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(54) Device for transmitting the movement to fans for cooling engines with stoppage of the fan in an idle condition thereof

(57) Device for transmitting the movement to a fan (1) for cooling the coolant in a motor vehicle, comprising:
- movement generating means (3,101);
- at least one friction clutch (100) formed by a first fixed electromagnet (132) and a second fixed electromagnet (133), a first armature (110) and a second armature (120), and a rotor (140) to which the fan (1) is constrained;
- at least one eddy-current clutch (200);
- a fixed support (21) on which the movement generating means (3) are mounted via a first bearing (11);

wherein:
- said first armature (110) is a driving element and is connected to the movement generating means (3), said rotor (140) is a driven element and is mounted idle on the support (21) via a second bearing (15);
- the eddy-current clutch (200) comprises a driving part (203) connected to the movement generating means (3,101) and a driven part (202,201) integral with said second armature (120) of the friction clutch (100).

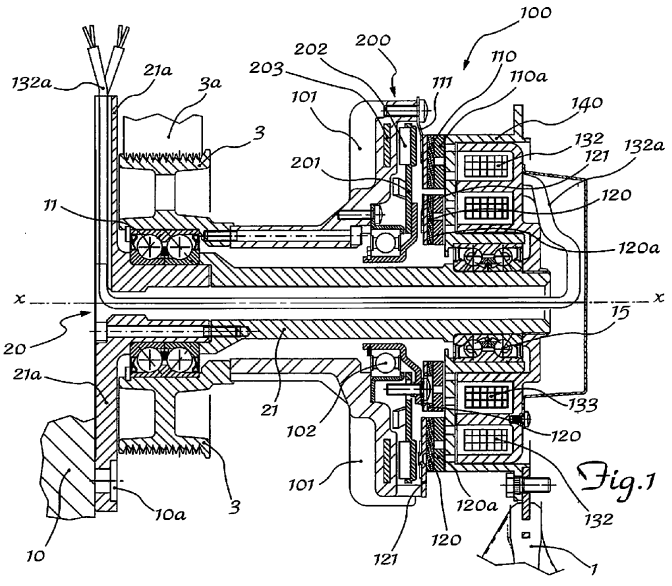

Fig.1

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Description

[0001] The present invention relates to a device for transmitting the movement to a fan for cooling the coolant in a motor vehicle, able to keep the fan at a standstill in the idle position thereof.

[0002] It is known in the technical sector relating to the cooling of coolants contained in the radiators of motor vehicles that there exists the need to force air onto the radiator itself so as to be able to obtain more rapid dissipation of heat from the liquid to the outside, said flow of forced air being obtained by causing the rotation of a fan, which is normally mounted either directly on the crankshaft or on the shaft of the water pump or on a driven and fixed shaft carrying a pulley which is driven by a belt actuated by the crankshaft.

[0003] It is also known that said fan must be made to rotate only when a certain predefined temperature of the water has been reached, said temperature being detected by means of a thermostat which activates an electromagnetic clutch, closing of which causes the fan to start rotating. For this purpose said fan must be able to rotate:

- at a speed slower than that of the drive shaft for cooling in conditions where there is a low external temperature;
- at a speed which is the same as or even greater than that of the drive shaft when there are higher external temperatures or during use under extreme conditions which cause overheating of the engine;
- at zero speed, namely with the fan in an idle condition relative to the drive shaft, in the case of particularly low temperatures where further cooling is unnecessary or even harmful.

[0004] In attempt to achieve such a performance, couplings of the mixed type have been developed, these comprising electromagnetically controlled friction clutches and drive couplings which use the eddy currents generated by the rotation of a conducting part in the vicinity of permanent magnets.

[0005] Although performing their function, these solutions nevertheless have the drawback arising from the fact that the fan still rotates, albeit slowly, even in the idle condition, owing to disengagement of the electromagnetic clutch and/or the auxiliary driving means; this residual rotation is substantially due to the friction of the bearings on which the various parts of the transmission are mounted.

[0006] In addition to producing an undesirable cooling effect - even during start-up of the engine (when it is instead required that the engine should heat up as rapidly as possible) - the residual rotation of the fan, in the idle condition, also produces a torque and therefore power consumption which, although limited in absolute terms, assumes significant proportions if considered in relation to the major distances travelled by commercial vehicles.

[0007] The technical problem which is posed, therefore, is to provide a device for transmitting the rotational movement to a fan for cooling the coolant in motor vehicles, which is able to allow the fan to rotate at a number of revolutions which can be controlled and adjusted depending on the actual need for cooling of the engine and which also allows the fan to be kept at a standstill in its idle condition.

[0008] In connection with this problem a further requirement is that the device should have compact dimensions, that it should not require means for braking the fan which, although able to stop the fan, would nevertheless result in an increased power consumption, and that it should be able to be controlled by means of direct sensing of the coolant temperature.

