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Guier

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[54] **APPARATUS FOR ROTATING A MEMBER**

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[52] **U.S. Cl.** **81/57.17,** 81/57.33

[51] **Int. Cl.** **B25b 17/00,** B25b 13/50

[58] **Field of Search** 81/54, 186, 64, 3.4, 3.43, 81/57.17, 57.11, 57.33; 294/DIG. 2

[56] **References Cited**

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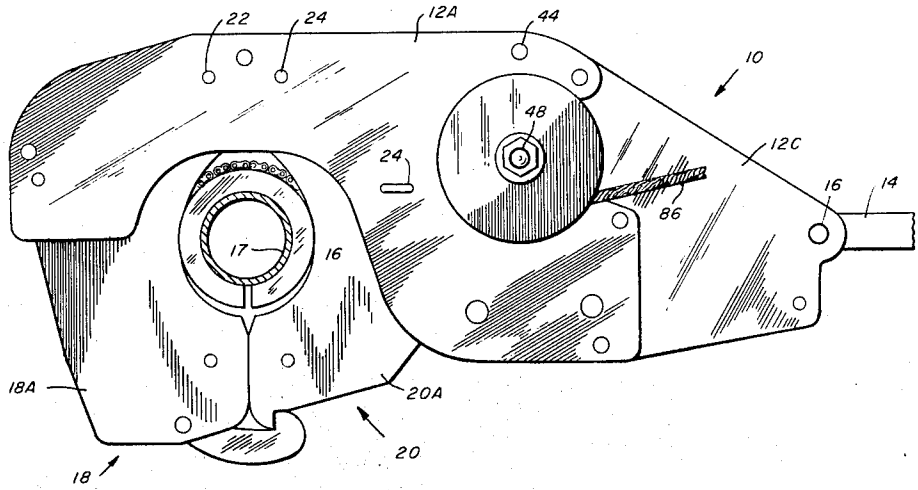
Attorney, Agent, or Firm—Head & Johnson

[57] **ABSTRACT**

An apparatus for rotating a member, such as oil well tubing, casing or a drill string, including first and second arms movable between opened positions to receive the member to be rotated and closed positions encompassing the member to be rotated, chain sprockets carried by the arms, an endless chain carried on the sprockets and engagable with the member to be rotated when the arms are in closed position, means of tightening the chain when the arms are in closed position to firmly contact the chain with the surface of a member to be rotated, and means of moving the chain over the sprockets to rotate the member. In addition, the invention discloses improved means of latching the arms in closed position, improved means of moving one of the arms into closed position and latching the arms in closed position utilizing a single actuating member, and improved means of moving the other arm into and out of closed position and tightening the chain utilizing a single actuating member.

