

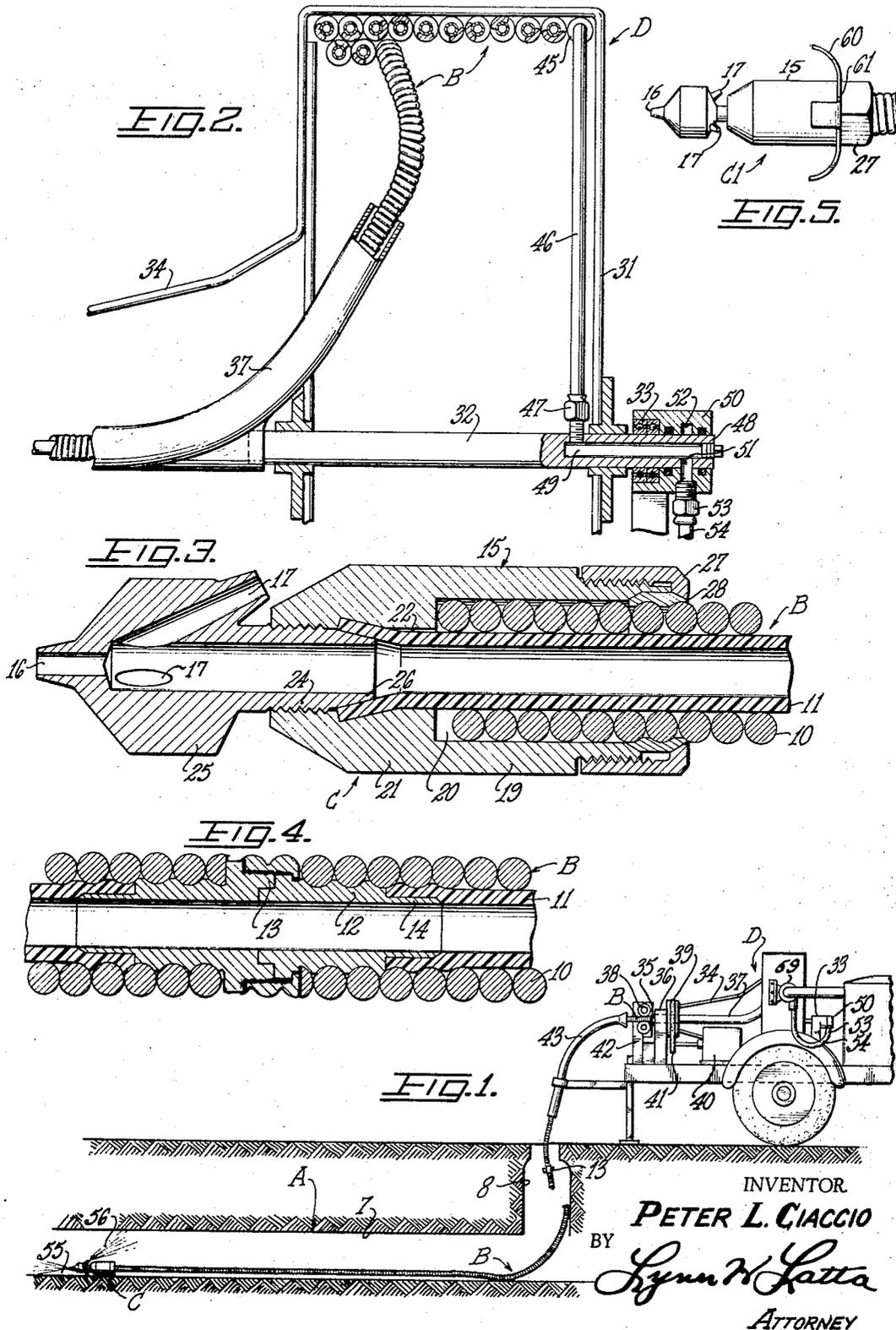
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SEWER CLEANING APPARATUS WITH ROTARY HYDRAULIC CLEANING TOOL

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SEWER CLEANING APPARATUS WITH ROTARY HYDRAULIC CLEANING TOOL

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ABSTRACT OF THE DISCLOSURE

Disclosed herein is a sewer cleaning apparatus utilizing a plurality of hydraulic jets delivered from the front end of a hose that is simultaneously projected into a sewer and rotated by a reeling-feeding machine positioned externally of a manhole. Hydraulic dredging and flushing action is achieved by the rotating jets.

