

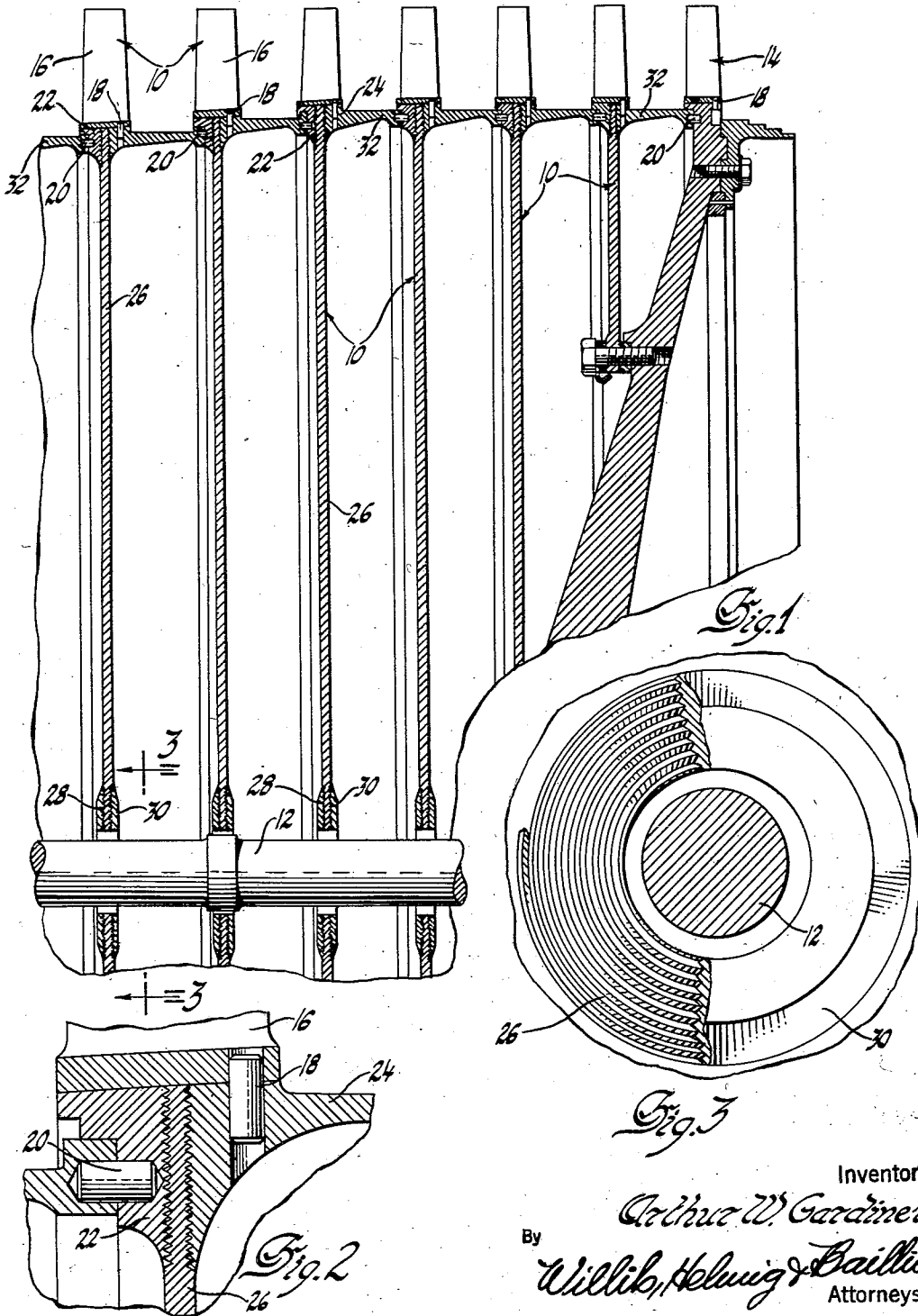
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COMPRESSOR WHEEL

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COMPRESSOR WHEEL

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This invention relates to disk-like wheels having thickened rim or hub portions and more particularly to the manufacture of compressor wheels or disks for multi-stage axial flow compressors.