11 Claims, 6 Drawing Figures



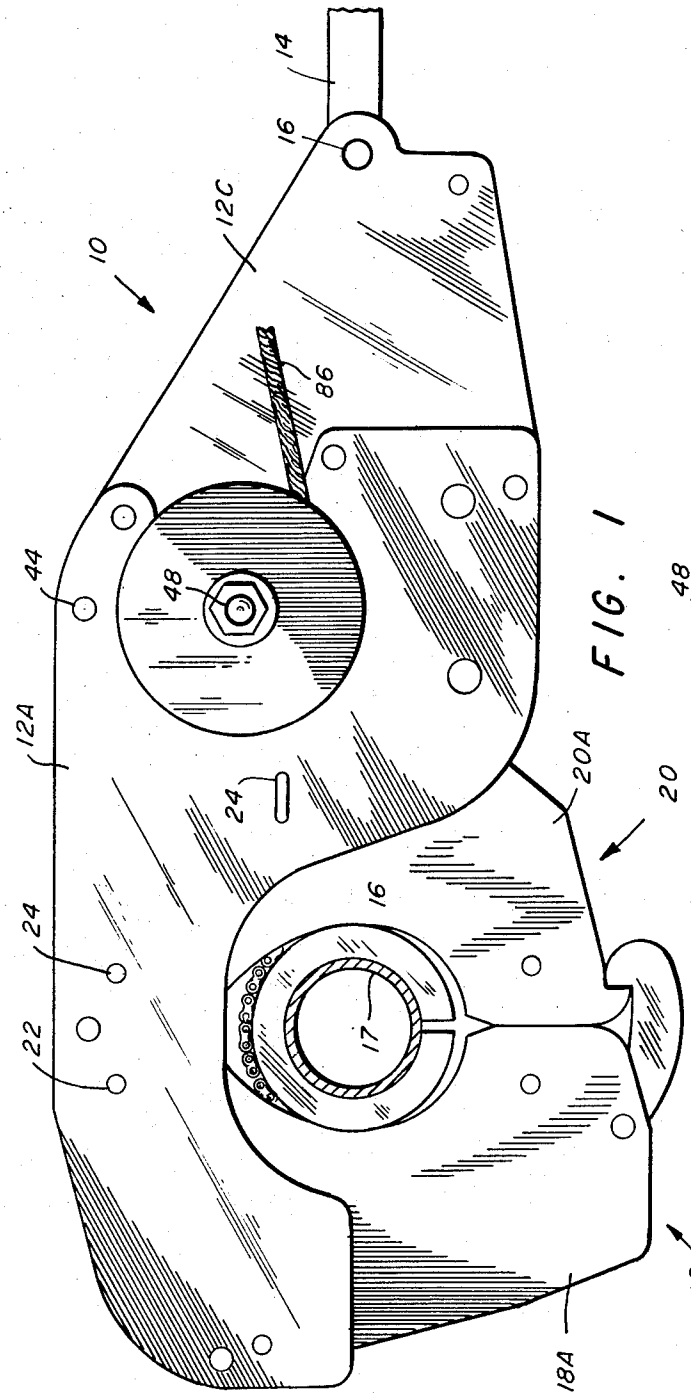

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FIG. 1

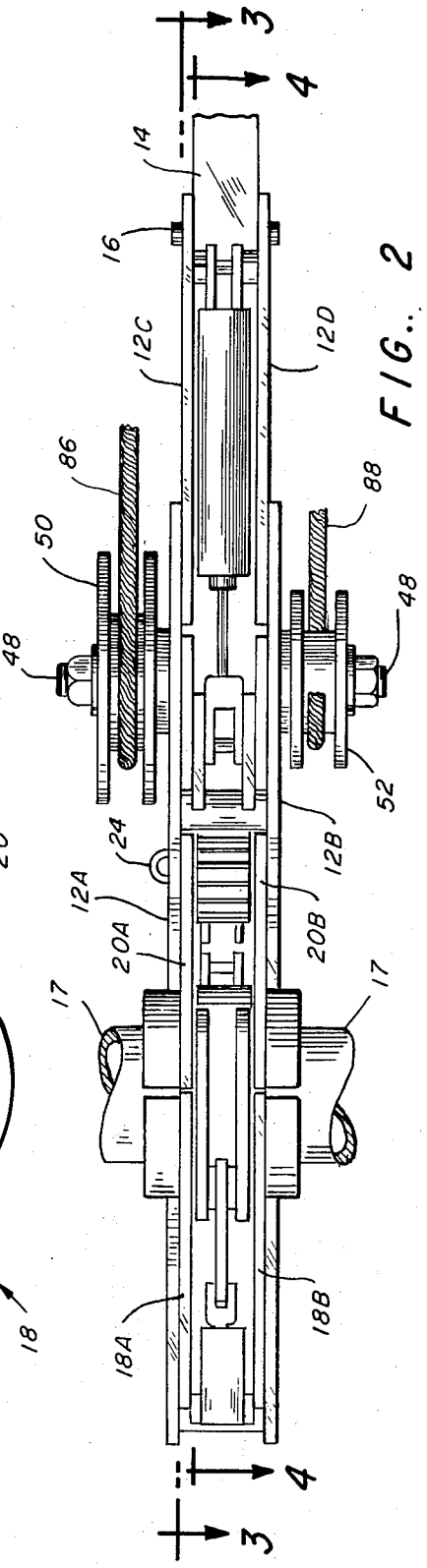
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FIG. 2

