PROCESS AND APPARATUS FOR GRINDING SURFACES

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This invention relates to an apparatus and method for finishing internal surfaces of a turbine casing.

An object of this invention is to provide a grinding tool and a mounting arrangement therefor adapting it for finishing rebuilt worn surfaces of a turbine casing.

Another object of this invention is to provide a pivotally mounted grinding tool that may be moved back and forth about the axis of the steam turbine casing for the purpose of accurately finishing the internal surfaces of this casing.

Another object of this invention is to provide a grinding tool arrangement that is mounted on a rod which is accurately supported with its axis coinciding with the axis of a turbine casing so that the grinding tool may be moved along this rod from stage to stage of the turbine casing for the purpose of accurately grinding rebuilt surfaces of the turbine casing.

Still another object of this invention is to provide an improved method of repairing the worn interior surfaces of steam turbine casings, said method including building up the worn surfaces by welding or the like and thereafter grinding away the excess metal by the use of a grinding tool pivotally mounted to swing about the axis of the turbine housing that is being repaired.

Other and further objects of this invention will be apparent to those skilled in the art to which it relates from the following specification, claims and drawings.

In accordance with this invention the two halves of the steam turbine casing to be repaired are first separated and the individual halves of the casing are supported so that the eroded interior surfaces thereof may be built up by welding metal thereto. This is a relatively simple procedure and the arduous part of the reconstruction of the turbine casing lies in the restoration of the weld-filled interior surfaces to the proper dimensions and satisfactory smoothness. Prior to the process and tool of the present invention, two techniques were used in the art for this refinishing: (1) by the successive manual steps of filing, scraping, and stoning and (2) by reboring of the reassembled casing using the same tools and techniques as in the original manufacture of the turbine. Of these two refinishing procedures, the former is suitable only for small spots and is sensitive to human error.

Since the cost of dismantling the equipment is substantial, the subject repairs were normally deferred until extensive reconstruction was required, thus necessitating the use of the boring process for the finishing operations. The boring operation was conducted on the assembled case which was assembled without the diaphragms or rotor and this demanded alignment of the halves of the casing. The boring tool capable of the close tolerances of the machining operation was driven by an external motor and speed reducer while inspection and inspection was made internally of the assembled casing at frequent intervals during the refinishing operation. This boring operation required specialized equipment which was normally rented from turbine manufacturers and it was usually attended by a special mechanic skilled in this particular operation.

The present invention concerns an improved process and apparatus for repairing and finishing the internal surfaces of a turbine casing and by its use the desired repairs are made at considerable saving in time and expense.

Referring to the drawing briefly:

Fig. 1 is a perspective view showing a grinding tool of this invention pivotally mounted on one of the two halves of a turbine casing which is shown in broken outline;

Fig. 2 is a side view of the grinding tool showing the rod supporting the tool partially broken away to reduce its length;

Fig. 3 is a sectional view taken across the pivot rod of the grinding tool showing one side of the tool;

Fig. 4 is a detailed view of the clamping arrangement employed for engaging and supporting the housing of the grinder motor;

Fig. 5 is a side view of the grinder showing the side opposite that shown in Fig. 3; and

Fig. 6 is a sectional view taken through the bottom shell of a turbine and this view is employed for the purpose of facilitating an understanding of this invention.

Referring to the drawing in detail, there is shown in Fig. 1 a perspective view illustrating the use of this invention in the grinding away of excess metal that has been added to worn surfaces of a steam turbine casing, the bottom half of which is shown in this figure in broken outline and is designated by the reference numeral 10. A sectional view of this casing is shown in Fig. 6 and in this latter figure are also shown the stationary baffles 11 and the rotatable blades 12 as well as the shaft 13 to which the rotatable blades 12 are attached. The baffles 11 are provided with ridges 14 that extend into grooves 15 formed around the inside of the turbine casing. Suitable centering or crush pins 14a are provided between peripheral surfaces of the baffles 14 and surfaces of the turbine casing in and adjacent to the grooves 15, as shown in Fig. 6, for the purpose of holding these baffles in place.

During the operation of the turbine the ledges around the grooves 15 receive considerable wear and after a certain period of operation the eroded metal must be replaced in order to maintain the operating efficiency of the turbine. This metal is replaced by building up the surfaces of the grooves 15 by welding additional metal thereto as shown in Fig. 3. This welding operation, of course, cannot be so accurately controlled as to leave the surface of the turbine casing perfectly smooth and at the close tolerances required.

In accordance with this invention, the excess metal built up on the surfaces of the grooves 15 and adjacent thereto is removed by the use of a motor driven grinding tool. This grinding tool includes an abrasive wheel 16 that is driven by an electric motor 17 which is attached to an arm 18 by means of a clamp 19 of split hexagonal shape as shown in Fig. 4. This clamp 19 is of hexagonal shape to conform to the outer configuration of the housing of the motor 17 and it encircles this housing and it may, of course, be of any other shape for this purpose. The ends of the split part of the clamp are provided with a bolt 20 which is employed for the purpose of tightening the clamp around the outside of the motor. Additional bolts 21 are provided so as to select suitable portions of this clamp and these bolts may be employed for the purpose of more positively gripping and clamping the motor housing and also for the purpose of shifting the position of the motor and grinding wheel 16 slightly in order to make small adjustments in the course of the grinding operation so that greater precision may be obtained.

