Turbine guide vanes

October 6, 1953 w BOYD ET AL 2.654.566 TURBINE GUIDE OF VANE CONSTRUCTION Filed on February 11, 1950 2 Sheets-Sheet 1 INVENTOR WINNET T BOYD JOSEPH T Pl/HVI-f LAWYER Patented in October. 6, 1953 TURBINE NOZZLE GUIDE VANE CONSTRUCTION Winnett Boyd, Bobcaygeon, Ontario, and Joseph Thompson Purvis, Toronto, Ontario, Canada, assigns to A. V. Roe Canada Limited, Ontario, Ontario, Ontario, Canada, an Application Corporation February 11, 1950, Serial No. 143,724 4 Claims. This invention concerns turbine and other axial flow energy conversion machines in which blading is subjected to a fluid flow at relatively high temperatures. The invention relates more specifically to a mount for turbine nozzle guide vanes. One purpose of the invention is to provide an assembly for the turbine nozzle vanes that provides firm support against the loads imposed by the work fluid, but allows a wide relative movement between the blading and adjacent structures in response to temperature variations. Another purpose of the invention is to provide an assembly that allows each guide vane to expand or contract independently in relation to the adjacent guide vanes. Another purpose of the invention is to provide a guide vane assembly system where the loads imposed by the working fluid tend to hold the guide. vans firmly against their mounts, thus helping to support the guide vanes and minimizing the leakage of working fluid through the interstice between the base parts of the guide vanes and between the base parts and adjacent limbs. Another purpose of the invention is to provide a guide vane assembly system that allows prompt removal and replacement of worn or damaged parts. Other objects and advantages will become apparent during the course of the following description. In the drawings that accompany and are part of this specification, in which reference characters are used to designate parts as parts along the various views, Fig. 1 is a fragmentary perspective view of a turbine casing structure and turbine guide vanes constructed according to the invention, as observed when seen in a direction parallel to the turbine shaft and in the same direction as the flow of fluid; Fig.2 is a fragmentary sectional view taken on a radial plane through the casing structure and seen in the direction of arrow 2 in Fig. l; E. Fig. 3 is a fragmentary perspective view that shows one of the turbine nozzle guide vanes in relation to the vane mounting ring, as observed when seen in a direction opposite to that of fluid flow. Referring to the drawings, a typical turbine comprises a fixed external casing I and a fixed internal structure II spaced from the said enclosure and providing a passage to the fluid flow of the usual nozzle box shown) in the turbine. Adequate means are provided to hold the casing and internal structure in Relationship. (The internal and external words as used here refer to the radial directions to the engine, and the words front and rear are used in reference to the direction of the flow of gases passing through the engine, denoting the front or inlet and rear denoting the downstream or exit side.) According to the invention, a plurality of guide I2 vanes extends radially through an annular gap I3, located between the fixed internal structure II and the fixed outer housing II). A circumferential channel I4 is provided in the internal structure I I, the sides of that channel being defined by an annular flange I5 in the internal structure II and a flanged Retaining Ring I5 attached to it. On the outer side of the annular gap I3 is also provided a circumferential channel I1 lying between the rear face III of the outer housing I0 and an I8 turbine shroud ring attached to the outer housing. Each reed guide has a member of the external base or I9 platform and a member of the internal base or platform 20, which provide means for mounting the reeds on channels I I and I4. Once the I2 vanes curve away from the axial direction at a considerable angle and the adjacent vanes should be spaced relatively together, the inner and outer platforms of vanes 20 and I 9 are tilted so that the rear edge of each vane platform is not in axial alignment with the front edge, but is tangentially shifted to the turbine in the direction of the curvature of the guide vanes (see Fig. The inner platform 20 has a Built-in design, riding dowel 2! which wraps itself in a 22' hole in a 22-van mount mounting ring located on channel I4. The mounting ring 22 is prevented from rotating in relation to the internal structure II by means of teeth 23 involving symmetrically spaced radial grooves 24 supplied in flange I5 of the internal structure II. The engagement of teeth 23 in grooves 24 also predicts the concentricity of the mounting ring 22 in relation to the internal structure II, regardless of the relative expansion or contraction of ring 22 and the internal structure I. The external platform 19 of each of the Tab I2 reeds is located on channel I! and has on the back of a flange 25 protruding externally, the outer end