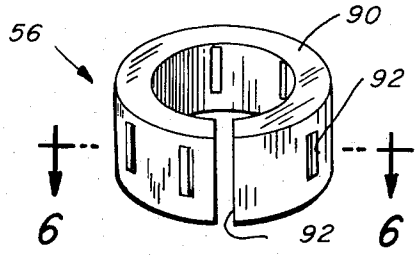

FIG. 5

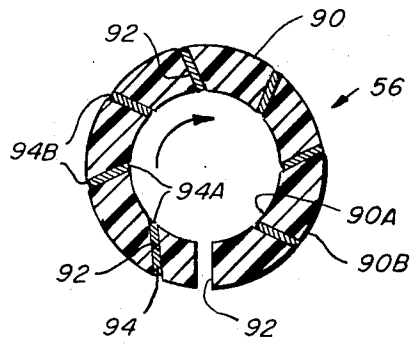

FIG. 6

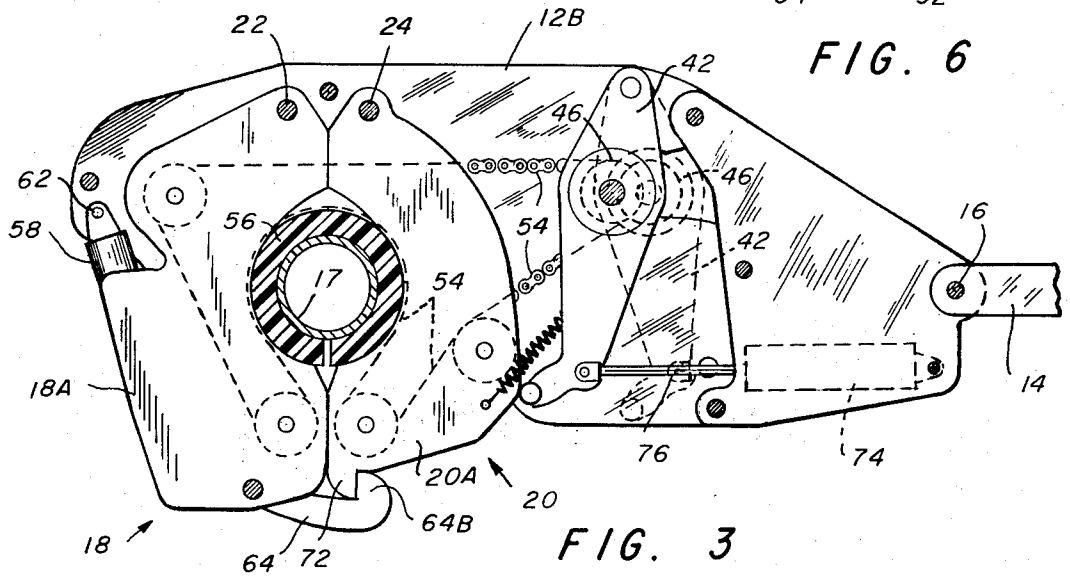

FIG. 3

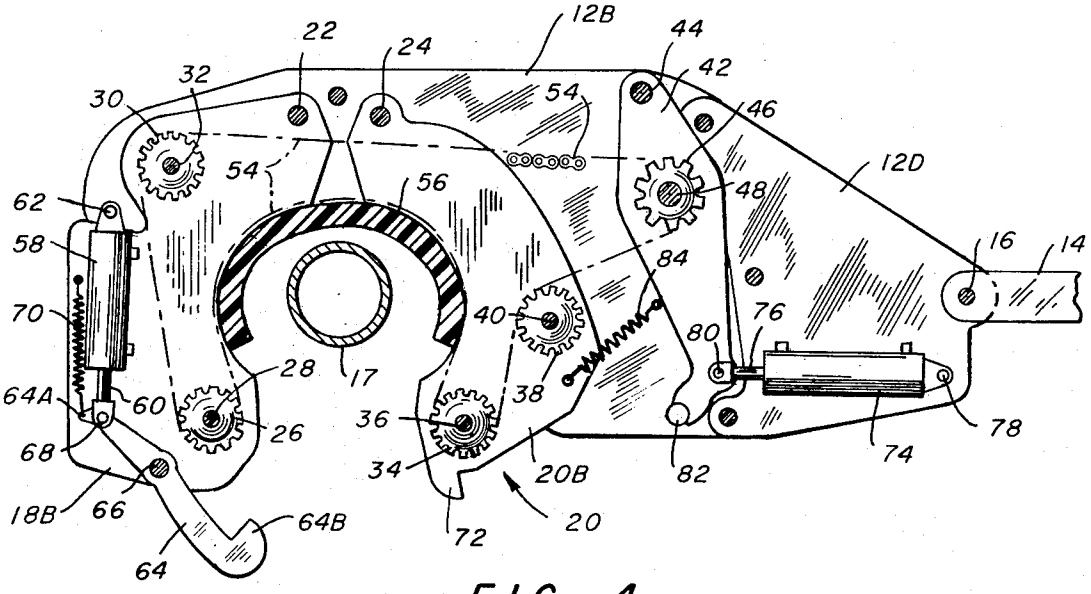

FIG. 4

APPARATUS FOR ROTATING A MEMBER

CROSS REFERENCE

This invention is an improvement in the invention disclosed in my previously issued United States Pat. No. 3,308,691, entitled CLUTCH BETWEEN A SOURCE OF POWER AND MEMBER TO BE ROTATED, issued Mar. 14, 1967.

BACKGROUND AND SUMMARY OF THE INVENTION

My previously issued patent referred to above discloses an apparatus for rotating a member, such as a length of drill pipe, casing or tubing as utilized in the petroleum industry for drilling, completing and working over oil and gas wells. The patent discloses a means of rotating or spinning the member to be rotated by means of an endless chain which engages a resilient deformable body positioned between the chain and the rotated member. To position the chain about the deformable body and the rotated member pivotal arms are provided which move apart to receive the member to be rotated and close upon the member so that the chain engages the external circumferential surface of the resilient body to cause the member to be rotated. This invention is directed toward refinements and improvements in the basic subject matter of my previously issued patent. This invention includes improved means for latching the arms in closed position about the member to be rotated. Further, the present invention includes improved means of tightening the endless chain to securely engage the member to be rotated. In addition, the present invention includes improved means of moving the arms into and out of closed position, locking the arms in closed position and tightening the chain, all utilizing only two operating devices. An additional improvement disclosed herein is an improved resilient collar for more effective positive transmission of rotational force between the chain and the member to be rotated.

OBJECTS OF THE INVENTION

