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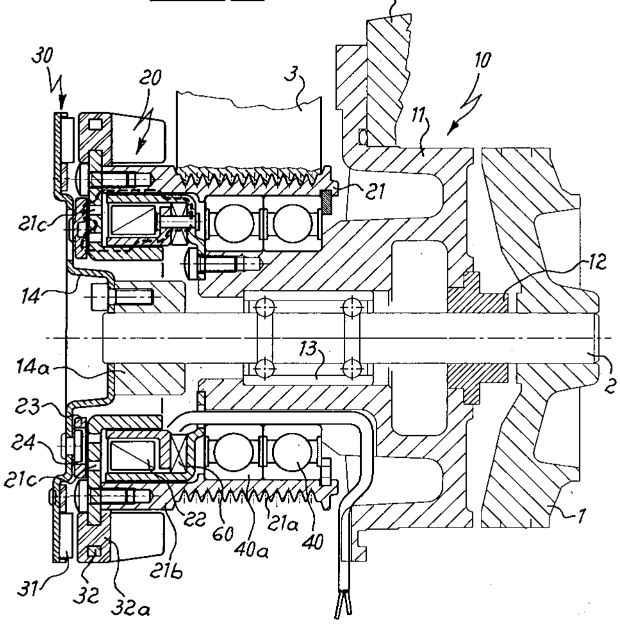
(54) Device for transmitting the rotating movement to a driven shaft, in particular for fluid recirculating pumps

(57) Device for transmitting a rotating movement from movement generating means (21) to a driven shaft (2), comprising at least one friction coupling (20) and at least one induction coupling (30), arranged between said movement generating means (21) and the driven shaft (2) and substantially concentric with each other, wherein said movement generating means consist of a circular ring (21) having, formed on its outer circumferential edge, a pulley (21a) suitable for engagement with a corresponding drive belt (3); said circular movement-generating ring (21) is mounted on a bearing (40) keyed onto the fixed support body (11) of the driven shaft (2); the circular ring part (21) formed in the manner of a pulley (21a) is situated axially outside the fixed control element (22) of the friction coupling (20).

Fig.1



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Description

[0001] The present invention relates to a device for controlling the means for recirculating an engine cooling fluid, in particular for vehicles.

[0002] It is known in the sector relating to the production of engines, in particular internal-combustion engines, that there exists the need to cool said engines by recirculating a cooling fluid moved by means of a corresponding recirculating pump, the impeller of which is made to rotate by a shaft actuated by a pulley and by a belt connected to the driving shaft.

[0003] It is also known that recirculation of the cooling fluid must be performed at a rate corresponding to the actual cooling requirement determined by the real conditions of use and by the external temperature so as to avoid the constant and needless rotation, at full speed, of devices which draw useful power, increasing the wear of the various component parts and the consumption levels of the vehicle.

[0004] It is also known that, in order to solve this problem, friction clutch and parasitic current coupling devices have been proposed, said devices being able to produce two different speeds of rotation - i.e. full speed and slower speed - of the pump shaft.

[0005] Examples of these devices are known, for example, from DE 101 58 732 and EP 1,353,051.

[0006] Although performing their function, these devices nevertheless have drawbacks which limit the application thereof; the first device in that, despite having smaller axial dimensions, it envisages, however, a magnetic induction coupling for the slower speed which is unable to achieve high values of the torque to be transmitted to the pump shaft, making the device unsuitable for high-capacity pumps such as those used in heavy vehicles, in particular of the type having a low engine rpm, but a high number of revolutions of the pump.

[0007] The second device instead envisages radial dimensions which, extending beyond the dimensions of the clutch rotor, said rotor being normally incorporated in the pulley connected to the driving shaft, make it difficult to house the pumps in the different engine compartments of the vehicles.

[0008] The technical problem which is posed, therefore, is that of providing a device for controlling the means for recirculating engine cooling fluids for vehicles and the like, which is able to produce a variation in the speed of rotation of the impeller of the said recirculating means depending on the actual operating requirement of the engine.

[0009] Within the scope of this problem it is also required that this device should have small dimensions, in particular radial dimensions, but at the same time should be able to produce high torques also at a slower speed of rotation of the engine so as to be applicable also to high-performance pumps of heavy vehicles with low-revolution engines.

[0010] It is also required that the device should be easy and inexpensive to produce and assemble and should be able to be installed easily on the pump body without the need for special adaptation.

