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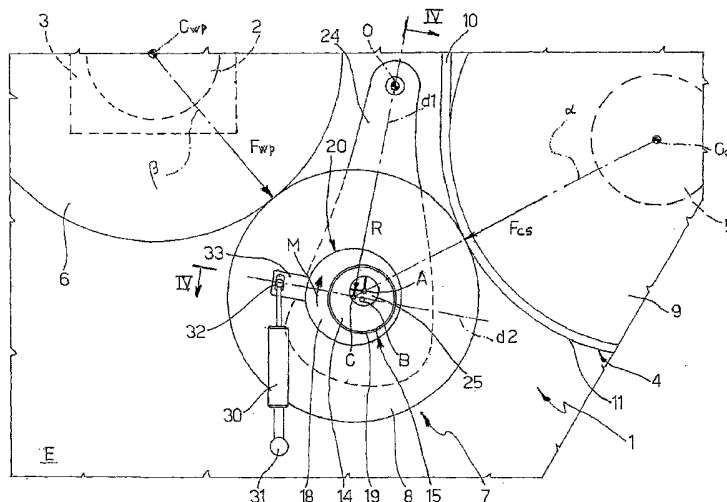
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(54) Title: A CLUTCH-WHEEL DRIVE DEVICE



(57) Abstract: A clutch-wheel drive device (1) comprises a drive wheel (4), a driven wheel (6), and an intermediate clutch wheel (8), which co-operates by friction with the drive wheel (4) and with the driven wheel (6), in which the intermediate wheel (8) is mounted on an arm (18), which can turn on a pin (14), having an axis B distinct from the axis (C) of the clutch wheel (8), and is loaded by a spring (26) so as to push the clutch wheel (8) substantially in a first direction (d1) towards a position of contact with the drive wheel (4) and the driven wheel (6); the pin (14) is, in turn, mounted so that it can turn about a further axis (0) so as to enable a displacement of the axis (C) of the clutch wheel (8) in a second direction (d2) different from the first direction (d1) and ensure a correct contact between the clutch wheel (8) and both the drive wheel (4) and the driven wheel (6) even in the presence of wear. The device (1) optionally comprises an actuator (30) for detaching the clutch wheel (8) from the driven wheel (6).



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A CLUTCH-WHEEL DRIVE DEVICE

TECHNICAL FIELD

The present invention relates to a clutch-wheel drive device for transmission of motion from a drive wheel to a driven wheel by means of an intermediate clutch wheel, which co-operates by friction with both the drive wheel and the driven wheel.

The present invention finds a preferred, but non-exclusive, application in the actuation of a water pump for cooling an internal-combustion engine, an application to which reference will be made in what follows for greater clarity, without this implying any loss of generality.

For connecting a driven member rotationally to a drive member it is known practice to use a clutch wheel co-operating by friction with a drive wheel fixed to the drive member and with a driven wheel fixed to the driven member under the action of elastic means.

BACKGROUND ART

A problem connected to known drive devices of the aforementioned type is linked to the fact that the conditions of contact may vary with respect to a theoretical condition of design, both as regards the tolerances of fabrication and assembly and, above all, as regards the wear of the wheels. This phenomenon is particularly marked in the case where the surfaces of

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contact of the driven wheel and drive wheel are made of different materials and consequently are subject to different degrees of wear.

DISCLOSURE OF INVENTION

A purpose of the present invention is consequently to provide a clutch-wheel drive device which will be able to ensure a proper contact pressure between the wheels even in the presence of deviations from the ideal geometrical conditions and which, in particular, will be able to recover automatically the play due to the wear of the wheels.

The above purpose is achieved by a drive device according to Claim 1.

Another problem connected to clutch-wheel drives is linked to the fact that it could be necessary to uncouple upon a command the driven wheel from the drive wheel. For example, in the case of actuation of a water pump of an internal-combustion engine, during cold starting it is preferable for the pump to be deactivated so as to enable the normal-running thermal conditions of the engine to be reached as fast as possible and hence limit harmful emissions during the transient.

A further purpose of the present invention is to provide a drive device that will enable deactivation of the driven member, however constantly keeping the drive wheel and the clutch wheel in contact with one another so as to prevent any impact or vibrations, and

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consequent phenomena of instability and wear, which occur whenever contact between the two wheels is restored after interruption.

BRIEF DESCRIPTION OF THE DRAWINGS

For a better understanding of the present invention, there follows a description of two preferred embodiments, provided purely by way of non-limiting examples and with reference to the annexed drawings, in which:

- Figure 1 and Figure 2 are schematic front views of a drive device according to a first embodiment of the present invention;

- Figure 3 is an exploded perspective view of a component of the device of Figures 1 and 2;

- Figure 4 is a cross-sectional view according to the line IV-IV of Figure 1;

- Figure 5 and Figure 6 are schematic front views of a second drive device according to the present invention, in two different operative positions; and

- Figure 7 is a cross-sectional view according to the line VII-VII of Figure 5.

