Nov. 15, 1966 J. E. McDONALD 3,285,501

CENTRIFUGAL FANS

Filed Dec. 7, 1964 2 Sheets-Sheet 1

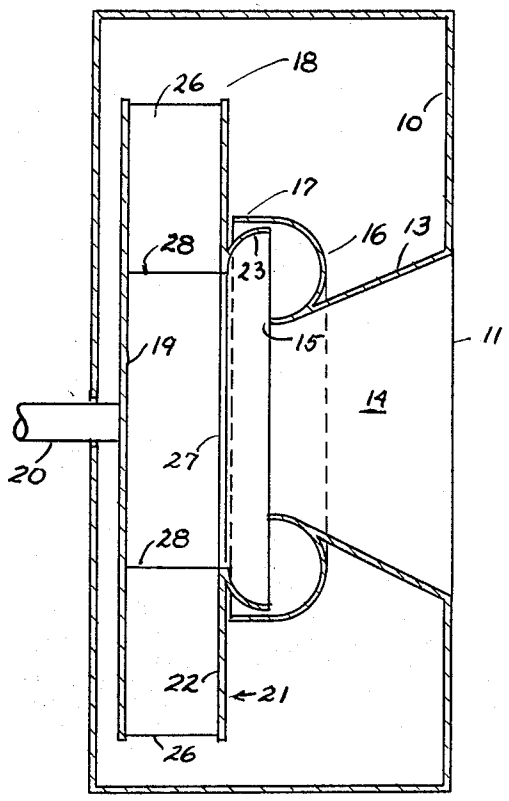


Fig. 1

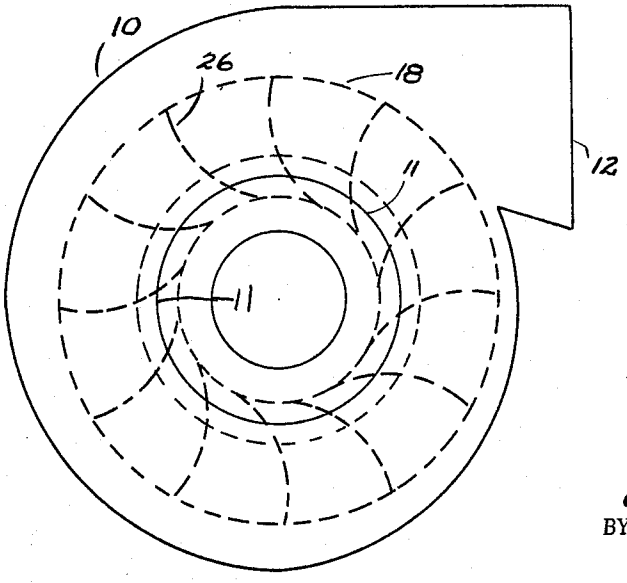


Fig. 2

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Nov. 15, 1966 J. E. McDONALD 3,285,501

