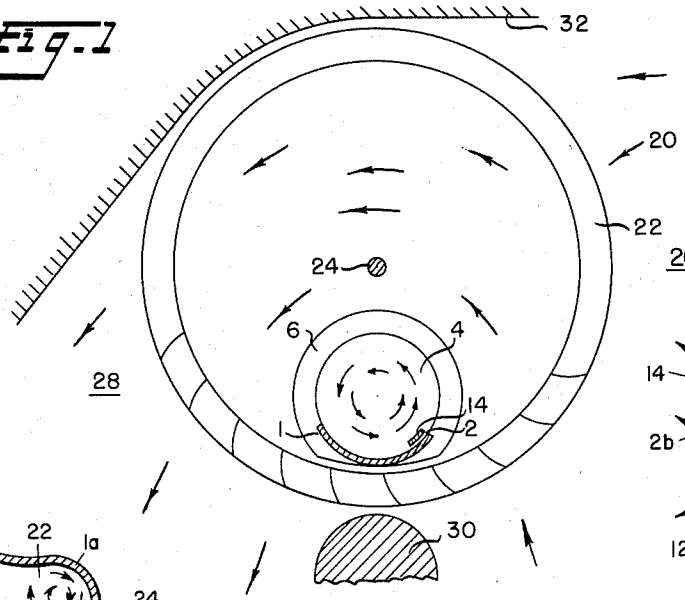
Aug. 11, 1964 T. HELMBOLD 3,144,202

STABILIZING DEVICES FOR GENERATING AND GUIDING POTENTIAL WHIRLS

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Fig. 1



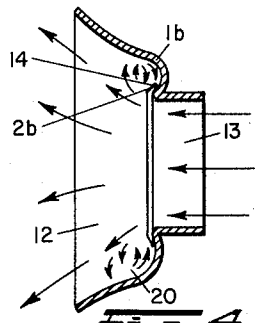


Fig. 4

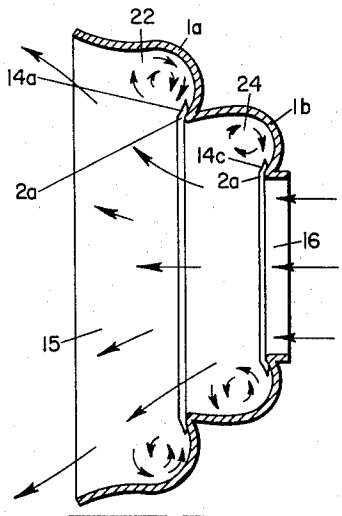


Fig. 5

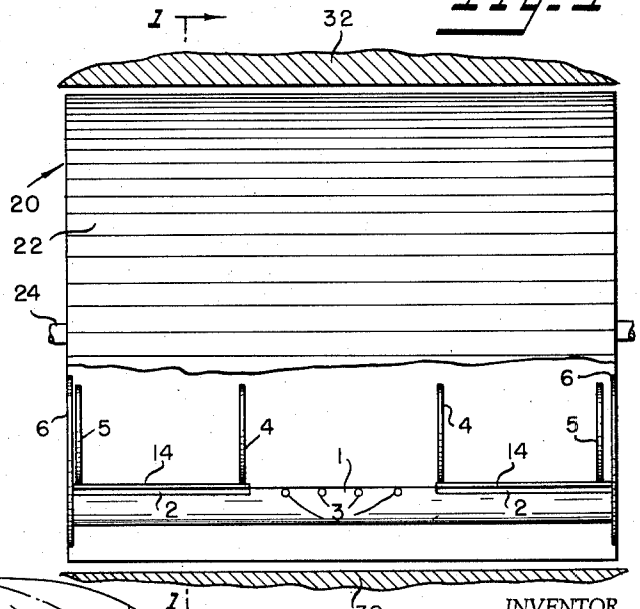


Fig. 3

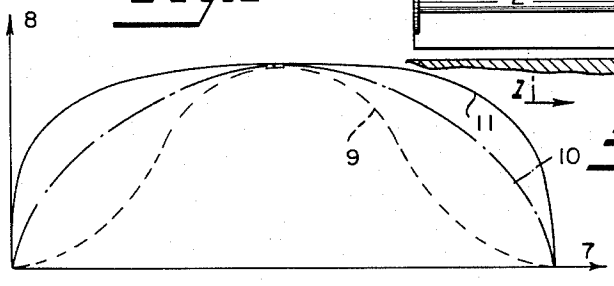


Fig. 2

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STABILIZING DEVICES FOR GENERATING AND GUIDING POTENTIAL WHIRLS

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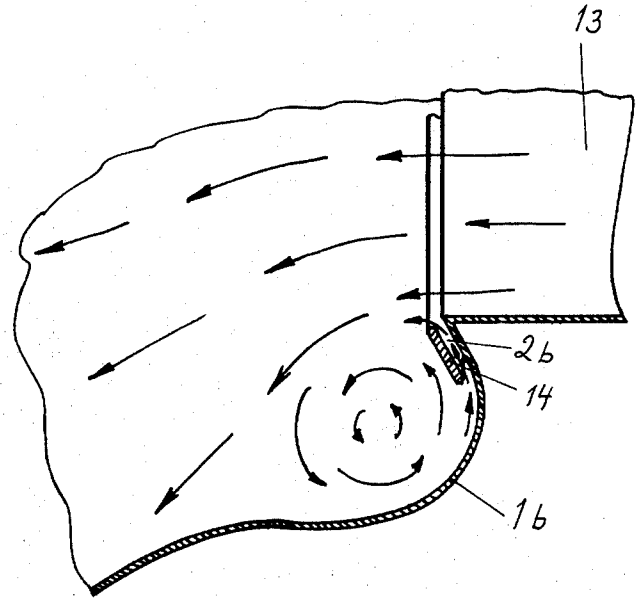


Fig. 4a

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3,144,202

STABILIZING DEVICES FOR GENERATING AND GUIDING POTENTIAL WHIRLS

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8 Claims. (Cl. 230—125)

The present invention relates to stabilizing devices for the development and control of whirling masses of a supplied medium which are known as potential whirls or vortices such as roller-shaped or ring-shaped potential whirls.

This is a continuation-in-part of my copending application Serial No. 96,953, filed March 30, 1961, and entitled Transverse Flow Type Blowers.

Such potential whirls are suitable as means for bending a fluid stream, as, for example, in transverse flow type blowers, diffusers, valves, flue gas chimneys, whirls at the rear of motor cars, or liquid streams.

