International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 10 Issue: 03 | March - 2026 SJIF Rating: 8.659 ISSN: 2582-3930

Design and Fabrication of Gearless Transmission System Using Elbow Mechanism

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Abstract - This project "GEARLESS TRANSMISION USING ELBOW MECHANISM" can be a small and lightweight piece of equipment that is capable of transmitting power at various angles without the use of gears. The El-bow Mechanism transfers input power to the output side in such a way that the angular forces generated in the slacks are transmitted with the aid of rods that absorb the input power and pass the right angle drive to the output slack and rod assembly. As a result, it is recognized that gearless transmission mechanisms can achieve efficiencies of up to 92 percent. For transmitting rotational velocity from an input connected to three bent ties, a gearless transmission is given. The input shaft's rotational axis is angled in relation to the housing's rotational axis at various angles. As a consequence, rotation of the input shaft causes the bent link's axis to move in a processional motion. The bent link's rotary and reciprocating motion transmits the prime mover's rotation to a variable angle without the use of a gear system to an output shaft.

Key Words: Gearless transmission, elbow mechanism, power transmission, fabrication, efficiency, linkage mechanism

1.INTRODUCTION

The gear drives are mostly used for accurate and variable power transmission in various sectors such as aerospace, defense, marine and automotive industrial cutting and machine tools, lift and hoisting equipment, etc. Gears have a significant drawback in that they are less successful as a result of mistakes such as backlash, which causes vibrations during operations and reduces product life due to higher wear rates.

The project "EL-BOW POWER TRANSMISSION" was being minimized and convenient hardware, which is able and is, having something, rehearses in the sending power at right point with no pinion wheels being fabricated. The majority of the material is made accessible by our school. The parts can be effortlessly made in our school shop its cost is additionally less.

Fig -1: Elbow Mechanisms at Right Angle

This undertaking gives us information, experience, expertise and ground breaking thoughts of assembling. It's a working task and having assurance of achievement. This task is the hardware helpful which can improve the nature of the stuff being made and it can be made in less time, thus I have chosen this undertaking el-bow equipment is decent connection slider system and kinematic chain standard. This is additionally called as "gearless transmission component" the system is extremely helpful for sending movement at right angle. Anyway in certain modern application "gearless transmission at right angle" can likewise work at insensitive or up to worm can be measured with an exact point plane and worm stuff and pinion gear which is constantly utilized in the business for various applications.

2. LITERATURE SURVEY

R. Somraj et al. [1] designed and fabricated a gearless transmission system for skew shafts using three L-pin rods. The system operated at 0.25 HP and 140 RPM with smooth motion transmission. The study concluded that the mechanism is suitable for shafts at various angles with

equal RPM and provides efficient and reliable performance with proper construction.

Neeraj Patil et al. [2] studied a gearless transmission mechanism using C-45 material links capable of transmitting motion from 0° to 180°. The system was applied in a go-kart model and found suitable for low to medium torque applications. The study suggested that performance can be improved using advanced materials and flexible link designs.

Ashish Kumar et al. [3] studied a multi-angular gearless drive using three L-pins. The mechanism was modeled in SolidWorks and analyzed using ANSYS. Results showed effective power transmission at various angles, and the study suggested that further analysis can expand its applications.

Solanki Nehal et al. [4] analyzed a gearless transmission using an elbow mechanism with four L-pins and a 1 HP motor. The system was tested at different speeds using ANSYS. It was concluded that mild steel links provide better performance and increasing the number of elbow rods improves smoothness of operation.

3. METHODOLOGY

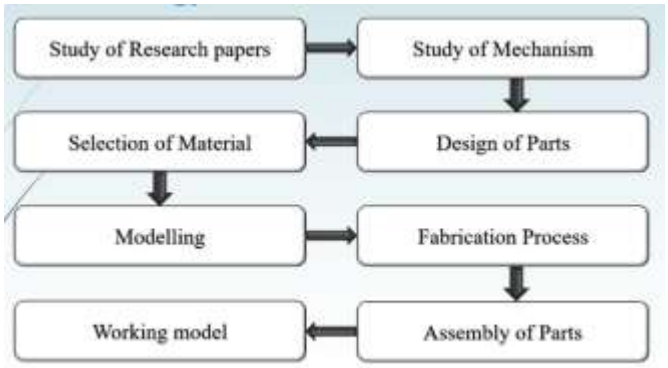


Fig -2: Methodology

4. WORKING PRINCIPLE

The gearless transmission system using an elbow mechanism operates on the principle of linkage motion and constrained kinematic chains. When the driving shaft rotates, the attached elbow link converts the rotary motion into a combined angular and reciprocating motion. This motion is transmitted through intermediate links connected via joints to the driven shaft.