It is an object of this invention to provide an improved apparatus for rotating a member.

More particularly, an object of this invention is to provide an apparatus for rotating a member including pivoted arms each movable between an opened position to receive the member to be rotated therebetween, and a closed position encompassing the member, the arms having sprockets supporting an endless chain, and including improved means for latching the arms in closed position.

Another object of this invention is to provide an apparatus for rotating a member having first and second arms pivotal between opened and closed positions, sprockets supported by the arms, an endless chain carried by the sprockets, the chain engaging the member to be rotated, including improved means of tightening the chain when the arms are in the closed position to securely engage the member to be rotated.

Another object of this invention is to provide an apparatus for rotating a member including first and second arms pivotal between an opened position to receive the member to be rotated and a closed position encompassing the member to be rotated, means of latching the arms in the closed position, and means of tightening the chain when the arms are in the closed position, including improved means for pivoting the arms, latching the arms, and tightening the chain.

Another object of this invention is to provide an improved resilient collar for positioning between an endless chain and a member to be rotated to afford improved positive transmittal of rotational energy from the chain to the member to be rotated.

These objects, as well as others, will be fulfilled in the following description and claims, taken in conjunction with the attached drawings:

DESCRIPTION OF THE VIEWS

FIG. **1** is a top view of an apparatus embodying the principles of this invention as an illustration of one means of practicing the invention.

FIG. **2** is a front elevational view of the apparatus of FIG. **1**.

FIG. **3** is a cross-sectional view taken along the lines **3—3** of FIG. **2**.

