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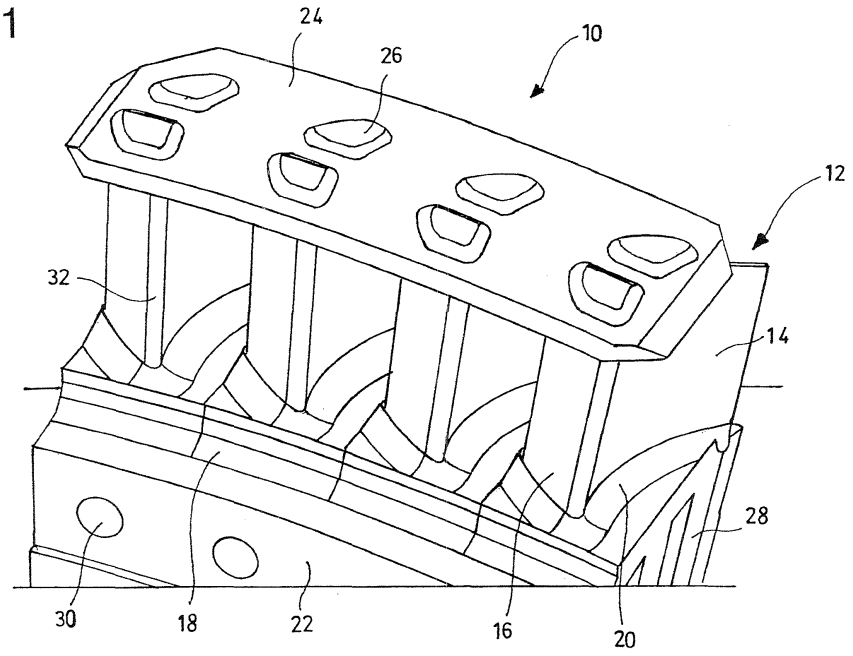
(54) Rotor blade of a first phase of a vapor turbine with a fork foot and covering belt

(57) A rotor for traction engines, in particular of a first phase of a vapor turbine, comprising a series of blades (12) arranged circumferentially on the rotor by the interposition of a base portion (18) formed in a single piece with the blades (12), on the opposite portion of the blades (12) with respect to the base portion (18), one or more covering belts (24) also being envisaged which group the blades (12) of the rotor in packs. The blades (12) and the covering belts (24) are coupled by the riveting of pins (26) integrated with the blades (12), and the coupling between the base portion or foot (18) of the blades (12) and the main body or disk (22) of the rotor is effected by fork insertion in the radial direction of the rotor.

Fig. 1



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Description

[0001] The present invention relates generally to a rotor for traction engines such as turbines and, more specifically, to a first phase, or action phase, of a rotor of a vapor turbine.

[0002] A vapor turbine is a rotary machine which exploits the thermal energy of pressurized vapor for converting it to useful mechanical energy. This energy transformation takes place with intermediate transformation into kinetic energy.

[0003] All the phases of a vapor turbine consist of two essential organs: a distributor, in which the thermal energy is either totally or partially converted into kinetic energy, and a disk wheel, in which the residual thermal energy contained in the vapor is converted into kinetic energy and it is then all transferred into mechanical energy which can be used at the shaft.

[0004] In order to increase the overall efficiency, the vapor in turbines normally expands passing through different phases in succession. Each phase consist of two series of blades: the stator blades (or nozzles) are fixed and integral with the casing of the turbine, whereas the rotor blades are moveable and are integral with the shaft. As a whole, the fixed parts in contact with the vapor are called stator, whereas the unit consisting of the shaft and parts integral therewith are called rotor.

[0005] The phases are characterized by the mode with which the vapor yields its energy to the shaft, and on the basis of this are called "action" or "reaction". In order to optimize the performances and costs, action and reaction phases can be found in a single vapor turbine.

[0006] In particular, the action step consists of fixed nozzles which cause the expansion of the vapor, creating high-velocity jets and kinetic energy, with a strongly angular direction with respect to the axis of the machine. When the jets meet the rotor blades, they considerably vary the direction as a result of the specific concave profile, and the vapor yields part of its kinetic energy in the form of mechanical rotation energy to the shaft.

[0007] One of the drawbacks that can arise in vapor turbines is the presence of water in the vapor itself. Due to the centrifugation of the water particles in the rotor, feeding with wet or saturated vapor can in fact cause the precocious corrosion and erosion of the rotor blades, in particular in correspondence with the contact surface between the tops of two adjacent blades, i.e. the outer ring of the rotor.