CENTRIFUGAL FANS

Filed Dec. 7, 1964 2 Sheets-Sheet 2

Fig. 3

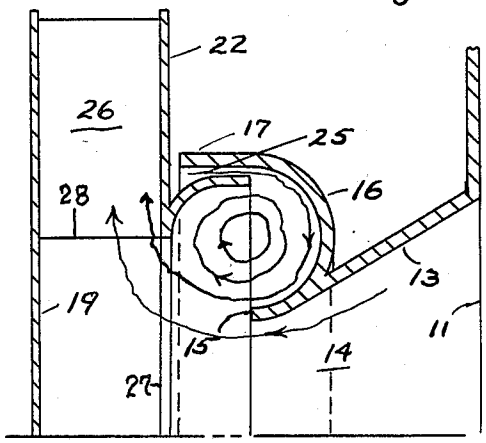


Fig. 4

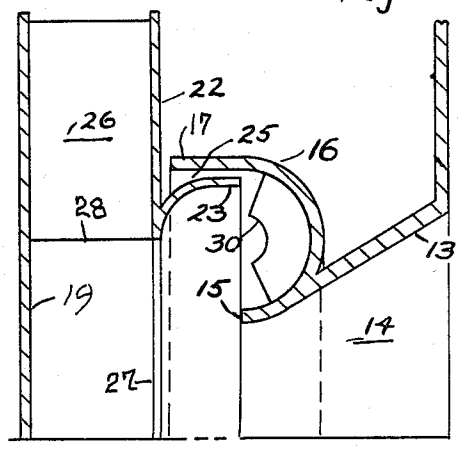


Fig. 5

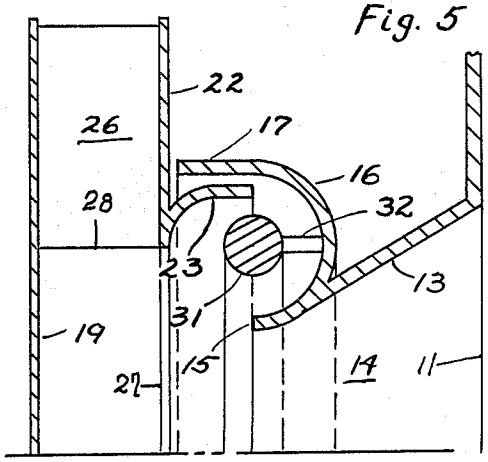


Fig. 6

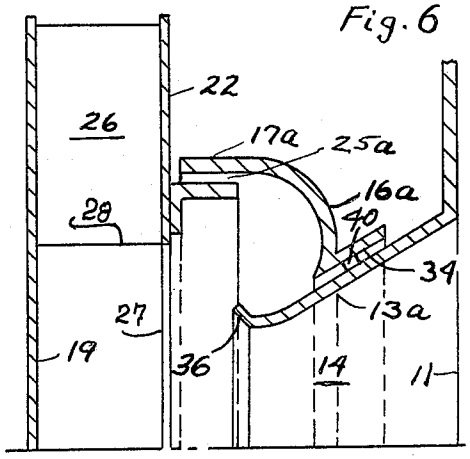
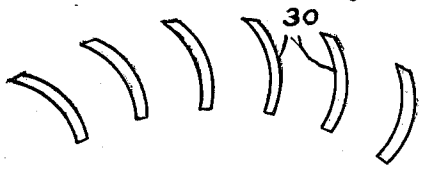


Fig. 7



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CENTRIFUGAL FANS

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12 Claims. (Cl. 230—127)

This invention relates to centrifugal fans, and has as an object to improve the inlet passages of such fans.

Conventional centrifugal fans have converging casing walls forming axial inlet passages to their wheels, and their wheels have side plates with straight, radially extending outer portions joined to inner portions which are curved to attempt to change the direction of the air entering the wheels from axial to radial. Experience has shown that the air passing through such a wheel does not follow closely the shape of its side plate, but breaks away from the latter, resulting in the fan blades being only partially loaded.

This invention produces an annular ring of spinning air around the inlet of a fan wheel, with the air spinning in a direction to cause the air entering the wheel to change from an axial to a radial direction. In one embodiment of this invention this is accomplished by forming an inner portion of a side plate of a fan wheel as a portion of an annular ring, and by forming an adjacent portion of a fixed casing wall as a portion of an annular ring extending partially around the ring shaped portion of the side plate. High pressure air from within the casing of the fan is directed between the two ring shaped portions, and is caused by their curvature to spin around the inlet of the fan wheel, and by induction to cause the direction of the air entering the fan wheel to change from axial to radial.

Another object of this invention is to use air spinning around the axial inlet of a wheel of a centrifugal fan, to cause the direction of the air entering the fan wheel to change from axial to radial.

This invention will now be described with reference to the annexed drawings, of which:

FIG. 1 is a side view, in section, of a centrifugal fan embodying this invention;

FIG. 2 is an end view of the fan of FIG. 1, looking at its inlet end; the scale being reduced;

FIG. 3 is an enlarged, fragmentary view, in section of the upper portion of FIG. 1, and shows by arrows the directions of the spinning air, and the air entering the fan wheel;

FIG. 4 is a modification of FIG. 3, with the arrows omitted;

FIG. 5 is another modification of FIG. 3, with the arrows omitted;

FIG. 6 is still another modification of FIG. 3, with the arrows omitted, and

FIG. 7 is a fragmentary end view of the spin removing vanes of FIG. 4.

Referring first to FIGS. 1–3, a conventional scroll-shaped casing **10** has the usual axial inlet **11** and tangential outlet **12**. The casing **10** has a wall **13** converging inwardly from the inlet **11**, and forming a converging, axial inlet passage **14**. Inner end **15** of the wall **13** has joined thereto a wall portion **16** formed as a portion of an annular ring, and which has joined thereto, radially outwardly of the inner end **15** of the wall **13**, a cylindrical wall portion **17**. A fan wheel **18** has a back plate **19** attached to a shaft **20**, the usual hub not being shown, and has a side plate **21**. The side plate **21** has a radially extending, outer portion **22**, and has an inner portion **23** formed as a portion of an annular ring, and which extends inwardly of the cylindrical wall portion **17**, and the axially outer end of which is in a vertical plane containing the inner end **15** of the wall **13**. An annular passage **25** is formed between the ring-shaped side plate portion **23** and the cylindrical wall **17**, and supplies high pressure air from within the casing **10** tangentially into the space bounded by the ring-shaped wall portion **16**. The wheel **21** has conventional fan blades **26**, and has an axial inlet **27** axially aligned with noses **28** of the blades **26**, and the inner end of the straight portion **22** of the side plate **21**.

