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(11)

EP 0 775 538 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
28.05.1997 Bulletin 1997/22

(51) Int. Cl.⁶: **B21D 7/06**

(21) Application number: **96117812.6**

(22) Date of filing: **07.11.1996**

(84) Designated Contracting States:
AT CH DE ES FR GB IT LI

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(30) Priority: **23.11.1995 IT MI950811 U**

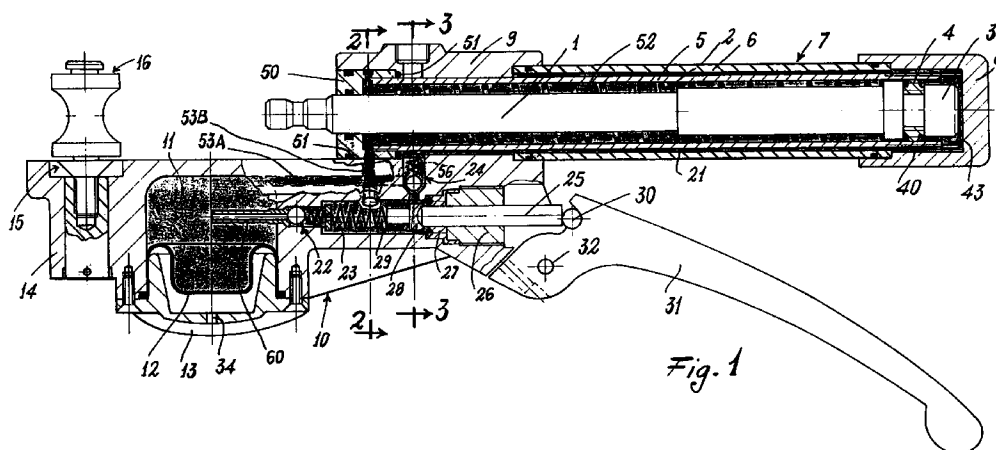
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(54) Pipe bending apparatus with hydraulic transmission

(57) A pipe bending apparatus with hydraulic transmission, operable with one hand, of the type comprising a cylinder (5,8,50,6) in which there is movable in both directions a die-carrying rod (1), comprises, fixed in correspondence with that (3) of its ends located within the cylinder, a seal element (4) defining together with portions of the walls of said cylinder a first and a second chamber (43,52) of volume variable in relation to the

movements of said rod, said chambers being connected via conduits (21,36,56,53A,53B) and at least one intermediate chamber (23) to a reservoir (11) for a fluid. The intermediate chamber (22,23,24) comprises a hydraulic pump operable by one hand, and unidirectional valve means (22,24). The reservoir (11) comprises an at least partly deformable sealing wall (12).



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Description

This invention relates to a pipe bending apparatus with hydraulic transmission, operable with one hand, in accordance with the precharacterising part of the main claim.

Apparatus of this type have been known for some time (see for example Italian utility model 207711 in the name of the present applicant). Although such apparatus provide acceptable operation they present certain drawbacks. The first of these is the fact that the deformable wall of the reservoir containing the fluid for the hydraulic circuit undergoes relatively large deformation, leading to its breakage or imperfect sealing, in this latter case air bubbles possibly entering the reservoir to cause maloperation of the hydraulic circuit. It has also been found experimentally that dirt tends to accumulate in the open front part of the cylinder with the passage of time, making the movement of the rod more difficult and possibly cause it to seize.

An object of the present invention is to provide a pipe bending apparatus of hydraulic transmission type, operable with one hand, which obviates the aforesaid drawbacks and in particular reduces the deformation of the deformable wall of the reservoir for the hydraulic circuit fluid.

A further object is to provide an apparatus in which the possibility of air bubbles entering the apparatus hydraulic circuit is limited.

These and further objects which will be apparent to an expert of the art are attained by an apparatus in accordance with the characterising part of the main claim.

The present invention will be more apparent from the accompanying drawing, which is provided by way of non-limiting example and on which:

Figure 1 is a schematic longitudinal section through an apparatus according to the invention;

Figure 2 is a schematic cross-section therethrough taken on the line 2/2 of Figure 1;

Figure 3 is a schematic cross-section therethrough taken on the line 3/3 of Figure 1; and

Figure 4 is a partial section therethrough taken on the line 4/4 of Figure 1.

