United States Patent [19]

Bolter et al.

[11] **3,754,836**

[45] **Aug. 28, 1973**

[54] **STEAM TURBINES**

[75] Inventors: **John Reginald Bolter; Harry Ashley Kirby**, both of Newcastle-upon-Tyne, England

[73] Assignee: **Reyrolle Parsons Limited,** Newcastle-upon-Tyne, England

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[52] **U.S. Cl.** **415/136,** 415/101, 415/108

[51] **Int. Cl.** **F01d 25/26**

[58] **Field of Search** ..... 60/40, 102; 415/108, 415/110, 136, 178, 219 R

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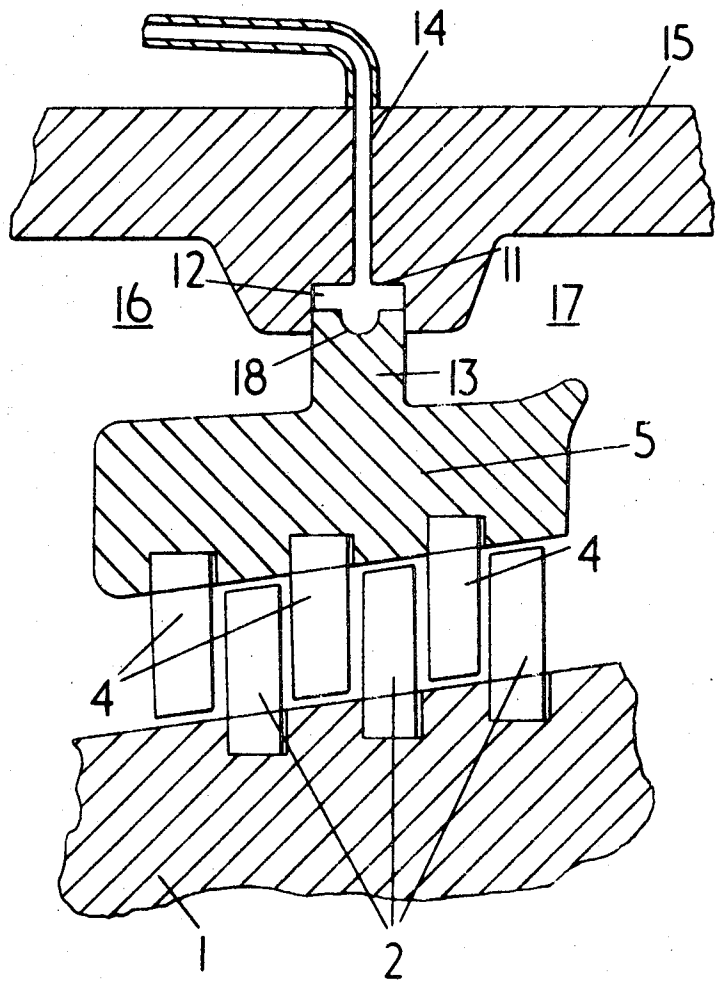
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Primary Examiner—Martin P. Schwadron
Assistant Examiner—H. Burks, Sr.
Attorney—Larson, Taylor & Hinds

[57] **ABSTRACT**

In an axial flow steam turbine, erosion of stator blade supporting structure is minimised in wet steam regions by injecting high pressure dry steam into the turbine by way of the said structure in such a way that the vulnerable areas of the structure are protected from the wet motive steam by the injected dry steam.

