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2 Sheets-Sheet 1

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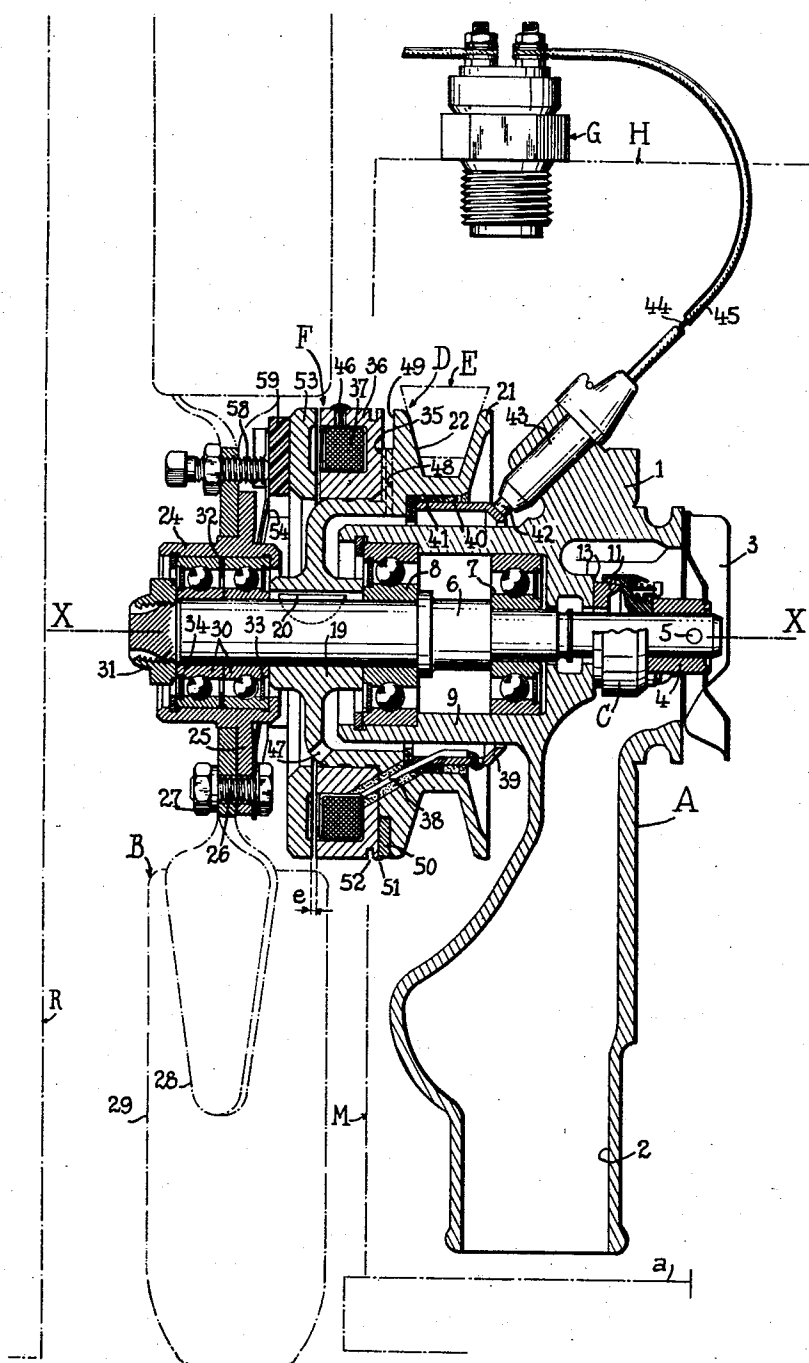