Axial flow compressors for aircraft gas turbines, and others that involve high-compression ratios, necessarily include a large number of stages. Such compressor rotors are usually built up of a series of coaxial wheels that have integral thick rim portions that carry spaced blade rows and spaced thin disk portions that serve to tension the rim portions against the centrifugal stresses imposed by rotation. The wheels are provided with intermediate spacer rings that may be integral with the rim portions, and are assembled into a drum-like rotor. The rotor has heavy wheels at its ends which include projecting shaft portions for journalling. A central tie rod extends through the rotor and interconnects the end wheels to retain the rotor in assembled relation. The wheel disks are centrally apertured about the tie rod, and the disks may be thicker around the aperture to form a hub-like portion. The hub-like portion may be mounted on the tie rod, or on a central driving shaft, for rotation therewith; but it is usually preferable to transmit the driving torque to the wheels through their rim portions, rather than through their disk portions, and to provide some clearance between the hub-like portions and the tie rod.

The wheels for compressor rotors are presently made with integral rim and disk portions by forging and machining aluminum or stainless steel stock, and while they perform satisfactorily, they are expensive and difficult to manufacture for they require large presses for the forging operation and extensive machining. The reason for the excessive cost and difficulty that is encountered in the manufacture of integral wheels is that a large amount of metal must be moved by forging and removed by machining. The wheels should have a high strength to weight ratio to withstand centrifugal stresses; therefore, casting of the wheels to reduce the manufacturing problems is undesirable.

An object of my invention is to devise a wheel for a multi-stage axial flow air compressor that may be readily manufactured at low unit cost and that will have a high strength to weight ratio.

Another object of my invention is to fabricate a wheel for a multi-stage axial flow air compressor from several parts, formed and united in such a manner as will result in a wheel having high strength.

In carrying out these objects, it is a further object to form an axial flow air compressor wheel having a thick blade carrying rim portion, and a thin tension disk portion, by brazing serrated rings to the sides of complementarily serrated disks.

Further objects and advantages of my invention will be apparent from the following description, reference being had to the accompanying drawings, wherein a preferred form of my invention is clearly shown.

In the drawings: Figure 1 is a partial view taken in section along the axis of a multi-stage axial flow air com-

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pressor rotor incorporating my invention; Figure 2 is an enlarged view of a portion of Figure 1; and Figure 3 is an enlarged view taken along the line 3—3 of Figure 1 and partially in section.

Referring now to the drawings in detail and more particularly to Figure 1, the compressor rotor is made up of a series of interlocked coaxial wheels 10 that are clamped in assembled relation by a tie rod 12 that extends between the heavy end wheels at either end of the rotor, only the outlet end wheel 14 being illustrated. The end wheels are formed with protruding shaft portions (not shown) so that the compressor rotor may be suitably journaled for rotation. Each wheel is equipped with a row of blades 16 that are dovetailed into the rim and secured therein against axial movement by the radial pins 18. The rims of the wheels may have a progressive increase in diameter as the blades become progressively shorter toward the outlet end so as to provide a rotor of constant overall diameter. The rims of the wheels are interlocked to each other by the longitudinal pins 20 so that driving torque may be transmitted through the rim portions of the rotor, and the wheels are centrally apertured about the tie rod 12.

