March 24, 1953 N. B. WALES, JR 2,632,598

CENTRIFUGAL BLOWER

Filed April 5, 1950 2 SHEETS--SHEET 1

Fig. 1.

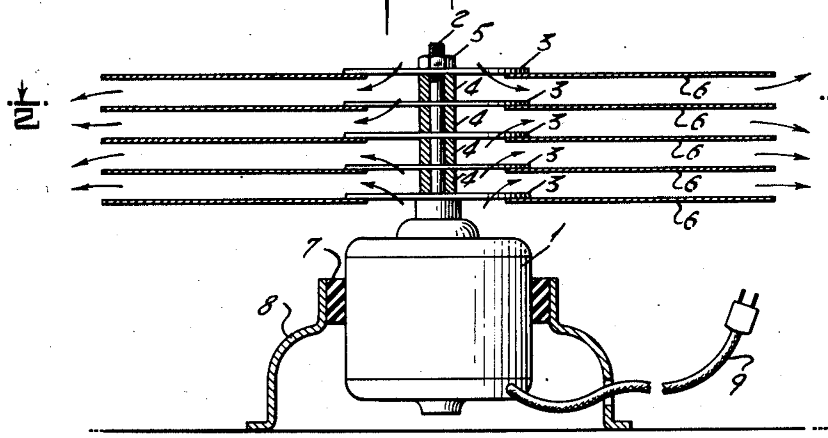
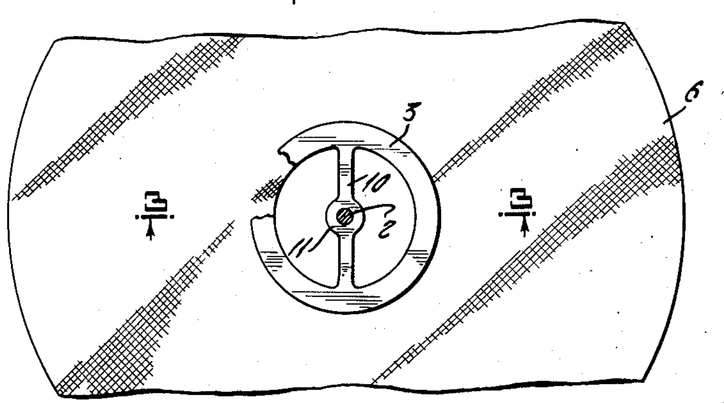


Fig. 2.



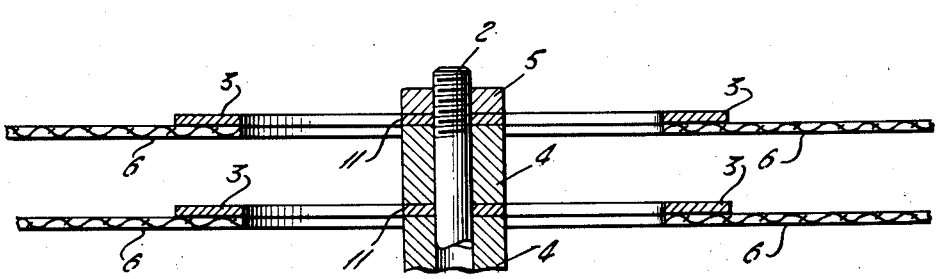


Fig. 3.

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Fig. 4.