[0008] This phenomenon can cause a lack of contact between adjacent blades and consequently excessive vibrations of the blades themselves which, under resonance conditions, can cause the cracking and consequent breakage of the blades.

[0009] An objective of various aspects of the present invention is therefore to overcome the above drawback, by providing a rotor for vapor turbines which avoids or in any case reduces the breakage of blades due to the use of wet vapor and, at the same time, which allows a high aerodynamic efficiency.

[0010] This objective according to various aspects of the present invention, in addition to others which will appear evident from the following detailed description, is achieved by providing a rotor for a vapor turbine as indicated in claim 1.

[0011] Further characteristics of aspects and embodiments of the invention are indicated in the subsequent claims.

[0012] The characteristics and advantages of a rotor for vapor turbines according to various embodiments of the present invention will appear more evident from the following illustrative and non-limiting description, referring to the enclosed schematic drawings, in which:

Figure 1 is a perspective view of a pack of blades grouped together on a rotor for vapor turbines according to an embodiment of the present invention;

Figure 2 is a perspective view of a single blade before the riveting of the covering belt of the rotor of figure 1;

Figure 3 is a side view of a single blade before the riveting of the covering belt of the rotor of figure 1; and

Figure 4 is a transversal sectional view of a single blade of the rotor of figure 1.

[0013] With reference in particular to figure 1 of the enclosed drawings, these show a sector of a rotor for vapor turbines according to an embodiment of the present invention, indicated as a whole with the reference number 10.

[0014] Each sector 10 comprises a varying number of blades 12 arranged circumferentially on the rotor. In the embodiment illustrated, the blades 12 are grouped into sectors 10 of four blades 12 each to form a rotor equipped with a total of hundred-and-twelve blades divided into twenty-eight sectors.

[0015] In general, the profile or "side" of each blade 12 comprises a first concave surface 14, which is pressurized for the action of the vapor, and a second convex surface 16, which, on the contrary, is in depression and which is opposite the first surface 14. The two concave 14 and convex 16 surfaces are continuous and connected to each other, and together form the overall aerodynamic profile, or side, of the blade 12 (figure 4).

[0016] On a base portion 18, commonly called "foot", of the blades 12 there is therefore a connecting joint 20 with the above aerodynamic profile of each blade 12, said base portion 18 being formed in a single piece with the blades 12 and being suitable for being fixed to the main body or disk 22 of the rotor of a vapor turbine.

[0017] On the opposite portion of the blades 12 with respect to the respective feet 18 a covering belt 24 is also envisaged, also called "top" of the blades 12, which form an outer ring for the rotor.

[0018] In practice, the jets of vapor coming from the

fixed nozzles (not shown) are directed onto the concave surface 14 of the blades 12, between the base portion 18 and the covering belt 24, to start the movement of the rotor.

[0019] The blades 12 and covering belt 24 are advantageously coupled by riveting and, more specifically, each blade 12 has, on its contact portion with the covering belt 24, one or more pins 26 (figure 2) which are inserted in corresponding holes situated on the covering belt 24 itself, said pins 26 then being riveted after insertion in the above holes to effect the definitive coupling between the covering belt 24 and the blades 12.

[0020] In addition, the coupling between the base portion 18 of the blades 12 and the disk 22 of the rotor is effected by "fork" insertion in the radial direction of the rotor itself.

[0021] More specifically, on the circumference of the disk 22, there is a series of grooves in which a series of corresponding "prongs" 28 is inserted, obtained on the base portion 18 of the blades 12. The blocking in position of the blades 12 on the disk 22 is therefore obtained by means of a series of pins 30 which are introduced into specific pass-through holes situated on the prongs 28 and on the disk 22 itself, in a direction parallel to the axis of the machine.

[0022] On the basis of technical studies, it has been found that the contemporaneous application of the covering belt 24 by riveting, together with the particular radial "fork" insertion of the blades 12 on the disk 22 of the rotor, considerably reduces the risks of breakage, due to vibrations at a frequency close to resonance frequency, of the blades 12 in the presence of saturated vapor.

[0023] It can thus be seen that the rotor of a first phase of a vapor turbine according to the present invention achieves the objective specified above of reducing the breakages of the blades, due in particular to the use of wet vapor, by means of a series of expedients which at the same time do not jeopardize the aerodynamic efficiency of the turbine as a whole.

[0024] The rotor of a first phase of a vapor turbine of various aspects of the present invention thus conceived can in any case undergo numerous modifications and variants, all included in the same inventive concept.

[0025] Furthermore, in practice the materials used, as also the dimensions and components, can vary according to technical demands.