BEST MODE FOR CARRYING OUT THE INVENTION

With reference to Figures 1 to 4, designated as a whole by 1 is a clutch-wheel drive device for the actuation of a shaft 2 of a water pump 3 of an internal-combustion engine E, not illustrated as a whole.

The device 1 basically comprises a drive wheel 4

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fitted on an engine shaft 5 of the engine, having axis Ccs, a driven wheel 6 fitted on the shaft 2 of the pump 3, having axis Cwp, and a clutch assembly 7 provided with an intermediate clutch wheel 8 co-operating by friction with the drive wheel 4 and with the driven wheel 6.

The drive wheel 4 is conveniently defined by a pulley 9, fitted on the engine shaft 5, over which there is run a drive belt 10 for actuation of other auxiliary members of the engine (not illustrated) such as, for example, an alternator and a compressor of the air-conditioning system.

The belt 10, of the poly-V type, co-operates with the pulley 9 along a circumferential stretch or arc of winding, and has a back 11, which, in the arc of winding, defines a surface of friction of the drive wheel 4.

The clutch assembly 7 is illustrated in detail in Figures 3 and 4, which provide a constructional example thereof, and comprises: a pin 14 having an external cylindrical surface 15 of axis B; an arm 18, defined by an eccentric bushing, which is hinged on the pin 14 with the interposition of a clutch bushing 19 and is provided with an external cylindrical surface 20 having an axis C parallel to the axis B; and a bearing 21, which is mounted on the arm 18 and on which there is, in turn, mounted the clutch wheel 8, which is consequently free

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to rotate about the axis C.

According to the embodiment of the invention illustrated in Figures 1 to 4, the pin 14 is fixed to a mobile supporting plate 24 and, in particular, is hinged to the engine E about an axis O parallel to the axes B, C and is set conveniently in an area comprised between the drive wheel 4 and the driven wheel 6.

Fixing of the pin 14 on the plate 24 is obtained by means of a screw 25, which engages an eccentric axial hole 29 of the pin 14, said hole having axis A.

A spiral spring 26, which is constrained between a ring 27 fixed to the arm 18 and an anchoring plate 28 rigidly fixed on a free end of the pin 14, exerts a torque M on the arm 18 such as to keep the clutch wheel 8 in contact with the drive wheel 4 and with the driven wheel 6.

With reference to Figure 1, which illustrates an operative position of engagement of the clutch wheel 8, this wheel, as a result of the torque M, is set in contact with the drive wheel 4 and with the driven wheel 6, from which it receives the contact forces F_{cs} and F_{wp} , respectively. If, as a first approximation, the forces of friction are neglected, the forces F_{cs} and F_{wp} can be assumed as being normal to the contact surfaces and hence incident on the axis C.

The resultant R of the forces F_{cs} and F_{wp} , which balances the thrust that the clutch wheel 8 receives

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from the spring 26, has a direction d_1 , which, for equilibrium to rotation of the clutch assembly 7 about the axis O, passes through this axis. Moreover, if the axis O is contained in the plane that bisects the dihedral angle defined by the planes α , passing through the axis C and the axis Ccs of the engine shaft 5, and the plane β , passing through the axis C and the axis Cwp of the shaft of the water pump 2, the forces Fcs and Fwp are equal in modulus to one another.

The hinge constraint of the plate 24 bestows upon the clutch wheel 8 a second degree of freedom; rotation of the plate 24 about the axis O brings about a displacement of the axis C, which may be likened, for small rotations, to a translation in a direction d_2 transverse, and in particular orthogonal, to the direction d_1 . Thanks to this further degree of freedom, the device is able to ensure contact between the clutch wheel 8 and both of the wheels 4, 6, automatically recovering the play that occurs as a result of wear.

Furthermore, the device 1 optionally comprises an actuator for activation and deactivation the water pump. This actuator is preferably an electrically operated linear actuator 30, which has an end 31 constrained to the engine E, and the other end 32 constrained with play to the arm 18, and preferably to a radial appendage 33 of the ring 27, which is fixed to the arm 18 and extends on the opposite side with respect to the drive wheel 4.

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The actuator 30 is mobile between an extended position (see Figure 1) and a retracted position (see Figure 2). In the extended position, on account of the play between the end 32 of the actuator and the appendage 33, the actuator 30 has altogether no effect, and consequently the arm 18 is pushed by the spring 26 in the position in which the clutch wheel 8 is in contact with both of the wheels 4, 6, as described above. In the retracted position (see Figure 2), the arm 18 is rotated in a counterclockwise direction about the axis B, further loading the spring 26. In this way, the clutch wheel 8 is detached from the driven wheel 6.

