Design and Fabrication of Gearless Right Angled Transmission and Continuous Variable Transmission

Prithviraj Patil, Bhushan Patil, Avinash Kale, Rajay Rathod, Prof.S.B.Patil

ABSRTACT:- Introduced gearless power transmission arrangement used for skew shafts. In this transmission system no. of pins or links used must be odd..3,5,7,9…..& centers of any two pins or links hole must not be on that line which represent the diameter of the shaft. If more pins or links used motion will be smoother, but increase in no. of pins or links not at the cost of strength of the shaft. Pins or links are fixed (may be permanent of temporary) in the drilled holes at the both shaft ends due to which motion is transferred. The dimensions of the pins or links and angle for the pins are all given very precisely, holes drilled very accurately. Proposed arrangement used for skew shafts at any angle & if there is a need we can change the angle between shafts during motion or during intermittent motion with any profile of shafts having rotational motion along its own axis. The Working of this arrangement is very smooth & use very effectively with a very minimum amount of power losses.

Keyword: skew shaft, revolve pair, sliding pair, hyperboloids, front/side/top view, intermittent motion

INTRODUCTION

This project is about "GEARLESS RIGHTANGLED TRANSMISSION AND CONTINUOUS VARIABLE TRANSMISSION".

- Project is divided in three parts.

First part gearless rightangle transmisssion.
second part continuous veriable transmission.
third part is of application i.e. wood cutting (application).

- Gearless Right Angle Transmission.

A machine consists of a gearless power transmission system, which provides controlled application of the power. Merriam-Webster defines transmission as an assembly of parts including the speed-changing gears and the propeller shaft by which the power is transmitted from an engine to a live axle. Often transmission refers simply to the gearbox that uses gears and gear trains to provide speed and torque conversions from a rotating power source to another device.

This project is based on two parts. First part is based on "Gearless transmission" in which there is motion is transferred from one shaft to another which is at right angle. In this there is mechanism constructed in such a way that right angle welded link slides in the disc allows disc rotating and transfer motion from one shaft to another.

Gearless right angle transmission consists of three right angle pin supported in the disc. This disc is connected to shaft. This is very smooth acting device has exact velocity ration and no slip while transferring motion from one shaft to another shaft.

Now day's gears are used for transmission of powers. Also with gears, couplings, belt and pulleys system, chain drives are used. In bevel gear also coupling is used for meeting motion through shaft which is at right angle.

But power transmission with help of gear in machine is done, but manufacturing of these gears in case of right angle transmission bevel gear is complex and costly. Power loss in gear due to sliding motion and shaft orientation is very limited means not for every orientation because of standardization of gears so need arrases for a better system.

Working Principle of the project is Transmits the power between two shafts whose axes are at 90 degree through bent links. Three links slide relatively according to the motion given to input shaft. Due to this, the rotational motion of input shaft is converted into sliding motion of links which is then converted to rotational motion of the output shaft.

So we introduce gearless power transmission system for shaft which reduces losses, cost and saves time. Also gives exact velocity ration and economical also in case of failure because in this mechanism we have to change any single pin which was broken and hence saves time and cost. While in case of failure of gear we have to replace whole gear. i.e., broken of gear teeth.

In this project second mechanism is based on continuous variable transmission by using face plate variety. There is gear are used for transmitting power but gear has step drive. In this drive we can have limited velocity ratio and fixed speed transmission but with continuous variable transmission we can able to change velocity continuously and can produce step less drive system. Because of this we have wide range of velocity transmission with number of velocity can be continuously changed.

In this face plate variater there are two face plates with knurled and tapered disc which slides with the help of threaded shaft between face plate and this knurled and tapered disc transmission of power from one shaft to another shaft through faceplate by using friction.
Advantage of this mechanism is that it provides continuous variation in sp.

