APPARATUS FOR CLEANING A CONDUIT INTERIOR AND METHOD THEREFOR

An apparatus, method and system for cleaning a conduit interior is provided wherein the apparatus comprises a cable (20) having cleaning members (80a, 80b, 80c) capable of being pulled through the conduit from an outlet of the conduit. Preferably, the apparatus comprises a leader (20, 30, 31, 32, 33) for guiding the cable through the conduit interior. In use, the leader is preferably pushed through the conduit from an inlet. In one embodiment, the method includes the steps of inserting into a conduit inlet a cable having cleaning member(s), wherein the cable is moved through the conduit interior from the inlet until an end of the cable exists an outlet of the conduit, and pulling the cable and cleaning member(s) through the conduit interior from the conduit outlet. The apparatus and method may be used to clean or clear partial or complete obstructions within the conduit.
"APPARATUS FOR CLEANING A CONDUIT INTERIOR
AND METHOD THEREFOR"

FIELD OF THE INVENTION

THIS INVENTION relates to an apparatus and method for cleaning a conduit interior, in particular a pipe interior completely or partially obstructed.

BACKGROUND OF THE INVENTION

Conduits, for example pipes, may occasionally become obstructed with debris, for example sludge and grease, thus reducing or preventing flow. It is not uncommon for pipes linking a kitchen with a remotely located grease trap to become obstructed with grease build up. Accordingly, it is often necessary to remove the grease build up. Conventional pipe cleaning means include an elongate, flexible cable often referred to as a snake or eel, which is inserted into a pipe inlet commonly located in a kitchen and positive pressure is applied to push the snake forward towards a pipe outlet. The forward pressure is combined with rotational movement to cut through the obstruction.

US 4,218,802 relates to a power driven pipe cleaning apparatus for cleaning pipes comprising a flexible, rotating cable or "plumber's snake" designed to cut through an obstruction. The apparatus is inserted into a pipe and pushed forward to clear an obstruction.

FR 2632547 relates to an apparatus for scrapping an interior of pipes comprising a pair of substantially hemispherical or ogive shaped heads
located at each end of the scrapping apparatus. Each head is attached to a pulling cable. The heads are joined by a steel cable and each rear face of the heads are fitted with resilient scraper discs.

US 4,656,685 relates to a duct cleaner comprising spray nozzles and sponge which are attachable to a rope and may be pulled through the duct by the rope. This apparatus is relatively complex and requires use of a cleaning solution to be sprayed inside the duct.

JP 09-355572 relates to a method for cleaning a pipeline, for example a duct. The method includes the step of inserting round objects or pigs into the duct. There is provided an electrostatically charged pig, a static pig and a cleaning pig which are propelled through the duct by liquid or gas pressure. The cleaning pig may consist of a sponge. The pigs are not particularly well suited to remove or clear complete obstructions, for example viscous grease clogs.

SU 1810135 relates to an apparatus for cleaning an internal pipe surface comprising cleaning elements characterised by flanges having collars with cutting edges which are interconnected by a plurality of flexible rods. This apparatus is suitable for cleaning an interior circumference of a conduit.

GB 2320076 relates to an apparatus for advancing a semi-rigid elongate member through a pipe interior. In particular, the apparatus is used for advancing a hose of a cleaner for a heat exchanger. The apparatus comprises a motor, a drive means for frictional engagement of the hose and a belt which connects the motor and the drive means.
JP 10075514 relates to an apparatus for advancing an electrical cable. The apparatus comprises a pair of adjustable endless rotating belts which contact the cable at a location therebetween thereby advancing the cable.

The abovementioned plumbing snake may damage the pipe interior, is typically messy and requires a means for providing torque to the snake. Pushing the snake may result in kinking, particularly at bends in the pipe. Methods using water pressure are typically messy and require high water pressure. Apparatus relating to pulling a cleaning member through a conduit may be relatively complex or not suitable for clearing or cleaning a pipe interior with a complete or near complete obstruction. These apparatus clean an interior circumference of a conduit. Also, apparatus disclosed in patents FR 2632547, FR 2613258, US 4,656,685 and SU 1810135 are not suitable for use in conduits which comprise short radius bends, for example a right angle bend. Apparatus for advancing cables do not provide a means for overcoming obstructions which may be encountered when advancing the cable through a conduit.

**SUMMARY OF THE INVENTION**

An object of the invention is to provide an apparatus and method to overcome one or more of the limitations of, improve upon, or provide an alternative to the prior art as discussed above.

The present invention provides an efficient, simple and relatively sanitary means for cleaning a conduit interior, for example a pipe interior, and a means for advancing and/or withdrawing a leader or cable.
The invention may be used with a conduit interior which is partially or completely obstructed. It will be appreciated that the invention is particularly useful for cleaning or clearing an obstruction in a conduit comprising one or more sharp or short radius bends.

In accordance with a first aspect of the invention, an apparatus for cleaning an interior of a conduit comprising one or more opening(s) is provided, said apparatus comprising:

(a) a cable comprising one or more cleaning member(s); and

(b) a leader attachable to the cable;

wherein the leader is capable of being pushed through a conduit interior from a first opening of the conduit and said cleaning member(s) are capable of being pulled through the conduit interior from a second opening of the conduit.

In one embodiment, the leader and cable are integral.

In another embodiment, the leader and cable are separate items attachable to each other.

Preferably, the leader is at least as long as the conduit to be cleaned.

Preferably, the respective one or more cleaning member(s) of the first aspect comprises:

(A) a disk;

(B) a retaining member adjacent to a side of the disk, in use facing towards the conduit outlet; and
(C) a backing plate located adjacent a side of the disk, in use facing towards the conduit inlet.

Preferably, the diameter of the disk is selected based on the conduit diameter and characteristic of material to be removed from the conduit interior.

More preferably, the diameter of the disk ranges from less than to larger than the diameter of the conduit interior.

