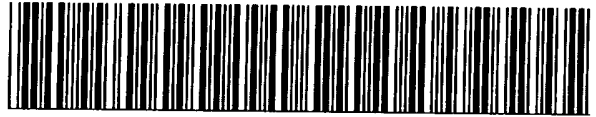


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<p>(21) International Application Number: PCT/FI95/00421 (22) International Filing Date: 9 August 1995 (09.08.95) (30) Priority Data: 943685 9 August 1994 (09.08.94) FI (71) Applicant: TELATEK OY [FI/FI]; Varvintie 17, FIN-92100 Raahe (FI). (72) Inventor: TENKULA, Jaakko; Ruskontie 1 C, FIN-92120 Raahe (FI). (74) Agent: BERGGREN OY AB; P.O. Box 16, FIN-00101 Helsinki (FI).</p>		<p>(81) Designated States: CZ, HU, PL, RU, SK. <b>Published</b> <i>With international search report. In English translation (filed in Finnish).</i></p>
<p>(54) Title: PROCESS FOR RECONDITIONING STEEL SURFACES (57) Abstract The invention relates to a method for the reconditioning and coating of bearing and sealing surfaces of a steam turbine rotor and of other steel parts which in a turbine are exposed to corrosive and/or erosive wear caused by hot, moist steam or to mechanical damage, in such a manner that the surface to be reconditioned and coated is sprayed thermally with a coating material alloyed with a large amount of nickel and chromium, which, after the coating process, is machined to the desired shape, dimension and surface quality.</p>		

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## Process for reconditioning steel surfaces

The invention relates to a method for the reconditioning of rotor axle labyrinth sealings and bearing surfaces in a steam turbine so as to restore the said surfaces to their original dimensions.

As stated in FI patent applications 762881 and 771073, steel surfaces exposed to hot, moist steam at high pressure and velocity are subject to strong erosive and corrosive wear.

The labyrinth sealing grooves in a steam turbine rotor may in certain cases wear out entirely. The depth of the groove is usually 3-5 mm. In certain cases the bottom of the groove also becomes worn, and therefore 4-7 mm of new material must be introduced onto the surface in the reconditioning of the sealing groove, if restoring of the original dimensions is desired.

In general, thick coating layers are not necessary for the bearing surfaces of a turbine rotor in connection with reconditioning. However, in cases of severe damage, grooves several millimeters deep may form in the bearing surfaces, and thus thick coating layers may be necessary also for their reconditioning.

Damage due to the wear of a steam turbine rotor labyrinth sealing has up to now been repaired in two ways:

1. New grooves are machined in the rotor axle. Thereby the axle diameter is reduced.
2. The blades and other parts are removed from the rotor. After this the sealing surfaces are fill-welded and the axle is heat-treated, and thereafter the grooves are

machined to the desired dimensions and the blades are reinstalled.

The reconditioning methods described above have the following  
5 drawbacks:

- 10 - In each case the rotor must be transported from the power plant to the machine shop or the turbine manufacturer, and back, and this results in a long down time.
- If the reconditioning is carried out by machining new grooves, the axle diameter is reduced, and after a few machinings a new rotor must be acquired.
- 15 - When the diameter of the labyrinth sealing grooves of the rotor is reduced, it is necessary to acquire new sealings, also with smaller diameters, for the mating side. This further leads to an increase of the number of spare parts.
- 20 - If the rotor axle is fill-welded, it is necessary to carry out a large number of various time-consuming steps, such as dismantling of the blades, preliminary heating, welding and the related long heat treatments, reassembling, etc. This further increases the down time and production  
25 losses.

In seeking a new method for the reconditioning of the sealing and bearing surfaces of a rotor axle, the problem is to find a coating material and method by which coatings which fulfill  
30 the following requirements can be produced:

- the thickness of the coating must be at minimum 10 mm
- 35 - the coating must be capable of being applied at the power plant
- the coating must be machinable by lathing

- the coating must be sufficiently strong and adhere well to the base material
- 5 - the coating must be resistant to erosive and corrosive wear caused by moist steam
- the coating must not cause corrosive problems between the different parts of the turbine or in the steam pipe system and the heat exchangers
- 10 - the thermal expansion of the coating must be close to the thermal expansion of carbon steels.

The above requirements substantially limit the alternative coatings usable. It is known that thick coatings can be formed by spraying martensitic stainless steels or aluminum bronze or tin bronze.

