

“5 Speed Gearbox Mechanism”

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Abstract - An industrial gearbox is a system in which the mechanical energy is transferred from one device to another and is used to increase torque while reducing speed. Gearboxes can modify their speed, and torque to convert energy into a compatible format. They are useful in easing out the mechanical functioning in industries. Helical gearboxes, Coaxial helical line, Bevel helical gearboxes, Skew bevel helical gearboxes, Worm reduction gearboxes, Planetary gearboxes are some of the standard gearboxes used in industries. The 5 Speed Gearbox aims to present the mechanism of a gearbox. Gears of different sizes are placed on three different shafts. The gears on the shaft are located at a specific distance from each other. The topmost shaft is driven with the help of a motor. The 2nd shaft or the middle shaft acts as an intermediary between the first and third shaft. This shaft is manually operated and can be set in 6 positions. The first position is the idle position i.e., only the driven shaft rotates. The other 5 positions cause the other two shafts to rotate in different speed.

Key Words: Industrial Gearbox, Mechanical Energy Transfer, Torque Increase, Speed Reduction, Power Transmission, Energy Conversion, Gear Mechanism, Helical Gearbox, Coaxial Helical Gearbox, Bevel Helical Gearbox, Skew Bevel Gearbox, Worm Reduction Gearbox, Planetary Gearbox, Multi-Speed Gearbox, 5-Speed Gearbox, Shaft Arrangement, Input Shaft, Intermediate Shaft, Output Shaft, Gear Ratio, Motor Drive, Manual Gear Selection, Idle Position, Speed Variation, Torque Variation, Industrial Applications

1. INTRODUCTION

The main purpose of a gearbox is to transmit power according to variable needs from an input power source to the desired output member. A Gearbox is a mechanical device that is used to provide Speed and Torque conversions from a rotating power source to output shaft. As the speed of the shaft increases, the torque transmitted decreases and vice versa. Multi speed gearboxes are used in applications which require frequent changes to the speed/torque at the output shaft. Gearboxes work on the principle of meshing of teeth, which result in the transmission of motion and power from the input source to the output. Transmission of a gearbox: A transmission or gearbox provides speed and torque conversions from a rotating power source to another device using gear ratios. The transmission reduces the higher engine speed to the slower wheel speed, increasing torque in the process. A transmission will have multiple gear ratios, with the ability to switch between them as speed varies. This switching may be done manually, or automatically. Directional (forward and reverse) control may

also be provided. Most modern gear boxes are used to increase torque while reducing the speed of a prime mover output shaft, and this reduction in speed will produce a mechanical advantage, causing an increase in torque.

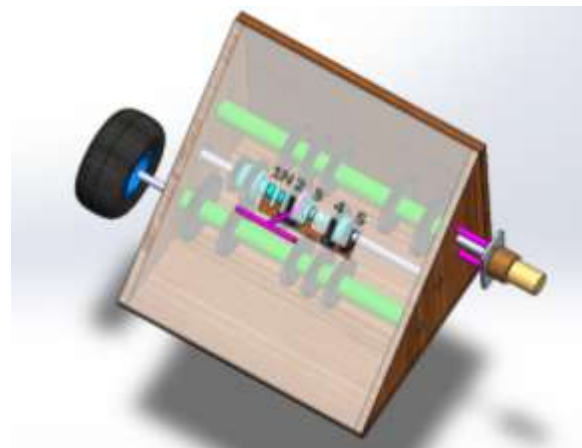
2. Literature Review:

- A.Y.V. Gopi Krishna, R.V. Kiran [1] (2019) presented a paper on Gearbox, which has a set of gears that are enclosed in a casing, the gears are mounted on shaft which rotate freely about their axis. The gears are fixed on a shaft by key, this reduces the capacity of power source required and hence less fuel consumption.
- Ujjayan Magumdar, Sujitb Maity [2] (2018) describes the study of shaft material, gear box components and types of gearing etc. Gear box is a mechanical device which is used to provide torque and its conversion from input to output shaft. Whenever there is an requirement of frequent change in speed and torque at output shaft, multispeed gear boxes are used. Gear boxes work on the principle of meshing of teeth, which result in the transmission of motion.
- Heel Patel, Harsh Patel [3] (2018) presented that, gear is a machine part having a clogs which contact with other toothed part in order to transmit the torque. This paper describes about various type of gears and need of efficient and compact gear boxes in industrial applications to improve their power density. Low efficiency of the gear box is a serious problem, because it increases the cost of maintenance and affects the prestige of the enterprise.
- Whenever a frequent change of speed/torque at the output is required, we use a multispeed multistage gearbox. Francesca Cura [4] (2017) This paper proposes a method in the ISO -standard environment for calculating a single global dynamic factor, Kav, by replacing Ka and KV, in the case of gears subjected to shift and load conditions and this process based on the Miner damage rule and calculate the equivalent tangential Force values, including all dynamic effects.
- Neeraj Patel & Aniket Wankhede [5] (2017) This paper has attempt to automate preliminary design of gear box by using the software like kiss. The objective function is constrained by the bending strength contact stress plane width and the number of pinions and gear teeth. The design optimizes the action of the two-stage gearbox by using KISS -soft achieved by easily supplying the requested design parameters.
- Muhammad Irfan [6] (2017) A study on the mechanism modeled by the mechanical system was carried out. The full gear shifting process in stages, which gives the opportunity to capture the nature of the body, solve the complexities of the detailed kinematic description.

- Rahi Jain and Pratik Goyal [7] (2016) It is shown that the spur gear is designed with software like Creo parametric and ANSYS. S the finite element method(FEM)is an easy and accurate technique for pressure analysis, FEA is performed in the finite element software ANSYS14.0. Also, due to the efficiency of the gear depends on its deformation, the variants 15nic1mo15 and SCM415 are obtained. 5-Speed Gearbox Mechanism — IJSREM*
- Design, gear ratios, synchronizers, shift mechanism, optimization strategies Site - <https://ijsrem.com/download/5-speed-gearbox-mechanism/>
- 5-Speed Gearbox Mechanism — IRJMETS Journal (PDF)*
 - o Gear positions, overdrive, constant mesh, design & development
 - o https://www.irjmets.com/uploadedfiles/paper/issue_3_mar_ch_2023/3_18_4620/final/fin_irjmets1679506866.pdf
- Development of a Cut-Away Working Model of 5-Speed Synchromesh Transmission — IJPREMS* Synchromesh mechanism, gear engagement, synchronizer rings, hub & sleeve <https://www.ijprems.com/ijprems-paper/development-of-a-cut-away-working-model-of-5-speed-synchromesh-transmission>

mechanism includes components such as shift forks, selector rods, and gear levers, which help in engaging and disengaging gears smoothly. Bearings are used to support the shafts and ensure smooth rotation with minimal friction. 33 The entire gearbox assembly is enclosed in a rigid casing filled with lubricating oil to reduce wear, dissipate heat, and ensure efficient operation. Proper alignment and spacing of gears are maintained to achieve smooth power transmission and long service life.

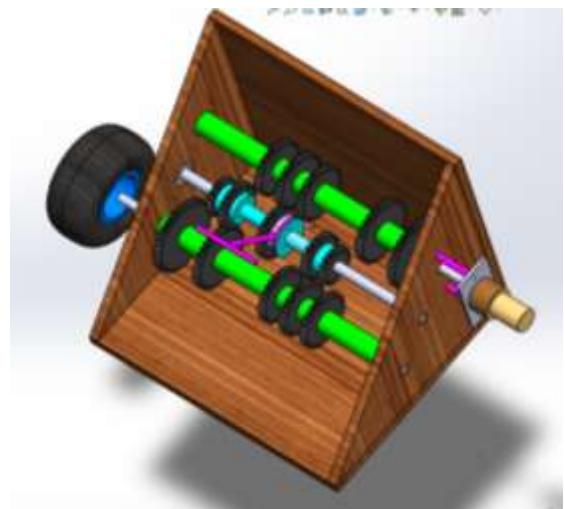
4. PROJECT IMAGES:



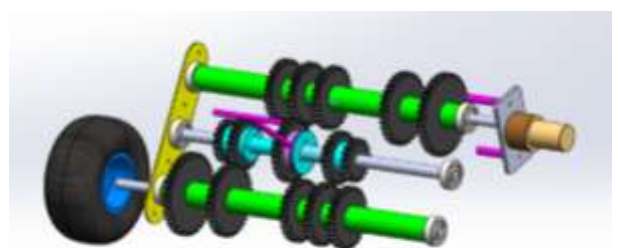
3. CONSTRUCTION OF 5 SPEED GEARBOX MECHANISM:

Construction of 5 Speed Gearbox Mechanism: - It consists of the following components: -

- Gears of different size
- Ball bearings
- Shafts
- Wooden Frame
- Handle
- DC Motor
- Switch
- Mounts and Clamps
- Base Frame
- Supporting Frame
- Screws and Bolts



The construction of a 5-speed gearbox mechanism consists of a systematic arrangement of gears, shafts, and supporting components designed to transmit power and provide different speed ratios. The gearbox mainly includes three shafts: the input shaft, intermediate (counter) shaft, and output shaft. The input shaft receives power from the motor and carries a driving gear which is in constant mesh with the gear on the intermediate shaft. The intermediate shaft consists of a set of gears of different sizes fixed rigidly on it. These gears rotate along with the shaft and are always in mesh with the corresponding gears on the output shaft. The output shaft contains gears that are either freely rotating or can be engaged using a sliding mechanism or synchronizers to obtain different speeds. A gear shifting mechanism is provided to select the desired gear ratio. This





5. SPECIFICATIONS

Specifications of the Machine: -

1. Number of gears: 5 forward speeds + 1 neutral position
2. Number of shafts: 3 (Input shaft, Intermediate shaft, Output shaft)
3. Type of gears used: Spur gears
4. Gear ratio: Different for each gear stage
5. Speed range: Varies depending on motor RPM and gear ratio
6. Torque capacity: Higher in lower gears, lower in higher gears
7. Material of gears: Polyacetal
8. Material of casing: MDM Wooden
9. Type of operation: Manual gear shifting mechanism
10. Components used: Gears, shafts, bearings, synchronizers, selector mechanism
11. Mounting: Rigid casing with proper alignment of components
12. Efficiency: High efficiency with proper gear meshing
13. Application: Used in automobiles and industrial machinery

6. CONCLUSION:

This project demonstrates a mechanical system that transmits power through a set of gears to provide different speed and torque outputs. The 5-speed gearbox mechanism allows the selection of different gear ratios, enabling efficient operation under varying load conditions. The system ensures smooth power transmission from input to output shaft through proper gear engagement. It provides controlled variation of speed and torque, where lower gears produce high torque and higher gears provide higher speed. The gearbox has been designed and developed according to the required specifications, ensuring proper functioning and reliability. Thus, the objective of developing a “5-Speed Gearbox Mechanism” has been successfully achieved.

7. REFERENCES

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- [5] A Textbook of Machine Design 1st Multicolored Edition - By (RS.KHURMI & JK GUPTA)
- [6] Christina Umstatter carried out research on “The evolution of virtual fences “in this they studied about virtual fences. A virtual fence can be defined as a structure serving as an enclosure, a barrier, or a boundary without a physical barrier.
- [7] Siavash Reza zadeh and Jonathan W. Hurst carried out research on the Optimal Selection of Motors and Transmissions for Electromechanical and Robotic Systems With regard to the important role of motors and transmissions in the performance of electromechanical and robotic systems, this paper intends to provide a solution for the problem of selection of these components for a general load case.
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