United States Patent [19]

Wood

[11] **3,781,127**

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[54] **CENTRIFUGAL FAN INLET AND VANE CAPACITY CONTROL**

[75] Inventor: **Carl O. Wood**, Needham Heights, Mass.

[73] Assignee: **Westinghouse Electric Corporation**, Pittsburgh, Pa.

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[52] **U.S. Cl.** **415/147**, 415/160

[51] **Int. Cl.** **F01d 7/00**, F01d 7/14

[58] **Field of Search** 415/160, 151, 182, 415/183, 184, 147

[56] **References Cited**

UNITED STATES PATENTS

2,233,983	3/1941	Kice, Jr.	415/160
2,235,260	3/1941	Kice, Jr.	415/160

FOREIGN PATENTS OR APPLICATIONS

1,060,663	11/1953	France	415/160
1,088,030	9/1954	France	415/160

Primary Examiner—Henry F. Raduazo

Attorney—F. H. Henson et al.

[57] **ABSTRACT**

This invention relates to a centrifugal fan having an inlet cone and a rotating fan wheel, and more particularly to a centrifugal fan inlet capacity control. The capacity control consists of a plurality of spin inducing inlet vanes and means to pivotably support the vanes circumferentially around the outer wall of the inlet cone. The vanes may be pivoted in unison through their respective pivot axes which are adjacent the periphery of the inlet cone and generally parallel to the cone outer wall. As the vanes are pivoted away from the outer inlet cone wall, the induced spin can be thereby increased and also the volume of gas flowing through the inlet cone can be reduced.