[0011] These results are obtained according to the present invention by a device for transmitting a rotating movement according to the characteristic features of Claim 1.

[0012] Further details may be obtained from the following description of a non-limiting example of embodiment of the subject of the present invention provided with reference to the accompanying drawings, in which:

- Figure 1 shows a partially sectioned view of a first example of embodiment of the device according to the present invention;
- Figure 2 shows a second example of embodiment of the device according to the present invention; and
- Figure 3 shows a variation of embodiment of the device according to Fig. 2.

[0013] As shown in Fig. 1, the impeller 1 of a pump for recirculating the cooling fluid of vehicles and the like is mounted on a first end of a shaft 2 supported by a stationary assembly 10 comprising the body 11 of the pump fixed to the base 11a of the vehicle engine.

[0014] The pump body 11 has, arranged inside it, a sealing bearing 12, coaxial with the shaft 2, and a bearing 13, on the inner race of which the shaft 2 of the impeller is keyed.

[0015] The pump body 11 has, keyed onto the outside thereof, a second bearing 40, the outer race 40a of which is integral with a circular ring 21 which is suitably shaped and on the outer circumferential edge of which there is formed a pulley 21a, suitable for engagement with a belt 3 for transmission of the movement to the ring 21.

[0016] Since the pulling force of the belt 3 is transmitted to the outer bearing 40 it is possible to limit the size of the inner bearing 13, which is not subjected to dynamic loads, resulting in a longer working life and reduction in the overall dimensions.

[0017] The circular ring 21 has an extension in the axial direction 21b which forms the rotor of an electromagnetic coupling 20 which comprises a fixed electromagnet 22 housed inside a corresponding seat of the said rotor 21 and an armature 23 made of friction material and arranged facing the rotor 21 on the opposite side to the electromagnet and integral with a resilient membrane 24 in turn constrained to a driven element consisting of a flange 14 mounted on the shaft 2 by means of a corresponding sleeve 14a.

[0018] With this coupling the armature 23 is able to perform movements in the axial direction towards/away from the rotor 21, but is locked as regards relative rotation with respect to the flange 14.

[0019] As shown in Fig. 1, a permanent magnet 60 is also envisaged, being arranged on the fixed support of the electromagnet 22.

[0020] The rotor 23 also has, mounted thereon, a conductive support 32a with a magnetizable element 32 which forms the first part of a second Foucault current induction coupling 30, the second part of which is formed by a plurality of small magnets 31 integral with the circular flange 14 connected to the driven shaft 2 so as to be axially opposite the said magnetizable element 32 with a predetermined air gap.

[0021] The rotor part 21 with the magnetizable element 32 has interruptions 21c in the magnetic conductivity of the rotor so as to cause suitable annular closing of the magnetic flux lines as shown in Fig. 1.

[0022] Operation of the pump actuating device is of the conventional type:

- when the electromagnet 22 is de-energized, the armature 23 is constantly recalled by the magnet 60 against the rotor 21 with which it engages axially, transmitting the movement of the rotor to the driven shaft 2 which therefore rotates, together with the impeller 1, at the same speed as the pulley 21a ("fail safe" operation);
- when the electromagnet 22 is energized, the effect of the said magnet 60 is eliminated, with consequent separation of the armature 23 from the rotor 21; in this situation the Foucault current coupling 30 intervenes and causes a rotation of the driven shaft 2 at a slower speed than that of the rotor 21 owing to relative slipping of the rotor 21 and the fan 14.

[0023] It can therefore be seen how with the device according to the invention it is possible to obtain efficient operation of rotating devices such as water pumps for recirculating the cooling fluid of vehicles while maintaining, however, small radial dimensions both of the armature 24 and of the rotor 21.

[0024] Owing to this reduction in radial dimensions, together with the arrangement of the armature 23 outside of the rotor 21 in the axial direction, it is possible to obtain a pulley 21a of small diameter with a consequent multiplication of the revolutions transmitted by the belt 3, this making the device, and therefore the pump, suitable also for vehicles with engines which rotate at a low number of revolutions, but require a high speed of rotation of the cooling pump and a high transmission of torque via the friction coupling even though the latter uses an armature/rotor driven surface area smaller than the rotor surface area used for the induction coupling.