Claims

1. A rotor for traction engines, in particular of a first phase of a vapor turbine, comprising a series of blades (12) arranged circumferentially on the said rotor by the interposition of a base portion (18) formed in a single piece with said blades (12), on the opposite portion of said blades (12) with respect to said base portion (18), one or more covering belts (24) also being envisaged which group the blades (12) of said rotor in packs, **characterized in that** said blades (12) and said one or more covering belts (24) are coupled by riveting, and the coupling between said base portion (18) of the blades (12) and the main body or disk (22) of said rotor is effected by fork insertion in the radial direction of said rotor.

2. The rotor according to claim 1, **characterized in that** each of said blades (12) has, on its contact portion with said one or more covering belts (24), one or more pins (26) which are inserted in corresponding holes situated on said one or more covering belts (24).

3. The rotor according to claim 2, **characterized in that** said pins (26) are riveted after insertion in said holes to effect the definitive coupling between said one or more covering belts (24) and said blades (12).

4. The rotor according to any preceding claim, **characterized in that** on the circumference of said disk (22) there are one or more grooves inside which one or more corresponding prongs (28) are inserted, obtained on said base portion (18) of the blades (12).

5. The rotor according to claim 4, **characterized in that** the blocking in position of said blades (12) on said disk (22) is obtained by means of a series of pins (30) which are introduced into specific pass-through holes situated on said prongs (28) and on said disk (22), in a parallel direction to the axis of the rotor.

6. A rotor for traction engines, in particular of a first phase of a vapor turbine, as previously described and illustrated and for the purposes specified above.