4 Claims, 6 Drawing Figures

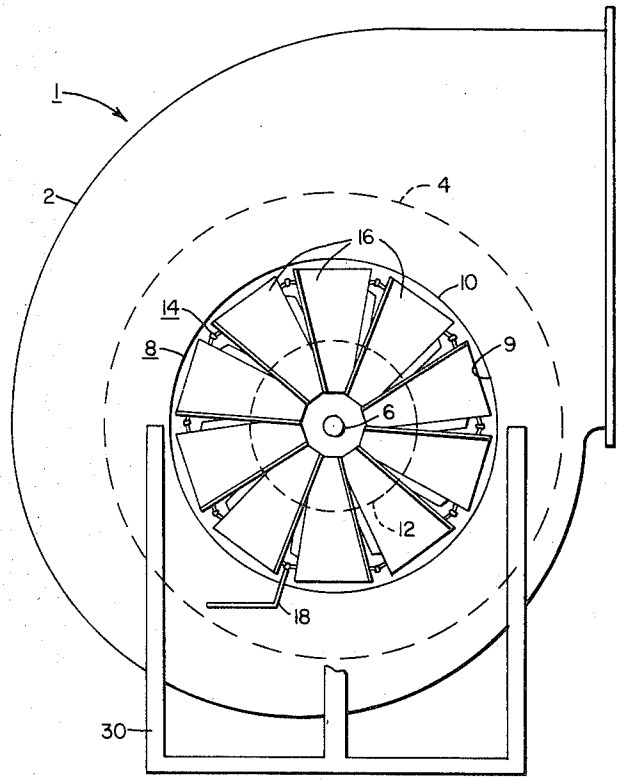


FIG.1

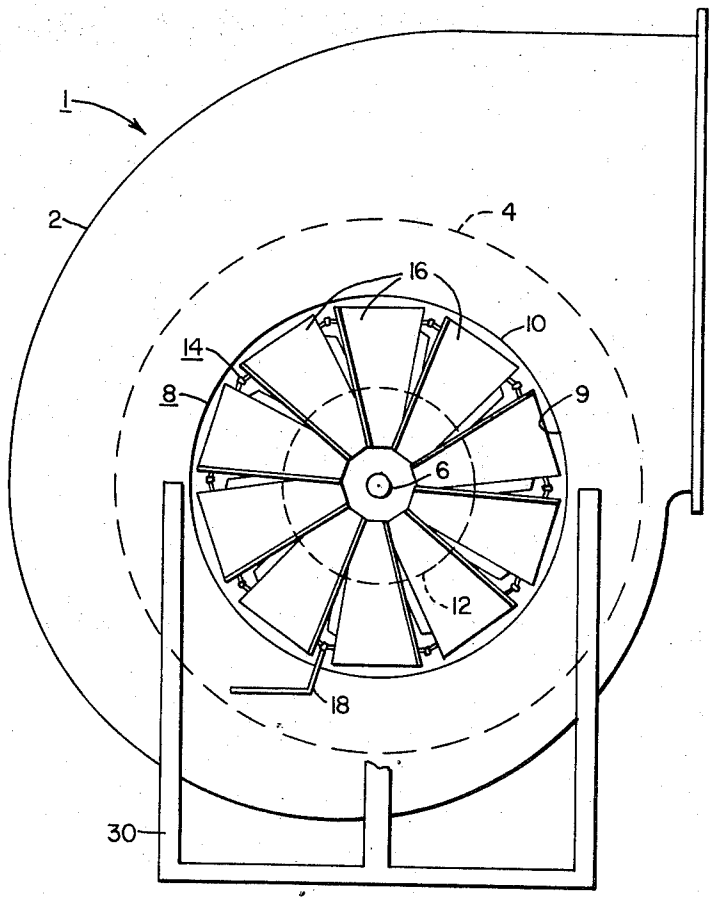

1
2
4
16
10
14
8
9
6
12
18
30

FIG.3

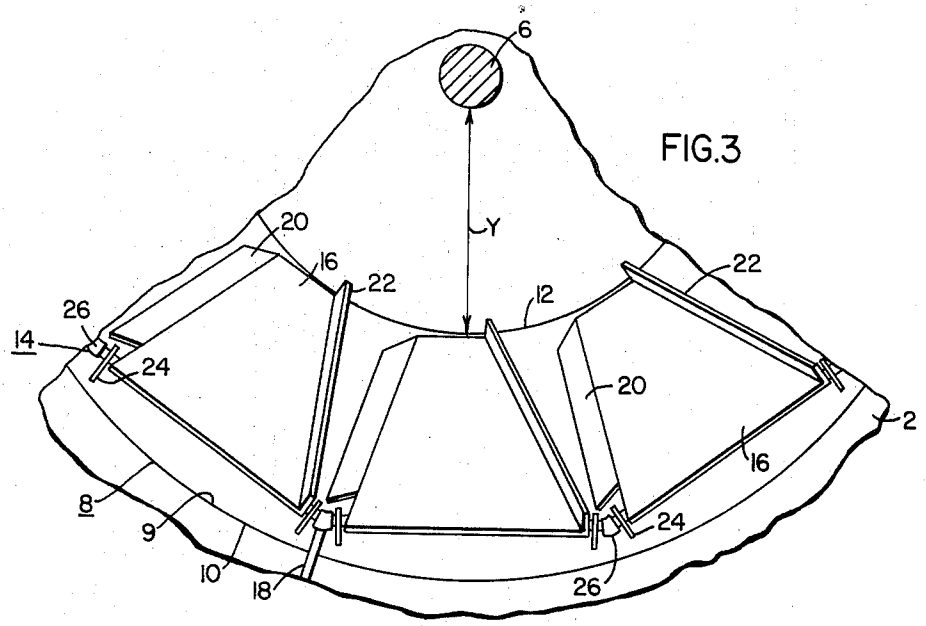

