

Review On Gear Less Power Transmission

Prof. Mr. Shelke Amruta A¹ Mr. Bhalke Ganesh Machhindra² Mr. Bhusari Sagar Sampat³ Mr. Pawar Govind Janardan⁴ Mr. Rokade Rahul Gangadhar⁵

¹Assistant Professor ^{2,3,4,5}Student

^{1,2,3,4,5}Department of Mechanical Engineering

^{1,2,3,4,5}S.C.S.C.O.E, Shrishivajinagar, India

Abstract— New magnetic gears gives promise as replacements for mechanical gears, not only because of high reliability and low maintenance, but also because of superior torque-to-weight ratios. A superior torque-to-weight ratio is most unexpected but is surfacing as a real possibility when the full perimeter of the gear is used to generate torque. Mechanical gears are to be distinguished in this one particular part since only two to three teeth are engaged in a single stage. For this same reason, high gear ratio magnetic gears can be constructed without the use of multiple stages. In this paper, we were planning for design and fabricate a Magnetic Gear drive which will utilize Electric energy as a input source and further with the help of magnetic gear drive we will be transmitting the speed variation at output shaft. Using Magnetic Gear drive we will be able to increase or decrease the output speed at the output shaft. So by using the no of gears we will be able to transmit different gear ratios.

Key words: Skew Shaft, Revolute Pair, Sliding Pair, Hyperboloids, Front/Side/Top View, Intermittent Motion

I. INTRODUCTION

Gears and gearboxes are mostly used for speed change and torque transmission in various industrial applications. It is well known that the mechanical gear has a high torque density, but suffers from some immanent problems such as contact friction, noise, and heat, while vibration and reliability are of great concern. In contrast, the magnetic gear (MG) offers significant benefits of decrease acoustic noise, minimum vibration, free from maintenance, improved reliability, inherent overload protection, and physical isolation between the input and output shafts. However, for a long period, MGs have received relatively little attention, probably due to the poor torque density and relative complexity of the magnetic circuits. The magnetic gear equal in part, the traditional mechanical gear. All cogs of each gear parts of magnetic gears act as a magnet with periodic alternation of opposite magnetic poles on mating surfaces. Gear components are mounted with a "cushioned" backlash ability similar to other mechanical gearings with no cushioning effect. Although they can exert as much force as a traditional gear, such gears work without touching and so are immune to peak of mating surfaces, have very low noise and can slip without damage making them very reliable. They can be used in configurations that are not possible for gears that must be physically touching and can operate with a blockage completely separating the driving force from the load. The magnetically coupled gear can transmit force into a hermetically sealed precinct without using a radial shaft seal, which may leak. Hermetically sealed processes are not contaminated or chemically affected by the magnetic gear. This can be a benefit in explosive or otherwise harmful environments where leaks constitute a real danger. A

magnetic gear uses permanent magnets to transmit torque between an input and output shaft without mechanical contact. Magnetic gears can get with efficiency greater than 99% at full load and with much higher part load efficiencies than a mechanical gear. For higher power ratings a magnetic gear has a higher cost. Depending on the space available a magnetic gear may be the only viable technology.

II. LITERATURE REVIEW

In 1913, a U.S. Patent Application described an electromagnetic gearing which should be the original topology, but almost no one was interested in it at that time. Until a MG topology defector similar to a mechanical spur gear was proposed by Faus in 1941, people gradually paid attention to MGs. However, low uses and poor performance of ferrite permanent magnet (PM) material made it not possibly to be widely used in industry. Until the high-performance neodymium iron boron (NdFeB) PM material was invented in the 1980s, the research on MGs response great interests again. Naturally, the earlier MG topologies were converted from mechanical gear topologies. These changes MGs simply replaced the slots and teeth of iron core by N-poles and S-poles of PMs, respectively. The low use of PMs was the key problem which caused poor torque density.

Atallah and Howe proposed a high-performance MG named as the coaxial magnetic gear (CMG) in 2001, whose principle of operation was based on the modulation of the magnetic fields produced by 2 PM rotors via the ferromagnetic pole-pieces. Unlike the converted MGs, the CMG has a higher torque density, because all the PMs simultaneously contribute to torque transmission. Based on the field modulation principle, many civilized CMG topologies are plan to further obtain a better performance. In view of the coaxial structure, the CMG can be artfully integrated with a high speed outer-rotor PM brushless machine to establish a composite electrical machine named as the magnetic-gear permanent-magnet (MGPM) machine, which can achieve low-speed high-torque driving while providing increased torque density.

An analysis has been done by X. Li, K.T. Chau, M. Cheng¹ and W. Hual [1] paper deals with the comparison between magnetic gears and the mechanical gears.

And another study done by K. T. Chau¹, Dong Zhang, J. Z. Jiang, Chunhua Liu¹, and Yuejin Zhang [2] and it deals with shocker in-wheel motor, which artfully integrates a magnetic gear into a permanent-magnet brushless (PMBL) DC motor so that they can share a common PM rotor, hence offering both high efficiency and high power density. the low-speed requirement for direct driving and the high-speed requirement for compact motor design can be achieved simultaneously.

