

(19)



Europäisches Patentamt

European Patent Office

Office européen des brevets



(11)

EP 0 980 484 B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention
of the grant of the patent:

24.03.2004 Bulletin 2004/13

(21) Application number: **98921980.3**

(22) Date of filing: **07.05.1998**

(51) Int Cl.7: **F16J 10/00**

(86) International application number:
PCT/SE1998/000833

(87) International publication number:
WO 1998/051945 (19.11.1998 Gazette 1998/46)

(54) **HYDRAULIC CYLINDER MECHANISM**

HYDRAULISCHER CYLINDER

VERIN HYDRAULIQUE

(84) Designated Contracting States:

BE DE ES FI FR GB IT NL

Designated Extension States:

LT LV RO SI

(30) Priority: **09.05.1997 SE 9701733**

(43) Date of publication of application:

23.02.2000 Bulletin 2000/08

(73) Proprietor: **Structo AB**
688 29 Storfors (SE)

(72) Inventor: **LARSSON, Göran**
S-688 29 Storfors (SE)

(74) Representative: **Johansson, Lars E.**
Dr. Ludwig Brann Patentbyrå AB
P.O. Box 171 92
104 62 Stockholm (SE)

(56) References cited:

US-A- 2 724 368

US-A- 2 893 209

US-A- 3 945 300

Note: Within nine months from the publication of the mention of the grant of the European patent, any person may give notice to the European Patent Office of opposition to the European patent granted. Notice of opposition shall be filed in a written reasoned statement. It shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

EP 0 980 484 B1

Description

Technical Field of the Invention

[0001] This invention relates to a hydraulic cylinder mechanism of the type that comprises a tube of cylindrical basic shape and two gable pieces for the sealing thereof, of which pieces a first one has an axial through-bore for a rod and a piston, the cylinder tube being made by cold forming of a tube-shaped blank of metal.

Prior Art

[0002] Conventional cold-formed cylindrical tubes for hydraulic cylinders have a truly cylindrical shape, as far as they have one and the same material or wall thickness from one end to the other, in addition to which the two gable pieces are produced as separate units which are mounted on the tube in a suitable manner. In other terms, the outer and inner surfaces of the tube have a cylindrical shape the whole way between the two opposed end openings of the tube. Dimensioning for the material thickness is not only the maximal pressure that the cylindrical tube must be able to resist, but also the stress forces applied to the end portions of the cylindrical tube in connection with the coupling of the two gable pieces of the mechanism to the tube. In the case of conventional hydraulic cylinders with one single piston rod, one of the gable pieces is formed with a through aperture or bore, while the opposed gable piece lacks an aperture. The gable piece with an aperture on the piston rod side of the cylinder is frequently connected to the tube via either inner or outer screw joints, although welding and locking by means of a locking ring, respectively, are also applied sometimes. The other gable piece on the piston side of the cylinder is usually connected to the cylinder tube by means of welding, although also here screw joints may occur. In order to, in practice, be able to apply these joining methods, it is required that the cylinder tube has a certain smallest diameter at its ends. As an example, it may be mentioned that hydraulic cylinders with an internal diameter of 100 mm under normal conditions require a smallest wall thickness of 5 mm (other standard thicknesses are 7,5 and 10 mm, respectively).

[0003] One disadvantage of previously known cylinder tubes is that the material consumption becomes relatively large. This implies that the manufacturing cost becomes comparatively large, at the same time as the mass of the cylinder tube as such influences the dead weight of the finished cylinder in a negative way. Another disadvantage, which to a large extent contributes to a high manufacturing cost, is the fact that the two gable pieces are manufactured as separate components. Thus, the manufacturing not only of the tube and the piston rod with the piston, but also the manufacturing of each one of the two gable pieces, must be realized in separate work operations, each one comprising several

machining steps; something that *inter alia* involves that many different parts have to be kept and transported in a circumstantial manner before they reach a final assembly station. In connection with such a handling, there is a risk of an erroneous assembly as well as of cassations. Another disadvantage being inherent in the type of hydraulic cylinders that utilizes welding for joining a gable piece with the tube, is that the welding partly destroys the tensile strength that is conferred to the tube in connection with cold forming. In other terms, the welding operation as such implies that the tube must be given relatively strong dimensions.

