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L. WEIL

CENTRIFUGAL PUMP OR BLOWER

Filed April 1, 1922

Fig. 1.
1-1

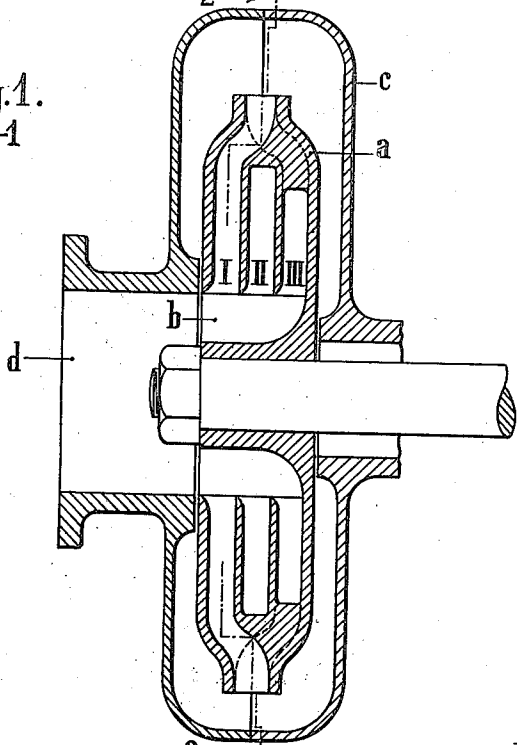
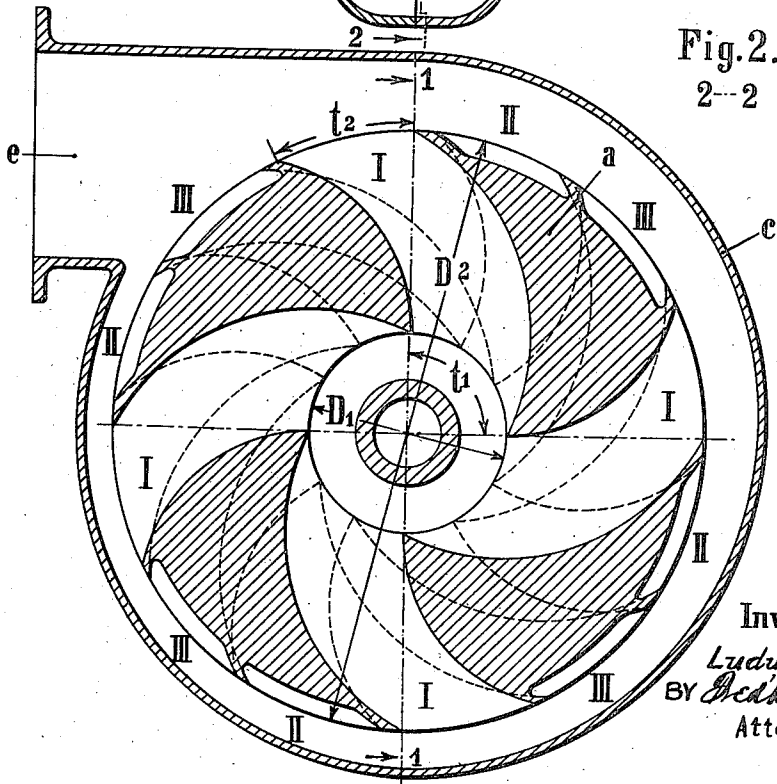


Fig. 2.
2-2



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UNITED STATES PATENT OFFICE.

LUDWIG WEIL, OF BIEBRICH-ON-THE-RHINE, GERMANY.

CENTRIFUGAL PUMP OR BLOWER.

Application filed April 1, 1922. Serial No. 548,682.

To all whom it may concern:

Be it known that I, LUDWIG WEIL, a citizen of Austria, and resident of Biebrich-on-the-Rhine, Prussia, Germany, have invented new and useful Improvements in Centrifugal Pumps or Blowers, of which the following is a full, clear, and exact specification.

My invention relates to improvements in centrifugal pumps or blowers, and the object of the improvements is to provide a pump or blower in which the fluid is uniformly discharged from the rotary member or fan, and in which dead spaces at the discharge of the fan and eddy currents are avoided so that the efficiency is increased.

In centrifugal pumps or blowers the medium (water, air, etc.) is moved by these liquids or gases being accelerated within the hollow spaces of the rotary member by the rapid rotation of the latter, and thus being moved in the direction of the circumference of said rotary member. Every acceleration of a body depends upon a power acting in the direction of movement, said power being supplied in the present case by the pressure of the blades or vanes of the rotary member on the fluid strata enclosed between these vanes. When the rotary member begins to rotate the fluid particles are moved by this pressure in the direction of the circumference and after their inertia has been overcome they are brought to the so-called centrifugal pressure which is equal to the pressure of the blades necessary for bringing these particles into movement, said pressure increasing proportionally to the square of the distance of the fluid particles from the axis of rotation. If the rotary member were closed at its outer circumference by a solid wall or the like it would behave as a fluid filled rotating drum in which each fluid particle continuously maintains the pressure to which it has been brought by the rotation, and its circumferential speed even if uniform rotation is continuously maintained. If, however, the fluid can issue from the rotary member at its outer circumference into a pressure channel or into a free space the phenomena are different. It is known that in fluids the pressure of each fluid particle is uniformly transmitted in all directions. Therefore, the fluid particles at the outer circumference of the rotary member produce a pressure also in an out-

ward direction, and as the counter-acting pressure in the pressure channel or the atmosphere is less than their own pressure they issue from the rotary member under the action of this pressure difference. Under the influence of the centrifugal pressure of the next inferior fluid stratum, this fluid stratum will fill the interstice produced within the outer ends of the blades by the issue of the outer fluid particles and this phenomenon will be transmitted correspondingly throughout the whole length of the channel between the blades, a real constant flow of the fluid admitted through the suction pipe being thus produced. Therefore, not only an increase of pressure by the centrifugal pressure and a speed in the direction of the circumference is imparted to the single fluid particles, but also a speed along the blades of the rotary member, the fluid particles entering the rotary member from inside being thus moved in an outward direction through said member.

