C. H. SMOOT.

CENTRIFUGAL BLOWER WHEEL.

APPLICATION FILED JULY 13, 1911.

1,052,291. Patented Feb. 4, 1913.

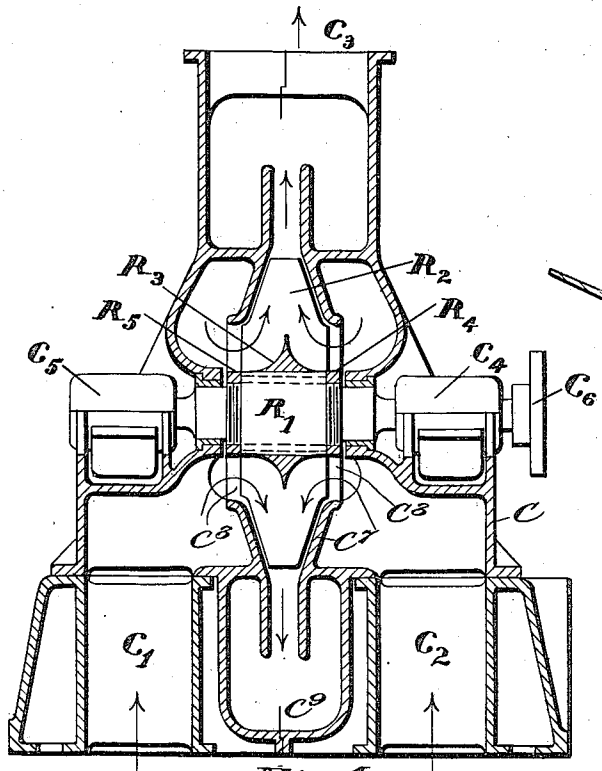

Fig. 1

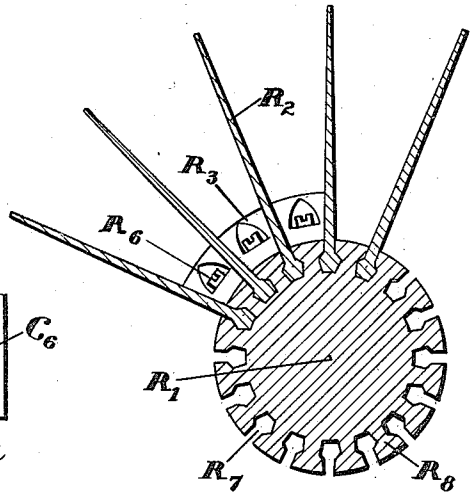

Fig. 2

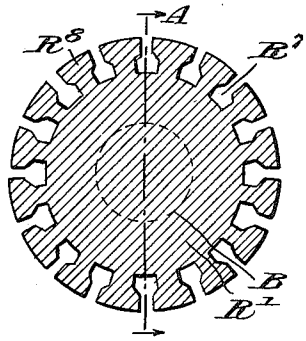

Fig. 5.

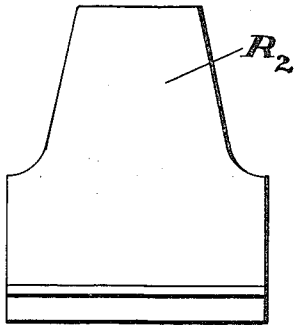

Fig. 3

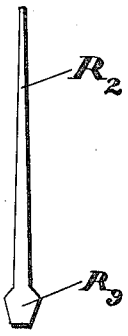

Fig. 4

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CENTRIFUGAL BLOWER-WHEEL.

1,052,291. Specification of Letters Patent. Patented Feb. 4, 1913.

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To all whom it may concern:

Be it known that I, CHARLES HEAD SMOOT, a citizen of the United States, residing in New York, county of New York, and State of New York, have invented certain new and useful Improvements in Centrifugal Blower-Wheels, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawing, forming part of this specification.

