Title:

Manufacturing Method of Pinion Member of Large-Sized Skew Bevel Gears Using Multi-Axis Control and Multi-Tasking Machine Tool

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Abstract:

Skew bevel gears have teeth that are straight and oblique, and are widely used at the plants of large-sized power generation when the gears have large size. In recent years, the renovation for the maintenance of plants have been active because the large-sized plants have become old and out of date . At the same time, the skew bevel gears have been also necessary to change in the plant. According to this situation, there is a case where only pinion member is changed. In this case, it is necessary to manufacture the pinion member that has a good performance mating with the gear member.

In this paper, a manufacturing method of the pinion member of the large-sized skew bevel gears using multi-axis control and multi-tasking machine tool considering that gear member is provided is proposed. The manufacturing method has the advantages of arbitrary modification of the tooth surface and machining of the part without the tooth surface.

First, the tooth forms of skew bevel gears are modeled mathematically and the tooth contact pattern and transmission errors of these bevel gears are analyzed. Next, the real tooth surfaces of the gear member are measured using a coordinate measuring machine and the deviations between the real and theoretical tooth flank forms are detected using the measured coordinates. It is possible to analyze the tooth contact pattern of the skew bevel gears with consideration of the deviations of the real and theoretical tooth flank forms expressing the deviations as polynomial equations. Fourth order components of the deviations of tooth flank forms which correspond to the distortions of heat treatment and lapping and so on are utilized because the motion concept may be implemented on multi-tasking machine. Moreover, the deviations of the tooth flank of the gear member are fed back to the analysis of the tooth contact pattern and transmission errors, and the tooth form of the pinion member that has a good performance mating with the gear member. Finally, the pinion member is manufactured by a swarf cutting using multi-axis control and multi-tasking machine tool. Afterwards, the real tooth surfaces of the manufactured pinion member were measured using a coordinate measuring machine and the deviations of the tooth flank form were detected. As a result, the obtained tooth flank form errors were small. In addition, the tooth contact pattern of the manufactured pinion member and provided gear member was compared with those of tooth contact analysis. As a result, there was good agreement.