6 Claims, 2 Drawing Figures



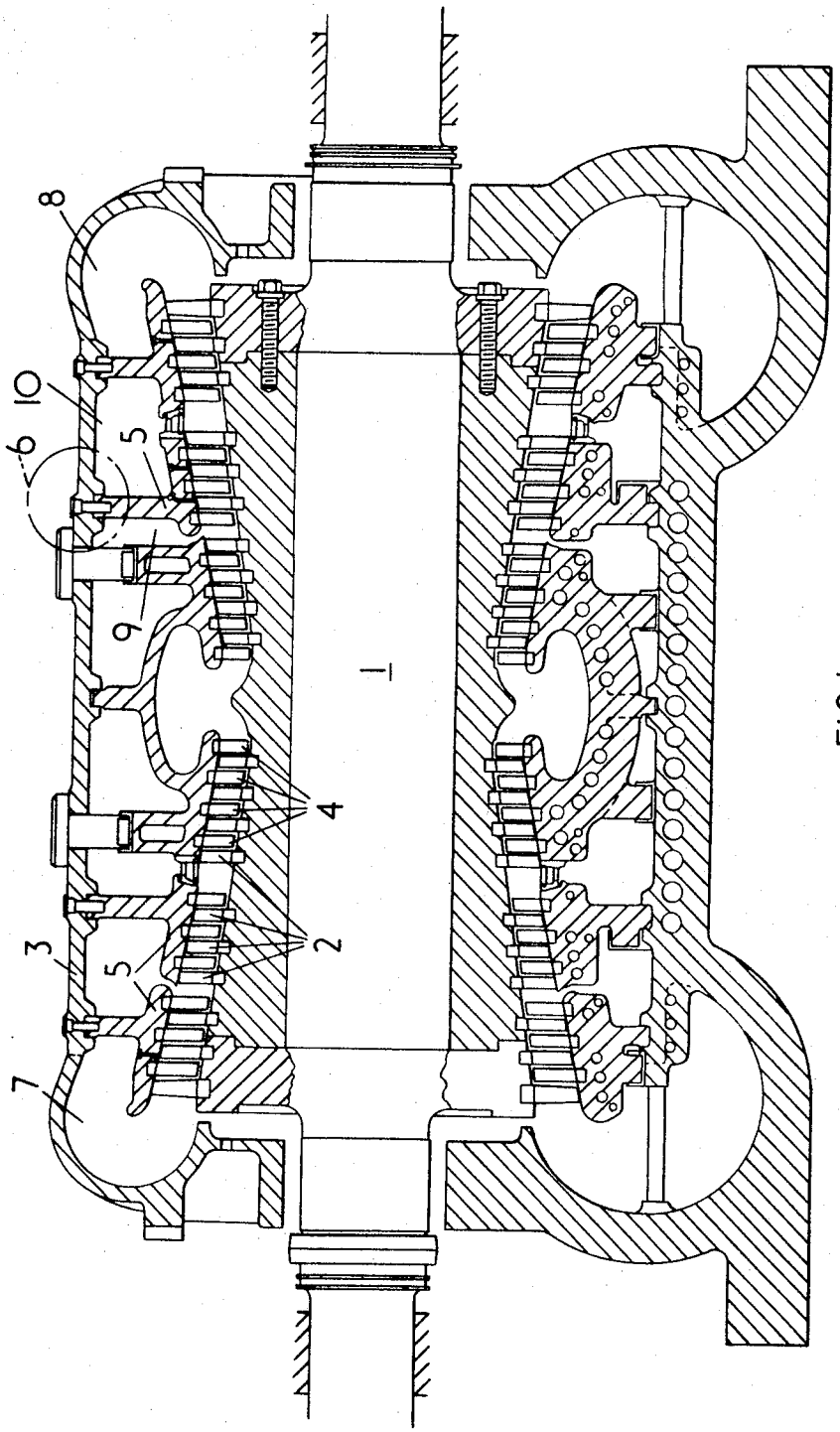


FIG. 1

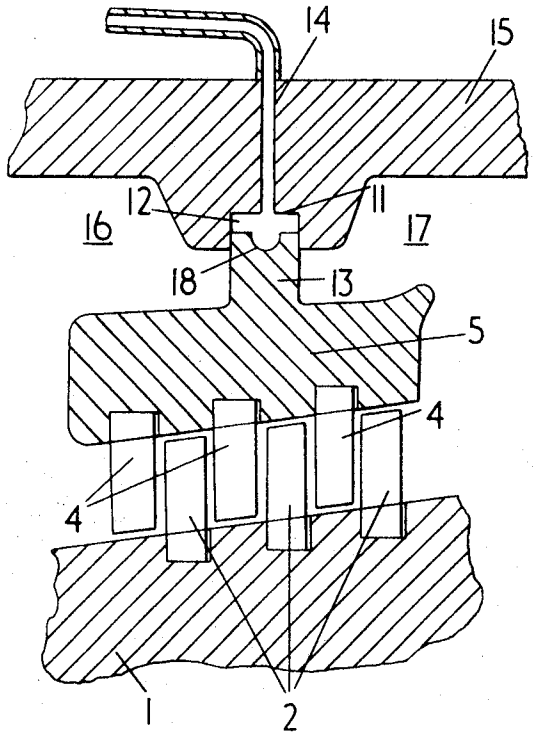


FIG.2

STEAM TURBINES

This invention relates to steam turbines and is more particularly concerned with turbines required to operate with poor steam conditions.

One of the principal problems associated with the use in a steam turbine of steam at poor conditions, for example as occurs when 'wet' steam as supplied by certain types of nuclear power steam generating plant is used to drive the turbine, is that of erosion of the turbine parts due to steam containing water particles flowing over them. Erosion caused in this way can seriously affect support arrangements for stator blade carrier rings which are mounted within the stator casing of certain forms of turbine.

The object of the present invention is to provide a stator blade carrier ring support arrangement for steam turbines in which the problem of erosion due to wet steam flow in the region of the support is reduced or obviated.

The invention consists in an axial flow steam turbine comprising a plurality of bladed rotor wheels and associated rings of stationary blades mounted within a stator casing, in which turbine a group of adjacent stator blade rings is carried by a carrier ring supported by way of a support arrangement at its outer periphery by the stator casing and the which means are provided to inject dry steam at the carrier ring support arrangement.

The support arrangement for the carrier ring preferably takes the known form of a circumferentially extending tongue on the radially outer periphery of the carrier ring located within a corresponding groove formed in the stator casing, the dry steam in accordance with one form of the invention being injected into a space at the bottom of the groove by way of one or more ducts passing through the stator casing wall.

The wall of the tongue or groove may be shaped to provide a circumferential channel of substantial cross-section extending around the tongue and groove arrangement. Alternatively, the dry steam may be supplied to the space by two or more circumferentially spaced radial ducts through the casing wall which are tapped from a circumferentially extending duct situated outside the casing wall.