- **Continuously variable transmission**

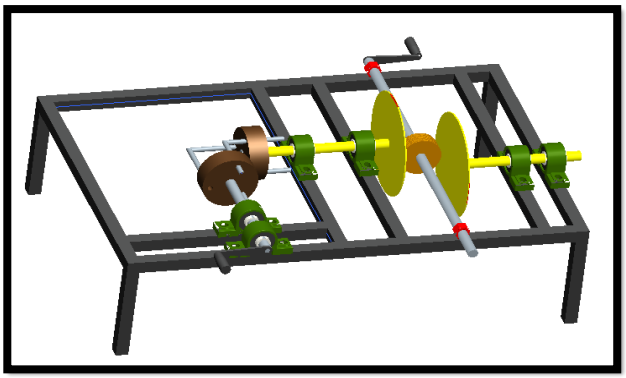
The continuously variable transmission (CVT) is a transmission in which the ratio of the rotational speeds of two shafts, as the input shaft and output shaft of a vehicle or other machine, can be varied continuously within a given range, providing an infinite number of possible ratios. The CVT allows the driver or a computer to select the relationship between the speed of the engine and the speed of the wheels within a continuous range. This can provide even better fuel economy if the engine constantly runs at a single speed. The transmission is, in theory, capable of a better used experience, without the rise and fall in speed of an engine, and the jerk felt when changing gears poorly

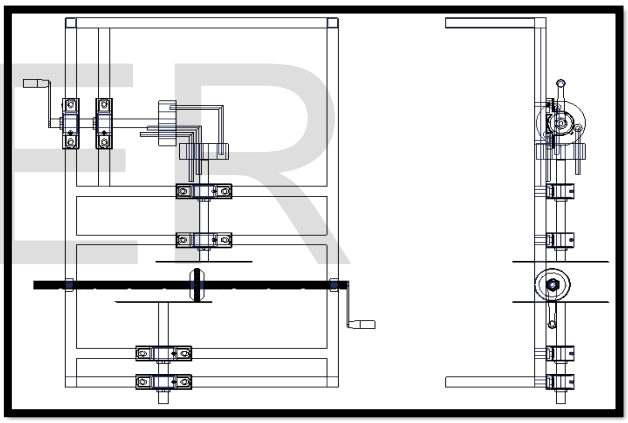
- **Wood cutting (Application)**

After designing Gearless Right angle Transmission and Cont. Variable Transmission (i.e. Face Plate Variator) , we attached wood cutting setup at the end of CVT .

Then the whole setup will be Wood Cutting Machine .There is need of maximum RPM to cut the wood. So firstly power will be transferred in 90 degree by using Gearless right angle transmission then by using CVT we control the output (i.e. RPM) of shaft on which cutting blade is attached.

DESIGN





PROBLEM DEFINATION

Some of the applications are there in which, accurate angular velocity is required and is to be changed frequently as per requirement. In wood cutting machines, stepped drives are not useful.This type of machines can have step less drive system and control the output of wood

cutting machine using CVT.

Material Used

A.Properties Of Mild Steel Mild/Low Carbon Steel

Introduction:

Mild steel has excellent welding properties and is suitable for grinding, punching, tapping, drilling and machining processes. Yield strength of mild steel is less than that of cold roll steel, thus enabling mild steel to bend more readily than cold roll steel. Normally, larger diameters in mild steel are not produced since C1018 hot roll rounds are used.
Mild steel is usually available in the following forms:

- Rectangle bar
- Square bar
- Circular rod

Steel shapes such as channels, angles, H-beams and I-beams.

Machining :

The machinability rate of mild steel is estimated to be 72%, and the average surface cutting feed of mild steel is 120 ft/min. Machining of mild steel is not as easy as that of AISI 1018 steel.

Welding :

Mild steel is easy to weld using any type of welding methods, and the welds and joints so formed are of excellent quality.

Heat Treatment :

Normalizing, Annealing, Stress relieving, Carburizing, Hardening processes are carried out for manufacturing mild steel.

Machining :

The machinability rate of mild steel is estimated to be 72%, and the average surface cutting feed of mild steel is 120 ft/min. Machining of mild steel is not as easy as that of AISI 1018 steel.

