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REVIEW PAPER ON DESIGN AND ANALYSIS OF COMPOSITE POLY-ACETYLENE EPICYCLIC GEAR

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ABSTRACT

Gearing is one of the most critical components in mechanical power transmission system and in most industrial rotating machinery. It is possible that gears will predominate is the most effective mean of transmitting power in machines due to their high degree of reliability and compactness. In addition, the rapid shift in industry from heavy industry such as ship building, industries, auto mobile manufacture and auto machine tools will necessitate a refined application of gear technology. Gears are generally made from metallic materials but advanced polymers were developed which must have sufficient strength and properties similar to the metallic materials so they can easily replace the metallic gears if some care is taken. Nylon, polycarbonate, acetlas and delrin are structure polymeric materials used in printing and robotics mechanism with good functionality but polymers gears are not used in heavy loading application. Especially polymer gear gives extra benefits compared to metallic gears like less noise-vibration, low requirement of maintenance-lubrication, low cost and easy manufacturing. This paper describes design and analysis of Epicyclic gear. In the present work, it is proposed to substitute the metallic gear with Composite Poly-acetylene Gear to reduce the weight and noise. The Composite Poly-acetylene Gear have provided alternatives to metal gears in lightly loaded drives. The main purpose to analysis the Composite Poly-acetylene Gear casting and their viability checked with counterpart metallic gear like as cast iron. The aim of our project casting of Composite Poly-acetylene Gear and its testing we have to process and its suitability for different lightly loaded drives are found out.

KEYWORDS: Composite Poly acetylene gear, Epicyclic gear

INTRODUCTION

Composite materials are engineered materials made from two or more constituent materials with significantly different physical or chemical properties which remain separate and distinct on a macroscopic level within the finished structure. The upcoming requirement of power saving and efficiency of mechanical parts during the past few years increased the use of composite materials. Composite materials are preferred in place where lighter materials are desired or required without sacrificing strength. Nowadays, composite materials are used in large volume in various engineering structures including spacecrafts, airplanes, automobiles, boats, sports equipments, bridges and buildings. Widespread use of composite materials in industry is due to the good characteristics of its strength to density and hardness to density.

Poly-acetylenegearsare the most common means of transmitting power in the modern mechanical engineering world. The gear materials used for the manufacture of gears depend upon the strength and service conditions like wear and noise etc. The gears may be manufactured from Metallic or non – metallic Materials. The cast iron is widely used for the manufacture of gears due to its good wearing properties, excellent machine ability and ease of producing complicated shapes by casting method. The non – metallic materials like wood, rawhide, compressed paper and plastics like Nylon, Acetal, Acrylic and Polycarbonate etc. are used for gears, especially for reducing weight and noiseThe conventional steel alloy used for the gear material have disadvantages such as low specific stiffness and strength and high weight. Substituting the composite material for the gear have advantage of higher specific strength, less weight, high damping capacity, longer life, high critical speed and greater torque carrying capacity and can results in considerable amount of weight reduction as compared to steel The composite material have the orthotropic elastic behavior rather than linear elastic properties.

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Epicyclic gear or more commonly named planetary gear is a form of gear setup typically used in applications where high gear ratio and/or small dimensions are sought after. There are several different kinds of epicyclical gears available, the most common being the three and four wheel types. The gearbox in this thesis uses a three wheel design implementing three planetary gears in two stages. A three wheel design must however not use three planetary gears as three refer to the number of different sized wheels not the number of planetary wheels.

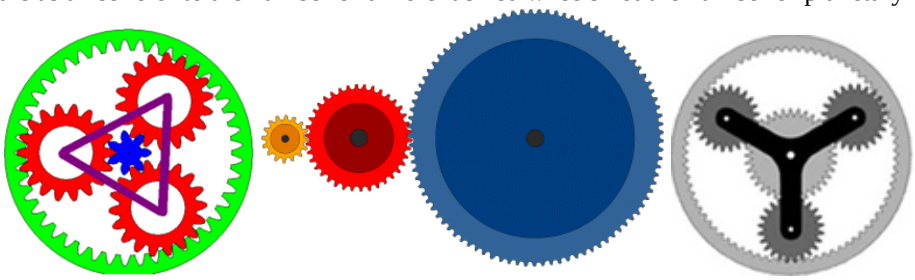

Fig.1 Planetary Gear Train

MATERIALS

Polyacetylene (Acetal)

Crystalline type plastics generally provide characteristics that ensure reliable gear operation, as well as consistent shrinkage needed for precision molding. These materials include nylon 6/6, polyacetal, polyphenylene sulfide (PPS), thermoplastic polyester, long fiber reinforced plastic and liquid crystal polymers (LCP). Most plastic gears are made from nylon and Acetal. But nylon absorbs moisture with resultant changes in properties and dimensions. Acetal copolymers provide long-term dimensional stability as well as high fatigue and chemical resistance over a wide temperature range.

