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Performance Analysis of 5-D Coupling for Parallel Angular Transmission

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***Abstract*—**Five dimensional coupling is a mechanical transmission system used to transmit the mechanical power in parallel as well as angular offset. The main function of coupling is to transmit the power from input shaft to output shaft without any loss. There are many types of couplings used for power transmission. In this transmission system three linear offset & two angular offset are present. Five dimensional coupling gives the step less variation in power transmission. Generally coupling used in power transmission have maximum friction, also power losses. By using five dimensional coupling all losses can be avoided. This paper explains the details of performance of coupling by using the rope brake dynamo meter. This gives the detailed information about the increase or decrease in torque, O/P power, Efficiency with respect to input power.

***Keywords*—**Coupling; effiency; torque; missalignment; offset power transmission.

I. INTRODUCTION

A coupling is a device used to connect two shafts together at their ends for the purpose of transmitting power. Couplings do not normally allow disconnection of shafts during operation, however there are torque limiting couplings which can slip or disconnect when some torque limit is exceeded. The primary purpose of couplings is to join two pieces of rotating equipment while permitting some degree of misalignment or end movement or both. By careful selection, installation and maintenance of couplings, substantial savings can be made in reduced maintenance costs and downtime.

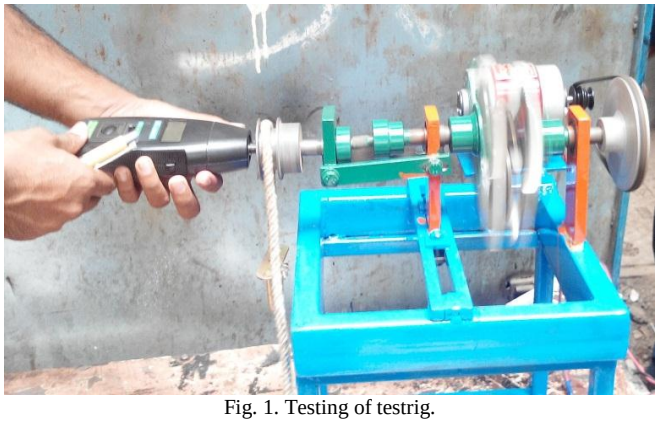

Fig. 1. Testing of testrig.

II. WHY A FLEXIBLE COUPLING?

A flexible coupling connects two shafts, end-to-end in the same line, for two main purposes. The first is to transmit power (torque) from one shaft to the other, causing both to rotate in unison, at the same RPM. The second is to compensate for minor amounts of misalignment and random movement between the two shafts. Belt, chain, gear and clutch drives also transmit power from one shaft to another, but not necessarily at the same RPM and not with the shafts in approximately the same line.

Such compensation is vital because perfect alignment of two shafts is extremely difficult and rarely attained. The coupling will, to varying degrees, minimize the effect of misaligned shafts. Even with very good initial shaft alignment there is often a tendency for the coupled equipment to "drift' from its initial position, thereby causing further misalignment of the shafts. If not properly compensated, minor shaft misalignment can result in unnecessary wear and premature replacement of other system components.

In certain cases, flexible couplings are selected for other protective functions as well. One is to provide a break point between driving and driven shafts that will act as a fuse if a severe torque overload occurs. This assures that the coupling will fail before something more costly breaks elsewhere along the drive train. Another is to dampen torsional (rotational) vibration that occurs naturally in the driving and/or driven equipment.

Each type of coupling has some advantage over another type. There is not one coupling type that can "do it all". There is a trade-off associated with each, not the least of which can be purchase costs. Each design has strengths and weaknesses that must be taken into consideration because they can dramatically impact how well the coupling performs in the application.

