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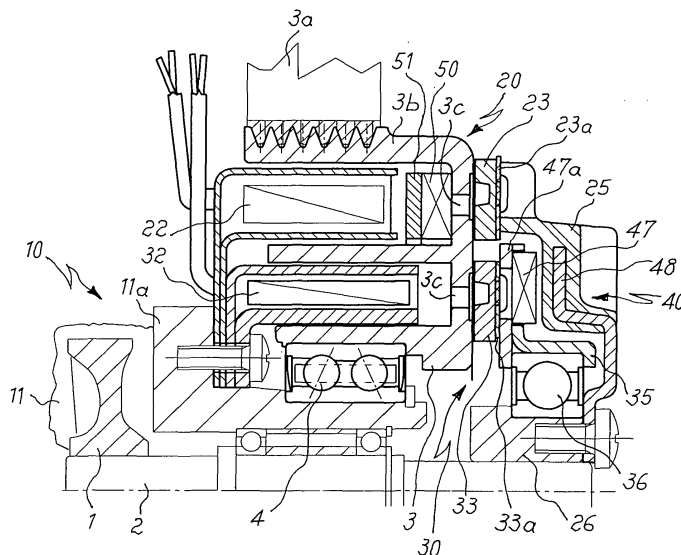
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(54) **Pump for recirculating fluids with multiple-speed device for transmitting the rotational movement to the impeller**

(57) Pump for recirculating a cooling fluid, comprising a device for transmitting the movement from movement generating means (3a,3) to the impeller (1) rigidly connected to a driven shaft (2), where said transmission device comprises at least one first friction coupling (20) and at least one second friction coupling (30) which are substantially concentric with each other and at least one

induction coupling (40) situated between said movement generating means (3) and the driven shaft (2); said first friction coupling (20) and second friction coupling (30) are of the electromagnetic type and one of said friction couplings (20,30) comprises a permanent magnet (50) which is integral with said movement generating means (3).

Fig.1



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Description

[0001] The present invention relates to a device for actuating the means for recirculating a fluid for cooling engines, in particular for motor 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 which is moved by means of a corresponding recirculating pump, the impeller of which is rotationally driven 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 flowrate corresponding to the actual cooling requirement which is determined by the real operating conditions and the external temperature, so as to avoid keeping devices which consume useful power from running constantly and unnecessarily at full speed, increasing the wear of the various component parts and 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 a lower speed - of the pump shaft.

[0005] Examples of these devices are, for example, known from IT-MI2005U 56 in the name of the same present Applicants.

[0006] Although performing their function, these devices nevertheless have drawbacks arising from the fact that it is impossible to deactivate the pump completely, the latter running continuously even when it is not required, continuing to draw power unnecessarily, and from the fact that safety means which are automatically activated in the event of a fault in the electric circuit are not envisaged.

[0007] The technical problem which is posed, therefore, is to provide a device for actuating the means for recirculating fluids for cooling engines of vehicles and the like, able to cause a variation in the speed of rotation of the impeller of the said recirculating means, depending on the actual operating requirements of the engine, and in particular cause rotation of the pump at a number of revolutions different from that of the driving shaft and able to be determined depending on the actual cooling requirement of the engine, which device has compact dimensions and is without costly projecting rotating masses and formed by a small number of costly parts.

[0008] In connection with this problem it is also convenient if the device is able to keep the pump stopped in the idle position and also ensure safety rotation of the pump also in the event of faults affecting the associated power supply and control devices.

[0009] In connection with this problem it is also required, moreover, that this device should have small dimensions, in particular small radial dimensions, but at the same time should be able to generate high torques also at a low engine running speed so as to be able to

applied also to high-performance pumps of heavy vehicles which have an engine performing a small number of revolutions.

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

[0011] These results are achieved according to the present invention by a pump for recirculating a cooling fluid, comprising a device for transmitting the movement from movement generating means to the impeller rigidly connected to a driven shaft, in which said transmission device comprises at least one first friction coupling and at least one second friction coupling which are substantially concentric with each other and at least one induction coupling situated between said movement generating means and the driven shaft, said first and second friction couplings being of the electromagnetic type, and in that one of the said friction couplings comprises a permanent magnet which is integral with said movement generating means.

