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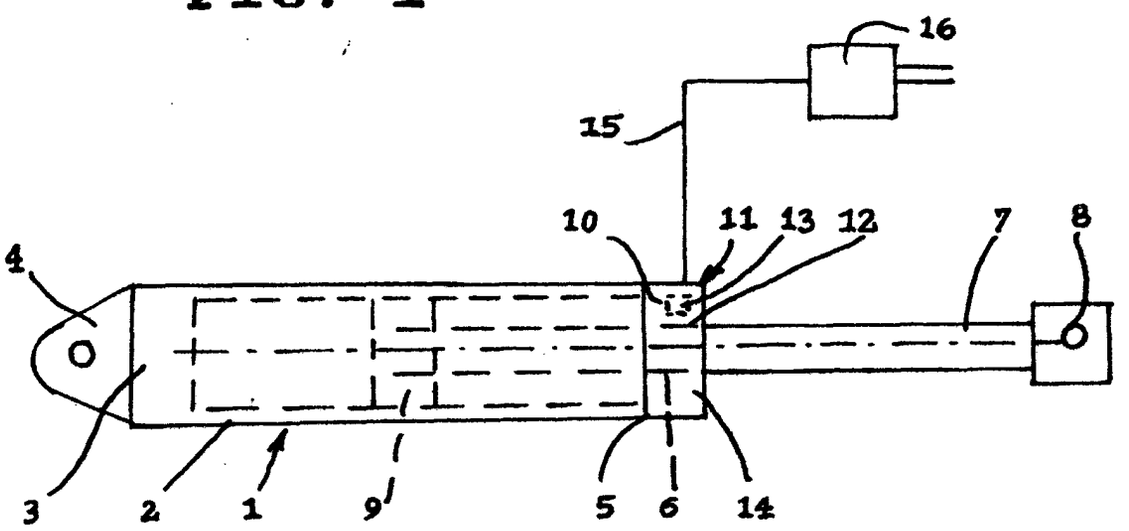
(54) Measuring method for determining the displacement of a movable part of an actuator and device for applying the measuring method

(57) Measuring method and device for determining the displacement of a movable part of an actuator such as the axial and/or rotational movement of the piston rod (7) in relation to the cylinder housing (2) with a pressurized medium-operated cylinder (1). Optical means (12) are applied, which can be aimed at the outer surface of the movable part of an actuator, such as the piston rod (7). The light reflected by the movable part (7) is absorbed by an absorbing chip (13) suitable for it, which electronically, by means of a converter (16) produces a signal, from which the position or the velocity of the movable part (7) can be determined. The piston rod (7) can have undergone the usual polishing processing. The optical means (12) comprise the means as they are applied in a computer mouse.

FIG. 1



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Description

[0001] The invention relates to a measuring method for determining the displacement of a movable part of an actuator such as the axial or rotational movement of the piston rod in relation to the cylinder housing with a pressurized medium-operated cylinder.

[0002] In certain cases, it is desirable to be able to determine the position or the displacement of the piston rod in a pressurized medium-operated cylinder during its use. This is the case when a hydraulic cylinder is used in operating the bottom doors of a floating dredge. Therein, it can be important to be able to determine both the position of the bottom doors and their velocity of movement. Thus, it must be guaranteed that the doors are actually in the closed position and that there is no obstacle between the doors as a result of which no proper sealing would be obtained.

[0003] In a system as applied by applicant, to that end the piston rod is provided with parallel grooves extending across an oblique angle with the axis of the piston rod. For determining the position or the velocity of movement of the piston rod, two sensors are arranged at said piston rod, which extend substantially square to the axis and, seen in the direction of the axis, enclose a straight angle.

[0004] Since hydraulic medium should not leak out along the grooves provided in the piston rod, the grooves are filled with a non-metallic medium, such as a ceramic material, for example. Obviously, the final surface of the piston rod must be smooth, so that a further processing of the piston rod is required. Thus, manufacturing such a piston rod is costly, so that also the complete hydraulic cylinder per se is relatively expensive.