It has been previously suggested to utilize potential whirls for influencing flowing media. In transverse flow type blowers, trough-shaped guiding bodies have been used to generate and guide such potential whirls as disclosed, for example, in said copending application. As disclosed in said copending application, the shape of the trough-shaped guiding bodies correspond to the shape of the guided potential whirl. Such trough-shaped guiding act to hold the potential whirl substantially in place within the transverse blower rotor in opposition to the influence exerted on the whirl by rotation of the rotor. As a result of the influence of the guiding body on the whirl, an air cushion is developed between the whirl and the trough-shaped body. This air cushion interferes with the proper and accurate guidance of the whirl and makes it noisy with the result that the efficiency of the transverse flow type blower is reduced. This air cushion is formed by eddies along the inwardly directed surface of the trough-shaped guiding body which tend to push the whirl or vortex away from the guiding body to thereby make the whirl unsteady. This unsteadiness of the whirl contributes to noise and impairs the efficiency of the blower.

The object of this invention is to avoid the foregoing problems and disadvantages. This is accomplished in accordance with the present invention by providing a special trough-shaped body or stabilizing device for guiding the potential whirl. This special trough-shaped body has a passage extending from the interior of the trough with respect to the turning direction of the whirl and the rear part of the body is arranged so that it does not touch the whirl.

