J. E. GREENAWALT.

FAN BLOWER.

APPLICATION FILED NOV. 8, 1916.

1,261,807.

Patented Apr. 9, 1918.

4 SHEETS—SHEET 1.

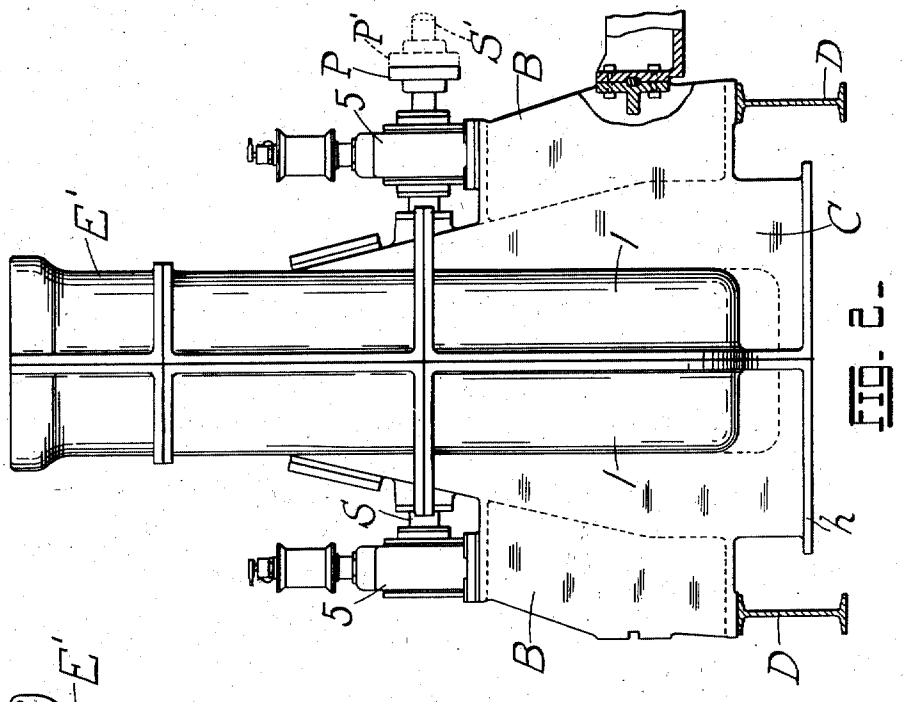


FIG. 2.

