Tool Innovation of Field Replacement Process for Governing Valve Seat of Feed-Water Pump Steam Turbine

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Abstract

This article aims to solve the problem of field replacement of the valve seat of the feed water pump steam turbine. By creating a new high-temperature and high-pressure portable special turning tool, the valve seat of the defective valve can be dismantled under normal temperature conditions and guarantee the strength of the valve body.Ultimately, the replacement process can be completed on-site.It has a wide application prospect in promoting the scientific and technological progress of the new tools and the new process.

Keywords

Feed-Water Pump Steam Turbine, Turning Tool,Field Replacement,Valve Seat.

1. Introduction

Jiangsu Kanshan Power Company Limited feed water pump turbine (commonly known as small steam turbine) technology from Siemens designed and manufactured by Hangzhou Steam Turbine PlantNK63/ 71/ 0 steam turbine, single-cylinder, single-flow, single-axis, reaction-type, pure condensation, external switching.

During normal operation, the steam source is the fourth stage of steam turbine extraction, the standby steam source is high pressure cylinder exhaust, and the start up steam source is auxiliary steam.The working steam first enters the steam box through the speed shut-off valve (SSV). The steam chamber is equipped with a plate-type adjustment steam valve. The oil engine determines the opening degree of the governing valve through the lever mechanism to control the opening degree of the valve and controls the steam flow entering the small steam turbine[1].The standby steam is controlled by the pipeline control valve.The outlet flange of the pipeline governing valve is connected to the speed shut-off valve. After the standby steam is adjusted by the pipeline governing valve, it passes through the speed shut-off valve, the governing valve and the nozzle successively to enter the governing stage to do work. At this time, the governing valve is fully opened and can not be used for regulating.

2. Feed-Water Pump Steam Turbine Working Procedure

The company's small steam turbine start up debugging steam source for the auxiliary steam, auxiliary steam steam pipe normal pressure of 0.8~1.0MPa, the temperature is 200~ 380 °C.

Firstly, a good vacuum should be established and the shaft seal system should be put into operation for the start-up process of the feed water pump steam turbine.Meanwhile, the jigger is drived by the oil turbine, and the speed of the jigger is approximately 300r/min. Feed water pump steam turbine is allowed to latch after the inlet pipe has been fully warmed up and drained.The process of latching is to open the speed shut-off valve. After the steam passes through the speed shut-off valve, it enters the interior of the governing valve chamber. The governing valve does not open at this time. In this state,

the rotation speed of the feed water pump steam turbine remains constant, and the rotating speed of the jigger is maintained. The next step is to warm up the feed water pump steam turbine. At this time, the governing valve is opened according to the command of the controller, and steam turns the feed pump turbine rotor. By controlling the opening degree of the governing valve, the rotation speed is controlled at 800 r/min, and the warming time is required to be at least 45 minutes. The procedure is aimed to make the rotor and the cylinder heat evenly, fully expanded.

3. Problem Description

During the start-up process on March 9, 2015, the automatic mode was entered and the target speed 800 r/min was set. When the speed shut-off valve was fully open and the governing valve was not opened, the speed of the small turbine increased to 1700 r/min abnormally.

From Figure 1, it can be judged that due to the small steam turbine adjusting valve inner leakage, the auxiliary steam leaks from the valve, the steam turbine initial steam inlet amount deviates from the target value, the turbine rotor lift rate is large, the steam flow excitation force increases, and the rotor is in the starting process.

In this case, if the start of the small turbine is realized, the site adopts a scheme for adjusting the inlet speed shut-off valve (SSV) opening to steam.The quantity is controlled, and the most serious hazard caused by the small turbine governing valve is that the small turbine speeds.As the prime mover of the feed pump, the small turbine has a powerful dynamic torque, which causes the stress of the rotor part due to over-speed operation.

If the speed exceed the allowable value, it will cause either the blade to shake off or the bearing damage, even entire small steam turbine scraps.

Therefore, the speed of small turbines is a serious accident that poses great danger to human safety and equipment [2,3,4,5]. In order to implement the requirements of the “Anti-measures to prevent 25 electric power accidents” and ensure the safe and stable operation of the electric power system, it is imperative that the valve tightness test and valve replacement work be carried out without delay.

