July 24, 1962 E. A. STALKER 3,045,964

BLADED WHEELS FOR COMPRESSORS, TURBINES AND THE LIKE

Original Filed Feb. 14, 1957 3 Sheets-Sheet 1

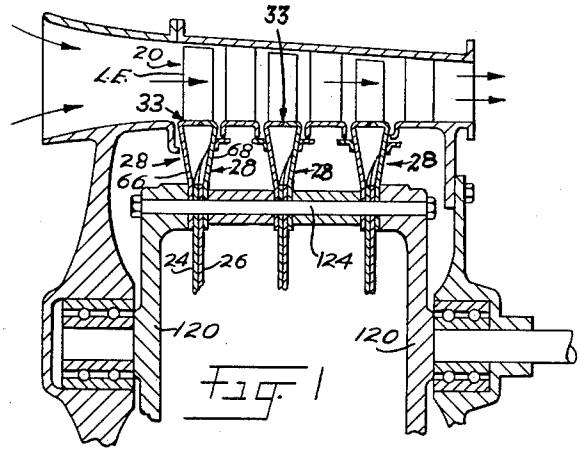


Fig. 1

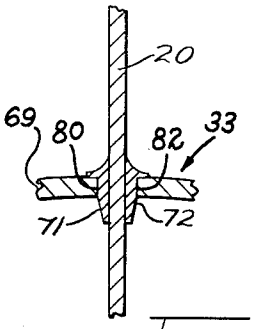


Fig. 6

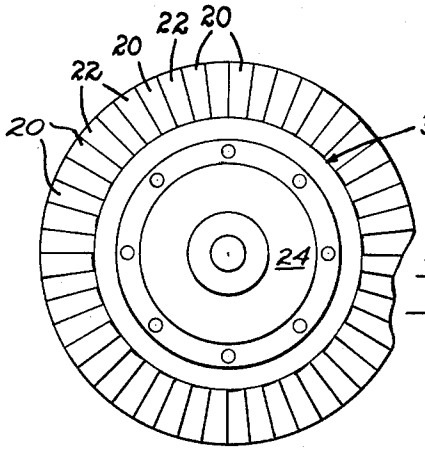


Fig. 2

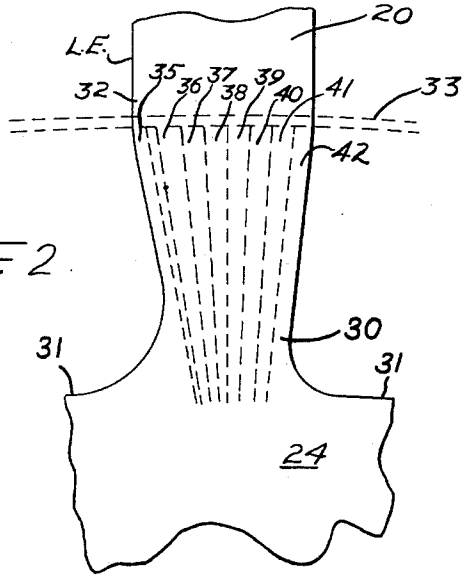


Fig. 4

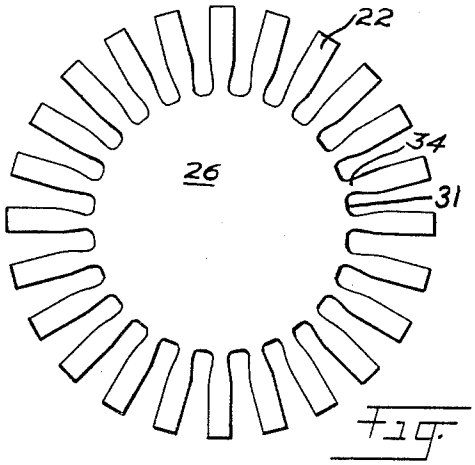


Fig. 3

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BLADED WHEELS FOR COMPRESSORS, TURBINES AND THE LIKE

Original Filed Feb. 14, 1957 3 Sheets-Sheet 2

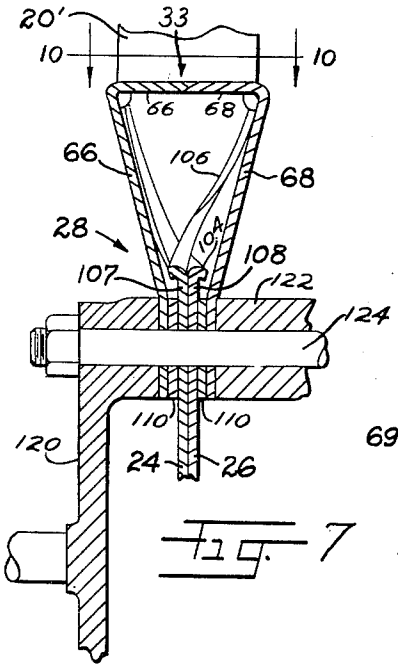


Fig. 7

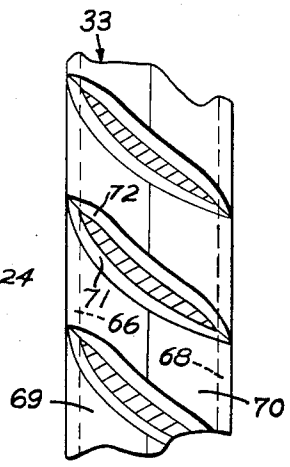


Fig. 10

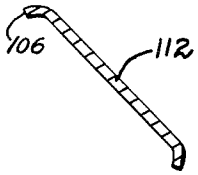


Fig. 9

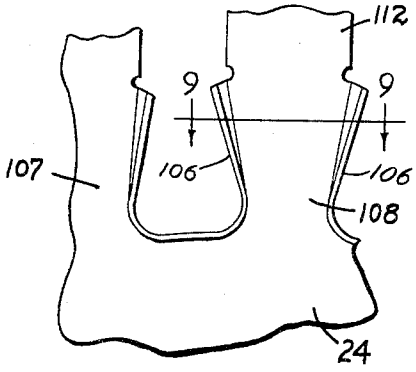


Fig. 8

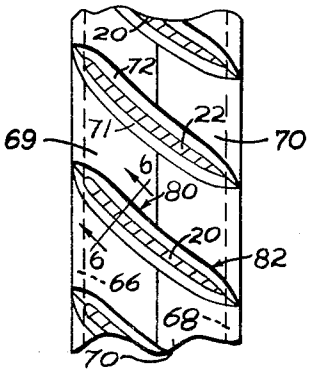


Fig. 5

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BLADED WHEELS FOR COMPRESSORS, TURBINES AND THE LIKE

Original Filed Feb. 14, 1957 3 Sheets-Sheet 3

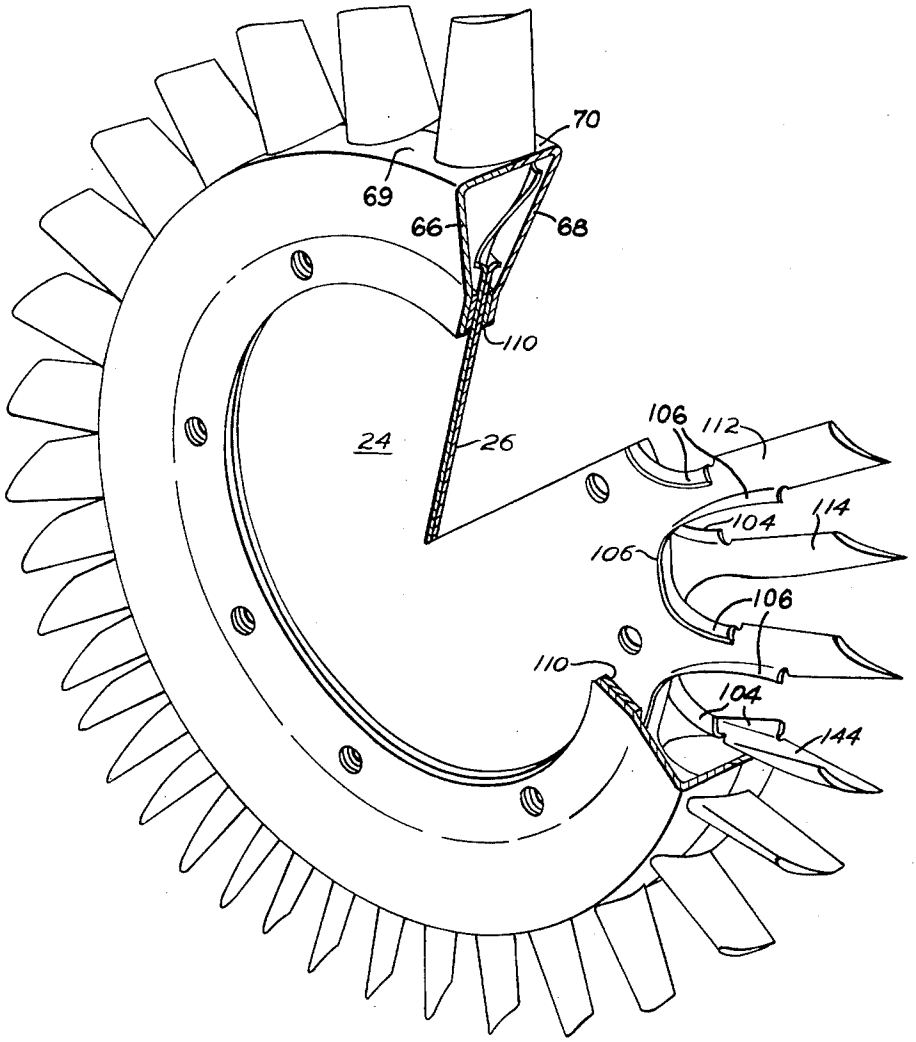


Fig. 11

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United States Patent Office

3,045,964

Patented July 24, 1962

3,045,964

BLADED WHEELS FOR COMPRESSORS, TURBINES AND THE LIKE

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Original application Feb. 14, 1957, Ser. No. 640,199, now Patent No. 2,986,375, dated May 30, 1961. Divided and this application June 6, 1958, Ser. No. 740,276

3 Claims. (Cl. 253—39)

This invention relates to bladed rotary fluid machines such as compressors and turbines.

An object of the invention is to provide an axial flow bladed wheel in which the blades are integral with a central disk and each blade is connected to said disk in such a manner as to minimize distortion under the action of centrifugal force acting on each blade.

Another object is to reduce the number of brazed joints in such a wheel to a minimum.