6
Y
20
16
22
12
22
26
14
24
20
2
16
8
9
10
18
24
26

FIG.2

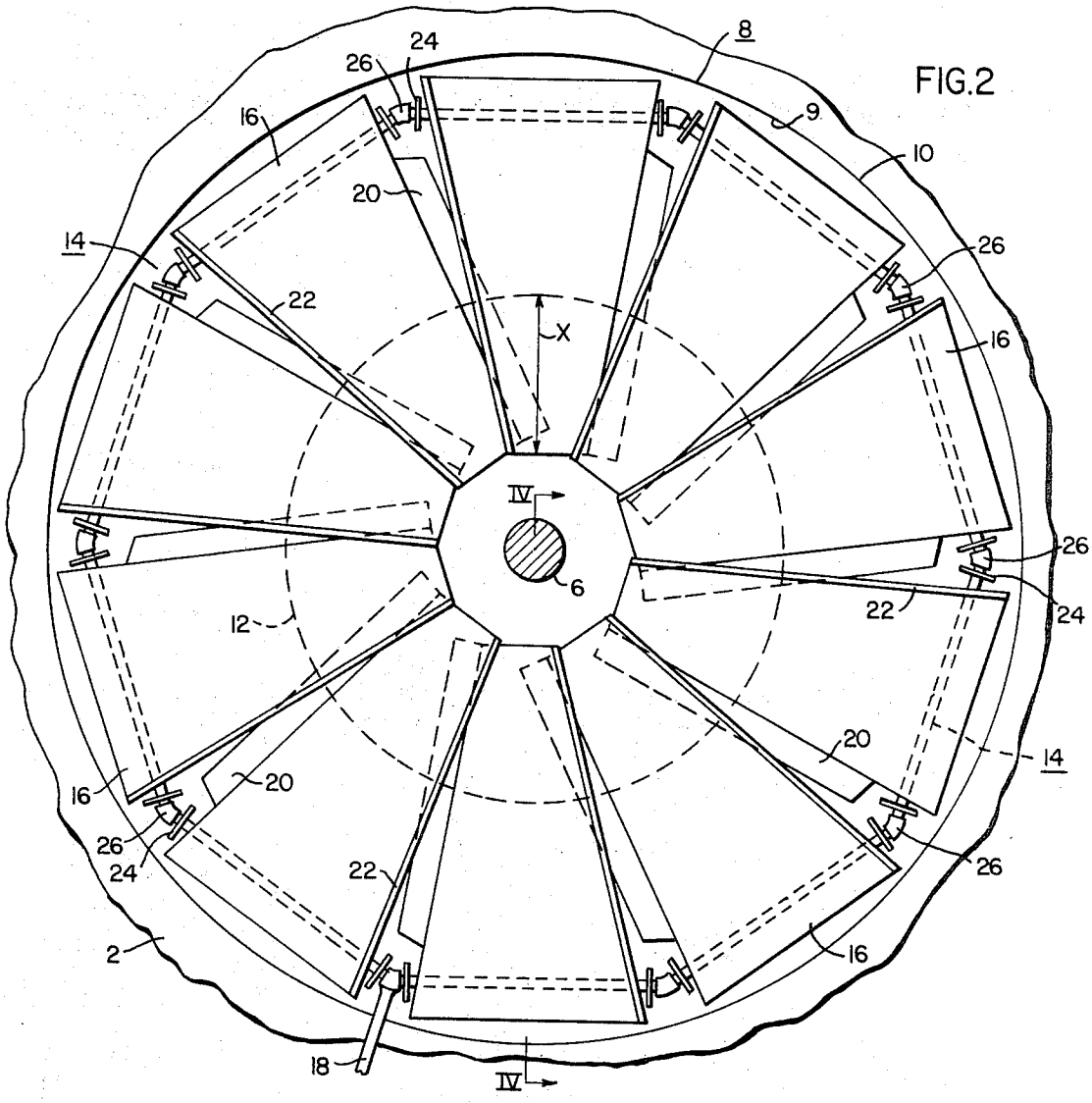


FIG.5

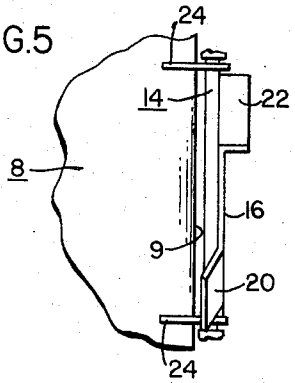
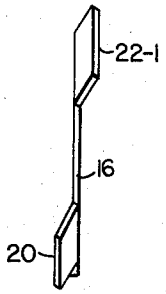