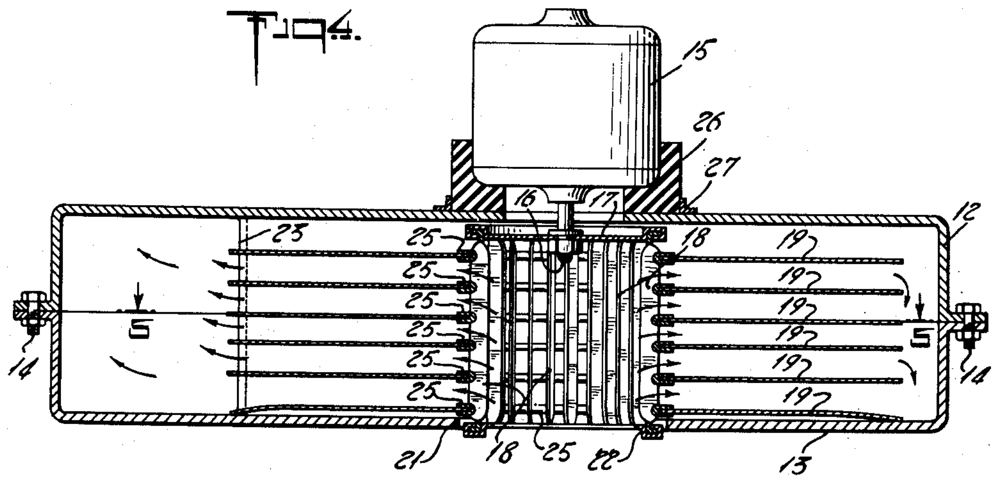
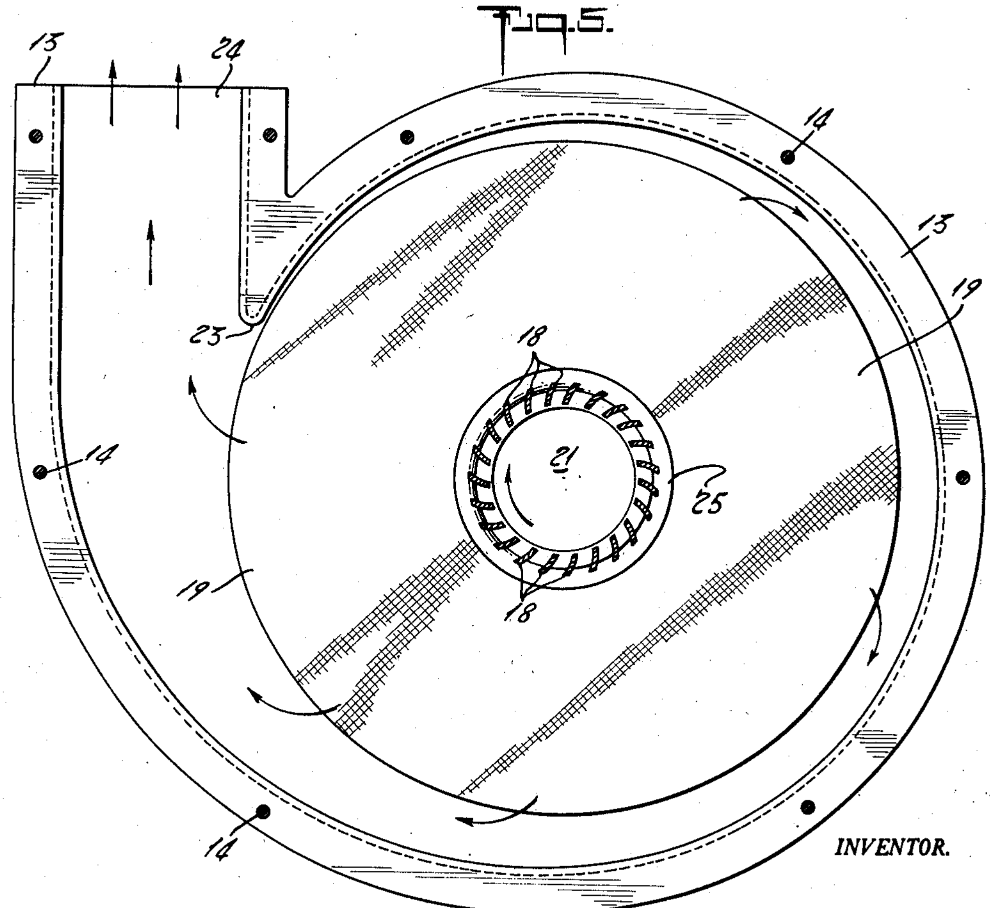


Fig. 5.



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CENTRIFUGAL BLOWER

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7 Claims. (Cl. 230—129)

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This invention relates to a novel principle and construction of centrifugal air blowers which results in substantially silent delivery of appreciable pressures and volumes of air.

In the art of fan and squirrel-cage blowers it is well known that the product of the rotational frequency of a blower rotor with the number of its impeller blades gives rise to a sonic note or noise, especially where a casing having a discrete number of exit orifices enhances the oscillatory pressure fluctuations generated by the passage of such blades by such orifices.

If it were possible to construct a blower having an infinite number of blades it would be expected that the air delivery from such a device would be without pulsation. The present invention simulates such a condition by utilizing for the impelling members the innumerable minute protuberances which a rotating disk having a flocculent or roughened surface presents. For instance, the surfaces of a series of felt disks, or disks of emery paper, or fabric disks present such a scabrous or scaly texture.

