

⑫ **EUROPEAN PATENT APPLICATION**

⑲ Application number: **86850143.8**

⑤① Int. Cl.⁴: **F 15 B 15/12, B 63 H 25/30**

⑳ Date of filing: **21.04.86**

③① Priority: **25.04.85 NO 851671**

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④③ Date of publication of application: **12.11.86**
Bulletin 86/46

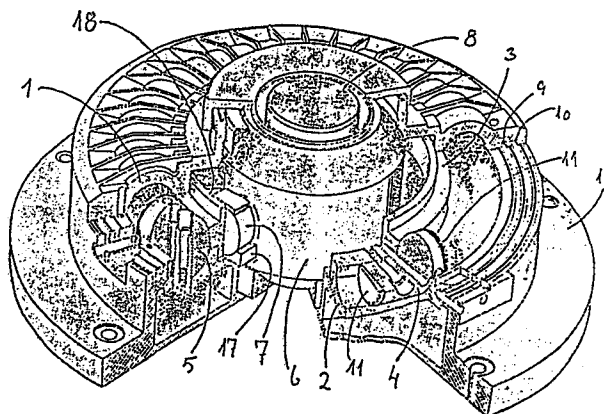
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⑧④ Designated Contracting States: **BE DE FR GB IT NL SE**

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⑤④ **Hydraulic actuator.**

⑤⑦ Hydraulic actuator for turning movement of a knuckle, especially a steering knuckle, a torus shaped guiding path for pistons (4, 5) comprising a carrier ring (3) connected to the knuckle (8), the carrier ring (3) thereby establishing the inner circumference of the path and being sealingly moveable against a lower part (2) and an upper part (1) which is secured to the lower part and which together establish the rest of the path and being stationary, at least one piston (4) being sealingly displaceable in the guiding path and fixed to the carrier ring (3) and at least one fixed piston (5) secured to the lower part (2), whereby channels (9, 10) establish input and output for hydraulic fluid to diametrically opposed spaces between a displaceable piston (4) and a fixed piston (5), the carrier ring (3) being connected turnable with the steering knuckle (8) and displaceable in the axis direction thereof by means of two diametrically opposed pins (7) connected with the knuckle (8), received in corresponding bearing linings in the inner circumference of the carrier ring.



HYDRAULIC ACTUATOR

The present invention is related to a hydraulic actuator for turning movement of a knuckle, such as a steering knuckle, demanding less than 360° turning for actuation.

6 Prior art actuators for knuckles of the above cited type are mechanical transmissions or hydraulic actuators having rectilinear movements which are translated to the knuckle by means of levers, resulting that the turning movement is performed with variable forces, dependent of the knuckle position.

10 Known actuators of the above-mentioned type furthermore having fixed activation points on the knuckle which may lead to difficulties in connection with especially steering knuckles which due to the force acting against the knuckles, may achieve a bending deviating from the theoretical axis of the knuckle and furthermore an extension due to temperature variations.

15 With the hydraulic actuator according to the invention these disadvantages are avoided due to the fact that the acting point of the actuator permanently have the same distance from the center axis of the knuckle. Furthermore is the activating point displaceable in the actuator in the longitudinal direction of the knuckle and the knuckle is allowed to be bent as opposed to the theoretical longitudinal axis without causing special forces acting between the actuator and the knuckle.

20 Theese advantages are achieved by the hydraulic actuator according to the invention by means of the features stated in the characterizing clauses of the claims.

30 The actuator according to the invention is well suited for turning knuckles where the turning movement being more than 300° , whereby here two pistons are used, one fixed and one displaceable. For actuating the steering knuckle on ships, however, two pistons of each type will be adequate and for steering knuckles on greater ships where normal turning is 2×35 degrees, three pistons will be suitable.

35 In the drawing Figure 1 discloses a perspective representation of the hydraulic actuator according to

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the invention, different parts thereby being removed for simplification, Figure 2 discloses a horizontal projection of the actuator, the upper part thereby being removed, Figure 3 discloses a cross section of the actuator, through a piston, Figure 4 discloses a section along IV-IV in Figure 2 and Figure 5 discloses schematically the actuator including the hydraulic units.

