

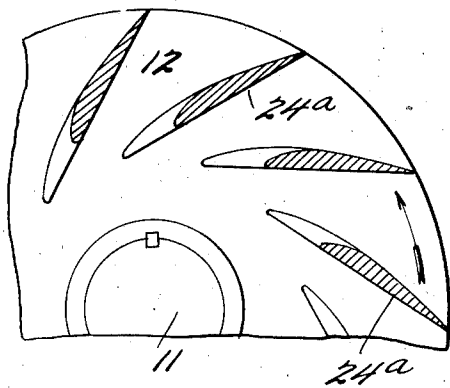
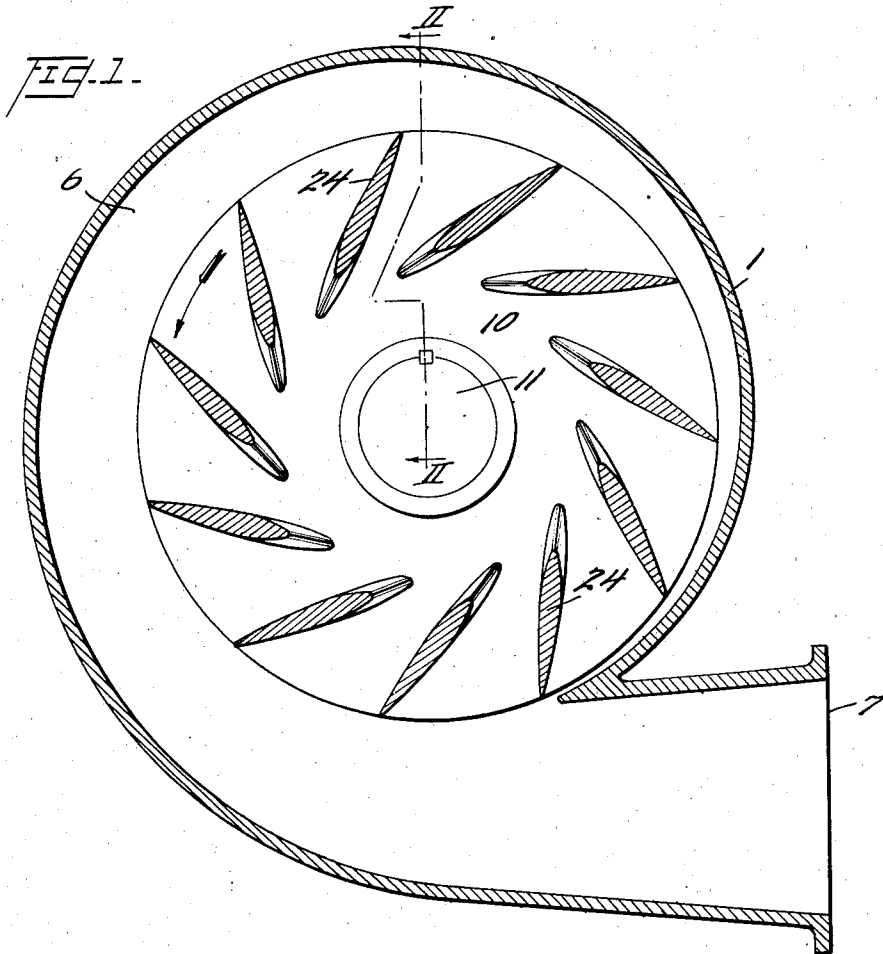
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J. FÜLLEMANN
IMPELLER FOR BLOWERS