FIG. **4** is a cross-sectional view taken along the lines **4—4** of FIG. **3**.

FIG. **5** is an isometric view of an improved resilient collar for use in transferring rotational energy from an endless chain to a member to be rotated.

FIG. **6** is a cross-sectional view taken along the lines **6—6** of FIG. **5**.

DETAILED DESCRIPTION

An exemplified embodiment shown in the drawings will now be described. It is understood that in practice the invention may take many various forms, arrangements and configurations, and the appearance of devices encompassing the principles of this invention may be entirely different from the apparatus to now be described which is set forth only as one example of a way in which the invention may be practiced.

Referring first to FIGS. **1** and **2**, a spinning apparatus, generally indicated by the numeral **10**, is shown. The apparatus includes a frame consisting of an upper frame plate **12A**, a lower frame plate **12B**, an upper frame plate extension **12C** and a lower frame plate extension **12D**. A pivot arm **14** is secured to the frame plate extensions **12C** and **12D**, such as by means of a pin **16**. The pivot arm is utilized to pivot the spinning apparatus **10** into and out position relative to the pipe **17** which is exemplary of an apparatus to be rotated. Pipe **17** may typically be a length of drill string, casing, or tubing as utilized in the petroleum industry. It can be seen that if desired plates **12A** and **12C** may be of one piece and plate **12B** and **12D** of one piece.

The plates **12A–12C** and **12B–12D** provide spaced parallel frame plates which pivotally receive a first arm, generally indicated by the numeral **18**, and a second arm, generally indicated by the numeral **20**. As shown in FIG. **2**, arm **18** includes an upper plate **18A** and a spaced paralleled lower plate **18B**. In like manner, second arm **20** includes an upper plate **20A** and a lower plate **20B**. First arm **18** pivots relative to the frame about a hinge pin **22** and in like manner arm **20** pivots relative to the frame about a hinge pin **24**. The hinge pins **22** and **24** extend between upper plate **18A** and lower plate **18B**.

The weight of the apparatus is typically supported by a chain or cable secured to a hook **24** attached to upper frame plate **12A**, although other means of supporting the mechanism may be utilized.

Referring to FIGS. 3 and 4, first arm 18 carries between plate 18A and 18B a forward sprocket 26 which rotates about a pin 28A, and a rearward sprocket 30 rotated about pin 32. Second arm 20 carries between plates 20A and 20B a forward sprocket 34 rotated about pin 36 and a rearward sprocket 38 rotated about pin 40.

Pivotally affixed to plates 12A and 12B is a sprocket lever 42, pivoted about pin 44. Rotatably secured to sprocket arm 42 is a tightening sprocket 46. Sprocket 46 also serves as a drive sprocket, the sprocket being rotated by shaft 48 which extends beyond plates 12A and 12B (see FIG. 2). Shaft 48 has affixed to it above plate 12A a drive spool 50 and below plate 12B is a take-up spool 52.

Referring again to FIGS. 3 and 4, an endless chain 54 is received about sprockets 26, 30, 34, 38 and 46. The chain loops about pipe 17 as a means of rotating it. In the preferred arrangement, as fully described in my above referenced prior issued U.S. Pat. No. 3,308,691, a resilient flexible drive collar 56 is placed about the member to be rotated, such as pipe 17, so that chain 54 engages the external circumference of collar 56 to rotate it, and thereby rotate pipe 17.

To provide for the pivotation of first arm 18, a cylinder 58, having a piston rod 60 reciprocally extending therefrom is utilized. Cylinder 58 is attached to upper and lower frame plates 12A and 12B by pin 62. A latch lever 64 is pivotally affixed to first arm 18 by a pin 66. The inner end 64A of latch lever 64 is pivotally affixed to piston rod 60 by means of a pin 68. The outer end of the latch lever includes a latching portion 64B. A spring 70 resiliently extends from the latching arm inner end 64A to first arm 18. The purpose of spring 70 is to impose a pivotal force on arm 18 as piston rod 60 is extended to pivot arm 18 to its closed position prior to the latching operation, in a manner to be described in more detail subsequently.