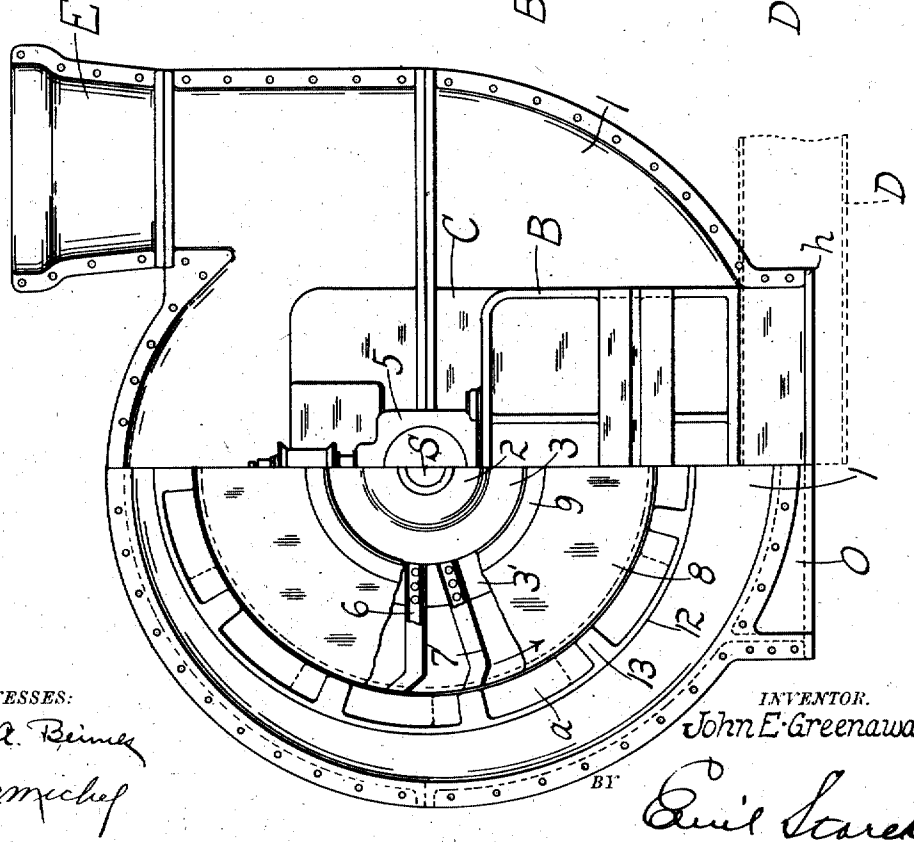


FIG. 1.

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4 SHEETS—SHEET 2.

