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(54) **Hydraulic cylinder**

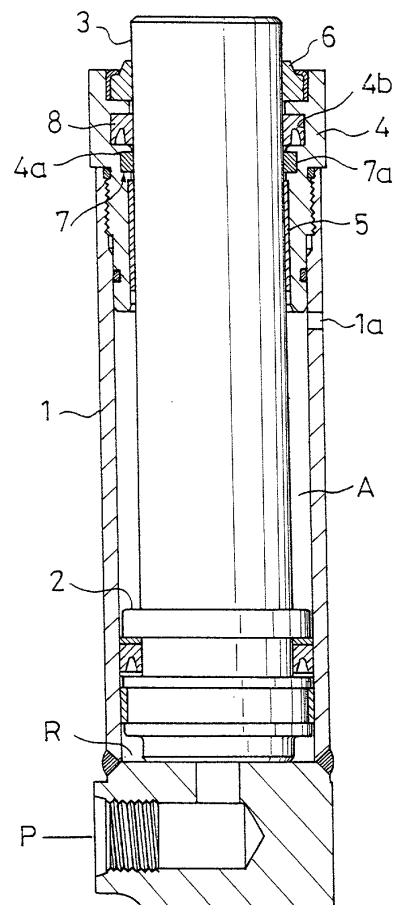
(57) A hydraulic cylinder comprises a cylinder body (1), a piston (2) slidably received in the cylinder body (1) to partition a rod side chamber (A) from a counter rod side chamber (R), a rod body (3) having an end connected to the piston (2), and a head member (4) at an end of the rod side chamber (A) opposite to the piston (2), the head member (4) having a bearing (5) in sliding contact with the outer circumference of the rod body (3) and a dust seal (6).

The hydraulic cylinder extends when pressurized liquid (P) is supplied to the counter rod side chamber (R) and contracts when the pressurized liquid (P) is released from the counter rod side chamber (R).

The head member (4) includes lubrication means (7) in sliding contact with the outer circumference of the rod body (3) between the bearing (5) and the dust seal (6), and an oil seal (8) in sliding contact with the outer circumference of the rod body (3) between the lubrication means (7) and the dust seal (6).

The lubrication means (7) lubricates the inner surface of the bearing (5) and the outer surface of the rod body (3) to provide a smooth sliding operation with low friction and without rusting or scratching of the outer surface of the rod body (3) which might abrade the bearing (5) or damage the dust seal (6). The oil seal (8) retains the lubricant within the cylinder body (1) to prevent excessive cumulative loss of lubricant as the hydraulic cylinder repeatedly expands and contracts.

FIG. 1



## Description

### BACKGROUND OF THE INVENTION

**[0001]** The present invention relates to a hydraulic cylinder, and particularly to an improvement in a single-acting type hydraulic cylinder suitable for use with a forklift.

**[0002]** In the past, a single-acting type hydraulic cylinder for a forklift is operated to be extended, for example, as shown in FIG. 2, when liquid pressure P is supplied from the outside to a liquid chamber R which is a chamber on the counter rod side partitioned by a piston 2 slidably inserted into a cylinder body 1.

**[0003]** Further, the hydraulic cylinder is operated to be contracted when a supply of liquid pressure P to the liquid chamber R is released whereas a rod body 3 having a proximal end connected to the piston 2 gets into the cylinder body 1 due to own weight or load exerting on the extreme end to contract the liquid chamber R through the piston 2.

**[0004]** At this time, the rod side chamber partitioned by the piston 2 within the cylinder body 1 which is an air chamber A is in many cases communicated with the atmosphere outside the cylinder body 1 through a communication hole 1a bored in the cylinder body 1.

**[0005]** On the other hand, the rod body 3 which moves in and out of the cylinder body 1 extends through an axial part of a head member 4 forming an open end of the cylinder body 1. At this time, a bearing 5 for causing the outer circumference of the rod body 3 to sliding contact therewith is disposed in the inner circumference internally of the cylinder body 1 in the head member 4, and a dust seal 6 for causing the outer circumference of the rod body 3 to sliding contact therewith is disposed in the inner circumference of an open end in the head member 4.

**[0006]** Therefore, in the hydraulic cylinder, for example, when it is used for a forklift, a fork loaded with baggage can be moved up by the extension action thereof, and the fork loaded with baggage can be moved down by the contraction action thereof. At this time, when the rod body 3 is moved in and out of the cylinder body 1, the bearing 5 compensates for slidability of the rod body 3 with respect to the head member 4 whereas the dust seal 6 wipes out so-called dust adhered to the outer circumference of the rod body 3 so that dust is not drawn into the cylinder body 1.

