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AXIAL FLOW FAN

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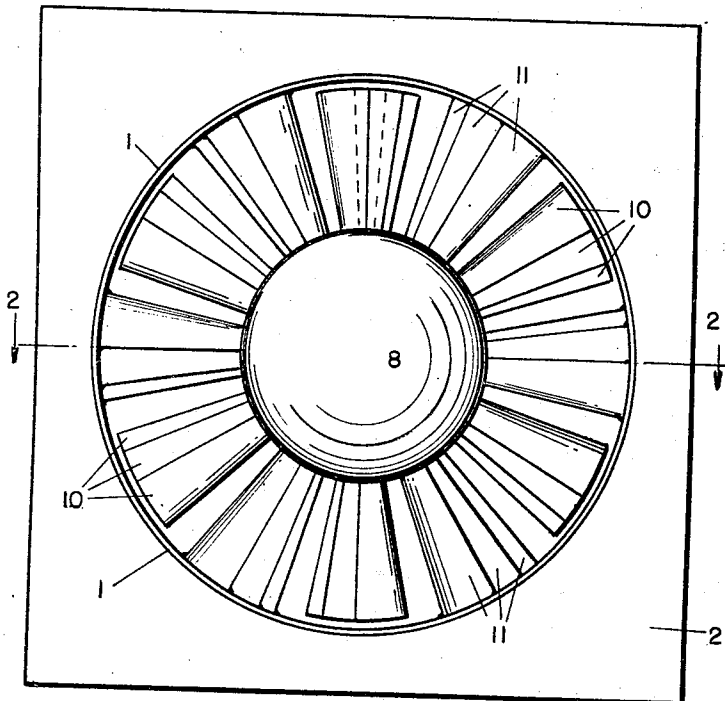


FIG. 1.

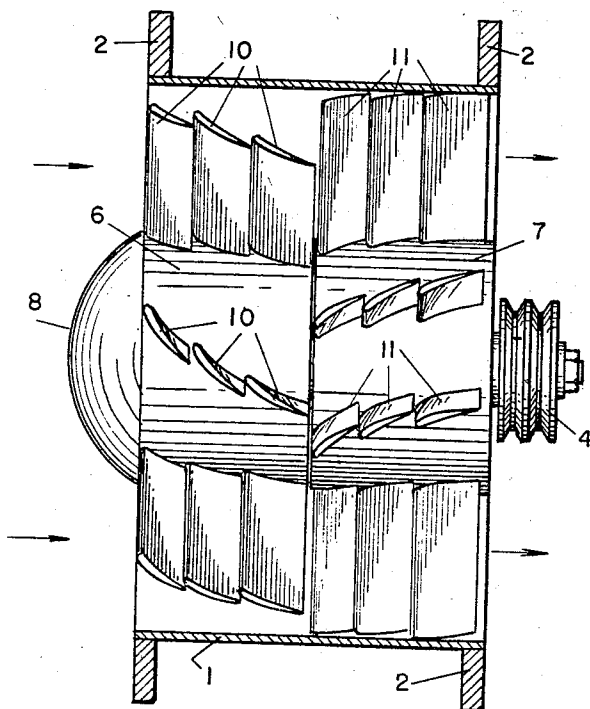


FIG. 2.

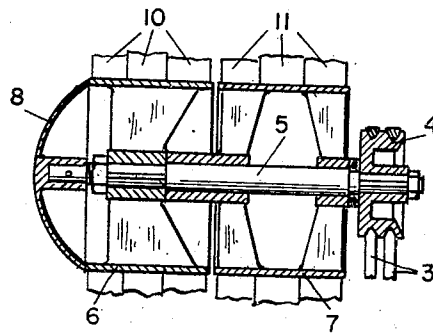


FIG. 3.

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AXIAL FLOW FAN

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3 Claims. (Cl. 230-120)

The rotating as well as the stationary blades of axial flow fans produce a deflection of the flow in circumferential direction in addition to the axial direction of flow through the wheel. Thus if flow of air approaching the wheel is axial only, circular motion will be found to exist as well when the air leaves the wheel, such deflection in circumferential direction being proportional to the torque acting on the shaft. High torque and consequential high power input results in a large deflection in circumferential direction. Conventional blades do not permit of a high deflection, since the flow separates over the back of the blades causing eddying and stalling.

The present improvements, relating as indicated to a fan of the axial flow type, have as their object to increase output as to quantity of air handled, pressure produced and air horsepower, as compared with conventional fans of this type. This is accomplished by a special arrangement of plural series of fan blades on the hub or rotor, and at the same time by employing a similar unique arrangement of vanes stationarily mounted immediately beyond such rotating blades, not only is desired axial direction imparted to the air stream, but vortices at this point in the air stream where it is thus straightened out are reduced or eliminated, thus doing away with a source of energy loss. A further object is to provide a fan which for a given capacity will reduce the fan noise below that of fans of conventional design, and thus overcome this drawback.

To the accomplishment of the foregoing and related ends, said invention, then, consists of the elements hereinafter fully described and particularly pointed out in the claims.

The annexed drawing and the following description set forth in detail certain structure embodying the invention, such disclosed elements constituting, however, but one of various structural forms in which the principle of the invention may be used.

In said annexed drawing:

Fig. 1 is a front elevational view of a fan embodying my present improvements;

Fig. 2 is a horizontal sectional view thereof taken on the plane indicated in line 2-2 of Fig. 1; and

Fig. 3 is a sectional view at right angles to that of Fig. 1, showing certain details of the fan mounting.