A torus shaped guiding path is created by the lower part 2 and the upper part 1 of the actuator, together with a carrier ring 3 arranged in the inner circumference of the guiding path. The torus shaped guiding path is arranged around and substantially in a right angel to a knuckle, in the present case a steering knuckle 8.

To the lower part two pistons 5 are fixed diametrically opposed to each other and two pistons 4 being fixed to the carrier ring 3, also arranged diametrically opposed to each other and between the pistons fixed to the lower part. All pistons having sealings 11 in both sides, sealingly abutting against the torus shaped guiding path.

The upper part 1 is fixedly connected to the lower part 2, whereas the carrier ring 3 is sealingly turnable as opposed to the upper part and the lower part. In this way the pistons 4 fixed to the carrier ring may be displaced in the torus shaped guiding path in relation to the pistons 5 which are fixed to the lower part 2.

The upper part 1 and the lower part 2 both have two grooves which together establish channels 9, 10 for hydraulic fluid. From the channel 10 a connection channel 12 is arranged to an output 13 near one side of one of the pistons 5 secured to the lower part 2, whereas a corresponding connection channel and an output being arranged on the other side of the same piston from the channel 9. Correspondingly connection means being arranged on the lower part 2 for supply and discharge respectively of hydraulic fluid to and from the channels 9 and 10.

A direction cock 14 is arranged in each connection channel 12 whereby connection can be established between channel 9, respectively 10, and the guiding path, or from

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the guiding path to a reservoir 15 arranged in the lower part 2. The arrangement of the direction cock 14 makes it possible to decrease the pressure in certain parts of the guiding path if this should be desirable, such as by defects, leakage and such in a certain part of the guiding path.

The lower part 2 suitably is provided with a flange 16 for securement at a suitable position.

By pressurizing one of the channels, such as channel 10, hydraulic fluid will flow through the connection channel 12 and out through the output 13 to the two diametrically opposed arranged spaces of the guiding path and the piston 4, secured to the carrier ring 3, will be pressed away from the corresponding fixed piston 5, whereas the hydraulic fluid on the other side of the piston 5 is discharged through the opposed arranged output, the connection channel and to the channel 9 for returning the hydraulic fluid to the reservoir 15 arranged in connection with the hydraulic unit. Hereby the carrier ring will be displaced in relation to the lower part 2 and thereby moving two diametrically opposed arranged pins 7 which are connected with the steering knuckle 8. The pins 7 are mounted in linings 17 of bearing in such a way that the pins 7 can be turned in relation to the linings 17. Each lining 17 is arranged between two guiding means 18 in such a way that the linings 17 can be moved axially in relation to the carrier ring 3, thereby allowing possible extension of compression of the steering knuckle 8, caused by temperature variations.

In the disclosed embodiment the pins 7 are secured to a rotor 6 which again is rigidly connected to the steering knuckle 8. By the special embodiment of the hydraulic actuator according to the invention, the steering knuckle 8 can be turned in both directions by activating the channels 9 or 10 whereby no special forces are created in the connection between the pins 7 and the carrier ring 3 due to length variations of the pins 7 by temperature variations or bending of the steering knuckle from the theoretical middle axis due to forces against the steering

- . knuckle or the rudder. An oblique mounting of the actuator in relation to the steering knuckle will not influence the relationship between the actuator and the steering knuckle. A possible extension of the rotor 6 also can
5 be adapted by the bearing linings 17.