Second arm 20 includes a latching portion 72 arranged to engage the latching portion 64B of latching arm 64 to retain arms 18 and 20 in closed position.

A second cylinder 74, having a piston rod 76 reciprocally extending therefrom, is utilized for the purpose of moving second arm 20 into and out of closed position and for tightening chain 54. Cylinder 74 is secured to the frame between upper and lower frame extension plates 12C and 12B, by a pin 78. Piston rod 76 is pivotally affixed to sprocket lever 42 by means of a pin 80. The forward end of sprocket lever 42 includes a contacting element 82 adapted to engage second arm 20 to move it into the closed position. Extending from the frame plate 12B to second arm 20 is a spring 84, the purpose of which is to move the second arm 20 to the opened position when piston rod 76 is withdrawn.

Rotary energy applied to shaft 48 for the rotation of sprocket 46 and thereby chain 54, to rotate member 17, may be supplied in a variety of ways. In my previously issued U.S. Pat. No. 3,308,691 such rotary energy is supplied, by way of example, by a hydraulic motor. An electric or pneumatic motor may equally as well be employed. Another means, illustrated in FIGS. 1 and 2, includes the provision of drive spool 50 and take-up spool 52 attached to shaft 48. A cable 86 wrapped around spool 50 is utilized to rotate sprocket 46. Cable 86 may, when the invention is used on a drilling rig, be a jerk line extending to a drilling cat head, thus obviating the necessity for any other type of driving energy needed to rotate pipe 17. Take-up cable 88 typically extends to a counterweight. That is, cable 88 extends to a pulley and then to a weight which is raised as cable 86 is pulled to move chain 54 and, when the tension is released from cable 86, the counterweight pulls cable 88 downwardly rotating the sprockets 46 and chain 54 in the opposite direction.

OPERATION OF THE APPARATUS

With arms 18 and 20 in the opened position, as shown in FIG. 4, the spinner apparatus 10 is positioned about an object to be rotated, such as pipe 17. Resilient collar 56 is positioned about the pipe. Hydraulic pressure is applied to cylinders 58 and 74. The pressure applied to cylinder 58 causes piston rod 60 to extend. Spring 70 applies rotational force to arm 18 causing it to pivot about pin 22 to the closed position as shown in FIG. 3. Simultaneously hydraulic pressure applied to cylinder 74 causes the piston rod 76 to extend, rotating sprocket lever 42 about pin 44. Contact element 82 engages arm 22 and pushes it into the closed position as shown in FIGS. 1 and 3.

With the arm in closed position the further extension of piston rod 60 overcomes the force of spring 70 and causes the latch lever 64 to pivot to the closed position so that the latch portion 64B engages the latching portion 72 of arm 20. The arms 18 and 20 are now closed and are locked into position by latching lever 64.

In order to rotate pipe 17, a frictional force must be applied by chain 54 to the exterior of the collar 56 sufficiently to cause pipe 17 to rotate when the chain moves. In order to apply such frictional engagement between the chain and the collar the direction of the fluid pressure in cylinder 74 is reversed, retracting piston rod 76. This action causes sprocket lever 42 to pivot away from pipe 17 to the dotted position as shown in FIG. 3. Since the arms 18 and 20 are locked in position this reverse pivotation of lever 42 causes tightening sprocket 46 to move away from the other sprockets and thereby to tighten chain 54. The amount of tightening is proportional to the fluid pressure applied to cylinder 74.

The apparatus is now ready to be used to rotate pipe 17. Rotational force applied to shaft 48 causes the chain 54 to move around the sprockets and around the external periphery of collar 56. This rotary motion is applied by the collar to the pipe 17 rotating it. As previously indicated the rotational force to the shaft 48 may be applied in a variety of ways, such as pulling on cable 86.