In Figure 1, the reference numeral 1 indicates a die-carrying rod, 2 indicates a return element such as a spring, and 3 indicates the inner end of the rod 1, provided with a gasket 4 for its sealing, and slidable within the cylinder 5. Further in Figure 1 the reference numeral 6 indicates the outer part of the apparatus handgrip, indicated overall by 7, said part 6 consisting of a tubular element concentric to the cylinder 5 and having its two ends sealedly fixed to a cap 8 and to the apparatus body 9. The body 9 is advantageously formed integral with the remaining lower part, indicated overall by 10.

The reference numeral 11 indicates a cavity provided in the lower part of the body 10 and forming a res-

ervoir for oil or another suitable fluid (oil distribution within the apparatus is represented by grey shading in the figures). The reference numeral 12 indicates a cup-shaped elastic membrane, for example of rubber, plastic or another suitable material, which is fixed in position and sealed by a cup-shaped closure plug 13 comprising a vent hole 34.

In the lower part of the body 10 there is indicated by 14 a support for an element 15 carrying the counter-die 16, the element 15 being connected removably to the body 10 to allow rapid and easy replacement of the die-carrier assembly.

The reference numeral 21 indicates an interspace between the cylinder 5 and the piece 6 to allow the oil to pass in either direction, depending on whether the apparatus rod 1 is advancing, or returning under the action of the spring 2, the work having been completed.

A non-return valve 22, of ball type, enables the oil to pass from the reservoir 11 to the chamber 23. Advantageously the valve 22 is connected to a dip tube 60 in the centre of the reservoir 11. In this manner, even if air bubbles were to appear in the reservoir, they would not enter the hydraulic circuit of the apparatus. In this respect, whatever the inclination of the apparatus, the air bubbles would collect along the reservoir walls but never at its centre, and hence cannot enter the circuit. A second non-return valve 24 enables oil to flow from the chamber 23 to the interspace 21. The interspace 21 is hydraulically connected to the chamber 23 and to the chamber 43 defined by the walls of the cylinder sleeve and the gasket on the rod 1, by way of passages 40 provided within the sleeve.

The reference numeral 25 indicates a plunger free to slide axially within a cylindrical guide bush 26 which carries at that end facing the chamber 23 an annular gasket 27 sealing against the plunger 25.

A counteracting spring 29 is engaged in a support seat 28 provided on the end of the plunger 25 and acts against a shoulder formed at the end of the chamber 23.

The reference numeral 30 indicates a ball interposed between the end of the plunger 25 and the lever arm 31, said lever arm being pivoted on the pin 32.

At that end from which the rod 1 emerges, the cylinder 5 is sealed by an element 50 which engages the body 9. To ensure the seal, three usual annular gaskets 51 are provided. The element 50 together with the cylinder 5 and the gasket 4 of the rod 1 define a second chamber 52 connected to the reservoir 11 via a conduit divided into two mutually perpendicular portions 53A and 53B. The chamber 52 is also connected to the outside via a third conduit 54 (Figure 2).

The conduit portion 53A extends beyond the perpendicular portion 53B by a conduit portion 56 connected to the chamber 24 and acting together with the portion 53A as a return tube between this latter chamber and the reservoir 11.

The opening of said conduit 56 can be seen in Figure 3, a ball 41 maintaining closed a passage 36 which connects the chamber 24 to the conduit 56.

The threaded shank 39 of a cock 37 consisting of a manually operable external handwheel 38 acts on the ball 41 to close or open the passage 36.

Assuming the chamber 52 to be already filled with oil, the operation of the apparatus is as follows.

The apparatus is gripped by one hand, which embraces the handgrip 7 and the lever 31.

When the operator pulls the lever 31 towards the handgrip 7, the plunger 25, on which the annular seal gasket 27 operates, is urged to slide within the cylinder 23, and as said chamber is filled with oil, the penetration of said plunger into said chamber causes the delivery valve 24 to rise with the result that a quantity of oil equal to the volume of that part of the plunger which has entered the cylinder passes into the interspace 21.

In this respect, the oil finds the cock 37 closed, so that it is obliged to enter the interspace 21 and then the chamber 43, where it acts against the end 3 of the rod 1, causing it to advance an initial distance against the action of the spring 2.

The operator then releases the lever 31, with the result that the plunger 25 returns to its initial position under the action of the spring 29, which has been loaded during the preceding delivery stage. Because of the pressure difference induced across the chamber 23, the return valve 24 closes and the valve 22 opens to allow oil to pass from the reservoir 11 to the chamber 23, which is again filled.