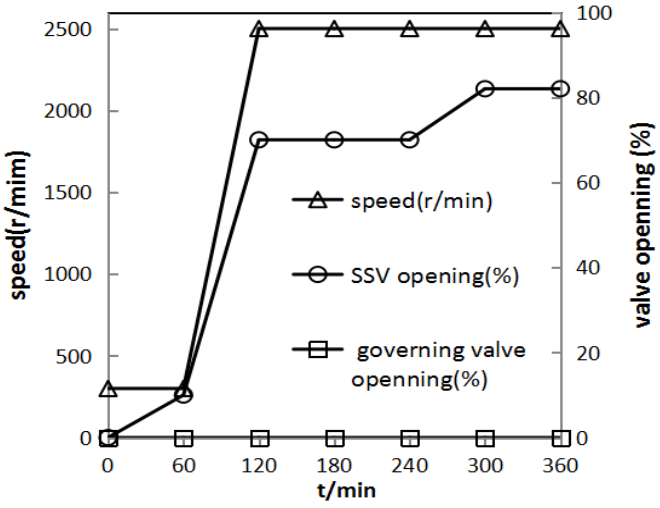

Figure 1. The curve of speed shut valve curve, low pressure regulator valve opening and rotating speed, which is before changing the seat of low pressure regulator valve

4. Seat Replacement Process Introduction

For the valve seat replacement process, the following three disassembly processes were obtained through literature research.

(1) Dry ice freezes and contracts the valve seat [6, 7].Due to the different metal expansion coefficients of the valve seat metal and the base metal, the valve seat has a large degree of contraction after freezing,

so that the valve seat is released from the base material.However, this solution requires the removal of the cylinder and the inlet chamber complete and return it to the original manufacturer. The site does not have the cold removal process conditions. The above scheme cannot meet the requirements of the construction period and quality during the shorter period of time or during the repair.

(2) Liquid nitrogen cold dismantling [8].The use of a cold dismantling solution to remove the valve seat is in principle consistent with the use of a dry ice-cooled dismantling process.

(3) Electric heating method.The heating method is the most commonly used disassembly method for interference fit. The principle is that alternating current generates alternating current eddy currents in the base metal, and the eddy current will generate heat due to the internal resistance of the metal to heat the base metal and increase the temperature difference between the base and the valve seat, make the valve seat out of the parent material.The above-mentioned demolition valve seat processes all have a series of problems, such as a long working period, complicated processes, and the influence of temperature on the material. To realize the replacement of valve seats in the field, it is necessary to research and develop a new type of tool which can meet the requirements of quickness, practicality, and handleability, thereby reducing the number of processes and workload, shortening the construction period, and ensuring that the metal material of the valve seat is not influenced by the installation technology.

5. Introduction to Special Tool

Process innovation can not be separated from the use of overhaul tools. The company has designed a new type of practical tool in the field replacement of valve seat of small steam turbine governing valve,including turning tool, vertical guide inner sleeve, outer sleeve, fixed flange, hand wheel, lock ring and so on, which is shown in Figure 2 .The new type of practical tool is essentially a portable movable lathe, with a turning tool driven by an motor that can rotate inside the valve seat.The turning tool is scalable horizontally, as a result,it can adjust the cutter feed in the horizontal direction. The outer sleeve is fixed to the flange by a locking ring, and the flange is mounted on the end cover of the governing valve as the basis of the lathe.The guide inner sleeve and the outer sleeve are connected by screw, and meanwhile they fit the key constraint inner sleeve rotation, which ensures that there is only vertical relative displacement between the inner and outer sleeve, and no relative rotation motion occurs between them.The relative position of vertical direction between inner sleeve is adjusted by rotating thread of hand wheel,thus the displacement of turning tool in vertical direction is embodied.According to the depth of the valve seat and the diameter of the seat hole, the horizontal position and depth of the cutter are adjusted reasonably, and the helical movement of the tool from top to bottom is embodied under the driving of the motor.Hence,the whole turning process of the valve seat is completed.