[0004] The present invention aims at eliminating the above mentioned disadvantages and at creating an improved hydraulic cylinder mechanism. Thus, a primary object of the invention is to provide a mechanism that may be composed by extremely few components. Another object is to provide a mechanism whose cylinder tube, for a given strength value relative to the capability of resisting hydraulic pressure as well as to impact resistance and similar, may be manufactured with a small material thickness. Still another object of the invention is to provide a mechanism that may be produced in series in an effective manner without any need of welding. It is also an object of the invention to provide a mechanism for which necessary channels for hydraulic oil may be accomplished in a simple and cost-saving manner.

[0005] According to the invention, at least the primary object is obtained by the features mentioned in the characterizing clause of claim 1. Advantageous embodiments of the hydraulic cylinder mechanism according to the invention are further defined in the dependent claims.

[0006] Document US-A-2,724,368 discloses an hydraulic cylinder mechanism comprising a tube and a gable piece for the sealing thereof and with a through-bore for a rod, said gable piece being made of one piece with the cylinder tube, said tube being made of cast iron.

Further Elucidation of the Prior Art

[0007] It is previously known per se to form tubes with thickened, ring-shaped portions at opposed ends by cold forming or cold drawing, see for instance FR 1 457 184, FR 1 458 820, FR 2 430 277, DE 2 741 071, DE 2 806 368 and EP 0 106 751. However, such tubes have not previously been used as cylinder tubes in hydraulic cylinder mechanisms and even less been formed with a piston rod bore with annular grooves for the accommodation of sealing rings.

Brief Description of the Appended Drawings

[0008] In the drawings

fig 1 is a partly cut planar top view of a mechanism made according to the invention, in the form of a hydraulic cylinder,

- fig 2 is a vertical longitudinal section through the hydraulic cylinder according to fig 1,
 fig 3 is an enlarged section through the piston rod end of the cylinder,
 fig 4 is an enlarged detail section showing the opposed end of the cylinder tube,
 fig 5 is a schematic illustration of a first step in a cold forming operation of a type known *per se*, and
 fig 6 is a schematic illustration of a second step in the operation.

Detailed Description of a Preferred Embodiment of the Invention

[0009] In fig 1 and 2 a mechanism is shown in the form of a hydraulic cylinder that comprises a cylinder tube generally designated by reference numeral 1 and two gable pieces 2 and 3, respectively, at opposed ends of the tube. Further, the mechanism includes a piston 4 and a rod 5 that are reciprocally movable relative to the cylinder tube. In the example, the hydraulic cylinder is double-acting, the piston 4 separating a plus chamber 6 from a minus chamber 7. The gable piece 3 comprises a flattened portion 8 with a transverse aperture 9 for receiving an arbitrary coupling means. In the gable piece 3 is also comprised an L-shaped channel 42 for the feeding of oil or any other hydraulic medium into and out of the plus chamber 6.

[0010] Contrary to conventional hydraulic cylinders, which are based on the use of two separately manufactured and mounted gable pieces, the first gable piece 2 according to the invention is made in one piece with the very tube 1. In order to briefly elucidate how the manufacturing is effected, reference is made to fig 5 and 6. Here is shown how a truly cylindrical blank 10 of a certain length is cold formed in one or several passes by means of one or several mandrels 11 and dies 12. In the example shown, the die 12 is thought to be fixed and the mandrel 11 movable reciprocally, although the inversed relation is also feasible. The die comprises a central hole 13 with a conically tapering front portion and a substantially cylindrical rear portion. When the blank 10 has been forced to pass the dies in question in one or several steps, the product shown in fig 6 is obtained, which has the character of an intermediate blank which is finish-machined by turning, milling and/or drilling. More precisely, this intermediate blank comprises a tube-forming portion 1', a first thickened portion 2' that is turned inwards, and a second thickened portion 14 that is turned outwards.