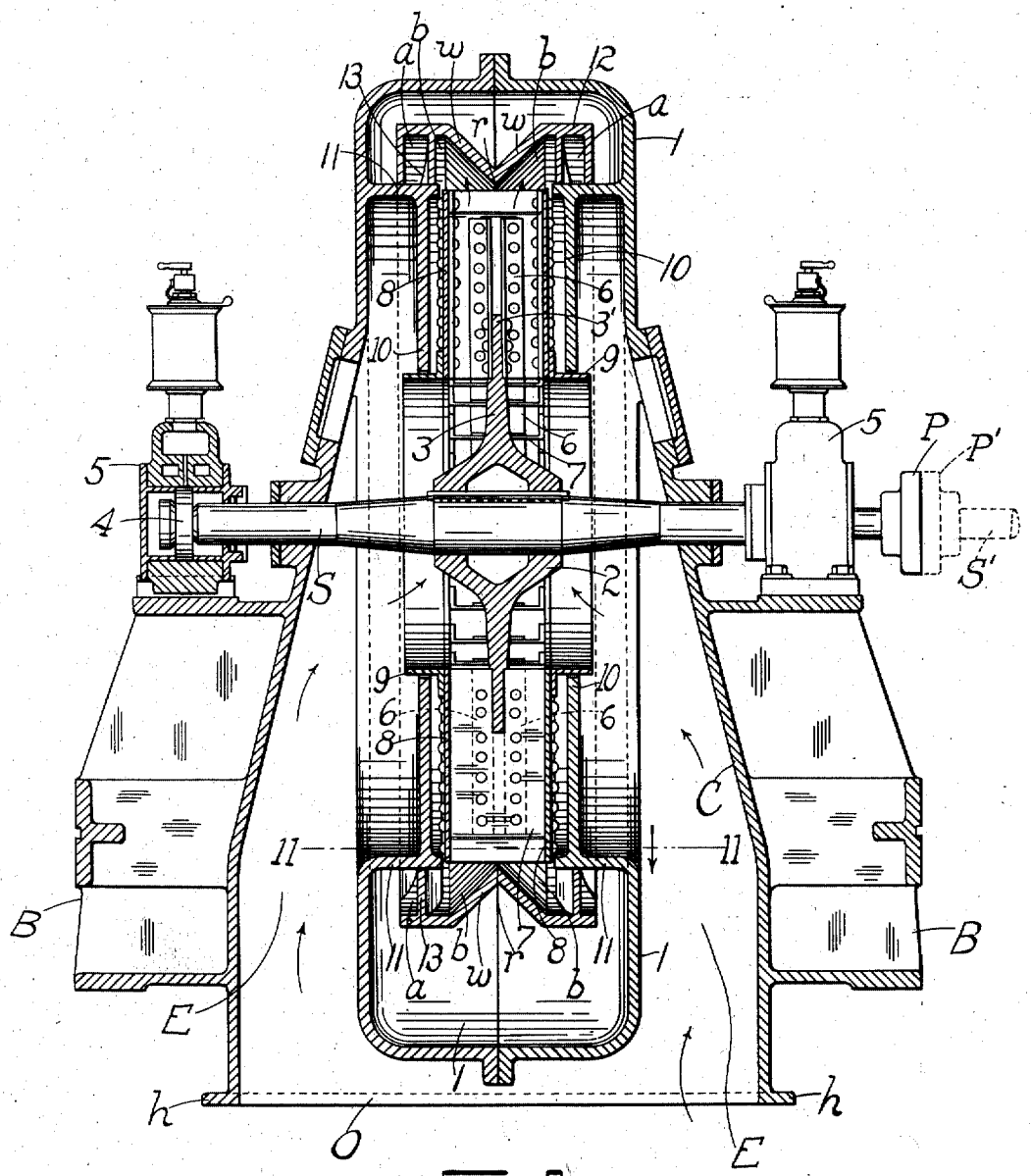


FIG. 3.

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4 SHEETS—SHEET 3.

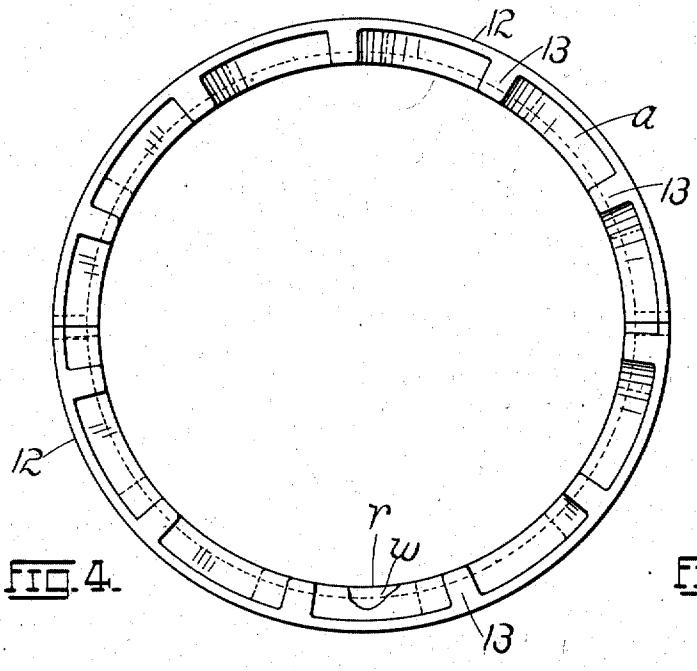


FIG. 4.

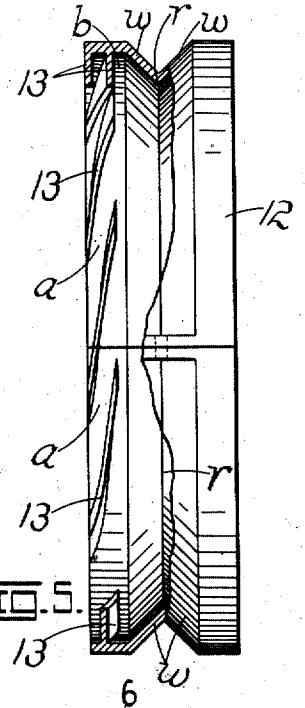


FIG. 5.

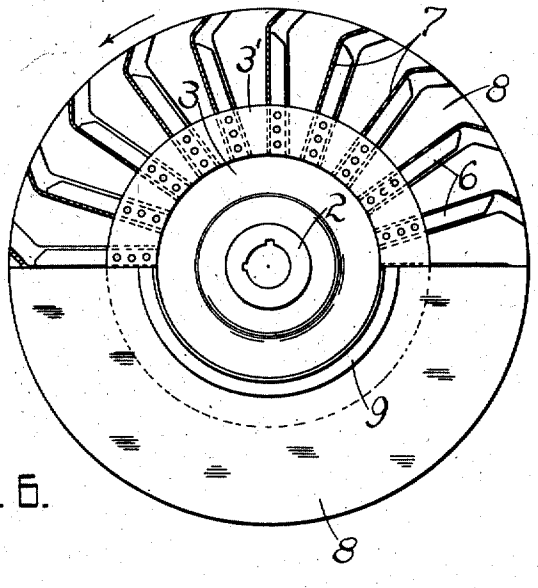


FIG. 6.

