the sewer conduit **30** through a manhole **32** and the nozzle **28** is positioned in an upstream direction. Water under pressure is then delivered through the hose **26** to the nozzle **28**, the water issuing from the nozzle openings to form a forwardly directed jet for dislodging solids from the sewer conduit, and the rearwardly directed jets propelling the nozzle through the conduit in an upstream direction. It is common in such units to supply the water to the nozzle at a pressure in the neighborhood of 1,000 p.s.i. to achieve a flow rate of approximately 60 gallons per minute through the nozzle **28**. In a typical case, the main water storage tank **22** has a capacity of approximately 1,000–1,200 gallons. Accordingly, under normal conditions the unit can be operated for only approximately 15 minutes before it is necessary to refill the tank **22**.

Frequently the sewer cleaning operation is not conducted in the immediate vicinity of an available source of water. Accordingly, to refill the tank **22**, the hose **26** and nozzle **28** and associated equipment must be withdrawn from the sewer conduit and the truck physically moved to a fire hydrant or other source of water. The tank may then be refilled after suitable connections to the fire hydrant have been made. It is then necessary to drive the unit **20** back to the original site, set up the equipment, lower the hose and nozzle into the sewer conduit, and resume the cleaning operation. Often the period between the cessation of cleaning and the resumption of cleaning may be half an hour or more.

The present invention, which may be incorporated readily in existing units of the general type shown in FIG. 1, includes a system for removing water from the sewer line, removing the grit and other abrasive fines from the water and delivering the grit-free water to the normal storage tank **22** for use in the normal manner.

Inasmuch as the present invention in effect provides a continuously available source of water, the size of the main storage tank may be reduced and all of the components necessary to effect the removal of water from the sewer line, cleaning the water, may thus be accommodated on the mobile unit without increasing the size or weight of the unit.

The principal components of the water handling and treatment apparatus of the present invention are a trash pump **34** for withdrawing the water from the sewer line, a constant level tank assembly, indicated generally at **36**, which forms a part of the water storage and water cleaning apparatus, a cyclone cleaner **38** and a grit pump **40**, which delivers the water from the constant level tank **36** to the cyclone cleaner **38**, and a solids receptacle **42** which receives and stores the solids removed from the fluid by the cyclone cleaner. The trash pump **34**, the grit pump **40** and the cyclone cleaner **38** are all commercially available items of proven reliability.

In the installation shown, the trash pump **34** is mounted in a protected location beneath and at the rear of the main body platform **44** of the mobile unit. It may be driven by a hydraulic motor for example of the type conventionally employed in such units to drive the main hose reel, or may be driven by a separate, small gasoline engine, a typical engine being shown, diagrammatically at **46**. Preferably the trash pump **34** has a capacity substantially in excess of the normal flow rate of water through the hose **26** and the nozzle **28** to assure a continuing supply of water despite temporary interruptions or variations in the flow of water through the conduit **30**.

The inlet of the pump **34** is connected through a permanently installed conduit section **48** to a readily accessible fitting **50** at the rear of the unit, in turn adapted for connection to one or more sections of flexible conduit **52** of sufficient length to extend from the unit **20** to the bottom of the sewer line **30**. The intake end of the conduit **52** is provided with a coarse mesh screen cover **54** to prevent the entry into the conduit of rocks or other debris often present in sewer lines.

The outlet of the trash pump **34** is connected through a conduit **56** to the constant level tank **36**. The output of the trash pump **34** is controlled by a valve **58** which also facilitates priming the pump.

As best shown in FIGS. 3 and 4, the constant level tank **36** is divided by a central, vertical partition **60** into compartments **62** and **64**, the former receiving the raw water form the sewage line delivered through conduit **56** and the latter receiving the grit-free water delivered by the cyclone cleaner **38** as will appear. The partition wall **60** is provided at its lower end with a flap valve **66** which permits the flow of water from the compartment **64** to the compartment **62** but prevents reverse flow. The compartments **62** and **64** are also connected by an overflow opening **68** provided in the partition wall **60** above the normal level of water to permit water to overflow from the tank section **62** to the tank section **64** under abnormal conditions.