Fig.1

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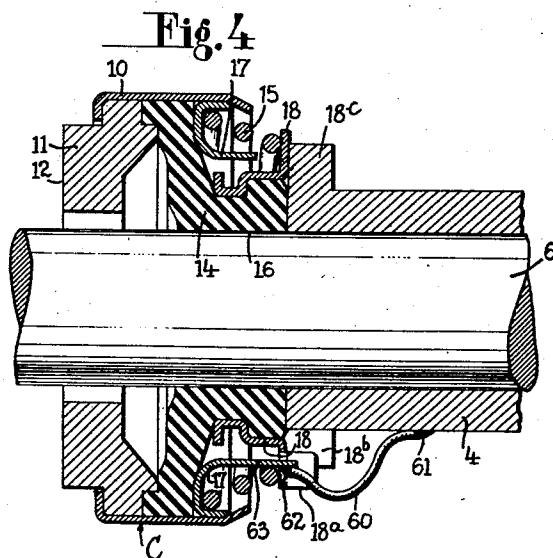
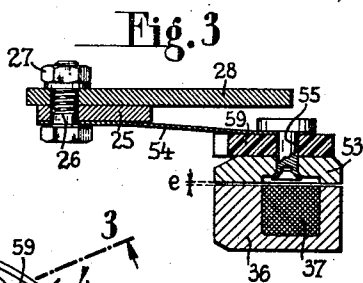
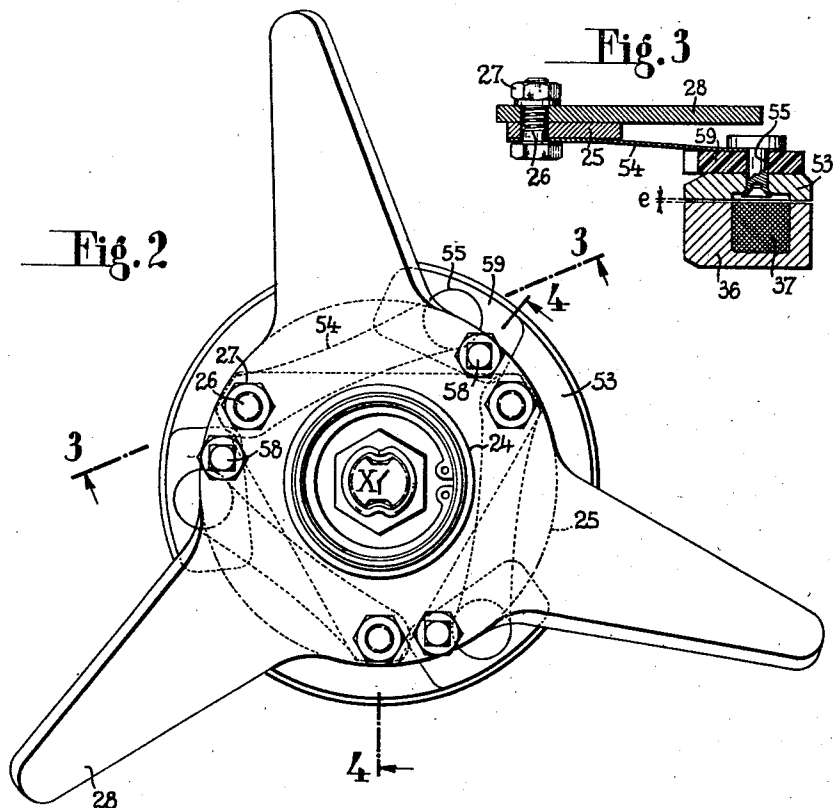
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FAN AND WATER PUMP UNIT FOR COOLING
AN INTERNAL COMBUSTION ENGINE

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2 Sheets-Sheet 2



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FAN AND WATER PUMP UNIT FOR COOLING AN INTERNAL COMBUSTION ENGINE

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5 Claims. (Cl. 123—41.12)

The present invention relates to the cooling of internal combustion engines and especially motor vehicle engines by circulation of cooling water which also flows through the tubes of a radiator, cooling air being blown through the latter by a fan.

An object of the invention is to provide an improved unit comprising a fan and a water pump and adapted to cool, in co-operation with a conventional radiator, an internal combustion engine of a vehicle or other engine. This unit, which is relatively simple in construction and has a perfectly balanced fan, is characterised in that a single shaft drives both the impeller of the water pump and the fan, the shaft being journaled in a bearing provided on the pump body inside which the impeller is keyed on the shaft, the part of the shaft outside the body supporting the fan freely rotative thereon and a driving pulley for the shaft keyed on the latter, said pulley, which is connected to the shaft of the engine so that the impeller is continuously driven when the engine is operating, carrying the driving element of an electromagnetic clutch whose driven element is connected to the fan, the source of current for the coil of the clutch being located outside said bearing and controlling in the known manner so that the fan is engaged by the clutch when the temperature of the engine reaches a pre-determined value and remains engaged so long as said temperature remains higher than another given value lower than said pre-determined value.