My invention results from the combination of an "infinite-blade" substitute such as the felt disks described above, with a close coaxial positioning of such disks so as to form an annular rotating air duct. This form of blower construction has two features, first, the silent acceleration of air radially through these rotating ducts, and second, when used in conjunction with a conventional bladed squirrel-cage input blower, the uninterrupted flow of the air leaving the booster or input blades through the annular rotating ducts permits an equalization or integration of the pressure discontinuities characteristic of such blades so that on reaching the outer periphery there is no pulsing when the air passes from the rotating duct to the stationary exit duct or ducts. This latter phenomenon results in remarkably silent air delivery. This pulse integration is also enhanced by the sound absorbing qualities of felt or fabric disks especially for high frequencies.

Another feature of the encased form of my blower is that the Bernoulli effect acting on the disk adjacent to the casing permits a positive seal against back leakage when a felt or fabric (i. e., non-abrasive) form of disk is used. This results in higher delivery pressures.

An object of my invention is to provide an inexpensive, silent, safe and compact form of air circulator or blower.

A second object is to disclose a design of encased blower capable of the silent delivery of appreciable pressures and volumes of air.

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Other objects are implicit in the subsequent specification and claims.

Referring to the drawings:

Figure 1 is a partial section in elevation of the preferred form of my invention;

Figure 2 is the plan section through 2—2 of Figure 1;

Figure 3 is an enlarged fragmentary section showing a detail of the spider construction of Figure 1;

Figure 4 is a section in elevation of an encased form of my invention; and Figure 5 is the plan section through 5—5 of Figure 4.

In Figure 1, the drive motor 1 is provided with a shouldered and threaded shaft 2 which carries the spider rings 3 clamped between the spacing washers 4 by the pressure of nut 5. The flocculent annular flexible disks 6 are preferably made of felt or fabric and are secured, such as by cementing, concentrically to the spider rings 3. The details of this assembly are apparent in Figure 3. The central portions of the spider disks 3 which undergo clamping between the spacing washers 4 are designated 11 whereas the two arms of the spider are designated 10. Motor 1 is shock-mounted by suitable means such as by rubber ring 7, and supported by a frame here shown in the form of a bell member 8. Line cord 9 emerging through a hole in support 8 affords connection of the motor 1 to a current supply.

In operation the air circulation of Figure 1 performs as follows:

The disks 6, being flexible, drape downwardly in repose when the motor is at rest. On starting the motor, centrifugal force carries the disks into the approximately radial configuration shown, and the myriad protuberances on the surface of these disks 6 accelerate the air tangentially and radially in the annular air duct formed between each pair of adjacent disks. The air thus accelerated emerges at high velocity at the periphery of the disks thereby drawing in air past the spider arms 10 of the disks 3 both from the top and from the bottom as shown by the air flow arrows of Figure 1. Due to the fact that air is discharged in all directions of azimuth, there results a gentle but positive and silent recirculation of the air of any room in which the device may be located. It is to be noted that the soft and flexible character of the centrifugally maintained disks 6 results in a high safety factor, since on contact of the hand with the rotating system these disks will simply yield. The degree of flocculence or roughness of these disks 6 will determine the optimum spacing to be chosen for the axial dimensions of spacers 4. Further, for a given outside diameter of the disks 6 there is a maximum speed of rotation which may be chosen without causing turbulent and noisy delivery of air due to axial flapping or oscillation of the disks. This speed of transition is observed to be quite discontinuous.

The structure of Figure 4 consists of drive motor 15 provided with shaft 16 to which is secured plate 17 which in turn carries the conventional squirrel-cage blower blades 18. An outer ring 22 clamping the outer end of blades 18 completes the mechanical structure of this input or booster blower whose intake orifice is designated 25.

The disks 19 which are carried bodily in rotation with the blades 18 are primarily the means of forming annular rotating ducts for allowing the pulses generated by impact of blades 18 on the relatively stationary intake air to be integrated and smoothed out before they encounter the knee 23 of the stationary exhaust duct 24.

However from a noise absorption standpoint, and also as a means more perfectly to seal the gap between the lowest disk 19 and the casing wall 13, it is desirable to make the disks 19 of a flexible material.

In addition, in order to multiply the pressure which the input blower blades 18 would deliver alone, it is further desirable to make the disks 19 of a flocculent or scabrous material.

For these several reasons in combination the preferred embodiment teaches the construction of disks 19 from a felt or fabric material having all three characteristics; that is, duct-forming, flexible, and rough-surfaced.

Annular disks 19 are clamped at their inner periphery by the U sectioned metal rings 25 which are assembled into indentations in the outer edges of blades 18 so as to be spaced coaxially as shown. The structure formed by plate 17 and blades 18 thus forms a spider to which disks 19 are secured. The casing is formed by an upper member 12 and a lower member 13 secured at a flange by bolts 14. Ring 27 secures rubber shock mount 26 to casing member 12, and the resilient member 26 in turn supports the drive motor and its rotor.

