United States Patent [19]

Kramer et al.

[11] **3,844,197**

[45] **Oct. 29, 1974**

[54] **HYDRAULIC MOTOR AND DRIVE ATTACHMENT**

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[22] Filed: **Oct. 18, 1972**

[21] Appl. No.: **298,594**

[52] **U.S. Cl.** ..... **91/52,** 91/337, 91/342, 91/44 C, 92/31

[51] **Int. Cl.** **F01l 23/00**

[58] **Field of Search** 91/342, 325, 337, 52; 92/31

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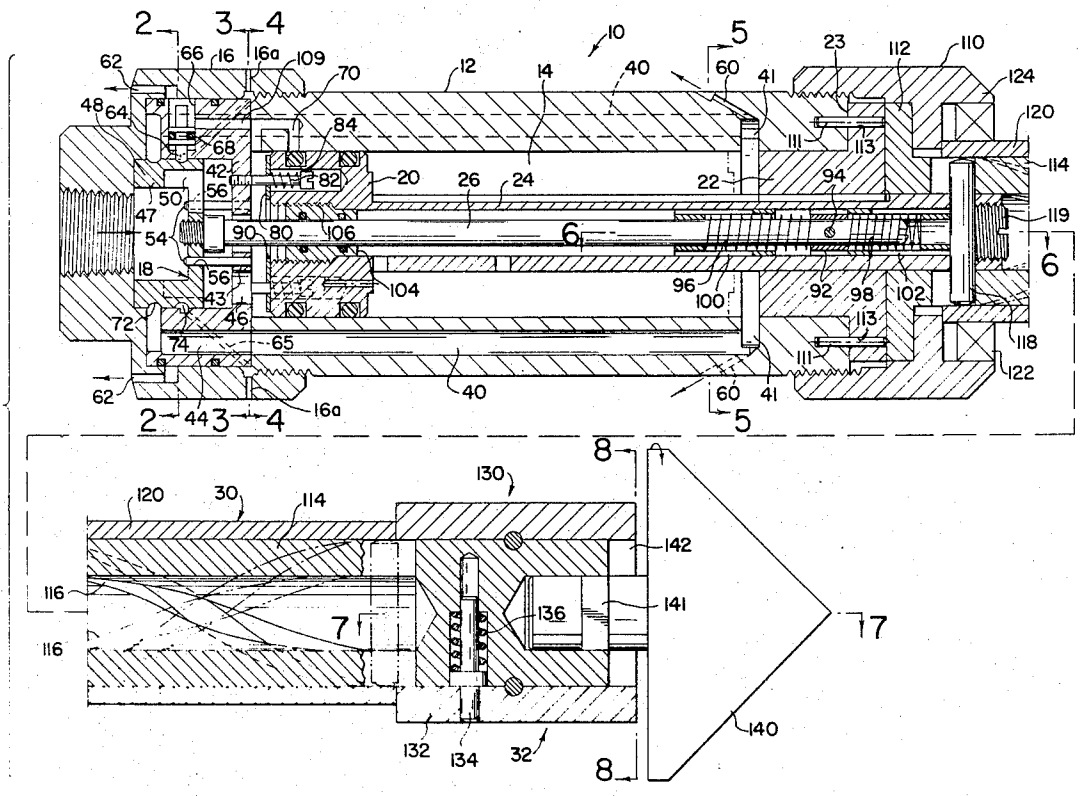
Primary Examiner—Paul E. Maslousky
Attorney, Agent, or Firm—Oldham & Oldham Company L.P.A.

[57] **ABSTRACT**

A small hydraulic motor of the type for being axially advanced in an enclosure tube and comprising a tubular frame means having an inlet at one end and operatively positioning an output shaft at the other for means such as a cutting tool or root saw. The motor includes an attachment for converting longitudinal movement to arcuate movement and valve means are provided in the frame means adjacent the inlet for transmitting pressure liquid to a piston in a pressure chamber in the frame means for advancing and retraction movement of the piston, alternately, and rearwardly directed jet exhaust bores are provided in the frame means and end cap to cause the motor to advance in an enclosure tube with flow of hydraulic pressure fluid into and through the motor and angled to resist rotation of the motor itself thus twisting the hose. Two sets of jets are provided angled oppositely so that a proper twist resistance is always present, in forward and reverse portions of the cycle.

This invention relates to small hydraulic motors, especially of the type that could be used in sewers and similar tubular enclosures for being progressively advanced through the sewer for clearing any obstacle provided therein, the motor is driven by pressure liquid supplied thereto through a flexible tube connecting to the inlet end of the motor and moving with the motor along in the sewer or other enclosure.