The apparatus of the first aspect may further comprise a guiding member for directing the leader through the conduit interior, the guiding member located at an end of the leader opposite an end attachable to the cable.

Preferably, the guiding member is tapered at an end which is inserted into the conduit inlet.

Preferably, the apparatus of the first aspect further comprise one or more disrupting member(s) on the cable for displacing debris which completely or partially obstructs the conduit interior.

More preferably, the one or more disrupting member(s) is located intermediate the retaining member and a conduit outlet when in use.

In a second aspect of the invention, a cleaning member for cleaning an interior of a conduit is provided, the cleaning member comprising:

(A') a disk;

(B') a retaining member adjacent to a side of the disk, in use facing towards the conduit outlet; and
(C') a backing plate located adjacent a side of the disk, in use facing towards the conduit inlet.

Preferably, the cleaning member further comprises one or more disrupting member(s) located on the cable for displacing debris which completely or partially obstructs the conduit interior.

More preferably, the one or more disrupting member(s) is located intermediate the retaining member and a conduit outlet when in use.

In a third aspect of the invention, a method for cleaning an interior of a conduit comprising one or more open(s) is provided, the method including the steps of:

(i) inserting an end of a cable into a first opening of said conduit wherein said cable comprises one or more cleaning member(s);

(ii) moving the cable through the conduit interior from the first opening of the conduit until the end of the cable exits a second opening of the conduit; and

(iii) pulling the cable and the cleaning member(s) through the conduit interior from the second opening of the conduit.

Preferably, the method further includes the step of attaching a leader to the cable, wherein the leader facilitates moving the cable through the conduit interior.

Preferably, the method further includes the step of attaching a guiding member to the leader for directing the leader through the conduit interior, the guiding member being attached to the leader at an end opposite an end attached to the cable.
In one embodiment, the method further includes the step of advancing or withdrawing the leader through or from the conduit using a line member feeding apparatus comprising a motor engageable with the leader and an oscillator for oscillating the leader.

Preferably, in use, the one or more cleaning member(s) are pulled through the conduit interior via the cable.

More preferably, the cable is pulled through the conduit interior from the conduit outlet.

In a fourth aspect of the invention, an apparatus for advancing and withdrawing a line member is provided, the apparatus comprising:

(I) a motor engageable with the line member for advancing and withdrawing the line member; and

(II) an oscillator for oscillating the line member.

Preferably, the motor engages the line member via a drive roller.

Preferably, the oscillator is driven by the motor.

In use, the line member is preferably advanced or withdrawn by the drive roller and oscillating motion is provided by frictional engagement of the line member with a pad driven by the drive roller.

Preferably, the pad moves in a linear reciprocating motion.

The apparatus for advancing and withdrawing a line member may be used with the method described above for cleaning an interior of a conduit.
The apparatus for advancing and withdrawing a line member may be used for advancing and withdrawing a leader in accordance with method described above.

In a fifth aspect of the invention, a system for cleaning a conduit interior is provided, the system comprising:

(i') a cable that includes one or more cleaning member(s) and one or more disrupting member(s);

(ii') a leader attachable to the cable and capable of facilitating moving the cable through the conduit interior;

(iii') a guiding member at an end of the leader opposite an end attachable to the cable;

(iv') a line member feeding apparatus capable of advancing and withdrawing the leader through or from the conduit interior; and

(v') a cable withdrawing apparatus capable of pulling the cable through the conduit interior;

whereby in use, the leader is inserted into an inlet of the conduit and advanced therethrough using the line member feeding apparatus, the leader is guided through the conduit interior via the guiding member from the inlet, the leader is pulled from the conduit interior from an outlet of the conduit with the cable attached to the leader, the cable is attached to and pulled by the cable withdrawing apparatus, thereby pulling the disrupting members and cleaning members through the conduit interior cleaning said conduit interior.

Preferably, the cleaning member(s) are respectively characterised by comprising a disk, a retaining member adjacent to a side of
the disk, in use facing towards the conduit outlet, and a backing plate located adjacent a side of the disk, in use facing towards the conduit inlet.

It is understood that "conduit" refers to a pipe, drain, cylinder, tube, duct or the like having any cross-sectional shape. A round cross-section may not be uncommon. An opening of a conduit may be either an inlet or an outlet.

It will be appreciated a leader of the invention attached or attachable to a cable as described herein is particularly useful with a conduit comprising sharp or short radius bends. Accordingly, the leader may facilitate moving a cable through a conduit when the leader pushed through the conduit from an opening. In one embodiment of the invention, a guiding member attached to the leader and may be used to direct the leader through a network of conduits so that the leader may traverse though a desired conduit of a conduit network.

It will be appreciated that the apparatus and method for cleaning a conduit may be used for cleaning or clearing a partial or complete obstruction in a conduit interior. For example, the method and apparatus may be used as part of preventative maintenance of a pipe, thereby cleaning an interior of a pipe before the pipe becomes completely obstructed.

It will also be appreciated that the above apparatus and method minimise potential damage to a conduit interior, provide an efficient means for advancing, withdrawing and directing a cleaning member through bends in a conduit interior, are simple to use, do not require large power equipment, minimises contamination, do not require rotational movement of a cable and
may be used on a network of conduits. The invention may be used with a conduit or network of conduits which have a short radius bend, for example, a right angle bend.

Throughout this specification unless the context requires otherwise, the word "comprise", and variations such as "comprises" or "comprising", will be understood to imply the inclusion of the stated integers or group of integers or steps but not the exclusion of any other integer or group of integers.