The dry steam is injected at a pressure higher than the pressures of the main steam flow through the turbine before entering and after leaving the blade rings supported by the carrier ring, and thus serves to prevent flow of wet steam past the tongue and groove mounting arrangement.

The invention will now be further described with reference to the accompanying drawings, of which

FIG. 1 shows a cross-section through the double-flow steam turbine to which the present invention is applicable, and

FIG. 2 shows a portion of a cross-section through a turbine similar to that shown in FIG. 1 in which a stator blade carrier ring is supported in accordance with one form of the present invention.

Referring first to FIG. 1, the turbine shown comprises a rotor 1 carrying a plurality of rotor blade wheels 2 and a stator casing 3 in which corresponding blade rings 4 are supported by means of blade ring carriers 5. The carrier rings 5 are supported by means of tongue and groove locating arrangements as indicated within the ring 6.

The motive steam for the turbine enters centrally at an annular chamber 7 where it divides into two flows, one passing through the blade arrangement to the left of the diagram and exhausting by way of chamber 7 whilst the other flows through the blading to the right of the diagram and exhausts by way of chamber 8.

The steam flow through the blading is allowed to leak through gaps between the blade carrier rings so that pockets of steam are formed between the blade carrier rings and the wall of the stator casing, for example, as indicated by the spaces given reference numerals 9 and 10 in FIG. 1. The pressure of the steam in space 9 is greater than that of the steam in space 10 since it is formed by leakage of steam from a point upstream in the main steam flow to the point from which leakage steam enters space 10. Consequently there is a pressure difference across the tongue and groove support arrangement for the carrier ring which is situated between and forms a dividing wall between the two spaces, and whilst the tongue and groove arrangement is made to be a tight fit leakage of steam from the higher pressure space 9 around the tongue to the lower pressure space 10 generally results. If the steam which is leaking past the support arrangement is wet steam, that is to say it contains water particles, severe erosion of the metal components forming the tongue and groove support can result due to the high velocity of the steam which leaks through the narrow gap formed between the tongue and groove.

