United States Patent [19]

Graybeal

[11] **3,774,827**

[45] **Nov. 27, 1973**

[54] **POWER RODDER CONSTRUCTION**

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[73] Assignee: **Champion Corporation,** Hammond, Ind.

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[52] **U.S. Cl.**..... **226/50,** 226/108, 226/177, 254/134.3, 15/104.3 SN

[51] **Int. Cl.**..... **B65h 59/00**

[58] **Field of Search**..... 254/134.3; 214/338; 226/50, 108, 25, 195, 177; 15/104.3 SN

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Attorney—McDougall, Hersh & Scott

[57] **ABSTRACT**

An apparatus for extending and retracting rod and similar lengths of material, the lengths being moved between opposed driven rolls. Drive means for the rolls comprise first and second motor means with each motor means serving to operate a distinct set of rolls. Control means are provided whereby one set of rolls is driven upon extension of the lengths with both set of rolls being driven during retraction of the lengths whereby considerably increased power is available during retraction. Means are provided for automatically varying the engaging pressure of the drive rolls in response to power requirements.

16 Claims, 6 Drawing Figures

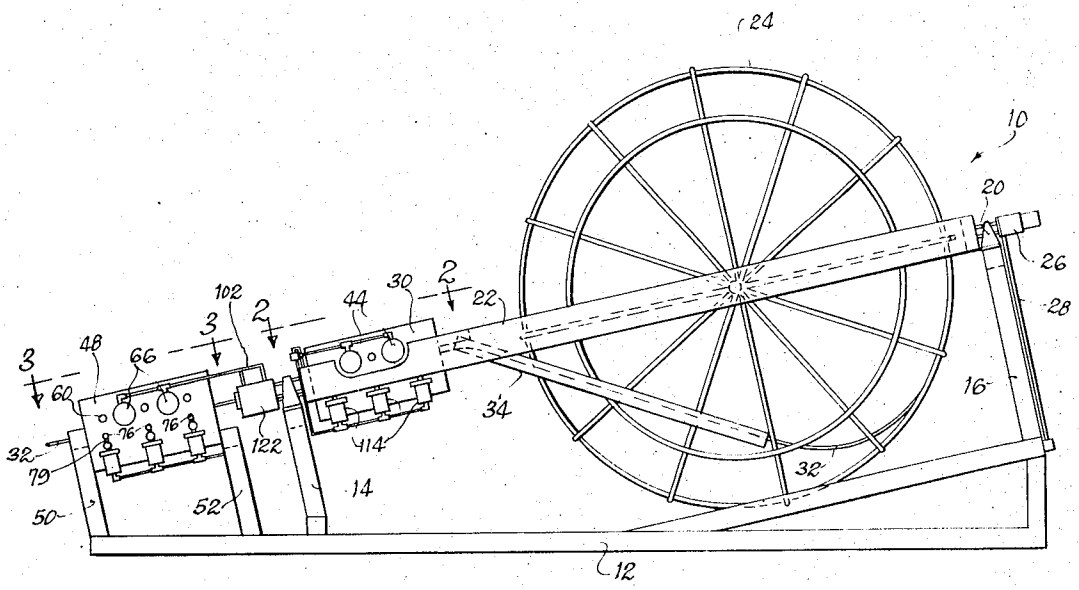


FIG. 1

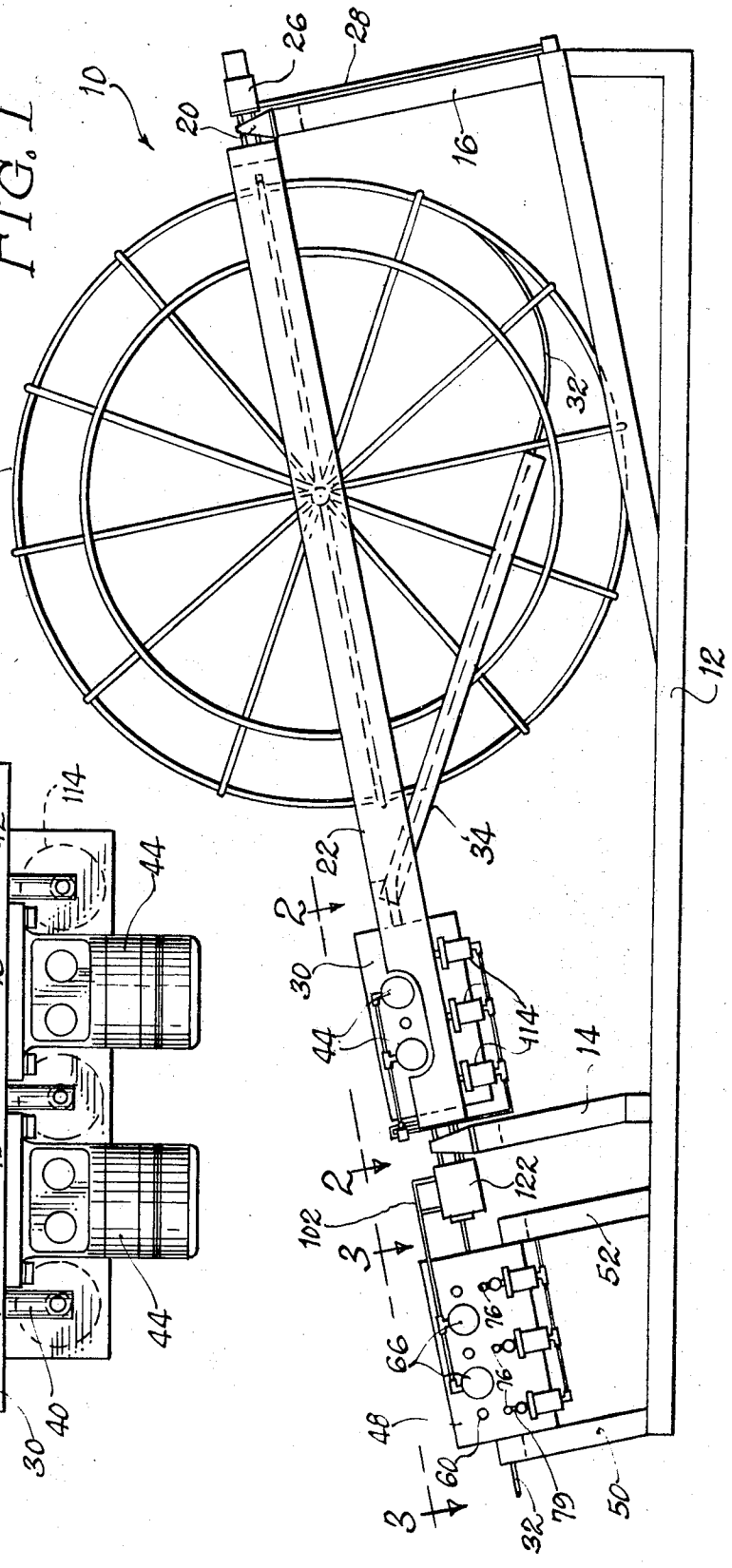

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44
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122
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FIG. 2

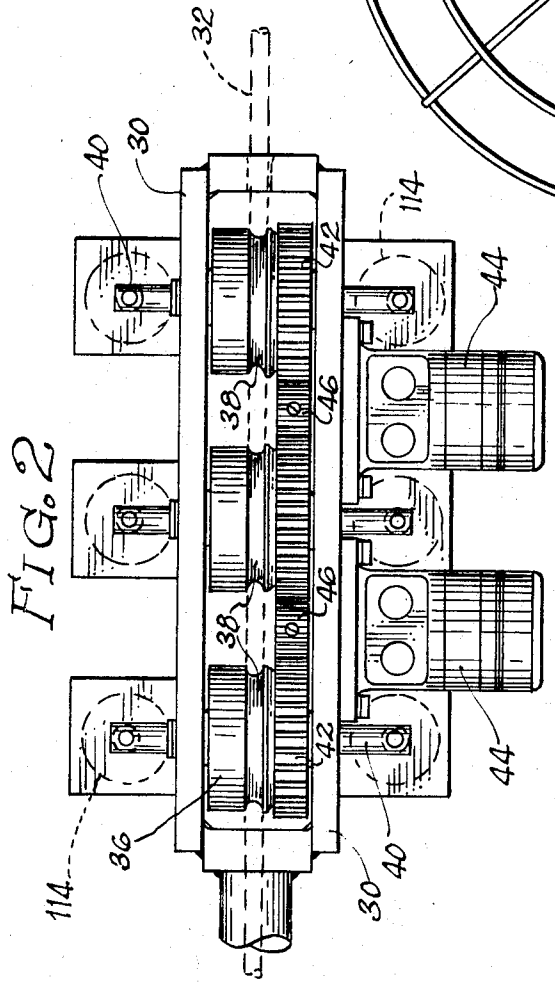

32
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114
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FIG. 3