DESCRIPTION OF THE DRAWINGS

In order that the invention may be readily understood and put into practical effect, preferred embodiments will now be described by way of example with reference to the accompanying drawings wherein like reference numerals refer to like parts and wherein:

FIG. 1 shows a sequential arrangement of the components of the apparatus for cleaning conduits;

FIG. 2 shows the apparatus for cleaning conduits in use with a grease trap and pipe connected thereto;

FIG. 3 is a close up view of the guiding member as shown in FIG. 1;

FIG. 4 is a close up view of the leader-cable joiner as shown in FIG. 1;

FIG. 5 a close up view of the cleaning members as shown in FIG. 1;

FIG. 6 is a side view of one embodiment of a line member
feeding apparatus for advancing and withdrawing a leader;

FIG. 7 is a front view of the line member feeding apparatus shown in FIG. 6;

FIG. 8 is a side view of another embodiment of a line member feeding apparatus for advancing and withdrawing a leader, a pivotal handle and part of the leader are not shown for clarity of those components shown;

FIG. 9 is a plan view of the line member feeding apparatus shown in FIG. 8, bold double headed arrows indicate direction of movement for the relevant components; and

FIG. 10 is a cross sectional front view of the line member feeding apparatus shown in FIGS. 9 as indicated by section A.

DETAILED DESCRIPTION OF THE INVENTION

The present invention has advantages over known conduit cleaning apparatus. For example, the present invention does not require rotation of a cleaning cable or "snake" or "eel" relative to a conduit. Rotating a cleaning device such as a scraper may damage the conduit interior. Also, known conduit cleaners that are pulled through a conduit interior are not suitable for cleaning or clearing viscous obstructions such as grease and wax. Further, conduit cleaners that are pulled through a conduit do not comprise a simple and efficient means for inserting and/or directing a cable through a conduit interior. These and other advantages of the present invention will become more obvious from the detailed description provided hereinafter.

FIG. 1 shows an apparatus 10 for cleaning an interior of a
conduit, shown in FIG. 2 as a pipe, comprising in sequential order starting at an end first inserted into a pipe interior at an inlet: a guiding member 20, a thin leader 30, a leader transition joint 31 where thin leader 30 transitions to thick leader 32, thick leader 32, excess thick leader 32 shown as coil 33, a leader-cable joiner 40 where thick leader 32 and cable 50 join, cable 50, excess cable 50 shown as coil 71, disrupting members 87a, 87b and 87c, cleaning members 80a, 80b and 80c attached to cable 50, cable terminal end 90, and auxiliary cable attachment means 91 attached to cable terminal end 90 which provides a means for attaching auxiliary cable 52.

Although FIG. 1 shows the components sequentially arranged and connected, each component listed above may be independently provided. Preferably, guiding member 20, thin leader 30, leader transition joint 31, thick leader 32 and excess coiled thick leader 33 comprise a first unit. Cable 50, excess coiled cable 71, disrupting members 87a, 87b and 87c, cleaning members 80a, 80b and 80c, cable terminal end 90, auxiliary cable attachment means 91 preferably comprise a second unit. Leader-cable joiner 40 is partly associated with the first unit and partly associated with the second unit as more clearly shown in FIG. 4. Auxiliary cable 52 may be attached to the end of the second unit.

Items 3, 4 and 5 on FIG. 1 refer to sections of apparatus 10 which are shown as close up views in respective FIGS. 3, 4 and 5.

Thin leader 30 may have any suitable diameter which is capable of bending the leader through a pipe bend. In one embodiment, thin leader 30 has a diameter of 3 mm. Thin leader 30 may pass through a short
radius bend, for example a right angle bend.

Thick leader 32 may have a diameter of 6 mm which is a useful diameter for providing strength and flexibility to push the leader through the pipe interior over distance. Thick leader 32 is also able to pass through a short radius bend. Respective diameters of thin and thick leaders 30 and 32 are provided as preferred examples and other diameters may be used as selected by one skilled in the art. Thin leader 30 and thick leader 32 are preferably fibreglass rod; however, other materials may be used as selected by one skilled in the art. Preferably, the leaders are flexible. Thin and thick leaders are useful for facilitating or guiding cable 50 through a conduit interior. Preferably, the leader is at least as long as a conduit to be cleaned so that the leader may be pushed from an opening of the conduit until the leader exists from another opening of the conduit.

Means for advancing, withdrawing and oscillating leader 30, leader 32 and/or cable 50 may be provided to assist advancing and withdrawing the leaders and cable through the pipe interior. For example, respective line member feeding apparatus for advancing and withdrawing the leader and pulling apparatus for pulling the cable as described herein may be useful. In use, the line member feeding apparatus may be used to advance the leader into a conduit opening.

Cable 50 is preferably a 6 mm braided steel cable. However, the term "cable" is meant to include, for example, non-braided cables, ropes, wire, string, chains, cords, leads, lines, rods, tubes, pipes and the like as may be selected by one skilled in the art for pulling the cleaning member. The
diameter of the cable may be any suitable diameter. Preferably, the cable is flexible so that it may bend easily through a short radius bend.

FIG. 2 shows conduit cleaning apparatus 10 inserted into interior of pipe 60 and being pulled by pulling apparatus 65 located above grease trap 61 which stores grease 62. Although this embodiment shows the apparatus in use to clean a pipe connected to a grease trap, it is understood that the apparatus can be used with any conduit. In use, apparatus 10 is inserted into pipe 60 through inlet 63. Guiding member 20 guides apparatus 10 through pipe 60. Thin leader 30 and thick leader 32 are pushed through pipe 60 preferably until at least guiding member 20 exits from pipe outlet 64. Advancing the leaders may be assisted, for example, using a line member feeding apparatus as herein described. A combined length of thin leader 30 and think leader 32 is preferably at least as long as a conduit to be cleaned. Once guiding member 20 exits pipe outlet 64, leaders 30 and 32 may be pulled with cable 50 attached thereto, thereby pulling cable 50 through pipe 60 from the pipe outlet 64 end. Once an end of cable 50 having leader attachment means 41 has exited pipe outlet 64, cable 50 may be disconnected from the thick leader 32 at cable attachment means 42 (shown in FIG. 4). Cable 50 may then be pulled through pipe 60 with disrupting members 87a, 87b and 87c and cleaning members 80a, 80b and 80c attached thereto.