The passage extending from the interior of the trough-shaped body connects an interior part of the trough-shaped body with a predetermined exterior region of the body. The interior part and the exterior region connected together by the passage are arranged such that the pressure, within the exterior region, is lower than the pressure within the interior part. As a consequence, the medium forming the whirl, as, for example, air is drawn in small quantities from the interior part of the trough to the exterior region, within which the whirl is turning off the trough. By transferring the medium to the exterior side of the trough-shaped body, the medium may be picked up by the fluid stream moving towards the whirl and is supplied again to the exterior part of the whirl. By evacuating the whirl forming medium from the interior of the trough which is guiding the whirl, no accumulation of the whirl generating medium is allowed to develop to lift the whirl off the guiding trough. In this manner the potential whirl is settled in its movement and position within the guiding body.

According to a feature of the invention the passage provided at a trough-shaped guiding body is slot-shaped and is arranged to extend either over the whole length of the trough-shaped guiding body or only over parts of the body.

The passage can also be formed by a series of bores.

Those guided potential whirls which have a comparatively long length in comparison to their diameter tend to increase their rotational diameter to a certain degree and consequently become shorter. In order to prevent the unfavorable effect which such a condition has on the efficiency of the potential whirl, partial disks are provided for at the trough-shaped guiding body and are arranged to extend approximately normal to the rotational axis of the potential whirl. These partial disks divide a long potential whirl into several short whirls such that each short whirl no longer has any disturbing effect. The partial disks preferably correspond in their form and size to the cross section of the guided potential whirl and are rotatably supported.

Since the static pressure near the core of a potential whirl is less than the static pressure nearer to the exterior of the whirl, the whirl tends to suck in additional medium in an axial direction with the result that its mass is increased. As a consequence, the favorable influence which the whirl has on the fluid stream is diminished. In order to avoid this increase in mass of the potential whirl, a set of double outer end disks is provided for. These double end disks essentially consist of two disks arranged at a small distance from each other and substantially normal to the rotational axis of the whirl. In accordance with the present invention, these double end disks have an effect similar to a labyrinth packing so as to prevent the potential whirl from drawing additional masses of the medium to its core. The inner end disks directly limit the length of the potential whirl and preferably correspond in form and size to the transverse cross section of the guided potential whirl. The outer end disks are larger than the inner disk and may be formed by the housing parts of the apparatus to which the disk assembly is applied, such as a transverse flow type blower, diffuser, flue gas chimney or the like.

By applying the stabilizer device according to the invention to transverse flow type blowers, less noise and increased flow over the whole width of the blower is attained.

Diffusers facilitate the transmutation of velocity head into a static pressure head. This is accomplished providing for a gradually increasing cross section of flow area extending away from the inlet opening of the diffuser. By this construction, velocity of the medium entering through the inlet is retarded. As a result, the static pressure of the medium is increased. In practice, the magnitude to which the diameter of known diffusers can be enlarged is limited since the medium will not flow along the wall of the diffuser and the stream

of the medium consequently will not fill the exit of the diffuser if the flare of the enlarging flow area is made too great. It is usually desirable to construct diffusers with an enlargement or flare angle that is greater than 15°. In order to minimize the slope of the flare to thereby insure that the fluid stream passing through the diffuser fills the exit thereof and at the same time to provide for an enlargement flare that is greater than 15°, it has been the practice in the past to increase the length of the diffuser. Diffusers which are relatively long, however, cannot be used advantageously in certain applications.

This foregoing difficulty is overcome by applying the stabilizing device of the invention, to a diffuser. The trough-shaped guiding bodies are arranged for generating and stabilizing one or several potential whirls lying in a plane normal to the flow direction and parallel to the wall of the diffuser.

The apparatus producing the potential whirls according to the invention, is arranged within the interior of the diffuser and effectuates an increased dispersion of the fluid stream passing through the diffuser to thereby insure that the medium fills the passage of the diffuser. As a consequence, the present invention enables diffusers to be constructed with wider enlargement or flare angles and appreciably shorter length without diminishing the efficiency of the diffuser.

