A Paper on Planetary Gear Train

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ABSTRACT: For power transmission, planetary gear trains are used extensively and are the most important part. Thus, Planetary gearboxes are mostly used to match inertia, lower engine speed, increase torque, and have a stable mechanical interface for pulleys, cams, drums and other mechanical components at the same time. This paper presents the benefits of planetary gear systems over others, to be taken into account when deciding the gear box reduction ratios, minimum and maximum reductions per planetary gear pair level. The case study to evaluate the two-stage gear box reduction ratio is also discussed. The comparison between the planetary gear system and the helical gear system is based on volume, weight and torque density.

KEYWORDS: Gear system, Planetary, Torque, Industrial application, Inertia, Train power, Gear box.

INTRODUCTION

In a broad variety of industrial applications, planetary gears are used to transmit power. A planetary gear schematic is shown in (Figure 1). Both planetary and epicyclical gears have three bodies, the carrier, the ring gear, and the sun gear, which we refer to as central members. The planet's gears are bound to the carrier by bearings and are meshed with the sun and ring gear at the same time [1]. Depending on the design load of the machine, the number of planetary gears varies. Having multiple planets offers multiple load paths and lightweight packaging for planetary gears. Both central members rotate along the same axis kinematically, although usually one central member is stationary. The planet's gears rotate around axes that are connected to the carrier, which can rotate as well.

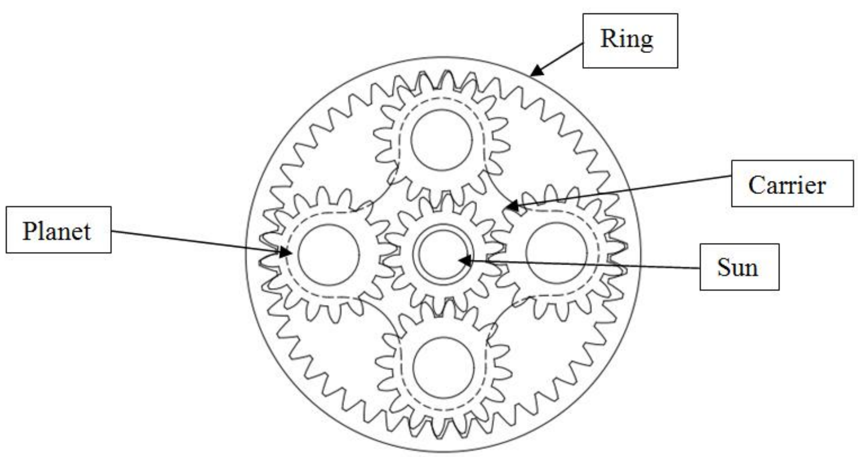

Figure 1: Schematic diagram of a planetary gear train

Industrial applications now need high torque in compact packages (high torque/volume) and light packages (high torque/weight ratio). In planetary gears, by multiple gear mesh points, torque density can be increased by adding more planets. This implies that three planets can transfer three times the torque of a similar sized fixed axis with a planetary gear with say-standard spur gear system. The applied load to planetary gears are distributed onto multiple gear mesh points means the load is supported by N contacts (where N = number of planet gears) increasing the torsional stiffness [2] of the gear train by factor N. It also decreases the lost motion relative to normal gear trains of comparable scale [3].

For applications with positioning accuracy and repeatability requirements, high rotational stiffness is necessary, particularly under fluctuating load conditions. This is why planetary gears are used in automation for such applications [4]. The added inertia results in an additional need for torque/energy for both acceleration and deceleration. Smaller gears result in lower inertia in the solar system. It is a reasonable estimate to conclude that the planetary gearbox inertia is smaller by the square of the number of planets relative to the same torque-rated standard gearbox. Again, this value is embedded in the distribution or branching into several gear mesh locations of the load. Fixed axis spur gears will exhibit lubrication, hunger, and fail quickly while operating at high speeds.

Hence, for better lubrication, pressurized forced lubrication systems are required. Grease lubrication, on the other hand, is impractical because of a tunneling effect in which the grease is forced away over time and is unable to flow back into the mesh. The lubricant is continually redistributed, pushed and pulled into the gear contacts or blended into the gear contacts in planetary systems. Planetary gearboxes can also be lubricated for life with grease [6]. Because of the relative motion between the various gears making up the arrangement, this feature is inherent in planetary gearing.

LITERATURE REVIEW

Prabhakar V Pawar et al in their research paper [3] titled “Critical Review of Design of Planetary Gears and Gear Box” told that in automotive and industrial applications, there is a great need for powerful and lightweight gear boxes to enhance their power density while reducing their complex vibration and noise delivery. Planetary gear transmissions are recognized to have many benefits over traditional transmissions, such as a high power density due to the division of power using several planetary gears.

Sylvester V. Ashok along with his team mates mentioned in their paper that the benefit of high speed reductions inside a limited space is provided by a planetary gear. It can be modified to be a CVT with speed transfer assistance from a motorized controller. This is the fundamental component of a CVT of this kind. This function should be adaptable to most helicopters' driving systems [6].Rotors are designed for operation at particular speeds and this system provides the capability of having a smooth transition between the required multi speeds.

RESULT AND CONCLUSION

Different manufacturing errors in planetary gears and how these errors influence dynamic response have been discussed in studies. Tooth surface modifications, which are used in nearly all gears, must be built instead of isolated sun-planet and ring-planet gear pair models using system planetary gear models. In short, the planetary gear systems, which are specifications for industrial applications, have high torque density, lightweight, low inertia and can be grease lubricated for life. The work on the design of compact planetary gear trains used in gearboxes used for automation in car parking systems was also carried out by the author.

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