Pulling apparatus 65 is a preferred means for pulling cable 50 through pipe 60. However, other means, for example hand pulling cable 50 and using a line member feeding apparatus as described herein may be used.
to pull cable 50. Apparatus 10 is shown in use, after insertion through pipe inlet 63 of sink 66, which may be located within a kitchen. Cleaning members 80a, 80b and 80c are shown attached to cable 50. Disrupting members 87a, 87b and 87c are shown spaced from each other, but the disrupting members may also be adjacent to each other. It is also understood that although disrupting members 87a, 87b and 87c are shown only intermediate of cleaning member 80a and pipe outlet 64, the disrupting members may also be located intermediate each cleaning member 80a, 80b and 80c. Auxiliary cable 52 is shown extending from pipe inlet 63.

FIG. 2 shows a single pipe 60; however, apparatus 10 is particularly useful with pipe networks comprising a plurality of interconnected pipes. Apparatus 10 may be inserted and guided through a selected pipe or pipe pathway in a network from an inlet without requiring other pipe pathways to be sealed. Once a first end of apparatus 10 inserted into the inlet has exited from an outlet, apparatus 10 may be pulled through the pipe or pipe pathway thereby preventing debris from entering other pipes in a network. Also, the pipe inlet area, for example a kitchen, remains uncontaminated by debris from within the pipe as cleaning apparatus 10 exposed by debris exits pipe 60 at outlet 64. It is understood that the invention may be used with any conduit or network of conduits comprising at least one inlet and at least one outlet.

For embodiments of the invention wherein the cable and/or leader(s) are capable of conducting an electrical current, eg comprised of metal, an electronic locating apparatus may be used to determine a location
of the cable and/or leader(s) within a conduit. An apparatus for locating a cable an underground or within a conduit are well known in the art.

Pulling apparatus 65 may also comprise a device for determining a length of cable that was been wound onto spool 68. Such a device may count rotations of spool 68 or may be a separate counting roller that determines a length of cable withdrawn from the conduit by counting a number of rotations of the counting roller, as would be understood by one skilled in the art. It will be appreciated that knowing a length of cable withdrawn from the conduit may provide an indication of a location of a cleaning member within a conduit when in use. This information may be important in the event that a cleaning member becomes stuck within a conduit.

As shown in FIG. 2, pulling apparatus 65 comprises upper support frame 67, spool 68, motor 69, motor controller 70 and extendable lower support frame 71. It will be appreciated that each of the components of pulling apparatus 65 may be detachable, replaceable and interchangeable with other similar components. For example, a plurality of spools 68 may be interchangeable with each other, wherein each spool is characterised by comprising a different diameter cable wound thereto. Likewise, each of the components may be removed to replace a defective, damaged or worn component. Pulling apparatus 65 may further comprise a protective guard, shield, cover or the like to protect a user from debris and/or prevent a user from potential injury from the winding cable when the apparatus is in use.

Upper support frame 67 is adapted to be supported by a top
part of grease trap 61 and may comprise trolley wheels 72 for convenient transport thereof. Spool 68 winds, collects and stores cable 50 as it exits from pipe outlet 64, motor 69 rotates spool 68 and controller 70 controls and monitors functions of motor 69.

Controller 70 may control an on/off switch, speed, force and load limit of cable 50, length of cable wound and other information. Controller 70 is shown electrically connected to and in communication with pulling apparatus 65 by a lead, however, controller 70 may also control pulling apparatus 65 via remote control.

Pulling apparatus 65 may also comprise an oscillating means for oscillating cable 50 which may assist moving cable 50 through pipe 60, in particular if the cleaning members encounter a major obstruction.

Extendable lower support frame 71 comprises guide wheel 73, trolley wheels 72 and spray nozzles 74. Extendable lower support frame 71 may be extend from upper support frame 67 into grease trap 61 to a length so that guide wheel 73 is approximately level with pipe outlet 64. As shown, this arrangement allows cable 50 to exit from pipe outlet 64 horizontally. Guide wheel 73 guides cable 50 from a horizontal orientation to a vertical orientation when attached to spool 68. Trolley wheels 72 provide a convenient means to transport pulling apparatus 65.

Spray nozzles 74 may spray any useful liquid, for example water and/or water comprising solvents or cleansing fluid for improved solubility, for removing debris from cable 50 which may have attached thereto when passing through pipe 60. The liquid may also be heated to improve
solubility and removal of grease, wax and other debris. It is appreciated that debris attached to cable 50 conveniently drips into grease trap 61. Spray nozzles 74 may be located at other locations not shown in FIG. 2, for example, they may be located intermediate of pipe outlet 64 and guide wheel 73 so that debris may drip directly into grease trap 61. It is also understood that any number of spray nozzles may be used, for example a single nozzle or more than two. A brush, scraper or other similar debris removing device may be used alone or in combination with the spray nozzle(s).

In another embodiment (not shown), a conical member is located around cable 50 so that a wider opening of the conical member is located above a smaller opening and cable 50 passes through a central axis of the conical member. One or more spray nozzle(s) sprays a liquid into the conical member so that the liquid swirls around cable 50 thereby removing debris attached thereto. The conical member may be adapted to allow a cleaning member to pass therethrough. For example, the conical member may be capable of separating along a vertical axis, thereby forming an opening to allow cleaning member(s) to pass therethrough.

FIG. 3 shows a close up view of guiding member 20 pivotally attached to thin leader 30 by universal joint 22. Guiding member 20 has head 21 shown tapered which assists guiding thin leader 30 through bends in pipes. Other shapes and designs of head 21 adapted to guide a cable or leader through a pipe interior may be selected by one skilled in the art. For example, head 21 may be pyramid shaped, and may also have channels, grooves and/or a cutting surface. Universal joint 22 provides movement of
head 21 in all orientations and does not allow head 21 to pivot to an angle greater than about 45 degrees relative to thin leader 30. It has been found that if head 21 pivots greater than about 45 degrees, head 21 may fold back on itself preventing forward movement. Weight of guiding member 20 may be selected so that gravity directs guiding member 20 and thin leader 30 attached thereto in a downward direction. However, in another embodiment, guiding member 20 may be adapted to guide thin leader 30 in directions other than downward by omitting universal joint 22 and fixing head 21 at a desired angle. A useful fixed angle is a 45 degree angle relative to thin leader 30. Head 21 may also comprise one or more wheel(s), bearing(s), roller(s) or other like structure that may assist with moving head 21 through a conduit. The wheel(s), bearing(s) and roller(s) are preferably located adjacent to an extreme end or tip of head 21.

