Oct. 23, 1962 N. F. ATHERTON 3,059,683

FLUID PRESSURE OPERATED ROTARY TORQUE APPLYING DEVICE

Filed April 1, 1960 3 Sheets-Sheet 1

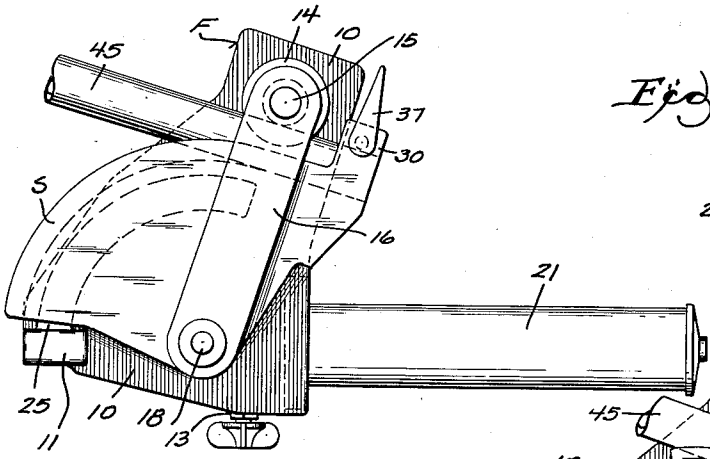


Fig. 2

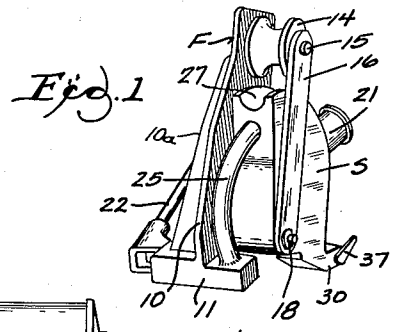


Fig. 1

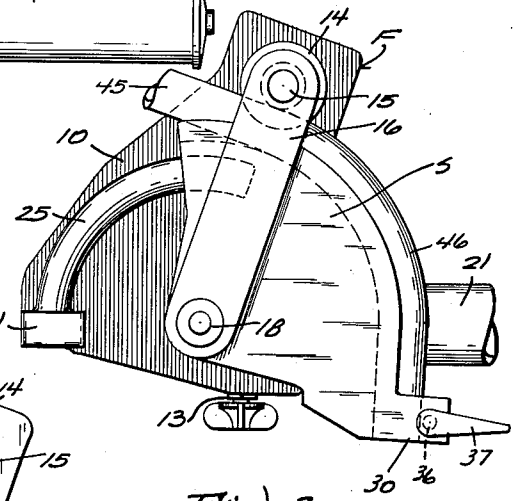


Fig. 3

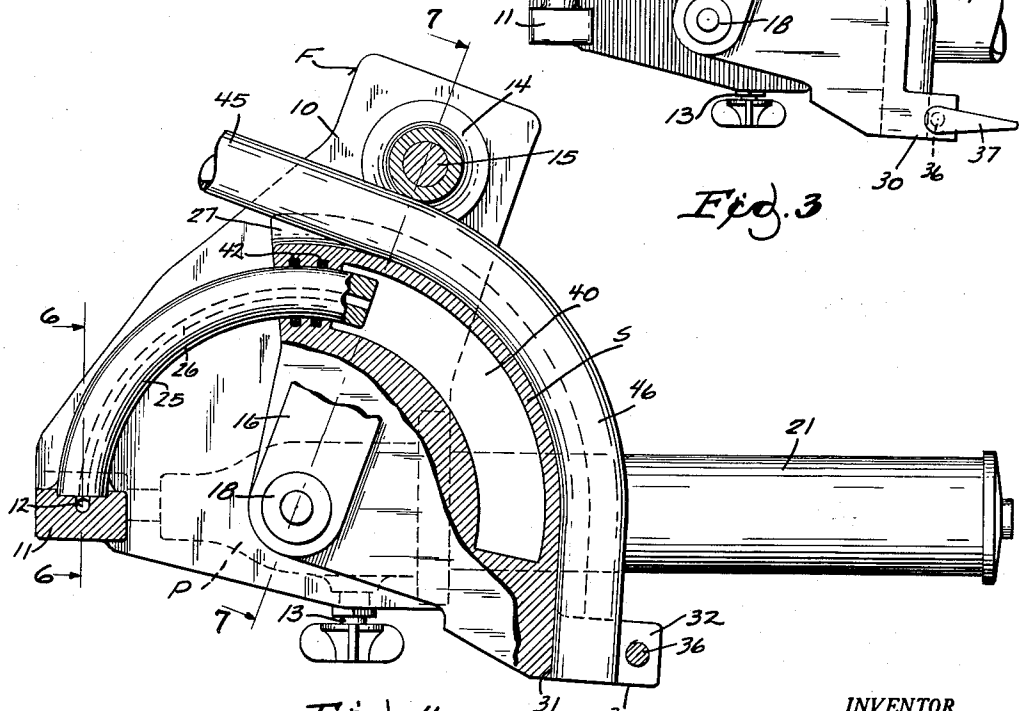


Fig. 4

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FLUID PRESSURE OPERATED ROTARY TORQUE APPLYING DEVICE

Filed April 1, 1960 3 Sheets-Sheet 2

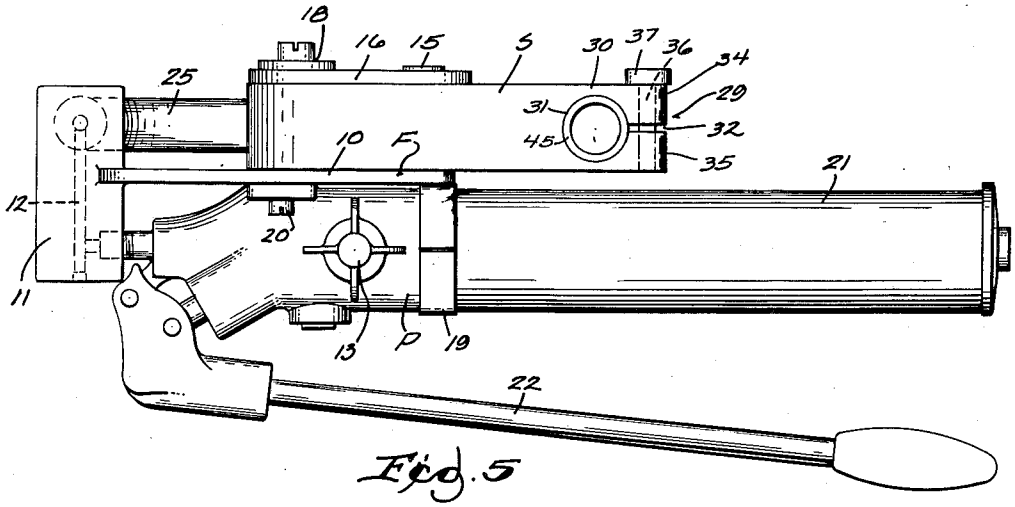


Fig. 5

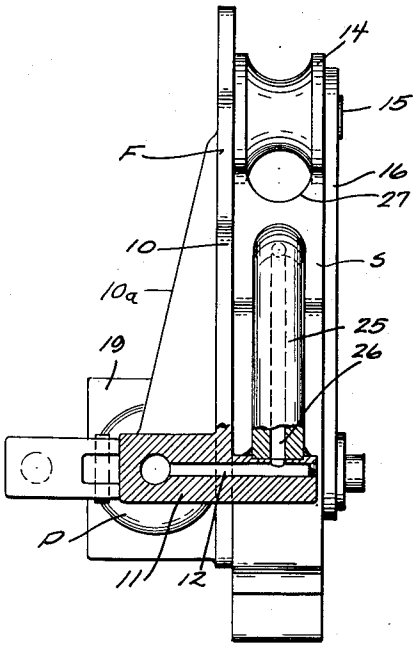


Fig. 6