STEPS IN PROJECT

Steps in Manufacturing

- Designing
- Welding
- Machining and Grinding
- Drilling
- Threading
- Boring
- Fitting
- Assembling

CALCULATIONS

Design Of Shaft:

Ultimate Strength ( ) =700N/mm²

Yield strength ( ) = 350 N/mm²

Torque (T) = (π /16) x d^3x

N = 30 rpm

Firstly find out the torque apply on shaft
Consider the manual force applied on handle is 20 kg We know that,

F= m x g
= 20 x 9.81
= 196.2 N

The length of handle is 200 mm So,

T= F x r
= 196.2 x 200
= 39240 N-mm
Torque acting on shaft-1= 39240 N-mm

Power=123.2136 W
=123.2 W

Shear stress (τ)= ultimate strength

factorof safety
Where, Factor of Safety = 4.

$$= \frac{700}{4}$$

$$= 175 \text{ N/mm}^2$$

$$T = \frac{3.14 \times \tau}{16}$$

D=10.45 mm

So 20mm standard diameter shaft are easily available in market so 20mm shaft is selected for our system which is safe.

Design of face plate transmission:

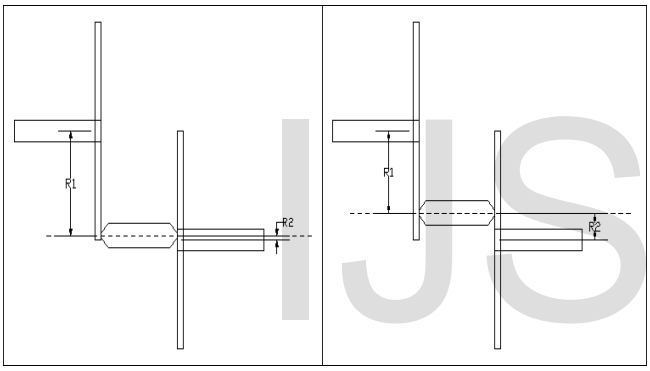


Fig.: Transmission by faceplate

The R_1 and R_2 varies from minimum limit to maximum limit.We know that speed is inversely proportional to diameter

$$\frac{N_2}{N_1} = \frac{R_1}{R_2}$$

R_1 is varies from 0 to 70

Same R_2 also varies from 0 to 70

1. $R_1 > R_2$

From equation 1 the speed is increase of output shaft.

2. $R_1 = R_2$

From equation 1 the speed is constant that is speed of input and output shaft is same.

3. $R_1 < R_2$

From equation 1 the speed of output shaft is decreases.

$R_2 = 215 - R_2$

$$N_2 = \frac{R_1 \times N_1}{70 - R_1}$$

At the middle position of the disc when,

When, $R_1 = 35$mm

And $R_2 = 35$mm

$$\therefore N_2 = \frac{R_1 \times N_1}{R_2}$$

But there is some slip also occurs which causes speed reduction and other losses like friction.

Friction is calculated below

Now when,R_1 is 1mm and R_2 is 69mm then

$$N_2 = \frac{1}{69} \times 30$$

=0.4347rpm

This is the starting speed

When R_2 =69mm

R_1=1mm

Then, N_2=2070rpm

Hence, range of velocity provided by faceplate variation is 0 to 2070rpm

Slips occurs is 0.15 to 0.20

Efficiency is 0.80% to 0.85%.

Now the axial force exerted by face plate on the tapered & knurled disc

P=Pressure / Area

$$\text{Preasure} = \frac{P}{\text{Area}}$$

Pressure= 9.4045

Torque,

T = Frictional Torque
f x r

=124.140

=10574N-mm.

Design of Spring:

Consider-

τ =0.5 x ultimate strength

=0.5 x 700

=300

Consider spring index c as 8 Wahlfactor (k)

$$k=\frac{4c-1}{4c-4}+\frac{0.615}{c}$$

k=1.184017

$$\tau=k \times \frac{8pc}{\pi d^2}$$

Required force at a face plate is 5kg then, 5p

$$350=1.184017 \times \frac{8x49.05x8}{d^2}$$

d=1.68mm

So, minimum diameter required for spring is 1.68mm.