[0005] In another method applied by applicant, an aperture is made in the closed end of the cylinder housing, that is, the end through which the piston rod does not extend. A measuring device connected to a copper thread extending through a bore in the piston rod is arranged at this aperture. Located on the head of the piston is a magnet, extending around the copper thread. A similar device is supplied by e.g. Balluf GmbH at Neuhausen, Germany.

[0006] In this case, the piston rod has to undergo a procession, namely longitudinally boring a hole in it, which obviously entails some drawbacks. Further, the cylinder housing should be processed too, again giving a relatively expensive structure.

[0007] The invention intends to overcome these drawbacks and to that end provides for, that optical means are applied, which can be aimed at the outer surface of the movable part of an actuator, such as the piston rod of a pressurized medium-operated cylinder, in which the light reflected by the movable part can be absorbed by an absorbing chip suitable for it, which produces a signal electronically, from which the position or the velocity of the movable part can be determined.

[0008] When it concerns a piston rod, this can be a normally processed piston rod, which is understood to mean a piston rod which has been polished in the usual way. This is necessary for obtaining a surface so smooth that a proper sealing between cylinder housing and piston rod can be obtained through resilient sealing means. However, it has turned out, that even then a certain part of the surface of the piston rod, irradiated by the optical means, has characteristics of its own, so that its displacement can be determined. It is obvious, that when the diplacement is plotted against time electronically, the velocity of displacement can be determined as well.

[0009] In general, a piston rod will undergo an axial displacement. When the piston rod or a part of another actuator also undergoes a rotation around the longitudinal axis, this angular rotation can be determined too.

[0010] One can think of e.g. a winch, in which the rotation of a part of it, such as the cable drum, should be determined for being able to determine the position of the end of the cable.

[0011] The absorbing chip cooperating with the optical means can be a commercially available absorbing chip, such as of the type HDNS-2000 of Agilent Technologies, Inc., which can be connected to a converter in a suitable way for supplying measuring and control signals. Naturally, another type of absorbing chip can be applied too.

[0012] By employing the measuring method according to the present invention the costs thereof can be relatively low in relation to those of the known methods.

[0013] The optical means and the absorbing chip will preferably be incorporated in a housing, which is connected to a fixed part of the actuator, such as a cylinder housing, so that the optical means are located directly near the part of the actuator to be monitored, such as a piston rod.

[0014] The invention is further explained by way of an example, illustrated in the drawing, in which:

fig. 1 illustrates schematically a side view of a pressurized medium-operated cylinder provided with a system according to the invention with accompanying parts; and
fig. 2 illustrates schematically the arrangement and function of said system employed.

[0015] Fig. 1 illustrates a hydraulic cylinder 1, comprising a cylinder housing 2 which is closed at the end 3 and is provided there with a part 4 by which cylinder housing 2 can be connected to a support structure.

[0016] The other end 5 of the cylinder housing 2 has a bore 6, through which the piston rod 7 extends outwardly. The free end of the piston rod 7 is provided with a part 8 that can be connected to an operable part. Within the cylinder housing 2, the piston rod 7 is connected to the piston 9.

[0017] The cylinder housing 2 is connected to a housing 10, in which the system 11 is incorporated. The system 11 comprises the optical element 12 and the ab-

sorbing chip 13. The optical element 12 is located close to the piston rod 7, but is not in engagement with it. The housing 10 will preferably be closed in relation to the cylinder housing 2 and in relation the surroundings be closed by the end wall 14. The end wall 14 is provided with means contacting the piston rod 7 in order to prevent dirt or dust from entering the housing 10. Obviously, the housing 10 can be entirely integrated in the cylinder housing 2.

[0018] By means of the line 15, the system 11 is connected to a converter 16 providing measuring and control signals and being arranged at a distance from said system.

[0019] Fig. 2 illustrates schematically the arrangement of the system 11 comprising the optical element 12, which aims a light beam through a lens 17 onto a movable part of an actuator, such as a piston rod 7. The light reflected by the piston rod 7 is aimed at the absorbing chip 13 through a lens 18.

[0020] Starting from an end position of the hydraulic cylinder 1, in which its piston rod 7 has been displaced to the left or to the right as much as possible as seen in fig. 1, the system can be calibrated.