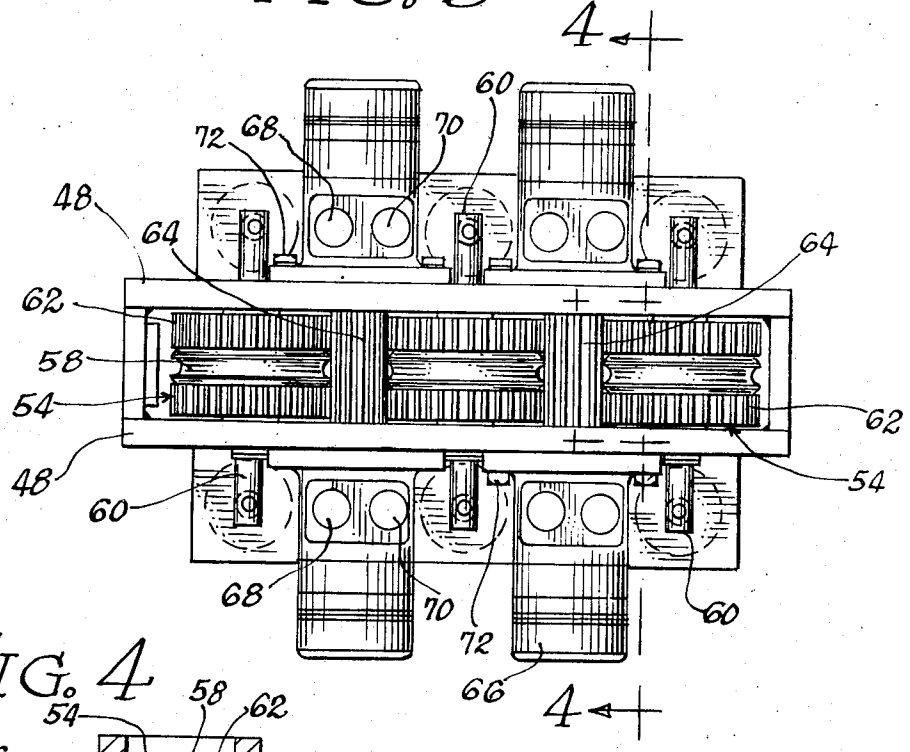


FIG. 4

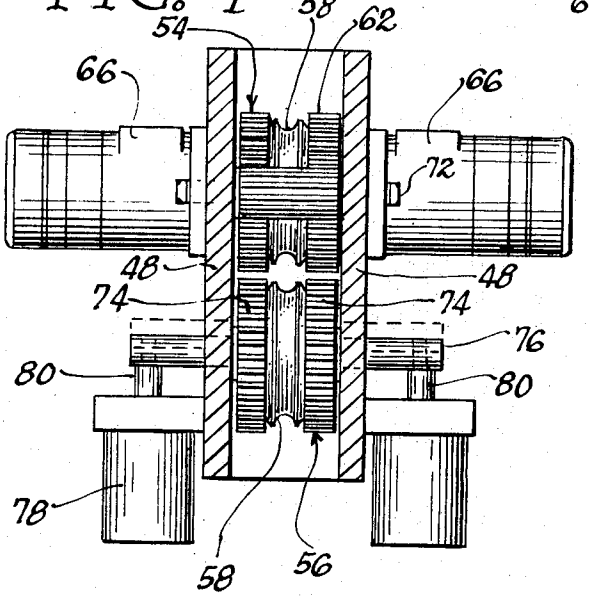


FIG. 5

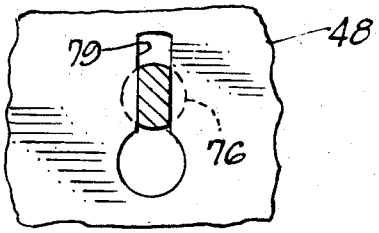
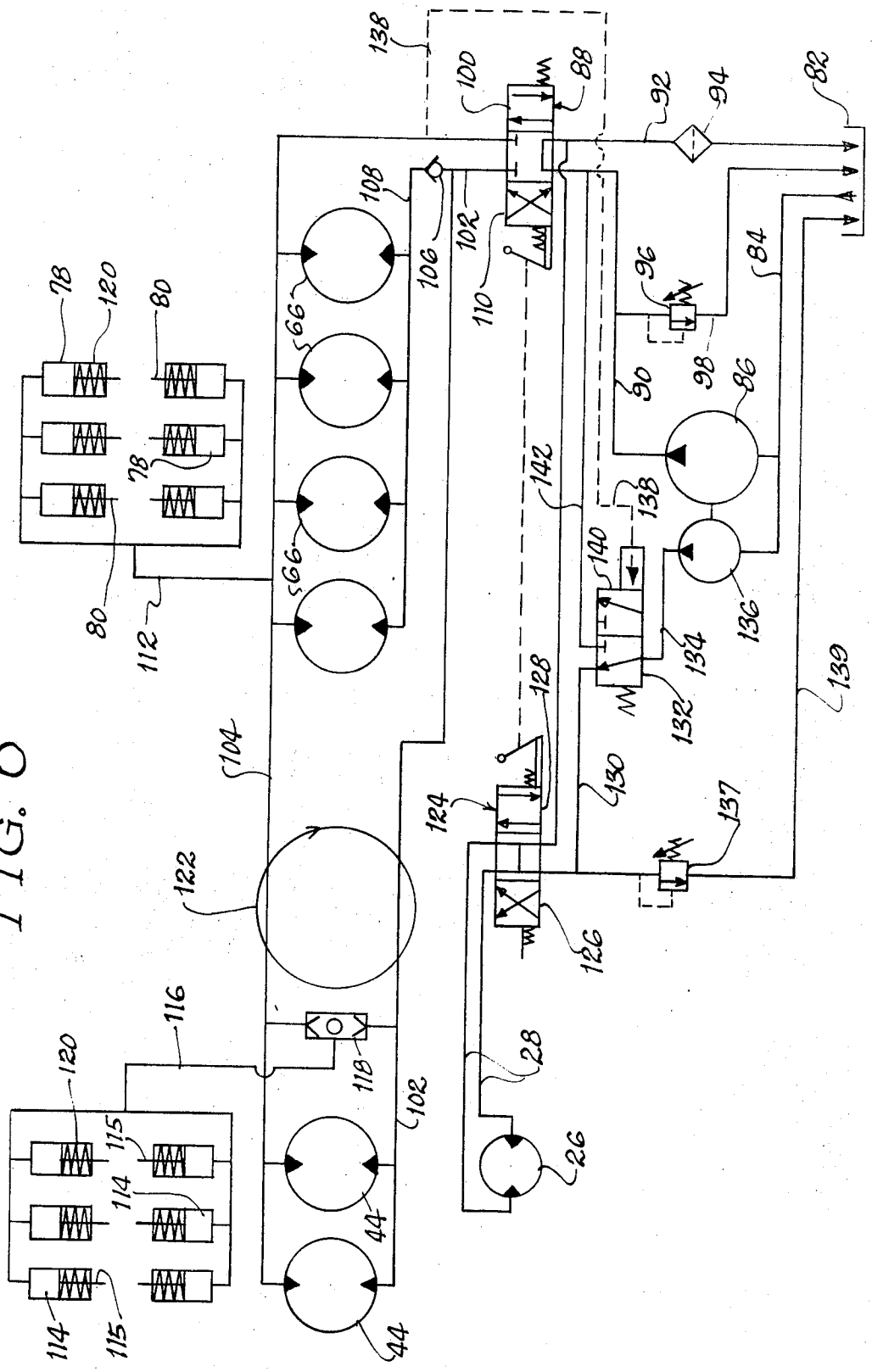