The reduction in the oil volume in the reservoir 11 is compensated by the oil originating from the second chamber 52 and pushed into the reservoir by the advancement of the rod 1. It should be noted that in this manner, compared with known apparatus, a much smaller stress is induced in the flexible wall 12, which is hence much less deformed.

The apparatus is in this manner again ready for a new pumping cycle. Each pumping cycle results in advancement of the rod 1, on which there is mounted a die of adequate size for the pipe to be bent, the die gradually approaching the corresponding counter-dies 16 to progressively bend the interposed pipe.

To cause the rod 1 to retract it is necessary merely to open the cock 37, which opens the hydraulic connection between the chamber 43 and the return tube 56 via the interspace 21.

The opposing action of the spring 2 causes the rod 1 to automatically re-enter the element 5, pushing the oil from the chamber 43 to the reservoir and into the second chamber 2. It should be noted that again in this case, as air can flow into the chamber 52, the flexible wall is subjected to lesser deformation than in known apparatus.

From Figure 4 it can be seen that the plate element 15 carrying the counter-dies is fixed to the support 14 by a screw 15B which fixes it to a vertical pin 15A maintained in position by a ball 15C urged by a spring and engagable in an annular groove 15D provided in the pin 15A.

Finally, it should be noted that the aforescribed

embodiment is provided by way of example only, and that numerous modifications are possible all falling within the same inventive concept, for example the form and position of the hydraulic circuit conduits could be different from those shown.

Claims

1. A pipe bending apparatus with hydraulic transmission, operable with one hand, of the type comprising a cylinder (58, 50, 6) in which there is movable in both directions a die-carrying rod (1) comprising - fixed in correspondence with that (3) of its ends located within the cylinder - a seal element (4) defining together with a first portion of the walls of said cylinder a first chamber (43) of volume variable in relation to the movements of said rod, said first chamber being connected, via a delivery conduit (21) and return conduits (36, 56) and at least one intermediate chamber (23), to a reservoir (11) containing an incompressible fluid, so as to form a closed circuit; said intermediate chamber (22, 23, 24) comprising a hydraulic pump (25, 31) operable by one hand, and unidirectional valve means (22, 24); said return conduit (56) comprising manually operable interception means (38); said reservoir (11) comprising an at least partly deformable sealing wall (12), said cylinder comprising elastic means arranged to return the rod to its rest position when said interception means are open; characterised in that said seal element (4) defines together with a second portion of the walls of said cylinder (50, 5, 6, 8) a second chamber (52), said first and second chambers being sealedly separated from each other and having a volume variable in relation to the movements of said rod (1), said second chamber (52) being connected to said reservoir (11) by at least one first further conduit (53A, 53B) and to the outside by a second further conduit (54) comprising a closure plug (55).
2. An apparatus as claimed in claim 1, characterised in that the intermediate chamber (23) is connected to the reservoir (11) by a tube (60) dipping into said reservoir in correspondence with a central region thereof.
3. An apparatus as claimed in claim 1, characterised in that the return conduit (56) of the first chamber and that (53A) of the second chamber (52) have a common portion.
4. An apparatus as claimed in claim 1, characterised in that the deformable wall (12) is cup-shaped.
5. An apparatus as claimed in claim 4, characterised by comprising a reservoir closure cover (13) arranged to fix and seal the deformable wall (12) to the lateral wall of the reservoir, said cover being

cup-shaped.

6. An apparatus as claimed in claim 1, characterised in that the cylinder (2) is sealed at both its ends by two different elements (8, 50), one of said elements having a through hole through which the die-carrying rod (1) can sealedly slide.