Other objects will appear from the description, appended claims and accompanying drawings.

The above objects are accomplished by the means illustrated in the accompanying drawings in which—

FIG. 1 is a fragmentary axial section through a rotary fluid machine according to this invention;

FIG. 2 is a fragmentary front view of a bladed wheel of the machine of FIG. 1 including two interdigitating series of blades;

FIG. 3 is an axial view of a central disk and its integral blades;

FIG. 4 is an enlarged fragmentary axial view of a blade and the associated portion of the central disk, before the blade is twisted;

FIG. 5 is a fragmentary radial view of a wheel rim with the blades in section at their root ends;

FIG. 6 is a fragment of a rim and blade on line 6—6 of FIG. 5;

FIG. 7 is a fragmentary axial section of a machine similar to FIG. 1 showing an alternate form of blade neck;

FIG. 8 is an enlarged view of a fragment of a blade disk showing the neck flanges;

FIG. 9 is a section through a blade on line 9—9 of FIG. 8;

FIG. 10 is a radial view of a fragment of the rotor rim on line 10—10 of FIG. 7; and

FIG. 11 is a perspective view of a rotor of FIG. 7 partly cut away to show the interdigitation of the blades.

In U.S. Patent No. 2,613,910, issued October 14, 1952, to the present inventor there is disclosed a sheet metal construction for bladed wheels wherein each blade is integral with a central disk. The neck connecting each blade to the central disk is twisted to place the root end of each blade at the proper angle with respect to the plane of the disk.

