Orbit Magazine

Throwback Thursday - Torsional Vibrations: Part 2

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Bently Nevada has a rich history of machinery condition monitoring experience and has always placed a high priority on educating and helping customers manage & maintain their equipment better. Every week, an article or Application Note that was published by Bently Nevada 'back in the day' will be highlighted. Although the format may be dated, the information is just as valid and informative as the original printing.

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Torsional oscillations from the synchronous motors manifest tn two distinct detrimental characteristics on the driven machinery. First, due to the cross coupling characteristic, (torsional motion to radial vibration) potentially destructive radial vibration may occur. The levels of radial vibration present can be measured directly with the use of proximity transducers. This data can be plotted as shown in FIG. 1 of PART I of these articles (see below). This plotting technique provides insight into the max levels present during start-up and also confirms the source of these vibrations to be directly associated with the tors tonal forcing function from the synchronous motor.

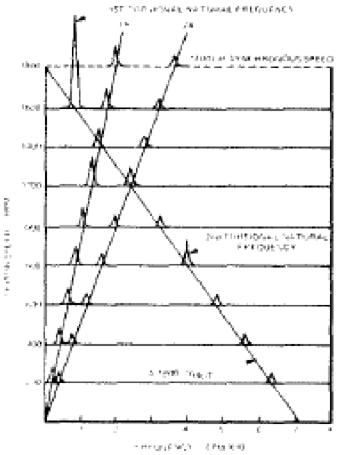


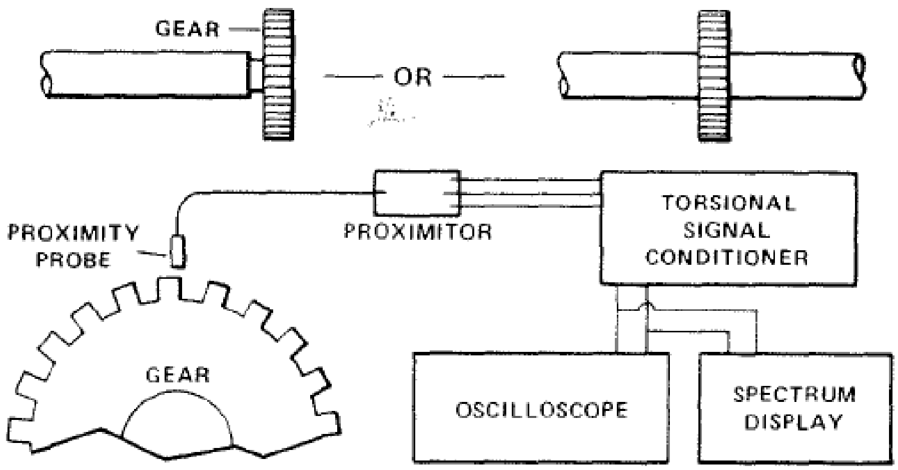
FIGURE 1

The second measurement required is to determine the magnitude of the torsional oscillation in 0-peak or peak-to-peak degrees. This measurement can ultimately then be utilized to determine the total angle of twist present across a shaft element, and the resultant shear stresses imposed on the shaft.

Most attempts to provide this measurement have employed the use of strain gauges mounted directly on the rotating element, (usually at the low speed coupling) with a slip ring assembly to monitor the strain gauges. Strain gauge technology has vastly improved in recent years, and can provide highly accurate measurements of stress levels present on a rotating element.

Another measurement technique for measuring torsional oscillations uses a proximity transducer, and a precision manufactured externally mounted reference gear. The proximity transducer ts mounted directly over the reference gear and observes the tooth passing velocity and time interval from tooth to tooth (See Fig. 2). If the shaft element is operating at constant velocity, i.e. no torsional action, the timing between teeth passing is a constant time interval. In the case of torsional oscillation, the time interval will change and the frequency of this rate-of-change will be sensed by the proximity transducer. This provides a means to determine the torsional velocity. This output is then integrated to yield torsional displacement in 0-peak or peak-to-peak degrees. If this measurement is performed at two planes of measurement along the axis of rotation, the total angle of twist and the resultant shear stresses can be calculated.

FIG. 2 MOUNTING ARRANGEMENT FOR REFERENCE GEAR



SUMMARY:
With the growing tendency toward utilizing synchronous motor-driven systems, a renewed appreciation and concern toward measuring torsional characteristics must be considered. Shaft stresses and potential cyclic stresses in the gear teeth must be properly documented to provide direct insight into the life expectancy of the rotating systems based on the number of stops and starts of the synchronous motor.

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