Further features and advantages of the invention will be apparent from the ensuing description, with reference to the accompanying drawings, to which the invention is in no way restricted.

In the drawings:

Fig. 1 is a vertical longitudinal sectional view of the unit embodying the invention, the engine to be cooled and the conventional radiator combined with the unit to effect this cooling being diagrammatically indicated by dot-dash lines;

Fig. 2 is a front elevational view of the hub of the fan and the connection of the latter to the movable armature of the electromagnet;

Fig. 3 is a partial sectional view taken along line 3—3 of Fig. 2, and

Figure 4 is an axial sectional view, on an enlarged scale, of the sealing joint of the pump incorporating a modification of a part of the grounding circuit.

In the embodiment shown in the Figs. 1 to 3, the unit of the invention is adapted to cool, in co-operation with a conventional radiator R, an internal combustion engine M whose driving shaft is designated by the reference character *a*. This unit comprises in combination: a water pump A adapted to pump cooling water through the motor M and the radiator R, and a fan B which creates a current of air through the radiator and cools the water in the latter.

Only a part 1 of the body of the pump A and its water inlet pipe 2 and impeller 3 have been shown. The hub

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4 of the impeller is fixed by a pin 5 to one of the ends of a single shaft 6 which has an axis XX, is driven by the shaft *a* of the engine M and is adapted to drive the impeller 3 continuously and the fan B intermittently.

The shaft 6 is journaled by two heavy-duty ball bearings 7 and 8 in a bearing 9 which is integral with the pump body 1. These two ball bearings are spaced apart such distance as to hold the axis XX of the shaft 6 correctly in position. The sealing of the body 1 where the shaft 6 passes therethrough is ensured by sealing means C of known type shown on an enlarged scale in Fig. 4.

The sealing means C comprise, held in position by a brass binding ring 10, a carbon ring 11, adapted to bear by its flat face 12 against a faced end 13 of the body 1 (Fig. 1), and a sealing ring 14 of rubber or like material which bears elastically by its bore 16 against the shaft 6 and is clamped against the ring 11 by a stainless steel spring 15 compressed between two annular members 17 and 18 of which the first bears against the ring 14 and the second is imbedded in the latter. The assembly of the sealing means C is driven in rotation by the shaft 6 owing to the provision of keying lugs 18^a which are carried by the member 18 and co-operate with abutments 18^b provided in a flange 18^c formed on the hub 4 of the impeller.

The shaft 6 extended by a cylindrical extension portion beyond the bearing 9 relative to the water pump and there are mounted on this portion a driving pulley which is keyed thereon and the hub of the fan B freely rotative thereon.

The driving pulley D comprises (Fig. 1) a hub 19, which a key 20 fixes to the shaft 6 as concerns rotation, and a rim 21 having a trapezoidal groove 22 whereby the pulley is rotated by a V-belt E having a corresponding cross-sectional shape and mounted on the shaft *a* of the engine M. The rim 21 is axially offset relative to the hub 19 so as to locate the mean plane of rotation of the belt E between the two bearings 7 and 8.

The fan B is disposed on the opposite side of the pulley D to the water pump A. The fan B comprises a hub 24 having a flange 25 on which is secured by bolts 26 and nuts 27 a star 28 carrying blades 29 which are fixed to the arms of the star by rivets or other means.

The hub 24 is held centrally of the axis XX of the shaft 6, on which it is freely rotative, by two ball bearings 30 which are held clamped against the hub 19 (which in turn bears against the bearing 8) by a nut 31 screw-threadedly engaged and riveted in position on the end of the shaft 6.

