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MEASURING THE AXIAL FORCES AND THE SEGMENT TEMPERATURES OF A STEAM TURBINE AXIAL BEARING

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The report deals with measuring the axial forces and the temperatures of composite metal linings of thrust bearing segments on a turbine unit rotor. Measurements were taken in primary running-in regime (condensating operation) of the machine up to approx. 70 % of its power.

1. INTRODUCTION

The magnitude of affecting axial force and warming-up the composite metal linings of separate segments during operation belong to those parametres, which significantly influence the calculation and in final form the operating reliability of the thrust bearing on a steam turbo-set.

The aim of this measuring consisted in experimental finding-out these parametres at steady-state regimes, when starting-up onto the power. The metodic process consisted of a proposal concerning the thrust sensor, of measuring way of segments temperatures, of thrust and temperature sensors calibration, of proposing the complete measuring chain and of a a way, how to process the data measured.

2. SENSOR OF AXIAL FORCE (THRUST SENSOR)

The adapted carrier of segments was used as the thrust sensor. The principle of this adaptation consisted in forming the simply bended beam, which is loaded by a concentrated force affecting the beam approximately at the centre between the two supports. The deformation has been measured by a pair of folio-type strain gauges 3/120 LY 11 HBM connected into a semibridge. Active side carried 6 measuring places, while the inactive one 8 measuring places. Placing of strain gauges was optimalized on PC with the aid of the MKP method.

The dynamometric rings (adapted carriers of segments) were calibrated on electrohydraulic loading device SCHENCK 250 kN at the dynamic testing laboratory of our plant. This calibration served for gaining the linear constant of dependence between the loading force of the dynamometric ring and its deformation expressed by a change of electric voltage on the strain gauge bridge. Measurements were taken at levels of 0 to 8,2 kN for the active side (ASB) and at levels of 0 to 3,7 kN for the inactive (ISB) one.

3. WAY OF MEASURING THE TEMPERATURES

The temperatures were measured by thermocouples built-in into the sliding linings of bearing segments. For taking these measurements 4 measuring places were prepared at active side and 6 measuring places at inactive one. The thermocouples of type T/(Cu-Ko) were used for this temperature measurings. Both at the active (ASB) and inactive (ISB) side, two places were fitted with steadily built-in and stripable jacketed thermocouples, the signal of which was led-out to control desk.

The thermocouples were calibrated on type WOBSER U-8 Ultrathermostat at dynamic testing laboratory of our plant. The calibration was carried-out gradually up to 110°C in extents of 10°C and the results consisted in defining the linear coefficients by interlacing with one or two straight lines.

4. MEASURING CHAIN

The measuring chain built-up from the measuring sensor (strain gauges LY 11 HBM), the amplifier (central unit UPM 60 with measuring circuits 3209 for measuring the deformations and 3205 ones for measuring the temperatures) and from the controlling and evaluating unit (LCD Portable Computer). (See Fig.1).