**[0007]** However, the conventional hydraulic cylinder shown in FIG. 2 involves a fear that when the rod body 3 is moved in and out of the cylinder body 1, so-called heat generation occurs, and rust, discoloration and scratch due to the heat generation appear on the outer circumference of the rod body 3.

**[0008]** That is, in the above-described hydraulic cylinder, since the rod side chamber partitioned by the piston 2 within the cylinder body 1 comprises the air chamber A, so-called dry is formed between the inner circum-

ference of the bearing 5 and the outer circumference of the rod body 3, tending to poor lubrication as compared with the case of so-called wet where an oily sliding coating is formed.

**[0009]** Therefore, when sliding movement is frequently repeated between the rod body 3 and the bearing 5, particularly when sliding movement such that the rod body 3 is pressed against the bearing 5 is repeated, a heat generation phenomenon tends to appear between the inner circumference of the bearing 5 and the outer circumference of the rod body 3.

**[0010]** Then, when the heat generation phenomenon appears, a degeneration is brought forth in the outer circumference of the rod body 3 due to the heat generation, and rust or discoloration appears on the outer circumference of the rod body 3 due to the degeneration.

**[0011]** At this time, also in the bearing 5, abrasion is accelerated to deteriorate a function of bearing, and scratched phenomenon appears on the outer circumference of the rod body 3, resulting in damage of even the dust seal 6.

**[0012]** As a consequence, occurrence of rust or formation of scratches in the outer circumference of the rod body 3 further lowers so-called slidability of the rod body 3 with respect to the cylinder body 1, posing an inconvenience being impossible to expect the desired permanent operation of the hydraulic cylinder.

### SUMMARY OF THE INVENTION

**[0013]** The present invention has been created in view of the above-described circumstances, and aims to provide a single-acting type hydraulic cylinder which is operated to be expanded and contracted by supply and discharge of liquid pressure from so-called bottom side, the hydraulic cylinder being optimum for permanently securing the desired operation without bringing forth abrasion of a bearing and damage of a dust seal caused by rust or scratch in the outer circumference of a rod body.

**[0014]** In accordance with the present invention, there is provided a hydraulic cylinder fundamentally constituted such that the cylinder is operated to be extended when liquid pressure from outside is supplied to a liquid chamber which is a counter rod side chamber partitioned by a piston slidably inserted into a cylinder body, the cylinder is operated to be contracted when a supply of liquid pressure to the liquid chamber is released whereas a rod body having a proximal end connected to a piston is moved into the cylinder body due to own weight or load exerting on the extreme end, and a head member forming an open end of a cylinder body for moving in and out of the rod body has a bearing for causing the outer circumference of the rod body to sliding contact therewith and a dust seal, the hydraulic cylinder, in the head member, comprising in series, a lubrication means in sliding contact with the outer circumference of the rod body on the bearing side between the bearing

and the dust seal, and an oil seal in sliding contact with the outer circumference of the rod body on the dust seal side.

**[0015]** In the above-described constitution, more concretely, the lubrication means is that for example, a lubricating material such as grease is stored in an inner circumferential groove at a predetermined position formed in the inner circumference of the head member, or a suitable impregnate material is received in the inner circumferential groove, the impregnate material being impregnated with a suitable lubricating material.

**[0016]** Further, the rod side chamber partitioned by a piston within the cylinder body comprising an air chamber is communicated with the atmosphere outside the cylinder body through a communication hole bored in the cylinder body, or is set to an air spring chamber having a seal construction not in communication with the atmosphere outside the cylinder body while being an air chamber.

#### DESCRIPTION OF THE DRAWINGS

##### **[0017]**

FIG. 1 is a partly cutaway cross sectional view of a hydraulic cylinder according to one embodiment of the present invention.

FIG. 2 is a partly cutaway cross sectional view of a conventional hydraulic cylinder.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

**[0018]** In the following, the present invention will be described on the basis of an embodiment shown in the figure. As shown in FIG. 1, the hydraulic cylinder according to the present invention is also constituted fundamentally similar to the aforementioned conventional hydraulic cylinder, which is set to a single-acting hydraulic cylinder operated to be expanded and contracted by a supply and discharge of liquid pressure P from so-called bottom side.

**[0019]** Therefore, in the following description, with respect to the constitution similar to that of the prior art shown in FIG. 2, parts thereof are designated by the same reference numerals in the figure except those as necessary, details of which are omitted.