The actuator 30 is set in such a way that the force F_a generated thereby will have an arm a with respect to the axis O such as to rotate the plate 24 in order to keep the clutch wheel 8 in contact with the drive wheel 4 (see Figure 2).

Figures 5, 6 and 7 illustrate a device 40 according to a different embodiment of the invention, which will be described in what follows in so far as it differs from the device 1, using the same reference numbers to designate parts that are the same as or correspond to parts of the device 1 already described.

The device 40 differs from the device 1 in that the clutch assembly 7 is mounted directly on the engine E, or on a supporting structure fixed thereto, rather than on the mobile plate 24, but the pin 14 can turn about

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the axis A of the screw 25 internal to the pin itself.

In this case, in fact, the screw 25 is mounted within a bushing 41 having axis A, to which there is rigidly fixed the plate 28, and which is secured by the screw itself on the engine block. The pin 14 is free to rotate about the axis A, thus bestowing upon the position of the clutch wheel 8 a second degree of freedom equivalent to the one defined, in the case of the device 1, by the rotation of the plate 20 about the axis O.

Conveniently, means are envisaged for limiting the angular travel of the arm 18 and thus ensuring that the assembly 7 is kept, prior to assembly on the engine and under the thrust of the spring 26, in a stable configuration, in which the relative angular position between the pin 14 and the arm 18 is compatible with proper kinematic operation following upon assembly. Said means may be constituted, for example, by a pin 45, which is carried by the plate 28 and slidably engages a circumferential slot 46 made in the pin 14 (see Figure 7) or, according to a variant not illustrated, in the arm 18.

Operation of the device 40 is altogether equivalent to that of the device 1 described previously; also in this case, when the actuator 30 is in the extended position, the clutch wheel 8 is kept in contact with both of the pulleys 4, 6 by the action of the spring 19.

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The further degree of freedom defined by the possibility of rotation of the pin 14 about the axis A enables the clutch wheel 8 to recover the play and to set itself correctly in contact with both of the wheels 4, 6 even in the presence of wear.

When the actuator 30 is set in the retracted position, the combined rotation of the arm 18 about the axis B and of the pin 14 about the axis A enable the clutch wheel 8 to detach from the driven wheel 6, at the same time remaining in contact with the drive wheel 4.

According to a variant (not illustrated), the plate 28 for anchoring of the spring 26 could be fixed to the pin 14 rather than to the bushing 41. In this case, the force exerted by the spring 26 would be a force internal to the clutch assembly 7 and, according to what has been described with reference to Figure 1, the resultant R of the forces F_{cs} and F_{wp} would pass through the axis A. Consequently, to ensure equality in modulus between these forces, the axis A should be set on the plane bisecting the angle formed between the planes α and β .

From an examination of the characteristics of the devices 1, 40 made according to the present invention the advantages that it enables emerge clearly.

According to the present invention, the means of constraint of the clutch wheel enable two independent degrees of freedom: a first degree of freedom enables the clutch wheel 8 to approach the wheels 4, 6 under the

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action of the spring 19; a second degree of freedom enables the clutch wheel 8 to adapt its own position so as to ensure contact with both of the wheels 4, 6 even as the geometrical conditions vary from the ideal conditions of design.

Moreover, in the case where an actuator 30 for engagement/disengagement of the drive is envisaged, the second degree of freedom enables the clutch wheel 8 to be kept constantly engaging the drive wheel 4, thus preventing any impact, vibration and anomalous wear in the manoeuvres of engagement and disengagement.

The aforesaid functions are obtained with a structure that is mechanically simple and very inexpensive to produce and install on the engine.

Finally, it is clear that modifications and variations may be made to the embodiments described herein, without thereby departing from the sphere of protection defined by the ensuing claims.

In particular, in the case where the function of engagement/disengagement of the drive is not required, the actuator 30 is not necessary and can be omitted.

In addition, either one or both of the degrees of freedom of motion of the axis of the clutch wheel 8, which in the examples of embodiment are defined by constraints of a rotational type, can be defined by constraints of a different type, including a linear one, with the condition that the two degrees of freedom are

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independent with respect to one another, i.e., that the displacements according to the two degrees of freedom enable the clutch wheel to move on a plane orthogonal to its own axis and not only along a single path. In the case of linear constraints, in particular, it is necessary that the allowed directions of motion should not be parallel to one another.

With reference to the embodiment of Figures 1 to 4, the plate 24 could be hinged to the engine about an axis O set in a different position, and in particular on the opposite side with respect to the direction d2 and/or at a distance from the bisector plane calculated so as to obtain appropriate differences in modulus between the forces Fcs and Fwp. In addition, the axis A of the screw 25 could coincide with the axis B of the pin 14.

The actuator 30 may be of any type, for example pneumatic or hydraulic.