[0011] In order to form the ready gable piece 2 that is integrated with the tube 1, the thickened portion 2' is finish-machined in different ways. In one step, the hole in the intermediate piece is drilled or turned under the formation of a cylinder-shaped bore 15 that has a comparatively snug fit in relation to the mounted piston rod 5 and that is centrally located in relation to the tube. In other terms, by fine machining of the intermediate blank,

it is guaranteed that the geometrical axis designated A becomes common for the bore or the cylinder surface 15, as well as for the inner, cylindrical surface 16. Moreover, in the cylinder surface 15 are provided a number of grooves 17, 18, 19 for a corresponding number of sealing rings 20, 21, 22. These sealing rings have two tasks, namely to achieve a reliable sealing in the boundary zone between the cylinder bore 15 and the outside of the piston rod, and to achieve a steering of the piston rod, so that it always moves centrically.

[0012] In another machining step, the thickened portion 2' is also formed with a conically shaped, smooth surface 23 which together with the outside of the piston rod delimits a space designated by 24, that opens towards the minus chamber 7.

[0013] In a further step a channel 25 is formed, preferably by drilling, for the feeding of hydraulic oil into and out of, respectively, the minus chamber. This channel consists of one single linear hole that may be manufactured in a very simple way, preferably by drilling. This linear, simple extension of the hole 25 is possible thanks to the fact that the hole leads to the cone surface 23 and its adjacent space 24. Although it would be feasible to make the hole oblique relative to the longitudinal axis of the cylinder, the former is, as shown in fig 3, advantageously perpendicularly oriented to said longitudinal axis, i.e., radially. The outer end of the hole leads to a plane-machined surface 26 and in connection with the hole 25 (see fig 1) there are provided four threaded holes 27, by means of which a hose coupling means may be mounted which is particularly resistant against high oil pressures. This coupling means is of a conventional type and is therefore not shown in the drawings. In this context it may also be mentioned that the outer diameter of the main part of the gable piece may, when necessary, be reduced at least somewhat in relation to the outer diameter of the tube.

[0014] Also the other thickened, outwardly directed portion 14 of the intermediate blank is finish-machined in a number of machining steps. Thus, the thickened portion 14 is internally recessed, e.g. by turning, so that the portion along a major portion of its longitudinal extension obtains a larger inner diameter than the tube part 1 *per se*. An internal thread 29 is delimited via an internal groove 28 from an inner region with a substantially cylinder-shaped portion 30 and a conically tapering portion 31. The gable piece 3 has an external thread 32 arranged to cooperate with the thread 29. At a certain distance inside the thread 32, there is provided a groove 33, in which is accommodated a sealing ring 34. More precisely, the groove 33 is formed in a substantially cylindrical portion 35 (and a conical portion 36) that is located inside the cylindrical surface 30 of the cylinder tube. The inner diameter of the thread tops of the internal thread 29 is somewhat larger than the outer diameter of said cylindrical portion 35. More precisely, this diameter difference is so large, that the sealing ring 33 has a clearance to the thread tops also when the sealing initially

protrudes somewhat from the cylinder surface 35.

[0015] According to the exemplified embodiment, the piston 4 is detachably connected with the piston rod 5. More precisely, the piston is connected with the rod via a locking ring 37 that engages into an external groove 38 in the piston rod and is kept fixed against the piston 4 by means of a clamping ring 39 and a screw joint comprising a suitable number of screws 40. On the outside of the piston 4, there are conventional sealing rings 41.