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P a t e n t c l a i m s

1. Hydraulic actuator for turning movement of a knuckle, especially a steering knuckle, CHARACTERIZED IN
5 a torus shaped guiding path for pistons (4, 5) comprising a carrier ring (3) connected to the knuckle (8), the carrier ring (3) thereby establishing the inner circumference of the path and being sealingly moveable against an lower part (2) and an upper part (1) which is secured to the
10 lower part and which together establish the rest of the path and being stationary, at least one piston (4) being sealingly displaceable in the guiding path and fixed to the carrier ring (3) and at least one fixed piston (5) secured to the lower part (2), whereby channels (9, 10)
15 establish input and output for hydraulic fluid to diametrically opposed spaces between a displaceable piston (4) and a fixed piston (5), the carrier ring (3) being connected turnable with the steering knuckle (8) and displaceable in the axis direction thereof by means of two diametrically
20 opposed pins (7) connected with the knuckle (8), received in corresponding bearing linings in the inner circumference of the carrier ring.

2. Actuator according to claim 1, CHARACTERIZED
25 IN sealings (11) being arranged on each side of each piston (4, 5), which sealings bearing sealingly against the guiding path.

3. Actuator according to claim 2, CHARACTERIZED
30 IN the side of each fixed piston (5) facing the carrier ring (3) being chamfered to a cylindrical surface parallel to the axis, thereby making it possible to mount and dismount the piston (5) without removing the carrier ring (3).

4. Actuator according to claim 1, CHARACTERIZED
35 IN the bearing linings being rectangular bearing bosses having sentrical holes for pivoting the pins (7) and the linings furthermore being vertically displaceable by means of guidings (18) on the carrier ring (3), abutting the outer vertical end faces of the linings.

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5. Actuator according to claim 1, CHARACTERIZED
IN a reservoir for hydraulic fluid being established in
the lower portion of the lower part (2).

6. Actuator according to claim 1, CHARACTERIZED
5 IN the channels (9, 10) for hydraulic fluid being two con-
centrical annular channels (9, 10) in the lower part (2)
and the upper part (1), one of the annular channels thereby
via a connection channel being connected to an output near
one side of each fixed piston (5) and the other annular
10 channel correspondingly being connected with the other
side of said piston (5).

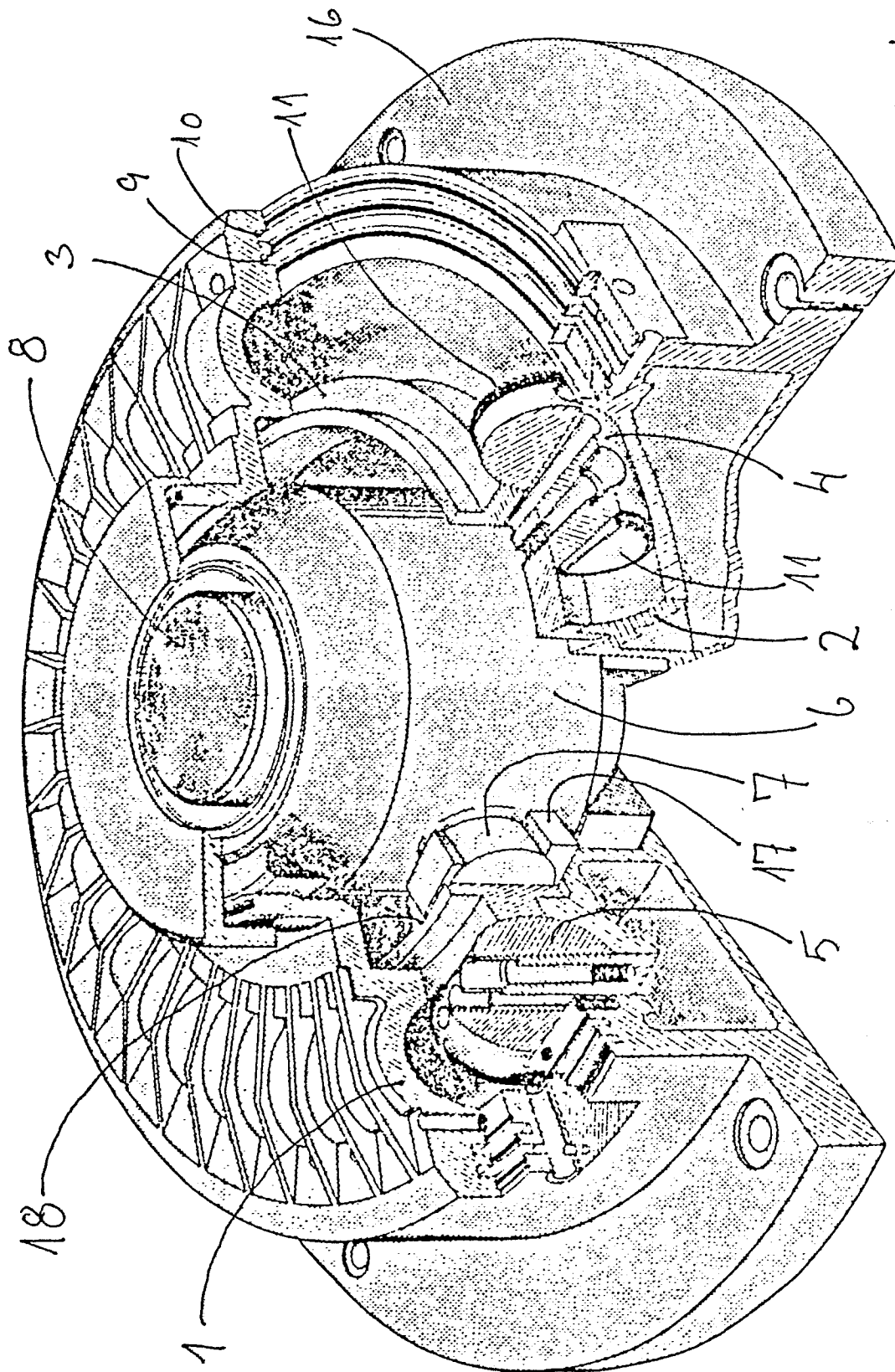
7. Actuator according to claims 5-6, CHARACTERIZED
IN each output being connected with the corresponding annu-
lar channel by a direction cock which in another position
15 connects the output with the reservoir for releasing the
hydraulic fluid pressure.