III. THEORY

In this project work, we were planning for design and fabricate a Magnetic Gear drive which will utilize Electric energy as an input source and further with the help of magnetic gear drive we will be transmitting the speed variation at output shaft. Using Magnetic Gear drive we will be able to increase or decrease the output speed at the output shaft. So by using the no of gears we will be able to transmit different gear ratios.

A. Basic Principle

First two gear blanks are taken. Material of gear blank is hilum sheet since it is a light weight non ferromagnetic polymer. Using an adhesive we are placing the magnets in alternate poles along the circumference of gear blank. One of the blank is driven by a motor which is the driving gear. Other driven gears are positioned near the driven gear. Driving gears are not in contact but lie inside the magnetic field of driving gear. By this way we can transmit torque from driving gear to driven gear except any frictional loss. Gear ratio can be change by changing the number of magnets and diameter of the gear blanks.

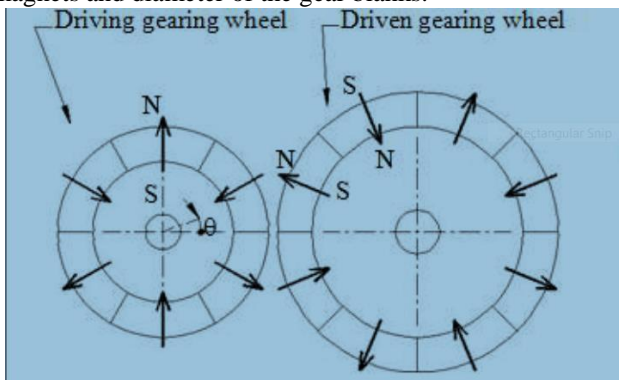


Fig. 1: Magnetic gear

B. Objectives

- 1) Maximum utilizations of repulsive magnetic force for generating rotary motion at output shaft Repulsive force is used to drive the output shaft.
- 2) Robust and no maintenance no lubrication required for long run. The use of Magnetic Gear drive components ensures high strength and robust in handling, which is not possible with the use of mechanical gears.
- 3) Mobility and easy to handle less running cost.

C. Methodology

The methodology of design for the design Magnetic Gear drive is explained by following steps,

- 1) Determining the required speed ratio.
- 2) Calculating the required the no of stages required.
- 3) Calculating the no of magnetic gears to be utilized.
- 4) Selecting suitable material for gear manufacturing.
- 5) Calculating the output capacity of reservoir.
- 6) Selecting required mechanical components of suitable dimensions and material.
- 7) Preparing production drawings and fabrication of mechanical elements.
- 8) Assembly of the device.
- 9) Demonstration.

D. Magnetic Gear drive circuit diagram

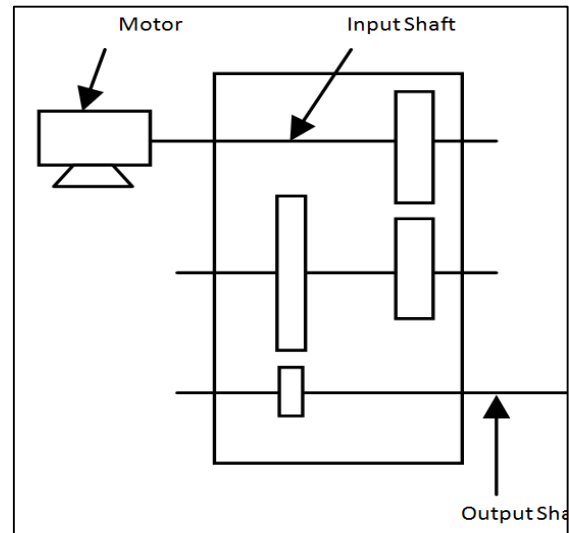


Fig. 2: Magnetic gear circuit diagram

IV. ADVANTAGES

- 1) Increased efficiency (>99% at full load and high part load efficiency)
- 2) Compliant transmission eliminates drivetrain pulsations
- 3) Very low acoustic noise and vibration
- 4) Torque fuse protection
- 5) Transmission through a sealed wall
- 6) Physical isolation between shafts

V. DISADVANTAGES

- 1) Initial cost is high.
- 2) Due to weak repulsive force slip occurs.
- 3) To increase the torque it required maximum repulsive force.
- 4) To increase repulsive force external power source required
- 5) External power source cost is high
- 6) To increase repulsive force external power source required.

VI. CONCLUSION

Magnetic gears afford the opportunity to provide speed and torque multiplication similar to a traditional geared gearbox, but by using magnetic attraction between rotating members somewhat actual physical contact, as between gear teeth. It may be possible to greatly reduce, or potentially eliminate, lubrication requirements, compared to existing traditional gearboxes. A magnetic gear based gearbox for more applications could increase reliability and mission availability by reducing or perhaps eliminating wear-related gearbox failures attributable to traditional tooth-to-tooth contact.

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