5 Claims, 9 Drawing Figures



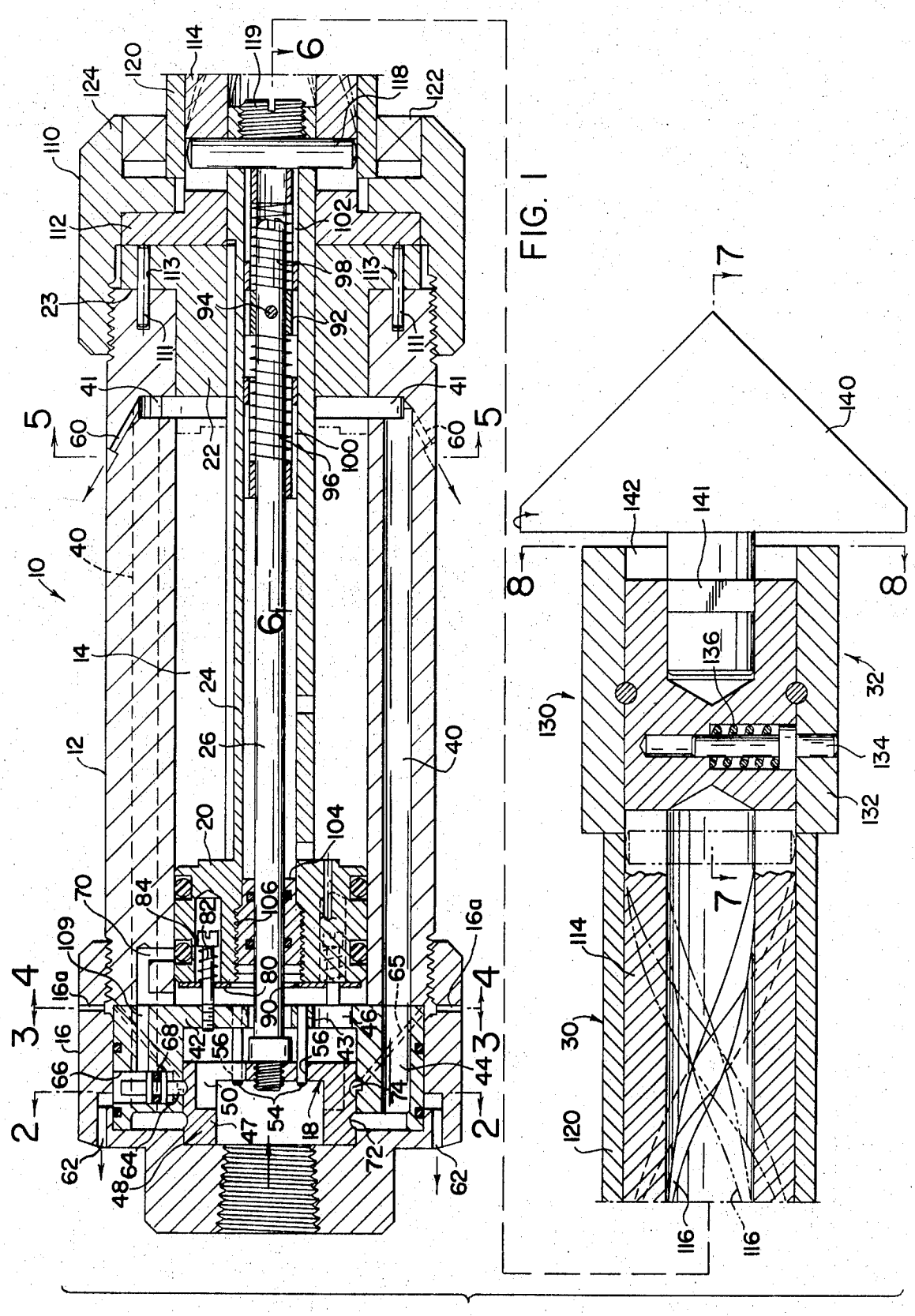


FIG. 1

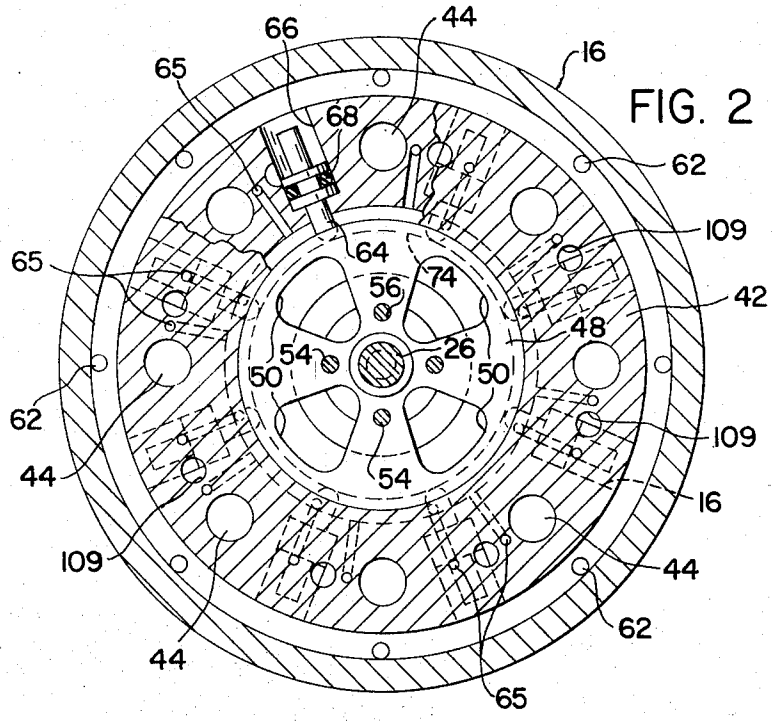

66
44
16
65
68
62
109
64
65
56
74
42
48
54
26
50
50
62
109
44
54
16
109
44
62
44
65