[0016] The assembly of the shown hydraulic cylinder is suitably effected in the following way. In a first step, the piston 4 is fixed on the rod 5, and the free end of the piston rod is led into the cylinder tube 1 from the left to the right in fig 2, to eventually be taken through the open gable piece 2. Thereafter, the separately manufactured gable piece 3 is mounted quite simply by being taken into the end of the cylinder tube and screwed by means of the thread coupling 29, 32. However, it is also possible to proceed in the opposite way, i.e., by introducing only the piston rod 5 via the bore 15 in the direction from the right to the left, whereafter the piston 4 is mounted on the piston rod before the gable piece 3 is applied.

[0017] A fundamental advantage of the invention is that the gable piece 2 provided with a hole does not need to be produced as a separate component. Inter alia, this implies that the accuracy requirements made on a hydraulic cylinder may be fulfilled in the simplest possible way. Thus, a dimensional accuracy is only required in connection with the drilling or the forming of the hole or bore 15 in the gable piece, but not in any coupling means, such as threads. Another advantage of the hydraulic cylinder according to the invention is that it lacks weakening welded joints, at the same time as the cylinder tube *per se* may be produced with a minimal material thickness for a given strength, in that the tube is manufactured by cold forming without thereafter being heated and, thereby, weakened. Moreover, the risk of defective welds is eliminated. To this comes the fact that the manufacturing becomes procedurally simple. Inter alia, the necessity of separate transports and storages of the tube and the gable piece provided with a hole is removed.

Feasible Modifications of the Invention

[0018] The invention is not restricted solely to the embodiment as described and shown in the drawings. Hence, it is feasible to connect the loose gable piece with the cylinder tube in another way than by means of an internal thread joint. For instance, an external thread joint, a joint with a locking ring or a bolt joint could be used. Other modifications are also feasible within the scope of the appended claims.

Claims

1. A hydraulic cylinder mechanism comprising a tube

(1) of cylindrical basic shape and two gable pieces (2, 3) for the sealing thereof, of which pieces a first one (2) has an axial through-bore for a rod (5) and a piston (4), said first gable piece (2) being made in one piece with the cylinder tube (1) *per se*, more precisely by having the shape of a first thickened material portion, which first material portion extends inwards in relation to the inside of the tube (1) *per se*, the through-bore being delimited by a generally cylindrical surface (15), in which is/are recessed one or several ring-shaped grooves (17, 18, 19) for the accommodation of a corresponding number of sealing rings (20, 21, 22), **characterized in that** the cylinder tube is made by cold forming of a tube-shaped blank (10) of metal, the first gable piece having been produced during said cold forming, and **in that** the second gable piece (3) is formed as a separate unit, which is - after the mounting of the piston (4) and the piston rod (5) in the cylinder tube - connected to a second thickened material portion (14) that has been produced during said cold forming, which second material portion extends outwards in relation to the outside of the tube (1).

2. A hydraulic cylinder mechanism according to claim 1, the same being of a double-acting type, **characterized in that** a channel (25) for the feeding of a hydraulic medium into and out of, respectively, a minus chamber (7) is provided in said first gable piece (2).

3. A hydraulic cylinder mechanism according to claims 1 and 2, **characterized in that** inside said groove (17, 18, 19) is a portion of the first gable piece (2) that is shaped with a space (24) which opens towards the interior of the cylinder tube, the hydraulic medium channel (25) leading to said space (24).

4. A hydraulic cylinder mechanism according to claim 3, **characterized in that** said space (24) widens in the direction of the interior of the cylinder tube, more precisely by being delimited by a conical surface (23).

5. A hydraulic cylinder mechanism according to claim 3 or 4, **characterized in that** the channel (25) has the shape of a simple, drilled hole that extends linearly between the outside and the inside of the gable piece.

6. A hydraulic cylinder mechanism according to claim 5, **characterized in that** the hole (25) extends radially, i.e., perpendicularly to the geometrical central axis (A) of the hydraulic cylinder.