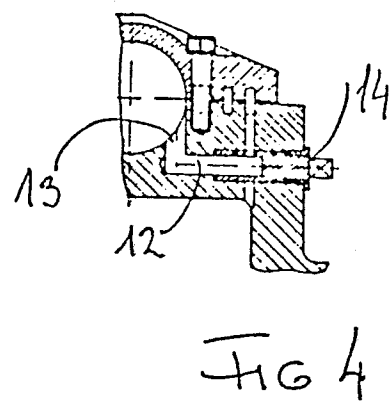
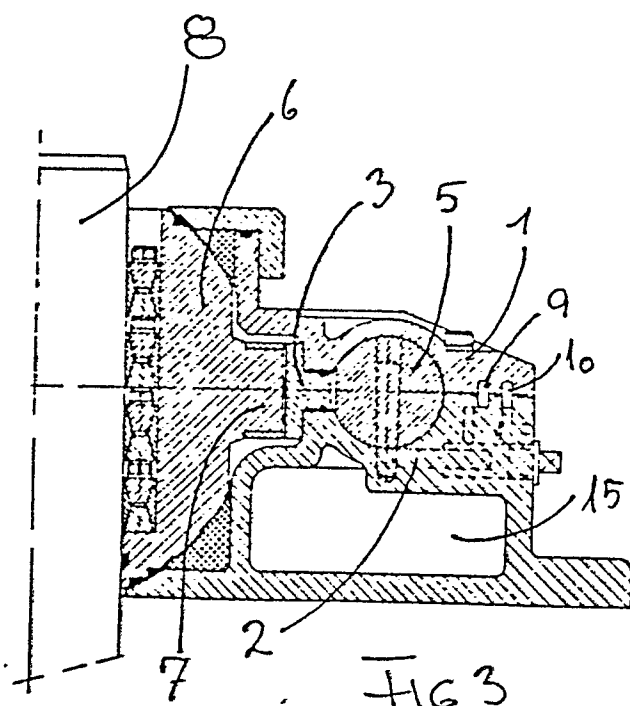
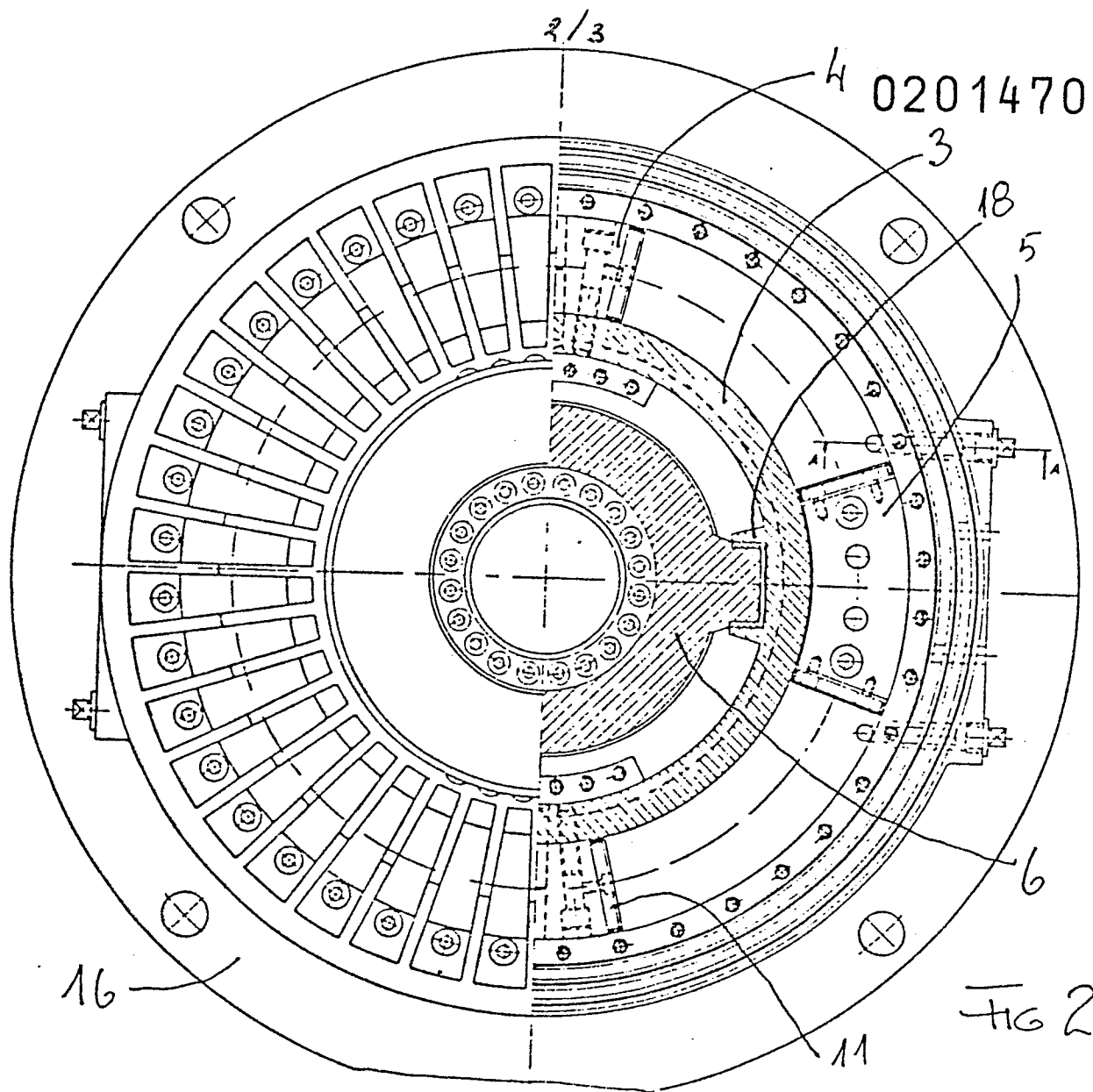
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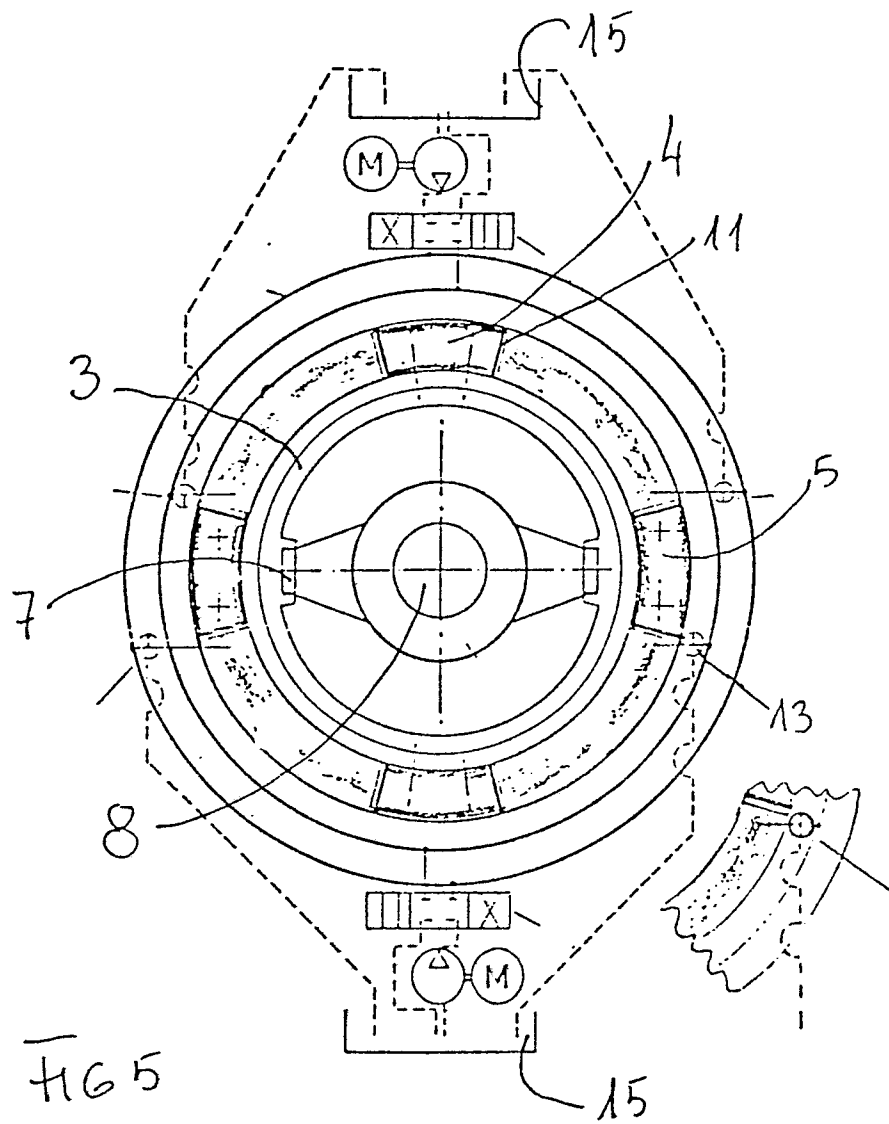
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European Patent
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EUROPEAN SEARCH REPORT

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Application number

EP 86 85 0143

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.4)
X	DE-A-1 503 343 (HAUSHERR) * Page 4, lines 1-24 *	1-3	F 15 B 15/12 B 63 H 25/30
X	DE-A-1 503 328 (HAHN) * Page 4, line 20 - page 6, line 25 *	1-3	
A	FR-A-2 119 235 (LERAY) * Page 3, lines 32-38 *	4	
A	US-A-2 025 573 (COLLINGHAM) * Page 1, lines 9,10 *	5	
A	GB-A- 742 271 (ATLAS-WERKE)		
A	GB-A-1 174 028 (AJAMIL)		
			TECHNICAL FIELDS SEARCHED (Int. Cl.4)
			F 15 B F 03 C B 63 H
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 06-08-1986	Examiner KNOPS J.
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	