[0021] It will be obvious, that only one possible embodiment of the invention of a measuring method and a device according to the invention applied with it, has been illustrated in the drawing and described above and that many changes can be made without leaving the inventive idea as it is indicated in the claims.

Claims

1. Measuring method for determining the displacement of a movable part of an actuator such as the axial or rotational movement of the piston rod (7) in relation to the cylinder housing (2) with a pressurized medium-operated cylinder (1), **characterized in that** optical means (12) are applied, which can be aimed at the outer surface of the movable part of an actuator, such as the piston rod (7) of a pressurized medium-operated cylinder (1), in which the light reflected by the movable part (7) can be absorbed by an absorbing chip (13) suitable for it, which produces a signal electronically, from which the position or the velocity of the movable part (7) can be determined.

2. Measuring method according to claim 1, **characterized in that** when applying it on a piston rod, this can be a normally processed piston rod, which is understood to mean a piston rod which has been polished in the usual way.

3. Measuring method according to claim 1 or 2, **characterized in that** the optical means (12) comprise of the means as they are applied in a computer mouse.

4. Measuring method according to one of the preceding claims, **characterized in that** the absorbing chip (13) cooperating with the optical means (12) can be a commercially available absorbing chip (13), such as of the type HDNS-2000 of Agilent Technologies, Inc., which can be connected to a converter (16) in a suitable way for supplying measuring and control signals.

5. Device for applicating the measuring method according to one of the preceding claims, **characterized in that** the optical means (12) and the absorbing chip (13) are accommodated in a housing (10), which is connected to a fixed part of the actuator, such as a cylinder housing (2), so that the optical means are located directly near the part of the actuator to be monitored, such as a piston rod (7).

FIG. 1

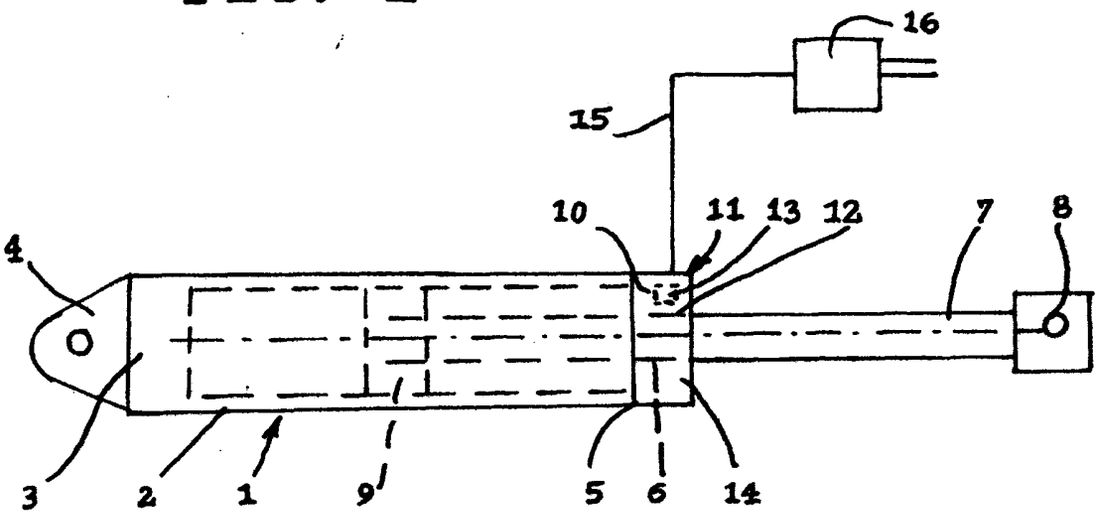
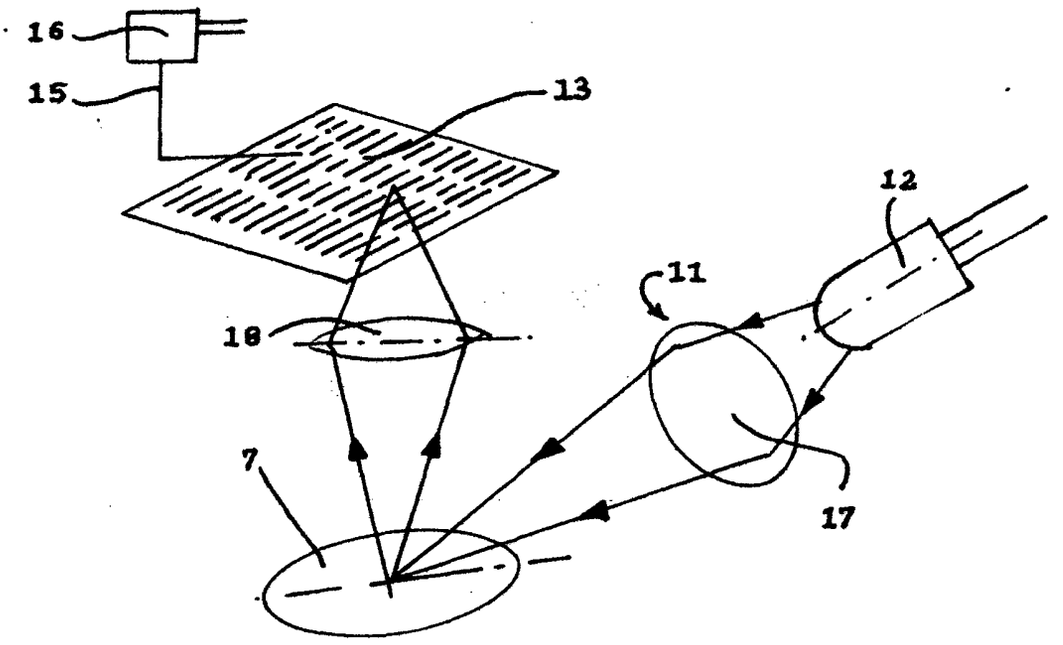


