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SHROUD RING CONSTRUCTION FOR TURBINES AND COMPRESSORS

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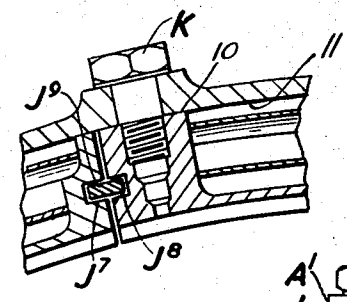

FIG. 3.

FIG. 1.

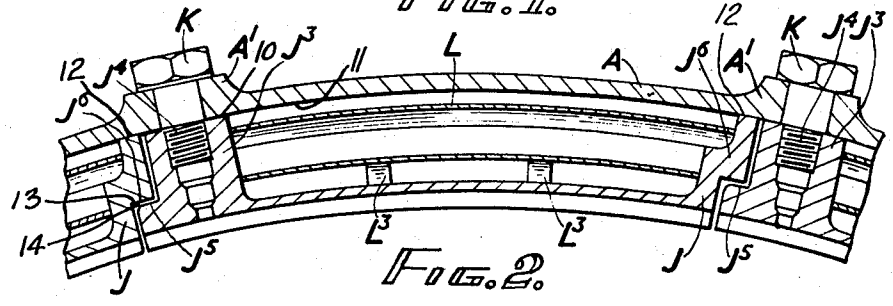

FIG. 2.

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SHROUD RING CONSTRUCTION FOR TURBINES AND COMPRESSORS

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5 Claims. (Cl. 253—78)

This invention relates to a construction of shroud ring for turbines or compressors, that is to say the shroud ring which closely surrounds a ring of rotor blades in a turbine or compressor. It is desirable that the clearance between such a shroud ring and the tips of the rotor blades shall be maintained small and shall not vary to any large degree under different operating conditions, and it is an object of the present invention to provide a shroud ring construction which will tend to enable the clearance between the shroud ring and the tips of the rotor blades to be maintained within small limits and to prevent or reduce any tendency for the shroud ring as a whole to be distored under operating conditions.

A shroud ring assembly according to the present invention comprises a tubular outer casting, and an annular shroud ring disposed within the outer casing and comprising a series of separate arcuate circumferentially extending sections each of which is rigidly connected at one end only (hereinafter called the fixed end) to the tubular outer casing and is supported at its other end (hereinafter called the free end) from the fixed end of the adjacent arcuate section through a connection which allows limited free relative circumferential movement between the adjacent ends of the two arcuate sections but substantially prevents relative radial movement between such adjacent ends.

In one convenient arrangement the connection between the fixed end of each arcuate section and the free end of an adjacent arcuate section is in the form of a step on the end face of one of the sections engaging a cooperating step on the adjacent end face of the other section, it being understood that the step is arranged so that the free end of the appropriate section is held from inward radial movement relatively to the fixed end of the other section by the inter-engaging steps.

Alternatively a key may be provided extending between and engaging axially extending slots in the adjacent ends of the two sections.

In any case each arcuate section of the shroud ring is preferably of such cross section as to provide within it a chamber having means by which cooling air can be supplied to and permitted to escape from it. Moreover one or more sheet metal baffle members are then preferably provided within each arcuate section and arranged to define with the inner circumferential wall at least of the arcuate section a narrow passage through which the cooling air is caused by the baffle member to flow.

Conveniently the fixed end of each arcuate section is secured to the tubular outer casing by means of a radially arranged bolt, stud, or the like engaging a bore in the appropriate end of the arcuate section. For example each of the bores in question may be screwthreaded and be engaged by the inner screwthreaded end of a bolt passing freely through a radial hole in the tubular outer casing.

In one preferred construction according to the invention

each arcuate section of the shroud ring is of channel-shaped cross-section in planes containing the axis of the tubular casing, and one construction embodying arcuate sections of this form and a modification thereof, are shown in the accompanying drawings, in which:

Figure 1 is a sectional view in a plane containing the axis of a combustion turbine of the part of such turbine including a shroud ring according to the invention and two adjacent rings of stator blades, the parts shown in the drawing being for convenience limited substantially to those necessary for an understanding of the invention itself and not representing a complete cross-section through the turbine,

Figure 2 is a cross-section on the line 2—2 of Figure 1 through the shroud ring assembly, and

Figure 3 is a fragmentary cross-section, corresponding to Figure 2, of a modified form of connection.

In the embodiment of the invention shown in Figures 1 and 2, A is the tubular outer casing of the turbine within which is mounted a ring of stator blades B of the kind sometimes called a nozzle ring through which the hot gases from combustion chambers, one of which is indicated at C, are delivered to a ring of rotor blades indicated at D supported upon a rotor disc D^1 in well-known manner. The gases leaving the rotor blades D then pass through a ring of stator blades E rigid with the casing A before impinging on the rotor blades F of the next stage carried by a rotor disc F^1.

The blades B constituting the nozzle ring are of known hollow form and are arranged in a manner known per se and in itself forming no part of the invention, to have cooling air delivered to their inner ends through a chamber G so that this cooling air flows through the blades into an outer annular cooling air chamber H.