FIG.6



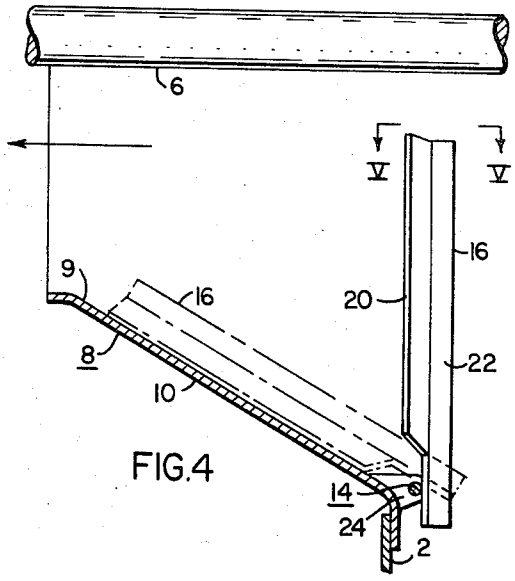


FIG.4

CENTRIFUGAL FAN INLET AND VANE CAPACITY CONTROL

BACKGROUND OF THE INVENTION

Centrifugal fans have been frequently fitted with well-known shutter devices to reduce the opening of the air passage formed through the fan casing to thereby control the capacity of the fan. The shutter arrangement could be closed to provide adequate air flow adjustment while, at the same time, reducing the horsepower requirements of the fan. However, it has been found that with these shutter arrangements, the problem of fan pulsations can occur when the air passage opening is partially closed, and the blades may be subjected to a flutter pattern which could adversely affect the fan output.

It would be desirable to provide a low cost, centrifugal inlet control means which could be applied as an add-on to the standard inlet and which would alleviate the above problems. It would also be desirable to accomplish the foregoing by providing a spin inducing and capacity control inlet vane arrangement which, in a wide open position, would impart a minimum spin to the incoming gas while restricting the gas less than conventional inlet control means, or in a closed position would impart a maximum spin to the incoming gas while providing a higher degree of no delivery closure.

By moving the entire support mechanism and control means for the spin vane arrangement to a position outside of the centrifugal fan inlet cone, the installation or servicing of the control mechanism could also be greatly facilitated.

PRIOR ART

The following patents disclose the general concept of a fan having a shutter or spin vane arrangement including a plurality of spin vanes or plates which are located in the inlet portion of the fan casing and which are adapted to be pivoted and substantially close the gas passage through the fan casing in order to vary the volume of gases being moved by the fan: U.S. Pat. Nos. 2,834,536, McDonald; 3,072,041, Downing.

However, none of the above patents discloses a centrifugal fan having a plurality of spin inducing and capacity control inlet vanes and means to pivotably support the vanes with their respective pivot axes being adjacent the inlet cone and generally parallel to the outer cone wall.

SUMMARY OF THE INVENTION

A centrifugal fan is disclosed having an inlet cone, a rotating fan wheel, and a plurality of spin inducing and capacity control inlet vanes. Means are provided to pivotably support the inlet vanes circumferentially around the outer wall of the inlet cone. The pivot axes of the respective vanes are adjacent the periphery of the cone and generally parallel to the cone outer wall. Control means are also provided to pivot the inlet vanes in unison through the pivot axes, whereby when the vanes are pivoted away from the inlet cone outer wall, the induced spin will be increased and the volume of gas flowing through the inlet cone will be reduced.

Each spin vane is provided with a leading and a trailing spin imparting edge with respect to the direction of rotation of the fan wheel. The leading and trailing edges extend in generally opposite directions out of the plane of the spin vane surface. The spin vanes and respective spin imparting edges are proportioned to enable each spin vane to overlap the preceding spin vane to substantially cause a reasonably tight, no delivery closure of the inlet cone when the spin vanes are pivoted through their pivot axes to the closed position away from the inlet cone.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a frontal elevation of a centrifugal fan employing an embodiment of the present invention;

FIG. 2 is a frontal elevation of the centrifugal fan inlet cone and the spin inducing vanes in a closed position with respect to the inlet opening;

FIG. 3 is a partially broken away frontal elevation of the centrifugal fan inlet cone and the spin inducing surfaces in an open position with respect to the inlet opening;

