



(11)

EP 3 483 456 A1

(12)

## EUROPEAN PATENT APPLICATION

(43) Date of publication:  
15.05.2019 Bulletin 2019/20

(51) Int Cl.:  
**F15B 15/28 (2006.01)**

(21) Application number: 18000841.9

(22) Date of filing: 29.10.2018

(84) Designated Contracting States:  
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB  
GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO  
PL PT RO RS SE SI SK SM TR**  
Designated Extension States:  
**BA ME**  
Designated Validation States:  
**KH MA MD TN**

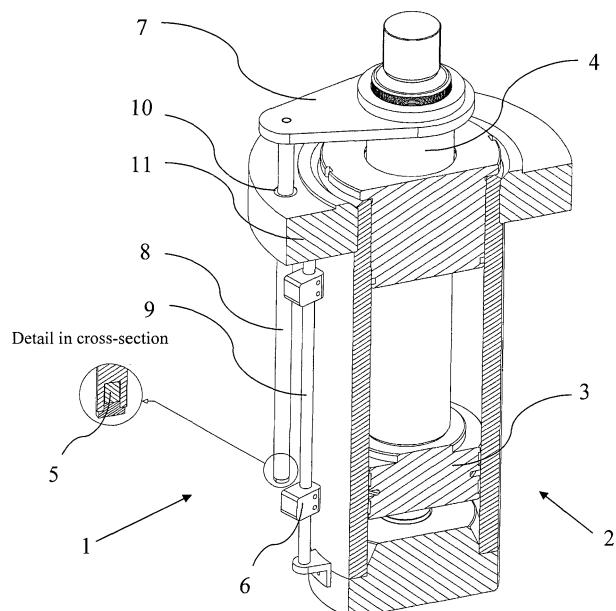
(30) Priority: 08.11.2017 SI 201700294

(71) Applicant: **INES d.o.o.  
4220 Skofja Loka (SI)**  
(72) Inventor: **JURCIC, Vinko  
4220 Skofja Loka (SI)**  
(74) Representative: **Golmajer Zima, Marjana  
Patentna pisarna d.o.o.  
Copova 14  
1000 Ljubljana (SI)**

### (54) DEVICE FOR DETECTING POSITION OF A PISTON IN A FLUID PRESSURE CYLINDER

(57) The invention refers to a device for detecting position of a piston in a fluid pressure cylinder by a magnetic sensor. The technical problem is how to conceive a device, in which the use of the material for the fluid pressure cylinder will not be limited to nonmagnetic materials, and to improve its reliability. The technical problem is solved by a device (1) for detecting a piston position in a fluid pressure cylinder, particularly in a hydraulic cylinder, comprising a fluid pressure cylinder (2), a piston (3) reciprocally slidable along the internal circumferential

surface of the fluid pressure cylinder (2), a piston rod (4) connected with its first end with the piston (3) and projecting with its another end through the front side of the fluid pressure cylinder (2), a permanent magnet (5), the movement of which corresponds to the movement of the piston (3), and at least one magnetic switch (6) arranged on the external side of the fluid pressure cylinder (2) and susceptible to being actuated by said permanent magnet (5), wherein the permanent magnet (5) is arranged on the external side of the fluid pressure cylinder (2).



## Description

### Field of Invention

**[0001]** The invention refers to a device for detecting position of a piston in a fluid pressure cylinder by a magnetic sensor, particularly in a hydraulic cylinder.

### Prior Art

**[0002]** Patent application US 4793241 A1 discloses a piston position detector for a fluid pressure cylinder operating by fluid pressure. The device comprises a non-magnetic cylinder, a piston sliding in the non-magnetic cylinder, an annular permanent magnet mounted circumferentially on the piston, and a magnetic detection element arranged on the outer surface of the cylinder to respond to the magnetic field formed by the permanent magnet, when the latter moves within the cylinder, and to generate electric signals. The cylinder is made of a non-magnetic material such as aluminium or non-magnetic steel.

### Technical Problem

**[0003]** The technical problem is how to conceive a device for detecting a piston position in a fluid pressure cylinder, particularly a hydraulic cylinder, wherein the use of the material for the fluid pressure cylinder will not be limited to non-magnetic materials such as aluminium or austenitic steel, as a result, a less expensive material such as conventional structural magnetic steel can be used as the material for the fluid pressure cylinder. A further goal of the invention is to conceive a device featuring better operation reliability.