III. EXPERIMENTAL ANALYSIS OF TESTRIG

A. Test & Trial Coupling at 30mm offset Parallel

Aim: - To conduct trial

1. Torque vs speed characteristic
2. Power vs speed characteristic
3. Efficiency Speed Characteristics

In order to conduct trial, Dynamo 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)

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3. Place the pulley cord on Dynamo 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
   1. Torque vs speed characteristic
   2. Power vs speed characteristic
   3. Efficiency Speed Characteristics

Observation table:-

Sr. No	Loading		Unloading		Mean Speed
	Weight (KG)	Speed rpm	Weight (KG)	Speed rpm	
1	0.2	1480	0.2	1460	1470
2	0.4	1400	0.4	1410	1405
3	0.6	1320	0.6	1340	1330
4	0.8	1210	0.8	1190	1200
5	1.0	960	1.0	920	940

Sample Calculations :- (at 0.8 kg Load)
Average Speed :-
$N= (N_1 + N_2)/2 = (1210 +1190)/2 = 1200$rpm
Output Torque:-
T_{dp} = Weight in pan x Radius of Dynamo brake Pulley
= (0.8x 9.81) x 25
= 196.2N.mm
T_{dp}= 0.1962 N.m

1) Input Power:- ($P_{i/p}$) = 39.6 WATT
2) Output Power:-($P_{o/p}$)

$P_{o/p} = (2 \square N T_{o/p})/60$
$= (2 x \square x 0.1962 x 1200)/60$
$P_{o/p}$ = 24.64 watt

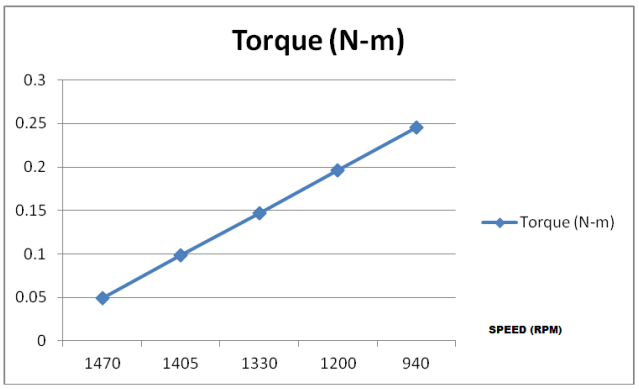
3) Efficiency:-

η = Output power/ Input power
= 24.6 / 39.6 = 62.77%

Efficiency of transmission of gear drive at 0.8 kg load= 62.77%

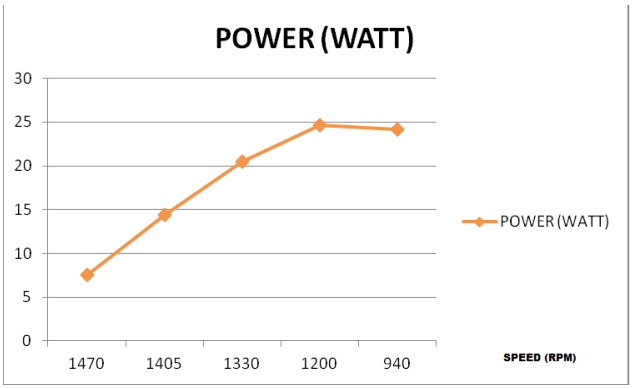
Result table:

Sr. No	Load (kg)	Speed (rpm)	Torque (N.M)	Power (watt)	Efficiency (%)
1	0.2	1470	0.0490	7.55	19.21
2	0.4	1405	0.098	14.43	36.76
3	0.6	1330	0.147	20.49	52.20
4	0.8	1200	0.196	24.65	62.77
5	1.0	940	0.245	23.85	60.80



Graph 1. Torque vs speed.

Graph shows that torque increases with decrease in output speed of coupling.



Graph 2. Power vs speed.

Graph shows that maximum power is delivered by the coupling at close to 1200 rpm. Thus this is recommended speed at maximum parallel offset condition.

Graph 3. Efficiency vs speed.

Graph shows that maximum efficiency is attained by the coupling at close to 1200 rpm. Thus this is recommended speed at maximum parallel offset condition for maximum efficiency.