In applying the guide body to a diffuser, the slot, hereinbefore referred to, which is formed within the guiding body in an axial direction to the guided potential whirl, extends over the entire length of the guiding body or over a part of the body. In forming the slot an essentially strip-shaped adjustably arranged body is provided for.

In order to divide the potential whirl extending over the circumference of the diffuser partial disks are provided for which support the whirl in an axial direction. These disks are arranged approximately normal to the rotational axis of the potential whirl and essentially correspond in shape and size to the cross section of the whirl. These disks also may be rotatably mounted.

The cross section of the fluid stream in the diffuser according to the invention is normally circular, but, alternatively, it may be of any other shape.

In diffusers constructed for greater velocity gradients two or more trough-shaped guiding bodies may be arranged within the diffuser such that they are positioned one behind the other with regard to the direction of fluid flow through the diffuser.

The trough-shaped guiding bodies preferably are formed by the wall of the diffuser.

The present invention will now be described with reference to the accompanying drawings, in which:

FIGURE 1 is a transverse sectional view of a transverse flow type blower rotor taken along lines **1—1** of FIGURE 2 and illustrating a vortex guiding and stabilizing device according to one embodiment of the present invention;

FIGURE 2 is a side elevational view of the blower shown in FIGURE 1 with the blower rotor partially broken away to illustrate the side elevation of the vortex guiding and stabilizing device shown in FIGURE 1;

FIGURE 3 shows a plotted graph of results of the device according to the invention when used in a transverse flow type blower;

FIGURES 4 and 4*a* show an embodiment of diffuser according to the present invention, equipped with means for guiding a potential whirl in one line, and FIGURE 5 shows another embodiment of diffuser according to the present invention.

Referring now to the drawings and more particularly to FIGURES 1 and 2 a trough-shaped guiding body **1** constructed in accordance with the principles of the present invention is shown to be mounted within a transverse flow type blower unit **20** (FIGURE 1) having a peripherally bladed rotor **22** mounted for rotation about a shaft axis **24**. Rotor **22** is positioned between and in the region of a fluid inlet channel **26** and a fluid outlet channel **28**. Channels **26** and **28** are separated from each other by a partition **30** disposed externally adjacent to rotor **22**. Channel **26** and **28** are suitable delimited at their sides opposite from partition **30** by means of a housing wall **32**.

The foregoing blower construction is disclosed in said copending application to which reference is made in the event a more detailed description is required for an understanding of the present invention.

As disclosed in said copending application, rotation of rotor **22** in a predetermined direction draws fluid from inlet channel **26**. The fluid stream passing from inlet channel **26** passes transversely through rotor **22**, as indicated by the arrows and is propelled into outlet channel **28**.

As disclosed in said copending application, when rotor **22** is rotated, a vortex or potential whirl is formed within rotor **22** radially between partition **30** and shaft **24**. It will be appreciated that this potential whirl thus formed, exerts a guiding influence on the fluid stream passing through rotor **22** in that the whirl will divert or bend the stream downwardly (as viewed from FIGURE 1) and somewhat towards itself.

According to the present invention, the trough-shaped guiding body **1** produces and holds the vortex in its proper position within rotor **22** and constitutes an improvement of the guiding body disclosed in said copending application. As shown, the guiding body, to accomplish its purpose, is mounted within rotor **22** radially between the shaft axis **24** and partition **30** and adjacent to partition **30** in the region where the vortex is to be formed and positioned. Arranged on the trough-shaped guiding body **1** are at least a pair of axially spaced apart parallel partial disks **4** corresponding in shape to the guided potential whirl. At opposite ends of the body **1** a pair of parallel outer end disks **6** are mounted on body **1** such that disks **4** extend axially between disks **6**. As shown, disks **6** are larger than the partial disks **4**.