FIG. 6


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26

POWER RODDER CONSTRUCTION

This invention generally relates to an apparatus of the type often referred to as a power rodder. Such constructions usually include menas such as a cage for storing an elongated section of flexible rod. The rod is adapted to be engaged by driven rolls associated with the apparatus whereby the rod can be extended outwardly to a remote location and then, upon reversal of the drive rolls, retracted back to the apparatus.

Power rodder constructions are typically used for sewer cleaning operations. In such constructions, means are provided for imparting rotary movement to the rod in addition to the extending and retracting movement referred to. Accordingly, the rod can be rotated for more effective movement through obstructions during extending of the rod. In addition, the rotary action permits the use of cutting blades and other implements which further increases the efficiency of cleaning operations.

Power rodders have also been employed in cable placing operations. The rodders may for example be used in conjunction with placing of telephone cable wherein the cable is to be located within an underground conduit.

In the placing of cable, power requirements in excess of the capabilities of typical power rodders are encountered. Thus, the power rodders which are available for sewer cleaning and similar operations do not have sufficient power for purposes of pulling cable through an underground conduit. Power rodders are, however, useful in cable-laying operations since they provide an extremely effective means for moving a rod through an elongated conduit.

In accordance with typical cable-laying operations, the power rodder is located at one end of a conduit and a power winch is located at the other end of the conduit. The power rodder drives the rod through the conduit for attachment of the leading end of the rod to the winch cable. The rodder is then employed for pulling the winch cable back through the conduit. The leading end of the cable is now located at the rodder position, and this cable is attached to a telephone cable which is usually mounted on a reel positioned adjacent the rodder. The winch, which has considerably greater pulling power, is then employed for pulling the telephone cable through the conduit.

It is a general object of this invention to provide an improved power rodder construction.

It is a more specific object of this invention to provide a power rodder construction which is characterized by great versatility wherein the rod handling efficiency of existing power rodders is combined with the power capabilities of a power winch.

It is a still further object of this invention to provide rodder constructions of the type described which include an automatic drive system wherein the application of power is automatically controlled so that the apparatus can accommodate to different power requirements.

It is a still further object of this invention to provide a rodder construction which eliminates the need for the use of a separate power winch in cable placing operations thereby saving considerable time and expense in the undertaking of such operations.

These and other objects of this invention will appear hereinafter and for purposes of illustration, but not of limitation, specific embodiments of the invention are shown in the accompanying drawings in which:

FIG. 1 is a side elevational view of a power rodder construction characterized by the features of this invention;

FIG. 2 is an enlarged fragmentary plan view taken about the line 2—2 of FIG. 1 and illustrating one drive roll section;

FIG. 3 is an enlarged fragmentary plan view taken about the line 3—3 of FIG. 1 and illustrating the second drive roll section;

FIG. 4 is a cross-sectional view of the second drive roll section taken about the line 4—4 of FIG. 3;

FIG. 5 is a fragmentary detail sectional view of the adjustable mounting provided for the lower rolls shown in FIG. 4; and,

FIG. 6 is a schematic illustration of the hydraulic circuit employed in the preferred form of the invention.

The subject matter of this invention generally comprises an apparatus for extending and retracting lengths of rod, cable and the like. The construction is similar to existing power rodder constructions in that the lengths are moved between opposed driven rolls which directly engage the lengths. A storage cage which may be in the form of a reel or cone-shaped cage is preferably employed for storing the lengths directly in association with the apparatus, for example where the lengths comprise a flexible rod.

The particular improvements of the invention relate to the drive means for the drive rolls which engage the lengths during extending and retracting operations. The drive rolls are divided into first and second sets, and separate motors are provided for driving the rolls in the respective sets. A control system is utilized for determining the operation of the motors whereby the rolls can be selectively driven.