[0025] In addition to this, the fact that the armature 24 is independent of the coupling 30 improves the operating conditions of the latter since dangerous contact between the magnets integral with the rotor and the support of the magnetizable elements 32 in the event of wear of the said armature is avoided.

[0026] The presence of the permanent magnet 60 ensures that, in the event of an electrical failure, the armature is always engaged with the rotor, ensuring recirculation of the cooling fluid ("fail safe" mode).

[0027] Fig. 2 shows a second embodiment of the device according to the present invention which, in this simplified form, has a flange 114 with a radial dimension substantially contained within the radial dimension of the bearing 40 and devoid of the Foucault coupling 30.

[0028] With this configuration it is possible to obtain operation of the ON/OFF type with a single speed of rotation of the impeller 1 which, otherwise, remains stationary in neutral.

[0029] Fig. 3 shows a variant of the second embodiment of the device shown in Fig. 2; in this configuration it is envisaged that, in addition to the reduction in the radial dimensions of the flange 114, the electromagnet 122 is of the conventional type, resulting in ON/OFF operation with a speed of rotation and neutral of the conventional type.

Claims

1. Device for transmitting a rotating movement from movement generating means (21) to a driven shaft (2), comprising at least one friction coupling (20;120) arranged between said movement generating means (21) and the driven shaft (2), **characterized in that**:

   - said movement generating means consist of a circular ring (21) having, formed on its outer circumferential edge, a pulley (21a) suitable for engagement with a corresponding drive belt (3);
   - said circular movement-generating ring (21) is mounted on a bearing (40) keyed onto the fixed support body (11) of the driven shaft (2);
   - the circular ring part (21) formed in the manner of a pulley (21a) is situated axially outside the fixed control element (22) of the friction coupling (20;120).

2. Device according to Claim 1, **characterized in that** a circular flange (14;114) is mounted on said driven shaft (2), axially opposite the movement generating ring (21).

3. Device according to Claim 1, **characterized in that** said friction coupling (20;120) is of the electromagnetic type.

4. Device according to Claim 3, **characterized in that** said friction coupling (20) comprises a fixed electromagnet (22; 122) and an armature (23) arranged on opposite sides of the movement generating ring (21) in the axial direction.

5. Device according to Claim 4, **characterized in that** said friction coupling (20) comprises a permanent magnet (60) arranged on the fixed support of the electromagnet (22).

6. Device according to Claim 4, **characterized in that** said armature (23) is integrally joined to the driven shaft (2) by means of a resilient membrane (24) able to allow movements in the axial direction towards/away from the rotor (21) and prevent the relative rotation of the armature with respect to the driven shaft.

7. Device according to Claim 6, **characterized in that** said armature (23) is integral with a circular flange (14;114) mounted on the driven shaft (2).

8. Device according to Claim 7, **characterized in that** said circular flange (114) has a radial dimension substantially contained within the radial dimension of the bearing (40).

9. Device according to Claim 7, **characterized in that** said circular flange (14) has a radial dimension which extends beyond the bearing (40).

10. Device according to Claim 9, **characterized in that** it comprises at least one induction coupling (30).

11. Device according to Claim 10, **characterized in that** said induction coupling (30) is concentric with the friction coupling (20).

12. Device according to Claim 10, **characterized in that** the induction coupling (30) comprises at least one magnetizable ring (32) integral with the movement generating ring (21) and a plurality of permanent magnets (31) integral with the flange (14) of the driven shaft.

13. Device according to Claim 11, **characterized in that** said magnetizable ring (32) is inserted inside a conductive support (31) integral with the rotor of the electromagnetic coupling (20).

14. Device according to Claim 1, **characterized in that** said driven shaft (2) is the shaft actuating the impeller (1) of a recirculating pump.

15. Device according to Claim 1, **characterized in that** said recirculating pump is the pump for the cooling fluid of a vehicle.

16. Pump for recirculating a cooling fluid comprising a device for transmitting the rotating movement from movement generating means (21) to the impeller (1) integral with a driven shaft (2) of the pump, said device comprising at least one friction coupling (20;120) arranged between said movement generating means (3, 21) and the driven shaft (2), **characterized in that**:

    - said movement generating means consist of a circular ring (21) having, formed on an axial section of the outer circumferential edge, a pulley (21a) suitable for engagement with a corresponding belt (3);
    - said circular movement-generating ring (21) is mounted on a bearing (40) keyed onto the fixed support body (11) of the driven shaft (2);
    - said circular ring part (21) formed in the manner of a pulley (21a) is axially arranged between the impeller (1) of the pump and the fixed control element (22) of the friction coupling (20; 120) .