2,285,266

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2 Sheets-Sheet 1



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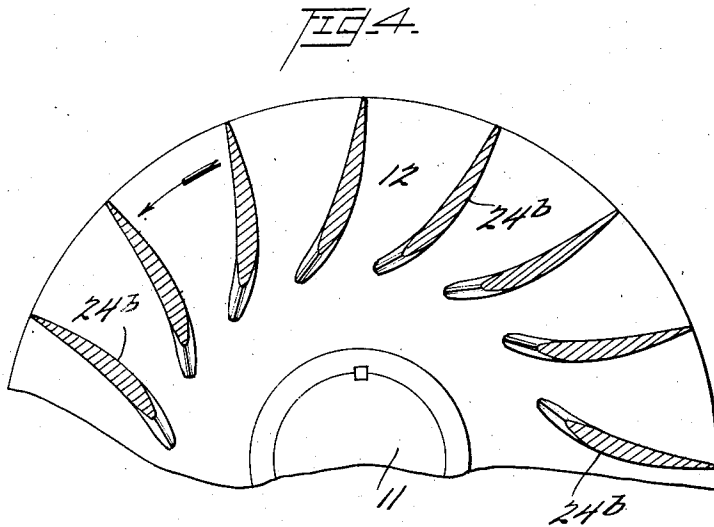
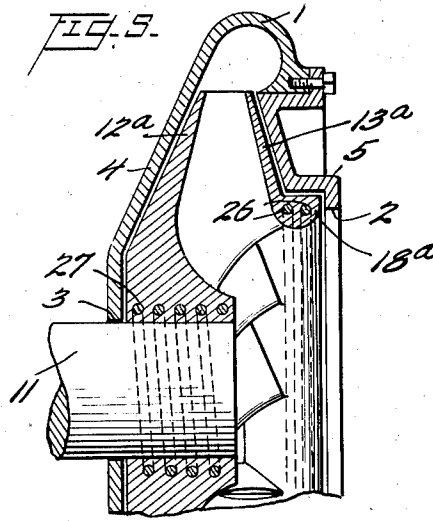
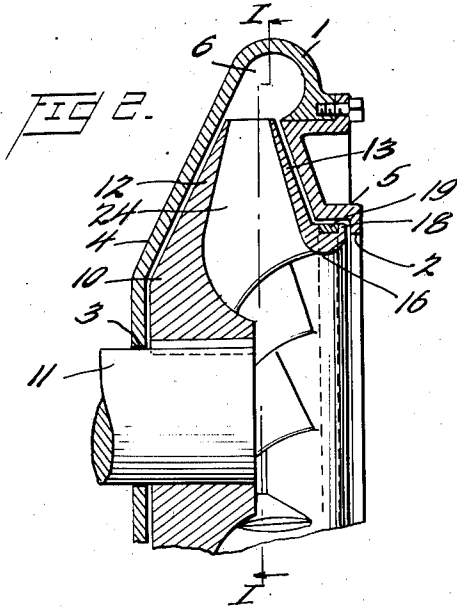
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IMPELLER FOR BLOWERS

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4 Claims. (Cl. 230—134)

This invention relates to improvements in impellers for rotary gas blowers and particularly to impellers of the "closed" type, that is, impellers in which vanes which extend in a generally radial direction are closed at their sides by discs, so that passages are formed by the vanes and discs which are open only at their inner and outer ends.

An object of this invention is to provide an impeller of the closed type adapted to be formed with the vanes and side-face discs in one single piece, for instance by a casting operation.

A further object of this invention is to provide vanes having fluid foil shape in cross section for the sake of efficiency in operation and having thick middle portions for facilitating and enabling the flow of molten metal to pass through the corresponding spaces in the mold in the casting operation without solidifying prematurely and thereby to reach all parts of the mold and form perfect castings.

A still further object of this invention is to provide impellers of this kind with vanes which are outwardly straight or, if curved at all, of such slight curvature that the side surfaces, due to their fluid foil shape, will be straight or slightly convex or will have no strongly concave parts, considered in the outward direction of extent of the vanes; whereby the finishing, smoothing or polishing of said surfaces can be performed more expeditiously by hand or even by machine than if the said surfaces were strongly concave. This feature is particularly desirable in an impeller cast in one piece because it is very difficult to smooth the vane surfaces, which operation could be performed rather simply if one of the side rings were formed separately and attached afterward.

Still another object of this invention is to provide a gas impeller with vanes having sufficient thickness at the center portion to ensure reliable casting and at the same time having forward, that is, inner, edges which are thin and properly rounded to give good aerodynamic efficiency and to have a good effect for noise (whistling) reduction.

A further object of this invention is to provide an impeller having substantially outwardly straight vanes free of strongly concave surfaces set at a forwardly inclined angle so that the general planes thereof are tangent to the surface of a cylinder coaxial and concentric with the axis of rotation of the impeller, whereby improvement in pressure relative to the circumferential speed of the impeller is attained over the ordinary backwardly curved vanes.

Another object of this invention is to provide a cast impeller for gas blowers which is formed in the greater part of light-weight metal adapted to operate at high speeds without the generation of excessively powerful centrifugal forces, and reinforced at certain critical points, preferably located relatively close to the axis of rotation by bands or particularly strong metal resistant to the centrifugal forces, said reinforcements being made integral with the other material in the casting operation and having surfaces which face inwardly toward the axis of rotation and are engaged by the light-weight metal. The reinforcements, usually being of heavier weight material than the rest of the impeller, are located as close to the axis of rotation as possible in order to reduce the centrifugal force of the heavier metal in operation.