As illustrated, the fan is shown as mounted in a cylindrical housing 1 which forms a duct

through which the stream of air generated by the action of the fan is caused to pass in the direction indicated by the arrows, Fig. 2. Depending upon the use to be made of the fan, this duct may discharge into a chamber or be part of a longer duct such as a wind tunnel or the like. The rectangular frame 2 in which the duct is shown as being supported is, of course, merely conventional, and this is also true of the drive means shown as consisting of a belt 3 which passes around a pulley 4 on the shaft 5 that carries the hub or rotor 6 of the fan proper. Such shaft is suitably journaled in a hub or stator 7 that is aligned with the rotor 6 and supported, as will be presently described, in the housing 1. Where the rotor and stator are of the diameter indicated relatively to that of the chamber or duct, they will preferably be of hollow construction as shown, the front end of the rotor being closed by a nose piece 8.

Mounted on the hub or rotor 6, as previously indicated, are two or more series of fan blades 10 arranged in a generally axial direction, successive blades of each series being slightly offset circumferentially with respect to the preceding blade. Furthermore, each successive blade in such series has an increased pitch over the preceding blade. The blades may be of airfoil shape in cross-section, as shown, or they may be simply curved blades of uniform thickness. The outer ends of the blades may be curved as shown in Fig. 1, and will, of course, have necessary clearance with respect to the wall of the chamber or duct 1 in which the fan is mounted.

The stator 7 is provided with similarly arranged series of blades or vanes 11, the outer ends of which may be utilized as shown to support the stator and the fan as well in the chamber or duct 1, or, if desired, additional supporting means of conventional type (not shown) may be provided.

While the number of series of such blades 11 as shown is the same as blades 10 on the rotor of the fan, such number may be greater or smaller. However, these series of blades 11 just as in the case of blades 10, are not only axially arranged but successive blades of each series are slightly offset circumferentially with respect to the preceding blade and are of increasing pitch. As shown in Fig. 2, both the direction of offsetting and inclination of the pitch of said blades or vanes 11 are opposite from the direction of offsetting and inclination of the blades 10. Such blades 11 will furthermore preferably, although not necessarily, be of airfoil shape.

In operation, the air is deflected only a part of the desired amount by the foremost blades 10 on the rotor. The second blades of each series being slightly offset circumferentially with respect to such foremost blades, will operate in air that has not been in contact therewith, and so will add to the circumferential deflection of the air. This process will be repeated in succeeding blade rows until the desired deflection has been accomplished, it being understood that while only three such rows are shown in the fan as illustrated, the number may be varied as required. Such arrangement of the blades 10 in rows or in tandem further renders possible a larger effective pitch of the fan wheel as compared with conventional blades. Consequently, a much larger quantity of air can be handled by a fan with the blade arrangement in question. Since more air can be handled at a higher pressure by a given fan at a given speed, where such fan embodies my improved construction, it follows conversely that the speed of the fan for a given capacity is lower than that of a conventional fan. This is of importance since such reduction of speed results in a corresponding reduction in the noise of operation.

As previously noted, the stationary or guide vanes 11 by virtue of their tandem arrangement, permit reduction or elimination of vortices in the space between the blades, with corresponding saving of energy expended. In other words, not only is the stream of air produced by the rotation of the fan proper engaged and divided up into a series of axial streams by the series of stationary vanes, but such air streams are in part further sub-divided and flow through between successive vanes, materially assisting in breaking up the vortices which otherwise tend to form in the spaces between such series.

It should be remarked that quite often, for instance, with fans that take air from a room, the casing will not be strictly cylindrical but have a converging, bell-mouth shape. Likewise the hub may have a shape like that of the nose of an airship, and both the bell-mouth and the streamlined nose may extend to the down-stream side of the runner or fan-wheel. It will accordingly be understood that the term "cylindrical"

as employed herein connotes such modified forms of casing and hub, since my improved construction of vanes or blades may be equally well applied to casings and hubs of other shapes.

Other modes of applying the principle of my invention may be employed instead of the one explained, change being made as regards the mechanism herein disclosed, provided the means stated by any of the following claims or the equivalent of such stated means be employed.

I therefore particularly point out and distinctly claim as my invention:

1. The combination with a cylindrical duct, of a cylindrical rotor mounted centrally therein, and a plurality of series of axially arranged fan blades carried by said rotor, successive blades of each series slightly overlapping the one preceding, being slightly offset circumferentially with respect to the preceding blade and being of increasing pitch as well.

2. The combination with a cylindrical duct, of a cylindrical rotor mounted centrally therein, a cylindrical stator aligned with said rotor, a plurality of series of axially arranged fan blades carried by said rotor, and a plurality of series of similarly arranged vanes carried by said stator, successive blades and vanes of each such series slightly overlapping the one preceding, being slightly offset circumferentially with respect to the one preceding and being of increasing pitch as well.

3. The combination with a cylindrical duct, of a cylindrical rotor mounted centrally therein, a cylindrical stator aligned with said rotor, a plurality of series of axially arranged fan blades carried by said rotor, and a plurality of series of similarly arranged vanes carried by said stator, successive blades and vanes of each such series slightly overlapping the one preceding, being slightly offset circumferentially with respect to the one preceding and being of increasing pitch as well, both the direction of offsetting and inclination of the pitch of the vanes carried by said stator being opposite from the direction of offsetting and inclination of the pitch of the blades carried by said rotor.

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