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THREE PIN CONSTANT VELOCITY JOINT FOR PARALLEL AND ANGULAR POWER TRANSMISSION

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ABSTRACT

Now a days, universal joint and couplings are used for parallel offset power transmission and angular offset power transmission. These joints are used to transfer power from engine shaft to rear wheels. These joints have limitations like offset distance, angle&speed and causes in vibrations and also low efficiency (below 65%). So the three pin constant velocity jointgives more advantages such as 15 mm parallel offset and 12 degree angular offset, at high speeds up to 2000 to 2400 rpm, and gives efficiency up to 85-90%. The three pin constant velocity joint minimizes the cost of production, space requirement and provides simple technology as compared to Oldham's coupling and universal joint.

Keywords*: *Angular Offset, Parallel Offset, Power Transmission, 3-Pin Constant Velocity Joint

I INTRODUCTION

The couplings are used to connect two shafts for power transmission. Couplings transmits power from engine shaft to rear wheel of vehicle, without disconnection of shafts during operations.

The main purpose of couplings is to transmit power between two rotating pieces, while permitting some degree of misalignment or end movement or both. Some of widely used couplings are as follows,

- Rigid couplings.
- Sleeve couplings.
- Flange Couplings.
- Flexible Couplings.
- Oldham's couplings.
- Universal Joints.

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1.1 Uses of Couplings

Shaft couplings are used in machinery for several purposes. The most common of which are the following.

1. To provide for the connection of shafts of units that are manufactured separately such as a motor and generator and to provide for disconnection for repairs or alterations.
2. To provide for misalignment of the shafts or to introduce mechanical flexibility.
3. To reduce the transmission of shock loads from one shaft to another.
4. To alter the vibration characteristics of rotating units.
5. To connect driving and the driven part
6. To transfer power one end to another end.(ex: motor transfer power to pump through coupling)for power transmission.

This couplings have following Drawbacks-

- Maximum efficiency is limited upto 65-70%.
- Maximum operating speed upto 1400 rpm.
- Radial and angular loads reduces bearing life.
- Maximum angular offset permissible upto 12mm only.
- Vibration problem.

This drawback overcome by using alternatives as constant velocity joints.

Types of constant velocity joint are-

- Rzeppa constant velocity (CV) joint.
- Tripod Constant Velocity Joint.
- Centre Support Bearings.
- Bendix-Weiss constant velocity (CV) joint.
- Three pin constant velocity.

II FEATURES & ADVANTAGES

The Three pin Constant velocity joint is an ideal solution to the power transmission between shafts and permits angular offset, the only wearing parts being the trunion joints. The Three pin constant velocity joint ensures that no fluctuating loads are transmitted across to the output shaft.

The features of the Constant velocity joint are as follows:

1. True constant velocity high angle shaft coupling through all angles and rotation and articulation
2. Maximum working articulation angle of 15 degrees. Coupling does provide a stroke limiting device to prevent angle being exceeded.
3. Nominal high torque rating
4. Maximum peak torque rating for short duration periods.
5. Maximum speed of rotation 2,400 rpm.

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6. Generation and excitation of vibration forces is minimised through patented spherical dividing mechanism providing true constant velocity rotation.
7. True point centricity enabling pivoting applications to be fully realised
8. High torsional and radial rigidity. Axial length compensation can be achieved by appropriate splined shaft connections or similar if required.
9. High axial rigidity feature allows for axial load transfer. eg transfer of thrust loads.
10. No requirement for phased or angular connecting flanges as with traditional UJ technology.
11. Minimal heat generation from roller bearing componentry unlike traditional cv joint technology thus providing highest efficiency and maximum service life at high speeds AND full angle.
12. Three pin constant velocity Joint is corrosion protected.
13. Actual bearing life depends on combination of factors including equivalent speed, torque and angle as well as shock loads, re-lubrication frequency and environmental conditions.

Figure 1. Constant Velocity Joint

2.1 Advantages of 3 pin constant velocity joints

- Step-less variation of angular offset: Any displacement between 0 to 60 mm can be obtained .Hence the drive provides flexibility in operation and setting as prime mover location can be varies as per space available
- Wide range of angular displacement: The wide range of angular displacement 30 to 65 degrees enables to get vibration free power transmission at high speed.
- Compact size: The size of the gear less variable speed reducer is very compact; which makes it low weight and occupies less space in any drive.
- Ease of operation : The changing of angular and angular offset is gradual one hence no calculations of speed ratio required for change gearing .Merely by rotating hand wheel speed can be changed
- Singular control: Entire range of offset is covered by a single hand wheel control.
- Maximum efficiency: The efficiency is increased upto 90%.

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III EXPERIMENTAL ANALYSIS

Figure 2. Experimental Setup

3.1 Parallel Offset: 12mm

Aim: -To conduct trial

a) TORQUE Vs. SPEED CHARACTERISTICS

b) POWER Vs. SPEED CHARACTERISTICS

c) EFFICIENCY Vs. SPEED CHARACTERISTICS

In order to conduct trial, a dyno brake pulley cord, weight pan are provided on the Output shaft.