FIG. 4 shows a close up view of leader-cable joiner region 40 which joins thick leader 32 and cable 50. Cable 50 at one end comprises leader attachment means 41, shown as a pivotal loop, to attach to cable attachment means 42. Thick leader 32 comprises a cable attachment means 42, shown as a clip, to receive leader attachment means 41. Thick leader 32 extends beyond cable attachment means 42. Other means for connecting thick leader 32 and cable 50 common to the art, for example clips, hooks, loops and other type fasteners, may be used. Although thick leader 32 and cable 50 are shown as removably attachable, they may be integral or permanently attached.

FIG. 5 shows a close up view of three cleaning members 80a,
80b and 80c attached to cable 50. Cleaning members 80a, 80b and 80c each comprise disk 81, a retaining member shown as sphere 82, backing plate 83 and securing clip 84. A cable terminal end 90 has an auxiliary cable attachment means 91 for attaching auxiliary cable 52. Although the cleaning members are shown comprising disk 81, shapes other than a disk are contemplated which may be useful in cleaning a conduit interior. For example, hexagonal, pentagonal and triangular.

Preferably, cleaning members 80a, 80b and 80c are attached near a terminal end of the cable 50 as shown. However, the cleaning members may be located at any desired or useful location along cable 50. Although the figures show three cleaning members 80a, 80b and 80c attached to cable 50, any number of cleaning members may be used.

In use, first cleaning member 80a is located closest the pipe outlet and accordingly is the first cleaning member to encounter debris within the pipe. Each disk 81 is shown having the same diameter; however, the diameter of disk 81 may vary depending on pipe diameter and amount of grease build up. For example, if the pipe has extensive grease build up or is completely obstructed, it may be desired for the diameter of disk 81 of first cleaning member 80a to be smaller than the diameter of disk 81 of second cleaning member 80b which may have a smaller diameter than disk 81 of third cleaning member 80c. This arrangement may provide for gradual increased grease removal from the pipe interior.

Disks 81 of respective cleaning members 80a, 80b and 80c may be composed of the same material, for example, rubber or resilient
material. Alternatively, disks 81 may be composed of different materials. For example, a tough brush-like material may remove large debris, a soft brush-like material may remove small debris and/or a rubber or resilient material may remove fine debris. Disk 81 may also have a cutting edge or surface to cut debris in a pipe interior.

A combination of different sized disks and disk composition may be used depending on the pipe interior diameter and cleaning requirement as could be determined by one skilled in the art. Accordingly, the invention provides a simple means for changing the cleaning members for different pipe interior diameters and cleaning requirement.

Cable distance 85 between first cleaning member 80a and second cleaning member 80b, and cable distance 86 between second cleaning member 80b and third cleaning member 80c may vary. Cable distances 85 and 86 may be selected, for example, depending on the amount of grease build up, whereby increasing cable distances 85 and 86 may provide for more space to collect grease removed from the pipe interior. Accordingly, the cleaning members may be located at different locations on cable 50 by loosening securing clip 84 and moving the cleaning member to a desired location. In this fashion, additional cleaning members may be added or removed.

Retaining member 82 is preferably composed of a durable metal. Retaining member 82 may assist with preventing disk 81 from folding and thereby retain disk 81 unfolded. Folding of disk 81 may occur when passing around a bend in the pipe, in particular a short radius bend.
Retaining member 82 may have shapes other than spherical which may be useful in preventing disk 81 from folding, for example conical, frusto-conical and pyramid shape. Retaining member 82 may also comprise grooves, channels and/or a cutting surface.

Backing plate 83 supports a back side of disk 81 and is secured by clip 84. Backing plate 83 is approximately the same diameter as retaining member 82; however, the diameter may vary. Auxiliary cable attachment means 91 is shown as a ring, but any suitable means for attaching auxiliary cable 52 may be used. Auxiliary cable 52 may be similar or identical to cable 50 and in use may be useful to pull cleaning members 80a, 80b and 80c in a direction towards the pipe inlet. Pulling on auxiliary cable 52 may be necessary, for example, if cleaning members 80a, 80b and 80c become stuck within the pipe interior. Additional cleaning members may be attached to auxiliary cable 52. Additional auxiliary cables with and/or without cleaning member(s) attached thereto may be serially attached as necessary.

In one embodiment, a cable consisting essentially of one or more cleaning members and one or more disrupting members attached thereto may form a cleaning unit attachable to cable 50. Such a cleaning unit is essentially shown in FIG. 5. One or more cleaning units may be attached to a cable, for example via auxiliary cable attachment means 91. In this manner, multiple cleaning units may be quickly and easily attached to a cable or to each other in series for use when cleaning a conduit with differing amounts of obstruction. Also, it will be appreciated each cleaning unit may comprise a different combination of cleaning members and disrupting
member as needed for cleaning a particular conduit. This may allow for quick and easy modification of the cleaning member when in use.