The elbow links are bent at a specific angle and fitted into corresponding holes or slots in the hub. As the input shaft rotates, the bent links undergo a precessional motion, simultaneously rotating and sliding within the hub. This combined motion enables the transfer of power from the input shaft to the output shaft, even when they are oriented at an angle to each other.

The mechanism ensures continuous and smooth transmission of motion without the use of gears. The output shaft rotates in synchronization with the input shaft, maintaining nearly constant speed depending on the alignment and number of links used. The system can transmit motion at different angles, typically up to 90° or more, based on design.

Thus, power transmission is achieved through direct mechanical linkage, reducing friction, noise, and maintenance compared to conventional gear systems.

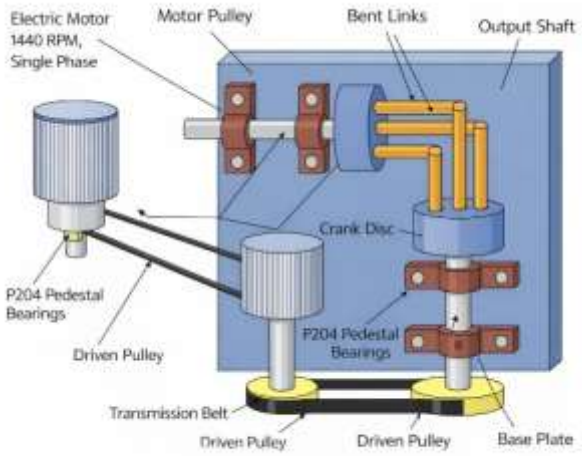


Fig -3 Working Model

5. APPLICATIONS

The gearless transmission system using an elbow mechanism has wide applications where power transmission is required at various angles without direct access. It is highly useful in situations where conventional gear systems are difficult to implement.

The mechanism can be effectively used as an extension for attachment wrenches, enabling easy access to fasteners in automobiles and mechanical industries where direct access is limited.

- It has potential applications in bicycles, toys, and hand-operated devices, where simple and flexible power transmission is required.
- It is suitable for outdoor mechanical systems and display mechanisms, such as rotating signage and moving structures.
- The elbow mechanism is used in four-faced tower clocks (e.g., Big Ben type), where motion is transmitted to multiple dials.
- It is applied in gang drilling machines, which involve multi-spindle drilling operations.

- It can be used for angular drilling operations ranging from 0° to 90°.
- The system is useful in lubrication pumps for CNC lathe machines.
- It is applicable in situations requiring motion transmission in awkward or confined positions.
- It can be used in air blowers and small electronic/mechanical systems.
- The mechanism also finds applications in submarines for periscope movement.

FABRICATION OF GEARLESS TRANSMISSION USING ELBOW MECHANISM

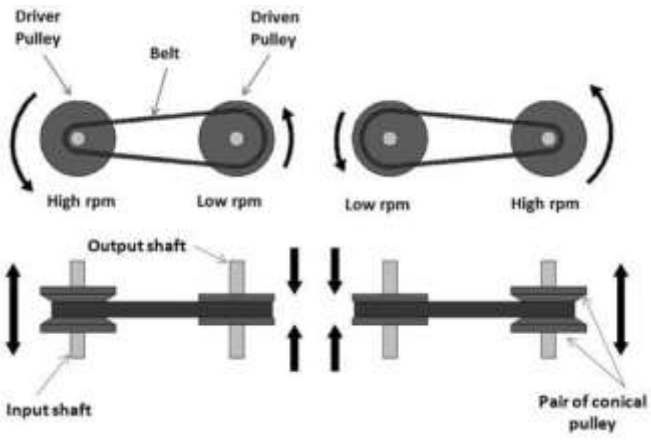
6. COMPONENTS

6.1 Base Frame

The base frame is the primary supporting structure of the gearless transmission system, typically fabricated using mild steel to ensure strength and rigidity. It supports all components such as shafts, bearings, elbow links, and the motor while maintaining proper alignment. The frame is designed to withstand operational loads and vibrations, ensuring stability and smooth functioning. Welding is commonly used for assembly, and a well-designed frame enhances the durability and reliability of the system.