**[0020]** That is, in the hydraulic cylinder according to the present invention, a bearing 5 is provided in the inner circumference inside a cylinder body 1 in a head member 4, and a dust seal 6 is provided in the inner circumference of an open end in the head member 4. A lubrication means 7 and an oil seal 8 are provided in series between the bearing 5 and the dust seal 6, that is, in series in an axial direction of a rod body 3.

**[0021]** At this time, in the inner circumference of the head member 4, the lubrication means 7 is located on the bearing 5 side, that is, on the air chamber A side

within the cylinder body 1 whereas the oil seal 8 is located on the dust seal 6 side, that is, on the external side of the cylinder body 1 to prevent the lubrication effect of the lubrication means from so-called escaping outside the cylinder body 1 by the oil seal 8.

**[0022]** Incidentally, in the illustration, the lubrication means 7 stores, for example, a lubricating material 7a such as grease within an inner circumferential groove 4a at a predetermined position formed in the inner circumference of the head member 4.

**[0023]** Incidentally, the lubrication means 7 will suffice, as a result, to form a lubricating coating (not shown and not designated by symbol) between the inner circumference of the bearing 5 and the outer circumference of the rod body 3. Therefore, in place of the above-described constitution, a suitable impregnate material may be received in the inner circumferential groove 4a, and a suitable lubricating material, that is, the lubricating material 7a such as grease described above may be impregnated in the impregnate material.

**[0024]** On the other hand, since the oil seal 8 comprises a so-called U packing received in an inner circumferential groove 4b at a predetermined position formed in the inner circumference of the head member 4 similar to the above-described inner circumferential groove 4a, the inner circumference of which comes in sliding contact with the outer circumference of the rod body 3.

**[0025]** At this time, the oil seal 8 has a function such that a lubrication coating from the internal side of the cylinder body 1 adhered to the outer circumference of the rod body 3, that is, from the lubrication means 7 side is remained on the lubrication means 7 side so as to prevent the coating from flowing out to the external side of the cylinder body 1, that is, to the dust seal 6 side.

**[0026]** Therefore, the hydraulic cylinder according to the present invention is operated to be extended, for example, when it is used for a forklift, when liquid pressure P from the outside is supplied to a liquid chamber R partitioned by a piston 2 within the cylinder body 1, at which time a fork loaded with baggage is to be moved up.

**[0027]** Further, when likewise it is used for a forklift, a supply of liquid pressure P to the liquid chamber R is released, whereas the hydraulic cylinder is operated to be contracted when the rod body 3 is moved into the cylinder body 1 due to a load such as own weight, at which time a fork loaded with baggage is to be moved down.

**[0028]** In the foregoing, the air chamber A which is a rod side chamber partitioned within the cylinder body 1 is communicated with the atmosphere outside the cylinder body 1 through a communication hole 1a bored in the cylinder body 1, and therefore, the above-described expansion and contraction operation is realized without so-called resistance.

**[0029]** Further, at the time of the above-described expansion and contraction, that is, at the time when the rod body 3 is moved in and out of the cylinder body 1, the outer circumference of the rod body 3 comes in slid-

ing contact with not only the bearing 5 and the dust seal 6 disposed in the inner circumference of the head member 4 forming an open end of the cylinder body 1 but also the lubrication means 7 and the oil seal 8.

**[0030]** At this time, the bearing 5 secures slidability of the rod body 3 with respect to the cylinder body 1 whereas the dust seal 6 prevents entry of dust adhered to the outer circumference of the rod body 3 into the cylinder body 1.

**[0031]** At the same time, the lubrication means 7 forms a lubrication coating between the inner circumference of the bearing 5 and the outer circumference of the rod body 3 to lower sliding friction therebetween, and the oil seal 8 is able to prevent the lubricating material 7a forming a lubrication coating from escaping to the external side of the cylinder body 1, thus permanently securing lubrication between the bearing 5 and the rod body 3.

**[0032]** In the foregoing, in the hydraulic cylinder, the rod side chamber partitioned by the piston 2 within the cylinder body 1 comprises the air chamber A which is communicated with the atmosphere outside the cylinder body 1 through the communication hole 1a bored in the cylinder body 1, but in place thereof, though not shown, there can be employed an air spring chamber having a seal construction in which the air chamber A is not communicated with the atmosphere outside the cylinder body 1.

**[0033]** And, in a case where the air chamber A is set in the air spring chamber, there is an advantage in that when the extended hydraulic cylinder is contracted, contraction of the hydraulic cylinder is quickly realized by spring reaction generated in the air spring chamber.