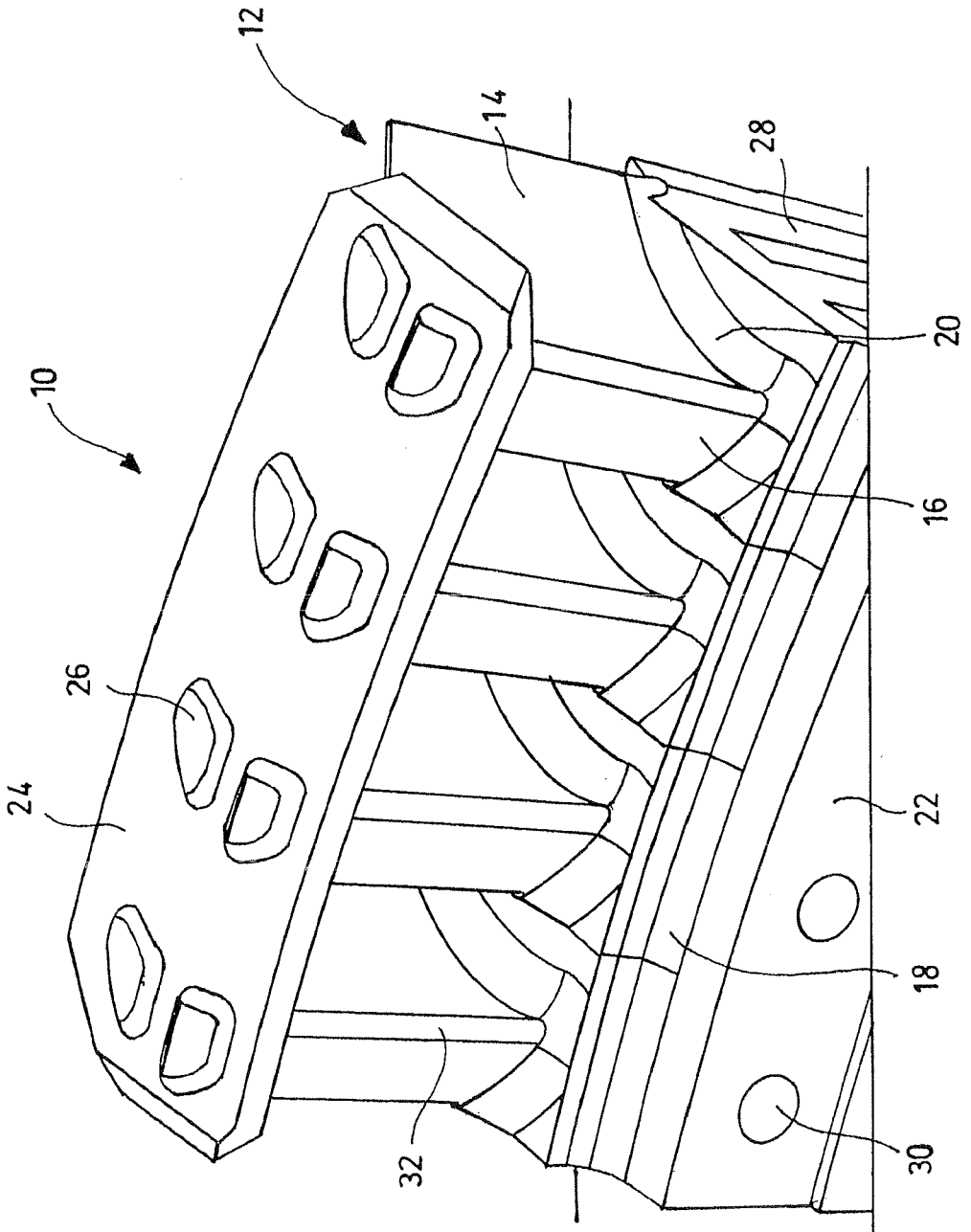


Fig. 1

Fig. 2

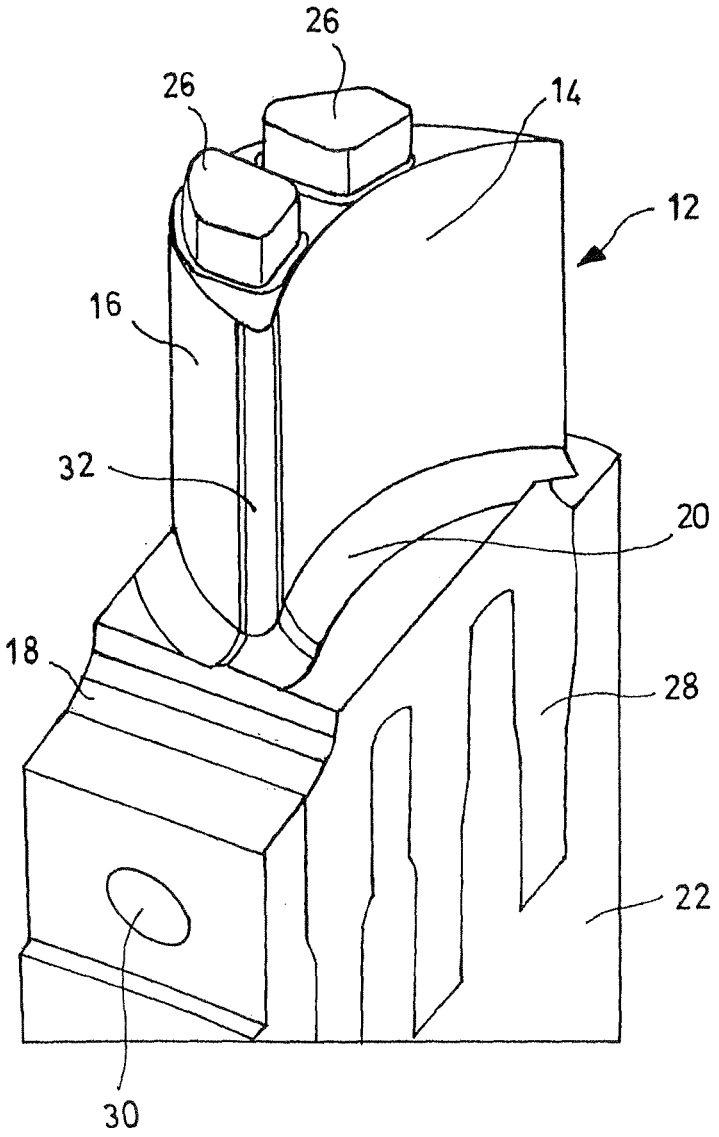
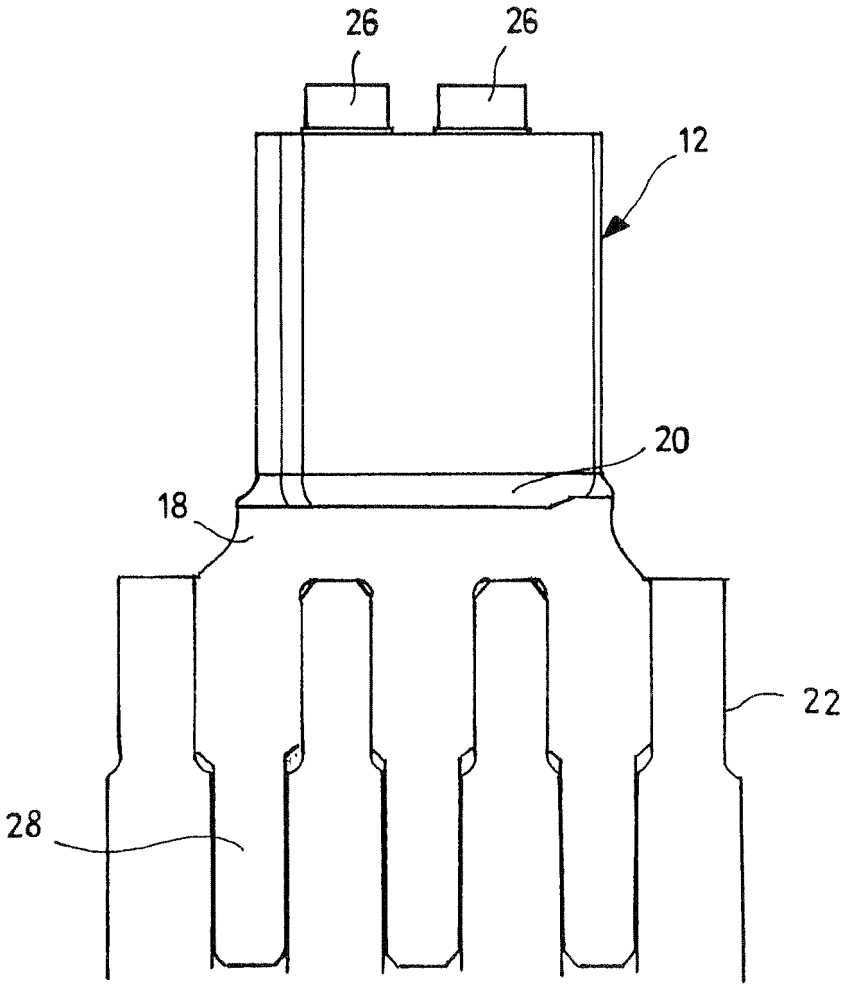


