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Centrifugal Fans

The invention relates to centrifugal fans of the kind in which the impeller comprises a back plate carrying an array of blades disposed around a peripheral region of the back plate with their inner edges equally spaced from the axis of rotation to provide an inlet region, commonly known as the impeller eye, into which a gas, such as air, is drawn to replace that which is expelled outwards between the blades as the impeller rotates. In such fans the impeller is normally housed within a casing in the form of a volute provided with an inlet opening which communicates with the eye of the impeller, and an outlet opening communicating with the space around the impeller through which the gas is discharged in use of the fan.

The flowrate of a centrifugal fan can be varied by varying the speed of rotation of the impeller but this is not always desirable or practicable.

An alternative is to provide dampers, which may be positioned either on the inlet or outlet side of the fan, depending on the nature of the fan and the characteristics required, and although such dampers tend to lower the fan efficiency to some extent depending on the form employed they have the advantage of simplicity and low initial cost compared with most methods used for varying the impeller speed.

One form of damper in common use consists of a plurality of parallel pivotable blades, usually disposed across the fan outlet, and providing a greater or lesser resistance to the gas flow depending upon their angular setting.

Another form of damper makes use of radially extending pivotable vanes at the fan inlet. In use of a centrifugal fan full pressure is developed by the fan only when gas enters the impeller eye axially and without swirl. The radial vane damper is arranged to develop

a degree of pre-rotation of the gas in the direction of impeller rotation, and as a result the pressure developed by the fan is reduced, with a consequential reduction in flowrate and power absorption. Such
5 damper permits the fan to operate at a greater efficiency than the parallel blade dampers referred to above, but the mechanism required to enable the blades to rotate in synchronism is considerably more complicated.

10 It is known that for a given blade arrangement and speed of impeller rotation the flowrate is a function of the blade width, and this is made use of in providing an alternative form of damper which has advantages over the forms of dampers above described,
15 as will be apparent from the following description.

According to the invention a centrifugal fan of the kind referred to has the inner edges of impeller blades extending parallel to the impeller axis and incorporates a damper plate in the form of a circular
20 disc supported coaxially and non-rotatably within the array of blades, with its edge closely adjacent the inner edges of the blades, the disc being movable in an axial direction within the array of blades by means of an actuator which is controllable automatically in
25 response to a control signal.

It has been found that such a damper effectively varies the useful width of the impeller blades, and enables the fan to operate at an efficiency which is comparable with one having a radial vane damper, but
30 is considerably simpler mechanically, requiring only a single primary moving part, and moreover, is able to give stable control to almost zero flow, added resistance being virtually negligible.

The axial movement of the damper plate may be
35 achieved by means of a pneumatic, hydraulic or electrically operated actuator, which is controlled automatically in response to a control signal derived

in any suitable way, for example in dependence, either directly or indirectly, upon the fan output; or even from manual control means.

5 The fan impeller can be driven by an electric motor or by any other suitable drive means. A variable speed electric motor may be used in association with the movable damper plate to give an additional degree of control.

10 The invention is particularly applicable to blowing systems utilising relatively wide impellers of high specific speeds, a substantial range of control being possible. With the damper plate acting on width operation is unaffected by blade shape, and the impeller
15 blades can therefore take any of the forms commonly employed in centrifugal fans; for example the blades may be backwardly inclined, backwardly or forwardly curved or of aerofoil section, provided their inner edges are parallel to the impeller axis as above described.
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One centrifugal fan in accordance with the present invention will now be described by way of example with reference to Figures 1 and 2 of the accompanying schematic drawing, in which

25 Figure 1 represents in diagrammatic form an axial section through the fan, and Figure 2 represents a transverse section in the plane indicated by the line II-II of Figure 1.

The fan comprises, in the usual way, an outer
30 casing 1 in the form of a volute having inlet and outlet openings 10, 20 and rotatably supporting within it an impeller 2, the impeller comprising a backplate 3 carried by a shaft 4 which extends through a bearing 5 mounted in the rear wall 6 of the casing for connection
35 to a suitable drive member (not shown) such as an

electric motor.

The backplate 3 supports an array of blades 7 disposed uniformly around the front face of the backplate, and having radially inner edges extending parallel to, and spaced equidistantly from, the impeller axis. An annular shroud 8 is attached to the front edges of the blades 7, its inner edge curving forwardly and surrounding the adjacent end of a stationary inlet venturi 9 which communicates with the inlet opening 10 in the front wall of the casing in known manner.

In accordance with the invention the fan incorporates a damper comprising a circular plate 11 supported coaxially within the array of impeller blades 7, and of a diameter such that its edge lies close to the inner edges of the blades with only a small clearance. The plate 11 is carried by an axially extending rod 12 which projects outwards through the inlet venturi 9, and is movable axially by means of an actuator 13 of any convenient kind, supported from the casing 1 by radially extending tie rods 14.

Movement of the actuating rod 12 alters the position of the damper plate 11 with respect to the impeller blades 7, and it has been found that this effectively controls the flowrate, by varying the useful width of the blades, without any substantial loss of fan efficiency, and with the minimum of moving parts. The flowrate can be varied from practically zero with the damper plate 11 in a withdrawn position closely adjacent the inlet venturi 9, to a maximum value when it lies close to the backplate 3.

The actuator 13 can be operated pneumatically, hydraulically or electrically or in any other convenient manner as may be convenient, depending on the nature of the installation of which the fan forms part.

In one arrangement the fan may be associated with a temperature responsive sensor, as at 15 arranged

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to generate an output signal dependent upon temperature and located in a position at which the temperature is responsive to changes in the output of the fan, the output signal controlling the actuator, and hence the position of the damper plate, in the sense which tends to maintain the temperature substantially constant. In an alternative arrangement the temperature sensor may be replaced by another form of sensor responsive to a different condition, for example humidity, which is variable in response to changes in the fan output. Means may be provided for adjusting the output signal, in order to vary the temperature or other condition obtainable by adjustment of the fan output.

Although the impeller blades 7 are shown as planar and backwardly inclined in Figure 2, it will be understood that they can take any of the forms commonly employed in centrifugal fans of the kind with which the invention is concerned.



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CLAIMS

1. A centrifugal fan of the kind referred to having the inner edges of the impeller blades extending parallel to the impeller axis, in which there is incorporated a damper plate in the form of a circular disc supported coaxially and non-rotatably within the array of blades, with its edge closely adjacent the inner edges of the blades, the disc being movable in an axial direction within the array of blades by means of an actuator which is controllable automatically in response to a control signal.
 2. A centrifugal fan according to Claim 1 including a sensor arranged to generate a signal which is dependent upon a condition variable in response to changes in the output of the fan, and means for applying said signal as a control signal for controlling the actuator, and hence the position of the damper plate, in a manner which tends to maintain said condition substantially constant.
 3. A centrifugal fan according to Claim 2 wherein the sensor is responsive to temperature changes.
 4. A centrifugal fan according to Claim 1, 2 or 3 wherein the actuator is operable electrically.
 5. A centrifugal fan according to Claim 1, 2 or 3 wherein the actuator is operable pneumatically or hydraulically.
 6. A centrifugal fan according to Claim 1 wherein the actuator is controllable in response to a manually produced control signal.
 7. A centrifugal fan according to any preceding Claim wherein the impeller is driven by a variable speed electric motor.
 8. A centrifugal fan of the kind referred to constructed and adapted to operate substantially as shown in and as hereinbefore described with reference to the accompanying drawing.
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