Strand Vibrations in Roller Chain Drives

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This paper presents an analytical study on the vibration of tight strand in chain drive, which occurs in a plane parallel to the plane of sprocket wheels and is perpendicular to the direction of tight strand.

In analysis of the vibration, numbers of teeth in sprocket wheels and tension due to chain weight were taken into account, and the equation of strand vibration was derived, under such considerations that one chain link is a rigid body and the chain is a train of rigid bodies. This equation was solved by Laplace-transformation and Z-transformation methods, in such cases as pitch diameters of driving and driven sprocket wheels are unequal or equal, and tight strand is inclined with horizontal plane, or it is horizontal. In cases of horizontal strand, it was shown that chain is represented as dynamical systems with several transfer functions, in compact.

In chain drive, its tight strand of chain may have a marked vibration at some special running velocity of chain. This special velocity is defined as the critical speed in chain drive and is of practical importance.

Making use of the solution of the above-mentioned vibration analysis, this phenomenon was analyzed and the critical speed was determined theoretically.

Among several conditions which affect the critical speed, such conditions as numbers of teeth in sprockets, numbers of free links in tight strand and inclination of tight strand are of practical interest. Therefore, the relations which exist between critical running velocity of chain or critical angular velocity of sprockets and numbers of teeth in sprockets were discussed. And, it was also shown how numbers of free links in tight strand had an effect on these critical speeds.

In cases when some alternative force acts on chain drive from its surroundings, tight strand of chain may show resonance phenomena.

As it is practically necessary to get the relation between running velocity of chain and natural frequencies of running chain, so an analysis of resonance phenomena was performed.

From this analysis it could be concluded that natural frequencies are determined even if working tension of chain is zero. And, in case of large initial tension, the natural frequencies well agree with theoretical natural frequencies of stationary chain, which is calculated by Binder's theory. Also there are fair agreements between experimental results and this theoretical results.

In the end of this paper, the resonance phenomena in chain drive, which is not in motion, was discussed and this result was compared with Binder's result.