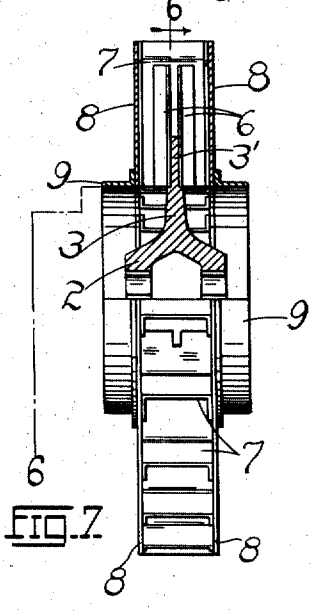


FIG. 7.

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4 SHEETS—SHEET 4.

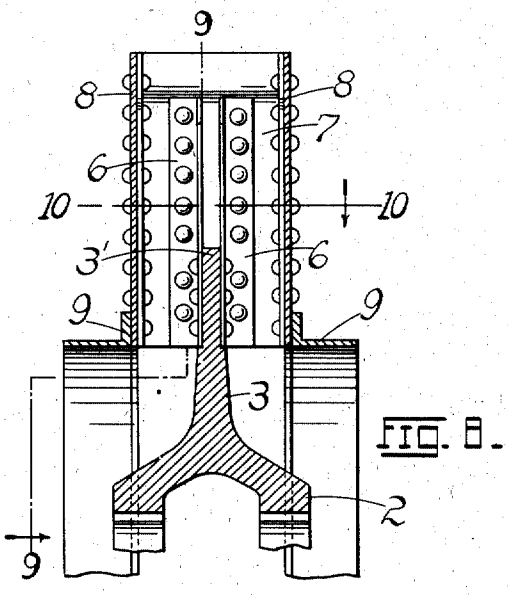


FIG. 8.

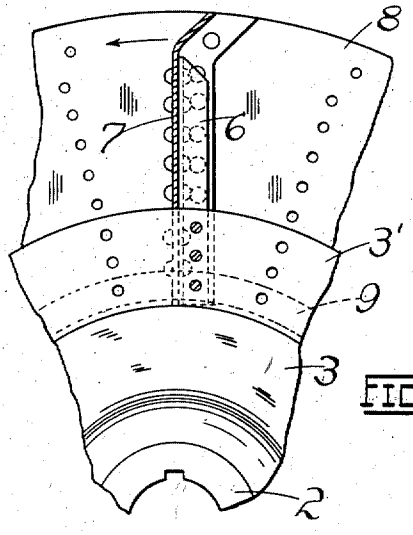


FIG. 9.

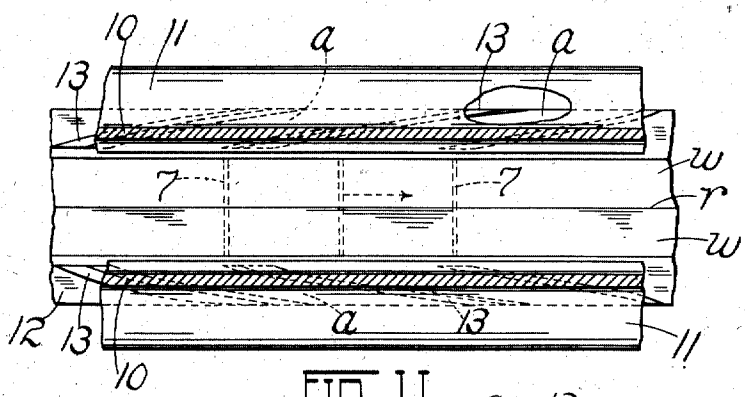


FIG. 11.