Procedure

1) Start motor

2) Let mechanism run & stabilize at certain speed (say 1500 rpm)

3) Place the pulley cord on dyno brake pulley and add 0.1 KG weight into,

The pan, note down the output speed for this load by means of tachometer.

4) Add another 0.1KG cut & take reading.

5) Tabulate the readings in the observation table

6) Plot Torque Vs. speed characteristic

Power Vs. speed characteristic

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Observation Table

SR.NO	LOADING		UNLOADING		MEAN SPEED
	WEIGHT (KG)	SPEED (RPM)	WEIGHT (KG)	SPEED (KG)	
1	0.2	1490	2	1470	1480
2	0.4	1408	4	1412	1410
3	0.6	1330	6	1350	1340
4	0.8	1200	8	1180	1190
5	1	950	10	924	937

Table.1 Observation Table

Sample Calculations (0.6 Kg Load)

1) Average Speed

$$N = \frac{N1+N2}{2} = \frac{1330+1350}{2}$$

N= 1340 Rpm

2) Output Torque

T_{dp} = Weight in pan x Radius of Dyno brake Pulley

= (0.6x 9.81) x 25

=147.15 N.mm

Tdp = 0.1475N.m

3) Input Power:- (Pi/p) = 29 WATT

4) Output Power:- (Po/p)

$$Po/p = \frac{2\pi NTo/p}{60}$$

$$= \frac{2\pi * 1340 * 0.14715}{60}$$

= 20.64watt

5) Efficiency:-

$$= \frac{O/p}{I/p} = \frac{20.65}{29}$$

η = 71.17%

Efficiency of transmission of gear drive at 0.6 kg load=71.17%

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Result Table

SR NO.	LOAD (kg)	SPEED (rpm)	TORQUE (n-m)	POWER (watt)	η (%)
1	0.2	1480	0.04905	7.6020	26.21
2	0.4	1410	0.0981	14.484	49.94
3	0.6	1340	0.14715	20.648	71.2
4	0.8	1190	0.1962	24.449	84.3
5	1	937	0.24525	24.064	82.87

Table.2 Result Table

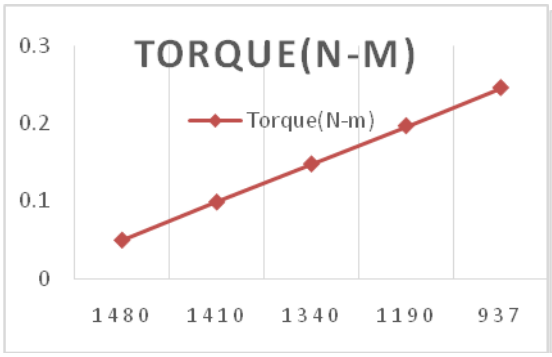

Figure.3 Speed v/s Torque

Graph shows that torque increases with decrease in output speed

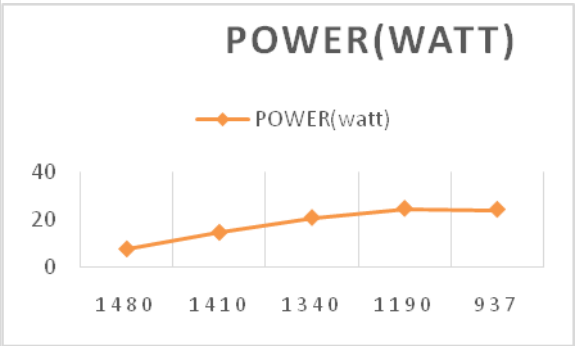

Figure.4 Speed v/s Power

Graph shows that maximum power is obtained around 1190 rpm thus it is recommended speed at maximum parallel offset

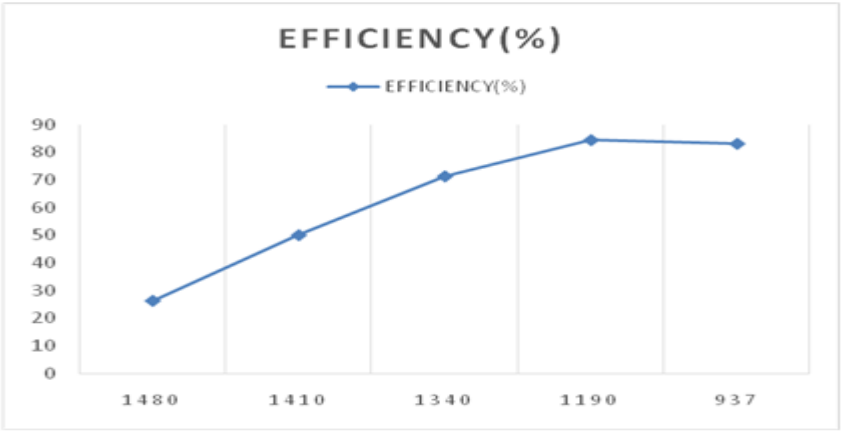

Figure.5 Speed vs Efficiency

Graph shows that maximum efficiency is obtained at about 1190 rpm thus it is recommended speed at maximum parallel offset

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3.2 Angular Offset: 14 Degree Maximum

Aim: -To conduct trial

d) TORQUE Vs SPEED CHARACTERISTICS

e) POWER Vs SPEED CHARACTERISTICS

f) EFFICIENCY Vs SPEED CHARACTERISTICS

In order to conduct trial, a dyno brake pulley cord, weight pan are provided on the output shaft.