7. A hydraulic cylinder mechanism according to any of the preceding claims, **characterized in that** the outwardly directed, second thickened portion (14)

has an internal thread (29), whose diameter in the region of the thread tops is smaller than the inner diameter of the tube (1), as well as the inner diameter of a cylindrical tube portion (30), against which acts an elastic sealing ring (34).

Patentansprüche

1. Hydraulikzylindermechanismus, aufweisend ein Rohr (1) zylindrischer Grundform und zwei Giebelelemente (2, 3) zur Abdichtung desselben, von welchen ein erstes Element (2) eine axiale Durchgangsbohrung für eine Stange (5) und einen Kolben (4) aufweist, wobei das erste Giebelelement (2) per se einstückig mit dem Zylinderrohr (1) hergestellt ist, genauer gesagt dadurch, dass es die Form eines ersten verdickten Materialabschnitts aufweist, der während eines Kaltformvorgangs hergestellt wird, wobei der erste Materialabschnitt sich per se einwärts relativ zur Innenseite des Rohrs (1) erstreckt, wobei die Durchgangsbohrung durch eine allgemein zylindrische Oberfläche (15) begrenzt ist, in welche eine ringförmige Nut oder mehrere derartige Nuten (17, 18, 19) zur Aufnahme einer entsprechenden Anzahl von Dichtringen (20, 21, 22) eingetieft ist, bzw. sind, **dadurch gekennzeichnet, dass** das Zylinderrohr durch Kaltformen aus einem rohrförmigen Rohlink (10) aus Metall hergestellt ist, und dass das zweite Giebelelement (3) als getrennte Einheit gebildet ist, welche - nach dem Anbringen des Kolbens (4) und der Kolbenstange (5) in dem Zylinderrohr - mit einem zweiten verdickten Materialabschnitt (14) verbunden wird, das während des Kaltformvorgangs hergestellt worden ist, wobei der zweite Materialabschnitt sich relativ zur Außenseite des Rohrs (1) auswärts erstreckt.
2. Hydraulikzylindermechanismus nach Anspruch 1, vom doppelt wirkenden Typ, **dadurch gekennzeichnet, dass** ein Kanal (25) zum Einleiten eines Hydraulikmediums in eine Minuskammer (7) bzw. zum Ausleiten aus derselben in dem ersten Giebelelement (2) vorgesehen ist.
3. Hydraulikzylindermechanismus nach Anspruch 1 und 2, **dadurch gekennzeichnet, dass** in der Nut (17, 18, 19) ein Abschnitt des ersten Giebelelements (2) vorgesehen ist, der mit einem Raum (24) geformt ist, der in Richtung zum Inneren des Zylinderrohrs ausmündet, wobei der Hydraulikmediumkanal (25) zu dem Raum (24) führt.
4. Hydraulikzylindermechanismus nach Anspruch 3, **dadurch gekennzeichnet, dass** der Raum (24) in Richtung zum Inneren des Zylinderrohrs aufweitet, genauer gesagt, indem er durch eine Konusfläche (23) begrenzt ist.

5. Hydraulikzylindermechanismus nach Anspruch 3 oder 4, **dadurch gekennzeichnet, dass** der Kanal (25) die Form eines einfachen Bohrlochs aufweist, das sich linear zwischen der Außenseite und der Innenseite des Giebelelements erstreckt.
6. Hydraulikzylindermechanismus nach Anspruch 5, **dadurch gekennzeichnet, dass** das Loch (25) sich radial, d. h., senkrecht zur geometrischen Mitlenachse (A) des Hydraulikzylinders erstreckt.
7. Hydraulikzylindermechanismus nach einem der vorangehenden Ansprüche, **dadurch gekennzeichnet, dass** der auswärts gerichtete zweite verdickte Abschnitt (14) ein Innengewinde (29) aufweist, dessen Durchmesser im Bereich der Gewindeoberseite kleiner ist als der Innendurchmesser des Rohrs (1) und der Innendurchmesser eines zylindrischen Rohrabchnitts (30), gegen welchen ein elastischer Dichtring (24) wirkt.