FIG. 4 is a section taken along lines 4—4 of FIG. 3;

FIG. 5 is an end view taken from lines 5—5 of FIG. 4; and

FIG. 6 is an alternate embodiment of the spin inducing vanes employed in the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings, FIG. 1 shows a centrifugal fan 1 having a casing 2 and a fan wheel 4. Fan wheel 4 has a plurality of fan blades (not shown) of conventional design and is supported for rotation by means of shaft 6. Shaft 6 is supported by means of any suitable support frame 30. A gas to be passed through fan 1 is received by the gas inlet cone 8. Inlet cone 8 consists of an outer wall 9 and an inner wall 10 and defines the inlet opening for a gas passage 12 formed through fan casing 2.

In order to regulate the volume of gas being moved by the fan and to thereby control the fan output, an inlet spin vane, capacity control arrangement according to the invention is provided in the inlet portion of fan 1. The spin vane arrangement includes a support ring mechanism 14 which extends around shaft 6. A plurality of generally planar spin inducing and capacity control inlet vanes 16 are circumferentially disposed around inlet cone 8 and are pivotably secured to the support mechanism 14 to enable spin vanes 16 to be opened or closed relative to inlet cone 8 by a suitable control means 18 for the purpose of regulating the volume of gas flowing therethrough. (The spin vane arrangement in the relatively opened and closed positions will be more fully explained hereinafter). For example, pivot control means 18 is connected to support ring mechanism 14 and may be actuated either manually or automatically to open or close spin vanes 16 in unison. A more detailed description of pivot control means 18 is not considered essential to the understanding of the instant invention. The spin vane arrangement of the present invention may be employed both to reduce the opening of the axial gas passage 12 to thereby control the capacity of the fan and to also impart a spin to the incoming gas, as well known in the art, for guiding the gas in a direction coinciding with the rotating fan wheel 4 to regulate the capacity of the fan.

Referring to FIG. 2 of the drawings, the spin vane and capacity control arrangement is shown with the spin inducing vanes 16 in a closed position relative to inlet cone 8. Each spin vane 16 is provided with a respective leading 20 and trailing 22 spin imparting edge with re-

gard to the direction of rotation of fan wheel **4.** The leading and trailing spin imparting edges **20** and **22,** which are adapted to guide the incoming gas into a spin direction coinciding with the direction of the fan wheel rotation, extend in generally opposite directions and out of the plane of the respective spin vanes **16.** Each spin vane and its respective leading and trailing edges are proportioned in a suitable manner, whereby each spin vane **16** may overlap its preceding vane in order to substantially decrease the volume of gas flowing through the inlet opening of gas passage **12** when the spin vanes are pivoted to a closed position with respect to inlet cone **8.** Thus, with the spin vanes in a closed position (as illustrated in FIG. **2**), that portion of the inlet opening represented by arrow X of gas passage **12** can be subjected to a reasonably tight, no delivery closure. When in the closed position with respect to inlet cone **8,** the incoming gas will be subjected to the greatest flow restriction and a maximum amount of spin will also be imparted to the incoming gas with the effect of throttling the fan while producing the least amount of fan output.

Referring to FIG. **3** of the drawings, and also the dotted line position of FIG. **4,** the spin vane and capacity control arrangement is shown with the spin inducing vanes **16** in an opened position laying down on the surface of the inlet cone **8.** With the spin inducing vanes **16** pivoted in a wide open position, as shown, the incoming gas flowing through that portion of the inlet opening of gas passage **12** now represented by arrow Y will be subjected to a relatively minimum flow restriction. Consequently, the spin vane arrangement will impart a minimum spin to the incoming gas while the capacity of the fan and the output of the fan could be at relative maximums as compared to having the spin vane and capacity control arrangement in a generally closed position.