In the present invention a series of wheels are assembled as shown in FIG. 1, each wheel including a pair of central disks with necks joining the individulal blades. Each neck is formed between dies so that each element of the neck is straight along its extent from the perimeter of the disk to the root section of the blade which is positioned adjacent the wheel rim. This prevents untwisting of the neck between the disk and the rim so that the tip of the blade cannot move radially outward under the action of the centrifugal force of the blade when the wheel is rotated at high speed. Then the blades have a substantially constant tip diameter and the tips can be accurately finished to always conform closely to the inside surface of the case enclosing the wheel. Means are also disclosed for providing substantial fillets at the root sections of the blades.

The wheel comprises the sets of blades 20 and 22,

integral respectively with central disks 24 and 26 of the hub means 28, the two sets being assembled face to face with the blades interdigitating to form the wheel as shown in FIGS. 1 and 2. The blades 20 are connected to their disk 24 by the necks 30 and 34 extending from the periphery 31 of the central disks 24 and 26 to the root sections 32 of the blades. These sections are at about the radial level of the rim 33. Blades 22 are connected in like manner by the necks 34 to their disks 26.

The necks 30 and 34 are formed on dies to have straight elements extending from the central disk to the root ends of the blades. That is, each neck may be considered as comprised of a series of straight line side-by-side elements represented by the series of dotted lines 35–42, FIG. 4, each of which extends from the perimeter 31 of the central disk to the root of its respective blade in a straight line. Then each element of the neck can carry its portions of the centrifugal load of the blade without elongation from a bow in the element. Were such elements bowed along their length the blade would move outward as the centrifugal load removed the bow.