17. Pump according to Claim 16, **characterized in that** a circular flange (14;114) is mounted on said driven shaft (2), axially opposite the movement generating ring (21).

18. Pump according to Claim 16, **characterized in that** said friction coupling (20;120) is of the electromagnetic type.

19. Pump according to Claim 18, **characterized in that** said friction coupling (20) comprises a fixed electromagnet (22; 122) and an armature (23) arranged on opposite sides of the movement generating ring (21) in the axial direction.

20. Pump according to Claim 19, **characterized in that** said friction coupling (20) comprises a permanent magnet (60) arranged on the fixed support of the electromagnet (22).

21. Pump according to Claim 19, **characterized in that** said armature (23) is integrally joined to the driven shaft (2) by means of a resilient membrane (24) able to allow movements in the axial direction towards/away from the rotor (21) and prevent the relative rotation of the armature with respect to the driven shaft.

22. Pump according to Claim 21, **characterized in that** said armature (23) is integral with a circular flange (14;114) mounted on the driven shaft (2).

23. Device according to Claim 22, **characterized in that** said circular flange (114) has a radial dimension substantially contained within the radial dimension of the bearing (40).

24. Device according to Claim 22, **characterized in that** said circular flange (14) has a radial dimension which extends beyond the bearing (40).

25. Device according to Claim 24, **characterized in that** it comprises at least one induction coupling (30).

26. Pump according to Claim 25, **characterized in that** said induction coupling (30) is concentric with the friction coupling (20).

27. Device according to Claim 25, **characterized in that** the induction coupling (30) comprises at least one magnetizable ring (32) integral with the movement generating ring (21) and a plurality of permanent magnets (31) integral with the flange (14) of the driven shaft.

28. Device according to Claim 26, **characterized in that** said magnetizable ring (32) is inserted inside a conductive support (31) integral with the rotor of the electromagnetic coupling (20).

Fig.1

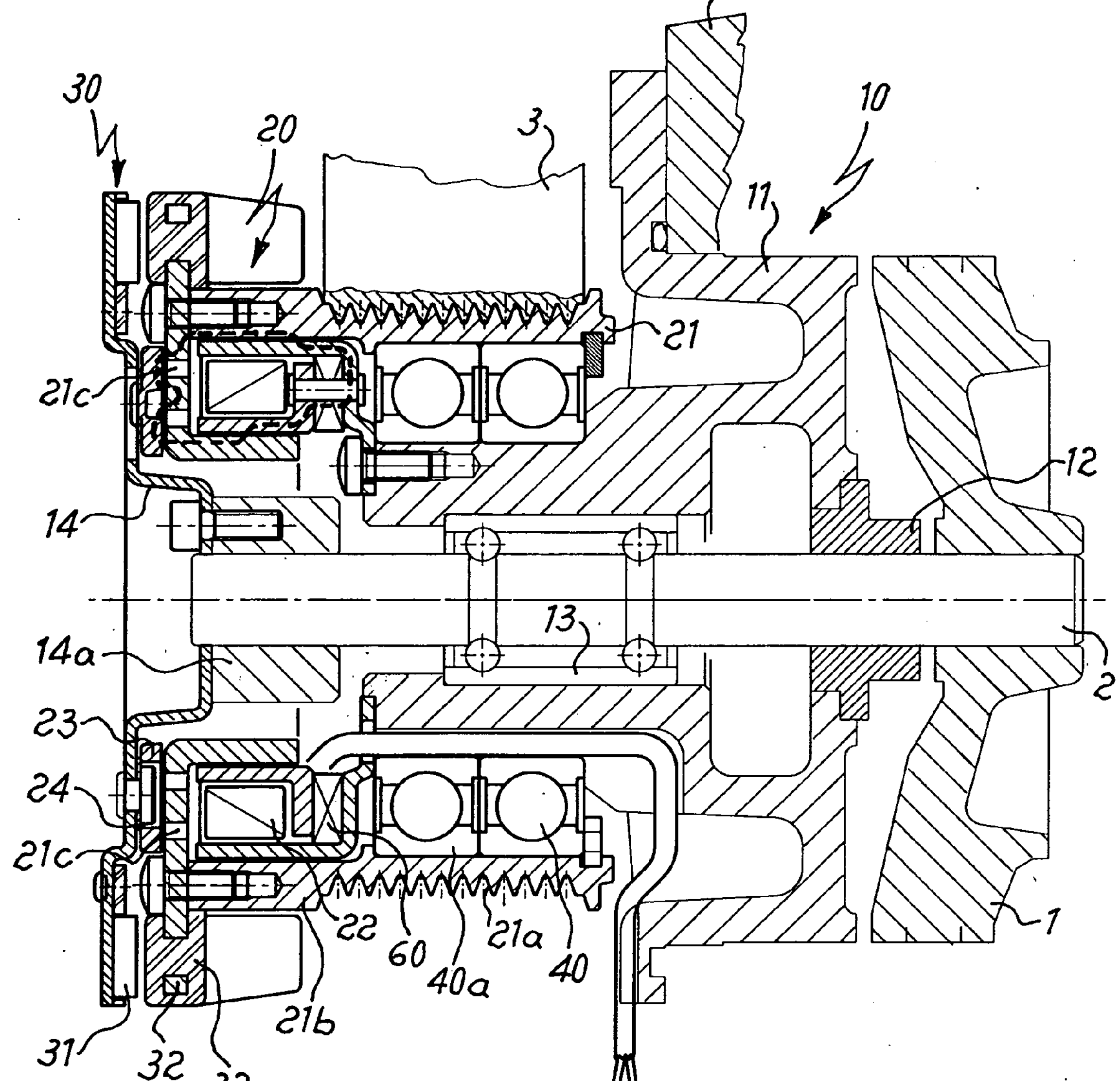
11a
30
20
3
10
11
21
21c
12
14
13
14a
2
23
24
21c
22
60
40a
21a
40
1
21b
31
32
32a