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CLAIMS

1.- A clutch-wheel drive device (1, 40) comprising a drive wheel (4), a driven wheel (6) and a clutch assembly (7), which, in turn, comprises a clutch wheel (8) co-operating by friction with the drive wheel (4) and with the driven wheel (6), means of constraint (24, 14, 18) for constraining said clutch wheel (8) to a fixed supporting structure (E), and elastic means (26) for exerting on said clutch wheel (8) a thrust designed to keep it in contact with said drive wheel (4) and with said driven wheel (6), said means of constraint (14, 16, 24, 25) defining a first degree of freedom, for enabling a displacement of said clutch wheel (8) away from and in the direction of at least one of said drive wheel (4) and driven wheel (6), and a second degree of freedom, that is independent of said first degree of freedom.

2.- The device according to Claim 1, characterized in that said means of constraint comprise a pin (14), having a first axis (B), and an arm (18), which can turn about said pin (14) and defines a second axis (C), said clutch wheel (8) being free to turn about said second axis (C), said first degree of freedom being defined by a rotation of said arm (18) about said first axis (B).

3.- The device according to Claim 2, characterized in that said pin (14) can turn about a third axis (O; A) fixed to and distinct from said first axis (B) and said

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second axis (C), said second degree of freedom being defined by a rotation of said pin (14) about said third axis (O; A).

4.- The device according to Claim 3, characterized in that said means of constraint (14, 16, 24, 25) comprise a supporting element (24), which can turn about said third axis (O) with respect to said fixed structure (E), said pin (14) being rigidly fixed on said supporting element (24).

5.- The device according to Claim 3, characterized in that said third axis (A) is internal to said pin (14) and is defined by an eccentric axial hole (29) of the pin itself, said means of constraint (14, 16, 24, 25) comprising at least one element (25, 41) for fixing of the pin (14) to said fixed structure (E), said element engaging in an angularly free way said hole (29).

6.- The device according to Claim 5, characterized in that said third axis (O; A) is set at least in the proximity of a plane that bisects the dihedral angle formed between a first plane (α), passing through the second axis (C) and the third axis (Ccs) of said drive wheel (4), and a second plane (β) passing through said second axis (C) and the axis (Cwp) of said driven wheel (6).

7. The device according to any one of the preceding claims, characterized in that it comprises an actuator (30) acting between said arm (18) and said fixed