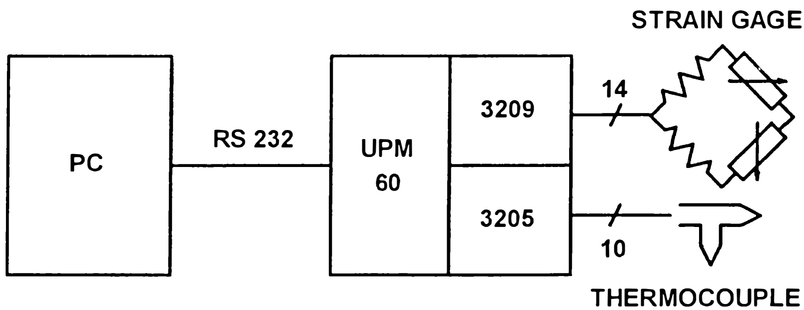

Fig. 1

5. PROCESSING THE VALUES MEASURED

The measured values were gained by measuring the thrusts and temperatures of thrust bearing segments at various regimes of the turbine, which have been pre-set on the control desk. The main values set were represented by the machine power and speed. The inlet and outlet parameters of the steam (pressure, temperature and flow rate) were followed as depended values and further the same values at steam bleedings. The steam turbine has operated in its running-in regime only and therefore the loading cycle has finished on approx. 70 % of maximum power of the machine. On each stage of loading two measurements were taken, at which the axial force and temperature was measured of each segment. The values measured served for defining the total force F_c at active and inactive side of the bearing. Next, the average force F_s and specific pressure p_s were calculated, which affect the segment of both bearing sides. Similarly, the average temperature t_s was stated from separate thermocouples measured including the jacketed ones. Fig.2 shows distribution of total force F_c and of average temperature of thermocouples t_s, speed, power output and flow rate for both the active(A) and inactive(I) side(S) of the bearing(B) in the time dependence.

6. CONCLUSION

The measuring proper has confirmed a good correspondence of the thrusts measured with calculated values for the sort of load given (condensating operation). The same can be noted for the measured temperatures of segments. When comparing the starting values of the dynamometers and the values measured after assembly of segments into the bearing, a smooth overload has been found-out practically at all the dynamometers. This can be explained by cumulation of material allowances, which appears at final assembly. Finally, there was noted a necessity to gain a complete set of measured values at all the operating regimes, which will be possible to be effected as late as at guarantee measurings of the machine at its handing-over.

Literature:

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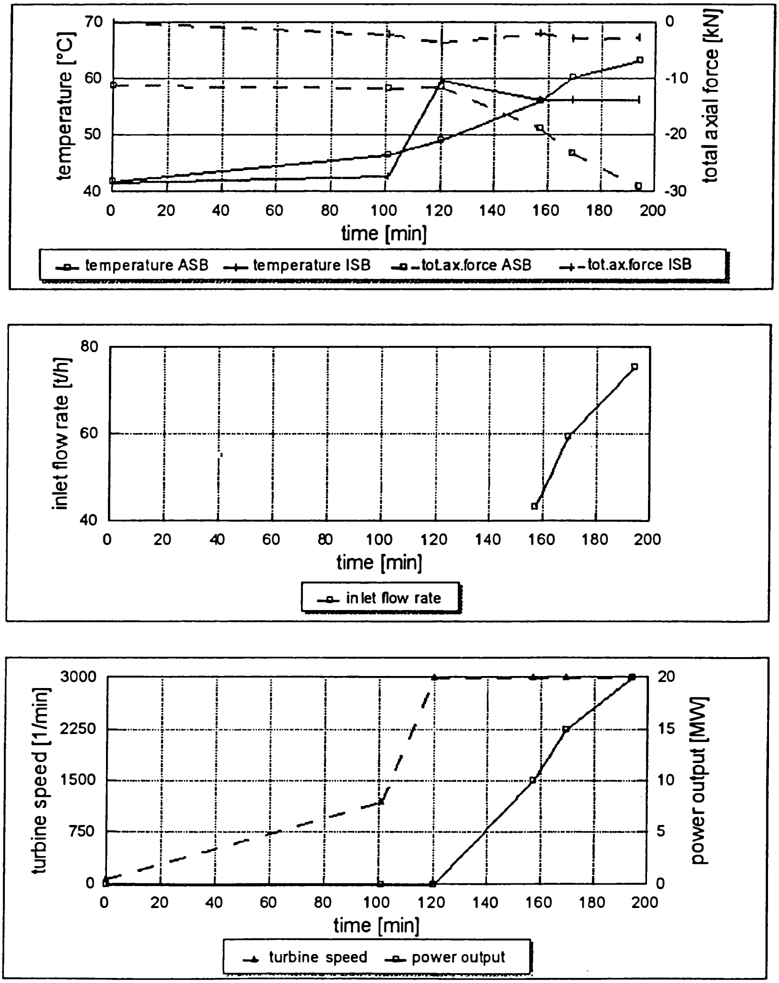

Fig. 2

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