[0009] These results are achieved according to the present invention by a device for transmitting the movement to a fan for cooling the coolant in a motor vehicle, according to the characteristic features of Claim 1.

[0010] 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 schematic axially sectioned view of a first example of embodiment of the device according to the invention; and

Figure 2: shows a schematic axially sectioned view of a second example of embodiment of the device for fail-safe operation.

[0011] As shown in Fig. 1 and assuming for the sake of convenience of description a longitudinal direction X—X coinciding with the axis of rotation of the fan; a downstream part corresponding to the fan itself and an upstream part, opposite to the previous part, corresponding to the movement generating means, the device for transmitting the movement to a fan 1 for cooling motor vehicles comprises:

a fixed support 20 consisting of a hollow sleeve 21, the upstream end of which is in the form of a flange 21a fastened to the base 10 of the engine via fixing means 10a.

[0012] The hollow sleeve 21 has, keyed thereon, a first bearing 11 seating a pulley 3 connected to the crankshaft of the vehicle by means of a belt 3a and forming the means for generating the movement of the device.

[0013] A first friction clutch 100 and a second eddy current or Foucault clutch 200 are arranged between the fan 1 and the pulley 3.

[0014] The friction clutch 100 comprises a first armature 110 provided with friction material 110a and connected by means of a resilient element 111 to a flange 101 axially connected to the pulley 3 with which it rotates integrally.

[0015] The resilient element 111 allows movements of the armature in the axial direction, but prevents relative

rotation thereof with respect to the flange 101.

[0016] The flange 101 also has an associated bearing 102, the inner race of which, towards the axis of rotation, supports a flat member 201 made of magnetic material and carrying permanent magnets 202 arranged in a suitable radial position so as to be situated axially opposite a conducting disc 203 inserted in the flange 101; said magnets 202 and conducting disc 203 forming the linking elements of the said Foucault or eddy-current induction clutch 200.

[0017] Said disc 201 in turn has a second armature 120 which is concentric with the first armature and provided with respective friction material 120a and connected to the disc by means of a resilient element 121 which allows movements of the armature in the axial direction, but prevents the relative rotation thereof with respect to the said disc. Said armatures 110 and 120 form the driving element of the clutch 100 comprising a first annular electromagnet 132 and a second annular electromagnet 133 which are fixed onto the sleeve 21 and electrically connected to a thermostat (not shown) for example for sensing the temperature of the cooling water via cables 132a.

[0018] The two electromagnets 132,133 are situated radially opposite the respective armature 110 and 120.

[0019] A rotor 140 with a suitable C-shaped cross-section for concentrically containing the two electromagnets 132,133 is arranged between the electromagnets 132,133 and the armatures 110,120; said rotor is mounted on a second bearing 15 keyed onto the fixed support 21.

[0020] The rotor 140 therefore forms the driven part of the device and carries the fan 1 which is made to rotate in the manner described below.

[0021] With this configuration the operating principle of the transmission device is as follows:

- the pulley 3 is driven by the belt 3a and keeps the flange 101 constantly rotating and therefore the first armature 110 directly connected to the flange and the second armature 120 connected to the flange by means of the disc 201 and coupling 200 for eddy currents induced by the relative rotation of the disc 203 and the magnets 202;
- energization of only the first electromagnet 132 recalls the first driving armature 110 which, adhering to the driven rotor 140, causes rotation of the latter and therefore the fan 1 at a high speed the same as that of the pulley 3;
- energization of only the second electromagnet 133 recalls the second driving armature 120 which, adhering to the driven rotor 140, causes rotation of the latter and therefore the fan 1 at a speed which is slower than that of the pulley 3 and determined by the size of the Foucault coupling;
- de-energization of both the electromagnets 132,133 keeps the rotor 140 and therefore the fan 1 at a standstill in the idle condition.

[0022] In this idle condition the two races of the second bearing 15 are both at a standstill and therefore do not have a relative speed; simultaneously the two races of the bearing 102 which supports the eddy-current coupling 200 rotate at the same speed, in turn producing a zero relative speed; since there is no relative speed of the races of the two bearings 15 and 102 there is likewise no frictional driving of the driven parts mounted thereon, thus ensuring stoppage of the fan which in the idle condition does not rotate.

[0023] It is therefore clear how with the configuration of the transmission device which comprises: a driven rotor mounted on a fixed support via an associated bearing separate from the movement generating means (pulley) and a pair of driving armatures, one of which is directly connected to the movement generating means and the other one of which is connected to the latter via an associated bearing mounted on the driving flange, it is possible to neutralize the bearing driving effects due to the relative friction within them, therefore reducing the torque acting on the crankshaft and therefore the power consumption due to the free rotation of the fan in the idle condition, as occurs in the devices of the prior art.