FIG. 2



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EUROPEAN SEARCH REPORT

Application Number
EP 03 07 8838

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.7)
X	DE 100 14 194 A (LEUZE ELECTRONIC) 25 January 2001 (2001-01-25) * column 3, line 2 - line 30; figures 1,2 *	1,3-5	F15B15/28
X	GB 2 335 980 A (BAMFORD EXCAVATORS) 6 October 1999 (1999-10-06) * page 5, line 20 - page 6, line 6; figures 1,2 *	1,3-5	
X	DE 86 27 037 U (HUGLER) 8 January 1987 (1987-01-08) * claim 1; figure *	1,3-5	
X	GB 2 068 150 A (RANSBURG) 5 August 1981 (1981-08-05) * abstract; figure *	1,4,5	
X	PATENT ABSTRACTS OF JAPAN vol. 012, no. 182 (M-702), 27 May 1988 (1988-05-27) -& JP 62 292901 A (TOSHIBA CORP), 19 December 1987 (1987-12-19) * abstract; figures *	1,4,5	TECHNICAL FIELDS SEARCHED (Int.Cl.7) F15B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	25 March 2004	SLEIGHTHOLME, G

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25-03-2004

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 10014194 A	25-01-2001	DE 10014194 A1	25-01-2001
GB 2335980 A	06-10-1999	CA 2267806 A1	02-10-1999
		EP 0947805 A2	06-10-1999
		JP 11320457 A	24-11-1999
		US 6452158 B1	17-09-2002
DE 8627037 U	08-01-1987	DE 8627037 U1	08-01-1987
GB 2068150 A	05-08-1981	AU 529910 B2	23-06-1983
		AU 6619981 A	22-04-1982
		BE 886934 A1	16-04-1981
		BR 8100252 A	04-08-1981
		CA 1154844 A1	04-10-1983
		DE 3101193 A1	26-11-1981
		FR 2474192 A1	24-07-1981
		GB 2068152 A ,B	05-08-1981
		HK 28288 A	29-04-1988
		HK 28588 A	29-04-1988
		IT 1143276 B	22-10-1986
		JP 56121654 A	24-09-1981
		SE 452209 B	16-11-1987
		SE 8100214 A	19-07-1981
JP 62292901 A	19-12-1987	NONE	

EPO FORM P0459

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