When the pipe 17 has been rotated the amount desired the pull on cable 86 is terminated. Hydraulic pressure in cylinder 74 is removed and hydraulic pressure is applied in reverse direction to cylinder 58, pivoting latch lever 64 back to the open position of FIG. 4. The force applied by spring 70 pivots arm 18 to the opened position. Fluid pressure is applied in cylinder 74 retracting piston rod 76, pivoting sprocket lever 42 away from arm 20. Spring 84 pulls arm 20 into the opened position as shown in FIG. 4. The apparatus can then be removed from around pipe 17 or pipe 17 may be axially moved up or down.

It can be seen that the force applied to move chain 54 may equally as well be applied to any of the sprockets 26, 30, 34 or 38 and not necessarily only to sprocket 46.

ALTERNATE EMBODIMENT OF COLLAR MEMBER

FIGS. **5** and **6** show an alternate arrangement of the resilient collar **56.** In this alternate arrangement the collar includes a generally tubular resilient body **90** having a slit **92** in a plane of the collar longitudinal tubular axis. The interior diameter **90A** of the resilient body is configured to engage the object to be rotated, such as a pipe, while the exterior diameter **90B** is engaged by the chain of the spinning apparatus.

Formed in resilient body **90** is a plurality of spaced-apart longitudinal slots **92,** each slot **92** extends from the interior surface **90A** to the exterior surface **90B.** Positioned in each slot **92** is a metallic element **94** each of which has an inner edge **94A** and an outer edge **94B.** The inner edges **94A** extend to engage the member to be rotated, such as a pipe, while the outer edges **94B** are contacted by the chain so that positive rotational force is applied from the chain to the rotated member. The planes of each of the slots **92** and the metallic elements **94** is in a cord through the inner diameter **90A** so that the inner edge **94A** engages to dig into the metallic member to be rotated. Specifically, the elements **94** are arranged as the member would be utilized for rotating a member in a direction of the arrow.

The embodiment of the collar **56** as shown in FIGS. **5** and **6** is shown and described as a tubular configuration which is the configuration which the collar assumes as rotated about a cylindrical member, such as a pipe. It is normally desirable that in the relaxed condition wherein the collar is not engaged by the drive chain it opens up or expands as shown in FIG. **4** to facilitate removal from and insertion around a rotated member. Thus, the description of the device as being "tubular" is applicable to the configuration when in use to impart rotational motion to a member to be rotated.

While the invention has been described with a certain degree of particularity, it is manifest that many changes may be made in the details of construction and the arrangement of components without departing from the spirit and scope of this disclosure. It is understood that the invention is not limited to the embodiments set forth herein for purposes of exemplification, but is to be limited only by the scope of the attached claim or claims, including the full range of equivalency to which each element is entitled.

What is claimed:

1. An apparatus for rotating a member comprising:
- a frame;
- a first and second arm pivoted to said frame, said arms pivotable to an open position to receive a member to be rotated therebetween, and pivotable to a closed position to encompass the member to be rotated;
- a sprocket level pivoted to said frame;
- sprockets carried by said arms and said sprocket lever;
- an endless chain positioned on said sprockets arranged to engage said member to be rotated when said arms are in the closed position;
- a latch lever pivoted to one of said arms and a latch dog affixed to the other said arm, the latch lever pivotal between a latched position in which it engages said latch dog to retain said arms in closed position and an unlatched position;
- a first actuating means responsive to signals for pivoting said first arm between the opened and closed positions;
- a second actuating means responsive to signals for pivoting said sprocket lever towards said arms and away from said arms;
- means responsive to the pivotation of said sprocket lever of pivoting said second arm between the closed position and the opened position;
- means responsive to one of said actuating means of pivoting said latching lever to the closed position whereby said arms are latched in the closed position, the pivotation of said sprocket lever away from said arms when the same are latched in the closed position serving to tighten said chain against said member to be rotated; and
- means of moving said chain over said sprockets to rotate said member.

2. An apparatus for rotating a member according to claim **1** wherein said first actuating means is a cylinder having a piston rod reciprocably extending therefrom, said cylinder and said piston rod being connected between said frame and said first arm.