This invention relates to the cleaning of accumulated sediment and debris from sewers and has as its general object to provide an improved apparatus for such cleaning, wherein a rotary cleaning tool, rotated within a sewer by rotary drive transmitted through a coil type flexible drive rod, provides a hydraulic cleaning action of improved efficiency and rapidity as compared to conventional non-hydraulic rotary cleaning.

RESUME OF INVENTION

The present invention particularly improves upon previous hydraulic sewer cleaning apparatus in that it utilizes simultaneously a forwardly directed cleaning jet and a rearwardly directed jet with a propulsive reaction compensating for the rearward reaction of the cleaning jet and thus assisting forward feed of the hose in the sewer.

Specific objects are to provide such an apparatus:

(1) Wherein a rotary hydraulic cleaning tool is driven by a tubular coil which functions both as a flexible drive rod and as a sheath for a flexible hydraulic hose for delivering a pressurized stream of water to the tool for hydraulic jet cleaning.

(2) Wherein the tool is adapted to deliver a forwardly-directed hydraulic cleaning jet for flushing away accumulated sediment and debris.

(3) Wherein the tool also embodies a means for delivering one or more rearwardly-directed propulsion jets, which assist in the forward propulsion of the tool into the sewer, thus reducing the amount of pressure that must be applied longitudinally through the flexible drive rod, for pushing the tool into the accumulated debris in the sewer.

(4) Wherein the tool embodies means for delivering a hydraulic cleaning jet or jets which will be rotated through a succession of revolutions as the tool is rotated by the flexible drive rod, thus subjecting the internal wall of the sewer conduit to a hydraulic scouring action throughout its full circumferential area.

(5) Embodying a novel and improved hydraulic cleaning tool having means for securely anchoring it to the forward end of a coiled drive rod and for coupling it to the forward end of the hydraulic hose extending through the coiled drive rod; and which is readily attachable to and detachable from the drive rod and the hose.

(6) Embodying novel and improved coupling means for coupling together adjacent ends of successive sections of coiled drive rod and hydraulic hose.

(7) Embodying improvements in a rodding machine such as to provide for delivering a pressurized stream of water from a source of supply to the rear end of a hydraulic flexible drive rod within a storage reel which is

rotative in order to transmit rotation through the drive rod to a rotary hydraulic tool on the forward end of the drive rod.

These and other objects will become apparent in the ensuing specification and appended drawing, wherein:

FIG. 1 is a fragmentary longitudinal sectional view of a sewer undergoing cleaning by the method and apparatus of this invention, the apparatus being shown in side elevation and largely in schematic form;

FIG. 2 is a fragmentary axial sectional view of the reel and associated parts of a drive-rod reeling, rotating and feeding machine which is utilized in the practice of the invention;

FIG. 3 is a full-scale axial sectional view of the rotary hydraulic tool of the invention;

FIG. 4 is an axial sectional view of one of the drive-rod couplings of the invention; and

FIG. 5 is a side view of a modified form of the rotary hydraulic tool.

Referring now to the drawing in detail, and in particular to FIG. 1, I have shown therein, as an example of one form in which the invention may be embodied, the cleaning of a sewer A by the use of a rotary hydraulic tool C driven by a flexible hydraulic drive rod B which is reeled, rotated, and fed longitudinally by means of a rodding machine D (similar to that of my Patent No. 3,025,547).

Sewer A, in accordance with standard design, embodies a longitudinal underground conduit 7 and one or more manholes 8 distributed at intervals along its length, for service access.

Flexible drive rod B comprises a tubular coil 10 of hard spring wire and of closed-coil form; and a hydraulic hose 11 enclosed within the coil 10 and thereby supported against expansion and/or bursting under the high hydraulic pressures that are utilized by the invention (e.g. up to 10,000 lbs. p.s.i.). For convenience in manufacture, assembly and handling, the drive rod B is in sections (e.g. of 100 ft. length) which are joined together by couplings such as that shown in FIG. 4. Each coupling comprises a pair of tubular screw-coupling members 12, each of which has an external thread contoured to mate with the helical interior of the coil 10, the coupling members 12 projecting axially from a central collar 13 and terminating in respective thin-walled end nipples 14 adapted to be forced into the ends of respective hose sections 11 and to expand the latter into tight engagement with the convolutions within the ends of coil sections 10. The collar 13 has a helically-convoluted periphery conforming to that of the coil 10 and providing a continuation thereof when the coupling members 12 are threaded full-depth into the ends of coil section 10. The coupling (except for its tubular feature and the means for sealing the hose sections thereto) is of the sectional, separable construction shown in my Patent No. 2,960,851, to which reference is made for a disclosure of such details, the separable construction being indicated in FIG. 4 without specific description herein.