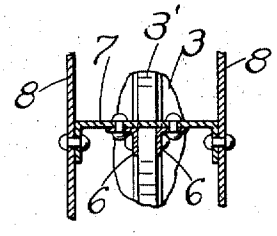


FIG. 10.

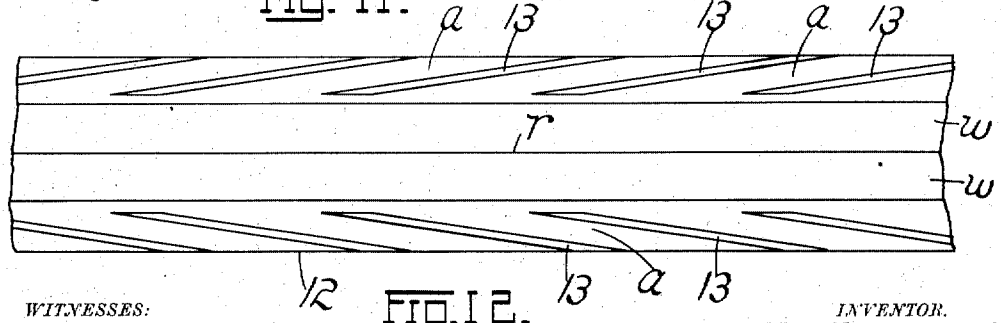


FIG. 12.

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UNITED STATES PATENT OFFICE.

JOHN E. GREENAWALT, OF NEW YORK, N. Y.

FAN-BLOWER.

1,261,807. Specification of Letters Patent. Patented Apr. 9, 1918.

Application filed November 8, 1916. Serial No. 130,176.

To all whom it may concern:

Be it known that I, JOHN E. GREENAWALT, a citizen of the United States, residing at New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Fan-Blowers, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming a part hereof.

My invention has relation to improvements in turbine fans and blowers; and it consists in the novel features of construction more fully set forth in the specification and pointed out in the claims.

The present invention is directed to turbine fans, compressors, blowers, or pumps of the centrifugal type for compressing or moving fluids such as air and gases, the object of the invention being to provide effective means for converting the kinetic or velocity energy of the fluid as it leaves the impeller into potential energy in the form of static pressure. In its generic contemplation this energy converter assumes the form of a diffusion ring interposed between the impeller and scroll chamber, said ring operating to conduct the fluid from the impeller to the sides of said chamber. The diffusion ring is not claimed broadly herein, the generic idea already forming the subject-matter of a previous application for patent, filed May 12, 1915, Serial Number 27,574; and in so far as the present invention may be directed to the feature of the diffusion ring, it is to be understood as being limited to the specific details by which said ring is characterized. The present invention is however not limited to the structural details of the diffusion ring, but contemplates in addition the inclusion of all such features as are not part and parcel of the ring, said features in cooperation with the ring resulting in the present instance in an apparatus having a maximum efficiency; one which is comparatively free from objectionable noise while running; one which is simple, strong and durable, uniform in action, and one possessing further and other advantages better apparent from the following detailed description of the invention in connection with the accompanying drawings, in which—

Figure 1 represents a combined outside and inside elevation of the outer casing of the fan or blower, showing one-half of the diffusion ring and impeller in side elevation, parts of the impeller being broken away; Fig. 2 is an end elevation of the apparatus; Fig. 3 is an enlarged vertical middle transverse section, parts being left in elevation; Fig. 4 is a side view of the annular diffusion member or ring detached with parts broken away; Fig. 5 is an outer face view of the diffusion ring, parts being broken away; Fig. 6 is a combined side elevation and middle longitudinal section of the rotary impeller on the zig-zag line 6—6 of Fig. 7; Fig. 7 is a half face elevation and half radial transverse section of the impeller detached; Fig. 8 is an enlarged radial transverse section through the impeller showing the detailed construction of one of the blades; Fig. 9 is a section parallel to the plane of rotation of the impeller on the zig-zag line 9—9 of Fig. 8; Fig. 10 is a cross-sectional detail on the line 10—10 of Fig. 8; Fig. 11 is a sectional detail through the inner side walls of the collecting scroll on the line 11—11 of Fig. 3, with parts broken away; and Fig. 12 is a development of the diffusion ring.