In operation, the blower of Figures 4 and 5 performs as follows:

In rotation, blades 18 draw air through intake orifice 25 and deliver it to the annular ducts formed by disks 19 as shown by the air flow arrows. If an instantaneous polar plot of the pressures obtaining within these ducts at the radius just outside blades 18 were made, it would be found that this graph would have a lobe corresponding to each blade. In conventional squirrel-cage blowers these pressure lobes are impinged on the knee of the casing which must necessarily be close to the blades for any efficiency. This impingement is the major cause of blower noise. However, in the structure shown, as these pressure lobes are translated outward within the rotating ducts formed by disks 19 there is ample opportunity for these lobes to merge and disappear by equalization of pressures before reaching the point of impingement on knee 23 of the blower casing, and consequently silent operation ensues.

It is especially to be noted that the identical principle of input pulse equalization takes place in the simpler structure of Figure 1, since it is impossible for the intake air to pass the spider arms 10 without receiving a pulsing modulation, although this pulsing is here minimized due to the geometry and smaller number of "blades" 10 as compared to the large number of blades 18.

In both cases the rotating duct principle introduces a smoothing acoustical impedance preceding delivery to the exhaust orifices.

Returning to the operation of Figures 4 and 5 after entry between disks 19, the air is further radially and tangentially accelerated by the myriad fibrous impelling members on the surfaces of these disks until at discharge into the scroll of casing 12—13 it has high velocity and pressure. The air is thence discharged through orifice 24.

The lowest rotating disk 19 is caused to bend downward at its outer edge to form a sliding contact seal with the bottom casing member 13 due to the pressure differences on its two sides. One way of looking at this effect is to consider that the Bernoulli principle is producing this difference. The result, however, is to deliver greater output pressures.

It is of course defined that references to "air" in this application includes gases or vapors of any type.

I claim:

1. In a centrifugal air blower, the combination comprising: a plurality of rigid annular disk members, a motor, a spindle for said motor, means for securing said rigid annular members to said spindle in parallel coaxial spaced relation to one another, and a plurality of annular flexible air-accelerating flocculent members secured at their inner peripheries to said rigid annular disk members and adapted to assume a parallel coaxial disk configuration under the centrifugal force of rotation, the surfaces of said air-accelerating flocculent members containing a myriad of minute filaments in sufficient number and distribution to effectively radially accelerate the air particles during rotation while at the same time producing no appreciable sonic beat.

2. In a centrifugal blower, the combination comprising: a spindle, motive means to drive said spindle in rotation, a plurality of rigid annular disks, means to secure said rigid disks to said spindle in spaced, parallel, coaxial relation thereto, and a plurality of annular circular air-accelerating flocculent members secured at their inner peripheries to said rigid disks and adapted to assume a parallel coaxial disk configuration under the centrifugal forces of said rotation, the surfaces of said air-accelerating flocculent members containing a myriad of minute filaments in sufficient number and distribution to effectively radially accelerate the air particles during rotation while at the same time producing no appreciable sonic beat.

3. In a centrifugal blower, the combination comprising: a spindle, motive means to drive said spindle in rotation, a plurality of rigid annular disks, means to secure said rigid disks to said spindle in spaced, parallel, coaxial relation thereto, a corresponding plurality of flexible circular annular members secured at their inner peripheries to said rigid disks and adapted to assume a parallel coaxial disk configuration under the forces of said rotation, and a myriad of flexible air accelerating fibers carried by the surfaces of said flexible circular annular members sufficient to produce a substantial radial flow of air without any appreciable blower noise.

4. In a centrifugal air blower the combination comprising a spindle, a motive means for rotating said spindle, a plurality of relatively disk-like members each of which is comprised of elements which form surfaces having a myriad of minute protuberances, said disk-like members being

axially spaced along the axis of said spindle for substantially parallel operative relation to each other during rotation, and means for securing said disk-like members to said spindle, said minute protuberances being in sufficient number and distribution to effectively angularly accelerate the air particles and thereby produce centrifugal force causing a component of radial discharge of air from said disk-like members during rotation of said disk-like members while at the same time being substantially silent in operation.

5. The subject-matter of claim 4 wherein the disk-like members are formed of a plurality of annular flexible air-accelerating flocculent members.

6. The subject-matter of claim 4 wherein the disk-like members are formed of a felt material.

7. The subject-matter of claim 4 wherein the disk-like members are formed of sandpaper.

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