My present invention relates to the construction of the rotary element of a centrifugal pump or compressor, and the primary object of the invention is the production of such a rotary element especially adapted for operation at very high speeds. Heretofore, such a rotary element has comprised as essential elements a shaft, radially extending blades or vanes, and a hub separate from but surrounding the shaft and serving to connect the blades or vanes to the shaft. With my present invention I dispense with the hub as an element separate from the shaft and secure the blades in axial slots formed in the shaft proper. The latter may advantageously be enlarged in circumference at what I may call the hub portion where the axial blade receiving slots are formed.

The rotary element constructed in accordance with the present invention is inherently capable of safe operation at higher speeds than, and possesses marked advantages over, the construction with separate hub and shaft elements heretofore employed, as is hereinafter explained.

The various features of novelty which characterize my invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, however, and the advantages possessed by it, reference should be had to the accompanying drawings and descriptive matter in which I have illustrated and described forms in which my invention may be embodied.

Of the drawings, Figure 1 is a horizontal sectional elevation of a compressor having a single wheel with two inlets for the fluid to be compressed. Fig. 2 is a transverse section through the shaft, illustrating the manner in which the blades are attached to the shaft. Figs. 3 and 4 are side and end elevations, respectively, of one of the blades, and Fig. 5 is a section of the shaft taken similarly to Fig. 2 but on a larger scale, and with all of the blades removed.

In the drawings, C, represents the stationary casing or framework element of the compressor.

C_1 and C_2 represent the ducts by which the fluid to be compressed enters the compressor, the fluid passing from these ducts into the wheel chamber C_7 through the central openings C_8. At its periphery the wheel chamber opens to the customary volute discharge passage C_9 from which leads the discharge duct C_3 of the compressor.

The framework is provided with bearings C_4 and C_5 for the shaft R_1 of the rotary element, and C_6 represents a coupling member by means of which the compressor may be connected to and driven by a suitable power device such as a turbine.

The blades R_2 of the compressor wheel are received in axial undercut slots R_7 formed in the enlarged central portion of the shaft R_1, the blades being enlarged at their bases to fit the slots R, as shown clearly in Fig. 2. Sections R_3, providing curved guide surfaces for the fluid passing into the compressor wheel, are secured by screws R_6 to the teeth R_8 between the slots R_7 of the shaft R. These guide sections R_3 in the assembled wheel unite to form what may be regarded as a ring surrounding the shaft and slotted to receive the blades R_2.

R_4 and R_5 represent nuts threaded on to the portions of the shaft R_1 at the opposite ends of the slotted portion and serving to hold the blades R_2 against axial movement with respect to the shaft.

As shown best by Figs. 3 and 4, the cross-sectional area of each blade R_2 decreases as the distance from the base of the blade increases, thus giving more metal to hold the blade in place at its base where the centrifugal strain is the greatest. By properly shaping the blades in this manner I can obtain a practically uniform stress at all points in the blades and which, even for very high speeds of rotation, can be brought within a practical working limit.

It will be apparent that the invention is not limited to use in blowers in which the shaft carries a single wheel as a plurality of wheels may be formed on a single shaft by lengthening the latter and inserting in each

slot R_7 several blades, thus building up several wheels on a single shaft.