The encircling grip of coils 10 against the expanded ends of hose sections 11 is operative by hoop tension to clamp the hose sections in fluid-tight engagement with the nipples 14. The compressible walls of hose sections 11, tightly engaged between coils 10 and nipples 14, will resist unthreading of the coils from the coupling.

Rotary hydraulic tool C comprises a body, indicated generally at 15, having means for securing and coupling it to the flexible drive rod assembly B, and having a forwardly-directed cleaning jet nozzle 16 and one or more rearwardly-directed propulsion nozzles 17 (three nozzles, disposed in an annular array, 120° apart, as best indicated in FIG. 5, are preferred).

Tool body 15 may comprise a cylindrical receptacle including a skirt portion 19 providing a cylindrical chamber 20 to snugly receive the coil 12 of drive rod assembly B, and a head 21 provided with a bore 22 terminating in a frusto-conical annular recess, the bore 22 loosely receiving an end portion of hydraulic hose 11 projecting from the end of coil 10. The forward portion of bore 22 is internally threaded to receive the threaded stem 24 of a nozzle head 25, in which the cleaning jet nozzle 16 and propulsion nozzle 17 may be mounted or formed integrally as shown. Stem 24 defines a hydraulic passage which extends into nozzle head 25 and communicates with the nozzles 16 and 17 as shown.

Nozzle head stem 24 has at its end a tapered nipple 26 adapted to be wedged into the end of the forward hose section 11 and to expand it tightly into the annular recess of bore 22, thus providing a high-pressure, fluid-tight coupling between nozzle head 25 and tool body 15. A gland collar 27, threaded onto the end of tool body 25, may be utilized to contract a split locking ring 28 into locking engagement with the turns of forward coil section 11, the ring 28 having internal thread grooves for mating with the coil turns.

Rodding machine D can be largely the same as the machine disclosed in my prior Patent No. 3,025,547. It embodies a reel 31 for storage of the drive rod B within the periphery thereof, the reel having an axle 32 which is rotatably journaled in a bearing 33. Reel 31 has a forwardly tapering cage portion 34 terminating in a tubular trunnion 35 journaled in a bearing 36. Bearings 33 and 36 are aligned on a horizontal axis about which reel 31 rotates for transmitting rotation to drive rod B, which issues and is retracted through a guide nozzle 37. Nozzle 37 extends into trunnion 35 at its forward end. Thus the drive rod B can be fed out of the reel through the trunnion 35, along the axis of reel rotation. Feeding movement is imparted to the drive rod B by a pair of feed rolls 38 which may have serrated, grooved peripheries geared to the convolutions of drive rod coil 10 for positive feed. Trunnion 35 is formed integrally with or secured to a drive pulley or sprocket 39, to receive drive from a motor 40 through a belt or chain 41. Feed rolls 38 are driven through suitable drive means 42. Drive rod B, after issuing through tubular trunnion 35, travels through an elbow tube 43 which guides it downwardly through a manhole 8 and hence into the sewer conduit 7.

At the rear end 45 of drive rod B, which is always retained in (and may be attached to) the reel D, the hydraulic hose 11 is extended therefrom to provide a connecting tube 46 extending radially inwardly to the axle 32, to which it is connected by suitable means such as a coupling 47. The connecting tube 46 can as well be a separate length of rigid tubing extending from the axle 32 to the periphery of the reel D and there coupled to the hose 11. The axle 32 has a tubular rear end portion 48 providing an axial passage 49 with which the connecting tube communicates. The tubular portion 48 of the axle extends through the bearing 33 and into a rotary hydraulic coupling gland which may comprise a fixed cylindrical housing 50 formed integrally with the housing of bearing 33, a radial port 51 in tubular axle portion 48 communicating with port 51, and a radial port in housing 50, communicating with annular port 52 and with a suitable hydraulic coupling 53. A hydraulic supply line (e.g. hose) 54, coupled to the coupling 53, serves to deliver water from a suitable high pressure pump 59 or other high pressure source, through the rotary hydraulic coupling 48-52 to the connecting tube 46 and thence to the hose 11 and through the full length of the drive rod B to the rotary hydraulic tool C. From the nozzles of the tool a jet 55 will be directed forwardly for dredging away the accumulated debris ahead of the tool, and jets 56 will be directed rearwardly, with a scouring action against the wall of conduit 7, cleaning away any dirt still clinging thereto. The reaction of jets 56 will sub-