The polyacetal resins are among the strongest and stiffest of all thermoplastics, and are characterized by good fatigue life, low moisture sensitivity, high resistance to solvents and chemicals, and good electrical properties. Because of these properties, polyacetals often compete with nylons for many of the same applications. Polyacetals may be processed by conventional injection molding and extrusion techniques. The main area of application for polyacetal is industrial and mechanical products.

Thermoplastic polyesters are also more dimensionally stable than nylon. Where no lubricant is used, both nylon and polyester provide good lubricity when mated with polyacetal. Liquid crystal polymers give high dimensional stability and chemical resistance, plus low mold shrinkage and high accuracy. To date they have been used only for small gears under light loads, such as watch gears. Linear polyphenylene sulfides have high temperature and chemical resistance and good fatigue life. They work well in highly loaded parts molded with fine details.

Glass fiber

Fiber reinforcement such as glass, carbon, or aramid improves the mechanical properties of plastics. Glass-reinforced plastics used for dry-running gears usually contain a lubricant such as PTFE. Carbon fiber reinforced plastics may also contain a lubricant. Aramid fibers are used mostly to reduce wear.

Long fiber reinforced plastics impart high strength and fatigue endurance. They also shrink uniformly and consistently, which improves gear molding accuracy. Such reinforcements are often used in higher power, lubricated systems where excessive tooth deflection may be a problem.

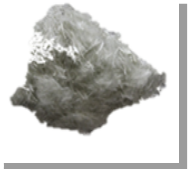

Fig. 2 Glass fiber

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Graphite

Graphite is used as an additive in this work. It has an well Anti oxidants property. Also used as lubricant.

Fig.3 Graphite

METHODS

Petry-Johnson developed a four-square-type gear test rig to investigate gear efficiency. The concept of this test rig is that one gear from each gearbox is connected to the corresponding gear of the other gearbox. Input is given by a high-speed spindle which driven by a belt with a 3:1 ratio speed increase from a variable speed AC motor. Separate temperature controlled oil circulation system is used which gives 2.25 LPM at gear mesh zone. Testing done at 10000rpm with a gear pitch-line velocity of 48 m/s. Maximum torque value applied it 680 Nm. Test duration was selected as 10 min, where the last 5 min used for data measurement.

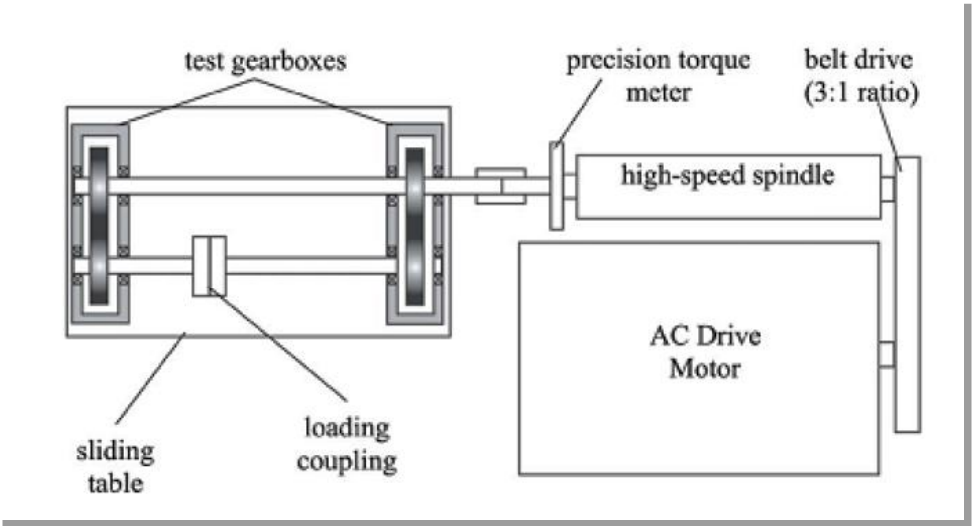

Fig. 4 Four square type gear test ring to investigate spur gear efficiency

CONCLUSION

The gear needs to be redesigned providing energy saving by weight reduction, providing internal damping, reducing lubrication requirements without increasing cost. This work is concerned with the replacement of existing metallic gear with composite material gear in order to make it lighter and increasing the efficiency of mechanical machines. The objective of the research is to reduce the stress distribution, deformation and weight of Epicyclic gear by using composite materials in the application of gear box .The comparison between the conventional steel gear material and composite materials for different loading condition were we have to carry out. From the analysis it can be conclude that the composites material can successfully replaced the steel gear for the gearbox application.

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