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BLOWER

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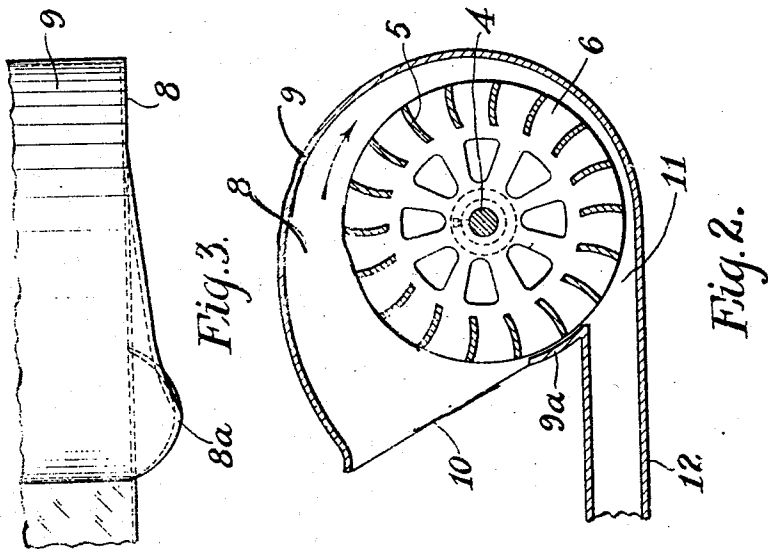


Fig. 2.

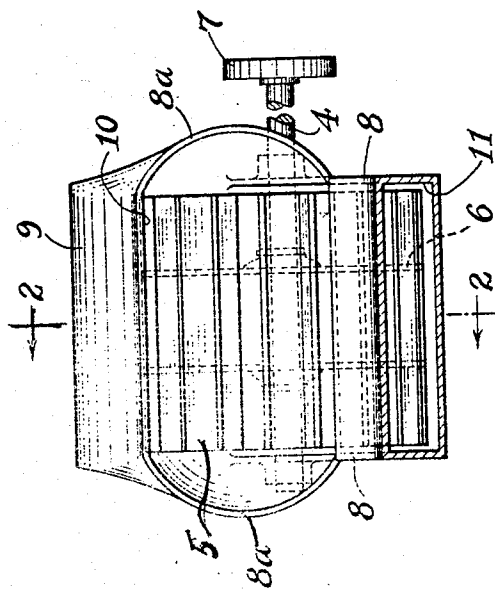


Fig. 1.

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BLOWER

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7 Claims. (Cl. 230—125)

This invention relates to blowers and is concerned with a novel type of blower mechanism especially adapted to produce a current or stream of air of relatively great width having uniform density not only throughout the thickness of the air stream but also throughout the width thereof.

It might also be noted at the outset of this specification that, because of its improved characteristics, the blower of this invention is particularly adapted for use in air conditioning equipment and pulverized fuel feeding apparatus such as the type disclosed in my copending application Serial No. 503,169, filed December 18th, 1930, now Patent 1,893,857, of January 10, 1933, of which this application is a division.

How the foregoing is accomplished and how other objects and advantages are obtained will be more apparent from a consideration of the following description making reference to the accompanying drawing, in which—

Figure 1 is a side elevational view of a blower or fan structure constructed in accordance with this invention;

Figure 2 is a vertical sectional view taken as indicated by the section line 2—2 on Figure 1; and

Figure 3 is a partial top plan view of certain portions of the blower casing which I preferably employ.

Referring to the drawing it will be seen that the fan of the blower structure includes a mounting or axis member 4 on which a ring of blades 5 is mounted as by means of the circular members 6. The fan may be driven by any suitable means such for example as the pulley 7 shown in Figure 1 and rotates in the direction of the arrow applied to the showing in Figure 2.

With regard to the structure of the fan itself it is to be observed that the blades or vanes 5 are of somewhat curved or arcuate formation, their concave sides being presented forwardly with respect to the direction of rotation. As best seen in Figure 1, furthermore, the fan blades may be considerably elongated axially of the rotational mounting 4 and, as will be brought out more fully hereinafter, the axial length of these blades, and therefore of the fan, may even be many times that suggested in the present embodiment. A further characteristic of the fan which should be noted at this point is the fact that the pockets formed between adjacent blades 5 are open at their inner edges, i. e., toward the center of the fan structure, this being of importance in order to ensure operation of the fan

in a highly desirable manner as more fully set forth below.