FIG. 2

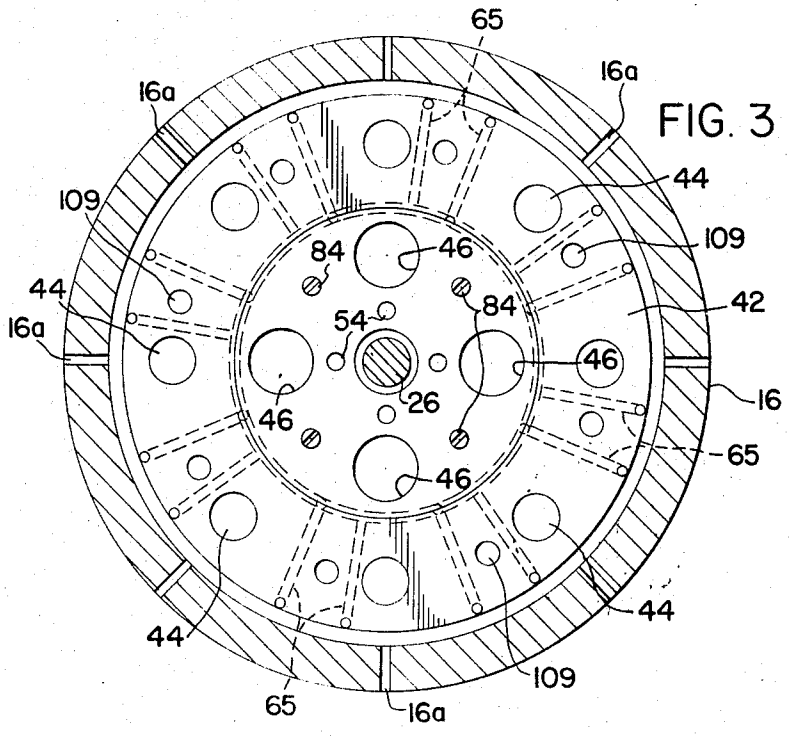

65
16a
16a
44
109
109
84
46
44
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42
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16a
46
46
16
26
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46
44
44
65
109
16a