In the operation of FIGS. 1–3, the high pressure air within the casing **10** flows through the annular passage **25**, and is caused by the curved wall portion **16** to spin as shown by the arrows of FIG. 3, around the inlet **27** of the wheel **21**. Approximately one-fourth of the boundary layer of the spinning air is in contact with the boundary layer of the air leaving the passage **14**, and the latter air is caused by induction to turn from an axial to a radial direction, the boundary layer of the spinning air passing into the inlet **27** of the fan wheel with the main air stream.

Under certain conditions, the spinning air may tend to rotate bodily in the same direction as the rotation of the fan wheel. To prevent this, the spin removing vanes **30** shown by FIGS. 4 and 7, extend axially inwardly from the axially inner surface of the ring-shaped wall **16** into the path of spinning air rotating in the direction that the fan wheel does. The vanes **30** do not interfere with the air spinning in an annulus, and may be shaped to increase such spin.

In a high pressure fan, the velocity of the spinning air at the center of its vortex may increase to such a high velocity that shock waves and/or noise may be produced. To prevent this, an annular core **31** in the form of a toroid, as shown by FIG. 5, can be placed in the center of the vortex to fill in its central portion. The core **31** is supported from the curved wall portion **16** by spin removing vanes **32**, similar to, but smaller, than the vanes **30** shown by FIGS. 4 and 7.

In the embodiments of the invention shown by FIGS. 1–5, the curved wall portions **16** and the side plate portions **23** are circular in section. FIG. 6 shows a modification in which a side plate portion **23***a* corresponding to the side plate portions **23** of FIGS. 1–5, is straight and is parallel to cylindrical wall portion **17***a* extending therearound, and which corresponds to the wall portions **17** of FIGS. 1–5, with a tangential, annular passage **25***a* corresponding to the passages **25** of FIGS. 1–5, between the side plate portion **23***a* and wall **17***a*. Wall portion **16***a* corresponding to the wall portions **16** of FIGS. 1–5, has, in section, a smaller arc than the wall portions **16**; is not joined to the axially inner end of wall **13***a* corresponding to the walls **13** of FIGS. 1–5, and its radially inner end is joined to a wall portion **34** spaced radially outward from and parallel to the wall **13***a*, with a tangential, annular passage **35** formed between the wall **13***a* and the wall portion **34**. Inner end portion **36** of the wall **13***a* is turned outwardly towards the side plate portion **23***a*. The wall portion **34** is supported from the wall **13***a* by spaced apart struts **40**.

The operation of FIG. 6 is smiliar to that of FIGS. 1–3 with tthe exception that additional high pressure air from within the casing flows through the passage **35** tangentially into the space bounded by the wall portion **16***a* and the inner end portion of the wall **13***a*. The outwardly turned inner end portion **36** of the wall **13***a* greatly increases the spinning.

The inlets of the fan wheels of FIGS. 1–6 are circular and axial as is conventional. The inner ends of the walls **13** of FIGS. 1–5, and the inner end of the wall **13***a* of FIG. 6, are in circles having smaller diameters than the inlets of their respective fan wheels, such circles being in planes normal to the axes of the respective wheels.

The wall portions **16** and the inner end portions of the walls **13** of FIGS. 1–5, form generally parti-toroidal wall means extending partially around circular axes in planes normal to the axes of the respective fan wheels, such wall

means being open between the inner ends of the walls **13** and the inlets of the respective fan wheels. The wall portion **16***a* and the inner end portion of the wall **13***a* of FIG. 6 form generally parti-toroidal wall means extending partially around a circular axis in a plane normal to the axis of the associated fan wheel, such wall means being open between the inner end of the wall **13** and the inlet of the associated wheel.

The core **31** of FIG. 5 is a toroid on the circular axis which the wall **16** and the inner portion of the wall **13** of FIG. 5 extend.