Referring now to FIG. 2, an arrangement is shown in accordance with the present invention wherein the possibility of erosion is eliminated or reduced, by providing means whereby a supply of dry steam can be led to the bottom of the groove 11 of a tongue and groove support arrangement of the type previously described. The dry steam is fed to the space 12 between the groove 11 and tongue 13 by way of one or more ducts 14 passing through the wall 15 of the stator casing.

The dry steam passing to space 12 may be obtained from a higher pressure stage of the turbine, or from the steam plant supplying the turbine, or as a further alternative may be obtained from a separate source of supply, the steam flow required to space 12 not needing to be high. Whatever the source of supply of dry steam, however, its pressure at the space 12 is arranged to be higher than the pressure of the steam in the spaces 16 and 17 on either side of the tongue and groove support, and a leakage of dry steam past the tongue from space 12 into spaces 16 and 17 results. Wet steam from spaces 16 and 17 is thus prevented from flowing past the tongue and groove around the tongue 13 thereby preventing erosion of the metal surfaces in this region.

Two or more ducts 14 may be distributed circumferentially around the stator casing and, in one form of the invention, a groove 18 may be formed in the tongue 13 to provide an annular channel merging with space 12 to ensure an even distribution of dry steam around the groove. The enlargement could alternatively be formed in the bottom of the groove, and in a further alternative form of the invention, not shown, a circular duct may be provided passing around the outside of the stator casing from which a number of tapping points can lead to the ducts 14 in the casing wall.

What we claim is:

1. An axial flow steam turbine comprising a plurality of bladed rotor wheels and associated rings of stationary blades mounted within a stator casing, in which tur-

bine a group of adjacent stator blade rings is carried by a carrier ring supported by way of a support arrangement at its outer periphery by the stator casing and in which means are provided to inject dry steam at the carrier ring support arrangement.

2. An axial flow steam turbine as claimed in claim 1, in which the support arrangement for the carrier ring comprises a circumferentially extending tongue on the radially outer periphery of the carrier ring locating within a corresponding groove formed in the stator casing, there being a space formed at the bottom of the groove leading into which space a duct or ducts for the injection of dry steam are provided.

3. An axial flow steam turbine as claimed in claim 2, in which the said ducts pass through the stator casing wall.

4. An axial flow steam turbine as claimed in claim 1, in which the support arrangement for the carrier ring comprises a circumferentially extending tongue on the radially outer periphery of the carrier ring locating within the corresponding groove formed in the stator casing, there being a circumferential channel of substantial cross-section formed extending around the tongue and groove arrangement into which channel at least one duct for injection into the channel of dry steam is led, the said duct or ducts extending through the stator casing wall.

5. An axial flow steam turbine as claimed in claim 1, in which the support arrangement for the carrier ring comprises a circumferentially extending tongue on the radially outer periphery of the carrier ring locating within a corresponding groove formed in the stator casing, there being a space formed at the bottom of the groove leading into which spaced at least two circumferentially spaced radially extending ducts for the injection of dry steam are provided, and there being provided a circumferentially extending supply duct for dry steam situated outside the stator casing wall, the said radially extending ducts communicating with the said circumferentially extending duct.

6. A method of reducing corrosion in a steam turbine of the type described hereinbefore in which dry steam is injected into a support arrangement for a stator blade ring in a region of the turbine where the motive steam contains water particles, the dry steam for injection being at a higher pressure than the motive steam in the said region.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,754,836 Dated August 28, 1973

Inventor(s) John Reginald Bolter et al.

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

On the cover sheet insert the following:

--[30] Foreign Application Priority Data

April 19, 1971 Great Britian 9825/71 ---.

Signed and sealed this 26th day of March 1974.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

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