FIG. 3

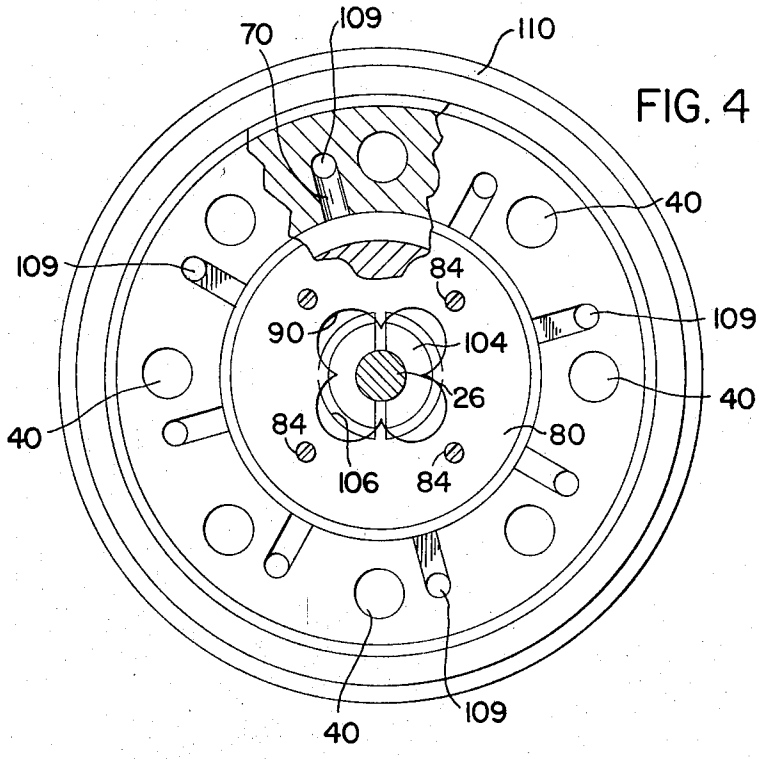

70
109
110
40
109
84
90
104
109
26
40
40
84
80
106
84
40
109

FIG. 4

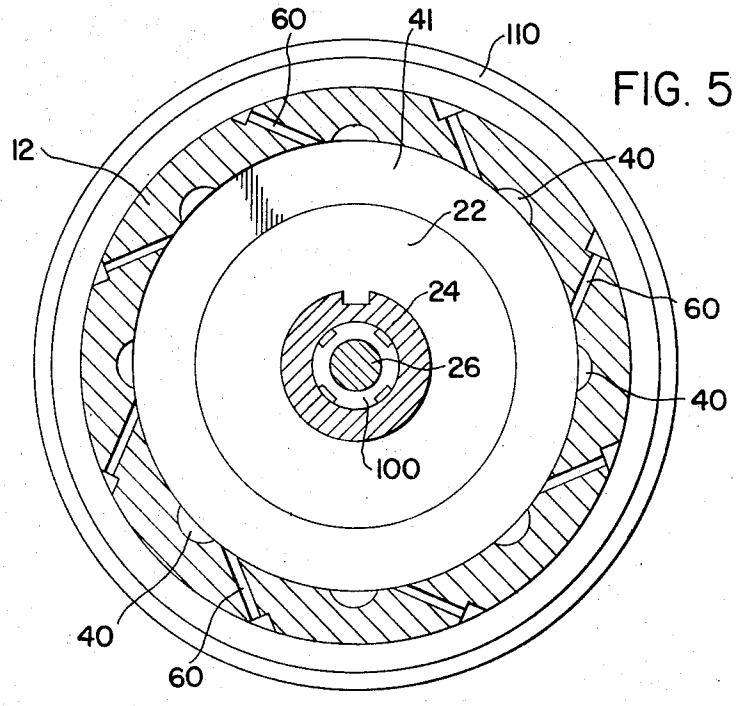

60
41
110
12
40
22
24
60
26
40
100
40
60

FIG. 5

FIG. 6

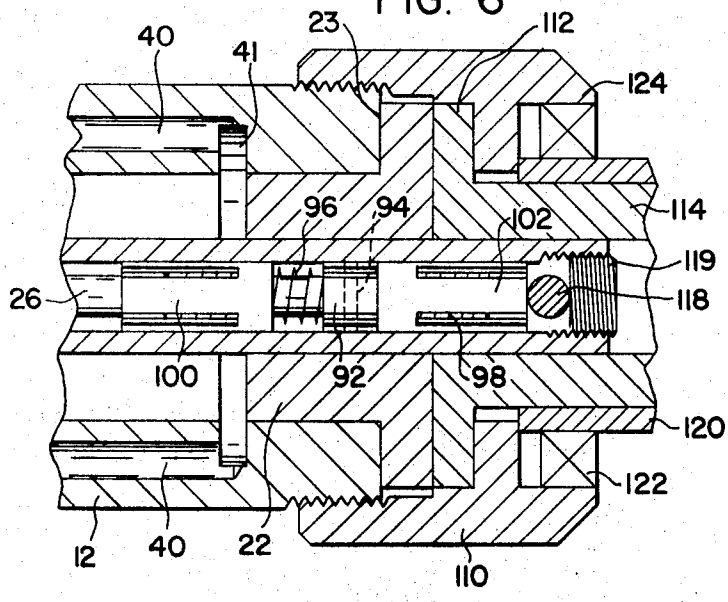


FIG. 8

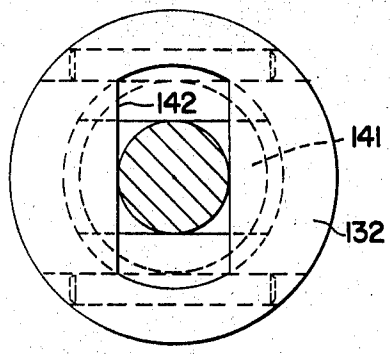
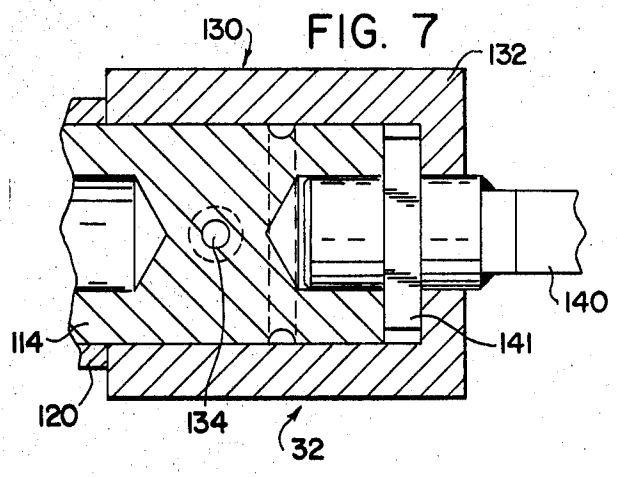


FIG. 7



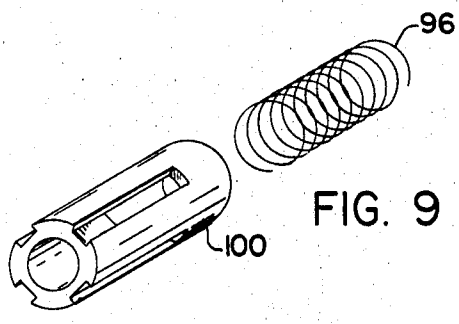


FIG. 9

HYDRAULIC MOTOR AND DRIVE ATTACHMENT

BACKGROUND OF THE INVENTION

Heretofore hydraulic motors have been provided wherein valving action in the motor is controlled by means associated with the pressure piston in the motor and where the motor includes a piston received in a pressure chamber for reciprocation therein. An auxiliary rod is provided in the bore of a tubular piston rod engaging the piston, which rod extends through a portion of the valve means and connected thereto so that it can control valving action in the motor dependent upon the piston position. Some motors of this type include those shown in U.S. Pat. Nos. 526,149; 1,205,857 and 1,355,208.

It is particularly desirable that motors of the type to which the present invention relates be relatively compact, but still provide an appreciable amount of driving energy both for forward movement of the motor and for forcing an output member through a drive arc and then for retracting the output member for a further cutting or drive action on advancement of the motor. Also, these motors should be durable and have minimum maintenance required thereon.