Referring to the drawings, C represents the outer casing of the fan (or blower) the sides of the casing being made sloping or inclined as shown, and provided on the outside with brackets or overhanging portions B by which the casing may be supported on suitable structural members D as shown. The casing is made in two sections separable along a central vertical longitudinal plane, each section being integral with the corresponding section of the collecting scroll 1, which projects a suitable distance above the upper terminals of the inclined sides of the casing, and extends downwardly between said sides to a point near the open bottom of the casing. By this arrangement there is formed between the collecting scroll and each of the inclined sides of the outer casing, a receiving chamber E into which the air, gas, or other fluid is drawn through the bottom intake opening O by the action of the rotary impeller from which the currents are delivered into the chamber of the collecting scroll, said scroll being provided with the usual eduction leg E′ as well understood in the art. In the present embodiment of my invention the impeller comprises a central hub 2 formed with a disk portion 3, and keyed to the shaft S, the latter passing through the sides of the

casing and supported by suitable bearings 4 in the housings 5 mounted on the brackets B, one end of the shaft being provided with a coupling member P which is secured to a corresponding member P′ of any motor or power shaft S′. To the opposite faces of the outer reduced portion 3′ of the disk are riveted angle plates 6, the transverse legs of which are riveted to the webs of the channel plates 7, which may be considered as the blades of the impeller. The outer free ends of the blades are bent rearward or in a direction opposite to that in which the impeller is rotated when the fan is in operation. The side flanges or wings of the blades 7 are in turn secured to the side plates or disks 8, the inner ends of said flanges and the inner portions of the plates being in turn jointly secured to the radially disposed legs of the side angle rings 9 as shown. The horizontal legs of the rings 9 project outwardly slightly beyond the inner parallel side walls 10 leading from the annular ledges or seats 11 of the collecting scroll, the said legs passing loosely through said walls, and the blades 7 revolving freely between them. And desired number of blades may of course be provided depending on the size and capacity of the fan. The manner of constructing the impeller and the blades thereof here described need not be adhered to, and any other suitable mechanical construction is contemplated under my present invention.

Resting on the annular ledges 11 within the scroll chamber is a diffusion ring 12 the medial portion of which is in the form of two truncated conical walls w, w, with the narrow ends intersecting at the center of the ring, the ridge r formed by the meeting of said walls being disposed close to the peripheral sweep of the blades of the impeller. The peripheral walls of the ring 12 on either side of the central reëntrant angular portion formed by the walls w, w, are substantially cylindrical, the inner faces of said cylindrical portions being provided with a series of parallel ribs or vanes 13 spaced apart and inclined at a slight angle to the medial ridge r of the ring (or any line parallel thereto) and extending diagonally across the major portions of the widths of said faces (Fig. 5) the ribs directly engaging the ledges 11. The inner and outer ends of successive ribs overlap whereby suitable spiral eduction channels or passages a are formed (with the ledges 11) between the ribs, the inner terminals or intakes of the several channels communicating with the chambers b, b, formed in the diffusion ring between the walls w, w, ribs 13 and periphery of the impeller. These chambers b, b, will hereinafter be designated as "whirlpool chambers," the currents as they leave the periphery of the impeller being initially projected into said chambers and then educted laterally therefrom by the channels or conduits a into the sides of the scroll chamber. While in the present embodiment of my invention there result two distinct whirlpool chambers by reason of the central reëntrant angle formed by the walls w, w, it is obvious that by having a ring without the reëntrant formation referred to, we would have a single whirlpool chamber, substantially U-shaped in cross-section instead of two chambers each triangular in cross-section. In this connection I desire it to be understood that I do not wish to limit myself to any particular form of cross-section of diffusion ring, so long as the same offers a whirlpool chamber (or chambers) into which the impeller may initially project its currents before the latter are conducted into the scroll chamber. The walls of the whirlpool chamber (or chambers) should in practice be sufficiently distanced from the peripheral sweep of the impeller to reduce the noise of impact of the currents against said walls to a minimum. In practice I find that a cross-section of diffusion ring such as herein shown with two contiguous whirlpool chambers b, b, operates to reduce the impact and attendant noise to such an extent, that the fan even when running at a very high rate of speed, is comparatively noiseless.

