Case History	Rotor Vibration of Steam Turbine	Rotating machinery (turbine & generator)
Forced		

Object Machine

Steam turbine (generator drive, extraction condensing type, Fig.1)

Observed Phenomena

As per indications of the shaft vibration meter for monitoring turbine operation at site, vibrations up to the rated rotation (6,263 rpm) at no-load are small in amplitude (peak-to-peak amplitude of 25 μm or less), while they increase (30~75 μm) for increasing load (1~16 MW). Vibrations also change according to the amount of steam extraction (20~120 t/h) (Fig.2).
Results of frequency analysis of the shaft vibration meter output using a handy type FFT analyzer indicate the major synchronous component of the vibration (Fig.3).

Cause Presumed

Judging from the prominent synchronous component of the vibration as shown in Fig.3, unbalance was estimated to be the cause, while changes in the amplitude according to load changes illustrated in Fig.2 led us to assume that thermal unbalance was the cause.

Analysis and Data Processing

After making it possible for us to measure the phase angle of shaft vibration by detecting the reference position (one pulse per one revolution) of the rotating shaft, further analysis was made of shaft vibration using a field balancer (Fig.4).

Countermeasures and Results

Balancing was performed by using an added mass as a compromise measure for thermal unbalance due to the rotor bending and eccentricity caused by difference in thermal expansions of turbine rotor materials (Fig.5).

Lesson Learned

Unbalance correction has been applied this time. It is, however, important at the same time to minimize the sensibility of the rotor shaft system to unbalance.

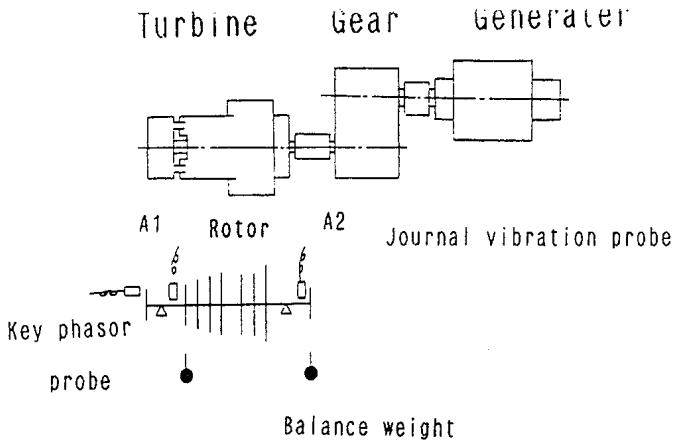
References

Shiraki, Kazuhiro; Kanki, Hiroshi. 1977. Series course "Vibration Problems in Machinery Industry (5)". *Research of Machine* 29(11)

Keyword

Thermal unbalance

★ Transient thermal bending of rotors is an inevitable phenomenon, thus attention shall be paid to steam turbines and the like that are subject to significant thermal changes. It is important to minimize the unbalanced vibration sensibility at operation rotating speed.



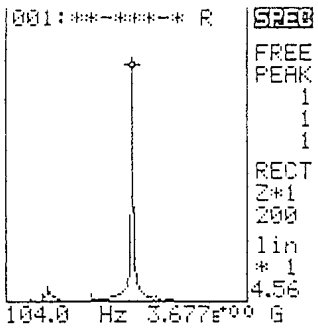


Fig.1

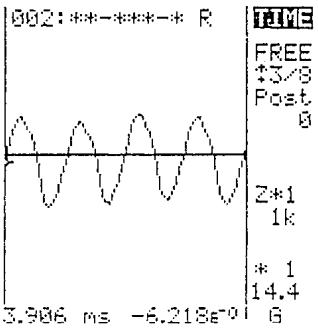


Fig.3: by Probe A1

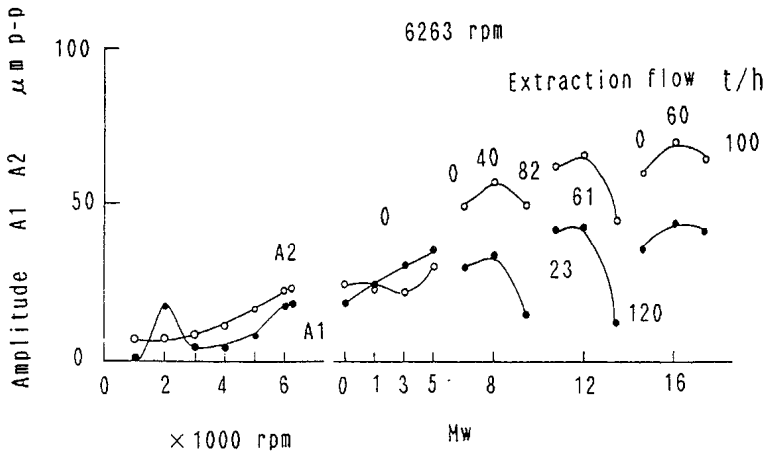


Fig.2

★ In case a large amount of absolute unbalancing is distributed in a balanced mode, vibration changes may occur due to changes in alignment, as shown here.

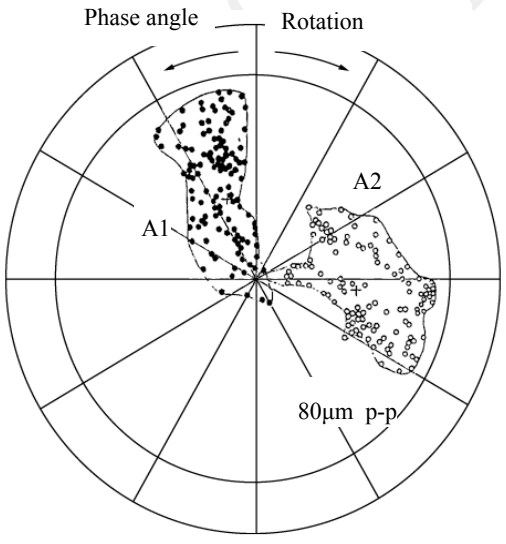


Fig.4: Before field balancing

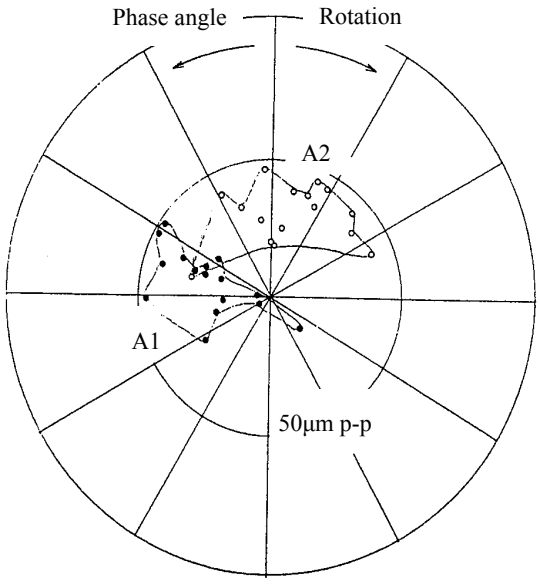


Fig.5: After field balancing