of which is sufficiently spaced from the inner surface III of the outer housing II) on channel I1 to provide clearance for the maximum external expansion of the guide vane l2 and the mounting ring 22. The release thus provided is, however, shorter than the length of dowel 2| on the internal platform 20, for reasons that will later appear. In front of the external platform Hi is provided a flange 2B protruding externally that has a groove 21 enveloping with one of a series of evenly spaced teeth 28 supplied in the outer housing Il), whereby the tangential displacement of the reed I2 is while allowing radial displacement caused by relative relative or contraction of the reed and outer casing. As in the case of the 25 rear flange, the dimensions of the front flange 26 are arranged to provide sufficient clearance for such radial displacement. A 29 clamping range of relatively thin flat material with standard means suitable for adjusting its tension surrounds all the external platforms of the guide vanes and is held in place by the 3D and 3| provided on the external platforms [9. In the first assembly of the motor, the 29 band is adjusted so that it fits under light tension. As the machine heats up, the 22 mounting ring and the Guide I2 vanes expand externally against the clamping range 29, stretching the latter beyond its yield point and causing the plastic yield of the band. The tension in the band keeps all guide vanes in firm contact with the mounting ring and ensures that they remain concentrically arranged on the machine shaft. By cooling the fixing strip 29 I no tighter, and the vanes at the bottom of the engine are prevented from falling out of place by the rear flange 25 on the external platform IS; clearances are such that the outer ends of the rear flanges will then wrap the inner surface l of the outer casing I0, and avoid dowel 2| be removed from hole 22 in the mounting ring 22. When the machine is run again and heats up to operating temperature, the guide vanes expand until they take the clearance in the clamping range 29 and an additional expansion will result in the back of the lower side of the engine being restored to their original positions by the outer expansion of the blades at the top. Thus, the entire assembly of the guide vane resumes its concentric arrangement on the machine shaft, and the outer platforms of the blades support each other against the radially offset out, through the middle of the band that surrounds all of them. Although the band acquires a permanent stretch during the initial operation of the engine, it retains some elastic properties over its newly acquired length and is still able to withstand the vanes, radially, so that its outer flanges 25 are free of the outer casina l0, when they have reached their operating temperature on successive subsequent occasions. Small tangential clearances are provided between the platforms [9 and 20 of the adjacent blades when the machine is cold. The clearances disappear when the machine heats up so that a smooth contour passage through the annular gap between the internal structure I l and the external casing ID are presented to the working fluid flow. The loads on the vanes imposed by the work fluid can be resolved in axial and tangential components. At the inner end of each vane, both components are transported by dowel mount 2|. At the outer end of each vane, charging is transported by the reaction of the shroud ring of the turbine 18 against rear extension 25 of the external platform 19. Tangential loading is transported by the tangential reaction of tooth 28 against groove 21. One of the advantages of the invention can be better understood considering the couples acting on the platform of external vanes l9 and resolving them on the point of contact between tooth 28 and slot 21, it will be seen that the turning moment induced by the result of gas loads in the vane should be balanced by the moment of an axial reaction between the shroud ring of the turbine [8 and the rear flange 25 of the external platform i9. Due to the tangential displacement of the rear flange 25 in relation to the front flange 26, the reaction force against the rear flange 25 that produces the balancing pair tends to be evenly distributed across the width of the rear flange. If desired, the thermal insulation material can be placed in the l4 and IT channels in order to avoid excessive heat loss from the guide vanes and also to avoid damage to other parts that this leaking heat can cause. It is understood that the form of the invention, thus shown and described, should be taken as a preferred example of it, and that various changes in the shape, size and arrangement of the parts can be redecorated, without departing from the spirit of the invention or from the scope of the claims. What we claim as our invention is: 1. In an axial flow elastic flow conver machine comprising a flxed outer casing structure and a fixed internal structure spaced from the said casing structure and defining it with an annular passage to the fluid