International Journal of Engineering and Advanced Technology (IJEAT)
ISSN: 2249-8958 (Online), Volume-8 Issue-6S3, September 2019

Design and Analysis of Gearless Drive System

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Abstract: ***The paper 'GEARLESS DRIVE' being compact and portable equipment which transmits power at right angle without any gears. Here, the L - shaped joint transmits the input power in such a way that the angular forces are produced and transmitted by the joints. The amount of friction generated is minimal compared to the power being transmitted. The material used for El-bow is made up mild steel material. The mechanism is screwed to the spindle which is driven by the gearless drive transmission connected to the drive system. The entire setup is constructed and placed on the base plate. There is no back lash during the power transmission. Therefore, the efficiency of 90% - 93% can be obtained in a gearless transmission mechanism. The Mechanical drives systems are economic when compared to electrical drives and their control and components are much simpler. These are widely used in industries ranging from aviation to heavy industry. In recent trends and advancements these types of drive has become more efficient.***

Keywords: Elbow mechanism, cylindrical bars, Pulleys, Spindle

I. INTRODUCTION

The slider and kinematic link, carries force through an angle of 90°. The rotary motion of the input shaft is converted into a sliding motion through the bent link. The rotation and reciprocation of the bent link transmits the output, to the right angle to an output shaft. In traditional methods of transmission the gears are normally involved in power transmission. There are some complications while using gears for transmission purpose. The maintenance and slip are major disadvantages, due to that the efficiency in transmission decreases. In this technology, smooth cylindrical L-shaped bars of 90º are used for smooth and simple transmission.

II. EL-BOW MECHANISM

The right angled joint helps in transmitting the input power from the motor to the driver. The joints are positioned in such a way that the rotary motion is converted into sliding motion, by the el-bow mechanism. The amount of friction being generated is minimal when compared to the amount of power transmitted.

Manuscript published on 30 September 2019.
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The mechanism consists of three sliding pairs. The zero back lash is also achieved during transmission. Therefore, the efficiency of 90% - 93% is possible in gearless transmission system. The cylindrical L-shaped 90º bars is placed equally spaced to each other in a hub. The mechanism is then mounted on a channel. The electric power supply is supplied with the help of a prime mover.

Table 2.1: Components of Gearless drive system

S.No	Component	Mtl.	Qty.
1	90º bar	MS	3
2	Plummer block	CI	2
3	Pulley	CI	2
4	Spindle	MS	2

2.2 Components

The construction and the components involved in construction of gearless drive system is very simple. The components that are used in the construction of gear less drive system are 90º bar, plummer block, pulleys, shaft are the major components that are being used for the gear less drive system.

2.3 90º bar

The L angle is a shaft which is 90° bent and used for transmission purpose. The dimensions and the geometry of the 90º bar is shown in the figure.

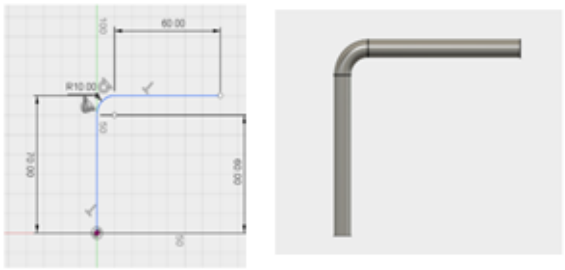
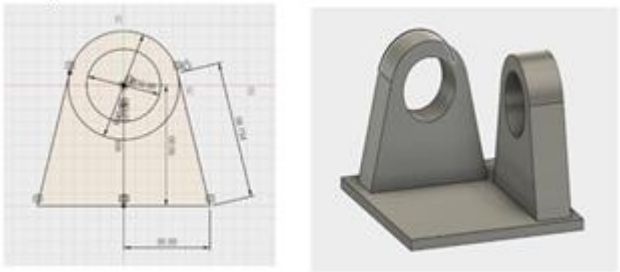


Figure 2.1: Dimensions of L – Angle

1.4 Plummer Block and Housing

The plummer block consists of a rigid housing, base and a hole where the shaft is mounted and revolves. The dimensions of the plummer block and the housing is shown in the figure.



2.5 Shaft

The shaft is a rotating element, it is used for the transmission of motion. The dimensions of the shaft are shown in the figure.