Provided between the two outer races of the bearings 30 is a spacer washer 32 which permits modifying the positions of the races of the balls and thereby provides a plane of rotation of the fan which is as fixed as possible relative to the pulley D. Seals 33 and 34 prevent outward projection of lubricating grease from the bearings 30.

The intermittent rotation of the fan B by the shaft 6 is ensured through the medium of the pulley D and an electromagnetic clutch F whose operating current is controlled in the known manner by a quick-acting thermostatic device G fixed on the head H of the engine M to be cooled, so that engagement of the fan B by means of the clutch is obtained when the temperature of the water in the engine M reaches a given maximum value *t_m* and ceases only when the temperature of the water drops to a value *t_m* several degrees lower than the value *t_m* so as to avoid too frequent stoppage and starting up of the fan B.

The electromagnetic clutch F comprises a driving element rigid with the pulley D and a driven element rigid with the fan B.

The driving element is disposed in a rebate 35 which is formed in the pulley D and is concentric with the hub 19 and the shaft 6. This driving element comprises a soft iron ring 36 in which is embedded a toric coil 37.

One end of the coil 37 is connected by a conductor 38 to a slip-ring 39 fixed coaxially in the rim of the pulley D, with interposition of an insulating cement 40, by a ring 41 of plastic material, such as that known in France under the trade name "Céloron."

A brush 42, carried by a brush-holder 43 fixed to the body 1, rubs against the slip-ring 39 and this brush is connected to the output terminal of the ignition contact of the engine M by a conductor 44 which has an insulating sheath 45 and in which is inserted the thermostatic device G. The latter need not be described as it can be any one of the well-known types.

The other end of the coil 37 is connected to ground in the following manner. This end is soldered to the ring 36 at 46 which is in close contact with the pulley D. Starting from the pulley, the grounding circuit comprises: the shaft 6, the hub 4 of the impeller, 3, the member 18, the spring 15, the member 17, the ring 10, and the ring 11 of the sealing means C, the ring 11 being in close contact by its face 12 with the face 13 against which this ring rubs in rotating about the axis XX with the shaft 6.

The electrical resistance of the contact between the ring 11 and the face 13 of the pump body 1 may be decreased by providing between these contacting faces a film of electrically conductive oil containing metal salts.

Further, it will be observed that the grounding circuit described hereinbefore is at least partially shunted by the bearings 7 and 8 which directly connect the shaft 6 to the body 1, but owing to the first-mentioned grounding circuit, the intensity of the current passing through the balls is very small and any deterioration of the latter is thus avoided.

The contact surface of the slip-ring 39 is screened from the lubricating oil or grease of the bearings 7 and 8 owing to the ring 41 and to the fact that the oil can flow out of the pulley through holes provided in the latter. These holes could be disposed either at 47, as shown in Fig. 1, or at 48 as shown in dot-dash line at the upper part of Fig. 1, the hole communicating with a recess 49 provided in the pulley adjacent the rebate 35 receiving the driving element of the clutch F.

This recess 49 permits fixing, if required, one or more counterweights 50 for balancing the pulley so as to compensate for any lack of balance of the latter; such a weight has been shown at the lower part of Fig. 1. This weight is held in position by the riveting over at 51 of a flange formed on the periphery of the ring 36 by a recess 52.

The driven element of the clutch is resiliently connected to the hub of the fan B and comprises an armature 53 (Figs. 1-3) which is concentric with the axis XX and connected to the hub 24 of the fan through the medium of three resilient strips 54. The latter are substantially tangential relative to the hub 24. Each strip is fixed at one end by a rivet 55 to the armature 53 and at its other end to the flange 25 of the hub 24 by one of the bolts 26 and corresponding nut 27. The bolts 26 are equispaced on a circle concentric with the axis XX and are parallel with the latter.

The manner of connecting the driven element of the clutch affords a sufficiently good centering of the armature 53 and a spring-back return motion of the latter which acts in the opposite direction to the attraction of the electromagnet and thus acts against the remanent magnetism.

In the position of a released clutch, the armature 53 rests against three studs 58 formed by screws which are screwthreadedly engaged in the star 28 of the fan and permit easily adjusting the air-gap e (Figs. 1 and 3) to a

correct value which can be made constant for the entire periphery of the armature.