The fan itself is surrounded by a casing which is generally of volute form, the casing being composed of end walls 8 and a curved generally circumferential wall 9 having an inlet opening 10 and a discharge or outlet opening 11. Further, with regard to the casing, it is to be observed that the fan and the casing are so relatively positioned that the wall 9 progressively approaches the periphery of the fan from the inlet opening 10 thereof to the discharge opening 11. The inlet as well as the discharge openings, therefore, are located, respectively at the large and small ends of a generally volute-like casing and it should also be observed that these two openings are disposed in relatively close proximity toward one side of the fan structure. Stated in another way, the inlet opening lies between the inner and outer portions of the spiral casing wall, and the outlet opening takes the form of an aperture in the inner portion of the spiral wall.

Between the inlet and outlet openings, however, I have positioned a portion 9a of the casing wall 9 closely adjacent to the periphery of the fan and therefore to the path of movement of the blades 5. As is mentioned hereinafter, it is highly desirable that this insert should be of relatively small arcuate dimension and also positioned very close to the fan, preferably closer than any other part of the casing wall 9.

With regard to the outlet opening 11 it should be observed that this is preferably of width substantially equal to the length of the fan blades 5 and that in the preferred form of apparatus the discharge conduit 12 which is extended from the outlet opening is of similar width as well as of relatively small height, the result, of course, being the discharge of a relatively wide but thin stream or current of air.

The inlet opening 10 is similarly of width at least equal to the length of the fan, as clearly shown in Figure 1, although, as seen in Figures 1 and 3, the end walls 8 of the fan casing are preferably tapered outwardly slightly as indicated at 8a from a point adjacent the top of the fan casing to the inlet opening.

One further structural feature to which attention is directed is the fact that the inlet as well as the outlet openings to the casing are arranged peripherally of the fan itself, i. e., so that the path of the air entering the opening 10 extends toward the periphery of the fan, rather than axially thereof, and, similarly, so that the air dis-

charged from the fan casing leaves in a path extended generally tangentially with respect to the ring of blades 5.

The foregoing features, as will readily be apparent, are in marked contrast to the more usual blower structure in which the air inlet is quite frequently arranged axially of the fan and in which the cross sectional area of the discharge opening is quite frequently much greater than that of the inlet opening. Before discussing the operation of the fan above described, it might be noted that prior fan or blower arrangements of the type just referred to are subject to a number of difficulties, especially where it is desired to produce a stream of air of relatively great width. With an axial air inlet the width of the fan must be very materially limited if a reasonably uniform air density is to be produced in the column of air discharged. Obviously, if a fan having an axial inlet is elongated to any material extent, the air stream discharged from the fan blades at the end of the rotor adjacent the inlet will be much greater than that discharged from the end of the rotor remote from the inlet and, similarly, even if inlets are provided at both ends of the fan, the density of the air stream is very irregular in the central as compared with the side portions thereof. This irregularity or non-uniformity in air density is of very great disadvantage in a number of types of equipment, for example, the types hereinbefore referred to (air conditioning equipment and pulverized fuel feeders).

I have found that a fan constructed in accordance with this invention at least in large part eliminates difficulties of the foregoing nature and further provides for highly efficient or low power operation in setting up a wide stream of air having uniform density throughout its width.

In operation, assuming, of course, that the fan rotor is driven in the direction indicated by the arrow in Figure 2, air enters the inlet opening 10 and approaches the fan rotor, in a region just above the casing part 9a, in a direction generally radially of the fan. Toward the upper part of the opening 10 the air approaches the rotor in a path more nearly approximating tangency and as the air is carried forward in the volute casing, certain volumes or portions thereof are apparently successively or alternately forced into the spaces between adjacent fan blades and discharged tangentially therefrom. This action continues as the volute passage becomes of decreasing cross sectional dimension under the influence, of course, of the relatively high rotational speed of the fan, up to a point adjacent the discharge or outlet opening 11. At this time, of course, a large proportion of the air has been forced into the spaces between the blades 5 and as these pockets pass the discharge opening, the air is propelled or thrown into the conduit 12. As a result, the pressure in the pockets between the blades is lowered considerably and this reduced or negative pressure condition is maintained by virtue of the immediate closure of the pockets by the casing part 9a which, as hereinbefore brought out, is disposed very close to the fan periphery and which, although of relatively small arcuate dimension is preferably of width slightly greater than the peripheral distance between adjacent fan blades (see Figure 2). With the fan rotating at a relatively high speed, and with the casing part 9a of relatively small arcuate dimension as just mentioned, the negative pressure condition set up in the manner just de-

scribed is carried beyond the upper edge of the wall 9a and this condition, of course, is that which produces the inflow or intake of air through the opening 10.