Other types of motors, such as, a compressed air driven motor or turbine or a suitable gas engine or turbine may be used instead of the electric motor 17 if desired.
The clamp 19 is attached to the block 22 which in turn is attached to the angle iron arm 18 that is attached to the collar 23. This collar may be fixed to the rod 24 or it may be fitted accurately around the rod 24 and rotated with respect thereto. The rod 24 is positioned with the axis thereof coinciding with the axis of the turbine housing. If the collar 23 is fixed to the rod 24 then the whole grinding assembly including the rod 24 may be shifted longitudinally along the axis of the turbine casing from one position to the next until all the turbine surfaces are finished as described hereinafter. However, if the collar 23 is fitted to the rod 24 and is rotatable with respect thereto, the rod 24 may be fixed in one position. In this latter case however, limiting collars must be fixed on the rod 24 on each side of the collar 23 to prevent undesired shifting of the collar 23 longitudinally on the rod. The positions of these limiting collars must of course be adjusted for each grinding position. Where the rod 24 and collar 23 are fixed together as described above, suitable limiting collars 28a must be positioned abutting one of the bearings of this rod as shown in Fig. 2 to prevent undesired longitudinal movement thereof.

The rod 24 is journaled in the bearings 25 and 26 that are secured to the angle iron members 27 and 28 respectively. These angle iron members are supported by pillow blocks 29 and 30 respectively, at the opposite ends of the turbine casing. The angle iron members 27 and 28 are bolted down to the turbine casing so that these members and the bearings associated therewith are securely held in place during the entire grinding operation. This grinding operation is performed by gradually moving the grinder through its arc of rotation after the grinding tool is adjusted to remove a certain amount of undesired metal from the turbine casing. This operation is repeated proceeding from one groove 15 to the next until the turbine casing surface is ground down and finished to the desired dimensions. If desired the surfaces between the grooves 15 may be ground and finished in like manner. If necessary the grinding operation may be started with a coarse grinding wheel and finished with a relatively fine grinding wheel in order to provide the desired finish to the surfaces.

In order to make the manipulation of the grinding arrangement of this invention easier for the operator, a counter balancing weight 18b that is attached to the collar 23 by means of the rod 188 may be employed for the purpose of at least partly counter balancing the weight of the grinding mechanism. This weight also makes it easier for the operator to control the movement of the grinding mechanism about its pivot because the operator does not have to lift the entire weight of the grinder.

While I have described in detail a particular embodiment and example of this apparatus and method, it is, of course, not desired to limit this invention to the exact details as set forth except insofar as they are defined by the claims.

What I claim is as follows:

1. A device for refinishing and restoring to cylindrical form the internal surfaces of a two-part turbine casing after said casing has been disassembled and the eroded internal surfaces thereof have been built-up by having metal irregularly deposited thereon, a shaft, an arm, arm mounting means rotatably mounting said arm on said shaft for movement longitudinally thereof, a grinding tool comprising an electric motor and an abrasive wheel driven by the motor, means adjustably securing said grinding tool to said arm and permitting adjustment thereof along said arm toward and away from said shaft, a pair of mounting means for mounting said shaft for rotation and longitudinal adjustment of the parts of said casing so that the longitudinal axis of said shaft is rectilinearly disposed with the longitudinal axis of the turbine rotor, said arm and grinding tool being located between the two mounting means thereby said grinding tool will be in position to engage the internal surfaces of the turbine casing when said shaft is mounted as aforesaid, said arm mounting means permitting said arm to be swung manually and slowly about the axis of said shaft whereby the abrasive wheel of said grinding tool describes an arc and grinds away the excess metal deposited on the internal surfaces of the turbine casing thereby restore said surfaces to their original condition.

2. In a device for refinishing and restoring to cylindrical form the internal surfaces of a two-part turbine casing after said casing has been disassembled and the eroded internal surfaces thereof have been built-up by having metal irregularly deposited thereon, a shaft, an arm, arm mounting means rotatably mounting said arm on said shaft for movement longitudinally thereof, a grinding tool comprising an electric motor and an abrasive wheel driven by the motor, means adjustably securing said grinding tool to said arm and permitting adjustment thereof along said arm toward and away from said shaft, a pair of mounting means for mounting said shaft for rotation and longitudinal adjustment of the parts of said casing so that the longitudinal axis of said shaft is rectilinearly disposed with the longitudinal axis of the turbine rotor, said arm and grinding tool being located between the two mounting means thereby said grinding tool will be in position to engage the internal surfaces of the turbine casing when said shaft is mounted as aforesaid, said arm mounting means permitting said arm to be swung manually and slowly about the axis of said shaft whereby the abrasive wheel of said grinding tool describes an arc and grinds away the excess metal deposited on the internal surfaces of the turbine casing thereby restore said surfaces to their original condition.

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