Revendications

1. Mécanisme de cylindre hydraulique comprenant un tube (1) d'une forme de base cylindrique et deux pièces de pignon (2, 3) pour son scellement, dont une première pièce (2) présente un alésage axial pour une tige (5) et un piston (4), ladite première pièce de pignon (2) étant constituée en une pièce avec le tube de cylindre (1), plus précisément en ayant la forme d'une première partie de matière épaissie qui a été produite pendant ledit formage à froid, laquelle première partie de matière s'étend vers l'intérieur par rapport à l'intérieur du tube (1), l'alésage étant délimité par une surface généralement cylindrique (15), dans laquelle sont disposées en creux une ou plusieurs rainures en forme de bague (17, 18, 19) pour la réception d'un nombre correspondant de bagues d'étanchéité (20, 21, 22), **caractérisé en ce que** le tube de cylindre (2) est fabriqué par formage à froid d'une ébauche en forme de tube (10) de métal et **en ce que** la seconde pièce de pignon (3) est formée comme une unité séparée, qui est - après le montage du piston (4) et de la tige de piston (5) dans le tube de cylindre - connectée à une seconde partie de matière épaissie (14) qui a été produite pendant ledit formage à froid, laquelle seconde partie de matière s'étend vers l'extérieur par rapport à l'extérieur du tube (1).
2. Mécanisme de cylindre hydraulique selon la revendication 1, celui-ci étant du type à double action, **caractérisé en ce qu'**un canal (25) pour l'alimentation d'un milieu hydraulique dans et hors de, respectivement, une chambre minuscule (7) est prévue dans ladite première pièce de pignon (2).

3. Mécanisme de cylindre hydraulique selon les revendications 1 ou 2, **caractérisé en ce que**, à l'intérieur de ladite rainure (17, 18, 19), est disposée une partie de la première pièce de pignon (2) qui est formée avec un espace (24) qui s'ouvre vers l'intérieur du tube de cylindre, le canal de milieu hydraulique (25) conduisant audit espace (24). 5
4. Mécanisme de cylindre hydraulique selon la revendication 3, **caractérisé en ce que** ledit espace (24) s'élargit dans la direction de l'intérieur du tube de cylindre, plus précisément en étant délimité par une surface conique (23). 10
5. Mécanisme de cylindre hydraulique selon la revendication 3 ou 4, **caractérisé en ce que** le canal (25) présente la forme d'un trou simple percé qui s'étend linéairement entre l'extérieur et l'intérieur de la pièce de pignon. 15
6. Mécanisme de cylindre hydraulique selon la revendication 5, **caractérisé en ce que** le trou (25) s'étend radialement, à savoir perpendiculairement à l'axe central géométrique (A) du cylindre hydraulique. 20 25
7. Mécanisme de cylindre hydraulique selon l'une quelconque des revendications précédentes, **caractérisé en ce que** la seconde partie épaissie (14) dirigée vers l'extérieur présente un filet interne (29), dont le diamètre dans la région des crêtes de filet est plus petit que le diamètre interne du tube (1), de même que le diamètre interne d'une partie du tube cylindrique (30), contre laquelle agit une bague d'étanchéité élastique (34). 30 35