### Solution to the Technical Problem

**[0004]** The technical problem is solved by a device for detecting a piston position in a fluid pressure cylinder, particularly in a hydraulic cylinder, comprising:

- a fluid pressure cylinder,
- a piston reciprocally slidable along the internal circumferential surface of the fluid pressure cylinder,
- a piston rod connected with its first end with the piston and projecting with its another end through the front side of the fluid pressure cylinder,
- a permanent magnet arranged on the external side of the fluid pressure cylinder such that its movement corresponds to the movement of the piston, and
- at least one magnetic switch arranged on the external side of the fluid pressure cylinder and susceptible to being actuated by said permanent magnet.

**[0005]** With both the permanent magnet and the magnetic switch being arranged outside the fluid pressure cylinder, the material selection is no longer limited to non-

magnetic materials such as aluminium or austenitic steel. The fluid pressure cylinder can also be made of magnetic materials such as martensitic or ferritic steels. This broadens the spectre of possible materials and a less expensive material can thus be selected, such as conventional structural steel.

**[0006]** The device of the invention has many other advantages over the prior art. One of these advantages is better reliability and better precision in detecting magnetic flux lines of the permanent magnet. When a permanent magnet is arranged within a fluid pressure cylinder, the magnetic flux lines get distorted due to the influence of the wall of the fluid pressure cylinder, due to the accumulation of tiny metallic particles on the permanent magnet, and due to an increased temperature within the fluid pressure cylinder. During the operation, the fluid in the fluid pressure cylinder heats due to the increased pressure of the fluid. A permanent magnet exposed to an increased temperature has a weaker magnetic field, though. The device of the invention eliminates these drawbacks and the reliability of operation of the device is better, thus contributing to the extension of the life time of the device. A further advantage of the device of the invention is observed in the event of maintenance when a permanent magnet needs to be replaced; there is no need to interfere in the interior of the fluid pressure cylinder.

**[0007]** Figure 1: Device for detecting position of a piston in a fluid pressure cylinder

**[0008]** The invention is described in more detail hereinbelow.

**[0009]** The technical problem is solved by a device 1 for detecting a piston position in a fluid pressure cylinder, particularly in a hydraulic cylinder, comprising:

- 35 - a fluid pressure cylinder 2,
- a piston 3 reciprocally slidable along the internal circumferential surface of the fluid pressure cylinder,
- a piston rod 4 connected with its first end with the piston and projecting with its another end through the front side of the fluid pressure cylinder,
- a permanent magnet 5 arranged on the external side of the fluid pressure cylinder such that its movement corresponds to the movement of the piston 3, and
- 40 at least one magnetic switch 6 arranged on the external side of the fluid pressure cylinder and susceptible to being actuated by said permanent magnet 5.

**[0010]** At the other end of the piston rod outside of the fluid pressure cylinder 2, a fixed arm 7 is foreseen, which carries a permanent magnet holder 8 arranged substantially parallel to the axis of the fluid pressure cylinder 2. The permanent magnet 5 is fastened on the permanent magnet holder 8. The permanent magnet holder 8 can be formed in the shape of a tube made of a non-magnetic material, in which the permanent magnet 5 is received.

**[0011]** The material of the fluid pressure cylinder 2 can also be selected among magnetic materials such as mar-

tensitic or ferritic steels.

[0012] The magnetic switch 6 is arranged on the external side of the fluid pressure cylinder either fixed or movable on a magnetic switch holder 9.

[0013] The magnetic switch 6 can be a Reed switch or any other switch formed by means of any known magnetic sensor, such as Hall, AMR, GMR, etc.

[0014] To better guide the permanent magnet holder 8, the fluid pressure cylinder 2 may be provided with a guide 10 formed as a through hole in a flange 11 of the fluid pressure cylinder, said through hole being formed in its axial direction.

[0015] When the device operates, the piston moves within the fluid pressure cylinder. The movement of the piston is transferred from the piston rod 4, the arm 7 and the permanent magnet holder 8 to the permanent magnet 5. When the permanent magnet 5 reaches the area of the magnetic switch 6, the latter detects the magnetic field of the permanent magnet and generates a signal for the control of the piston 3.

## Claims

1. A device (1) for detecting a piston position in a fluid pressure cylinder, particularly in a hydraulic cylinder, comprising:

- a fluid pressure cylinder (2),
- a piston (3) reciprocally slidable along the internal circumferential surface of the fluid pressure cylinder (2),
- a piston rod (4) connected with its first end with the piston (3) and projecting with its another end through the front side of the fluid pressure cylinder (2),
- a permanent magnet (5), the movement of which corresponds to the movement of the piston (3), and
- at least one magnetic switch (6) arranged on the external side of the fluid pressure cylinder (2) and susceptible to being actuated by said permanent magnet (5),

### characterized in that

the permanent magnet (5) is arranged on the external side of the fluid pressure cylinder (2).