As best shown in FIG. 4, the inlet side of the grit pump **40** is connected to the lowermost portion of the compartment **62** and the outlet side of the pump is connected through a conduit **70** to the inlet of the cyclone cleaner **38** suitably mounted adjacent the tank compartment **64** above the solids receptacle **42**. Cyclone cleaner **38** is effective to separate the grit and other abrasive fines from the water supplied to it and delivers the grit-free water through a conduit **72** to the upper portion of the tank compartment **64**. Preferably a baffle **74** is provided in the tank **64** to prevent splashing of the incoming fluid. The grit-free water in tank compartment **64** then flows upwardly through an internal conduit **76** to an outlet opening **78** from which it is gravity fed to the main storage tank **22** through a conduit **80**.

The solids removed from the raw water by the cyclone cleaner **38** are delivered from the bottom end of the cleaner into the solids receptacle **42** where they are retained for subsequent removal. As shown in FIG. 5 the receptacle **42** is provided with a door **82** preferably hinged at its bottom end to permit removal of the solids for disposal at any convenient location.

Preferably the tank compartment **62** and the solids receptacle **42** are connected to a common sump **84** provided with a valved outlet line **86** to permit periodic draining, cleaning and flushing of the entire apparatus. The bottom wall **88** of the constant level tank **36** as well as the bottom wall of the solids receptacle **42** are V-shaped and are inclined as shown in FIG. 4 to facilitate this operation.

In the operation of the unit, the main storage tank **22** is preferably filled with fresh water before the mobile unit is taken to the cleaning site. If desired the constant level tank **36** may also be filled with water at this time. The unit is then taken to the cleaning site and the conduit **52** which usually consists of a number of sections is assembled, connected and dropped into the sewer line with a screened foot **54** immersed in the flowing water.

Since the capacity of the constant level tank and the main storage tank are each about 400 gallons, both tanks may be filled more rapidly and economically than prior units in which the capacity of the main water storage tank was from 1000 to 1200 gallons.

Preferably a conventional L-shaped sand trap is inserted into the sewer line adjacent the end of the conduit to facilitate removal of sand and grit from the sewer line. The nozzle **28** is then positioned in the sewer line in accordance with now conventional practice, and the cleaning operation may be conducted in the usual manner. The pump **34** is started and its operation is continued until there is a sufficient supply of water in the first tank compartment **62** to assure a continuous supply to the pump **40** which is then started.

The raw water is then delivered to the cyclone cleaner **38** which separates the solids from the water, delivering the former to the solids container **42** and the latter to the tank compartment **64**, to fill this tank compartment or if it has been filled initially to deliver the overflow water through the conduit **80** to the main tank **22**.

Normally the level of the water in the tank **64** is maintained above the level of the opening **78**, and the tank compartment **64** accordingly functions as a grease trap. Usually the operator will regulate the valve **58** to assure that the amount of water supplied by the trash pump **34** matches the requirements of the system. In the event the operation of the main cleaning system is discontinued, the trash pump **34** will be stopped, although the grit pump **40** preferably remains in operation to assure continuous operation of the cyclone cleaner. It is preferable to supply water to the cleaner continuously since the separating efficiency falls off sharply during the start-up or shutdown portion of the cycle.

At the conclusion of a cleaning operation the main tank **22**, the constant level tank **36** and the solids receptacle **42** may be drained directly back into the sewer or alternately, the water may be retained for use in the next cleaning operation. Periodically, the solids are manually removed from the tank **42**. The solids may be placed in another truck or the entire unit **20** may be driven to a site where the solids can be disposed of conveniently.

From the foregoing it will be apparent that the present invention has eliminated the major deficiencies of prior hydraulic sewer cleaning units by the provision of a "water recirculation system" which eliminates the dependence of the unit on a separate water supply and at the same time imparts a solids removal capability to the unit. The increase in efficiency and versatility of the unit is accompanied by a significant decrease in operating costs and by the virtual elimination of hazardous working conditions.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiment is therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed and desired to be secured by Letters Patent is:

1. Method for cleaning a conduit through which is flowing a stream of raw liquid containing solid impurities comprising the steps of continually forcing cleansing liquid from a reservoir under pressure at relatively high velocity through a discharge nozzle into and along said conduit, continually extracting raw liquid from said stream and delivering it into a first confined zone, continually extracting raw liquid from said first zone and passing it through a separator wherein solids are removed and cleaned, liquid is passed into a second confined zone, and continually removing cleaned liquid from said second zone and delivering it into said reservoir to replenish liquid discharged through said nozzle.