Surrounding the ring of rotor blades D is a shroud ring assembly according to the invention comprising a supporting structure formed by the surrounding part of the casing A on which, to this end, are formed a series of circumferentially spaced bosses A^1, and a shroud ring comprising a series of separate relatively circumferentially aligned arcuate sections J each of channel-shaped cross-section, as shown and of closed-ended trough-like form, the inner circumferential wall of each section being in the form a section of a frustrum of a cone, while the flanges J^1, J^2 on the sides of each arcuate section are located between a flange A^2 formed on a ring A^3 rigid with the casing A and a ring A^4 also rigid with the casing A and serving to support the outer ends of the blades B of the nozzle ring. The arcuate sections J, of the shroud ring are not gripped between the flange A^2 and the ring A^4 but are held in position thereby while being free to slide relatively thereto.

Formed in one fixed end of each arcuate shroud ring section J is a boss J^3 provided with a circumferentially extending surface 10 having formed therein a radial hole which is internally screwthreaded as shown at J^4 to receive the inner end of a bolt K passing through one of the bosses A^1 and serving to immovably secure that end of the shroud ring section firmly to the casing A with its surface 10 flush against the inner circumferential wall 11 of the casing as shown most clearly in Figure 2. The free end of each said section is provided with a portion 12 normally abutting radially against the inner wall 11 of the casing in circumferentially sliding relation thereto.

The fixed end of each shroud ring section J adjacent to the boss J^3 is also provided with a step as shown at J^5 while the opposite or free end of the shroud ring section is provided with a step J^6 having a face or portion 13 spaced radially inwardly of its portion 12 and which, as clearly shown in Figure 2, circumferentially slidably engages and co-operates with the step J^5 on the adjacent end

of the adjacent shroud ring section to form a circumferential sliding connection between the adjoining ring section ends prevent the end provided with a step J^6 from moving radially inwards beyond a predetermined small amount represented by a limited working clearance 14 between the abutting steps J^5 and J^6. The arrangement is such that each shroud ring section J is free to expand circumferentially relatively to the casing A and to the adjacent shroud ring sections while, as will be seen, being maintained substantially in position both axially and radially and supported from the casing A at a single point by the bolt K.

In the arrangement shown there is mounted and located within each shroud ring section a thin sheet metal baffle L the edge L^1 of which is secured as by welding to the flange J^2 of the shroud ring section, while the edge L^2 is spaced from the inner circumferential wall 11 of the shroud ring section by spaced tabs L^3. Air outlet apertures M are formed in each shroud ring section and the arrangement is such, as will be seen, that cooling air delivered to the annular chamber H is caused to flow round the baffle L and out through the exit apertures M where it enters the gas stream flowing through the turbine and, by flowing over the tips of the rotor blades, tends to assist further in the cooling of the shroud ring and to assist in the cooling of these blades.

It will be apparent that the baffle means represented by the baffle L defines with the adjacent walls of the casing A and the shroud ring section J a narrow passage between the baffle means and the walls of the casing and shroud section, through which narrow passage the cooling air is caused to flow.

In the modified arrangement shown in Figure 3 which is otherwise similar to that described above, instead of the adjacent ends of the shroud ring sections being provided with the cooperating steps J^5, J^6 they are formed with axially extending slots J^7, J^8 lying opposite to one another, into which slots is slid a key member J^9 which permits relative circumferential movement between the adjacent ends of the shroud ring sections while virtually preventing relative radial movement between them.

What we claim as our invention and desire to secure by Letters Patent is:

1. A shroud ring assembly for an axial flow turbine comprising a tubular cylindrical outer casing having an inner circumferential wall, and an annular shroud ring disposed coaxially within the outer casing, said shroud ring comprising a plurality of separate circumferentially aligned arcuate sections, each section having a fixed end formed with a circumferentially extending surface and a free end at its opposite circumferential extremity, means fixedly and immovably securing the fixed end of each said section in said casing with said circumferentially extending surface flush against said inner circumferential wall of the casing, the remainder of each said section, including its free end, being disconnected from said casing, the free end of each said section being in circumferentially spaced relation to said fixed end of an adjoining section, and having a portion normally abutting radially against the said inner circumferential wall of the casing and having a further circumferentially extending portion radially inwardly spaced from said first mentioned portion, and a circumferential sliding connection between each free end and the said fixed end of an adjoining section, said connection being provided by disposition of said further portion of the free end in slidable overlapping relation to said fixed end in a circumferential direction, thereby permitting circumferential expansion of said free ends but preventing radial inward deflection of said free end.

2. A shroud ring assembly as claimed in claim 1, in which the connection between the fixed end of each arcuate section and the free end of an adjacent arcuate section comprises a step on the adjacent end face of one of the sections engaging a cooperating step on the end face of the other section.

3. A shroud ring assembly as claimed in claim 1, in which the said means by which the fixed end of each arcuate section is secured to the inner circumferential wall of the casing comprises a radially arranged bolt, engaging a bore in the appropriate end of the arcuate section.

4. A shroud ring assembly as claimed in claim 3, in which the said bore is screwthreaded and is engaged by the inner screwthreaded end of the bolt, which passes freely through a hole in the tubular outer casing.

5. A shroud ring assembly as claimed in claim 1, in which each arcuate section is of channel-shaped cross-section with the sides of the channel facing radially outwards and, the tubular outer casing includes parts rigid with it and locating the arcuate sections by engagement with the sides thereof.

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