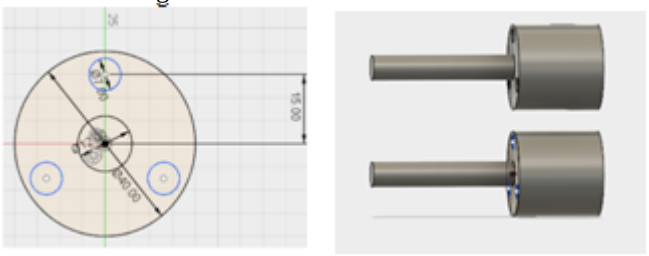
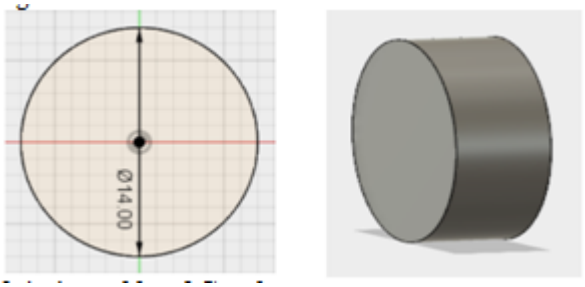


Figure 2.3: Dimensions of Shaft

2.6 Pulley

he pulley is a transmission element used for power transmission. The dimensions of the pulley is shown in the figure



2.4: Assembly of Gearless Drive System

III. DESIGN CALCULATION

Power of motor = ½ H.P = 186.5 watt

Speed of motor = 1440 Rpm

We know that,

$$P = \frac{2\pi NT}{60}$$

$$186.5 = \frac{2 \times \pi \times 1440 \times T}{60}$$

$$T = 1.23\ N - m$$

$$\mathbf{T = 1238\ N - mm}$$

Shaft and bent link shaft design based on power of motor

$$T = 1238\ N - mm$$

$$T_{max} = 1238 \times 12.5$$

$$\mathbf{T_{max} = 15475\ N - mm}$$

$$D = 10.4 \sim 10$$

$$D = 10\ mm$$

taking factor of safety = 2

Diameter of bent link shaft,

$$T = \frac{}{16} \times \tau_s \times d^3$$

$$3868.75 = \frac{\pi}{16} \times 70 \times d^3$$

$$d = 6.55mm^2$$

taking factor of safety = 1.5

$$d = 9.825\ mm \sim 10mm$$

a) 2.1 Design of HUB

$$M_t = \frac{\pi}{16} \times \tau_n \times \left(\frac{D_h^4 - D^4}{D_h}\right)$$

$$15475 = \frac{\pi}{16} \times \tau_n \times \left(\frac{120^4 - 20^4}{120}\right)$$

$$\tau_n = \frac{16 \times 15475}{\pi \times 1726666.66}$$

b) $\boldsymbol{\tau_n = 45.64 \times 10^{-3}}$ *N/mm²*

Here, allowable shear strength t of mild steel is 70N/mm²

$\boldsymbol{\tau_n = 45.64 \times 10^{-3}}$ **N/mm² is less than allowable shear strength.**

So design of hub is safe.

c) Design of DISC

$$M_t = \frac{\pi D^2}{2} \times \tau_n \times t_d$$

$$15475 = \frac{\pi \times 130}{2} \times \tau_n \times 10$$

$$\tau_n = \frac{15475 \times 2}{10 \times \pi \times 130}$$

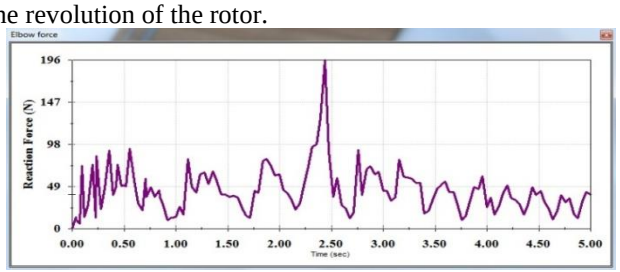
$$\boldsymbol{\tau_n = 7.57\ N/mm^2}$$

Here, allowable shear strength of mild steel is 70N/mm²

So design of Disc is safe.

IV. DYNAMIC ANALYSIS

From the analysis it is found that bar is subjected to bending stress. The total Bending stress is the sum of normal bending stress and the direct stress. The direct stress is proportional to the revolution of the rotor.



RPM	15	70	100	120	140
Direct stress (N/mm²)	2.86	4.44	2.57	4.42	4.63
Moment(N)	12.88	12.92	12.80	12.91	12.95

V. ADVANTAGES

- Reduced maintenance cost.
- Instant response.
- Simple in construction.
- Easy to maintain and repair.

VI. CONCLUSION

The gearless drive system is an alternate approach for transmission of power were traditional method could not be adopted due to various constraints. The design of the proposed is simple and efficient in power transmission. The maintenance and service is also comparatively low when compared with the traditional transmission system.

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