

Case History	Thermally Induced Bending Vibration in Large Turbine due to Contact with Bearing Seal	Rotating machinery (turbine & generator)
Self-Excited Vibration		

Object Machine

Large steam turbine

Observed Phenomena

Vibration of rotating speed component occurred that uniquely changes with time.

Cause Presumed

It is assumed that, due to heat input caused by contact with the bearing seals, the shaft bent microscopically, resulting in the generation of vibration. The mechanism of this phenomenon is indicated in Fig.1.

Analysis and Data Processing

Figure 2 shows plotting of vibration vectors (rotating speed component). It is also found that the vector changes make a circle, which takes about one day. Plotting of temporal variations in the vibration level of rotating speed component is given in Fig.3, where periodic changes are clearly illustrated.

Countermeasures and Results

Vibration vectors as shown in Fig.2 were plotted for several points along the axial direction. It was estimated from these data that the seals near the #3 bearing were likely to be in contact. For the purpose of verifying this estimation, bending was assumed at several points along the axial direction, which was compared with the actual measurements. Figure 4 is a comparison of calculated and measured values, which shows a very high degree of correspondence. After estimation as per this method, inspection was made of these positions in the machine at standstill, which revealed marks of slight contact as expected. After repairing of gaps, the problem was completely solved.

Lesson Learned

Thermally induced bending vibration may occur due to contact with gland seals or bearing oil deflectors of steam turbines, gas turbines compressors, etc., thus requiring attention to be paid.

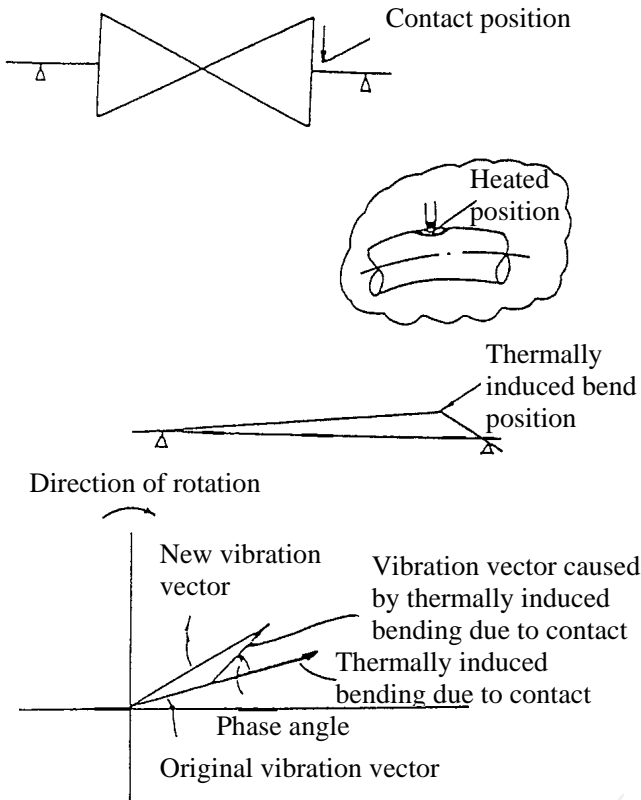
References

Shiraki et al. 1981 Health monitoring system by means of vibration of rotating machinery. *Technical Review of Mitsubishi Heavy Industries*18(6),

Keyword

Thermally induced bending vibration * May develop even by slight contact

★ In case of large rotating machinery, vibration due to rubbing normally occurs as changes in vibration of the synchronous component of rotation. The magnitude and speed of vibration depend on the strength and position of rubbing.



Since the thermally induced bending due to contact and the vibration vector caused by the bending have a phase difference, the direction of contact rapidly changes, and so does the vibration vectors.