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

- Figure 1 shows a schematic cross-section along an axial plane of an example of embodiment of the device according to the present invention.

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

[0014] The pump body has, arranged inside it (but not shown here), a seal which is coaxial with the shaft 2 and a bearing, on the inner race of which the shaft 2 of the impeller is keyed.

[0015] The base 11a of the engine also has, mounted thereon, a first bearing 4, on the outer race of which a circular ring 3 is keyed and has an extension in the axial direction 3b which has a form suitable for engagement with a drive belt 3a for actuating the ring which forms, in this way, the rotor of a first electromagnetic coupling 20 which comprises a fixed electromagnet 22 housed inside a corresponding first seat 3 of the said rotor and an armature 23 which is made of friction material and arranged facing the rotor 3 on the opposite side to the electromagnet and is integral with a resilient membrane 23a which is in turn attached to a driven element consisting of a flange 25 mounted on the shaft 2 by means of a corresponding sleeve 26.

[0016] With this coupled arrangement the armature 23 is able to perform movements in the axial direction towards/away from the rotor 3, but is locked as regards relative rotation with respect to the flange 25.

[0017] The device according to the invention envisages the presence of a second electromagnet 32 which is concentric with the first electromagnet and the current of which is in turn controlled for actuation of a second armature 33 forming part of a second coupling 30 and in turn connected to a resilient membrane 33a attached to a ring 35 keyed onto an associated bearing 36 mounted on the sleeve 26 integral with the shaft 2.

[0018] The said ring 35 has, mounted thereon, a conducting support 47a which carries a magnetizable element 47 which forms the first part of a Foucault current induction coupling 40, the second part of which is formed by a plurality of small magnets 48 which are integral with the circular flange 25 connected to the driven shaft 2 so as to be situated axially opposite the said magnetizable element 47 with a predetermined air gap.

[0019] The rotor parts 3 situated opposite the armatures 23,33 envisage interruptions 3c in the magnetic conductivity of the rotor in order to produce suitable annular closing of the magnetic flux lines for recall of the said armatures in the axial direction.

[0020] Fig. 1 also shows the presence of a permanent magnet 50 which is situated between the first electromagnet 22 and the first armature 23; in a preferred embodiment said magnet 50 is integral with an element 51 made of magnetizable material which is situated axially opposite the said armature 33.

[0021] The magnet is magnetized so as to have frontal segments alternating in the radial direction with N-S polarities, if necessary also with several poles and with the presence of an iron element 52 which is arranged on the opposite side to the armature 23 with the function of a flow concentrator.

[0022] In this configuration the device is also able to ensure the so-called "fail safe" safety condition since, during normal operating conditions, the current supplied to the first electromagnet 22 produces neutralization of the magnet field for recall of the armature 23, while in the event of a total power failure, the magnet 50 is in any case able to recall the first armature 23 and ensure fast rotation of the pump 1 which causes cooling of the engine liquid.

[0023] Although operation in fail safe mode is preferred with fast rotation of the fan 1, it is also envisaged that the magnet 50 may be applied in the region of the second magnet, in this case producing low-speed safety operation.

[0024] With the structure described, the operating principle of the pump actuating device is as follows:

- a) in conditions where the electromagnet 22 is excited and the electromagnet 32 is not excited, both the armature 23 and the armature 33 are detached from the rotor 3, the device is consequently in idle mode and does not transmit movement to the driven shaft 2 which, therefore, remains stopped together with the impeller 1;
- b) in conditions where the electromagnet 22 is excited and the electromagnet 32 is excited, the second

smaller size armature 33 is recalled and, overcoming the limited resistance in the axial direction of the membrane 33a, engages with the rotor 3 and transmits the movement to the shaft 2 via the Foucault coupling 40; since the transmission occurs with relative slipping of the ring 35 and the flange 25, the latter, and consequently also the driven shaft 2 and the impeller 1, rotate at a slower speed than that of the driving shaft;

c) in conditions where the electromagnet 22 is de-energized and the electromagnet 32 is de-energized, recalling of the first armature 23 and separation of the second armature 33 occur; the first armature, overcoming the resistance of the associated membrane 34a, engages with the rotor 3, transmitting the movement of the driving shaft 20 directly to the bell member 1a and producing a rotational speed of the fan which is the same as the rotation speed of the said driving shaft.