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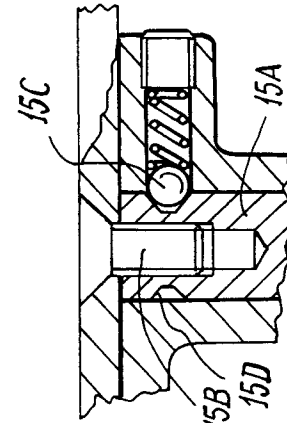
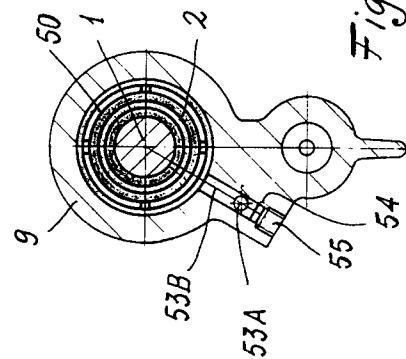
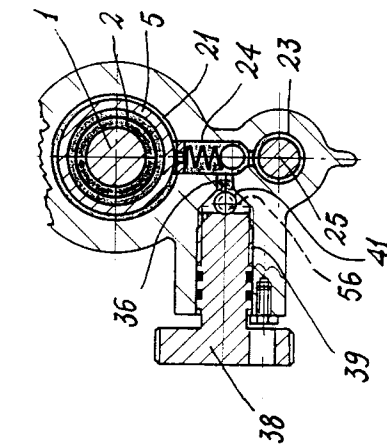
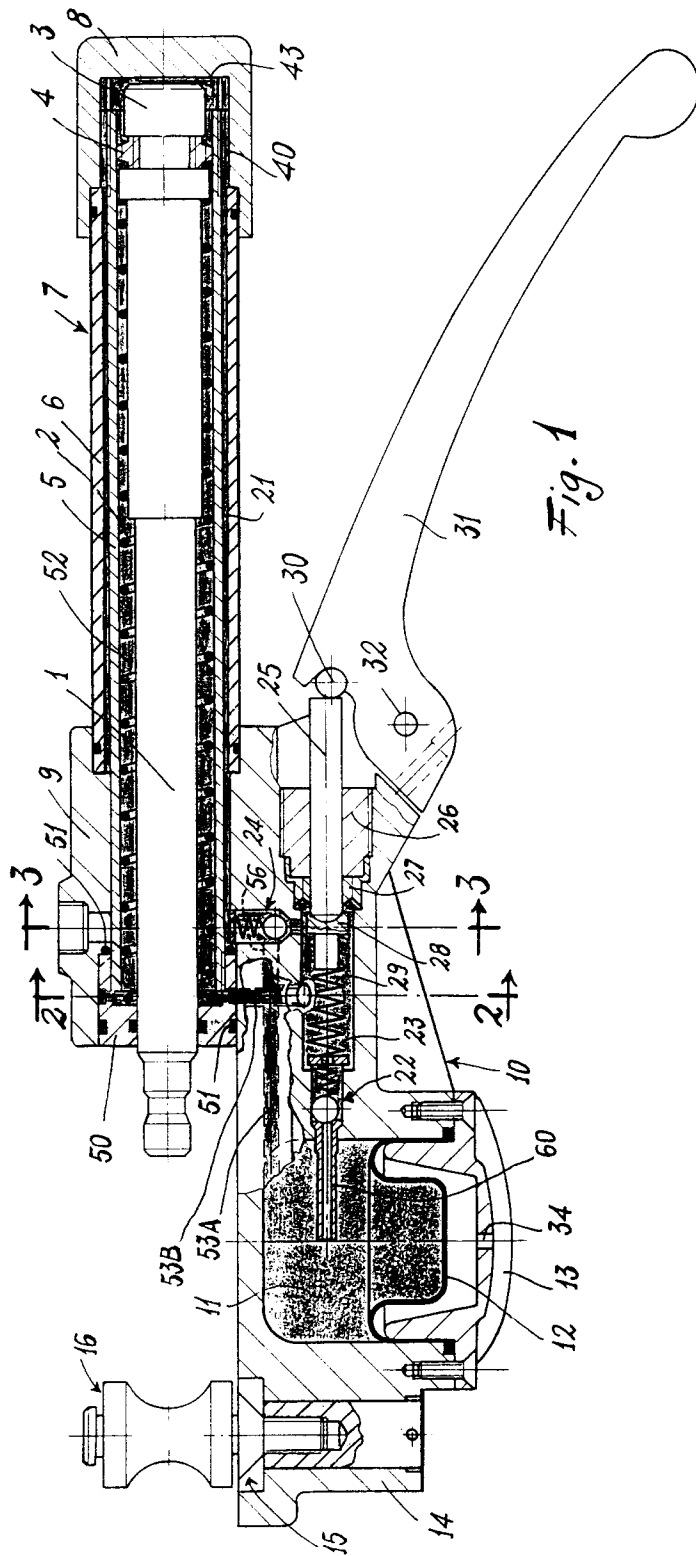
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EUROPEAN SEARCH REPORT

Application Number
EP 96 11 7812

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	EP 0 220 639 A (CBC SPA) 6 May 1987 * the whole document * -----	1	B21D7/06
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			B21D B25B
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 7 February 1997	Examiner Ris, M
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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