To avoid any noise in the released clutch position, the screws 58 come into contact with sheets 59 of fibre or plastic material fixed to the armature, for example by the rivets 55 securing the armature to the strips 54.

The unit operates in the following manner:

As soon as the engine M operates, its shaft a drives the pulley D through the belt E, and the pulley drives the impeller 3 of the water pump by way of the shaft 6. Water is thus circulated through the radiator R and the engine M.

As soon as the engine M has started up and during the heating up of the latter, the fan B is initially in its disengaged position, but when the temperature reaches the aforementioned maximum value t_m , the thermostatic device G supplies current to the coil 37 of the electromagnet of the clutch and the armature 53 is attracted. This armature rubs for a few minutes against the driving element of the clutch driven by the pulley D during the period of engagement of the fan B. Thereafter, the armature 53 becomes fixed to the driving element of the clutch and the fan B rotates at the same speed as the impeller of the water pump and causes a current of air to pass through the radiator R and thus cools the water circulating through this radiator. The engine M is therefore cooled.

During this cooling of the engine M, the fan B is first engaged by means of the clutch as mentioned hereinbefore, but as a result of the increase in the flow of air through the radiator R due to the action of the fan B, the radiator dissipates a greater amount of heat and the temperature of the water in the head H of the engine M drops.

When the temperature in the head H has dropped to the aforementioned value t_m , the device G suddenly cuts off the current. As the armature 53 is no longer attracted by the driving element of the clutch, it is urged by the strips 54 against the studs 58. The fan is then disengaged. However, it continues to rotate at reduced speed as it is driven by the friction of the ball bearings 30 and by the current of air in which it is situated.

In general, after releasing the fan, the temperature rises and the clutch is once more engaged and the foregoing cycle recommences.

In order to ensure a fairly long period of time between each fan engagement, the temperature drop ($t_m - t_m$) should be several degrees between clutch engagement and clutch disengagement, this being obtained by a suitable adjustment in the known manner of the device G.

The unit of the invention has many advantages.

With this relatively simple unit it is possible to drive the impeller 3 of the water pump A continuously and the fan B intermittently.

Owing to the fact that clutch engagement is electromagnetic and clutch disengagement mechanical:

(a) The armature 53 is urged against the studs 58 by a very small axial force, for example about 4 kg., so that the electromagnet adapted to attract the armature across the air gap e has but a very small force to overcome, whereas if the clutch engagement force were provided by springs co-axial with the electromagnet (which latter would then ensure clutch disengagement), in view of the dimensions and coefficients of friction, the axial force necessary for transmitting the driving torque to the fan would be at least 200 kg., so that for disengaging the fan the electromagnet would have to exert a force of attraction of 200 kg. and even—bearing in mind the various frictional losses—about 300 kg. therefore requiring an electromagnet having a portative force of 7 tons when the armature is in contact as against about 200 kg. in the embodiment described hereinbefore; it is thus clear that the solution opposite to that of the invention has many difficulties, if it is not impossible.

(b) In motor vehicles for which the device of the in-

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vention is intended, the fan is nearly always disengaged, which is obtained in the device of the invention without any consumption of electrical energy, whereas this consumption would be relatively high in the case of the opposite solution, in which the electromagnet would have to continually carry clutch disengaging current to overcome the action of clutch engaging springs.

(c) The bearings 30 of the hub of the engaged fan have to support an axial force of only 4 to 5 kg. exerted by the resilient strips 54, which is, moreover, decreased by the tractive force exerted by the fan and dependent on the rotational speed of the latter, whereas with the opposite solution of clutch engagement by means of springs, these bearings would have to support the normal force of these clutch springs, namely about 200 kg. to which is added the tractive force of the fan which acts in the same direction.

The proposed solution therefore permits reducing the portative force of the electromagnet and the size of the ball bearings.

The armature 53 moves axially without friction and without play when driving and therefore without noise or chatter.

Owing to the studs 58, the air gap e is readily adjusted.

When the fan is disengaged, the sheets 59 of plastic or like material against which the studs 58 bear prevent vibration and consequently noise.