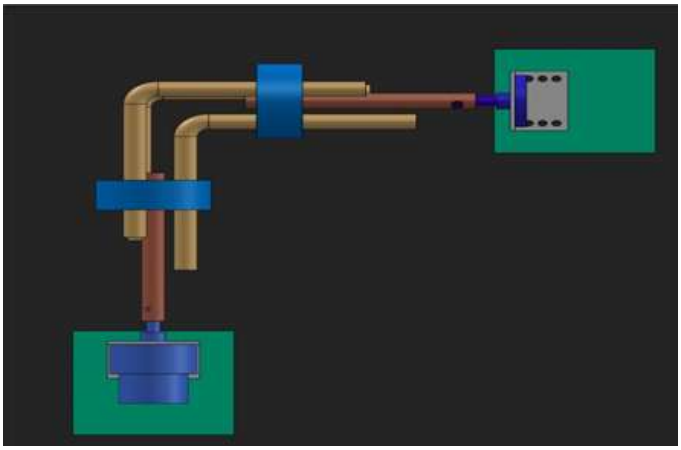
6.2 Driving and Driven Shafts

The driving shaft is the input component connected to the motor, responsible for transmitting initial rotary motion to the mechanism. It must be designed to withstand torsional stresses and ensure efficient power transfer. The driven shaft is the output component that receives motion from the elbow links and delivers it to the required application. Proper alignment of both shafts is essential to ensure smooth operation, minimize vibration, and reduce power losses in the system.



6.3 Elbow Mechanism

The elbow mechanism is the core component of the gearless transmission system, responsible for transmitting motion between intersecting shafts without the use of gears. It consists of bent links (L-pins) connected between the driving and driven shafts through a hub. When the driving shaft rotates, the elbow links undergo combined rotational and sliding motion, transferring power to the output shaft. The mechanism operates on the principle of constrained kinematic motion, ensuring smooth and continuous transmission. Its performance depends on link geometry, alignment, and material strength, making it suitable for low to moderate load applications.



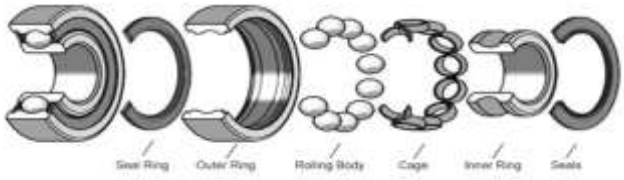
6.4 Crank Disc

The crank disc is a rotating component mounted on the driving shaft, used to convert pure rotary motion into a combination of rotary and reciprocating motion required for the elbow links. It contains holes or slots to accommodate the elbow pins, allowing them to move freely during operation. As the crank disc rotates, it drives the elbow links in a circular path, enabling the transmission of motion to the driven shaft. The design and balance of the crank disc are important to ensure smooth operation, reduce vibrations, and maintain uniform motion transfer within the system.

6.5 Bearings

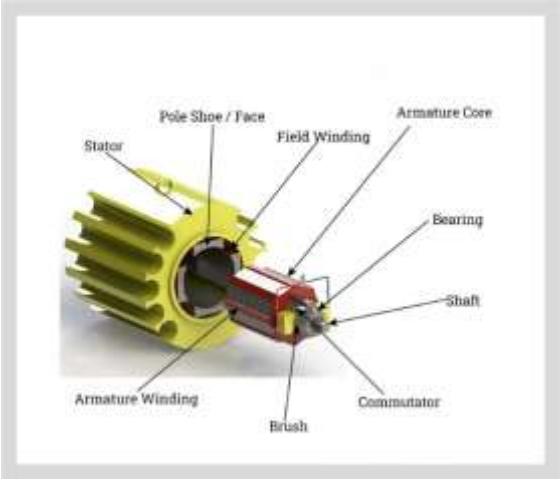
Bearings are used to support the rotating shafts and reduce friction between moving parts in the gearless transmission system. They ensure smooth and efficient rotation of the driving and driven shafts by minimizing wear and energy losses. Commonly used bearings include ball bearings due to their ability to handle both radial and limited axial loads. Proper selection and lubrication of

bearings are essential to improve performance, reduce vibration, and increase the overall life of the system.



6.6 Electirc Motor

The electric motor acts as the prime mover of the gearless transmission system, converting electrical energy into mechanical energy in the form of rotary motion. It provides the input power to the driving shaft, initiating the operation of the mechanism. The performance of the system depends on the motor's speed and torque characteristics. Typically, a low to moderate power motor is used for prototype models. Proper selection and alignment of the motor are essential to ensure efficient power transmission, minimize vibration, and maintain smooth operation of the system.



7. LIMITATIONS AND ADVANTAGES

The gearless transmission system using an elbow mechanism offers several advantages over conventional gear systems. It eliminates the need for gears, thereby reducing complexity, cost, and maintenance requirements. The system operates with less noise and provides smooth power transmission at various angles between shafts. Its simple construction makes it easy to fabricate and suitable for compact and lightweight applications. However, the mechanism also has certain limitations. It is not suitable for high load and high torque applications, as efficiency decreases under heavy operating conditions. Continuous sliding and bending motion of links may lead to wear and tear over time. Additionally, precise alignment of components is necessary to ensure smooth operation. Therefore, the system is mainly preferred for low to moderate load applications rather than heavy-duty industrial use.