2. Device (1) or claim 1, **characterized in that** at the other end of the piston rod outside of the fluid pressure cylinder (2), a fixed arm (7) is foreseen, which carries a permanent magnet holder (8) arranged substantially parallel to the axis of the fluid pressure cylinder (2).

3. Device (1) of claim 2, **characterized in that** the permanent magnet (5) is fastened on the permanent magnet holder (8).

4. Device (1) of claim 2 or 3, **characterized in that** the permanent magnet (5) is fastened on the permanent magnet holder (8).

5. Device (1) of any of claims 2 to 4, **characterized in that** the permanent magnet holder (8) is formed in the shape of a tube made of a non-magnetic material, in which the permanent magnet (5) is received.

10. Device (1) of any of preceding claims, **characterized in that** the material of the fluid pressure cylinder (2) is selected among martensitic or ferritic steels.

15. Device (1) of any of preceding claims, **characterized by** comprising a magnetic switch holder (9), on which the magnetic switch (6) is arranged in a movable manner.

20. Device (1) of any of preceding claims, **characterized in that** the magnetic switch (6) is a Reed switch.

25. Device (1) of any of claims 1 to 7, **characterized in that** the magnetic switch (6) is formed with a magnetic sensor, selected among a Hall sensor, AMR or GMR.

30. Device (1) of any of claims 2 to 9, **characterized in that** the fluid pressure cylinder (2) is provided with a guide (10) formed as a through hole in a flange (11) of the fluid pressure cylinder, said through hole being formed in its axial direction.