With regard to the belled or flared formation of the inlet passage, it might first be noted that currents of air normally tend to follow a curved rather than an angular path when changing their direction of flow, and by curving out the inlet so as to conform substantially with the curved path which the inflowing current of air at the sides of the fan casing would normally take, the capacity of the inlet is very materially increased and, in addition, local eddying and/or friction is substantially eliminated. As a result, although the inlet opening is curved outwardly to a somewhat greater width than the length of the fan, the air actually picked up or entrained by the fan blades is substantially uniform throughout the entire length of the fan rotor.

I claim:—

1. A fan or blower including a casing having end walls and a spiral wall between the end walls, and a fan rotor mounted in the casing with its periphery closely adjacent the inner or sharply curved portion of said spiral wall, the rotor including a plurality of blades spaced from each other peripherally thereof, the casing being provided with an inlet opening between the inner and outer portions of the spiral wall, and the casing further being provided with an outlet opening through said inner portion of the spiral wall, and the inlet and outlet openings being located sufficiently adjacent to each other on the same side of the rotor to retain the reduced pressure between the blades during movement thereof from the outlet to the inlet opening.

2. A fan or blower including a casing having end walls and a spiral wall between the end walls, and a fan rotor mounted in the casing with its periphery closely adjacent the inner or sharply curved portion of said spiral wall, the casing being provided with an inlet opening between the inner and outer portions of the spiral wall, and the casing further being provided with an outlet opening through said inner portion of the spiral wall, a discharge conduit communicating with the outlet opening and positioned with its outer wall substantially tangent to the periphery of the rotor.

3. A fan or blower including a casing having end walls and a spiral wall between the end walls, and a fan rotor mounted in the casing with its periphery closely adjacent the inner or sharply curved portion of said spiral wall, the rotor including a plurality of blades spaced from each other peripherally thereof, the casing being provided with an inlet opening between the inner and outer portions of the spiral wall, and the casing further being provided with an outlet opening through said inner portion of the spiral wall, the outlet opening having only a minor fraction of the total cross-sectional area of the inlet opening, and the inlet and outlet openings being located sufficiently adjacent to each other on the same side of the rotor to retain the reduced pressure between the blades during movement thereof from the outlet to the inlet opening.

4. A fan or blower including a casing having end walls and a spiral wall between the end walls, and a fan rotor mounted in the casing with its periphery closely adjacent the inner or sharply curved portion of said spiral wall, the fan rotor including a plurality of blades spaced from each

other peripherally of the rotor, the casing being provided with an inlet opening between the inner and outer portions of the spiral wall, and the casing further being provided with an outlet opening through said inner portion of the spiral wall, the said inlet and outlet openings being positioned toward the same side of the fan rotor and being spaced from each other a distance slightly greater than the distance between adjacent blades of the rotor.

5. A fan or blower including a casing having end walls and a spiral wall between the end walls, and a fan rotor mounted in the casing with its periphery closely adjacent the inner or sharply curved portion of said spiral wall, the rotor including a plurality of blades spaced from each other peripherally thereof, the casing being provided with an inlet opening between the inner and outer portions of the spiral wall, the casing further being provided with an outlet opening through said inner portion of the spiral wall, and the said inlet opening being at least as large in a direction axially of the fan rotor as the axial dimension of said rotor, and the inlet and outlet openings being located sufficiently adjacent to each other on the same side of the rotor to retain the reduced pressure between the blades during movement thereof from the outlet to the inlet opening.

6. A fan or blower including a casing having end walls and a spiral wall between the end walls,

and a fan rotor mounted in the casing with its periphery closely adjacent the inner or sharply curved portion of said spiral wall, the rotor including a plurality of blades spaced from each other peripherally thereof, the casing being provided with an inlet opening between the inner and outer portions of the spiral wall, the casing further being provided with an outlet opening through said inner portion of the spiral wall, and the said inlet and outlet openings being at least as large in a direction axially of the fan rotor as the axial dimension of said rotor, and the inlet and outlet openings being located sufficiently adjacent to each other on the same side of the rotor to retain the reduced pressure between the blades during movement thereof from the outlet to the inlet opening.

7. A fan or blower including a multi-bladed fan rotor, a spiral casing wall surrounding the rotor and positioned with the inner portion of the spiral adjacent to the periphery of the rotor, the casing having inlet opening between the inner and outer portions of the spiral wall, and the spiral wall being apertured in its inner portion to provide an outlet opening from the casing, the inlet and outlet openings being positioned sufficiently adjacent to each other to retain reduced pressure between blades of the rotor during movement thereof from the outlet opening to the inlet opening.

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