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CONCEPTUAL DESIGN OF COST OPTIMIZED AUTOMATED GEAR DEBURRING MACHINE

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ABSTRACT

Gears are an integral part of each and every mechanism that is used as a power-transmitting element. They are also used to increase or decrease the speed as per the requirements. Such gears have to be manufactured with the utmost care, accounting for their precision, strength, and durability. These gears are typically manufactured using a gear hobbing machine.

The gears that are manufactured need to undergo their final finishing process, i.e., the removal of burrs that are an integral component of the gears, regardless of the manufacturing process adopted. These burrs drastically lower the power transmission's functionality, efficiency, and lifespan. Thus, the goal of the research paper is to develop a conceptual design for an automated gear deburring system that optimizes the cost.

Key words: Conceptual Design, Computer Aided Design, Deburring, Gear box, Burrs.

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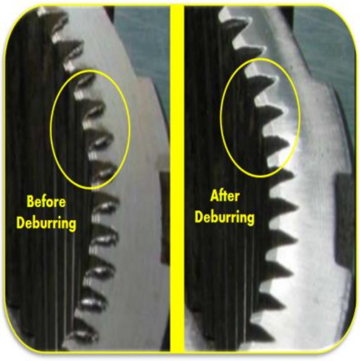
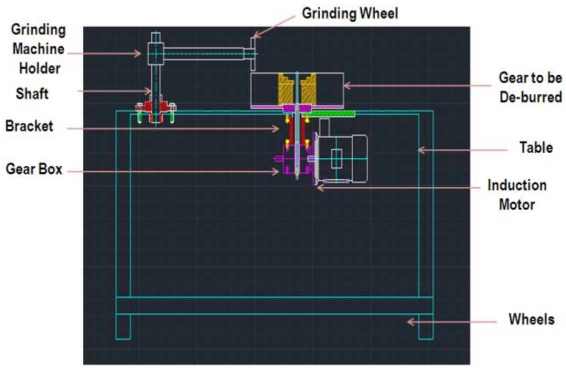
1. INTRODUCTION

Deburring is the process of removing the small imperfections, known as burrs that are left out during the gear manufacturing process. Deburring is commonly known to be an after-machining process or even a finishing process. The deburring process ensures the removal of even minute secondary burrs from the component, which results in a prompt gear tooth profile and accounts for the extended product life. Gear deburring promotes better quality of the gears, which facilitates hassle-free power transmission without any slip show in Fig:1[1]. Burrs left around the gear will hinder the proper meshing of the gear tooth or even lead to damage to the tooth when the burrs are hard. As a result, to eliminate the burrs around the gear tooth, this automated gear deburring machine paves the way for the removal of burrs through an efficient setup and cost-effective means [2,3].

2. DESIGN OF DEBURRING MACHINE

The design of the gear deburring machine is done using CREO parametric 3D modelling and Auto CAD software. Initially the table is designed and then the bracket, housing, shafts and the grinding machine mounts are designed as per required dimensions using Auto CAD shown in Fig:2. Then the same is modelled using CREO parametric 3D modeling software and all the individual components modeled are assembled together using appropriate constraints to get the overall setup of the machine shown in Fig:3.





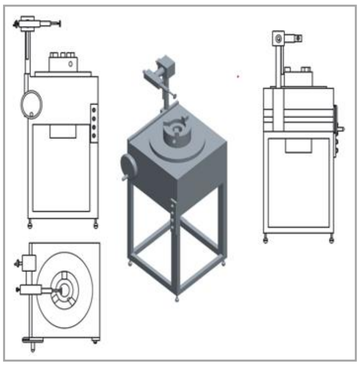


Figure.1 Gear Deburring **Figure. 2** 2D Conceptual Design **Figure.3** 3D Assembled View

3. METHODOLOGY AND FABRICATION PROCEDURE

The preliminary work in the methodology is the fabrication of the table. The table is made of L-angles to build up the legs of the table, with a heavy cast iron plate mounted on the top side of the table, which serves as the workbench of the machine. The table surface plate has a 400mm diameter at its center to accommodate the three jaw chucks. The three jaw chuck isplaced above the surface plate.

The shaft, which holds the three jaw chuck upright, is driven by a gear box, which is operated by a 0.5 HP induction motor. The gear box and the induction motor are held beneath the surface plate with the help of spigot which holds the gear box and the induction motor together rigidly. The axis of rotation of the induction motor is horizontal, such that the induction motor is kept in a horizontal mode with its base supported and mounted to the bottom side of the base plate.

The drive shaft of the induction motor is connected to the gear box, which acts as a speed reducer, and the output drive shaft of the gearbox is kept vertical, which is in turn connected to the three jaw chuck. The input to the gearbox is horizontal from the induction motor, but the output from the gearbox is vertical, which is achieved by the gearbox, thus enabling speed reduction. The gear box is held tightly with the help of a bracket that is attached between the bottom side of the surface plate and the gear box [4,5].

The drive shaft from the gearbox is taken through the bracket, and finally it is inserted into the bore of the three jaw chuck, which enables the rotation of the three jaw chuck. Now, a 35mm mild steel shaft is kept vertical and fixed on the surface plate with the help of the housing that is used to provide support to the shaft in the vertical direction. The bracket is fixed to the plate using the fasteners. A support clip is provided at the end of the shaft below the plate to stop the further movement of the shaft and to arrest its motion in all directions [6,7].

Two grinding wheel mounts are used, where one is fixed to the shaft and the other is used to hold the grinding wheel. The grinding wheel is mounted in a horizontal mode. At last, electrical wiring connections are given to the grinding wheel and the induction motor. A sheet metal of 4 mm thickness is provided at the bottom of the induction motor assembly, where it can be used to store the gears that are deburred and that are about to undergo deburring [8,9].

4. WORKING PRINCIPLE

First, the input power is given to the induction motor. Then the output power from the induction motor is given to the gear box. The gear box is used for speed reduction, and it converts the horizontal input to the vertical output. The output from the gearbox is given to the three jaw chuck for its rotation. A hand wheel is used to open and close the jaws.

Then the power is given to the grinding wheel. Once the wheel touches the burr, it removes it, and then the wheel travels along the direction of the burr in a single tooth. The grinding wheel is operated up and down with the help of a self-weight and lifting mechanism. The burr can be removed by rotating the grinding wheel over the gear over a few passes. Finally, the burr from the gear is completely removed, and the gear is ready for inspection and delivery.

5. CONCLUSION

The main aim of this research work is design of automated gear deburring machine to facilitate ease of gear deburring at a faster rate, which greatly supports mass production and thus proportionately increases the productivity and efficiency of the gear produced. This machine is easy to operate and work with because of its flexible design. The main concern of this machine is the achievement of cost optimization when compared to other types of gear deburring machines.

With this gear deburring machine, gears with an outer diameter of up to 300 mm can be deburred. For gears of an outer diameter above 300 mm, this machine serves as a standard prototype such that modifying the parameters proportionately would greatly contribute to the fabrication of gear deburring machines for larger diameter gears.

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