What is claimed, is:

1. A centrifugal fan comprising a casing; a fan wheel supported for rotation within said casing, said wheel having a circular axial inlet, and having a side plate around said inlet; said casing having an inlet concentric with said inlet, and having a relatively long annular wall extending from said inlet of said casing towards said inlet of said wheel, said wall having an axially inner end in a circle concentric with said inlets and in a plane normal to the axis of said wheel, said end being spaced axially outwardly from said inlet of said wheel; generally parti-toroidal, fixed wall means extending partially around a circular axis, and having a radially inner portion formed by a relatively short portion of said wall extending from said end towards said inlet of said casing, said circular axis having a smaller diameter than that of said wheel, said wall means having a radially outer portion with an axially inner end closely adjacent to said side plate, said wall means having a curved, in section, intermediate portion extending around said inner portion and bulging towards but terminating short of said inlet of said casing, said wall means being open between said inner end and said inlet of said wheel; and means for supplying high pressure air from the interior of said casing tangentially into the space bounded by said wall means, said wall means being shaped to cause the high pressure supplied into said space to spin around said circular axis.

2. A centrifugal fan as claimed in claim **1** in which a plurality of spin removing vanes are spaced apart in said space and have outer edges in contact with the inner surface of said wall means.

3. A centrifugal fan as claimed in claim **1** in which a toroid having a diameter, in section, substantially smaller than the diameter, in section, of said wall means is located on said circular axis.

4. A centrifugal fan comprising a casing; a fan wheel supported for rotation within said casing, said wheel having a circular axial inlet, and having a side plate with an inner edge around said inlet; said casing having an axial inlet concentric with said inlet, said casing having a relatively long annular wall extending from said inlet of said casing towards said inlet of said wheel, said wall having an axially inner end in a circle concentric with said inlets, said end being spaced axially outwardly from said inlet of said wheel, said circle having a smaller diameter than said inlet of said wheel; generally parti-toroidal, fixed wall means extending around a circular axis in a plane normal to the axis of said wheel, said circular axis being spaced axially outwardly from said side plate, having a smaller diameter than that of said wheel, and having a larger diameter than that of said circle, said wall means including a relatively short portion of said wall extending from said end towards said inlet of said casing, said wall means being open between said end and said side plate edge; and means for supplying high pressure air from within said casing tangentially into the space bounded by said wall means, said wall means being shaped to cause the high pressure air supplied into said space to spin around said circular axis.

5. A centrifugal fan as claimed in claim **4** in which

a plurality of spin removing vanes are spaced apart in said space and have outer edges in contact with the inner surface of said wall means.

6. A centrifugal fan as claimed in claim **4** in which a toroid having a diameter, in section, substantially smaller than the diameter, in section, of said wall means is located on said circular axis.

7. A centrifugal fan comprising a casing; a fan wheel supported for rotation within said casing, said wheel having a circular axial inlet, and having a side plate around said inlet; said casing having an inlet concentric with said inlet, and having a relatively long annular wall extending from said inlet of said casing towards said inlet of said wheel, said wall having an axially inner end in a circle concentric with said inlets, said end being spaced axially outwardly from said inlet of said wheel; generally parti-toroidal, fixed wall means extending partially around a circular axis in a plane normal to the axis of said wheel, said circular axis being spaced axially outwardly from said side plate, having a smaller diameter than that of said wheel, and having a larger diameter than that of said circle, said wall means having a radially inner portion formed by a relatively short portion of said wall extending from said end towards said inlet of said casing, said wall means having a radially outer portion with an end closely adjacent to said side plate, said wall means having an intermediate portion curved, in section, extending around said inner portion and bulging towards but terminating short of said inlet of said casing, said wall means being open between said inner end and said inlet of said wheel; said side plate having means extending axially outwardly and spaced radially inwardly of said end of said outer portion and forming with said end of said outer portion a passage for supplying high pressure air from within said casing tangentially into the space bounded by said wall means, said wall means being shaped to cause the high pressure air supplied into said space to spin around said circular axis.

8. A centrifugal fan as claimed in claim **7** in which a plurality of spin removing vanes are spaced apart in said space and have outer ends in contact with the inner surface of said wall means.

9. A centrifugal fan as claimed in claim **7** in which a toroid having a diameter, in section, substantially smaller than the diameter, in section, of said wall means is located on said circular axis.

10. A centrifugal fan as claimed in claim **1** in which said inner end of said wall is turned outwardly towards said side plate.

11. A centrifugal fan as claimed in claim **4** in which said inner end of said wall is turned outwardly towards said side plate.

12. A centrifugal fan as claimed in claim **7** in which said inner end of said wall is turned outwardly towards said side plate.

References Cited by the Examiner

UNITED STATES PATENTS

820,779	5/1906	Guy	230—122
971,850	10/1910	Krogh	103—103
1,787,656	1/1931	Anderson	230—127
2,798,658	7/1957	McDonald	230—127
3,070,025	12/1962	Cliborn	103—103

FOREIGN PATENTS

375,065	6/1921	Germany.
21,286	of 1901	Great Britain.
858,808	1/1961	Great Britain.

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