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REVERSIBLE FAN APPARATUS

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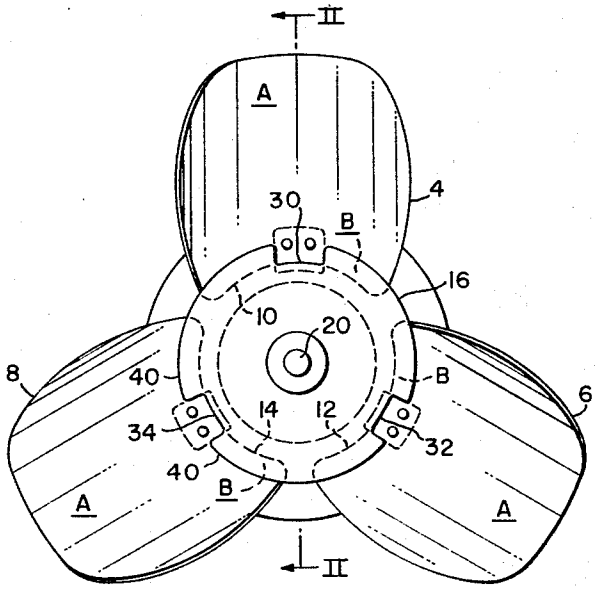


Fig. 1.

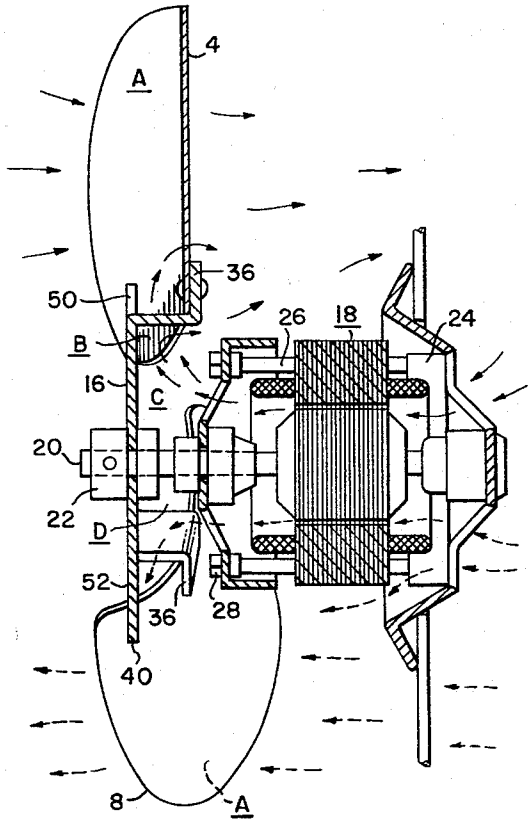


Fig. 2.

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REVERSIBLE FAN APPARATUS

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The present invention relates to rotating fan apparatus, and more particularly to rotatable fan apparatus whose direction of rotation may be reversed.

One of the serious problems in reversible fans is that of providing adequate cooling ventilation to the motor when the fan is rotated in either of its two directions of rotation. In many fan structures a temperature difference of 25 to 30° C. is not unusual when the fan is running in the direction to blow air toward the motor as compared to when the direction of operation is such as to blow air away from the motor. Because of the higher temperature when air is being blown toward the motor, the motor must be designed to accommodate the "worse" condition, and thus must be a higher cost motor. To take care of this problem, various complicated fan blades and spider structures have been devised in the past, however, none of these appear to have sufficiently overcome the cooling problem, at least from a cost point of view.

It is, therefore, an object of the present invention to provide new and improved reversible fan apparatus in which adequate ventilation is provided to the motor.

It is a further object of the present invention to provide new and improved reversible fan apparatus in which adequate cooling ventilation is provided to the motor when operating in either direction while still providing a design which is efficient and of low cost.