The control means include a first position serving to operate the first set of drive rolls during extending movement of the apparatus. These drive rolls operate in much the same fashion as drive rolls employed in standard rodder constructions. The rolls are preferably mounted on shafts journalled in a frame construction which is mounted for rotary movement. An additional motor serves to rotate this frame whereby rotary movement can be imparted to the lengths simultaneously with the extending movement achieved by the rolls.

The second set of rolls is preferably mounted on a stationary support, and the control means include a second position attached to operate this second set of rolls simultaneously with the first set of rolls. This arrangement provides for a substantial increase in the power imparted to the lengths by the drive rolls, and accounts for the ability of the apparatus to handle telephone cable and to otherwise operate in a manner corresponding with a power winch.

The specific control system employed in conjunction with hydraulic motors used for driving the rolls provides particular advantages. The over-all arrangement includes means for automatically varying the engaging of the rolls with respect to the elongated rod or other lengths. The preferred arrangement comprises hydraulic cylinder and piston assemblies which apply pressure to shafts supporting the rolls. The pistons engage at least one shaft in a roll pair, and the pressure within the hydraulic cylinders is adapted to vary automatically depending upon the power requirements of the apparatus. Accordingly, the pistons will apply increasing force to

the roll shafts and, therefore, greater engaging force of the rolls with the lengths whenever greater power is required. For example, if the apparatus is employed for pulling cable through an underground conduit, an obstruction or some other difficulty could be encountered which requires a greater pulling force. The hydraulic cylinder and piston assemblies referred to will immediately compensate for such conditions.

FIG. 1 illustrates a power rodder construction **10** including a horizontal frame **12** serving as a supporting base for the construction. Vertically extending frame members **14** and **16** include bearing supports **18** and **20** which serve as journals for a generally horizontally extending beam assembly **22.** This assembly defines a central opening for receiving a rod storing cage or reel **24,** the reel being journalled for rotation between parallel members of the assembly. Although the invention will be described with reference to the reel-type cage shown in FIG. **1,** it will be understood that the features of the invention are applicable to other arrangements, for example the cone-shaped cage structures described in Hammond, et al. U.S. Pat. Nos. 3,399,415 and 3,399,417.

A drive motor **26,** the illustrated motor being a hydraulic motor, is mounted at the end of beam **22** for imparting rotary movement to the beam and to the associated reel **24.** Hydraulic lines **28** extend to a source of hydraulic fluid (not shown). A first set of drive rolls is mounted between side plates **30** at the forward end of the beam. The drive rolls therein are adapted to engage a rod **32** which is normally stored in the reel **24.** This rod extends through guide tube **34** and then outwardly of the apparatus. Operation of the drive rolls imparts rotary movement to the reel **24** about the axis of the reel during which time the rod **32** is either moving into or out of the reel. The motor **26** is adapted to operate independently of or simultaneously with the drive rolls between the side plates **30.** Since the side plates **30** and the reel **24** are all mounted on the beam **22,** the side plates and reel will rotate with the beam. This corresponds with the operation of power rodder constructions, for example as described in the aforementioned Hammond, et al. patents.

The drive assembly including the side plates **30** is illustrated in FIG. **2.** This assembly includes opposed rolls with the upper rolls **36** being illustrated. These rolls include grooves **38** with corresponding aligned grooves being provided in a lower set of rolls. The grooves are dimensioned to receive the rod **32** whereby the rod is engaged by the rolls for achieving movement of the rod.

The rolls **36** are rotatably mounted on shafts **40** which are fixed in the side plates **30.** Each of the rolls is associated with a gear **42** which may be formed integrally with the roll body. A pair of motors **44** include drive shafts which extend through one side plate **30** and which carry drive pinions **46.** These pinions **46** engage the gears **42** for imparting rotary movement to the rolls **36.** The lower rolls are idler rolls including gears corresponding to the gears **42** whereby both upper and lower rolls are driven by the same drive motors.

A second set of drive rolls is mounted between plates **48** at the forward end of the horizontal supporting frame member **12.** The side plates are supported on vertically extending members **50** and **52.** The side plates **40** are not connected to the beam **22** and, accordingly, this assembly remains stationary relative to its supporting frame members.

As best shown in FIGS. **3** and **4,** the side plates **48** support upper drive rolls **54** and lower drive rolls **56.** These drive rolls each carry centrally located rod engaging grooves **58,** the grooves being dimensioned in accordance with the shape of the rod being handled.

The upper rolls are supported for rotation on shafts **60** which are secured to the side plates. The drive rolls include integrally formed gears **62** which are engageable by drive pinions **64.**

The drive pinions **64** are each connected to a pair of drive motors **66.** Thus, the opposite ends of the pinion shafts are connected so that each pinion is driven by a pair of these motors. The motors **66** are hydraulic motors with openings **68** and **70** being provided for each motor whereby the flow of hydraulic fluid can be accomplished. Each of the motors is secured to a side plate **48** by means of bolts **72.**

The gears **62** for the upper rolls mesh with gears **74** formed on the lower rolls **56.** Accordingly, movement of all the rolls is controlled by the drive pinions **64** although the lower rolls **56** are idler rolls.

