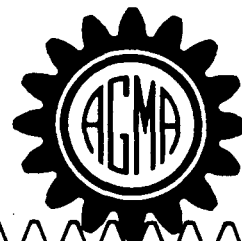


Failures of Bevel-Helical Gear Units on Traveling Bridge Cranes

by: J.M. Escanaverino, ISPJAE

American Gear Manufacturers Association



TECHNICAL PAPER

Failures of Bevel-Helical Gear Units on Traveling Bridge Cranes

Jose Martinez Escanaverino, ISPJAE

[The statements and opinions contained herein are those of the author and should not be construed as an official action or opinion of the American Gear Manufacturers Association.]

Abstract

Many bevel-gear units are employed in traveling drives of large industrial bridge cranes all over the world, as they form compact packages with couplings, brakes and electric motors other gear units do not allow for. In a number of drives, frequent failures of the bevel gear pose a difficult problem for maintenance, and have raised unclosed discussions about the necessary service or application factor. According to some standards, these drives require gear unit service factors as high as 3.0. This paper focuses on the origin of the troubles, with an insight on the dynamics of the gear train. Attention is also given, in such failures, to the influence of variable-speed controllers of electric motors. The theoretical analysis is backed by real industrial case studies, taken from the author's recent experiences.

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FAILURES OF BEVEL-HELICAL GEAR UNITS ON TRAVELING BRIDGE CRANES

Jose Martinez Escanaverino, Professor
Mechanical Engineering Faculty, ISPJAE
Havana 19390, Cuba.
escanaverino@hotmail.com

INTRODUCTION

Bridge cranes are among the most useful machines in many branches of modern industry. Using standard hooks or other specialized clamping devices, they can lift, transport, discharge, and stack a variety of loads.

Gear technology progress has been always influential to advances in bridge crane design, allowing lighter and more productive cranes. Many bevel-helical gear units are employed in traveling drives of big industrial bridge cranes, as they form compact packages with couplings, brakes and electric motors other gear units do not allow for.

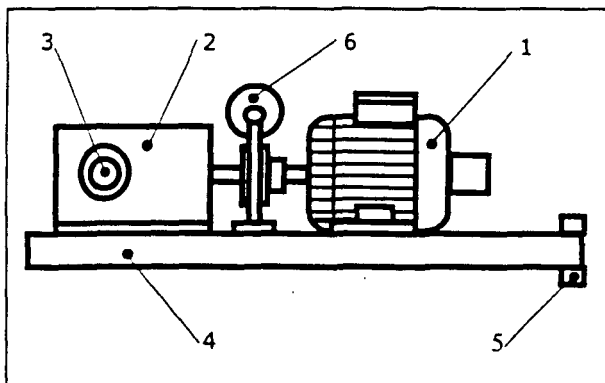


Figure 1: Typical bridge crane traveling drive

A sketch of a typical individual wheel traveling drive is shown in Figure 1, where position 1 is the electric prime mover, and position 2 is the gear unit, usually with a hollow low-speed shaft 3. The gear unit is mounted on a floating base 4, common with the prime mover. All the aggregate pivots on the low-

speed shaft and is vertically fixed, at the other end, to the crane framework by means of elastic blocks 5. The flexible coupling between prime mover main shaft and gear unit high-speed shaft usually combines with a drum brake 6.

In a number of cranes, frequent failures of travel bevel gears pose a difficult problem for maintenance, as a source of downtime. Besides, unclosed discussions have raised about the necessary service or application factor to avoid such failures. Recommendations found in prestigious sources give application factor values from as low as 1.1 to as high as 3.0. In many gear unit catalogs, crane traveling drive selection refers to the manufacturer, giving no other guidance to crane designers or plant maintenance engineers.

This paper focuses on the origin of troubles with standard general purpose bevel-helical gear units used in traveling drives of medium and large size bridge cranes, according to the author's theoretical research and practical experience.

NATURE OF THE FAILURES

Usually, failures of crane traveling drives are of a catastrophic character, with sudden fracture of one or several teeth in the bevel gear, ordinarily the high-speed stage in the gear unit.

The above mentioned failures are very difficult to anticipate, because time between failures [2] behaves chaotically. Sometimes the gear works well during a relatively long period, in the order of several weeks, and sometimes the gear breaks down after a few minutes of work.