3. An apparatus for rotating a member according to claim **1** wherein said latch lever is pivotally affixed at an intermediate point to said first arm, the latch lever having a latch portion at one end, and wherein said cylinder is affixed to said frame and said piston rod is affixed to said latch lever at the end thereof opposite said latch portion; and
- a spring having one end affixed to said first arm and the other end affixed to said latch lever at the end opposite said latch portion, said spring normally retaining said latch lever in the unlatched position, whereby upon application of fluid pressure to said cylinder said piston exerts force against said spring to pivot said first arm to the closed position and when the force of said spring is overcome, pivots said latching lever to the latched position.

4. An apparatus for rotating a member according to claim **1** wherein said second actuating means is a cylinder having a piston rod extending reciprocably therefrom, said cylinder and piston rod being connected between said frame and said sprocket lever.

5. An apparatus for rotating a member according to claim **1** wherein said sprocket lever is pivoted to said frame adjacent to said second arm at the side thereof opposite said first arm and wherein as said sprocket lever is pivoted towards said second arm said sprocket lever engages said arm and pivots the same to closed position.

6. An apparatus for rotating a member according to claim **1** including:
- a spring having one end affixed to said second arm and the other end to said frame whereby as said sprocket lever is pivoted away from said second arm said spring pivots said second arm to the opened position unless said second arm is latched in the closed position.

7. An apparatus according to claim **1** including:
- a body of deformable and resilient material arranged between the surface of said member to be rotated and said chain.

8. An apparatus according to claim **7** wherein said body of resilient material is, when positioned between the member to be rotated and said chain, of generally tubular configuration, the interior diameter engaging

the member to be rotated and the outer diameter engaging said chain and including a plurality of spaced apart metallic members encompassed by said resilient body extending from the interior to the exterior surface thereof, the metallic members each engaging the member to be rotated and said chain to impart positive rotary motion from said chain to the member to be rotated.

9. An apparatus for rotating a member, comprising:

a frame;

first and second arms pivoted to said frame, said arms pivotable to an open position to receive a member to be rotated therebetween, and pivotable to a closed position to encompass the member to be rotated;

a sprocket lever pivoted to said frame;

sprockets carried by said arms and said sprocket lever;

an endless chain positioned on said sprockets arranged to engage said member to be rotated when said arms are in the closed position;

a latch lever pivoted to said first arm and a latch dog affixed to said second arm, the latch lever pivotal between a first latched position in which it engages said latch dog to retain said arms in the closed position and a second unlatched position;

a first cylinder having a reciprocal piston rod, the cylinder and piston rod being connected between said frame and said first arm, the first cylinder operable in one direction to pivot said first arm towards the closed position and in the second direction to pivot said first arm towards the opened position;

a second cylinder having a reciprocal piston rod, the cylinder and piston rod being connected between said frame and said sprocket lever, the second cylinder operable in one direction to pivot the sprocket lever towards said second arm and operable in the other direction to pivot the sprocket lever away from said second arm;

means operable by said first cylinder of pivoting said latch lever to the latched position when said first arm is pivoted to the closed position and of pivoting the latching lever to the unlatched position preparatory to pivoting said arms to the open position;

means operable by said second cylinder of pivoting said sprocket lever to engage said second arm to pivot the same to the closed position and when said arms are in the closed position and latched, to pivot the latching lever away from said second arm to thereby apply tension to said endless chain to firmly contact said chain with the surface of said member to be rotated; and

means of moving said chain over said sprockets to rotate said members.

10. An apparatus for use in imparting rotary motion to an elongated, generally cylindrical member to be rotated, such as a length of pipe, comprising:

a resilient member of generally tubular configuration having an interior diameter substantially equal to the exterior diameter of the member to be rotated, and a longitudinal slit therein whereby said deformable member may be spread apart to receive the member to be rotated, and including a plurality of spaced apart metallic elements received in said resilient member each having one end coincident with the interior diameter of said resilient member and the outer end coincident with the outer diameter of the resilient member.

11. An apparatus for use in imparting rotary motion to an elongated, generally cylindrical member to be rotated according to claim **10** wherein each said metallic element is in the form of a flat plate, and wherein each such flat plate is in the plane of a cord parallel the tubular axis of the resilient member, such cord being of the internal diameter of the tubular resilient member.

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