To appreciate the advantages of my invention it should be understood that it is desirable in many cases to make the speed or rotation as high as possible in machines of the kind described. The speed of rotation of such a machine is limited in general by the strength of the parts subjected to centrifugal forces to resist such forces, and by the fact that ordinarily, it is highly desirable to operate such a machine at a speed below the so-called "critical speed" of its shaft. The "critical speed" of a shaft of given length is increased by increasing the stiffness of the shaft, *i. e.* by increasing its diameter, and is decreased by increasing the weight of the shaft and the wheel supported by it. With the new construction the entire section of the metal of the shaft cut by a plane, as that indicated in Fig. 5 by the line A—A, which passes axially through the shaft and intersects an opposed pair of axial slots R^7, is effective to resist the bursting tendency of the resultant centrifugal forces acting on, or transmitted by the blades to the shaft. If the hub portion of the wheel and shaft are divided into separate hub and shaft elements, as by the cylindrical surface indicated in Fig. 5 by the dotted circle B, only that portion of the metal cut by the plane A—A which lies on the outer side of the circle B, would be effective to resist the tendency of the centrifugal forces to burst the shaft apart along the plane A—A. In other words, the centrifugal forces acting on or transmitted by the blades to the separate hub element of the machine would have to be borne entirely by the hub element and would not be transmitted to the shaft element surrounded by the hub.

With the construction described and claimed herein the stiffness of the shaft and its "critical speed" is markedly increased by the portion of the shaft including the teeth R_8 lying on the outer side of the cylindrical surface indicated in Fig. 5 by the circle B, whereas, if the hub portion of the shaft were divided into separate shaft and hub elements, as by said cylindrical surface, the separate hub element would not appreciably stiffen the shaft in the manner required to increase the "critical speed" of the shaft. The increased capacity to resist centrifugal forces and the increase in the "critical speed" of the shaft had with the claimed construction disclosed herein is such that with the new construction a peripheral speed may be reached with safety which is substantially in excess of the safe peripheral speed of the tips of the blades heretofore obtainable.

In general, I propose to utilize my invention in wheels in which the diameter of the integral hub portion of the shaft is greater than that of the shaft proper, and is less than that of the hub element of prior wheels of the same diameter but having separate shaft and hub elements. By proceeding in this manner I am enabled to obtain a wheel having an increased capacity to resist centrifugal forces and having a higher critical shaft speed than is had with a wheel of the same diameter as heretofore constructed. This obviously permits of a desirable increase in the speed of rotation of the wheel. The increase in critical shaft speed obtained by following this plan is due both to the increase in stiffness of the shaft and to the decrease in the weight of the wheel. Moreover, the decrease in the diameter of the hub portion of the shaft enables me to decrease the diameter of the inlet openings C_8 to the wheel chamber, while at the same time securing the desirably large cross-section of the annular space between the hub portion of the shaft and the outer margin of the inlet openings C_8 necessary for the efficient influx of the maximum quantity of air desired to be passed into the wheel chamber. The increased radial blade depth in a wheel of given diameter thus obtained increases the efficiency of the machine and desirably increases the delivery pressure of the fluid compressed by the wheel, which it is possible to obtain with a wheel of given diameter operated at a given speed.

While in accordance with the provisions of the statutes I have illustrated and described the best forms of my invention now known to me, it will be apparent to those skilled in the art that changes may be made in the form of the apparatus disclosed without departing from the spirit of my invention, and that under some conditions certain features of my invention may be used with advantage without a corresponding use of other features.

Having now described my invention what I claim as new and desire to secure by Letters Patent is:

1. In a high speed rotary pump, the combination with a casing formed with an impeller wheel chamber having a peripheral outlet and an axial intake, and having impeller shaft bearings at opposite sides of said chamber, of an impeller comprising a shaft journaled in said bearings and formed between them with an axially slotted integral hub enlargement, and impeller blades secured at their bases in the slots of said hub enlargement and extending into said wheel chamber.

2. In a high speed rotary pump, the combination with a casing formed with an impeller wheel chamber having a peripheral outlet and an axial intake opening and having impeller shaft bearings at opposite sides of said chamber, of an impeller comprising a shaft extending through, but not filling,

said intake opening, and journaled in said bearings and formed between them with an integral hub enlargement having axially extending undercut slots in its periphery and impeller blades having ribbed bases anchored in said slots and extending into said wheel chamber.

In witness whereof, I have hereunto subscribed my name this 12th day of July A. D., 1911.

CHARLES HEAD SMOOT.

Witnesses:

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L. BATTIE.