Also shown in FIG. 5 are three disrupting members 87a, 87b and 87c. Although three disrupting members are shown, any number of disrupting members may be located on cable 50. In one embodiment, no disrupting members are attached to cable 50. Disrupting members 87a, 87b and 87c are shown as spheres, but they may have other shapes, for example conical, frusto-conical and pyramid shape. The disrupting members may also comprise grooves, channels and/or a cutting surface. Diameters of disrupting members 87a, 87b and 87c are shown as being different. Increasing diameters for a series of disrupting member as shown may be useful in displacing debris within a conduit. However, the disrupting members may have any diameter which may be useful in cleaning a conduit interior as may be selected by one skilled in the art, including a same diameter. Disrupting members 87a, 87b and 87c may also have grooves or channels to assist with disrupting debris within the conduit. Space between disrupting members 87a, 87b and 87c may range from zero where each disrupting member contacts each other, to any suitable distance. Disrupting members 87a, 87b and 87c are shown only in front of cleaning member 80a; however, disrupting members 87a, 87b and 87c may be located and attached in front of each cleaning member.

FIGS. 6 and 7 are respective side and front views of line member feeding apparatus 300, which is particularly useful for feeding leader 32 through a pipe interior. Line member feeding apparatus 300 has body
310 comprising fixed handle 320 and pivotable handle 330. Pivotable handle 330 functions to switch from a leader advancing or withdrawing configuration to an oscillating configuration as described in more detail hereinafter.

FIGS. 6 and 7 show line member feeding apparatus 300 in a configuration for advancing and/or withdrawing feeding leader 32. In this configuration drive roller 340 is driven in a rotational motion by motor 341. A first guide roller 342 applies a force to leader 32 so that the leader may be advanced and/or withdrawn by frictional engagement of drive roller 340. Tension is applied to first guide roller 342 by spring 343 which is adjusted by adjustment means 344. Adjustment means 344 is useful to change tension on leader 32 depending on a diameter of leader 32. Rotational motion of drive roller 340 is converted to oscillating motion by connecting rod or shaft 345 which is attached to pad 346. The oscillating motion is provided by linear reciprocating motion of pad 346 which frictionally engages leader 32.

In another configuration of line member feeding apparatus 300, pivotable handle 330 is moved towards fixed handle 320, pivoting at pivot location 347, as shown by bold double headed arrow in FIG. 6. When pivotable handle 330 is so moved, second guide roller 348 is also moved towards and contacts leader 32 to provide a force against the leader on a side opposite pad 346. In use, pivotable handle 330 may be moved by an operator's hand clamping pivotable handle 330 and fixed handle 320 together. In this configuration, linear reciprocating motion (as shown by bold double headed arrow in FIG. 6) of pad 346 functions to provide an oscillating motion to leader 32 at the same time disengaging roller 342. The oscillating
motion may assist in moving leader 32 past an obstruction in a pipe interior. An operator may also apply forward and/or backward pressure to leader 32 at handle 350.

FIGS. 8 to 10 show another embodiment of a line member feeding apparatus 400 that may be used to feed a leader. In the embodiment shown, line member feeding apparatus 400 comprises a hand drill 441 for providing a rotational force; a body 410 that comprises drive roller 440, pad 446, first guide roller 442, second guide roller 448, pivotable handle 430 and channel 420 through which leader 32 is locatable; and leader guides 421 and 422 located at opposite ends of body 410 that may guide leader 32 through body 410.

Channel 420 and body 410 are shown as two halves joined together, an upper half 432 and a lower half 431. The two halves of channel 420 and body 410 enables leader 32 to be inserted into line member feeding apparatus 400 at any location along the leader. Accordingly, line member feeding apparatus 400 may be attached to and removed from leader 32 at any location along the leader, even if leader 32 is inserted into a conduit. The two halves 432 and 431 are shown temporarily secured together by a wing nut and bolt 433, however, any suitable means for temporarily securing the two halves may be used, for example a D-clip, a strap including an adjustable strap such as a Velcro strap, snapped together, engage each other by interlocking members, or other like securing means. FIG. 10 shows the two halves joined together with a hinge 434 and wing nut and bolt 433. Although this is a preferred embodiment of line member feeding apparatus
400, line member feeding apparatus 400 may nevertheless have the two halves permanently joined or be integrally constructed.

It will be appreciated that hand drill 441 may be replace with any other suitable apparatus capable of providing rotational movement, for example a custom built motor that provides rotational movement. An extension member 411 extends from a rotational end of hand drill 441. As shown in FIG. 8, extension member 411 comprises a gear or cog at one end that engages another gear or cog of at an engaging member 412. Accordingly, in use, rotation of extension member 411 results in rotation of engaging member 412. Direction of rotation of extension member 411 may be changed by changing rotation of drill 441. Accordingly, a leader 32 may be advanced or withdrawn from a conduit by respectively switching drill 441 from forward to reverse.

Engaging member 412 is connected to drive roller 440, thereby rotating drive roller 440 when in use. Drive roller 440 is attached to pad 446 via a connecting rod or shaft 445. Rotational motion of drive roller 440 is converted to pivotal and/or vibrational motion by shaft 445. Pad 446 moves in a linear reciprocating motion as shown by a bold double headed arrow, thereby providing pivotal and/or vibrational motion when engaged with a leader.

FIG. 9 shows line member feeding apparatus 400 in a configuration wherein leader 32 is engaged with drive roller 440 and first guide roller 442. When the first guide roller 442 engages leader 32, a second guide roller 448 does not engage the cable as shown. In the configuration
shown in FIG. 9, first guide roller 442 applies a force against leader 32 so that drive roller 440 frictionally engages the leader thereby advancing or withdrawing the leader. First guide roller 442 is placed into contact with leader 32 by spring 443. Tension of spring 443 is adjustable using adjustment bolt and clocking nut 444 that may be tighten to apply a greater force against leader 32 or loosened to apply no or less force against leader 32. Adjustment bolt 444 may be tightened and loosened using a typical screw driver, wrench or a user's fingers depending on a shape of an outwardly exposed end of bolt 444. It will be appreciated that adjusting tension of spring 443 may be desired when using the line member feeding apparatus 400 with different diameter leaders or cables.

In another configuration of line member feeding apparatus 400, pivotable handle 430 is pivoted about pivot point 447 so that the second guide roller 448 engages leader 32. Pivot point 447 may comprise a pin, screw, rivet or like pivotable structure. In this configuration, the first guide roller 442 does not contact leader 32. The second guide roller 448 applies a force against leader 32 so that pad 446 frictionally engages the leader thereby oscillating leader 32.