The wheel hub means 28 comprises the central disks 24 and 26 and a rim means 33 which is comprised of the two rings 66 and 68 each of which has an integral flange 69, 70 which together define the hub rim extending between blades and from front to rear thereof. It also includes the fillet elements 71 and 72, FIGS. 5 and 6.

The rings have registering notches 80 and 82, FIG. 5, which in registration define blade openings through which the blades extend in the general radial direction. Each opening is preferably larger than the cross section of the root end of the blade so that the fillet elements 71, 72 can be inserted on each side of the root end of the blade. These fillet elements may be solid, preferably being made of sintered metal powder, such as stainless steel or nickel for instance, so that they will absorb braze material during a brazing operation and become essentially solid and bonded to the blades and rims, and preformed as shown in FIG. 6 providing concave fillets outwardly of rim 33 which fay the side surfaces of the blades and the exterior surface of the rim. Such powder material after being impregnated provides a high damping effect against the vibration of the blades. The side legs of the rim means are secured to the central disks preferably by braze material.

The rim prevents the blades from turning or untwisting under the action of centrifugal force and since straight line elements connect the root sections of the blades to the disks the tips of the blades are stabilized at a selected radius.

The blades may have any desired cross section impressed upon them. FIG. 5 shows cambered blade sections whose central portions have parallel sides and faired nose and tail portions.

Fluid flows through the passages between the blades extending from the front of the wheel to the back thereof in the downstream direction. The leading edges are at the front of the wheel, i.e., at the right hand edge as shown in FIG. 5.

In another form of the invention shown in FIGS. 7–11, a neck flange 104, 106 is formed along each side of a neck extending from one neck to the adjacent one. Each neck 107, 108 preferably comprises straight line elements as in FIG. 4. The neck flanges add greatly to the stiffness of each neck along their general radial extent and precludes a tendency for the blades to move outward from changes in shape of the necks.

The neck flanges 104 of the rear central disk 26 extend rearward and those (106) of the front central disk 24 extend forward. See FIGS. 7 and 11. This facilitates placing the central disks close together preferably in contact with annular spacers 110 as shown. The

necks connect the blades **112** and **114** to their respective disks. The blades may also have blade sections varying in thickness along the greater parts of their chord lengths.

The rotors are fixed between the end disks **120** and the cylindrical spacers **122** by the tie rods **124**.

While the invention has been described as embodied in a compressor wheel it can be incorporated in like manner in turbine wheels.

It will now be clear that there has been provided a novel bladed wheel wherein the blade is integral with a central disk and has a twisted portion or neck joining the blade to the disk. The neck is made to be a strong structural member by imparting the necessary twist therein by dies so that there is no bow along radial lines in elements extending from the disk to the roots of the blades, the elements all being straight. This configuration eliminates any significant displacement of the blade radially due to centrifugal force straightening out bowed elements.

This application is a division of parent application Serial No. 640,199, filed February 14, 1957, now U.S. Patent No. 2,986,375, issued May 30, 1961.

While the forms of apparatus herein described constitute preferred embodiments of the invention, it is to be understood that the invention is not limited to these precise forms of apparatus, and that changes may be made therein without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

1. In a bladed rotor for compressors, turbines and the like, a rim having a blade opening, a blade extending through said opening spaced from the sides thereof, a separately formed relatively porous sintered powder metal fillet element in each said opening extending radially outward of said rim and interposed between the side of said blade and the side of said opening, said element extending along the surface of said blade and the outer surface of said rim and forming a concave fillet surface above said rim, and fused braze material bonding said piece to said blade and said rim and infiltrating said sintered metal fillet element.

2. In a bladed rotor for compressor turbines and the like, a rim having a blade opening, a blade in said opening extending therethrough, a separately formed relatively porous sintered powder metal fillet element extending radially outward of said rim, said fillet element having a concave surface and faying the side surface of said blade and the exterior surface of said rim at the intersection of one with the other, and fused braze material bonding said fillet element to said blade and said rim and infiltrating said sintered metal fillet element.

3. In a bladed structure for compressors, turbines and the like, a rim having blade opening, a blade having a portion adjoining said rim and extending radially away therefrom, a separately formed relatively porous sintered powder metal fillet element extending radially outward of said rim, said fillet element having a concave surface and faying the side surfaces of said blade and the exterior surface of said rim at the junction of one with the other, and fused braze material bonding said fillet element to said blade and said rim and infiltrating said sintered metal fillet element.

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