With continued reference to FIGURES 1 and 2, trough-shaped guiding body **1** is provided over part of its length with a pair of axially spaced apart slots **2** extending from the interior part of the trough to its exterior part in the direction of the whirl movement. Between disks **4**, the mid-section of body **1** is provided with a series of axially spaced apart bores **3**. The function of bores **3** is the same as slits **2**, and they extend to permit the air cushion to be drawn off in the manner previously described. Partial disks **4** divide the guided potential whirl into several shorter whirls. At the ends of the trough-shaped guiding body **1** axially spaced apart parallel double inner end disks **5** are mounted between disks **4** and **6**. As shown in FIGURE 2, disks **5** are mounted on body **1** closely adjacent to disks **6**. The inner end disks **5** essentially correspond in shape and size to the cross section of the guided potential whirl. The outer end disks **6** are larger than the inner disks **5** which are about the same size as disks **4**. Each of the slots **2** extend between adjacently disposed disks **4** and **5** such that one disk **5** is positioned at one end of the slot and one disk **4** is positioned at the opposite end of the slot.

In operation of blower **20**, the whirl or vortex formed on guiding body **1** is guided and held in position by body **1**. As mentioned previously, an air cushion formed by small eddies tends to develop on guiding body **1** between the radially inwardly directed surface thereof and the vortex guided thereby.

With the provision of slits **2**, however, in the rearward edge of guiding body **1** with respect to the flow direction of the vortex as shown, a suction effect is established to continuously draw off fluid medium adjacent to the inwardly directed surface of body **1**.

Thus, the air cushion is continuously removed by slits **2** to maintain body **1** substantially free of disturbing air eddies which otherwise would tend to make the guiding vortex unsteady.

FIGURE 3 shows a series diagrammatically plotted curves representing the supply intensity with respect to the extension of the blower in the direction of the rotational axis of the potential whirl. The guiding body **1** functions to generate and guide the potential whirl for the blower and is positioned within the blower rotor. The abscissa **7** of the graph shown in FIGURE 3 represents the lateral extension of a blower incorporating guiding body **1**. The ordinate axis **8** represents the supply intensity depending on the lateral position. The plotted curve **9** is for a trough-shaped guiding body **1** without partial disks and without slots according to the invention. Curve **9** clearly shows that at the sides of the blower there is an essentially lower supply intensity than in the middle region. This effect is caused by the fact that the guided potential whirl in the interior of the blower rotor is sucking additional air into its core at its ends. Thus, the mass of the potential whirl is increased and, as a consequence, the favorable influence which the whirl has on the fluid flow through the blower is correspondingly diminished. In addition, the guiding of the whirl within the trough of the guiding body is interrupted by air cushions which are produced as a result of the influence of the whirl by the guiding body.

With continued reference to FIGURE 3, the curve **10** represents a trough-shaped guiding body **1** which is provided with the slots **2** extending from the interior of the trough to the exterior part of the guiding body in the direction of the whirl movement. With this slot construction, the air cushions are sucked from the interior of the trough through the slots so that an accurate guidance of the potential whirl is effectuated within the trough-shaped guiding body. The influence of drawing air from the interior of the body **1** by means of slots **2** is clearly shown by curve **10** in comparison to curve **9** in that the intensity of medium supply is appreciably improved throughout both sides of the blower.

With continued reference to FIGURE 3, the curve **11** is for a trough-shaped guiding body **1** equipped with slots **2** arranged according to the invention, and with partial end disks. Curve **11** shows an appreciable improvement of supply intensity over a very wide range. The improved supply intensity results from the arrangement of the end disks **6** which allows the potential whirl to suck only small quantities of separate air. Furthermore, the partial disks **4** prevent a deformation of the whirl when the whirl becomes relatively long.

FIGURES 4 and 5 illustrate diffusers which conventionally convert the velocity head of a flowing medium into pressure head. Thus, these diffusers act on a fluid stream having given velocity and pressure heads to increase the pressure head while reducing the velocity head.