Fig. 2

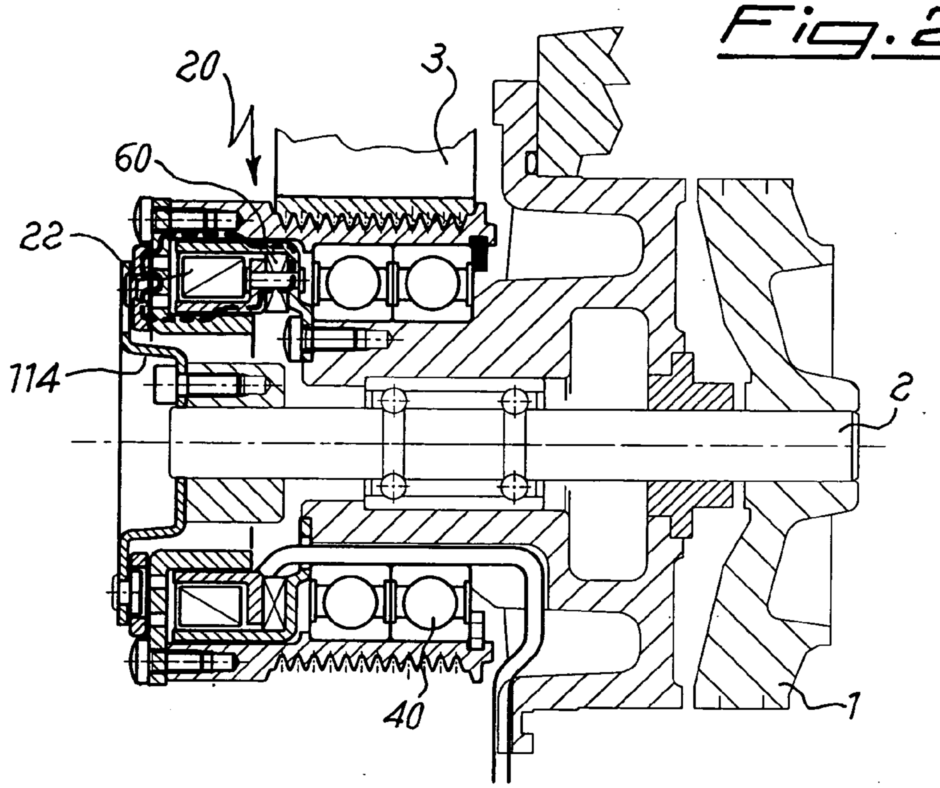

Fig. 3