Fig. 3



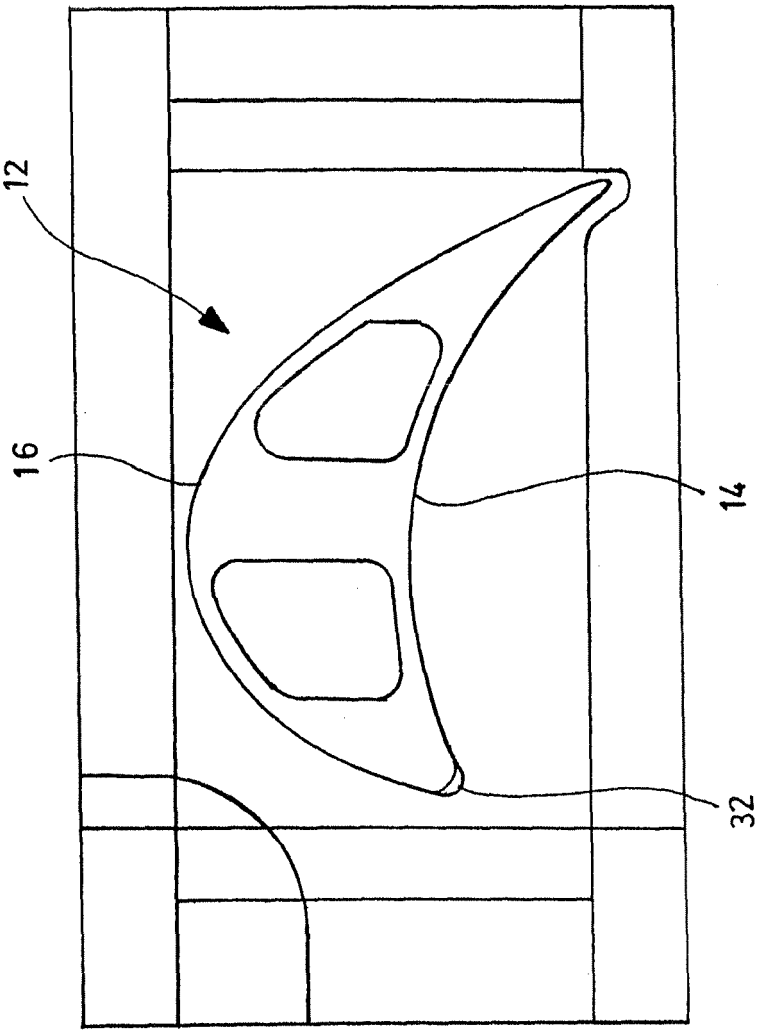


Fig. 4