B. Test & Trial Coupling at 4^O Angular offset

Aim: -To conduct trial

1. Torque vs speed characteristic

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2. Power vs speed characteristic
3. Efficiency Speed Characteristics

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

Procedure:-

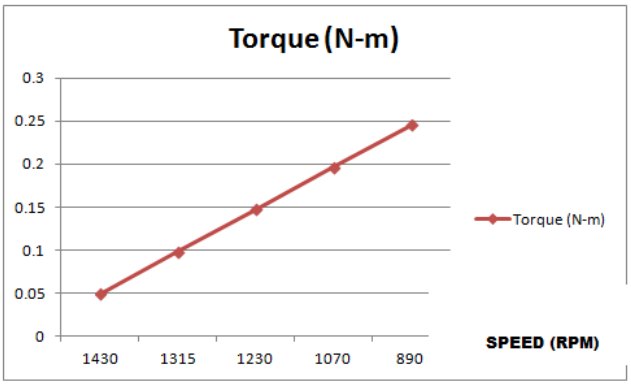
1. Start motor
2. Let mechanism run & stabilize at certain speed (say 1500 rpm)
3. Place the pulley cord on Dynamo brake pulley and add 0.1 KG weight into, the pan, note down the output speed for this load by means of tachometer.
4. Add another 0.2KG cut & take reading.
5. Tabulate the readings in the observation table
6. Plot
   1. Torque vs speed characteristic
   2. Power vs speed characteristic
   3. Efficiency Speed Characteristics

Observation Table:-

Sr. No	Loading		Unloading		Mean Speed
	Weight (KG)	Speed rpm	Weight (KG)	Speed rpm	
1	0.2	1440	0.2	1420	1430
2	0.4	1320	0.4	1310	1315
3	0.6	1220	0.6	1240	1230
4	0.8	1090	0.8	1080	1070
5	1.0	900	1.0	880	890

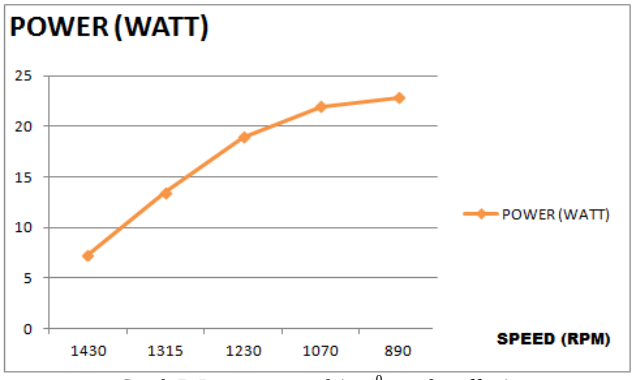
Result Table:-

Sr. No	Load (Kg)	Speed (Rpm)	Torque (N.M)	Power (Watt)	Efficiency (%)
1	0.2	1430	0.0490	7.346	18.70
2	0.4	1315	0.0981	13.510	34.42
3	0.6	1230	0.1471	18.956	48.28
4	0.8	1070	0.1962	21.987	56
5	1.0	890	0.2452	22.860	58.24



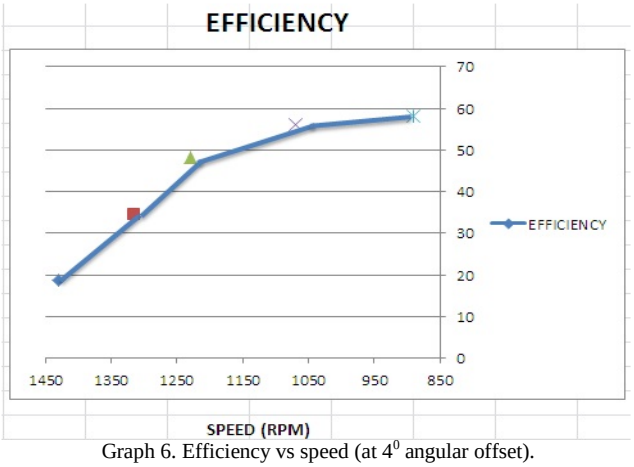
Graph 4. Torque vs speed (at 4^0 angular offset).

Graph shows that torque increases with decrease in output speed of coupling.



Graph 5. Power vs speed (at 4^0 angular offset).

Graph shows that maximum power is delivered by the coupling at close to 900 rpm .thus this is recommended speed at maximum angular offset condition.



Graph 6. Efficiency vs speed (at 4^0 angular offset).

Graph shows that maximum efficiency is attained by the coupling at close to 900 rpm. Thus this is recommended speed at maximum angular offset condition for maximum efficiency.

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