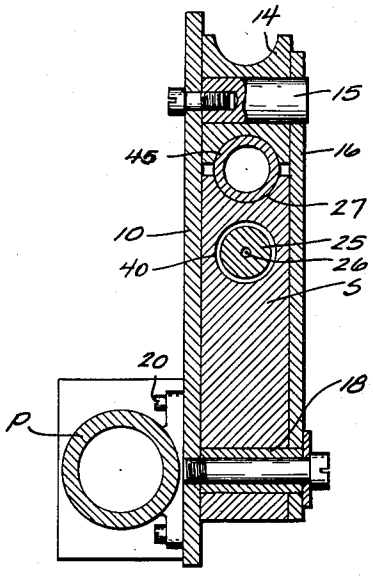


Fig. 7

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FLUID PRESSURE OPERATED ROTARY TORQUE APPLYING DEVICE

Filed April 1, 1960 3 Sheets-Sheet 3

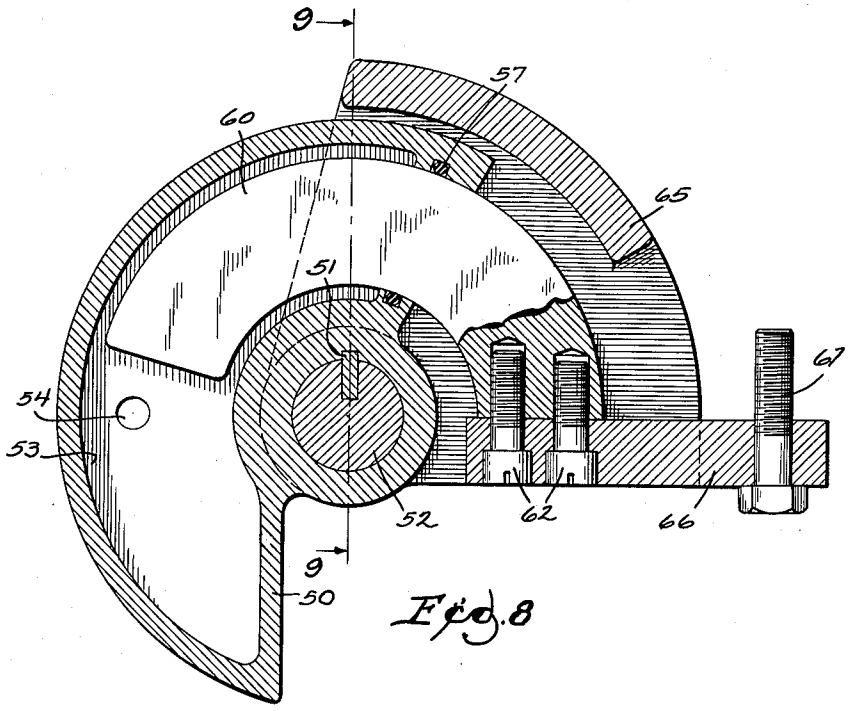


Fig. 8

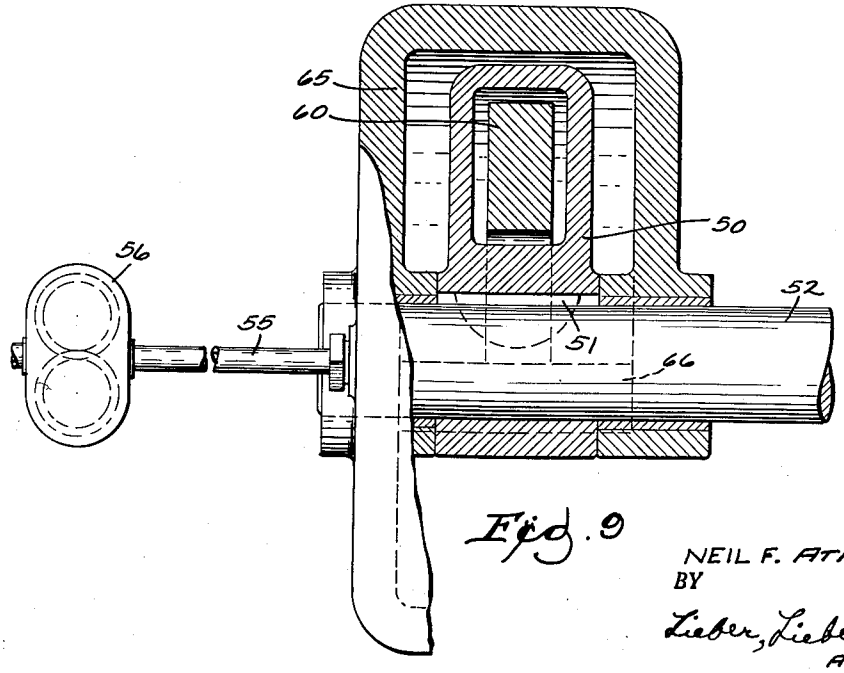


Fig. 9

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United States Patent Office 3,059,683 Patented Oct. 23, 1962

3,059,683

FLUID PRESSURE OPERATED ROTARY TORQUE APPLYING DEVICE

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Filed Apr. 1, 1960, Ser. No. 19,326
4 Claims. (Cl. 153—40)

This invention relates to fluid pressure applying devices and more particularly to devices of this type for applying pressure along a curved path.

According to the present invention an improved fluid pressure applying device has been provided which is capable of applying force along a curved path.

More specifically, the invention provides a device of the above type having means forming an arcuate displacement chamber, other means forming a complementary arcuate member extending into said chamber and movable in an arcuate path relative thereto, and means for supplying fluid pressure to said chamber.