The operation is substantially as follows: Rotation being imparted to the impeller in the direction indicated by the arrows in Figs. 1 and 6, the fluid (air, gas,) will be drawn through the opening O of the outer casing, into the chambers E, E, whence it will flow through the rings 9, 9, toward the opposite faces of the disk 3, the fluid thence following along the blades of the impeller by which it is projected at high velocity into the whirlpool chambers (or chamber) of the stationary diffusion ring 12. The velocity energy of the fluid thus projected into the whirlpool chambers is converted into a static pressure head in the passage of the fluid from the periphery of the impeller to the outlet of the scroll chamber, the channels a being so disposed as to cause an even diffusion of the fluid by a lateral movement thereof after leaving the whirlpool chambers, the fluid being finally discharged from the sides of the diffusion ring into the scroll chamber without material shock or impact, and without the formation of reacting eddies. It may be stated in passing, that in the operation of the blower the impeller is given a rotation in the direction indicated by the dotted arrow in Fig. 11, that is to say, the impeller should rotate in a direction toward the converging ends of the channels or ducts a (or toward the converging ends of the ribs 13), to properly direct the currents as they leave the whirlpool chambers, into and through said channels, the

fluid being finally discharged from the channels laterally into the sides of the scroll chamber. The apparatus as shown is used as an exhaust fan in ore sintering plants, a suitable casting (not shown) being bolted to the bottom flange *h* of the casing, the pipes leading from the sintering pan being bolted to this casting. Of course the apparatus may be used as a blower, in which event a suitable screen can be bolted to the flange *h* across the opening O to keep the dust out of the fan chamber. The design of apparatus here shown need not of course be adhered to whether used as an exhauster or blower, and the same may be changed to suit local conditions as will be quite apparent to the skilled mechanic.

The diffusion ring here shown (or its equivalent) is not restricted in its application to apparatus dealing with elastic fluids on the order of air or gases, that is to say apparatus such as fans, blowers, exhausters and the like, it being within the contemplation of my invention to utilize said ring in connection with centrifugal pumps operating on water, oil and other inelastic fluids or liquids; and I desire it to be understood that the diffusion ring may enter as an element in any apparatus either pneumatic or hydraulic where it can discharge the several functions or any of them attributed thereto in the present construction.

In diffusion rings constructed as here shown, the inclined walls *w*, *w*, meeting at the ridge *r* serve to initially direct the currents leaving the impeller, into the whirlpool chambers *b*, *b*, such direction being lateral of course, the conduits *a* subsequently completing the lateral diffusion by discharging the currents through the sides of the ring into the scroll chamber. It follows therefore that the lateral diffusion of the fluid begins the very moment it leaves the outer terminals of the impeller blades. Preferably, the diffusion ring is made in two sections with suitable provision for uniting the same as shown in Figs. 4 and 5, an expedient well understood in the art.

Having described my invention what I claim is:

1. In an apparatus of the character described, a diffusion member chamber to initially receive the currents delivered thereto, in combination with means for subsequently effecting a lateral diffusion of said currents.

2. In an apparatus of the character described, a diffusion ring chambered symmetrically about a medial line to initially receive the currents delivered thereto, in combination with means for subsequently effecting a lateral diffusion of said currents.

3. In an apparatus of the character described, the combination of a suitable impeller, a collecting scroll, a ring interposed between the impeller and scroll and chambered to receive the currents leaving the impeller, and means on the sides of the chamber for conducting the currents from the chamber to the scroll chamber.