FIG. **4** of the drawings shows the pivot axes of the spin vanes for both the opened and closed positions with respect to inlet cone **8.** In accordance with the instant invention, in the wide open position (corresponding also to FIG. **3** of the drawings), the pivot axis for the spin vanes **16** (shown in phantom in the wide open position) is generally parallel to the plane of the periphery of the outer wall **9** of inlet cone **8.** The spin vanes **16** are adapted to be pivoted in unison through their respective pivot axes about support mechanism **14** to or from the outer wall surface **9** of inlet cone **8** to thereby control the induced spin and volume of gas flow through inlet cone **8.**

In the closed position (corresponding also to FIG. **2** of the drawings) the pivoted position for the spin vanes **16** is shown in solid lines and is in a position substantially transverse to the direction of the gas flow, which is indicated by the arrow. The spin vanes are capable of being disposed at either pivot position or at any position therebetween, with the result being that as the vanes are pivoted away from the inlet cone outer wall **9,** the effective spin angle can be increased and the volume of gas flowing through the inlet cone can be reduced.

The support mechanism **14** for the spin vane arrangement is positioned outside the centrifugal fan casing **2** or, in the preferred embodiment, is circumferentially disposed and fixed around the periphery of the outer wall **9** of inlet cone **8.** Pivot support brackets **24** are secured to inlet cone **8** in any well-known manner, such as by welding or by bolting. By disposing support mechanism **14** outside the fan casing **2,** the installation and servicing of the mechanism can be greatly facilitated. In the preferred embodiment, but not limited thereto, a universal type linkage diagrammatically shown at **26** (best shown in FIGS. **2** and **3**), can be used to provide effective coupling means to connect the plurality of spin vanes in order to provide a suitable coordinated control and to thereby permit the spin vanes to be pivotable in unison.

Referring to FIGS. **5** and **6,** FIG. **5** shows one embodiment of a spin vane **16** being pivotably supported by support ring mechanism **14.** As previously disclosed, spin vane **16** is provided with leading and trailing spin imparting edges **20** and **22** respectively which extend out of the plane of the spin vanes in generally opposite directions and which are adapted to guide the incoming gas into a spin direction coinciding with the rotation of the fan wheel. It has been found that to further regulate the induced spin and the spin angle, an alternate spin vane embodiment may be employed. FIG. **6** shows such an alternate embodiment. The respective trailing spin imparting edge **22-1** can be designed to extend out of the plane of the spin vane **16** at any convenient angle, not necessarily a 90° angle of the spin edge **22** as previously shown in FIGS. **3** and **5,** which will provide a desirable induced spin in order to most effectively control the efficiency and capacity of the centrifugal fan. Another obvious modification of the spin vanes (not shown) would be to provide a spin imparting surface on one edge only of the respective vane.

The spin vane and capacity control arrangement of the instant invention may be of relatively low cost and can be applied to a standard centrifugal fan inlet. This arrangement can provide adequate pressure adjustment while, at the same time, reducing the horsepower requirements of the fan in a comparable manner to prior art inlet control means. With the spin vanes in a wide open position, there can be less restriction to air flow, and in a closed position, a more reasonably tight, no delivery closure can be maintained than with the conventional inlet vane control. Various other modifications will occur to those skilled in the art.

I claim:

1. A centrifugal fan having an inlet cone, a rotating fan wheel, a plurality of spin inducing and capacity control inlet vanes, means to pivotably support said vanes circumferentially around the outer wall of said inlet cone with the pivot axes of the respective vanes being circumferentially extending and fixed around the periphery of the cone to be generally parallel to the plane of the periphery of the cone outer wall, and control means to pivot in unison said inlet vanes through said pivot axes whereby said vanes may be pivoted to or from the surface of the inlet cone outer wall to thereby control the induced spin and volume of gas flow through said inlet cone.

2. The invention of claim **1** wherein each of said spin vanes is generally planar in shape, and each of said vanes is provided with a respective leading and trailing spin imparting edge with reference to the direction of rotation of said fan wheel, each of said leading and trailing edges extending in generally opposite directions out of the plane of said spin vanes.

3. The invention of claim **2** wherein each of said spin vanes is proportioned to overlap their respective preceding spin vane to substantially decrease the volume of gas flowing through said inlet opening when said spin vanes are pivoted through said pivot axes to be adjacent the periphery of the inlet cone.

4. The invention of claim **1,** wherein the control means is circumferentially disposed around the outer surface of said inlet cone.

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