The wheels 10 are composite structures having thick blade carrying rim portions and thin tension disk portions, and are constructed in accordance with my invention by brazing the spirally threaded rings 22 and 24 to the opposite sides of the complementarily threaded thin disks 26 in such a manner that the crests of the threads on the rings mate with the roots of the threads on the disks. The disks 26 are primarily tension members and are preferably made from cross-rolled sheet steel such as is generally used in the manufacture of circular saws and plow disks; the cross-rolling imparting equal physical properties in all directions and resulting in a disk that will perform as well as if it had been forged. The disks 26 may be slightly tapered toward the margin, however, tapering is not vital. Without tapering, the machining of the disk surfaces may be restricted to cutting the radially directed spiral threads. The rings 22 and 24 are preferably steel and are provided with complementary spiral threads, and the rings are unitarily united to the disks 26 by brazing the threaded surfaces together. As best seen in Figure 2, the threaded surfaces may be cut substantially coextensive with the planes of the unthreaded surfaces of the disks 26 after they have been cross-rolled to a desired thickness so as to reduce or eliminate further surface cutting on the disks. The threaded interconnection between the rings and disk provides a multitude of inter-engaging surfaces between the rings and disk that prevent their separation from centrifugal forces, and that furnish a large bonding area in a relatively small space for brazing.

A concentric series of radially spaced serrations or corrugations may be provided in the mating surfaces of the rings 22 and 24 and the disk 26 for brazing them into a unitary wheel in lieu of the threaded or spiral serration previously described. Wheels so constructed will perform satisfactorily, but I prefer to utilize a threaded interconnection because of its inherently precise registerability, and because its manufacture is much more economical and simple.

The wheels 10 may also be provided with a thickened hub portion by brazing the spirally threaded rings 28 and 30 to the opposite sides of the complementarily threaded inner portions of the disks 26. Figure 3 illustrates how my spirally threaded interconnection appears when viewed from an axial direction.

In the preferred form of my invention the rings 24 are formed with an integral annular flange portion 32 that acts as a spacer between the wheels 10; however, separate spacer rings may be used between the wheels 10 if desired.

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The preferred embodiment of the invention has been described fully in order to explain the principles of the invention. It is to be understood that modifications of structure may be made by the exercise of skill in the art within the scope of the invention which is not to be regarded as limited by the detailed description of the preferred embodiment.

I claim:

1. A composite blade supporting wheel structure comprising a disk having an outer peripheral surface and oppositely disposed substantially vertical side surfaces, one of said side surfaces having a spirally threaded portion, a ring forming a part of said composite wheel structure, said ring having a spirally threaded complementary surface to said one side and having the crests of its threaded surface mating with the roots of the threaded portion of said one of said side surfaces, said crests and said roots when in engaging relation fixing said ring to said disk against relative radial and rotary movement with respect to each other, and means fixing said disk and said ring against axial movement whereby said ring and disk forms a thickened blade supporting rim portion.

2. A composite blade supporting wheel structure as defined by claim 1 wherein said means fixing said disk and said ring against axial movement comprises a brazed bond between said ring and said disk.

3. A composite blade supporting wheel structure as defined by claim 1 wherein an annular row of blades

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are secured to said thickened blade supporting ring portion and said ring includes an integral annular spacer flange projecting axially of said blades.

4. A composite blade supporting wheel structure comprising a disk having an outer peripheral surface and oppositely disposed substantially vertical side surfaces, each of said side surfaces having a spirally threaded portion, a ring associated with each of said side surfaces forming a part of said composite wheel, each ring having a spirally threaded complementary surface to its associated side surface and having the crests of its threaded surface mating with the roots of the threaded portion on the associated side surface, said crests and said roots when in engaging relation fixing said rings to said disk against relative radial and rotary movement with respect to each other, and means fixing said disk and said rings against axial movement whereby said rings and disk form a thickened blade supporting rim portion.

References Cited in the file of this patent

UNITED STATES PATENTS

906,400	Ferranti	Dec. 8, 1908
927,515	Ehrhart	July 13, 1909
1,210,978	Parsons et al.	Jan. 2, 1917
1,637,750	Kilham	Aug. 2, 1927
1,895,133	Quarnstrom	Jan. 24, 1933
2,137,044	Dawson	Nov. 15, 1938