The general object of the present invention is to provide a novel and improved hydraulic motor especially adapted for self-propulsion through an enclosure tube and for providing a reciprocal arcuate output from a reciprocating piston means.

Another object of the invention is to provide an improved and effective valve means in a large volume flow hydraulic motor for reversing the flow circuit of pressure liquid in the motor and for providing self-propulsion action in the motor.

Other objects of the invention are to provide a more compact valve means operating on a shorter stroke than prior devices; a novel and improved control or rod engaging a valve means in a hydraulic motor and with the control rod being operatively carried within a tubular piston rod for actuation of the control valve as the piston approaches extremities of movement in the unit; to provide improved control rod operating means within the tubular piston rod; to provide detent means to aid in providing a snap action in a telescoping type 2-cup member valve means to control liquid flow in the motor; to convert axial reciprocation movement into arcuate movement effectively; to guide the movement of and accurately position a piston rod in the hydraulic motor; to provide effective propulsion forces in the motor by the hydraulic fluid received for drive of the motor; to provide a motor made from parts which are of sturdy construction and require relatively minimum maintenance thereon; to provide check valve means in the motor to aid in preventing leakage in the control valve for liquid flow into and through the motor; to provide a motor which will have a long service life; to provide a motor with improved flow control circuits for the hydraulic fluid received in and passing through the motor for drive thereof; to prevent intake of foreign matter in case of stall and restart of cycling; to provide a motor that is easy to assemble and disassemble and has a minimum of parts; and to provide an effective durable hydraulic motor for driving a cutting tool, for example, through a sewer pipe or similar enclosure.

The foregoing and other objects and advantages of the invention will be made more apparent as the specification proceeds.

Attention now is particularly directed to the accompanying drawings, wherein:

FIG. 1 is a longitudinal section through a hydraulic motor of the invention and output tool or cutter means operatively secured thereto;

FIG. 2 is a vertical cross sectional view taken on line 2—2 of FIG. 1;

FIG. 3 is a vertical cross section through the valve means and taken on line 3—3 of FIG. 1 looking in the direction indicated;

FIG. 4 is a vertical section taken on line 4—4 of FIG. 2 and looking in the direction stated;

FIG. 5 is a vertical section taken on line 5—5 through the pressure chamber of the hydraulic pump;

FIG. 6 is a horizontal section taken on line 6—6 of FIg. 1 to show the control rod and piston rod association and control means in more detail;

FIG. 7 is a fragmentary horizontal section taken on line 7—7 of FIG. 1 to show the means positioning the cutter member on the operative unit of the invention;

FIG. 8 is a fragmentary vertical section showing the positioning of the cutter tool on the end of the drive mechanism; and

FIG. 9 is an exploded perspective view showing the relationship of the guide sleeve and spring means used in the assembly controlling the piston rod as in FIG. 6.

When referring to corresponding members shown in the drawings and referred to in the specification, corresponding numerals are used to facilitate comparison therebetween. Also, the sectional drawings provided show some members, for clarity, not directly visible at the specific section line as shown.

INVENTIVE SUBJECT MATTER

The hydraulic motor includes, as one embodiment of the invention, a tubular member having a plurality of axially extending bores extending thereinto from an inlet end thereof and terminating at an annular recess formed in the inner wall of the member, the member forming a pressure chamber in combination with valve means positioned at an inlet end of the chamber and a guide disc and outlet end cap operatively secured to the chamber at the opposite end thereof, a piston slidably received in the pressure chamber in the tubular member, and a tubular piston rod is secured to the piston and protrudes from the outlet end of the tubular member. An inlet valve cap is secured to the inlet end of the pressure chamber of the tubular member and valve means are received within this inlet end cap and include an axially movable closure means. The valve means enable water flow therethrough to drive the piston in one direction and when closed forcing water into the bores in the tubular member for flow to the opposite end of the pressure chamber to force the piston in the opposite direction, and rod means are slidably received in the piston rod and extends through the piston to engage a movable portion of the valve means to control its position for valve action dependent on the position of the piston in the chamber. Movement control means are associated with the rod means to aid in snapping the movable valve portion or member from one position to another and other means are present that

include detents engaging the movable valve member to aid in providing snap action of the valve means dependent upon the operative position of the piston. Additional means operatively engage the tubular piston rod to convert axial movement thereof to arcuate movement and an operative outlet member, such as a cutter tool, is operatively associated with the member provided in the motor assembly and driven through an arc by the motor.

Reference now is made to the details of the hydraulic motor and associated means provided by the invention, and the hydraulic motor and outlet means therefor are indicated as a whole by the numeral **10.** This hydraulic motor **10** includes a tubular member **12** for forming a pressure chamber **14,** and an inlet end cap **16** is operatively secured to what is termed the inlet end of the hydraulic motor and which end cap is secured to an end of the tubular member **12,** Valve means indicated as a whole by the numeral **18** are provided within the inlet end cap **16** and operatively engage the inlet end of the tubular member **12** to form one end of the pressure chamber **14,** while a piston **20** is slidably received in the pressure chamber **14** for reciprocation along the axis of the tubular member.