Broadly, the above cited objects are accomplished by providing motor driven reversible fan apparatus in which ventilation is provided to the motor while the fan is being rotated in either direction by utilizing the inner edges of the fan blades in conjunction with the fan spider to act as a centrifugal fan to cause a radial flow of air over the motor regardless of the direction of rotation of the fan.

These and other objects and advantages will become more apparent when considered in view of the following specification and drawings, in which:

FIGURE 1 is a front view of the fan apparatus of the present invention; and

FIG. 2 is a side view in section of the fan apparatus of the present invention taken along the line II—II of FIG. 1.

Referring to FIGS. 1 and 2, the fan apparatus is shown having three blades **4**, **6** and **8**. The blades have a curvilinear outer surface and have a concave shape from the frontal view. The inner edges **10**, **12** and **14** of the blades **4**, **6** and **8**, respectively, are curvilinear in shape and taken together conform substantially to the shape of a circle. A spider member **16** being formed in the shape of a disc is attached to the motor **18** through the axle **20** of the motor. The spider **16** may be either die cast or of pressed steel and is formed in a flat plate rather than the usual cup shape. The spider **16** is fixed to the axle through the hub **22**. The motor **18** is fixed to the frame **24** of the fan apparatus through the bolts **26** and **28**.

The spider **16** has the slots **30**, **32** and **34** cut in the outer edge thereof toward the axle **20**. Extending from the inner edge of each of the slots is an L-shaped flange **36**. Each of the fan blades **4**, **6** and **8** is riveted to the bottom extension of the respective one of the flanges. The flanges **36** extend rearwardly from the inner planar

surface of the disc shaped spider **16** toward the motor. The blades **4**, **6** and **8** are so disposed that they are a predetermined distance away from the plane of the spider **16** in the axial direction for the motor. Moreover, each of the blades is disposed so that its inner edge **10**, **12** and **14** is behind the outer edge or periphery **40** of the spider **16**. Thus, the inner edges **10**, **12** and **14** of the blades extend beyond the outer edge **40** of the spider toward the axle of the motor. The spider **16** has the portions **50** and **52**, see FIG. 2, which extend outwardly beyond the inner edges of the blades.

Each of the fan blades has what will be designated an outer portion A and an inner portion B. The inner portion is shown shaded in FIG. 2. The outer portions A of the blades are such a configuration to direct air axially. When rotated in one direction air will be directed toward the motor and when rotated in the other direction the air will be directed away from the motor. The inner portions B of the blades act as a small centrifugal fan to direct air radially with respect to the motor when the fan is rotated in either direction; thus creating a flow of air around and through the motor tending to cool the motor regardless of its direction of rotation.

Referring specifically to FIG. 2 and considering the two directions of operation; first, assuming that air is being axially directed toward the motor according to the solid arrows appearing above the axle; and, second, the case where the fan is being rotated in the other direction to force air away from the motor according to the dotted arrows below the axle. In the first case, with the air being blown toward the motor as shown by the solid arrows above the axle, very little air will circulate through the motor from the action of the outer portion A of the blade. The air being forced by the outer portion A is moving at a high velocity and that at the inner portion B is at a much lower velocity. Moreover, due to the extended portion **50** of the disc **16**, the inner portion B of the blades cannot get air from the axial flow. However, a low pressure area C is established behind the spider **16**, as shown in FIG. 2. Therefore, air is induced to flow, as shown, from the relatively high pressure areas and back through and around the motor, which is the only available path, back to the low pressure area C. Air is thus circulated by the centrifugal action in a radial manner greatly aiding in the ventilation of the motor which would otherwise not be accomplished if it were not for the induced action of the inner portion B of the blade.

Now assuming the second case, when the fan is rotating in the other direction with the air being blown away from the motor, as is shown by the dotted arrows below the axle **20**; the axially directed air flow is produced due to the action of the outer portion A of the blades. There is some cooling air induced in the axial direction which passes through the motor as shown. However, since axial flow past the inner portions B of the blades is stopped by the extended portion **52** of the spider disc **16**, the air will be directed by the spider in a radially outward direction. Low pressure area D is thus created by this circumferential flow. There will then be a flow of induced air through and around the motor by the air passing from a high pressure area, through the motor and then to the low pressure area D.