[0024] Fig. 2 shows a variation of embodiment of the transmission device according to the invention which comprises in this case a permanent magnet 300 arranged opposite the second electromagnet 133; in this configuration the permanent magnet 300 constantly recalls the second armature 120 which is released only upon excitation of the electromagnet which eliminates the magnetic field of the magnet 300.

[0025] The fan 1 is therefore kept rotating slowly also in the event of faults affecting the electrical system, ensuring in any case cooling of the engine fluid (fail safe operation).

Claims

1. Device for transmitting the movement to a fan (1) for cooling the coolant in a motor vehicle, comprising:

- movement generating means (3,101);
- at least one friction clutch (100) formed by a first fixed electromagnet (132) and a second fixed electromagnet (133), a first armature (110) and a second armature (120), and a rotor (140) to which the fan (1) is constrained;
- at least one eddy-current clutch (200);
- a fixed support (21) on which the movement generating means (3) are mounted via a first bearing (11);

characterized in that

- said first armature (110) is a driving element and is connected to the movement generating means (3),

said rotor (140) is a driven element and is mounted idle on the support (21) via a second bearing (15);

- the eddy-current clutch (200) comprises a driving part (203) connected to the movement generating means (3,101) and a driven part (202,201) integral with said second armature (120) of the friction clutch (100).

2. Device according to Claim 1, **characterized in that** the fixed support (20) consists of a hollow sleeve (21), the upstream end of which is in the form of a flange (21a) fastened to the base (10) of the engine via fixing means (10a).

3. Device according to Claim 1, **characterized in that** said movement generating means comprise a pulley (3) connected to the driving shaft by means of a belt (3a) and a flange (101) axially connected to the pulley (3) with which it rotates integrally.

4. Device according to Claim 1, **characterized in that** said fixed electromagnets (132,133) are concentrically mounted inside the rotor (140) and constrained to the fixed support (20).

5. Device according to Claim 3, **characterized in that** the first armature (110) is directly connected to the flange (101) by means of a resilient element (111) which allows movements of the armature in the axial direction, but prevents relative rotation thereof with respect to the flange itself.

6. Device according to Claim 3, **characterized in that** said Foucault clutch (200) comprises a flat member (201) made of magnetic material and carrying permanent magnets (202) arranged in a radial position so as to be situated axially opposite a conducting disc (203) inserted in the flange (101).

7. Device according to Claim 6, **characterized in that** said flat member (201) forms the driven part of the clutch (200) and is mounted on the inner race, towards the axis of rotation, of an associated bearing (102), the outer race of which is mounted on the flange (101).

8. Device according to Claim 6, **characterized in that** the second electromagnet (133) of the friction clutch is associated with a permanent magnet (300) able to keep the second armature (120) recalled against the rotor (140).

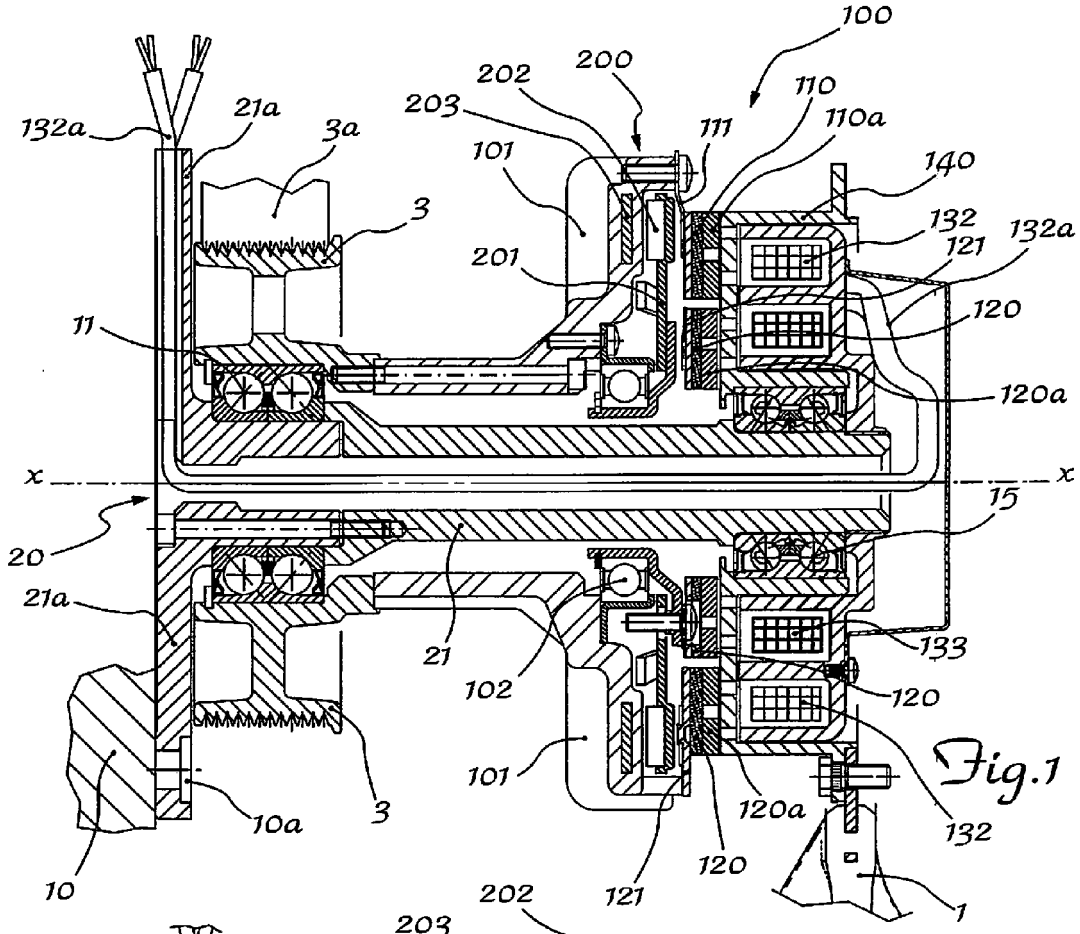
100
202
200
203
110
111
110a
101
140
132a
21a
3a
3
132
121
201
11
120
120a
x
x
15
20
21a
21
102
133
120
101
120a
132
10a
3
10
121
120
1