A guide means or disc **22** is operatively positioned at the other end of the tubular member **12** to form an additional closure for the outlet end of the pressure chamber **14.**

So as to convert axial reciprocating movement from the piston **20** into arcuate movement, a movement converting means **30** is operatively attached to the outlet end of the tubular member **12** and some suitable outlet tool assembly such as indicated at **32** is operatively attached to the free end of the movement conversion means or unit **30.**

A tubular piston rod **24** is secured to the piston and extends therefrom toward the outlet end of the pressure chamber **14,** while a control rod **26** is slidably received within the bore of the piston rod and it connects to a movable member in the valve means **18** for controlling the setting in the valve means dependent upon the axial position of the piston in the pressure chamber **14,** as hereinafter described.

VALVE MEANS AND ASSOCIATED MECHANISM

At the inlet end of the tubular member **12,** a plurality of circumferentially spaced axially extending bores **40** are provided in such member and they extend substantially the length of such member from the inlet end thereof. These bores are for the passage of hydraulic pressure liquid to the opposite end of the pressure chamber for retraction movement of the piston in the pressure chamber, as hereinafter described, and they terminate at and connect to a recess **41** formed in and extending circumferentially of the inner wall of the member.

The valve means **18,** as one of the components thereof, includes a substantially cup-shaped member **42** which is fixedly secured in position between an inner surface of the inlet end cap **16** and the inlet end of the tubular member **12.** A plurality of circumferentially spaced, axial bores **44** are provided in the wall of this cup member **42** and are positioned in alignment with the bores **40** in the tubular member to transmit pressure liquid thereto as hereinafter described. Inlet ends of these bores **44** are in communication with the interior surface of the cup member **42.** In the base **43** of the cup member **42,** a plurality of circumferentially spaced bores or holes **46** are provided, as best indicated in FIG. **4.** A second substantially cup-shaped member **48** is slidably received within the first cup member **42** for limited telescopic movement therein on the axis of the motor. This second cup member has a plurality of circumferentially spaced openings **50** in a base portion thereof and extending up into the wall **47** of the cup. Such openings **50** are larger than the holes **46** and are circumferentially offset with relation thereto whereby there is no axial overlapping of the holes **46** in the base of the first cup member in relation to these openings **50** to provide for valve closure action when the cup members are fully nested together, making possible large volume action with a very short stroke.

FIG. **1** shows the second cup member **48** with its open end abutted against the inner end of the inlet end cap **16.** This is one extremity of movement of such second cup member when the valve means is open and liquid forced into the motor through the opening in the inlet end cap flows through the openings **50** in the second cup member and then through the holes **46** in the first cup member to flow into the pressure chamber **14** to actuate the piston and cause it to move through a pressure or advance stroke. As the openings **50** extend slightly up into the axially extending wall **47** on the inner surface thereof, this aids in free fluid flow therethrough.

Guide pins **54** are secured to the base **43** of the first cup member and protrude towards the inlet of the motor, being received in corresponding circumferentially spaced bores or holes **56** provided in the base of the second cup member **48** to aid in maintaining the cup members in proper circumferential relationship with each other to provide for valving action between the holes formed in the cup bases. Thus, when the second cup member is moved axially of the first cup member into full engagement therewith, then no appreciable flow of pressure liquid through the valve means is permitted so that a "valve closed" action is provided in the motor.

It will be realized that any suitable source of hydraulic fluid under pressure, such as a flexible pressure hose or line, will connect to the inlet end cap **16** for continuously supplying pressure liquid thereto even as the hydraulic motor **10** moves axially through an enclosure, such as a sewer pipe. Likewise, the motor can be retracted from the sewer by the flexible pressure line connecting thereto.

In the position of the second cup member **48** shown in FIG. **1,** flow of pressure liquid to the relatively large bores **44** in the side walls of the cup member **42** and to the bores **40** in the tubular member is prevented. However, when the second cup member is moved axially inwardly to its closed position, at that time then pressure liquid will flow into and through the bores **44** for flow to the relatively large bores **40** the tubular member and for flow therefrom through the annular recess **41** provided in the inner wall of the tubular member **12** adjacent the outlet or exhaust end thereof for retractive movement of the piston on a pressure stroke in a direction to the left, as shown in FIG. **1** of the drawings.

A plurality of circumferentially spaced rearwardly directed exhaust jets or ports **60** are provided in the tubular member **12** and they connect to the recess **41.** Hence, on movement of the piston in a right-hand di-

rection as shown in FIG. 1, then pressure liquid trapped within the pressure chamber will flow out through the recess 41 and some liquid will escape through the jets 60 to provide an axial propulsion movement for the hydraulic motor. Pressure liquid also is present in the bores 40 in the tubular member and these bores operatively connect to liquid exhaust ports 62 or reduced diameter provided in the inlet end cap. Preferably this back pressure set up by a power stroke of the piston to the right in the hydraulic motor also preferably provides back-up pressure on a plurality of detents 64. These detents 64, FIG. 2, are provided in a plurality of radially extending holes 66 formed in the wall of the cup member 42 in equally circumferentially spaced relation to each other. The detents each carry an 0-ring 68 between a pair of axially spaced ribs thereon and with such rings being adapted to seal the detents in the holes 66 for slidable movement therein. The pressure liquid reaches the radially outer portions of the holes 66 by connecting bores 70 to aid in retaining these detents in an axially or radially inwardly protruding position. The inner ends of the detents are adapted to engage with either of two parallel circumferentially extending grooves 72 and 74 formed in axially spaced portions of the outer surface of the wall of the second cup member 48 dependent upon whether the second cup member is in a valve closed or a valve open position, respectively. The detents retain the cup member 48 in such position until suitable forces are exerted on the second cup member to move it from one valving position to another as controlled by motor operation and the desired accompanying valve action to provide change in the direction of stroke or movement of the piston in the motor.