We purchased steel spring of standard diameter 3mm from market which has mean coil diameter, D=25mm
Pitch=20mm

Gap between adjacent coil=10mm
Total gap spring=80mm

Now axial force exerted by spring,

$$\tau = k \times \frac{8pc}{\pi d^2}$$

$$P=\frac{xd^2}{kx8xc}$$

For steel spring index is 8.5k

=1.1+0.07235

=1.172358

$$P=\frac{xd^2}{kx8xc}$$

P=124.140N

Output Calculation:

Motor used 1HP and 1440 RPM

1. Pulley used at input d = 90 mm

Actual RPM =d x speed of motor
dia. of pulley (motor)

$$= \frac{90 \times 1440}{140}$$

= 925.71 RPM

At 925 RPM Bearing fails, so there is need to reduce speed.

2. Pulley used at input d =50 mm

Actual RPM = $\frac{50 * 1440}{140}$

= 514.28 RPM.…Runssuccessfully.
Output speed i.e. cutting speed at 3 different points by Tachometer.

Face plate variator diameter d =215 mm

1. at 47.5 mm - 100 to 105 RPM … Min speed
2. at 107.5 mm - 450 RPM …Avg. speed
3. at 167.5 mm - 1150 RPM … Max speed

At 167.5 mm diameter and 1150 rpm speed the wood is cutting successfully.

ADVANTAGES

1.Transmission is possible the angle between 90 degree.
2.It is the innovative type coupling.
3.The speed is constant for input and output shaft.
4.Easy to handle.
5.Simple design.
6.Step less drive.
7.Any Speed can adjust within range in CVT.
8.Compact size.
9.Easy to lubricate and cool as compared gear transmission.

APPLICATIONS

1.Usable for different machine like Wood Cutting.
2.Usable for home appliances.
3.Special purpose machines.
4.Different Mechanisms.
5.Automobile Tower clocks.
6.Gang drilling (multi spindle drilling).
7.Lubrication pump for CNC lathe.
8.Angular drilling between 0- 90 degree.
9.Movement of periscope in submarines.
10.Used in vehicles (go-carts).
11.Hmakers sheet folding machines etc.

DISADVANTAGES

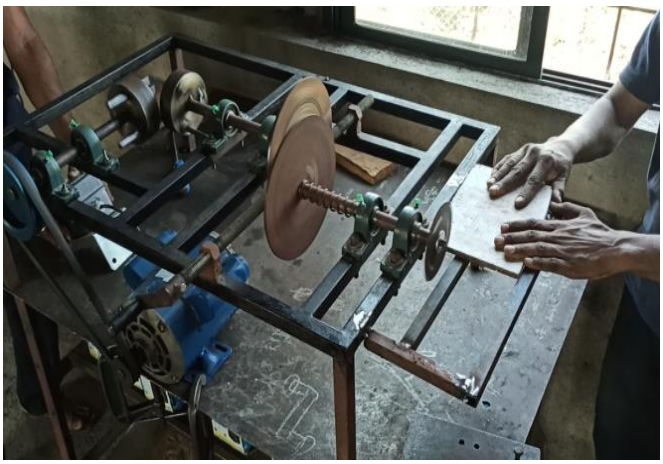
1.Initial cost is high.
2.Now that project is operate manually by using handle.
3.Speed depends on size of input disc.
4.Volume will be increased when we increasessize of input disc.
5.There are losses like friction loss and slip may occur during high speed.

CONCLUSION

- From this project we concluded that this prototype model help in increasing efficiency and save time; reduces cost and complexity in power transmission.

- It also improve other factors like less cooling requirement, less supervision, wide and continuous range of velocity for transmission, compared to conventional method of power transmission.

- Wood cutting application runs successfully.



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