Fig.1

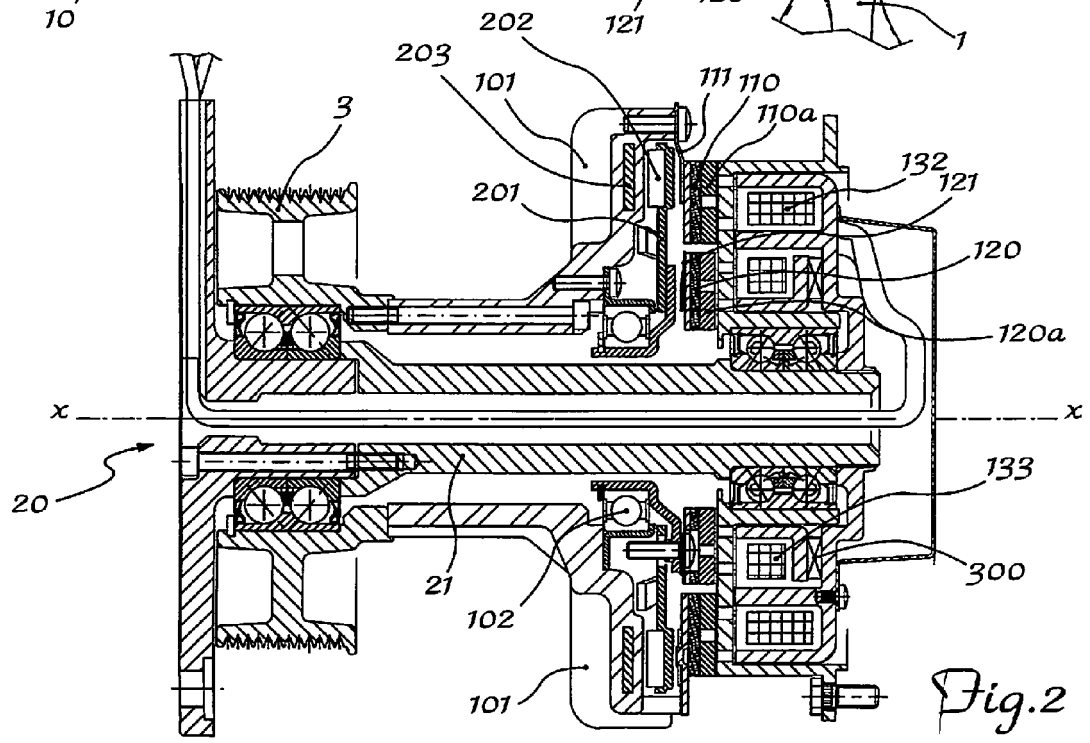
202
203
101
111
110
110a
3
132
121
201
120
120a
x
x
133
20
21
102
300
101

Fig.2

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EUROPEAN SEARCH REPORT

Application Number
EP 11 19 1671

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	EP 0 886 047 A2 (BARUFFALDI SPA [IT]) 23 December 1998 (1998-12-23) * column 4, lines 2-18; figure 4 * -----	1-8	INV. F01P7/08
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F01P
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	18 May 2012	Luta, Dragos

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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