Fig.1: Mechanism of thermally induced bending vibration due to contact

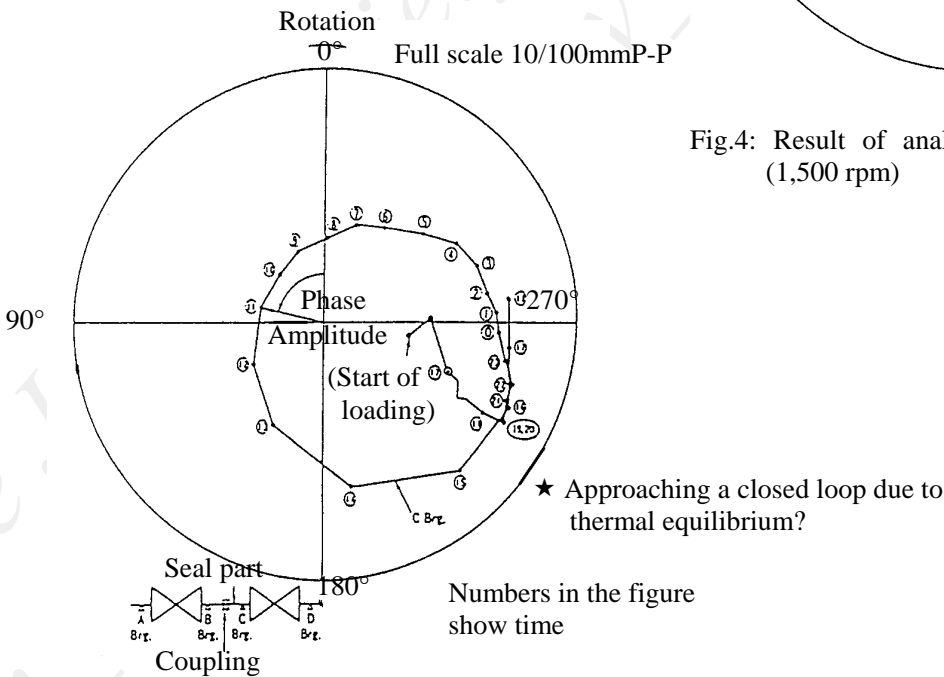


Fig.2: Changes in vibration due to seal contact

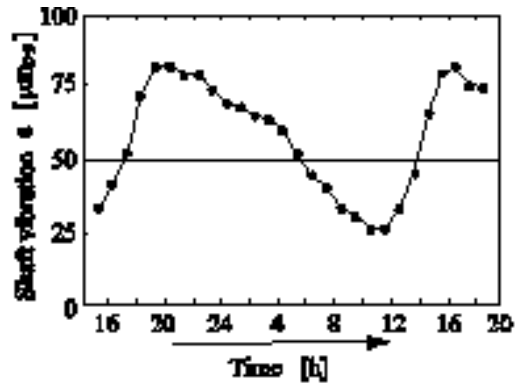


Fig.3: Changes in vibration due to seal contact

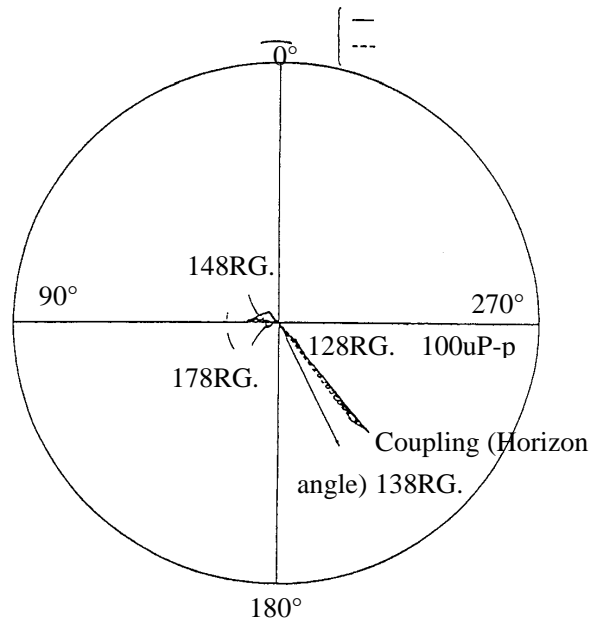


Fig.4: Result of analysis of contact response at seals (1,500 rpm)