**[0034]** Further, in the foregoing, the oil seal 8 is disposed adjacent to the dust seal 6, but a second lubrication means additional to the lubrication means 7 may be provided between the oil seal 8 and the dust seal 6. In this case, the outer circumference of the rod body 3 which is so-called dry in the oil seal 8 can be maintained to be wet, which is advantageous in that further lubrication is secured.

**[0035]** As described above, in the present invention, there becomes possible to effect expansion and contraction operation for moving the rod body in and out of the cylinder body by a supply and discharge of liquid pressure to the liquid chamber partitioned on the bottom side within the cylinder body. When the hydraulic cylinder is used, for example, for a forklift, it becomes possible to elevate the fork loaded with baggage.

**[0036]** At this time, in a case where the air chamber which is a rod side chamber partitioned within the cylinder body is communicated with the atmosphere outside the cylinder body, the expansion and contraction operation is realized without so-called resistance, and further, in a case where the air chamber is set in the air spring chamber having a seal construction, contraction of the hydraulic cylinder extended by spring reaction generated in the air spring chamber can be realized

quickly.

**[0037]** Further, in the above-described expansion and contraction, that is, when the rod body is moved in and out of the cylinder body, the outer circumference of the rod body comes in sliding contact with the bearing disposed in the inner circumference of the head member forming an open end of the cylinder body to secure slidability of the rod body to the cylinder body; the dust seal disposed in the inner circumference of the head member prevents dust adhered to the outer circumference of the rod body from entering the cylinder body; the lubrication means disposed between the bearing and the dust seal forms a lubrication coating between the inner circumference of the bearing and the outer circumference of the rod body to lower sliding friction therebetween; and the oil seal disposed in series with the lubrication means and in the inner circumference of the head member enables to prevent the lubricating material forming the lubrication coating from escaping to the external side of the cylinder body to permanently secure lubrication between the bearing and the rod body.

**[0038]** Moreover, with respect to the disposition of the lubrication means and the oil seal, a slight change in design of the head member will suffice, not requiring a large scale change in design.

**[0039]** As a result, according to the present invention, there is provided a single-acting type hydraulic cylinder subjected to expansion and contraction operation by supply and discharge of liquid pressure from the so-called bottom side, which does not bring forth rust or scratch in the outer circumference of the rod body but is optimum for permanently securing the desired operation.

## Claims

### 1. A hydraulic cylinder comprising:

- a cylinder body (1);
- a piston (2) slidably received in the cylinder body (1) to partition a rod side chamber (A) from a counter rod side chamber (R);
- a rod body (3) having an end connected to the piston (2); and
- a head member (4) at an end of the rod side chamber (A) opposite to the piston (2), the head member (4) having a bearing (5) in sliding contact with the outer circumference of the rod body (3) and a dust seal (6);

wherein the hydraulic cylinder is operable to be extended when pressurized liquid (P) from outside is supplied to the counter rod side chamber (R) and is operable to be contracted when the pressurized liquid (P) is released from the counter rod side chamber (R);

**characterized in that** the head member (4)

further comprises lubrication means (7) in sliding contact with the outer circumference of the rod body (3) between the bearing (5) and the dust seal (6), and an oil seal (8) in sliding contact with the outer circumference of the rod body (3) between the lubrication means (7) and the dust seal (6). 5

2. A hydraulic cylinder according to claim 1, wherein the lubrication means (7) comprises a lubricating material (7a) such as grease stored in a circumferential groove (4a) formed in the inner circumference of the head member (4). 10

3. A hydraulic cylinder according to claim 1, wherein the lubrication means (7) comprises a material impregnated with lubricant and received in a circumferential groove (4a) formed in the inner circumference of the head member (4). 15

4. A hydraulic cylinder according to any preceding claim, wherein the rod side chamber (A) is an air chamber sealed to function as an air spring. 20