The driving torque for driving the fan is transmitted by the spring steel strips 54 which ensure, on the one hand, a centering without play of the armature 53 with such precision as not to throw the unit out of balance, and on the other hand, an axial displacement of the armature without play in the direction in which the fan is driven, whether the fan is disengaged or engaged.

Fig. 4 shows a modification of the grounding of the excitation current of the coil 37. For the purpose of bypassing the spring 15 there is provided a conductor 60 soldered at 61 to the hub 4 of the impeller 3 of the water pump and at 62 to the metal ring 17.

Although a specific embodiment of the invention has been described, many modifications and changes may be made therein without departing from the scope of the invention as defined in the appended claims.

Having now described my invention what I claim as new and desire to secure by Letters Patent is:

1. In a unit which comprises a water pump and a fan and is adapted to cool an internal combustion engine having a rotative shaft, in cooperation with a radiator through which said pump pumps cooling water for cooling the engine, said fan circulating air through said radiator for cooling the water in the latter, in combination: a pump body, a bearing in the wall of the pump body, a driving shaft of the unit rotatably mounted in said bearing through which it extends so that a first portion of the driving shaft is located in the body and a second portion outside the body, a pump impeller keyed on said first portion of the driving shaft, driving means fixed to said second portion of the driving shaft whereas said fan is freely rotative on said second portion, transmission means connecting said driving means to the driving shaft so that the driving means, the driving shaft and said impeller are continuously driven in rotation when the engine operates, an electromagnetic clutch for connecting the drive means to the fan and located outside said bearing, said clutch comprising a driving element provided with a coil which carries the excitation current and is fixed to said driving means, one end of said coil being electrically connected to said driving shaft, and current supplying means for supplying current to said clutch, said current supplying means comprising on the one hand, connected in series relation to the other end of said coil, slipping connection means and a thermostat switch, and on the other hand, slipping grounding and sealing means for grounding said driving shaft and providing a water seal between said driving shaft and said pump body; and hand-operable mechanical

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adjusting and connecting means operatively connected with said fan whereby said fan can be mechanically connected to said driving element of said clutch for rotation therewith.

2. In a unit which comprises a water pump and a fan and is adapted to cool an internal combustion engine having a rotative shaft, in cooperation with a radiator through which said pump pumps cooling water for cooling the engine, said fan circulating air through said radiator for cooling the water in the latter, in combination: a pump body, a bearing in the wall of the pump body, a driving shaft of the unit rotatably mounted in said bearing through which it extends so that a first portion of the driving shaft is located in the body and a second portion outside the body, a pump impeller keyed on said first portion of the driving shaft, driving means fixed to said second portion of the driving shaft whereas said fan is freely rotative on said second portion, transmission means connecting said driving means to the driving shaft so that the driving means, the driving shaft and said impeller are continuously driven in rotation when the engine operates, an electromagnetic clutch for connecting the driving means to the fan and located outside said bearing, said clutch comprising a driving element provided with a coil which carries the excitation current and is fixed to said driving means, and current supplying means; said current supplying means comprising, on the one hand, connected in series relation to one end of said coil, a slip ring rigid with said driving element as concerns rotation, a brush carried by the pump body and rubbing on said slip ring, and thermostat switch, and, on the other hand, a grounded circuit electrically connected to the other end of said coil; said grounded circuit comprising in series relation as a first element said driving shaft, as a second element a current conducting seal for the water pump mounted on said driving shaft inside the pump body, said seal rubbing against said pump body, and as a third element said pump body, whereby said seal performs the function of a hydraulic seal for said pump and an electric slip contact for said grounded circuit.