2. Method for cleaning pipes through which a dirt laden stream of fluid flows, comprising the steps of removing a portion of said fluid from said pipe, delivering said fluid to a first collection point, delivering said fluid from said first collection point to a second collection point, removing a portion of the dirt from said fluid as it passes from said first collectoin point to said second collection point, delivering the removed dirt to a third collection point, delivering the partially cleaned fluid from said second collection point to a fourth collection point, and pumping said fluid into said pipe from said fourth collection point in the form of high velocity jets.

3. A mobile self-contained unit for cleaning sewers by pumping a high velocity stream of fluid into said sewer comprising a main storage tank on said unit for storing said fluid, an additional tank on said unit, a solids receptacle on said unit, means for pumping fluid from the sewer into said additional tank, means connecting said additional tank to said main tank for delivery of fluid from said additional tank to said main tank, and means on said unit for removing solids from said fluid before delivery of said fluid to said main storage tank and for delivering said solids to said solids receptacle.

4. Apparatus for cleaning a pipe through which a dirt laden stream of fluid flows, comprising a nozzle adapted to travel along the interior of said pipe, a first tank adapted to contain a fluid, means for delivering the fluid from said tank to said nozzle under pressure, the fluid issuing from said nozzle in high velocity jet streams, means providing a second and third tanks, means interconnecting said second and third tanks and arranged to permit flow from said third tank to said second tank while preventing reverse flow, means for delivering a portion of the fluid in said pipe to said second tank, an external fluid circuit connecting said second and third tanks, means for forcing fluid through said external circuit, a cleaner in said external circuit for removing a portion of the dirt in said fluid as it passes from said second tank to said third tank, and means connecting the upper portion of said third tank to said first tank through which fluid above a predetermined level in said third tank flows into said first tank to replenish the supply of fluid therein.

5. Apparatus for cleaning a pipe through which a dirt laden stream of liquid flows comprising a nozzle adapted to travel along the interior of said pipe, a main storage tank adapted to contain liquid, means for delivering liquid from said main tank to said nozzle under pressure, the liquid issuing from said nozzle in high velocity jet streams, means for providing at least one additional tank having means by which liquid may flow therefrom to said storage tank to replenish liquid delivered to said nozzle, means providing a receptacle for solids, means for continually extracting a portion of the stream liquid in said pipe and delivering it to said additional tank including means for removing solids therefrom and delivering said solids separately to said solids receptacle.

6. A mobile self-contained unit for cleaning a sewer conduit or the like through which is flowing a stream of raw liquid containing solid impurities comprising, a reservoir adapted to contain a supply of cleansing liquid on said unit, means for continually forcing cleansing liquid from said reservoir under pressure through a discharge nozzle into and along said conduit, means for continually extracting raw liquid from said stream and delivering it into a first confined zone on said unit, means for continually extracting raw liquid from said first zone and passing it through a separator on said unit wherein solids are removed and cleaned liquid is passed into a second confined zone on said unit, and means for continually removing cleaned liquid from said second zone and delivering it into said reservoir to continually replenish liquid discharged through said nozzle.

7. The unit defined in claim **6** wherein said reservoir and both said zones are defined by tank compartments on said unit, and said second zone compartment has an overflow connection to said reservoir compartment.

8. The unit defined in claim **7**, wherein the lower end of said first zone is in communication with the separator

by means of a conduit system on said unit containing a pump, said separator being disposed at a higher level, said conduit system positioned so as to allow cleaned liquid to flow by gravity from said separator into said second zone.

9. The unit defined in claim **7**, wherein said zone compartments have a common wall, there being an emergency overflow opening in said wall above the normal level of said overflow connection.

10. The unit defined in claim **9**, including a unidirectional valved opening in the lower end of said wall permitting flow of cleaner liquid from the second zone to the first zone but preventing liquid flow in the reverse direction.

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U.S. Cl. X.R.

134—24, 34, 168