The lower rolls **56** are rotatably supported on shafts **76** which are positioned within slots **79** defined by plates **48** (FIG. **5**). As shown, milled flats are formed on the portion of the shaft received within the slot whereby the shaft cannot rotate, however, vertical movement is permitted. A similar mounting arrangement is provided for the lower rolls associated with plates **30,** and it will be understood that the operating description for the rolls **56** also applies to these other rolls.

Each of the shafts **76** is associated with an assembly including hydraulic cylinders **78** and piston **80.** The pistons are connected to the opposite ends of each shaft whereby the shafts are movable between the solid and dotted line positions shown in FIG. **4.** It will be appreciated that this movement provides for varying the gap between the grooves **58** of the respective rolls. Accordingly, the position of the shafts **76** will determine the gripping force of the rolls relative to the rod being driven thereby. This, of course, also applies to the shafts of the lower rolls associated with plates **30.**

FIG. **5** illustrates a hydraulic circuit adapted for use in connection with the mechanisms described. The circuit includes a reservoir **82** of hydraulic fluid having a plurality of lines extending therefrom. These lines include a line **84** which delivers fluid from the reservoir to main pump **86.** The pump in turn feeds lateral control valve **88** through line **90.** A fluid return line **92** including filter **94** is provided for returning fluid to the reservoir during operation of the system or when the valve **88** is in the neutral position. A relief valve **96** is associated with line **98** for returning excess fluid to the reservoir when the pressure demand on the pump **86** exceeds a predetermined level.

When the valve **88** is shifted from right to left, the section **100** of the valve is adapted to direct hydraulic fluid through line **102** to drive motors **44.** A fluid return line **104** directs the fluid through the valve and through line **92** whereby dirculation is accomplished. The drive motors **66** are not driven under these circumstances because of the presence of a one-way check valve **106** in line **108.** Thus, all of the hydraulic fluid is directed through line **102** whereby only the motors **44** are driven when the valve **88** is shifted from right to left.

The drive motors **44** rotate the drive rolls for extension of the rods when the valve **88** is set in this manner.

When the valve **88** is shifted from left to right, the valve section **110** is placed in communication with the line **90.** In this instance, however, the valve passages pass the hydraulic fluid into line **104** whereby each of the motors **44** and **66** is fed hydraulic fluid. The motors **44** are, however, driven in the opposite direction due to the reversal of fluid flow. The motors **66** are set to rotate the drive rolls **54** and **56** in the same direction as the rolls **36** whereby all of the rolls operate to impart retracting movement to the elongated rod.

The hydraulic cylinders **78** associated with the roll shafts **76** are all connected by means of line **112** to the line **104.** A group of corresponding hydraulic cylinders **114** and pistons **115** are connected by means of line **116** to a shuttle valve **118.** These latter hydraulic cylinders, as best shown in FIG. **1,** are associated with the lower rolls of the roller pairs associated with side plates **30.**

When the section **100** of valve **88** is in the operative position, a portion of the fluid flow through line **102** passes to shuttle valve **118** and then through this valve through line **116** to the hydraulic cylinders **114.** The shuttle valve is controlled by line pressure, and when hydraulic fluid is being fed through line **102** for driving motors **44,** then the pressure balance becomes such that pressure is applied to the cylinders **114** through line **116.** In the event that a change in pressure in the line **102** is required, for example, due to a change in speed through operation of the control means or due to some condition encountered by the rod, then this pressure will automatically be applied to the cylinders **114.** It will be appreciated that the cylinders **114,** through the pistons which engage the roll shafts, will automatically apply greater pressure to the rod being moved between the roll pairs. The application of greater pressure necessarily results in an increase in the tractive forces applied to the rod passing between the rolls.

Essentially the same arrangement is accomplished by means of the hydraulic cylinder **78** and associated piston assemblies. Thus, when the section **110** of the valve **88** is moved into operative position, the pressure of hydraulic fluid will be high in line **104.** This will impart pressure within the cylinder **78** and, through shuttle valve **118,** within cylinders **14,** and this pressure will also vary depending upon the working force required of the apparatus. Thus, if the demands on the drive motors **44** and **66** increase, the cylinders **78** and **114** will automatically respond. The pistons **80** and **115** will then move the associated rolls upwardly to increase the force applied to the rod. When the demands are relieved, then the roll force will decrease by a proportional amount.

It will be noted that the cylinders **78** and **114** include internal springs **120** which normally hold the pistons in a retracted position. Accordingly, when the valve **88** is set at the position **100** with pressure being applied only to drive motors **44,** the springs **120** for cylinders **78** will maintain the pistons **80** in the retracted position illustrated in solid lines in FIG. **4.** Accordingly, the rod will pass freely relative to the rolls **54** and **56** under these conditions.

Although the motors **66** do not operate during extending movement of the rod, the circuit illustrated insures operation of both sets of motors during the retracting movement. Thus, when driving pressure is applied to the hydraulic cylinders **114,** irrespective of the direction of rotation, the gripping action of the rolls associated with motors **44** is retained. Accordingly, all of the drive rolls in the system are operative during retracting movement of the cable.