An additional optional leader feeding guide 450 may be attached to an end of line member feeding apparatus 400. Leader feeding guide 450 may be a rigid, semi-flexible or flexible tube through which leader 32 may pass therethrough. For example, leader feeding guide 450 may be made of PCV or plastic. It will be appreciated that in use, leader feeding guide 450 assists with guiding leader 32 into an opening of a conduit. For
example, if a user is standing and an opening of a conduit is at a level of the user's feet, leader feeding guide 450 will assist in guiding the leader towards the conduit opening. Leader feeding guide 450 may be attached to line member feeding apparatus 400 may any suitable means, for example via screw threads, clamp, forced fit and the like.

In summary, line member feeding apparatus 300 and 400 may be used with the present invention to assist with advancing a leader into a conduit. The line member feeding apparatus may advance and withdraw the leader into or out of a conduit and may also oscillate the leader if the leader encounters an obstruction or becomes stuck within the conduit. Line member feeding apparatus 300 and 400 may be used to withdraw the leader if the leader is unable to pass an obstruction. It will also be appreciated that line member feeding apparatus 300 and 400 may be used to withdraw a cable having cleaning members from an outlet rather than using cable pulling apparatus 65 as described herein.

Line member feeding apparatus 300 and 400 may also comprise a counter roller for counting a length of leader and/or cable that has passed by the counter roller. A counter roller may be useful for determining a distance of leader and/or cable that has been inserted into a conduit. Line member feeding apparatus 300 and 400 may also comprising a load indicator to indicate when the advancing or withdrawing line member may have encounter an obstruction. The line member feeding apparatus may further comprise a protective guard, shield or cover to protect a user from potential harm, for example, a guard to protect against the leader from hitting the user.
The line member feeding apparatus may also be useful with other line members, for example cables, leads, cords, electrical/computer lines, rods, tubes, wires, ropes, chains, pipes and the like, for advancing and/or withdrawing the line member. Leaders 300 and 400 may be useful, for example, when installing or removing computer or communication cables into a conduit, pipe, tube, casing, wall space, other interior space. The oscillating motion of line member feeding apparatus 300 and 400 may be useful to overcome obstructions.

It is understood that means other than rollers may be used for advancing and/or withdrawing the cable, for example, rotating belts. Also, other means for providing oscillating motion are contemplated. It will be understood that “oscillating motion” may refer to any back-and-forth, to-and-fro motion, pulsating, vibrational and like motion.

It is appreciated that the invention provides a means for cleaning a conduit interior which is simple, efficient and adaptable for conduits of different diameter size with various degrees of obstruction. Line member feeding apparatus 300 and 400 are preferably light weight, compact and easy to use with different diameter cables, leaders, and the like.

It is understood that the invention described in detail herein is susceptible to modification and variation, such that embodiments other than those described herein are contemplated which nevertheless falls within the broad scope of the invention.
CLAIMS

1. An apparatus for cleaning an interior of a conduit comprising one or more opening(s), said apparatus comprising:
   (a) a cable comprising one or more cleaning member(s);
   and
   (b) a leader attachable to the cable;

   wherein said leader is capable of being pushed through a conduit interior from a first opening of the conduit and said cleaning member(s) are capable of being pulled through the conduit interior from a second opening of the conduit.

2. The apparatus of claim 1 wherein the leader and cable are integral.

3. The apparatus of claim 1 wherein the leader and cable are separate items attachable to each other.

4. The apparatus of claim 1 wherein the leader is at least as long as the conduit to be cleaned.

5. The apparatus of claim 1 wherein the one or more cleaning member(s) comprises:
   (A) a disk;
   (B) a retaining member adjacent to a side of the disk, in use facing towards the conduit outlet; and
   (C) a backing plate located adjacent a side of the disk, in use facing towards the conduit inlet.

6. The apparatus of claim 5 wherein the diameter of the disk is
selected based on the conduit diameter and characteristic of material to be removed from the conduit interior.

7. The apparatus of claim 6 wherein the diameter of the disk ranges from less than to larger than the diameter of the conduit interior.

8. The apparatus of claim 1 further comprising a guiding member for directing the leader through the conduit interior, said guiding member located at an end of the leader opposite an end attachable to the cable.

9. The apparatus of claim 8 wherein the guiding member is tapered at an end which is inserted into the conduit inlet.

10. The apparatus of claim 5 further comprising one or more disrupting member(s) located on the cable for displacing debris which completely or partially obstructs the conduit interior.

11. The apparatus of claim 10 wherein the one or more disrupting member(s) is located intermediate the retaining member and a conduit outlet when in use.

12. A cleaning member for cleaning an interior of a conduit, the cleaning member comprising:

   (A') a disk;

   (B') a retaining member adjacent to a side of the disk, in use facing towards the conduit outlet; and

   (C') a backing plate located adjacent a side of the disk, in use facing towards the conduit inlet.

13. The cleaning member of claim 12 further comprising one or more disrupting member(s) located on the cable for displacing debris which
completely or partially obstructs the conduit interior.

14. The cleaning member of claim 13 wherein the one or more disrupting member(s) is located intermediate the retaining member and a conduit outlet when in use.

15. A method for cleaning an interior of a conduit comprising one or more open(s), the method including the steps of:
   (i) inserting an end of a cable into a first opening of said conduit wherein said cable comprises one or more cleaning member(s);
   (ii) moving the cable through the conduit interior from the first opening of the conduit until the end of the cable exits a second opening of the conduit; and
   (iii) pulling the cable and the cleaning member(s) through the conduit interior from the second opening of the conduit.

16. The method of claim 15 further including the step of attaching a leader to the cable, wherein the leader facilitates moving the cable through the conduit interior.