The invention is illustrated in the accompanying drawings showing several embodiments of the invention and in which

Fig. 1 is a sectional view of a blower taken on the section line I—I of Fig. 2 in a plane transverse to the axis of rotation, the parts not particularly related to the present improvements being shown in broken lines;

Fig. 2 is an axial sectional view of part of the impeller taken on the line II—II of Fig. 1;

Fig. 3 is a transverse sectional view similar to Fig. 1 of an impeller having vanes of different cross-sectional shape, the other parts of the blower being omitted;

Fig. 4 is a transverse sectional view similar to Fig. 3 of an impeller having vanes of still different cross-sectional shape; and

Fig. 5 is an axial sectional view similar to Fig. 2 of part of an impeller showing a different form of reinforcement.

In the drawings, numeral 1 indicates a blower casing of the general form of a volute. This casing comprises no part of the present invention and is shown only for illustrating the organization in which the impeller is to be used. The casing has a gas inlet opening 2 in one side, an opening 3 for the impeller driving shaft at the other side, walls 4 and 5 extending outwardly along the sides of the impeller, and a spiral, volute-shaped gas conduit 6 of progressively enlarging size toward an outlet 7.

Within the blower casing 1 (Fig. 1) is mounted a rotary impeller 10 mounted on driving shaft 11. The impeller is of the type generally known as "closed." By this is meant that both sides of the gas passages formed between the impeller vanes are closed by disc-like plates 12 and 13 respec-

tively. The plate 12 has a hub portion 15 into or through which driving shaft 11 extends, and plate 13 has a large central opening 16 which serves as an entrance for the gas, plate 13 being therefore of ring shape. It is also to be observed that the inner periphery of ring-shaped disc 13 is axially thickened so as to extend more or less abruptly beyond its side walls, and this enlarged flange-like portion 18 is provided with a reinforcing band 19 of a relatively heavy metal of high tensile strength and modulus of elasticity, for instance, steel, cast in the light-weight metal of the flange to assist in resisting deformation of the impeller under the influence of the strong forces created by centrifugal action when the impeller rotates at high speed. The impeller may be cast of a light-weight aluminum alloy for minimizing the centrifugal force and weight involved, the reinforcing being initially placed in position in the mold before pouring.

Between the two discs 12 and 13 extend a plurality of flat vanes 24 cast integrally with said discs. The shape and arrangement of these vanes are among the principal features of the present improvements. As shown in Figs. 1, 3 and 5, these vanes 24, 24a and 24b are of fluid foil cross section considered on a section plane extending transversely to the axis of rotation of the impeller. In the embodiment shown in Fig. 1, the central axes of the vanes are straight and the vanes are of double fluid foil shape, that is, both surfaces are curved in conformity of fluid foils. The principal characteristics of this shape are that the inner edges are comparatively thin and are smoothly rounded off, the central widths are comparatively great while the outer edges are relatively thin, preferably even thinner than the inner edges, and the intermediate surfaces gradually pass over into one another without abrupt changes of direction. The purposes of the fluid foil cross section and the roundness of the inner and outer edges are to improve the aerodynamic efficiency of the impeller, reduce the resistance of the air flow, and minimize the whistling noise incident to operation of such apparatus at high rotary speeds.

The vanes are preferably arranged between the discs at angles inclined forwardly with respect to the respective radial planes, that is, the vanes lie in planes which would extend tangent to a cylinder coaxial and concentric with the axis of revolution. This arrangement materially improves the aerodynamic efficiency in operation. The relatively thick central sections of the vanes enable the impeller to be cast with the two discs and vanes all in one piece, the large flow area of the thick central portions of the vanes facilitating flow of the molten metal to all parts of the vanes and between the discs without the danger of imperfections occurring from premature chilling and solidifying of the metal.

The cross-sectional shape of the vanes may be altered to some extent, for instance, as indicated in Fig. 3, in which one side of the vanes is substantially flat while the other side is relatively more strongly convex than in Fig. 1. However, the important features of the shape, rounded inner and outer edges, relatively thick central portions providing fluid foil section, and the avoidance of strong concavity at any point are maintained. This latter feature, avoidance of strong concavity, enables the surfaces of the vanes to be smoothed and possibly polished by simple hand operations, whereas if strongly concave surfaces were formed, considerable difficulty would be en-

countered in finishing the concave surfaces either by hand or machine, and therefore would render the production of the impellers by integral casting a very difficult or impractical matter.