stantially overcome or balance out the oppositely directed reaction of jet 55. Preferably, the nozzles are selected and arranged so as to produce a more powerful reaction in jets 56 than in jet 55, whereby a net forward propulsive thrust is provided. This propulsive thrust is utilized to drive the tool C forwardly and to pull a portion of the dead weight of drive rod B, thus reducing the amount of pressure that must be applied to the drive rod B to push it through the sewer conduit 7. This makes it possible to extend a cleaning operation a greater distance from the entry manhole 8 than is possible in the use of the conventional coil rod and its rodding machine.

The jets 56, being directed angularly outwardly at equally-spaced positions around the axis of tool C, will have components of radially reactive thrust tending to support the tool C in a floating or semi-floating condition, thus further facilitating the forward travel of the tool in the sewer.

The normal method of operation is to feed the tool C through the manhole into the sewer conduit, then to start the rotation of the tool C and the flow of a high pressure water stream from supply line 54 through the rotary coupling 50-52 into the reel to the rear end of drive rod B, thence through the drive rod to the tool C. By operation of separate controls (not shown) in the rodding machine D, the reel D is rotated, thus transmitting rotation through the drive rod to the tool C at a selected rate, and at the same time the feed rolls 38 are operated, under independent control, to slowly feed the tool C forwardly as the accumulated debris is loosened by dredging action of the forwardly-directed jet 55. The debris thus loosened will be flushed rearwardly by the rearwardly-directed jets 56, thus removing it from the immediate area of operation of tool C. In the event the debris thus loosened and deposited behind the tool C accumulates to a volume such as to interfere with satisfactory further operation of tool C, the tool can be withdrawn and a dredging bucket can be drawn into and through the sewer conduit on a drag line in accordance with well known practice, collecting and removing the loosened debris from the sewer. Where the sewer has only a thin deposit of debris, the loosened debris may be floated away in the sewer by the stream of water ejected from the tool C.

Where the sewer conduit is clogged by debris that is held by tree roots that have invaded the sewer, or is otherwise anchored too tightly for satisfactory removal by hydraulic dredging, the tool may be modified as at C 1 in FIG. 5, to include a rotary cutter 60 which may be in the form of a star disc having an annular hub portion 61 clamped between the tool body 15 and clamp collar 27.

A drive rod of suitable proportions for the invention is one having an external diameter of $1\frac{1}{4}$ inch, with the coil 10 being coiled from $\frac{3}{32}$ -inch diameter instead of the $\frac{5}{16}$ -inch wire now commonly used in $1\frac{1}{4}$ inch coiled rod; and wherein the hose 11 may be of rubber or equivalent synthetic resin plastic material having a $\frac{1}{2}$ -inch internal diameter and a wall thickness of approximately $\frac{3}{32}$ -inch. A wall of this thinness is satisfactory for high pressures up to 10,000 lbs. p.s.i. since the encircling closed coil 11 functions as a supporting sheath.

I claim:

1. Hydraulic sewer cleaning apparatus comprising: a tubular flexible drive rod comprising a sheath of coiled spring wire and a hydraulic hose extending through and supported by said sheath; means for storing said drive rod, for rotating an extended forward portion thereof within a sewer conduit and for feeding it into a sewer; means including a connection to the rear end of said hose, for delivering a pressurized stream of water to said hose; and means coupled to said hose at the forward end of said drive rod for delivering a portion of said stream in the form of a forwardly-directed jet for dredging accumulated sediment and debris loose from the wall of

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said conduit and for simultaneously delivering a rearwardly-directed jet having a forward propulsion action assisting the forward feed of said drive rod into the sewer conduit; said drive rod being in sections, and including a coupling joining said sections, end to end, said coupling comprising a central coupling collar having a periphery provided with convolutions constituting a continuation of the external convolutions of said sheath sections, and including tubular coupling members projecting from opposite sides of said collar and provided with male threads threaded into the adjacent ends of the sheath sections.

2. Apparatus as defined in claim 1, including at the ends of said coupling members, respective nipples inserted into the ends of respective hose sections and sealed thereto by hoop-clamping by surrounding turns of said sheath.

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