Procedure

7) start motor

8) Let mechanism run & stabilize at certain speed (say 1500 rpm)

9) Place the pulley cord on dyno brake pulley and add 0.1 KG weight into,

The pan, note down the output speed for this load by means of tachometer.

10) Add another 0.2KG cut & take reading.

11) Tabulate the readings in the observation table

12) Plot Torque vs. speed characteristic

Power Vs. speed characteristic

Observation Table

SR.NO	LOADING		UNLOADING		MEAN SPEED
	WEIGHT (KG)	SPEED (RPM)	WEIGHT (KG)	SPEED (KG)	
6	0.2	1425	2	1415	1420
7	0.4	1330	4	1310	1320
8	0.6	1230	6	1260	1245
9	0.8	1100	8	1070	1085
10	1	885	10	865	875

Table.3 Observation Table

Result Table

SR NO.	LOAD (kg)	SPEED (rpm)	TORQUE (n-m)	POWER (watt)	□ (%)
1	0.2	1420	0.04905	7.2938	25.15
2	0.4	1320	0.0981	13.560	46.75
3	0.6	1245	0.14715	19.184	66.15
4	0.8	1085	0.1962	22.292	76.86
5	1	875	0.24525	22.47	77.48

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Table.4 Result Table

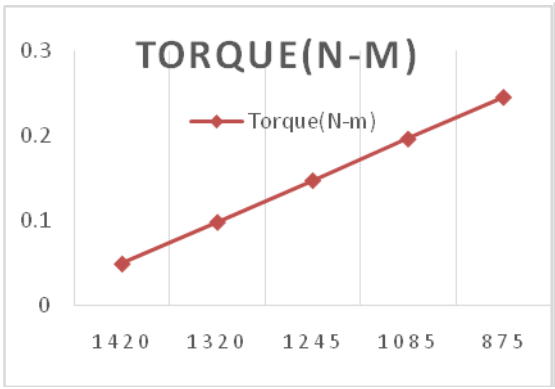

Figure.6 Speed v/s Torque

Graph shows that torque increases with decrease in output speed

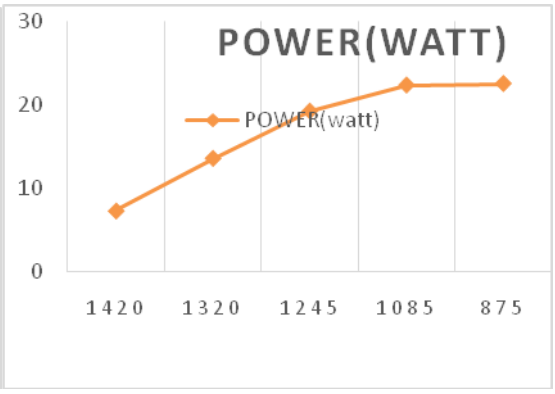

Figure.7 Speed v/s Power

Graph shows that maximum power is obtained around 875 rpm thus it is recommended speed at maximum angular offset

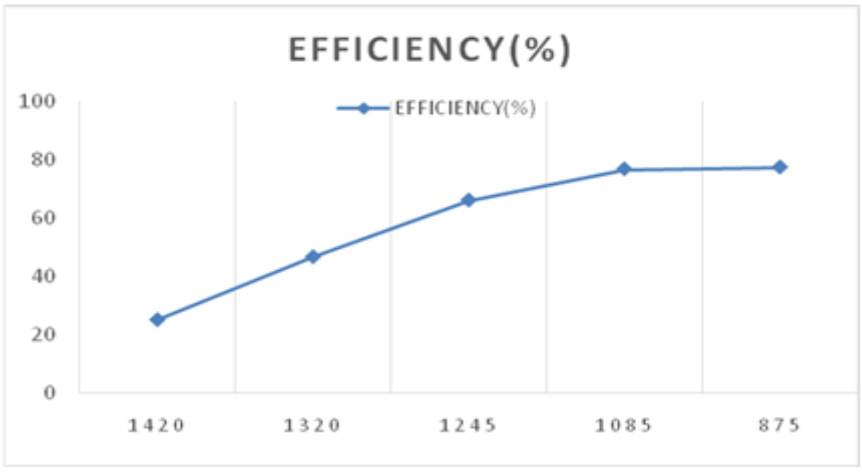

Figure.8Speed vs Efficiency

Graph shows that maximum efficiency is obtained at about 875 rpm thus it is recommended speed at maximum angular offset

IV CONCLUSION

The 3-Pin Constant velocity joint is the most suitable joint for transmitting power with maximum parallel as well as maximum angular offset. It transmits the power with less vibration also maximum efficiency obtained as compared to other power transmitting devices.

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