17. The method of claim 16 including the step of attaching a guiding member to the leader for directing the leader through the conduit interior, said guiding member being attached to the leader at an end opposite an end attached to the cable.

18. The method of claim 15 further including the step of advancing or withdrawing the leader through or from the conduit using a line member feeding apparatus comprising a motor engageable with the leader and an oscillator for oscillating the leader.
19. The method of claim 15 wherein the cable is pulled by a cable withdrawing apparatus.

20. A line member feeding apparatus for advancing and withdrawing a line member comprising:

   (I) a motor engageable with the line member for advancing and withdrawing the line member; and

   (II) an oscillator for oscillating the line member.

21. The apparatus of claim 20 wherein the motor engages the line member via a drive roller.

22. The apparatus of claim 20 wherein the oscillator is driven by the motor.

23. The apparatus of claim 20 whereby in use, the line member is advanced or withdrawn by the drive roller and oscillating motion is provided by frictional engagement of the line member with a pad driven by the drive roller.

24. The apparatus of claim 23 wherein the pad moves in a linear reciprocating motion.

25. The apparatus of claim 20 when used with the method of claim 15 for cleaning a conduit interior.

26. A system for cleaning a conduit interior comprising:

   (i') a cable comprising one or more cleaning member(s) and one or more disrupting member(s);

   (ii') a leader attachable to the cable and capable of facilitating moving the cable through the conduit interior;
(iii') a guiding member at an end of the leader opposite an end attachable to the cable;

(iv') a line member feeding apparatus capable of advancing and withdrawing the leader through or from the conduit interior; and

(v') a cable withdrawing apparatus capable of pulling the cable through the conduit interior;

whereby in use, the leader is inserted into an inlet of the conduit and advanced therethrough using the line member feeding apparatus, the leader is guided through the conduit interior via the guiding member from the inlet, the leader is pulled from the conduit interior from an outlet of the conduit with the cable attached to the leader, the cable is attached to and pulled by the cable withdrawing apparatus, thereby pulling the disrupting members and cleaning members through the conduit interior cleaning said conduit interior.

27. The system of claim 26 wherein the cleaning member(s) are respectively characterised by comprising a disk, a retaining member adjacent to a side of the disk, in use facing towards the conduit outlet, and a backing plate located adjacent a side of the disk, in use facing towards the conduit inlet.

28. The apparatus for cleaning an interior of a conduit substantially as herein described with reference to the accompanying drawings.

29. The apparatus for advancing and withdrawing a line member substantially as herein described with reference to the accompanying drawings.
30. The cleaning member for cleaning an interior of a conduit substantially as herein described with reference to the accompanying drawings.
**INTERNATIONAL SEARCH REPORT**

**A. CLASSIFICATION OF SUBJECT MATTER**

Int. Cl.²: B08B 9/043

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

REFER ELECTRONIC DATA BASE CONSULTED BELOW

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

DWPI IPC B08B 9/00, 9/02, 9/027, 9/04, 9/043, F16L 55/26, 55/28, 55/30, 55/46, 101/12, 101/50 & keywords: PIPE, TUBE, CABLE, LEADER, PULL, PUSH, CLEAN, DISRUPT, DISC, OSCILLATE and similar terms.

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

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<th>Category*</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
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<tr>
<td>X</td>
<td>JP 10118595 A (HAKKO CO LTD) 12 May 1998 See ESPACE abstract and Figs.1,2</td>
<td>1-30</td>
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<tr>
<td>X</td>
<td>US 4 656 685 A (WOOD) 14 April 1987 See whole document, particularly abstract &amp; figures</td>
<td>1-6, 8, 9, 12, 15-19</td>
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<tr>
<td>X</td>
<td>FR 2 632 547 A (DEVIN LEMARCHAND ENTR) 15 December 1989 See Fig.1 and abstract</td>
<td>1-6, 8-19, 26, 27</td>
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[X] Further documents are listed in the continuation of Box C  [X] See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search 12 April 2002

Date of mailing of the international search report 10 MAY 2002

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Form PCT/ISA/210 (second sheet) (July 1998)
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<td>US 6 145 150 A (KNAPP) 14 November 2000</td>
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<td>See Fig. 1 and column 2 line 47 - column 3 line 48</td>
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<td>A</td>
<td>US 3 928 885 A (PETERSON et al) 30 December 1975</td>
<td>20-25</td>
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INTERNATIONAL SEARCH REPORT

Box I Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos:
   because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos:
   because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos:
   because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

The international application does not comply with the requirements of unity of invention because it does not relate to one invention or to a group of inventions so linked as to form a single general inventive concept. In coming to this conclusion the International Searching Authority has found that there are several groups of claims as follows:

See continuation on supplemental sheet:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims
2. ☑ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest ☐ The additional search fees were accompanied by the applicant's protest.
☐ No protest accompanied the payment of additional search fees.
Supplemental Box
(To be used when the space in any of Boxes I to VIII is not sufficient)

Continuation of Box No: II

Claims 1-11, 15-19 and 26-30 define an apparatus for cleaning the interior of a conduit or a method of using the apparatus to clean a conduit. It is considered that the combination of features forming the apparatus comprises a first “special technical feature”.

Claims 12-14 define a cleaning member for cleaning the interior of a conduit. It is considered that the form of the cleaning member comprises a second “special technical feature”. The apparatus of the first group of claims is not limited to using the cleaning member of the second group of claims, nor is the cleaning member limited to be suitable to use with the first group of claims.

Claim 20-25 define a line feeding apparatus comprising a motor and an oscillator. It is considered that the form of line feeding apparatus including a motor and oscillator comprises a third “special technical feature”.

These groups are not linked as to form a single general inventive concept, that is, they do not have any common inventive features, which define a contribution over the prior art. The common concept linking together these groups of claims is cleaning a conduit interior. However devices for cleaning the interior of conduits by line feeding are well known and not novel in the light of CGK (common general knowledge). Therefore these claims do not relate to one invention only, a posteriori.
This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

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END OF ANNEX