[0025] It is therefore clear how, with the device according to the invention, it is possible to obtain effective operation of rotating devices such as water pumps for recirculating the cooling fluid of vehicles with the required operation at several speeds and idle operation, while keeping both the axial and radial dimensions small.

[0026] In addition to this, the presence of the permanent magnet ensures that in the event of an electrical failure the armature is always engaged with the rotor, ensuring operation of the pump and recirculation of the cooling fluid (so-called "fail-safe" operation).

Claims

1. Pump for recirculating a cooling fluid, comprising a device for transmitting the movement from movement generating means (3a,3) to the impeller (1) rigidly connected to a driven shaft (2), **characterized in that** said transmission device comprises at least one first friction coupling (20) and at least one second friction coupling (30) which are substantially concentric with each other and at least one induction coupling (40) situated between said movement generating means (3) and the driven shaft (2), **in that** said first friction coupling (20) and second friction coupling (30) are of the electromagnetic type and **in that** one of the said friction couplings (20,30) comprises a permanent magnet (50) which is integral with said movement generating means (3).
2. Pump according to Claim 1, **characterized in that** said movement generating means (3a,3) comprise a rotor (3) which is keyed onto a first bearing (4) integral with a fixed base (11a).
3. Pump according to Claim 2, **characterized in that** said first electromagnetic coupling (20) comprises a

fixed electromagnet (22) housed inside a corresponding first seat of the rotor (3) and an armature (23) which is made of friction material and arranged facing the said rotor (3) on the opposite side to the electromagnet.

second friction coupling (30).

4. Pump according to Claim 3, **characterized in that** said second coupling (30) comprises a second electromagnet (32) which is concentric with the first electromagnet for actuation of a second armature (33) made of friction material and arranged facing the said rotor (3) on the opposite side to the electromagnet. 10
5. Pump according to Claim 1, **characterized in that** the current of said first electromagnet (22) and second electromagnet (32) is controlled. 15
6. Pump according to Claim 1, **characterized in that** said first armature (23) is integral with a circular flange (25) which is situated axially opposite the rotor (3). 20
7. Pump according to Claim 1, **characterized in that** said flange (25) is integrally joined to the driven shaft (2) by means of a sleeve (26). 25
8. Pump according to Claim 4, **characterized in that** said second armature (33) is fastened to a ring (35) which is keyed onto an associated bearing (36) mounted on the sleeve (26) integral with the shaft (2). 30
9. Pump according to Claim 4, **characterized in that** said first armature (23) and second armature (33) are integral with respective supports (25,35) by means of a resilient membrane (23a,33a) which is able to allow movements in the axial direction towards/away from the rotor (3) and prevent the relative rotation of the armatures with respect to the driven shaft. 35
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10. Pump according to Claim 1, **characterized in that** said induction coupling (40) is of the parasitic current type.
11. Pump according to Claim 10, **characterized in that** said induction coupling (40) comprises a conducting support (47a) which carries a magnetizable element (47) integral with said ring (35) supporting the second armature (33) and a plurality of small magnets (48) which are integral with the circular flange (25) supporting the first armature (23). 45
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12. Pump according to Claim 1, **characterized in that** said permanent magnet (50) is associated with the first friction coupling (20). 55
13. Pump according to Claim 1, **characterized in that** said permanent magnet (50) is associated with the
14. Pump according to Claim 1, **characterized in that** it is the pump for recirculating the cooling fluid of a vehicle.

Fig. 1