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FIG. 1

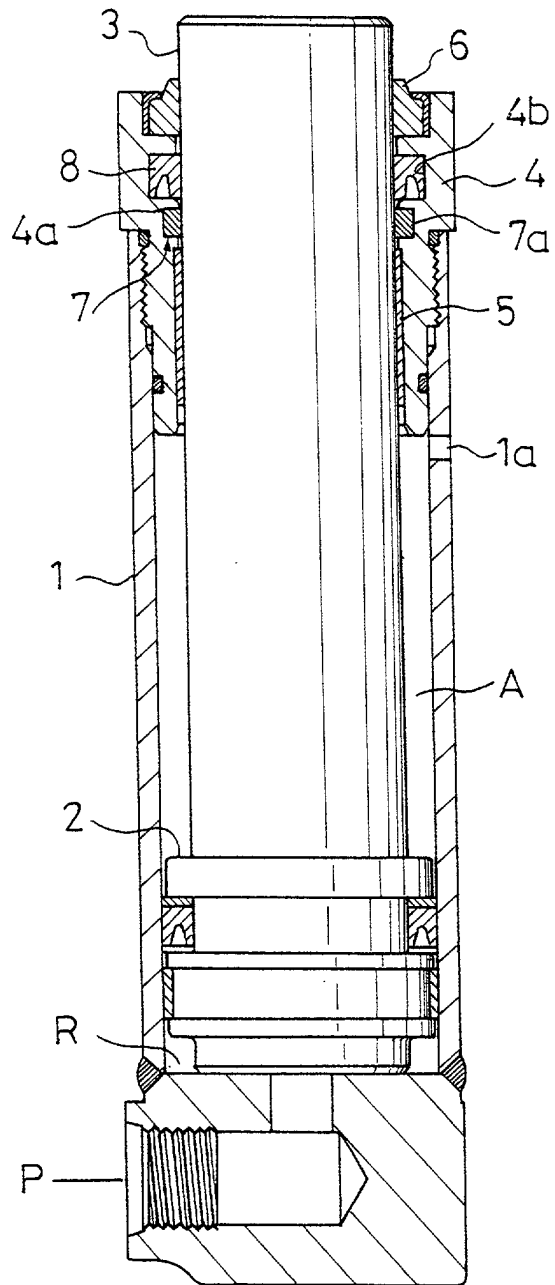
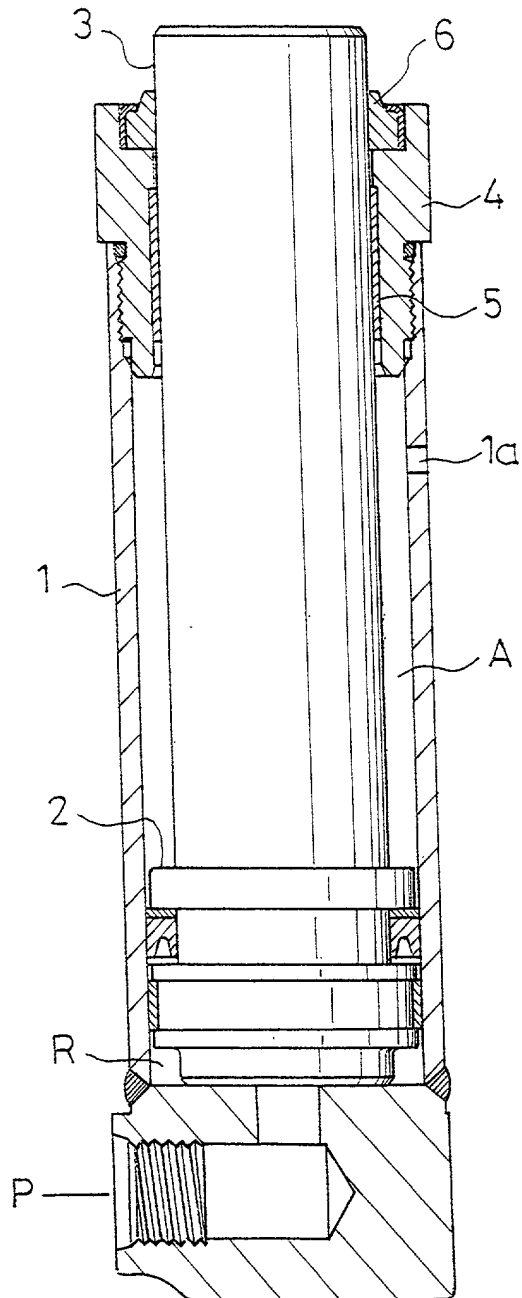


FIG. 2





European Patent  
Office

EUROPEAN SEARCH REPORT

Application Number  
EP 01 30 5519

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The present search report has been drawn up for all claims			
Place of search <b>THE HAGUE</b>		Date of completion of the search <b>15 January 2002</b>	Examiner <b>Busto, M</b>
<p>CATEGORY OF CITED DOCUMENTS</p> <p>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</p> <p>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</p> <p>.....                      &amp; : member of the same patent family, corresponding document</p>			

EPO FORM 1503 03/82 (P04C01)



**ANNEX TO THE EUROPEAN SEARCH REPORT  
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on  
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