20 Martensitic stainless steel is very difficult to machine, and therefore it is not usable for the present purpose. The thermal expansion of bronzes is so great that a thick coating may detach from the axle during the start-up of the turbine, and therefore they cannot be used.

25 Since there were no ready solutions, long development work had to be done in connection with the present invention to solve the problem.

30 The primary object of the present invention is to provide a method for the reconditioning of the labyrinth sealings and bearing surfaces of the rotor in a steam turbine in such a manner that there is obtained a reliable coating which is suitable for the operating conditions concerned and by means of which the dimensions of the sealing and bearing surfaces  
35 can be restored to their original dimensions, and that the coating and related machining can be carried out on site rapidly and economically.

The main characteristics of the invention are stated in the accompanying claims.

5 According to one preferred embodiment of the reconditioning technique according to the invention, the surface to be reconditioned is first preliminarily machined, for example by using a rotary lathe on site. Thereafter, thermal spraying is carried out using a NiCr-alloyed coating material. Finally the coated area is lathed to the desired shape and dimension. The  
10 bearing surfaces can additionally be ground on site to the desired surface quality.

According to the invention, the coating material used is preferably a metal alloy containing nickel 20-60 % by weight and  
15 chromium 15-30 % by weight, in particular nickel 40-60 % by weight and chromium 15-20 % by weight. The balance of the coating material may be steel. The coating material may be in the form of wire or powder. Commercial materials may be used as coating materials in accordance with the invention.

20 Coating materials according to the invention enable a coating over 10 mm thick to be sprayed. This is an essential prerequisite for the reconditioning work, as stated above.

25 According to the invention, preferably a single-layer coating having a post-machining thickness of approx. 0.3-10 mm is formed.

30 Coatings according to the invention are characterized in that there are large amounts of chromium oxides within the coatings, and that on the surface of the coating there is formed a dense and strong oxide film, which prevents erosive and corrosive wear caused by moist steam.

35 The thermal expansion of the coatings according to the invention is the same as that of carbon steels, and thus the start-ups and shut-downs of the turbine will not cause problems.

According to the invention the coating can be prepared by using flame, arc, plasma, and/or supersonic spraying, primarily, however, arc, plasma and/or supersonic spraying, in order to achieve a good adhesion of the coating to the base material and in order that the coating should have sufficient  
5 intrinsic strength against loads parallel to the axle.

The advantages of the reconditioning technique according to the invention over previous ones are as follows:

10

1. The labyrinth sealings and bearing surfaces of a rotor can be reconditioned rapidly on site at a power plant. Thus the down time will be short and production losses will be small.

15

2. The coatings used in the reconditioning technique will lengthen the useful life of the labyrinth sealings and at the same time the useful life of the rotor, and will lengthen the maintenance interval caused by sealing  
20 surfaces.

20

3. The dimensions of the sealing grooves and bearing surfaces are restored to the original dimensions by the reconditioning technique. This reduces the number of spare parts  
25 required.

25

Claims

1. A method for the reconditioning and coating of bearing and sealing surfaces of a steam turbine rotor and of other parts which in a turbine are exposed to corrosive and/or erosive wear caused by hot, moist steam or to mechanical damage, **characterized** in that the surface to be reconditioned and coated is sprayed thermally with a coating material alloyed with a large amount of nickel and chromium, which, after the coating process, is machined to the desired shape, dimension, and surface quality.
2. A method according to Claim 1, **characterized** in that the coating material is a metal alloy which contains nickel 20-60 % by weight and chromium 15-30 % by weight.
3. A method according to Claim 1 or 2, **characterized** in that the coating material is a metal alloy which contains nickel 40-60 % by weight and chromium 15-20 % by weight.
4. A method according to any of Claims 1-3, **characterized** in that a single-layer coating is formed which has a thickness of 0.3-10 mm.
5. A method according to any of Claims 1-4, **characterized** in that the thermal spraying is carried out by the arc, plasma or supersonic method.

**INTERNATIONAL SEARCH REPORT**

International application No.

PCT/FI 95/00421

**A. CLASSIFICATION OF SUBJECT MATTER**

IPC6: C23C 4/08 // F01D 5/28

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

IPC6: C23C, F01D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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WPI, EDOC

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

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Further documents are listed in the continuation of Box C.  See patent family annex.

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Date of the actual completion of the international search

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## INTERNATIONAL SEARCH REPORT

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