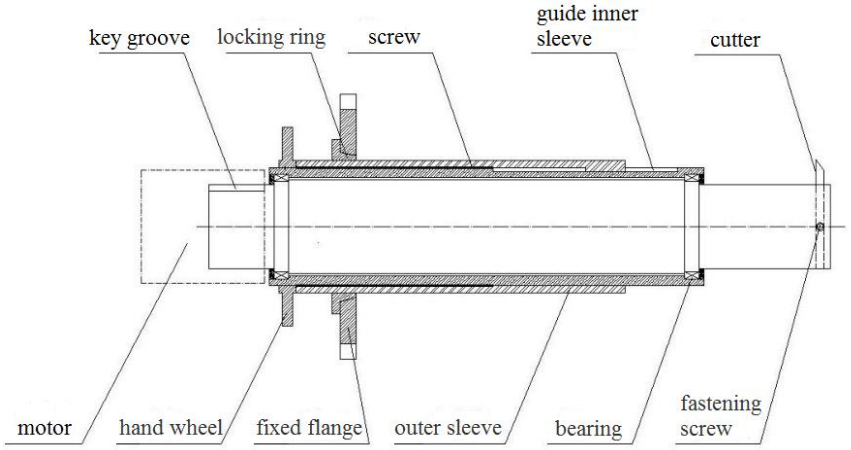

Figure 2. Structure of special tool

6. Removal of Seat Process

Remove the valve core before using and block off the valve hole with cotton cloth to prevent sundries from falling among the turning process. The tool is hoisted and fixed on the end cover of the governing valve. The flange depends on the locking ring to fix the depth of the outer sleeve entering the valve chamber and plays the role of coarse adjusting the depth of the turning tool.The flange is fixed firmly, according to the turning procedure from top to bottom and the depth parameter of the valve seat, adjust the depth of turning tool step by step.

Change the expansion and contraction quantity in horizontal direction of turning tool according to the radius of valve hole, and increase the turning radius step by step.After the turning tool is positioned correctly in the horizontal and vertical direction, motor is started .After slowly turning a horizontal plane, the depth and radius of the turning tool are adjusted, and the work on each horizontal plane is continued according to the above method.The motor is a constant speed, the motor drives the turning tool to rotate via the transmission shaft, it is vastly necessary to pay attention to the size of the feed cutter.When the amount of feed is too large, the required torque is too large either,it will entail the reduction of speed of the motor;When the amount of feed is too small, the required torque is too small either,so that the turning progress is slow.Through measuring and adjusting, it is determined that the feed amount of each cutter is 3~4 mm.After turning the whole seat, remove the tool and vacuum the seat to ensure that the valve box is free of impurities, and then remove the valve hole to block off.When installing the new seat, freeze the valve with dry ice for a period of time and load it into the base material.

The maintenance does not adopt the traditional freezing removal scheme[9,10], which ensures the stability of the crystal structure of the base material in the process of cold treatment and the precision of the structure before and after maintenance.After start up, when the speed shut-off valve(SSV) is fully open, the low-pressure throttling valve slowly opens, and the speed of the small turbine rises steadily to 800 r/min, as shown in Figure 3.In this way, the starting condition of small steam turbine can be satisfied and the unit can be started smoothly.

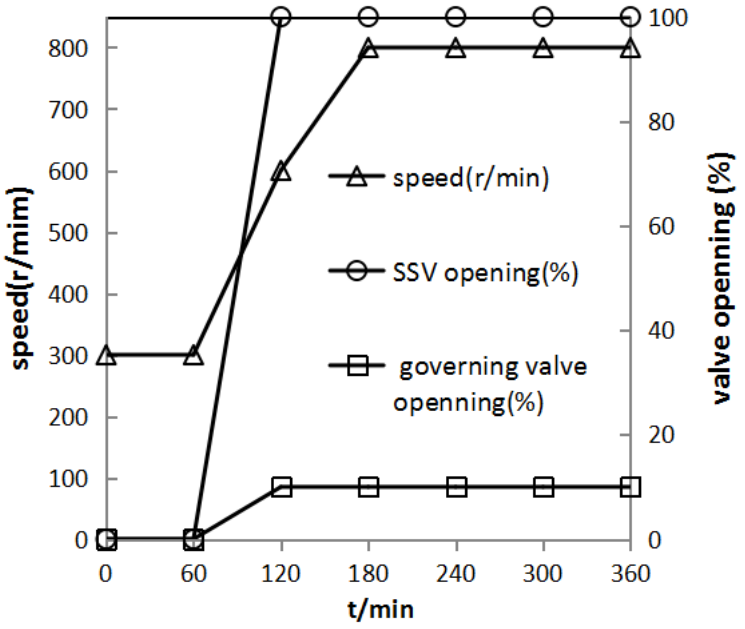

Figure 3. The curve of speed shut valve curve, low pressure regulator valve opening and rotating speed, which is after changing the seat of low pressure regulator valve

7. Conclusion

This article is aimed at the problem of field replacement of the valve seat of the feed water pump steam turbine. By creating a new high-temperature and high-pressure portable special turning tool, the valve seat of the defective valve can be dismantled under normal temperature conditions. It has a wide application prospect in promoting the scientific and technological progress of the new tools and the new process.

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