Theoretically, all particles having the same distance from the axis of rotation and being located within the channels between the blades should have absolutely the same centrifugal pressure, circumferential speeds and speeds in the direction of said channels as they are all under the influence of the same forces, said influence being theoretically modified only radially but not circumferentially. Therefore, the fluid particles arranged on a circular line around the centre of rotation should move on their whole way through the channel to the blades in paths parallel to each other and to the curvation of the blade and the values of their pressure and speed should be identical.

Practically the phenomena are different, for the reason that there are certain resistances to the issue of the fluid particles at the outer circumference of the rotary member. These resistances are substantially eddy-currents caused by the measurable thickness of the blades of the rotary member or the diffuser which blades artificially narrow the section of flow, further by incorrect angles of inclination of the blade ends of the pressure casing walls etc. which cause local jamming and shocks in the fluid issuing from the rotary member. These resistances are overcome most rapidly and strongly by those fluid particles which issue immediately along the driving front sur-

face of the blade, these particles receiving the mechanically accelerated pressure action immediately from the solid blade surface, a certain favorable action being at the same time produced by a frictional action of the outer blade edge. The fluid particles issuing at a distance from the driving blade surface receive the pressure and speed, causing them to issue from the rotary member by the intermediary of the particles flowing between the first named particles and the driving blade surface. These intermediate particles have lost part of their original energy in consequence of the resistances above referred to and therefore can transmit the issuing force only at a decreasing rate. In the current obtained, therefore, the particles flowing next to the driving blade surfaces will have a maximum pressure and speed energy progressively decreasing with the increased distance of the particle under consideration from the driving surface.

Therefore the single particles arranged on a common circular line around the centre of rotation will no longer flow in parallel paths nor have the same pressure or speed energy as required by theory, and this irregularity is continued at a long distance into the channel between the blades and considerably diminishes the rate of energy transmission from the rotary member to the fluid. Of course, this loss of energy is proportional to the circumferential width of the channel outlet and it is increased the greater this width is in proportion to the width of the inlet end of the channel.

In the usual rotary member of centrifugal pumps or blowers this proportion is very great in accordance with the proportion of the diameters at the inlet and outlet ends of the channels between the blades. In most of the cases the proportion is from 2:1 to 3:1 and consequently it is not possible to obtain a maximum of energy transmission.

In my improved blower or pump these objections are obviated by constructing the rotary member in the manner to be described hereinafter.

In order that my invention be more clearly understood an example embodying the same has been shown in the accompanying drawing, in which the same reference characters have been used in all the views to indicate corresponding parts. In said drawing,

Fig. 1, is a vertical section of the pump or blower taken on the line 1—1 of Fig. 2, and Fig. 2, is a vertical section taken on the line 2—2 of Fig. 1

In the example shown in the figures the pump or blower comprises a casing *c* having an axial inlet opening *d* and a tangential outlet opening *e*. The fan or rotary member *a* is formed with several sets of passages, the passages I, II, and III of each set being disposed at the inlet side one behind the

other in the direction of the axis of the pump or blower, and at the discharge side one behind the other in the direction of the circumference. In the example shown in the figures the circumferential widths t_1 and t_2 of the passages I, II and III at the inlet and discharge are alike. The diameters D_1 and D_2 at the inlet and discharge being at the ratio of 1:3, three passages are necessary in order that with the same cross-sectional area in each passage the fluid is discharged in a continuous flow all around the circumference of the rotary member. If it is desired to reduce the cross-sectional area from the inlet end to the discharge, or if the ratio of the diameters is different from the one shown in the figures, the number of the passages must be changed accordingly. However, in no case the passages should flare outwardly, for the reasons stated above. In the preferred form shown in the figures the passages I, II, and III are symmetrical with their inlet ends to the medial plane of the rotary member.

By constructing the rotary member in the manner described, the flow of the fluid through the passages is uniform, and the fluid is discharged in a continuous jet extending all around the circumference of the member.

While in describing the invention reference has been made to a particular example embodying the same I wish it to be understood that my invention is not limited to the construction shown in the drawings, and that various changes may be made in the general arrangement of the apparatus and the construction of its parts without departing from the invention.

What I claim is:—

1. In a centrifugal pump or blower, the combination, with a casing having an axial inlet and a circumferential discharge, of a rotary member within said casing formed between said inlet and discharge with sets of passages, the passages of each set being disposed at the inlet end one behind the other in the direction of the axis of the member and at the outlet end one behind the other in the direction of the circumference of the member.

2. In a centrifugal pump or blower, the combination, with a casing having an axial inlet and a circumferential discharge, of a rotary member within said casing formed between said inlet and discharge with sets of passages, the passages of each set being disposed at the inlet end one behind the other in the direction of the axis of the member and symmetrically relatively to the medial plane thereof and at the outlet end one behind the other in the direction of the circumference of the member.

3. In a centrifugal pump or blower, the combination, with a casing having an axial

inlet and a circumferential discharge, of a rotary member within said casing formed between said inlet and discharge with sets of passages of uniform cross-sectional area throughout their length, the passages of each set being disposed at the inlet end one behind the other in the direction of the axis of the member and at the outlet end one behind the other in the direction of the circumference of the member. 10

In testimony whereof I have affixed my signature.

LUDWIG WEIL.