# PATENT SPECIFICATION 1,155,225

DRAWINGS ATTACHED.

1,155,225

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Int. Cl.:—F 04 d 27/00.


## COMPLETE SPECIFICATION.

## Motor-Driven Fan Unit for Internal Combustion Engines.

We, LANCIA & C. FABBRICA AUTOMOBILI TORINO, S.p.A., a Company incorporated under the laws of Italy, of 27, Via Vincenzo Lancia, Turin, Italy, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:

The invention relates to motor driven fan units for use with radiators of liquid cooled internal combustion engines.

An object of the invention is to provide a control for driving the fan so as to suit its operation to the actual cooling requirements of an internal combustion engine.

The motor driven fan unit according to the invention comprises an electric motor directly coupled to a fan and a centrifugally operated clutch adapted to connect the fan with the internal combustion engine to cause the fan to be driven thereby when the speed of the fan as driven by the electric motor exceeds a predetermined speed.

In preferred embodiments of the invention a thermally responsive switch is provided in the electrical power supply to the motor, which switch is effective to cause operation of the motor only when the coolant liquid temperature exceeds a predetermined value.

Preferably the fan hub is directly coupled to the shaft of the electric motor and constitutes the driven member of the centrifugally operated clutch, the driving member of which is rotatable with the internal combustion engine and is rotatably mounted on the shaft of the electric motor.

The centrifugally operated clutch preferably comprises at least one radially movable clutch element having a torque-transmitting connection to the fan hub and having spring biassing means urging the or each said element radially inwardly towards the axis of the hub.

Further characteristic features and advantages of the invention will be understood from the following description, given by way of non-limiting example, referring to the accompanying drawings, in which:—

Figure 1 is a partly sectional side view of a motor driven fan unit according to one embodiment of the invention;

Figure 2 is an exploded view similar to Figure 1, of parts of the motor driven fan unit in axial section;

Figure 3 is a cross sectional view on the line 3—3 of Figure 1, and

Figure 4 shows diagrammatically the electrical circuit of the motor-driven fan unit.

Referring to Figures 1 to 3, a radiator 1 (broken lines) forms part of a liquid circulation cooling system of an internal combustion engine on a motor vehicle. An axial flow fan 2 co-operates with the radiator 1 for promoting air circulation through heat-exchange elements thereof.

The fan 2 has a hub 3 connected to an annular hub plate 4 having a central sleeve portion 5 secured non-rotatably by means of a key 6 to a shaft 7 of an electric motor 9. An internally screw-threaded collar 8 is screwed on a threaded end of the shaft 7 and retains the hub plate 4 axially on the shaft 7. The electric motor 9 is mounted on the internal combustion engine, part of which is indicated at 13, by means of a strap 10 secured to the engine 13 by screw bolts 11.

Two axially extending pins 15, $15^1$ are secured to the hub plate 4 fast with the fan hub 3. The pins 15, $15^1$ engage in respective recesses 18, $18^1$ on the radially inner surfaces of two semicircular clutch elements 16, $16^1$ which encircle an axially extending inner annular flange 14 on the hub plate 4 and which are provided on their radially outer surfaces with circumferential friction linings 17, $17^1$.

The elements 16, $16^1$ are radially movable with respect to the axis of the hub 3 under the

[*Price* 4*s.* 6*d.*]

action of centrifugal force, the elements 16, $16^1$ being rotated with the fan 2 through the interengagement of the pins 15, $15^1$ and the recesses 18, $18^1$, which form a torque-transmitting connection. Two semi-circular grooves 19, $19^1$ in the respective elements 16, $16^1$ form an annular seating for a continuous circumferentially extending helical tension spring 20 which urges the elements 16, $16^1$ radially inwardly towards each other.

The biassing action of the spring 20 is overcome by the centrifugal force on the elements 16, $16^1$ when the rotational speed of the fan 2 reaches a predetermined limit, whereupon the elements 16, $16^1$ move radially apart so that their friction linings 17, $17^1$ engage the internal surface of an outer axially extending annular flange 21 provided on a pulley wheel 22, the flange 21 being concentric with the inner annular flange 14. The pulley wheel 22 is rotatably mounted on the sleeve portion 5 of the hub plate 4 by way of an antifriction bearing 24.

The pulley wheel 22 is connected by a drive belt 23 to a pulley wheel (not shown) driven by the engine 13. The pulley wheel 22 acts as a driving member for the centrifugally operated clutch constituted by the elements 16, $16^1$, the driven member of this clutch being the fan 2 connected to the shaft 7 of the electric motor 9. The pins 15, $15^1$ of the said torque-transmitting connection remain engaged in the recesses 18, $18^1$ upon radially outward movement of the clutch elements 16, $16^1$ to their engaged positions.