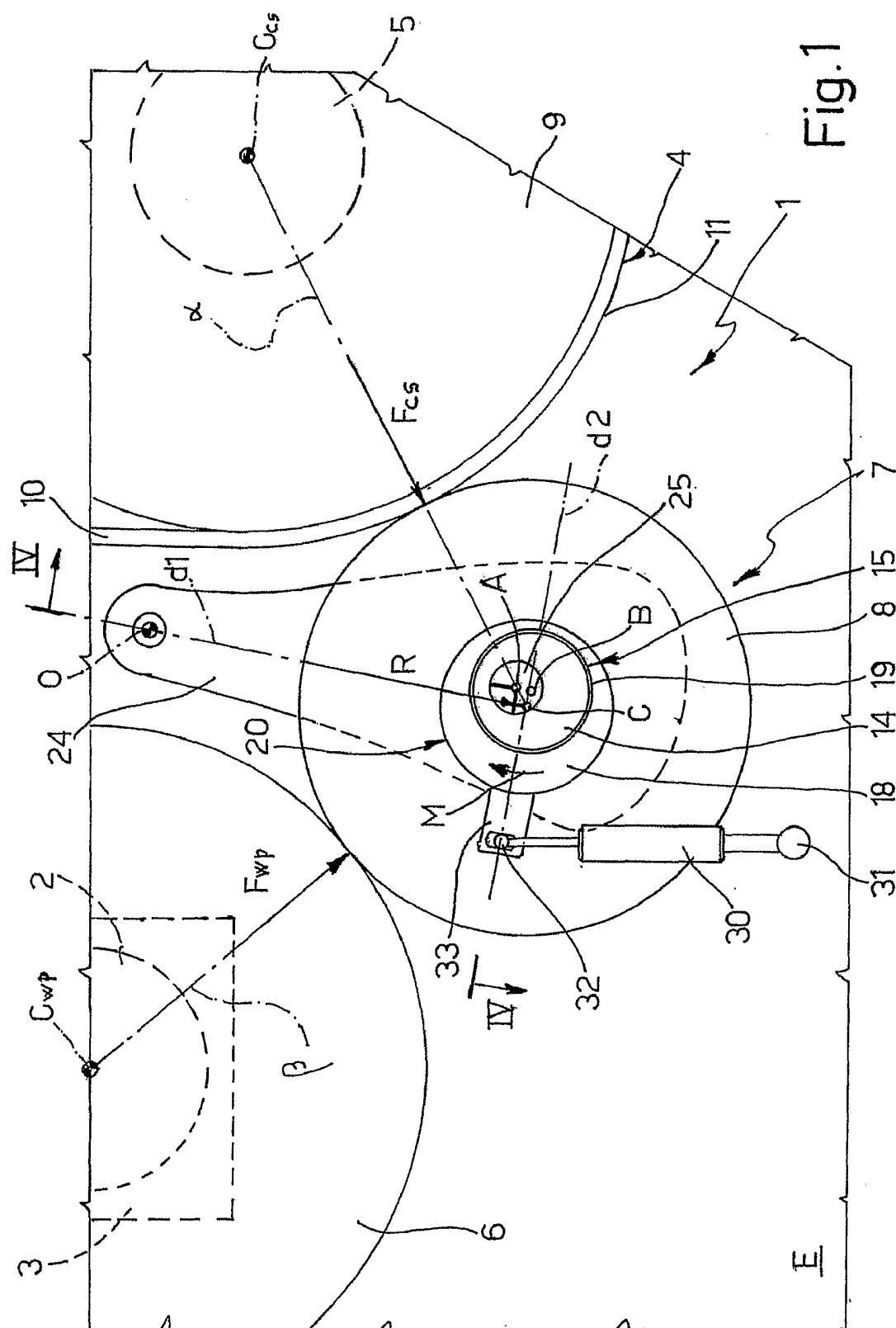
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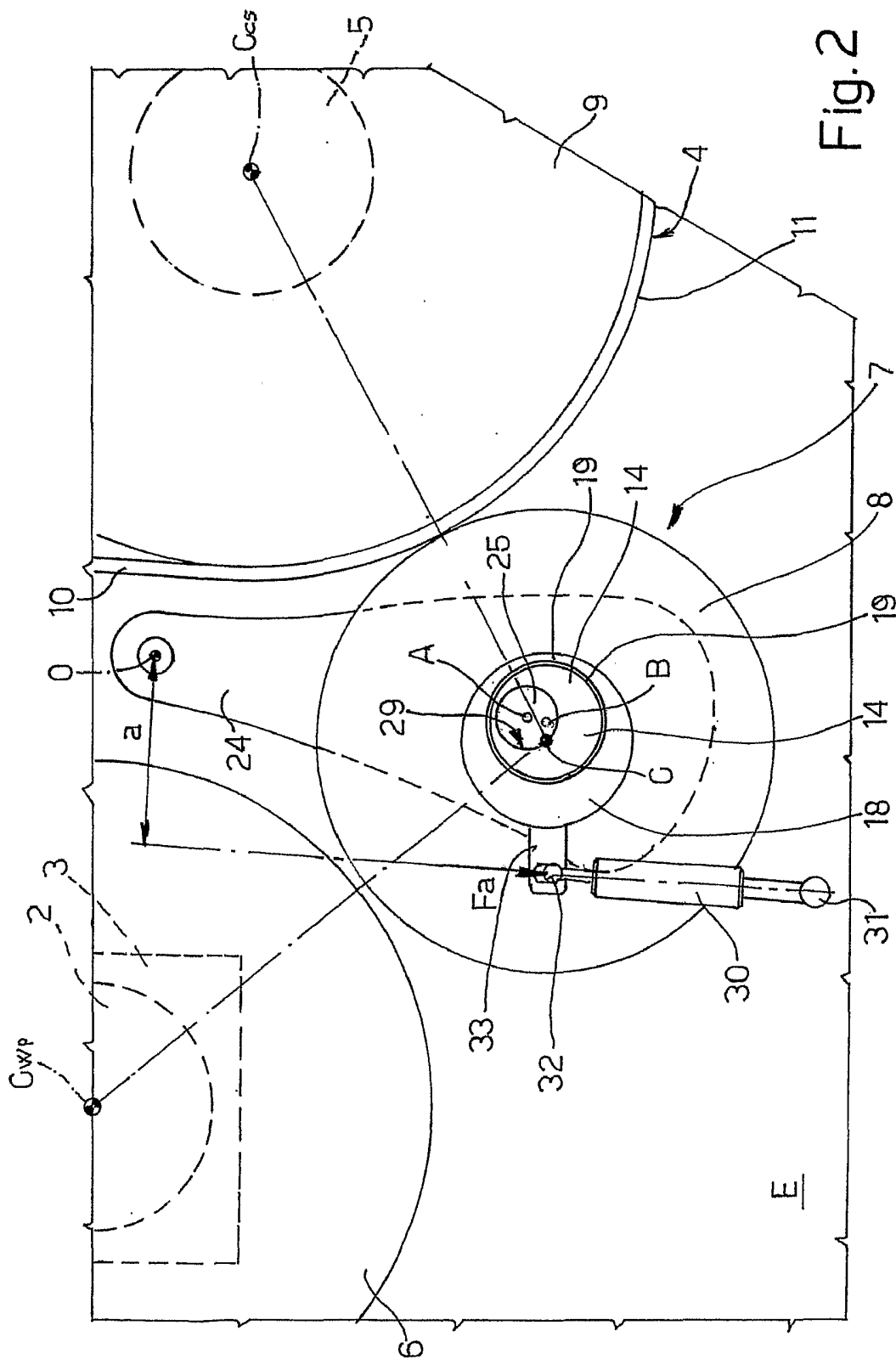
structure (E) in opposition to said elastic means (26) for moving said clutch wheel (8) away from at least one between said drive wheel (4) and driven wheel (6).