As described in the aforementioned Hammond, et al. patents, a swivel coupling is preferably employed for feeding hydraulic fluid to the motors **44** which are mounted for rotation on the beam **22.** This coupling is shown schematically at **122** in FIG. **5,** and is located adjacent the journal **18** as shown in FIG. **1.**

The drive motor **26** employed for rotating the beam **22** is supplied with hydraulic fluid through rotational control valve **124.** This valve includes sections **126** and **128** whereby the beam and associated rod can be rotated in either dierection. A single lever control as described in the aforementioned patents may be employed for operating the control valves **88** and **124.**

Hydraulic fluid for the motor **26** is delivered to valve **124** through line **130** and diverter valve **132.** Line **134** connects the diverter valve with auxiliary pump **136** which is connected to supply line **84.** A pressure relief valve **137,** which may be integral with control valve **124** is associated with the line **130** and return line **139.**

With the valve **132** in the position shown, fluid is directed to the valve **124** whereby the motor **26** will operate to rotate the beam **22** whenever the valve **124** is located in either position **126** and **128.** The position of the diverter valve **132** is normally maintained as shown due to the spring action of means connected to the valve core. This spring is adapted to be offset, however, by a pilot signal directed to the valve through line **138.** This line is in communication with line **104** whereby increased pressure will be applied to the valve **132** whenever the valve **88** is located in the position **110** during retracting movement of the rod. The increased pressure applied to the diverter valve overcomes the action of the valve spring whereby the section **104** of the valve is moved to an operative position. This results in passage of fluid through line **142** rather than through line **130,** the valve **124** being cut off under these circumstances. Accordingly, the output from pumps **86** and **136** is all fed to the valve **88** during retracting movement whereby maximum flow is available for driving the motors **44** and **46.** Rotation of the beam **22** is not possible under these circumstances; however, such rotary movement is neither required nor desirable during retracting movement. It will be appreciated that when the valve **88** is located in the neutral position, hydraulic fluid is pumped through valve **132** to valve **124** whereby rotation of the beam can be achieved. Under these circumstances, all of the cylinders **78** and **114** are in the retracted position whereby free rotation of the rod can be accomplished.

As indicated, the construction described provides distinct advantages in that significant versatility is provided. The advantages of a conventional rodder are achieved during extending of rod, and this can be accomplished at relatively high speed since the full pump output can be applied to the motors **44** at this time. During retracting movement, a significant increase in power is developed since all motors are driven with all rolls engaging the rod whereby great pulling force is accomplished. In a standard rodder of high performance, approximately 7,000 pounds of pull are achieved. With applicant's construction employing two sets of rolls, approximately 20,000 pounds of pull can be achieved.

The fact that all of the motors are in parallel with each other provides additional power for the system.

The provision of the hydraulic cylinders **78** and **114** is of great significance since these enable automatic application of power to the proper drive rolls under all operating conditions. The automatic disengagement of drive rolls **54** and **56** is particularly significant since without this action the drive motors **44** could not drive the rolls **36** during rod extension. The cylinders **78** and **114** also provide for variations in the application of force of driven rolls depending upon the load conditions on motors **44** and **66.** Since such conditions can vary considerably during operation of the system, the ability of the rolls to automatically change gripping force provides an important advantage.

It has been found that the construction of this invention completely eliminates the need for a power winch during telephone cable placing operations. Constructions of the type described are adapted to extend rods through an underground conduit to the location of a cable reel. The rods can then be directly connected to the cables and then pulled back through conduit for location of the cable in the conduit. This provides a significant savings in operating time and equipment costs.

It will be understood that various changes and modifications may be made in the above described invention which provide the characteristics of the invention without departing from the spirit thereof.

That which is claimed is:

1. In an apparatus for extending and retracting lengths of rod, cable and the like, wherein the lengths are moved between opposed driven rolls which engage the lengths, the improvement wherein said rolls are divided into two sets with each set including at least one pair of upper and lower rolls, drive means comprising first motor means for the first set of rolls and second motor means for the second set of rolls, control means for said motor means, means for locating said control means in a first position to operate said first motor means to drive said first set of rolls in a direction to achieve extension of said lengths, location of said control means in said first position excluding operation of said second set of rolls, and means for locating said control means in a second position to thereby automatically operate both of said motor means to drive both of said sets of rolls simultaneously in a direction to achieve retracting of said lengths, and wherein said motors are hydraulically driven, said control means including a control valve, hydraulic lines extending from said control valve to said motor means and back to said control valve, one-way valve means in one of said lines, a source of hydraulic fluid, location of said control valve in one position directing fluid from said source to said first motor means, said one-way valve means blocking passage of fluid from said control valve to said second motor means, and location of said control valve in a second position directing fluid to each of said motor means through a line other than the line including said one-way valve means.

2. An apparatus in accordance with claim **1** including a single lever for operating said control valve.

3. An apparatus in accordance with claim **2** including a separate motor menas, separate hydraulic lines extending between said separate motor means and said control valve, and a cage mounted on said apparatus for holding said lengths, said separate motor means being adapted to rotate said cage during extension of said lengths, the rotation of the cage imparting rotation to said lengths during such extension.