A further embodiment of the shape of the vanes is shown in Fig. 4 in which the vanes 24b are formed as double fluid foils but about curved surfaces whereby the forward surfaces are substantially flat or only slightly concave while the after surfaces are of stronger convexity. In this case, also, the important features of the shape of the vanes are adhered to, that is, the thin, rounded inner and outer edges, the relatively thick central portions, the fluid foil shape, and the avoidance of strongly concave surfaces. The curvature of the curved surfaces about which the vanes are formed is preferably such that their outer edge portions extend approximately or exactly parallel or coincident with the respective radii R of the impeller axis.

Fig. 5 illustrates another embodiment of reinforcement 26 for the flange 18a of disc 13a, and also in this embodiment the hub 15a of disc 12a is provided with a similar reinforcement ring or coil 27. The reinforcement members 26 and 27 may be round bands of steel entirely embedded in the light weight metal by casting or may be helical springs.

By forming the impeller according to the present invention, it is an entirely practical matter to cast it in one casting operation, particularly by reason of the large flow areas of the central portions of the vanes, and to finish or polish the vanes and other parts by simple operations without such difficulties as would arise if strongly concave surfaces were formed on the vanes, while at the same time, the thickness of the vanes does not impair the aerodynamic efficiency of the blower; but, on the contrary, the fluid foil section and forward pitch of the vanes provide efficiency unsurpassed even by very thin vanes which are entirely impractical for casting, and, furthermore, the shape of the vanes is such as to minimize the whistling noise incident to high-speed operation.

I claim:

1. A rotary impeller of the closed type for centrifugal gas blowers comprising a plurality of impeller vanes extending generally outwardly from the axis of rotation of the impeller and angularly spaced apart from each other, a pair of discs closing the sides of the spaces between the vanes so that only the inner and outer ends of the gas passages provided by said spaces are open, said discs and vanes being formed of a single piece of metal, the material of said vanes and discs being light-weight metal to reduce centrifugal force, one of said discs having a relatively wide hub portion, and a reinforcement band extending around said hub located entirely within the metal of said hub portion and integrally united therewith, said band being of a heavier, stronger metal than the rest of the disc.
2. A rotary impeller of the closed type for centrifugal gas blowers comprising a plurality of impeller vanes extending generally outwardly from the axis of rotation of the impeller and angularly spaced apart from each other, a pair of discs closing the sides of the spaces between the vanes so that only the inner and outer ends of the gas passages provided by said spaces are open, the material of said vanes and discs being light-weight metal to reduce centrifugal force, one of said discs having a relatively wide hub portion, a substantially ring-shaped reinforce-

ment band extending around said hub located entirely within the metal of said hub portion, said band being of a heavier, stronger metal than the rest of the disc, and the other of said discs having an inner portion thicker than its outer portion and being provided with a substantially ring-shaped reinforcing band of strong metal located entirely within said thicker inner portion.

3. A rotary impeller of the closed type for centrifugal gas blowers comprising a plurality of impeller vanes extending generally outwardly from the axis of rotation of the impeller and angularly spaced apart from each other, a pair of discs closing the sides of the spaces between the vanes so that only the inner and outer ends of the gas passages provided by said spaces are open, one of said discs having a comparatively thick central hub portion, a spring steel coil integrally embedded in said hub portion entirely within the metal of said hub, the other disc having a thickened inner edge portion, and a ring-like member of heavy strong metal entirely embedded in and integrally united with said edge

portion and extending entirely around said inner edge.

5 4. A rotary impeller of the closed type for centrifugal gas blowers comprising a plurality of impeller vanes extending generally outwardly from the axis of rotation of the impeller and angularly spaced apart from each other, a pair of discs closing the sides of the spaces between the vanes so that only the inner and outer ends of the gas passages provided by said spaces are open, said discs and vanes being formed of a single piece of metal, said vanes being substantially straight in the inward-outward direction so as to be free of concave surfaces, the material of said vanes and discs being light-weight metal to reduce centrifugal force, one of said discs having a relatively wide hub portion, and a reinforcement band extending around said hub located entirely within the metal of said hub portion and integrally united therewith, said band being of a heavier, stronger metal than the rest of the disc.

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