An additional feature of the valve means 18 provided in the apparatus is a check valve plate 80 that is operatively associated with and carried by the base of the first cup member 42. This check plate or disc 80 is on the exhaust or downstream face of the base 43 of this cup member 42 and is resiliently urged thereagainst as by a plurality of coil springs 82 that are individually carried by a plurality of circumferentially spaced cap screws 84. These screws engage the base of the cup member with the spring being compressed against this check disc 80 to retain the valve in its closed condition when the piston is being moved to the left as the motor is shown in FIG. 1 of the drawings. However, when the valve is open, liquid readily unseats the valve plate from the cup member 42 and pressure liquid flows into the pressure chamber through a center aperture 90 in the plate, and the valve plate becomes a back-up system to prevent malfunction under widely varying loads.

VALVE CONTROL MEANS

The valve control means in the motor 10 of the invention are shown to include a stop collar 92 that is secured as by pin 94 to the control rod 24 adjacent the downstream or outlet end of the motor. Coil springs 96 and 98 are in telescopic engagmenet with the piston rod 24 and will abut on opposite ends of this collar 92. Motion producing sleeves 100 and 102 individually engage ends of the coil springs 96 and 98, respectively, remote from the collar 92. These sleeves receive the control rod 26 in their bores and at least the coil spring 96 and sleeve 100 are in permanent engagement with the control rod.

As previously indicated, the valve means 18 is moved from its open position as shown in FIG. 1 to a closed position wherein the second cup member 48 is moved axially inwardly to seat on the base of the cup member 42 when the piston 20 approaches the end of its power stroke moving to the right in the tubular member 12. At that time, a guide sleeve or collar 104 which is in threaded engagement with a tapped end of a bore provided in the piston, as indicated at 106, has moved to the right with the piston and contacts the adjacent end of the sleeve 100 to force it toward the collar 92. Hence, this action initially compresses the coil spring 96 and ultimately sufficient axial movement of the control rod 24 causes the sleeve 100 to abut against the collar 92. Then slight additional movement of the piston causes the second cup member 48 to snap from the open position shown in FIG. 1 to a closed position. The detents 64 that are seated in the groove 74 in the second cup member in its axially outer position are released and they engage the second groove 72 in the periphery of the cup members 48 when the valve has been moved to its closed position. Such valve closing action also immediately opens the bores 40 in the tubular member through the axially aligned bores 44 in the cup member 42 to clear them for flow of the inlet pressure liquid thereto. The final movement of the piston 20 to the right has also compressed the coil spring 98 by the collar 92 forcing such spring into its positioning sleeve 102. Such sleeve 102 abuts against associated means used in providing output from the motor 10 of the invention, as herein after described, in the valve closed position.

As the piston 20 initially moves to the right in the pressure chamber 14, it exposes the plurality of circumferentially spaced bores 70 formed in the tubular member 12. These bores 70 extend radially from the pressure chamber and then axially to connect to bores 109 in the wall of the first cup-shaped member 42 to connect to the detent receiving holes 66. Hence, on a power stroke to the right, pressure liquid flows through these bores 70 and 109 to the axially outer ends of the detents 64. Such pressure transmission to the detents aids in retaining them in locked operative engagement with the recess 74 in the second cup member 48 when at its innermost position. Some pressure liquid exhausts through the axially directed, circumferentially inclined small diameter bores 62 to propel the motor 10 forwardly. Also, pressure liquid in the chamber 14 flows to the holes 66 for exhaust through bores 62 when the piston moves to the left in the chamber.

As the piston 20 is moved to the left in the pressure chamber and approaches the position shown in FIG. 1, then the piston 20 will serve to seal or close off the inlet ends of these bores 108 and remove the backing pressure from the locking detents 64. At that time, then the spring 98, having been compressed by previous movement of the piston and associated means then will act to snap the second cup member 48 from its previous valve closing position to the position shown in FIG. 1 and the valve open position.

MOTOR OUTPUT AND MOTION TRANSLATING MEANS

An outlet cap 110 is secured to the right-hand end of the tubular member 12 as shown in the drawings, and such member is in threaded and removable engagement with the tubular member. The end cap 110 rotat-

ably engages a flange **112** provided at an end of a tubular member **114** which extends axially from the end cap **110** and motor for output transmission purposes. This tube **114** has a pair of diametrically opposed helically shaped slots **116** formed therein. Such slots receive or engage the ends of the tubular piston rod **24** as by an end set screw **119** so that the pin, by reciprocation of the piston causes the tube **114** to move through an arc of 180° with each stroke of the piston in either direction. This pin **118** has the sleeve **102** butted thereagainst for the valve control action as described heretofore. Also a closure sleeve or tube **120** is secured over the tube **114** and is retained in place by any suitable means such as a seal or gasket ring **122** operatively positioned between an overhanging flange **124** on the outlet end cap and the periphery of the sleeve **120** to keep out dirt from this part of the motor.