4. In an apparatus of the character described, the combination of a suitable impeller, a collecting scroll, a ring interposed between the impeller and scroll and chambered symmetrically about a medial line to collect the currents leaving the impeller, and means on the ring for laterally diffusing the currents from the chambered portion thereof into the scroll chamber.

5. In an apparatus of the character described, a diffusion ring provided with an inner chamber divided into two contiguous sections disposed on opposite sides of a center line of the ring, and means leading from said chamber sections for conducting the currents therefrom through the sides of the ring.

6. In an apparatus of the character described, a diffusion ring formed with a central reëntrant angular formation, and means on the inside of the ring on either side of the reëntrant formation for laterally diffusing the currents accumulating at said formation.

7. In an apparatus of the character described, a cylindrical diffusion ring formed with a central reëntrant angular portion substantially V-shaped in cross-section, and ducts disposed on the inside of the ring on either side of the reëntrant portion, said ducts discharging through the sides of the ring.

8. In an apparatus of the character described, the combination of a suitable impeller, a collecting scroll, and a laterally diffusing member provided with a whirlpool chamber, interposed between the impeller and scroll for discharging the currents into the scroll chamber.

9. In an apparatus of the character described, a diffusion ring having a medial portion formed of two truncated cones with the narrow ends intersecting at the center of the ring, and cylindrical portions leading from the bases of the respective truncated cones, and suitable fluid eductors disposed on the inner faces of the cylindrical portions operating to discharge the fluid at the sides of the ring.

10. In an apparatus of the character described, the combination of a suitable impeller, a collecting scroll, a stationary whirlpool chamber maintained between the impeller and scroll chamber, and means for conducting the currents from the whirlpool chamber into the scroll chamber.

11. In an apparatus of the character described, the combination of a rotary impeller, a collecting scroll, a member surrounding the impeller and forming a whirlpool chamber at points beyond the periph-

ery of the impeller, and means for conducting the currents from the whirlpool chamber into the scroll chamber.

12. In an apparatus of the character described, the combination of a rotary impeller, a collecting scroll, a member surrounding the impeller and forming a whirlpool chamber for receiving the currents leaving the impeller, and means for laterally diffusing the currents from the whirlpool chamber into the scroll chamber.

13. In an apparatus of the character described, the combination of a rotary impeller, a collecting scroll, a whirlpool chamber maintained about the impeller and initially receiving the currents therefrom, suitable formations in the whirlpool chamber for directing the currents to the sides of the chamber, and means for conducting said laterally directed currents from the whirlpool chamber to the scroll chamber.

14. In an apparatus of the character described, the combination of a suitable impeller, a collecting scroll, and a diffusion ring interposed between said scroll and impeller, said ring being chambered symmetrically about a medial line for the whirlpooling of the currents delivered thereto by the impeller.

15. In an apparatus of the character described, the combination of a suitable impeller, a coöperating diffusion member provided with means for effecting an initial lateral diffusion of the fluid leaving the impeller, and independent means for completing said lateral diffusion.

16. In an apparatus of the character described, the combination of a suitable impeller, a coöperating diffusion ring provided with means for effecting an initial lateral diffusion of the fluid leaving the impeller, and independent means for completing said lateral diffusion.

In testimony whereof I affix my signature, in presence of two witnesses.

JOHN E. GREENAWALT.

Witnesses:
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LILLIAN FRIED.

Correction in Letters Patent No. 1,261,807.

It is hereby certified that in Letters Patent No. 1,261,807, granted April 9, 1918, upon the application of John E. Greenawalt, of New York, N. Y., for an improvement in "Fan-Blowers," an error appears in the printed specification requiring correction as follows: Page 3, line 52, claim 1, for the word "chamber" read *chambered;* and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 21st day of January A. D., 1919.

[SEAL.]

F. W. H. CLAY,
Acting Commissioner of Patents.

Cl. 253—192.