flow, a plurality of guide v-anes extending generally radially between the internal structure and the outer casing structure , and having internal and external platforms, a pin and socket connection between each of the internal platforms of the guide vanes and the internal structure, the pin being radially glided in the socket, and the blades being thus free for radial movement in relation to the internal structure, the said spacing connections said internal platforms angularly on the machine shaft , engaging the platform means connecting the external platforms of the guide vanes to the external structure of the casing , said that the activation of the platform means allowing radial expansion and contraction of the guide vanes and contain the tangential and axial displacement of it, and an elastic fixation range resiliently surrounding all external platforms and making the platforms mutually supporting the radially external displacement when the machine is at its operating temperature. 2. In an axial flow elastic energy conversion machine composed of a fixed outer casing structure and a fixed internal structure spaced from that enclosure and defining it with an annular passage to the fluid flow, a of guide vanes extending generally radially between the fixed fixed interior and the fixed structure of the outer casing and having internal and external platforms, a member of the ring in rotation prevention engagement with the fixed internal structure, a pin and socket connection between each of the internal platforms of the guide vanes and the internal structure, being the radially slid pin in the socket and the blades, thus being free for radial movement in relation to the internal structure , the engagement of the platforms means connecting the external platforms of the guide vanes to the external structure of the enclosure, said that the engagement of the platform means allowing the radial expansion and contraction of the guide vanes and avoid the tangential and axial displacement of it, and an elastic fixation strip of relatively thin material, surrounding all external platforms and making the platforms mutually supporting against the radially external displacement when the machine is at its operating temperature. 3. In an axial flow elastic energy conversion machine composed of a fixed outer casing structure and a fixed internal structure with a bean part with a plurality of radial grooves formed in it, they said external and internal structures defining a passage to the fluid flow, a plurality of guide vanes extending between the fixed internal structure and the fixed external structure of the housing , internal and external platforms in the guide vanes, an assembly ring with plurality of holes and having on an edge a plurality of teeth in engagement with the radial grooves in the fixed internal structure, dowels attached to the inner platforms of the guide vanes and extending to the holes in the ring member, said ring member engaging the inner platforms for the inner displacement of the vans guide the outer platforms of the guide vans are fixed axially , teeth on the side of the channel, and means on the outer platform to engage the teeth and protect the external platforms tangentially, and a clamping band surrounding the entire external platform and making the platforms mutually supporting against the displacement radially outward when the machine is at its operating temperature. 4. In an axial flow elastic energy conversion machine composed of a fixed outer casing structure and a fixed internal structure with a plurality-shaped radial belt structure, said external and internal structures defining a passage to the fluid flow from the front to the rear of the passage, a plurality of guide vanes extending between the fixed internal structure and the fixed outer structure , internal and external platforms on the guide vanes, a front flange and a rear flange on each of the outer platforms, the front flanges with notches on it, a mounting ring with a plurality of holes and bearing in a a plurality of teeth in engagement with the radial grooves in the fixed internal structure, dowels attached to the internal platform of the reeds and extending to the holes in the limb of the ring, said ring member engaging the inner decks to radially limit inside guide dsplacement vanes the fixed outer casing having a channel in which the front flanges and rear flanges on the outer platforms extend, teeth on the side of the channel wrapping the notches in the front flanges, and a fixing strip surrounding all the external platforms and making the platforms mutually supporting against the displacement radially outward when the machine is at its operating temperature. BOYD WINNETT. JOSEPH THOMPSON PURVIS. References Cited in the file of this patent PATENTS Name number 1.061.675 Junggren May 13, 1913 2.447.942 Imbert Aug. 24, 1948 2,488,875 Morley Nov. 22, 1949 2,494,821 Lombard January 17, 1950 FOREIGN PATENTS Country date 216.7 7 7 Great Britain June 5, 1924 611,326 Great Britain October 28, 1948