An electromagnetic relay 25 (Fig. 4) has normally open switch contacts 25*a* which are connected in the supply circuit for the electric motor 9 (Figure 4). The relay 25 is controlled by a temperature-responsive switch 26 responsive to the temperature of the coolant liquid (water) circulating through the radiator 1. The switch 26 is set to close, energising the relay 25, when the water temperature reaches an upper predetermined value, for example about 90°C, and to open when the water temperature falls below a lower predetermined value, for example about 80°C. A fuse 27 is interposed between the relay 25 and a storage battery 28 of the motor vehicle. A charging voltage is applied to the battery 28 by a voltage regulating unit 29 connected to an engine-driven generator (not shown) in a conventional way.

The fan driving unit operates as follows. On starting of the internal combustion engine 13, when the coolant water in the radiator 1 is still cold, the thermally responsive switch 26 is open, the relay 25 is de-energised, and the contacts 25*a* therefore open, so that no current is supplied to the motor 9 and the fan 2 is stationary. Since the fan 2 is not driven, the clutch elements 16, $16^1$ are drawn towards each other by the spring 20 and the centrifugally operated clutch is disengaged, so that the pulley wheel 22 driven by the engine 13 freely rotates and does not transmit any drive to the fan 2.

When the water temperature in the radiator reaches 90° the switch 26 closes and the relay 25 is energised, the contacts 25*a* being then closed and completing the power supply circuit to the motor 9 to drive the fan 2. The nominal supply voltage of the electric motor 9 remains the same as the voltage delivered by the storage battery 28, as controlled by the regulating unit 29, as long as the speed of the engine 13 is below a predetermined limit, for example, 2,200 revolutions per minute.

Under these conditions the fan 2 is driven by the electric motor 9 at a constant speed, for example, 2000 r.p.m., such as to cool the radiator 1 efficiently, regardless of the actual speed of the engine 13 below said limit. Such efficient cooling would not be possible if the fan 2 were driven directly by the engine 13, particularly when the latter runs at idling speed.

When the speed of the engine 13 exceeds the said limit of, for example, 2,200 r.p.m., with the water temperature above 80°C, the voltage delivered to the motor 9 by the generator of the vehicle increases, exceeding an upper adjustment limit and rising, for example, from 12 to 14 volts. This leads to a corresponding increment, of the order of 100 to 150 r.p.m., in the speed of the electric motor 9. This increment in the speed of the motor 9 causes the clutch elements 16, $16^1$ to move radially outwardly under centrifugal force, so that the friction linings 17, $17^1$ engage the outer flange 21, drivingly connecting the pulley wheel 22 with the fan hub 3. The fan 2 is then driven by the internal combustion engine 13. The motor 9 is also carried along in rotation by the engine 13, the motor 9 being designed to do this without suffering damage.

When the speed of the engine 13 falls below said predetermined speed (e.g. 2,200 r.p.m.), the centrifugal clutch elements 16, $16^1$ are disengaged and the fan 2 is again driven by the electric motor 9 alone at the above mentioned nominal speed, for example, 2,000 r.p.m., provided that the temperature of the coolant water has not fallen below said lower predetermined value (e.g. 80°C). Should the water temperature fall below this value the motor 9 is disconnected, as previously described, and the fan 2 stops.

It will be understood that various constructional details of the unit herein described may be changed without departing from the scope of the invention claimed. For example, the centrifugal clutch elements 16, $16^1$ may be replaced by any suitable form of centrifugally operated clutch.

WHAT WE CLAIM IS:—

1. A motor-driven fan unit for use with a

radiator of a liquid cooled internal combustion engine, comprising an electric motor directly coupled to a fan and a centrifugally operated clutch adapted to connect the fan with the internal combustion engine to cause the fan to be driven thereby when the speed of the fan as driven by the electric motor exceeds a predetermined speed.

2. Fan unit as claimed in claim 1 wherein a thermally responsive switch is provided in the electrical power supply to the motor, which switch is effective to cause operation of the motor only when the coolant liquid temperature exceeds a predetermined value.

3. Fan unit as claimed in claim 1 or claim 2 wherein the fan hub is directly coupled to the shaft of the electric motor and constitutes the driven member of the centrifugally operated clutch, the driving member of which is rotatable with the internal combustion engine and is rotatably mounted on the shaft of the electric motor.

4. Fan unit as claimed in claim 3 wherein the centrifugally operated clutch comprises at least one radially movable clutch element having a torque-transmitting connection to the fan hub and having spring biassing means urging the or each said element radially inwardly towards the axis of the hub.

5. Fan unit as claimed in claim 4 wherein the torque-transmitting connection of the or each radially movable clutch element to the fan hub comprises an axially extending pin attached to the fan hub and located in a recess on the radially inner surface of the said element, the pin remaining engaged in said recess upon radially outward movement of the movable clutch element.

6. Fan unit as claimed in claim 4 or claim 5 wherein the or each radially movable clutch element has a part-annular shape and is movable radially between inner and outer concentric annular axially extending flanges carried respectively by the fan hub and a rotary drive member adapted to be driven directly by the internal combustion engine.