4. An apparatus in accordance with claim **1** including a separate hydraulic motor, means supporting said first motor means, said separate hydraulic motor being connected to said supporting means for rotation of the supporting means about the axis of said rod, and wherein said control means include means for cutting off a supply of hydraulic fluid to said separate hydraulic motor when said control valve is rotated in said second position, and means for directing hydraulic fluid to said separate motor means when said control valve is in said one position.

5. An apparatus in accordance with claim **1** wherein said first and second hydraulic motor are connected in parallel.

6. In an apparatus for extending and retracting lengths of rod, cable and the like, wherein the lengths are moved between opposed driven rolls which engage the lengths, the improvement wherein said rolls are divided into two sets with each set including at least one pair of upper and lower rolls, drive means comprising first motor means for the first set of rolls and second motor means for the second set of rolls, said drive rolls being mounted on individual supporting shafts, each set of rolls including a driven roll and an idler roll, and wherein said second motor means comprise a separate motor at each end of each driven shaft whereby each such driven shaft is driven by two motors, control means for said motor means, means for locating said control means in a first position to operate said first motor means to drive said first set of rolls in a direction to achieve extension of said lengths, and means for locating said control means in a second position to operate both of said motor means to drive both of said sets of rolls simultaneously in a direction to achieve retracting of said lengths.

7. An apparatus in accordance with claim **6** wherein said second motor means comprise hydraulic motors, and including a common source of hydraulic fluid for said hydraulic motors whereby the operation of the motors is synchronized.

8. An apparatus in accordance with claim **7** wherein said first motor means comprise hydraulic motors, said source also providing hydraulic fluid for said first motor means, said control means applying said source only to the hydraulic motors of said first motor means during extension of said lengths, and said control means applying said source to the hydraulic motors of both the first and second motor means during retraction of said lengths.

9. In an apparatus for extending and retracting lengths of rod, cable and the like, wherein the lengths are moved between opposed driven rolls which engage the lengths, the improvement wherein said rolls are divided into two sets with each set including at least one pair of upper and lower rolls, drive means comprising first motor means for the first set of rolls and second motor means for the second set of rolls, control means for said motor means, means for locating said control means in a first position to operate said first motor means to drive said first set of rolls in a direction to achieve extension of said lengths, means for locating said control means in a second position to operate both of said motor means to drive both of said sets of rolls simultaneously in a direction to achieve retracting of said lengths, and including means for automatically

varying the pressure applied by the rolls to said lengths.

10. An apparatus in accordance with claim **9** wherein said rolls are mounted on shafts, and wherein said pressure applying mans engage the shafts of at least one roll in each set during operation when the rolls of that set engage said lengths.

11. An apparatus in accordance with claim **10** wherein said pressure applying means comprise hydraulic cylinder and piston assemblies, the pistons of the respective assemblies engaging roll shafts for applying force thereto, and means for varying the hydraulic pressure within said cylinders in proportion to the driving force of said first and second motor means.

12. An apparatus in accordance with claim **11** wherein said first and second motor means comprise hydraulic motors, a source of hydraulic fluid for said motors, hydraulic lines extending between said source and said motors, and by-pass lines connected to said hydraulic lines and extending to said cylinders whereby the hydraulic pressure in the lines connected to said motors determines the pressure within said cylinders.

13. An apparatus in accordance with claim **12** wherein said control means operate to apply said source only to feed the hydraulic motors of said first motor means during extension of said lengths whereby pressure is applied only to the hydraulic cylinders associated with said first motor means, and said control means operate to apply said source to the hydraulic motors of said first and second motor means during retraction of said lengths whereby the hydrualic cylinders for all of said hydraulic motors apply pressure during such retraction.

14. An apparatus in accordance with claim **13** wherein the pistons associated with roll shafts driven by said second motor means are in retracted position when only the first motor means are being driven whereby said lengths move freely relative to the rolls driven by said second motor means.

15. An apparatus in accordance with claim **14** including spring means normally retaining said pistons in said retracted position, the pressure applied during driving of said second motor means operating to move said pistons in opposition to said spring means for engagement with said rolls.

16. In a cable placing rodder wherein means are provided for extending a length of rod, attaching a cable to the rod, and retracting the rod to thereby pull the cable into a desired position, and wherein the rod is moved between opposed driven rolls which engage the rod, a cage mounted on said rodder, said rod being stored in said cage and adapted to be removed from and returned to said cage upon extending and retracting movement of said rolls, the improvement wherein said rolls are divided into two sets with each set including at least one pair of upper and lower rolls, drive means comprising first motor means for the first set of rolls and second motor means for the second set of rolls, control means for said motor means, means for locating said control means in a first position to operate said first motor means to drive said first set of rolls in a direction to achieve extension of said rod, location of said control means in said first position excluding operation of said second set of rolls, means for locating said control means in a second position to operate both of said motor means to drive both of said sets of rolls simultaneously in a direction to achieve retracting of said rod, and means for varying the pressure applied by said rolls to said rod whereby greater pulling force can be obtained during retraction of the rod.

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