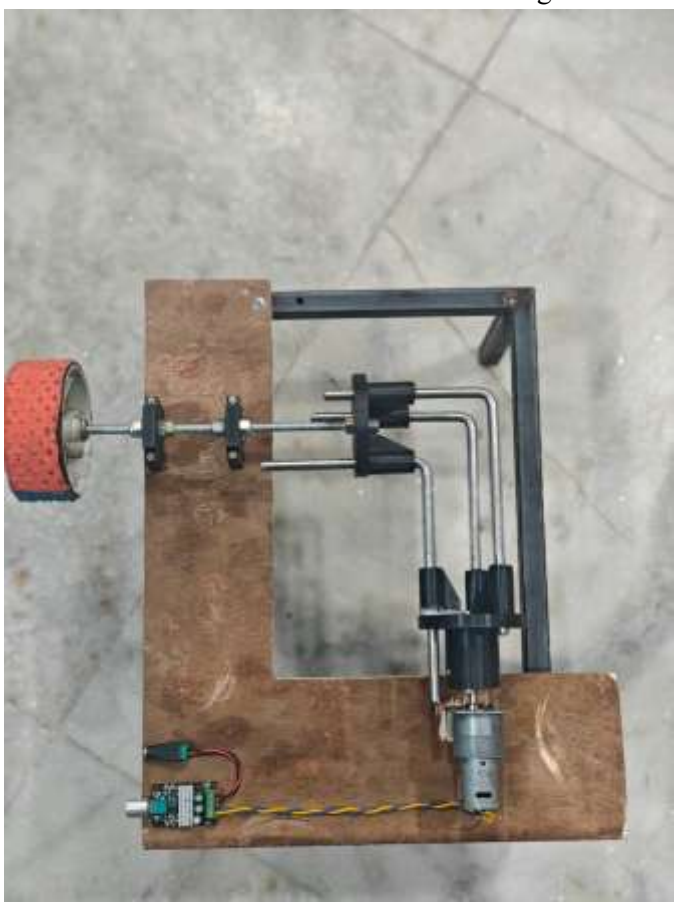
However, the mechanism also has certain limitations. It is not suitable for high load and high torque conditions, as the efficiency decreases due to friction and sliding motion between links. Continuous operation may lead to wear and fatigue in the elbow links, affecting durability. The performance of the system is highly dependent on precise alignment and proper material selection. Additionally, compared to conventional gear systems, the mechanism has limited applicability in heavy-duty industrial operations.

8. RESULTS AND DISCUSSIONS

The fabricated gearless transmission system using an elbow mechanism was tested under different operating conditions to evaluate its performance. The system was able to successfully transmit rotary motion between the driving and driven shafts at a fixed angle without the use of gears. Smooth and continuous motion was observed during operation, with minimal vibration when proper alignment was maintained.

The output shaft speed was found to be nearly equal to the input shaft speed, indicating efficient motion transfer with negligible slip. The mechanism operated effectively under low to moderate load conditions, demonstrating stable performance. However, slight power losses were observed due to friction between moving links and joints. It was also noted that increasing the number of elbow links improved the smoothness of operation and reduced fluctuations.

The system produced less noise compared to conventional gear systems, making it suitable for applications requiring quiet operation. However, under higher loads, efficiency decreased and minor wear was observed in the links due to continuous sliding motion.



8. CONCLUSIONS

The gearless transmission system using an elbow mechanism was successfully designed and fabricated to transmit rotary motion between intersecting shafts without the use of gears. The system demonstrated smooth and continuous operation with reduced noise and minimal maintenance requirements. It was observed that the mechanism performs efficiently under low to moderate load conditions, with nearly uniform motion transfer between input and output shafts.

The study confirms that the elimination of gears reduces complexity, cost, and lubrication requirements, making the system suitable for compact and economical applications. However, the mechanism is limited in handling high loads due to friction and wear in the links. Overall, the gearless transmission system using an elbow mechanism is a reliable and effective alternative for specific applications where simplicity, flexibility, and cost-effectiveness are important design considerations.

9. FUTURE SCOPE

- Use of advanced materials such as composites or coated alloys to reduce wear and improve durability.
- Application of low-friction coatings (e.g., graphene or Teflon) to enhance efficiency.
- Optimization of link design and geometry for improved power transmission and reduced vibration.
- Integration with high-power systems by strengthening components and improving load capacity.
- Development of adjustable angle mechanisms for variable shaft orientations.
- Implementation in automotive and robotic applications requiring flexible motion transmission.
- Incorporation of lubrication systems to minimize frictional losses and increase lifespan.
- Use of simulation and advanced analysis tools for performance optimization.
- Miniaturization for use in precision instruments and compact devices.
- Exploration of automation and smart control systems for better efficiency and monitoring.

10.References

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