7. Fan unit as claimed in any one of the preceding claims wherein the speed of the electric motor exceeds said predetermined speed when the voltage delivered by a voltage regulating unit controlled in accordance with the engine speed exceeds a given upper adjustment value.

8. A fan unit substantially as herein described with reference to and as shown in the accompanying drawings.

9. A liquid-cooled internal combustion engine having a radiator and a motor driven fan unit for enhancing air flow through the radiator, the fan unit being as claimed in any one of the preceding claims.

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2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 1

Fig. 1

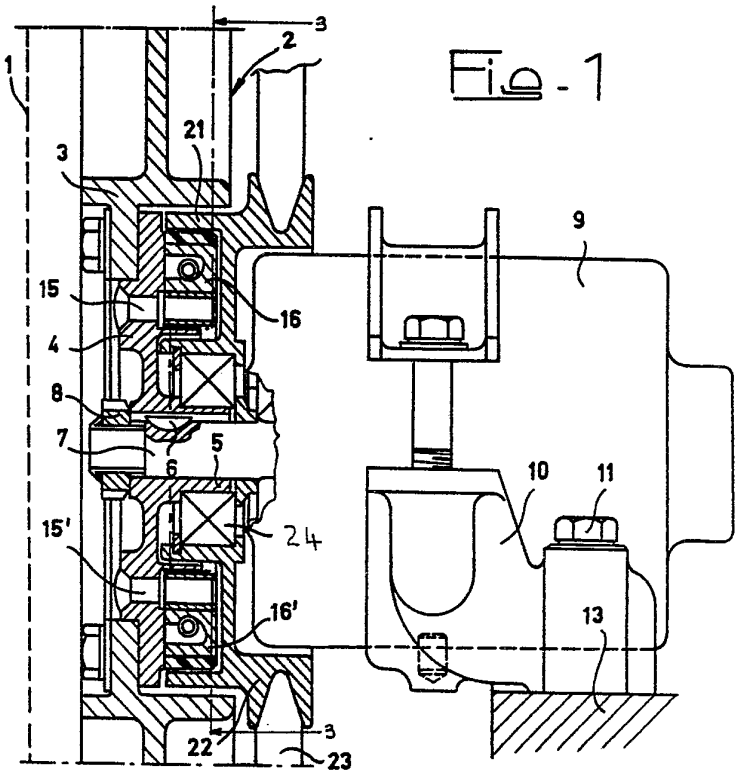
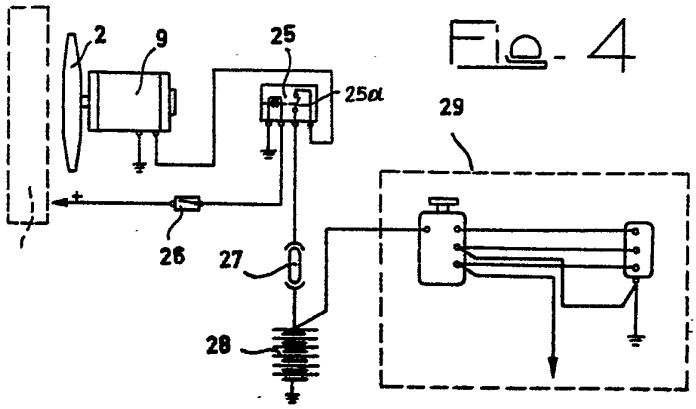



Fig. 4



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Sheet 2

Fig. 2

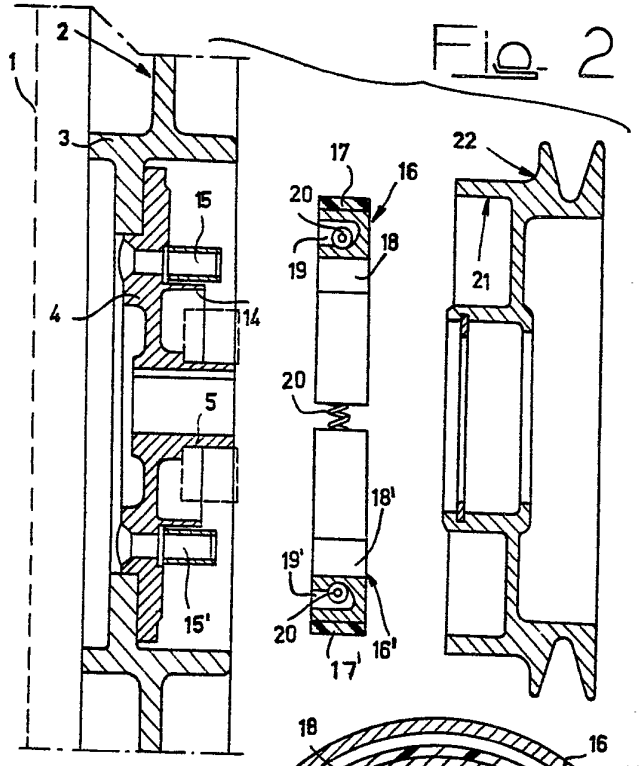


Fig. 3