These and other objects and advantages of the present invention will appear as this disclosure progresses, reference being had to the accompanying drawings in which:

FIGURE 1 is a generally front perspective view of a pipe bender embodying the present invention;

FIGURES 2 and 3 are side views, on an enlarged scale of the bender shown in FIGURE 1 and showing it at the beginning and the end, respectively, of a bending operation;

FIGURE 4 is a side elevational view, on a further enlarged scale, certain parts being shown in section and broken away;

FIGURE 5 is a bottom view of the bender;

FIGURE 6 is a view taken generally along lines 6—6 of FIGURE 4;

FIGURE 7 is a sectional view along line 7—7 in FIGURE 4;

FIGURE 8 shows a modified form of the invention, the view being a side elevation with certain parts in section and broken away; and

FIGURE 9 is a view taken generally along line 9—9 in FIGURE 8, with parts being shown in section or broken away for clarity in the drawings.

The invention will be shown and described as applied to certain specific uses such as a pipe bender or a rotary torque device for hub rotation work, but it should be understood that the invention is applicable to other fields and should not be limited to the forms shown here for illustrating the invention.

In addition, the invention is applicable to use with different types of pressure fluid, such as for example, oil or air.

Referring in greater detail to the drawings, and particularly FIGURES 1–7, a fixed frame F is provided which includes an upright member or plate **10** and a block **11** welded at the lower side of the plate and transversely in respect thereto. A reinforcing gusset plate **10***a* is welded between plate **10** and block **11**. A fluid passage **12** extends through block **11** for purposes that will presently appear. A rotatable sheave or pulley **14** is mounted at the upper end of the plate **10**. More specifically, the axis **15** on which the pulley is mounted is supported by and between the upper end of plate **10** and the upper end of a strap **16**. The strap **16** is mounted at its lower end on a shaft **18** fixed to plate **10**. Thus the fixed frame F comprises the plates **10** and **10***a*, block **11**, pulley **14** and strap **16**. While this frame has been described as being fixed, it should be understood that the bender shown in these figures is rather small and easily portable. By "fixed" is meant that it is stationary relative to the swingable force applying member S to be described.

A hydraulic pump P is secured by bracket **19** and

screws **20** to one side of the frame F and the cylindrical reservoir **21** forms a handle for the bender which is grasped by the operator when in use. The pump includes a pumping lever **22** by means of which pressure fluid can be supplied to the passage **12** which with the pump is in fluid communication. A manually operable release valve **13** opens the discharge side of the pump back to the tank when pressure is no longer desired in the system being served. The pump P is of conventional and well known design and further description of it is not believed to be necessary. It should be sufficient to say that it is of the general type shown in U.S. Patent 2,277,256 issued on March 24, 1942.

An arcuate shaped piston **25** is welded at its lower end to block **11**. A passageway **26** extends axially through this piston and is in communication with passage **12** in block **11**. This piston **25** forms an arcuate beam or fixed arcuate conduit which is formed with the shaft **18** as a center and may extend, for example, through an arc of about 100 degrees.

The piston **25** and the frame **10** constitute a piston assembly on which is pivotally mounted a swingable housing to now be described.

A swingable housing in the form of a force applying member S is oscillatably mounted on shaft **18**, is segmental in form and has a U-shaped pipe trough or track **27** along its periphery to constitute a bending shoe. Swingable housing S has a pipe clamping means **29** adjacent one end of the track **27**. This means includes a block **30** having an aperture **31** in which the end of the pipe to be bent is inserted. The block **30** is split as at **32** to form bifurcated ends **34** and **35**. A screw **36** extends through end **34** and is threadably engaged in end **35**, the screw having a thumb lever **37** fixed at its outer end by means of which the screw can be tightened to cause clamping action of the bifurcated ends on the pipe.

The swingable member S has an arcuately shaped displacement chamber **40** formed therein which is complementary in form to the piston **25** over which it oscillates. Sealing means or shaft seals **42**, such as O-rings, leather washers or a combination of them, are carried adjacent the outer end of chamber **40** to form a sealing fit with the piston and a pressurizable and expansible chamber within the swingable member S.

The operation of the pipe bending device is as follows. The straight pipe **45** is inserted in the clamping means **29** when the swingable member S is in the starting position shown in FIGURE 2.

At this time the valve **13** is shut and the lever **22** is pumped to force pressure fluid through passage **12**, passageway **26** and into the chamber **40**. This causes the member S to swing about its pivot shaft **18**, thereby pulling the pipe **46** under the guiding means in the form of a pulley **14** and bending it to conform to the arcuate track **27**. After the member S has traveled its full distance, as shown in FIGURES 3 and 4, the valve **13** would be opened, thereby releasing the fluid pressure in chamber **40** back to the reservoir 21.