In FIGURES 4 and 4*a* a diffuser **12** is shown to have an inlet **13**. The air stream enters inlet **13** for passage through the diffuser. Diffuser **12** comprises trough-shaped guiding body **1***b* arranged near the inlet **13** of diffuser **12** and functioning to guide a potential whirl indicated at **20**. Owing to the path of the fluid stream flowing through diffuser **12** and to the construction of body **16**, it is clear that whirl **20** (which is essentially a vortex or turbulence) is of annular shape surrounding the fluid stream. This whirl or vortex **20**, owing to the circular direction of movement of fluid therein, spreads the fluid stream passing through diffuser **12**, causing it to uniformly diverge and increase in cross-section without producing objectionable currents. As noted from FIGURE 4, whirl **20** is located adjacent to inlet **13**. As explained in connection with the embodiment of FIGURES 1 and 2, objectionable eddy currents tend to develop on guiding body **1***b*. These eddy currents are continuously removed by a slot **2***b*. Slot **2***b*, extending from the inner part of the trough in the movement direction of the potential whirl, is provided in a portion **14** of body **1***b*. As shown, the trough-shaped guiding body **1***b* is formed by the interior wall surfaces of the diffuser. The provision of slot **2***b* stabilizes whirl **20**, thus enabling it to act on the fluid stream passing through diffuser **12** without tearing the boundary layers of the stream.

FIGURE 5 shows a diffuser **15**. The air stream enters diffuser **15** through an inlet **16**. According to the invention there are provided two trough-shaped guiding bodies **1***c* and **1***a* arranged in the flow direction one behind the other. The annular whirls or vortices formed on guiding bodies **1***c* and **1***a* are respectively indicated at **22** and **24**. Both guiding bodies are provided with slots **2***a* formed in bodies **14***c*, **14***a*. As shown, the trough-shaped guiding bodies **1***b* and **1***a* are formed by the interior wall surfaces of the diffuser.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiments are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed and desired to be secured by United States Letters Patent is:

1. In combination with a fluid transfer device for conducting a fluid stream from one region to another, and having means for producing a potential whirl entirely within the device, vortex guide means in said transfer device for guiding and stabilizing the position of said potential whirl to control the direction of said fluid stream through said device, said vortex guide means comprising a body having a concave inner surface for supporting and guiding said potential whirl, said concave surface corresponding in size and shape to a substantial portion of the periphery of said whirl and located adjacent thereto, and fluid passage means providing at least one uninterrupted fluid passage in said body extending from the region of said inner concave surface to the rearward part of said body with regard to the flow direction of the potential whirl supported thereby, said passage means being operable in co-operation with said whirl and the fluid flow through the device to produce a suction effect for continuously removing fluid boundary layers forming between said whirl and said surface.

2. The combination defined in claim 1 wherein said vortex guide means comprises at least one disk shaped member mounted on said guide body intermediate the oppositely facing ends thereof facing axially with respect to the rotational axis of said potential whirl, said disk-shaped member projecting from said surface into the region of said potential whirl supported thereby in substantially perpendicular relationship to said rotational axis to axially divide said potential whirl into at least two segments.

3. The combination according to claim 1 wherein said passage means is formed by a series of bores.

4. The combination according to claim 2 wherein said disk shaped member corresponds in shape and size to the cross section of the potential whirl.

5. The combination defined in claim 4 wherein said vortex guide means comprises double outer end disk shaped elements mounted at opposite ends of said body and axially delimiting said potential whirl, said elements extending substantially normal to the axial flow direction of said whirl.

6. The combination defined in claim 5 wherein said elements are formed larger than said disk shaped member.

7. The combination defined in claim 1 wherein said

transfer device comprises a diffuser having a diffuser wall formed in part by said body.

8. The combination defined in claim 1 wherein said transfer device comprises a transverse flow type blower having an inlet and outlet, a rotor disposed transversely between said inlet and outlet and being rotatable to convey a fluid in a stream from said inlet to said outlet, and a partition separating said inlet from said outlet,

said vortex guiding means being disposed within said rotor radially between the rotational axis thereof and said partition.

References Cited in the file of this patent

FOREIGN PATENTS

225,767 Australia ---------- Dec. 4, 1959