40

45

50

55

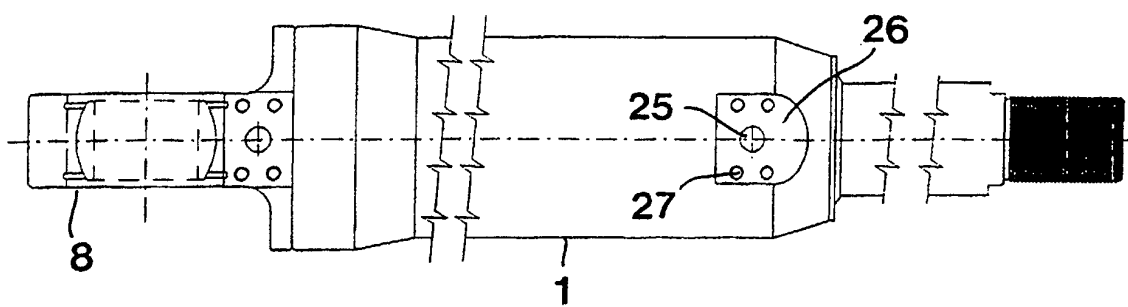


Fig 1

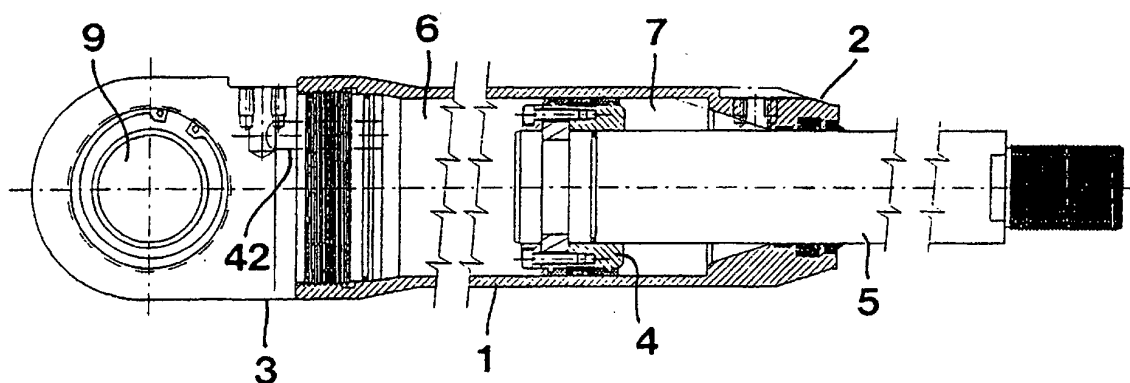


Fig 2

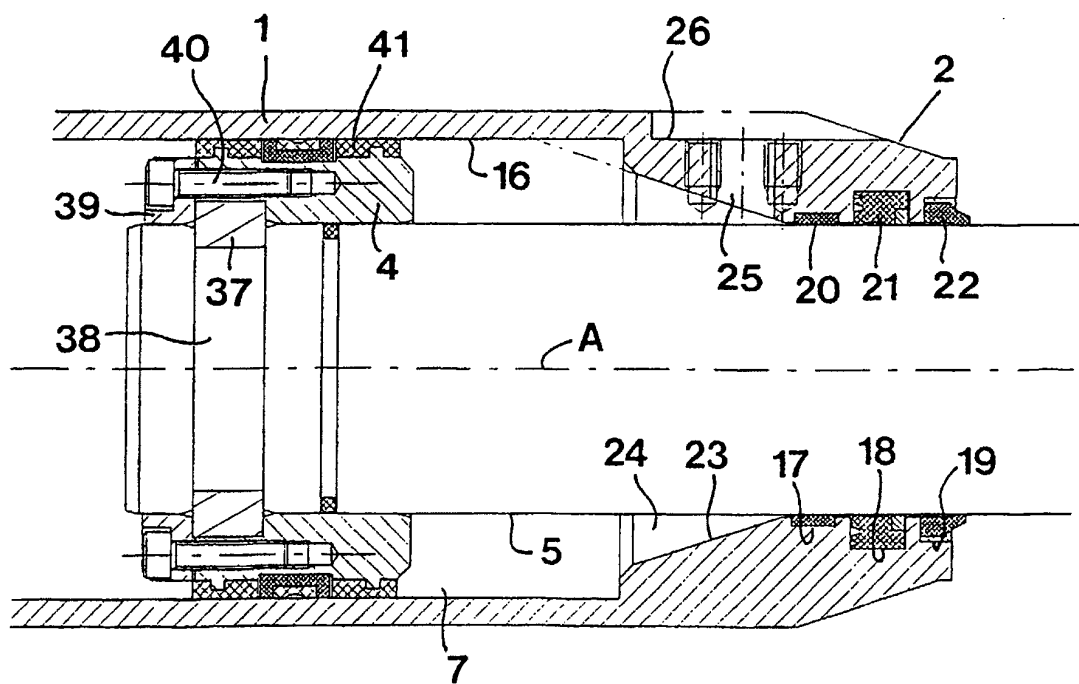