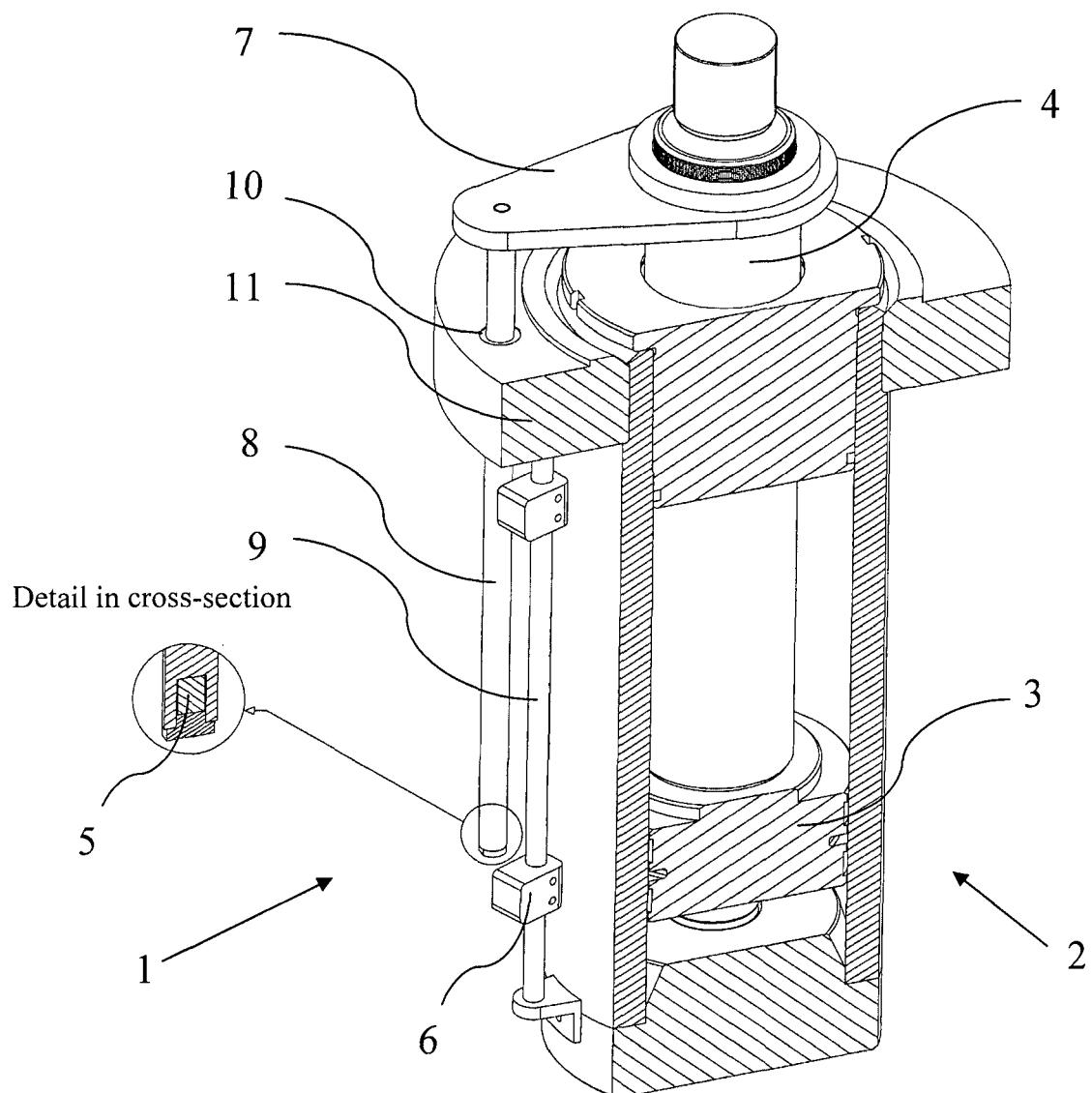


Figure 1



## EUROPEAN SEARCH REPORT

Application Number

EP 18 00 0841

5

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
10	X US 3 444 493 A (NIEUWHOF GERARDUS WILHELMUS EL) 13 May 1969 (1969-05-13) * column 2, line 27 - column 2, line 55; figures 1-4 *	1-10	INV. F15B15/28
15	X JP 2017 020532 A (HORIUCHI KIKAI:KK) 26 January 2017 (2017-01-26) * paragraph [0020] - paragraph [0031]; figures 1-9 *	1-10	
20	X US 4 176 264 A (TANN DAVID [US]) 27 November 1979 (1979-11-27) * column 2, line 51 - column 3, line 46; figures 1,2 *	1-10	
25	X US 2005/235824 A1 (SATO TOSHIO [JP] ET AL) 27 October 2005 (2005-10-27) * paragraphs [0019], [0022], [0023], [0027], [0041] - [0043]; figures 1-8 *	1-10	
30	X WO 2015/151622 A1 (SMC CORP [JP]) 8 October 2015 (2015-10-08) * page 4, line 22 - page 6, line 17 * * page 7, line 30 - page 8, line 26 * * page 12, lines 11-20; figures 1-8 *	1-10	TECHNICAL FIELDS SEARCHED (IPC)
35	A US 2009/160435 A1 (CAGNAC BASTIEN [FR] ET AL) 25 June 2009 (2009-06-25) * figures 1-4c *	1	F15B
40			
45			
50	1 The present search report has been drawn up for all claims		
55	Place of search Munich	Date of completion of the search 5 April 2019	Examiner Heneghan, Martin
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			

ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.

EP 18 00 0841

5 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 The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

05-04-2019

10	Patent document cited in search report	Publication date	Patent family member(s)			Publication date
	US 3444493 A	13-05-1969	NONE			
15	JP 2017020532 A	26-01-2017	NONE			
	US 4176264 A	27-11-1979	NONE			
20	US 2005235824 A1	27-10-2005	CN 1690450 A			02-11-2005
			CN 101311557 A			26-11-2008
			CN 101311558 A			26-11-2008
			DE 102005018999 A1			10-11-2005
			JP 4525155 B2			18-08-2010
			JP 2005315268 A			10-11-2005
25			KR 20060047470 A			18-05-2006
			KR 20060088097 A			03-08-2006
			KR 20060088098 A			03-08-2006
			TW I273178 B			11-02-2007
			US 2005235824 A1			27-10-2005
30	WO 2015151622 A1	08-10-2015	BR 112016022538 A2			10-10-2017
			CN 106133337 A			16-11-2016
			DE 112015001068 T5			01-12-2016
			JP 6240983 B2			06-12-2017
			JP 2015200403 A			12-11-2015
35			KR 20160140904 A			07-12-2016
			RU 2016138453 A			30-03-2018
			TW 201600736 A			01-01-2016
			US 2017097022 A1			06-04-2017
			WO 2015151622 A1			08-10-2015
40	US 2009160435 A1	25-06-2009	EP 2072969 A1			24-06-2009
			FR 2925673 A1			26-06-2009
			JP 2009150878 A			09-07-2009
			US 2009160435 A1			25-06-2009
45						
50						
55						

EPO FORM P0459  
For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

**REFERENCES CITED IN THE DESCRIPTION**

*This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.*

**Patent documents cited in the description**

- US 4793241 A1 [0002]