It may then be seen that in both directions of rotation the inner portion B of the blades are prevented from moving air in the axial direction by the extended portions **50** and **52** of the spider disc. This causes air to flow in a radially outward direction, from the low pressure areas C and D to cause air to be induced through the motor regardless of the direction of rotation. Approximately, an equal amount of air is induced by this

action through the motor in both directions of fan rotation. Since a substantial and adequate volume of cooling air is passed through and around the motor regardless of the direction of rotation thereof, there is no material difference in motor temperatures for the different directions of rotation; and consequently, the use of a lower cost motor within given temperature requirements is acceptable.

Although the present invention has been described with a certain degree of particularity, it should be understood that the present disclosure has been made only by way of example and that numerous changes in the details of construction and the fabrication and arrangement of parts may be resorted to without departing from the scope and spirit of the present invention.

I claim as my invention:

1. In motor driven fan apparatus, a motor including an axle, a disc shaped fan spider member operatively connected to the axle of the motor, a plurality of blades carried by said spider, each of said blades having an inner portion with opposed outside surfaces for moving air radially outward, each of said blades being connected to said spider member with the inner portion of each of said blades extending behind said spider member toward the axle of the motor a predetermined distance and being disposed away from said spider member a predetermined distance toward said motor, whereby the opposed outside surfaces of said inner portions cooperate with the rear surface of said spider to produce a zone of reduced pressure thereat regardless of the axial direction of air flow, said zone of reduced pressure effecting flow of air thereto past and through the motor to cool the latter.

2. In motor driven fan apparatus, the combination of a motor having an axle, a disc shaped spider member operatively connected to the axle of the motor, said spider member having a plurality of slots cut in the edge thereof and having a flange extending from the inside edge of each slot toward the motor, a plurality of blades, each of said blades being connected to one of said flanges with the inner edge of each of said blades extending behind said spider member and being disposed at the side of said spider member towards said motor, said inner edge having opposed outside surfaces cooperating with the interior surface of said spider to thereby function as a centrifugal fan in both directions of rotation of the motor to create a zone of low pressure adjacent the motor axle causing axial flow of cooling air through and past the motor.

3. In motor driven reversible fan apparatus, the combination of a motor having an axle, a disc shaped spider member operatively connected to the axle of the motor, said spider member having a plurality of flanges extending from the inside surface of said spider member toward the motor, a plurality of blades, each of said blades having an outer portion for moving air in an axial direction and an inner portion with opposed outside surfaces for moving air in a radially outward direction, each of said blades being connected to one of said flanges with the inner portion of each of said blades extending behind said spider member toward the axle of the motor a predetermined distance and being disposed away from said spider member a predetermined distance toward said motor so that during operation the opposed outside surfaces of said inner portions cooperate with the interior surface of the spider to form thereat a zone of reduced pressure regardless of the axial direction of air flow, said reduced pressure zone causing flow of air thereto past and through the motor for cooling the latter.

4. In motor driven reversible fan apparatus, the combination of a motor having an axle, a disc-shaped spider member operatively connected to the axle of the motor, said spider member having a plurality of slots cut in the edge thereof and having a flange extending from the inside edge of each slot toward the motor, a plurality of blades each of said blades having an outer portion for moving air in an axial direction and an inner portion having an inner edge with opposed outside surfaces for moving air in the radially outward direction, each of said blades being connected to one of said flanges with the inner portion of each of said blades extending behind said spider member toward the axle of the motor a predetermined distance and being disposed away from said spider member a predetermined distance toward said motor whereby said opposed outside surfaces cooperate with the interior of said spider to provide a radial flow fan which functions regardless of the direction of rotation of the motor, said radial flow fan creating a zone of reduced pressure adjacent one end of the motor, and said reduced pressure inducing flow of air through and past the motor to cool the latter.

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