Fig 3

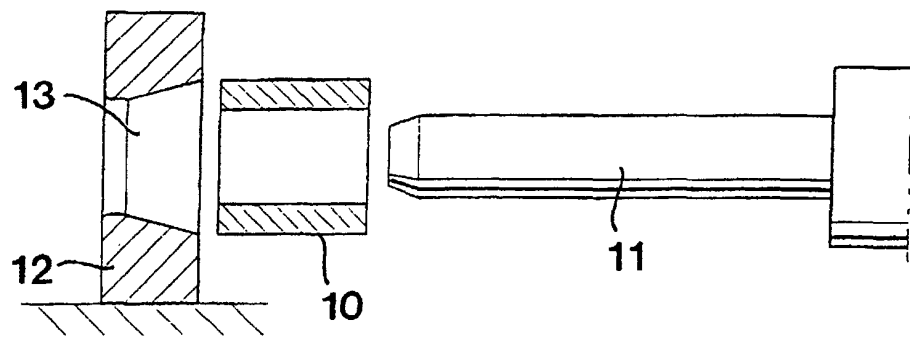


Fig 5

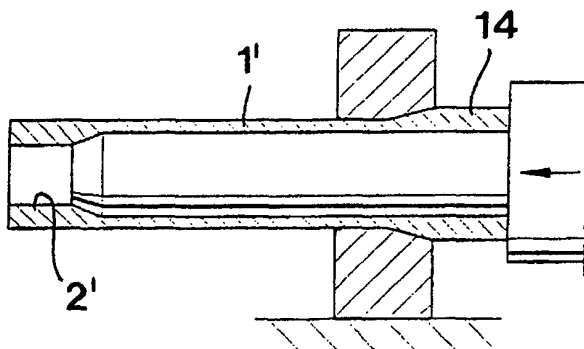


Fig 6

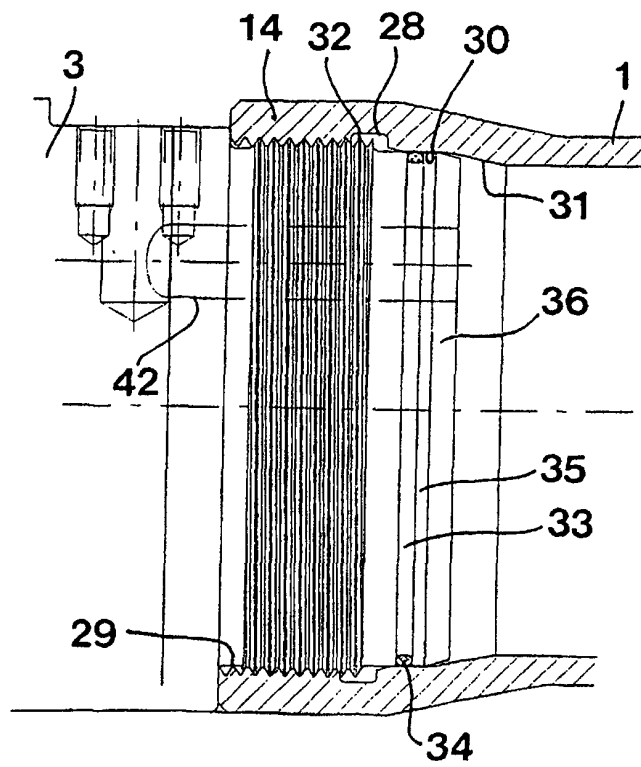


Fig 4