8.- The device according to Claim 7, characterized in that said actuator (30) is set so as to exert a force having an arm with respect to said third axis (O; A) tending to rotate said clutch assembly so as to move said clutch wheel (8) away from said driven wheel (6) keeping it in contact with said drive wheel (4).

9.- The device according to any one of the preceding claims, characterized in that said elastic means comprise a spring (26) acting between said arm (18) and said pin (14).

10.- The device according to any one of the preceding Claims 1 to 8, characterized in that said elastic means comprise a spring acting between said arm (18) and said fixed structure (E).





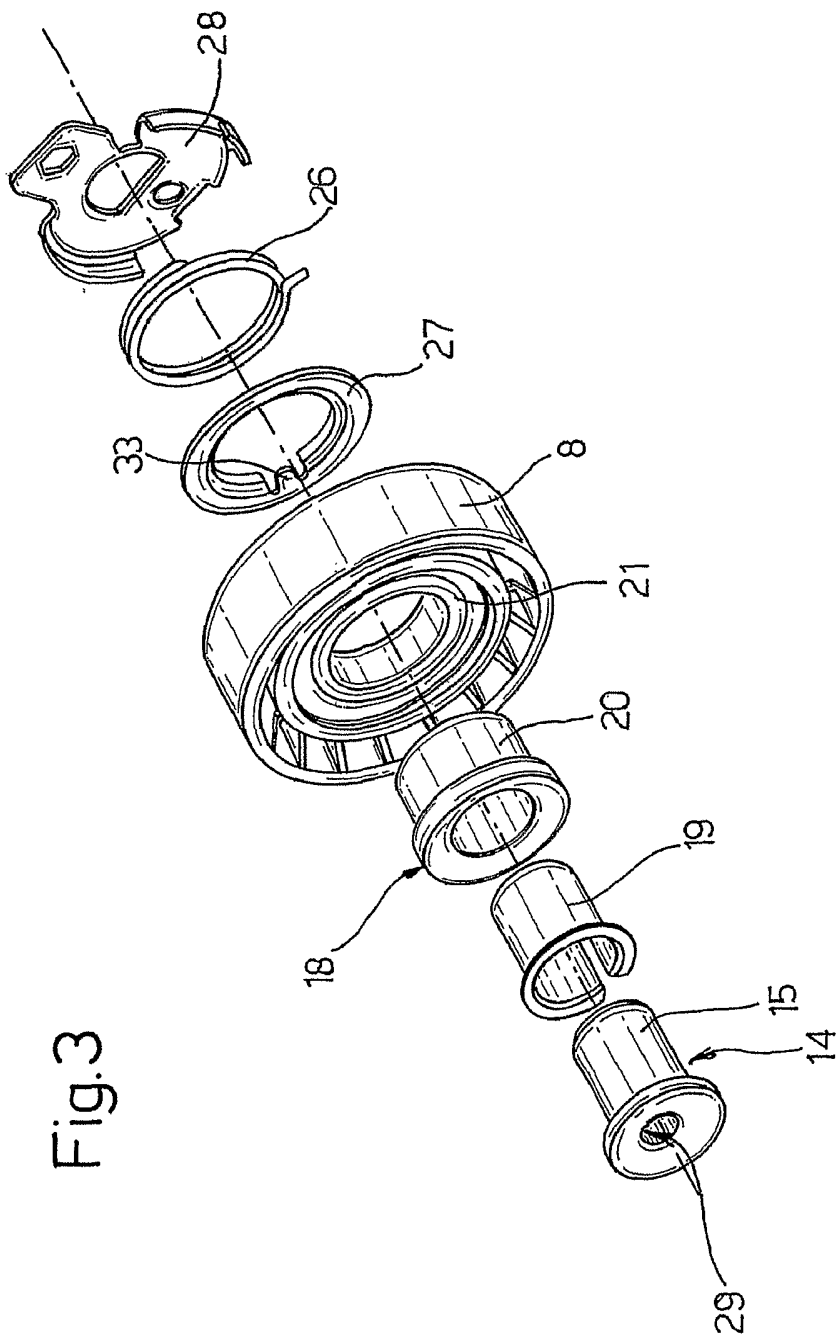


Fig.3

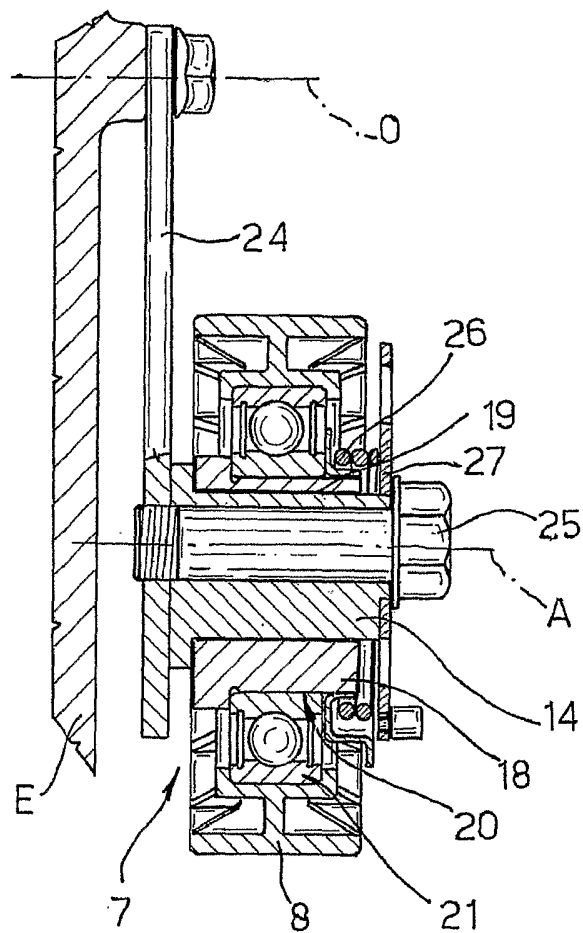


Fig. 4

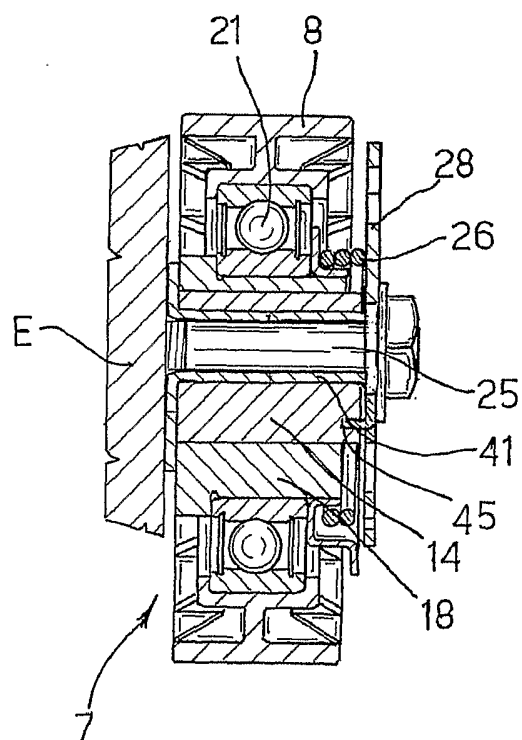
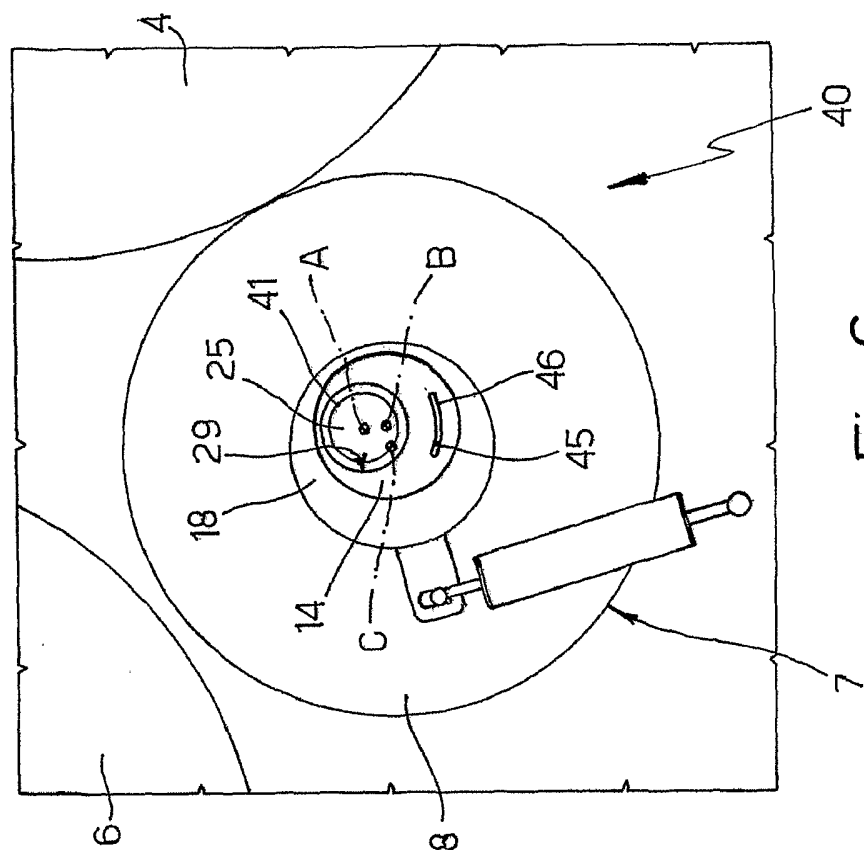
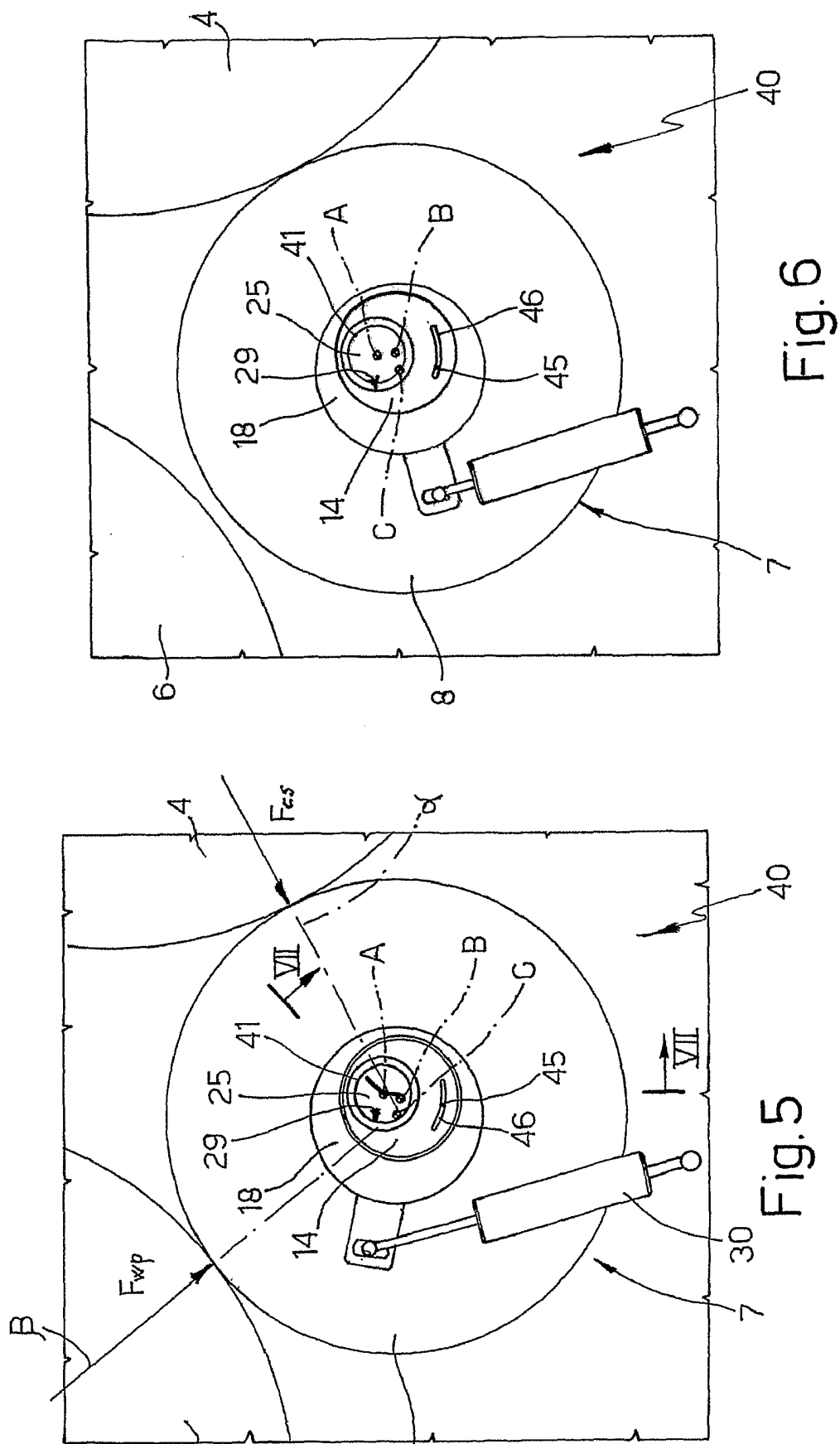


Fig. 7



INTERNATIONAL SEARCH REPORT

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According to International Patent Classification (IPC) or to both national classification and IPC

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Minimum documentation searched (classification system followed by classification symbols)
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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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☒ Patent family members are listed in annex.

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INTERNATIONAL SEARCH REPORT

International Application No
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