The action of the bender is such that a constant torque is applied along an arcuate path.

Referring now to FIGURES 8 and 9, the invention has been illustrated as applied to a rotary torque device for rotating a member that is fixed to a shaft. In this embodiment the rotating or swinging member **50** is secured by a key **51** to a shaft **52**. Member **50** has an arcuate chamber **53** having a fluid pressure opening **54** in its wall through which pressure fluid may be admitted or exhausted via a flexible conduit **55**, for example, from pump **56**. Seals **57** are provided adjacent the outer end of the chamber for slidable and sealing engagement with the relatively stationary or fixed arcuate piston **60** which constitutes a curved beam or ram.

The seals may be of a molded neoprene, together with an O-ring, all shaped to fit the ram **60**.

It will be noted that in this modification both the chamber **53** and piston **60** are generally rectangular in cross section. The piston is mounted at one end by cap screws **62**, to a fixed or stationary frame **65**. The piston and frame **65** constitute a piston assembly which would in this modification be secured through its flange **66** by bolts **67** to any suitable fixed part (not shown) of the machine with which it is used.

In this modification, the swingable housing **50** is capable of rotating through an arc of about 150 degrees, and the amount of angular travel, of course, depends on the volume of oil pumped into the chamber.

It is not necessary that the cross sectional shape of the chamber and its piston are similar. However, in either embodiment of the invention, the cross sectional size and shape of the piston is uniform throughout its length. The effective cross sectional area against which the pressure fluid can act is this cross sectional area.

Certain definite advantages are obtained, however, with a piston of rectangular cross section, and particularly one having its radial dimension greater than its width as shown in FIGURE 9. This is because the piston tends to "straighten out," when in use, that is, the torque forces acting on the piston end tend to urge it from its arcuate position to a straight one. By utilizing a rectangular section rather than a round one, more effective use is made of the piston's cross sectional area because more of this area is located both radially outwardly and inwardly of the center axis of the piston. Thus in a rectangular cross section piston, the compressive and tensile loads on the piston are better distributed, and the piston is better able to withstand the stresses which tend to straighten it when in use.

The present invention provides a compact, lightweight and economically produced, rotary torque actuator, capable of using high pressure hydraulic fluid for the power medium, and which actuator provides a constant torque throughout its angular stroke.

Various modes of carrying out the invention are contemplated as being within the scope of the following claims particularly pointing out and distinctly claiming the subject matter which is regarded as the invention.

I claim:

1. A fluid pressure operated pipe bender comprising a fixed frame, an arcuate piston rigidly secured at one end to said frame, a swingable member pivoted to said frame about an axis, said member having an arcuate chamber complementary to said piston for slidably receiving the latter therein, said member also having means for holding a pipe to be bent and including an arcuate guide track, sealing means between said piston and chamber so the latter can be pressurized, said arcuate chamber and arcuate piston formed with said axis as a center, and means for supplying fluid pressure to said chamber to cause said member to swing about said axis.

2. A fluid pressure operated pipe bender comprising a fixed frame, an arcuate piston rigidly secured at one end to said frame, a bending shoe pivoted to said frame about an axis, said shoe having an arcuate chamber complementary to said piston for slidably receiving the latter therein, sealing means between said piston and chamber so the latter can be pressurized, said arcuate chamber and arcuate piston formed with said axis as a center, and means for supplying fluid pressure to said chamber to cause said shoe to swing about said axis.

3. A fluid pressure operated pipe bender comprising a fixed frame, pipe guiding means on said frame, an arcuate piston rigidly secured at one end to said frame, a swingable bending shoe pivoted to said frame about an axis, pipe clamping means carried by said shoe, said shoe having an arcuate chamber complementary to said piston for slidably receiving the latter therein, sealing means between said piston and chamber so the latter can be pressurized, said arcuate chamber and arcuate piston formed with said axis as a center, and means for supplying fluid pressure to said chamber to cause said shoe to swing about said axis.

4. A rotary torque applying device comprising, a supporting frame, a force applying member pivotally secured to said frame for rotation relative thereto, said force applying member having an arcuate displacement chamber therein, an arcuate piston fixedly secured at one end to said frame with its free end extending into said chamber, said piston being complementary in shape with said arcuate chamber and the axis of the arc of both said chamber and said piston being concentric with the pivotal axis of said member, sealing means between said chamber and said piston permitting relative sliding movement therebetween, means for supplying fluid under pressure to said chamber to cause said force applying member to rotate relative to said frame and means for attaching a workpiece to the forward end of said member to transmit rotary force thereto, said member having an arcuate bearing surface for said workpiece extending rearwardly from said attachment means.

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