3. In a unit which comprises a water pump and a fan and is adapted to cool an internal combustion engine having a rotative shaft, in cooperation with a radiator through which said pump pumps cooling water for cooling the engine, said fan circulating air through said radiator for cooling the water in the latter, in combination: a pump body, a bearing in the wall of the pump body, a driving shaft of the unit rotatably mounted in said bearing through which it extends so that a first portion of the driving shaft is located in the body and a second portion outside the body, a pump impeller keyed on said first portion of the driving shaft, driving means fixed to said second portion of the driving shaft whereas said fan is freely rotative on said second portion, transmission means connecting said driving means to the driving shaft so that the driving means, the driving shaft and said impeller are continuously driven in rotation when the engine operates, an electromagnetic clutch for connecting the driving means to the fan and located outside said bearing, said clutch comprising a driving element provided with a coil which carries the excitation current and is fixed to said driving means, and current supplying means, said current supplying means comprising, on the one hand, connected in series relation to one end of said coil, a slip ring rigid with said driving element as concerns rotation, a brush carried by the pump body and rubbing on said slip ring, and thermostat switch, and, on the other hand, a grounded circuit electrically connected to the other end of said coil; said grounded circuit comprising in series relation as a first element said driving shaft, as a second element a current conducting seal for the water pump mounted on said driving shaft inside the pump body, said seal comprising a current-conducting carbon ring rubbing by one of its flat faces against a faced end of said pump body, and as a third

element said pump body, whereby said carbon ring performs the functions of a hydraulic seal for said pump and an electric slip contact for said grounded circuit.

4. In a unit which comprises a water pump and a fan and is adapted to cool an internal combustion engine having a rotative shaft, in cooperation with a radiator through which said pump pumps cooling water for cooling the engine, said fans circulating air through said radiator for cooling the water in the latter, in combination: a pump body, a bearing in the wall of the pump body, a driving shaft of the unit rotatably mounted in said bearing through which it extends so that a first portion of the driving shaft is located in the body and a second portion outside the body, a pump impeller keyed on said first portion of the driving shaft, driving means fixed to said second portion of the driving shaft whereas said fan is freely rotative on said second portion, transmission means connecting said driving means to the driving shaft so that the driving means, the driving shaft and said impeller are continuously driven in rotation when the engine operates an electromagnetic clutch for connecting the driving means to the fan and located outside said bearing; said clutch comprising a driving element comprising a coil which is fixed to said driving element, a driven armature movable in the direction parallel with said driving shaft and adapted to be engaged with said driving element when said coil is energized, adjustable abutments carried by said fan, and elastically yieldable means interposed between and connected with said fan and said driven armature to connect said fan to said armature for rotation therewith and to return said armature onto said abutments upon de-energization of said coil; said adjustable abutments being also capable of so pressing said fan into engagement with said armature as to positively connect said fan to said driving element.

5. In a unit which comprises a water pump and a fan and is adapted to cool an internal combustion engine having a rotative shaft, in cooperation with a radiator through which said pump pumps cooling water for

cooling the engine, said fan circulating air through said radiator for cooling the water in the latter, in combination: a pump body, a bearing in the wall of the pump body, a driving shaft of the unit rotatably mounted in said bearing through which it extends so that a first portion of the driving shaft is located in the body and a second portion outside the body, a pump impeller keyed on said first portion of the driving shaft, driving means fixed to said second portion of the driving shaft whereas said fan is rotatably mounted on said second portion by a hub, transmission means connecting said driving means to the driving shaft so that the driving means, the driving shaft and said impeller are continuously driven in rotation when the engine operates, an electromagnetic clutch for connecting the driving means to the fan and located outside said bearing; said clutch comprising a driving element comprising a coil which is fixed to said driving element, a driven armature movable in the direction parallel with said driving shaft and adapted to be engaged with said driving element when said coil is energized, adjustable abutments carried by said fan, and elastically yieldable strips disposed in substantially tangential directions about said hub of the fan to which one end of each strip is connected whereas the other end is fixed to the armature to connect said fan to said armature for rotation therewith and to return said armature onto said abutments upon de-energization of said coil; said adjustable abutments being also capable of so pressing said fan into engagement with said armature as to positively connect said fan to said driving element.

References Cited in the file of this patent

UNITED STATES PATENTS

1,900,586	Rippe	Mar. 7, 1933
2,452,264	Russell	Oct. 26, 1948
2,796,963	Harter	June 25, 1957

OTHER REFERENCES

"Case for On-Off Engine Cooling Fan," Diesel Power, published May 1956.