The end cap **110** also retains the guide means **22** in position by engaging an end flange **23** thereon to retain it against an end of the tubular member **12.**

Guide pins **111** carried by the tubular member **12** extend therefrom to seat in bores **113** in the guide means **22** to position such members in desired axial alignment.

Any suitable tool mounting means is secured to the end of the tube **114** for action such as cutting roots or obstructions that are present in any confining tube or pipe in which the motor **10** is positioned. Thus a suitable plug type connector member or coupling means of any type, indicated by the numeral **130,** is operatively engaged with and/or suitably secured to the exposed end of the tube **114.** Such connector or coupling means is shown as including a carrier device **132** which may be removably secured to the connector **130** as by a lock pin **134** urged into its operative position engaging device **132** and securing it to the connector **130** by a coil spring **136.** Such a device **132** has a member such as a cutting head or tool **140** with a T shaped shank **141** secured to the end thereof and in axial alignment with the hydraulic motor. Such shank **141** can be inserted through an elongated slot **142** in the end of the device **132** and then be twisted to be engaged therewith. The cutting head **140** is of any known construction and is operatively secured to the device **132** in any conventional manner. The cutting head **140** has known types of cutter blades, tools or similar means thereon. It is secured in place by a bayonet type joint as described or by any suitable connection means.

Hence operative movement of the hydraulic motor **10** will move the cutting tool **140** axially with axial movement of the hydraulic motor and the cutting tool is moved back and forth through arcs of 180° depending upon whether the piston **20** is being given an advance stroke or a retraction stroke. Sufficient power is exerted on the tool to give it a repetitive cutting action on any obstacles encountered.

Any liquid received in the radially inner ends of the detent bores **64** as by blow-by due to valve wear will exhaust therefrom through bores **65** formed in the wall of the first cup member **42** and connecting to bores **16a** in the inlet end cap **16.**

Suitable sealing rings and guide keys are provided in portions of the motor **10** as required. A large volume of liquid will flow through the motor and a short stroke piston is obtained.

FIG. **5** shows that the exhaust jets **60** are inclined to the motor radius to oppose twisting of the water pressure supply hose.

An improved hydraulic motor for sewer cleaning and similar action is provided. The motor is effective in service and has a good power output. Hence, the objects of the invention have been achieved.

While one complete embodiment of the invention has been disclosed herein, it will be appreciated that modification of this particular embodiment of the invention may be resorted to without departing from the scope of the invention.

What is claimed is:

1. A hydraulic motor comprising a tubular member having an inlet end and a center bore and having a plurality of axially extending bores extending into the wall of the tubular member from an inlet end thereof and terminating in communication with the center bore of the member, such member forming a pressure chamber,

a piston slidably received in said tubular member,

a tubular piston rod secured to said piston and protruding from the other end of the tubular member,

an inlet end cap secured to the inlet end of said tubular member,

valve means including an axially movable closure means received in said end cap and forming a closure for the inlet end of said pressure chamber, said valve means when open enabling water flow therethrough to drive said piston in one direction and when closed forcing water into said bores in said tubular member for flow to said chamber to force said piston in the opposite direction,

rod means slidably received in said piston rod and extending through said piston to engage said closure means to control its position and the action of said valve means dependent on the position of said piston in said chamber;

said valve means including an inner cup member, an outer cup member slidably receiving said inner cup member, said rod means engaging said inner cup member, and detents engaging said inner cup member to retain it in a valve open or a valve closed position; and

a check valve plate operatively engaging the downstream face of said outer cup member, and spring means engaging said check valve plate to urge it into engagement with said outer cup member for valve closing action.

2. A hydraulic motor as in claim **1** where bore means connect an inlet section of said pressure chamber to radially outer portions of said detents to provide inner cup member retentive pressure thereon.

3. A hydraulic motor as in claim **1** and including an outlet end cap secured to said other end of said tubular member, a guide disc means secured within the motor and extending across the chamber to close the outlet end thereof, said disc means slidably engaging said piston rod, a tubular means rotatably engaged and positioned by said outlet end cap, a tool means operatively carried by said tubular means, and means connecting said tubular means to said piston rod for axial and rotary drive thereby.

4. A hydraulic motor as in claim **1** wherein said outer cup member abuts on the inlet end of said tubular member and has a wall with axially extending bores

connecting to the wall bores in said tubular member, said outer cup member having valve bores in a base portion thereof, said inner cup member having circumferentially spaced valve bores in a base portion thereof and having valve open and valve closed positions, said valve bores in said inner and outer cup members being circumferentially offset from each other, said detents being carried by said outer cup member to engage said inner cup member and resiliently retain it in valve open or closed position, said detents being positioned for movement radially of said cup members.

5. A hydraulic motor as in claim **4** where said rod means has a collar fixed thereto adjacent its end remote from said valve means, a spring is in telescopic engagement with said rod means at each end of said collar, and sleeve means individually operatively engage the opposite ends of said springs to compress one of said springs as said piston approaches an end of its movement to aid in moving said second cup member from one valving position to another.

* * * * *