Research Paper

PERFORMANCE INVESTIGATION OF A SINGLE BALL TRACTION DRIVE

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ABSTRCT

There are many machines and mechanical units that under varying circumstances make it desirable to be able to drive at a barely perceptible speed, an intermediate speed or a high speed. Hence an infinitely variable (step less) speed variation in which it is possible to get any desirable speed. Some mechanical, hydraulic, drives serve as such step less drives. However the torque Vs speed characteristic of these drives does not match torque at low speeds. As per requirement of operation various speeds required to be maintain for maintaining that various speeds no of speed controls are provided that are complicated to operate instead of it only one knob control provided for getting various speed ranges with help of single ball traction drive.

INTRODUCTION

There are many machines and mechanical units that under varying circumstances make it desirable to be able to drive at a barely perceptible speed, an intermediate speed or a high speed.

Thus an infinitely variable (step less) speed variation in which it is possible to get any desirable speed. Some mechanical, hydraulic, drives serve as such step less drives. However the torque Vs speed characteristic of these drives does not match torque at low speeds.

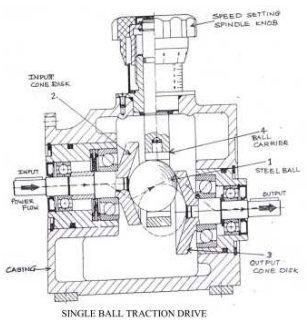
The Single Ball Traction Drive concept consisting of one ball rotates between two cones. Actual drive in consist of input cone, output cone and ball, special ball holder is provided for holding rotating ball. Ball is rotated in between input and output cone. And total position of ball is control by rotating knob, total upward and downward position of ball is control by rotating knob. For carry out performance investigation special experimental set up made for determining performance characteristics.

NEED FOR STEPLESS DRIVE

- Step less or infinitely varying speed.
- Wide range of speed variation i.e. (Nmax-Nmin).
- Shifting from one speed to another should be shock less.
- Minimum number of controls for speed changing
- Ease of operation.
- Power transmission will be properly balanced.
- Multiple speeds can be obtained.
- Infinitely variable speed will available over a given range.

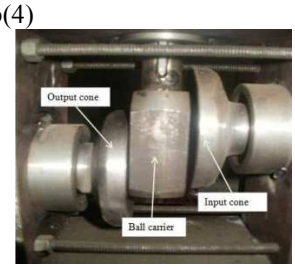
PRINCIPLE OF OPERATION

The major components of the drive are steel ball (1) positioned between two axially displaced hollow cone discs (2 & 3) and acts as a power transmission element.



Single ball traction drive

When the load is applied, the transmission ball is pulled into a triangle formed by the two hollow cone disks by an amount equal to the elastic deformation of the parts under load. Thus the contact pressure is directly proportional to the output torque. Torque-dependent pressure devices are unnecessary. Clockwise or counterclockwise rotation is permissible .The output speed of the drive is infinitely variable and is achieved by adjusting the position of the steel ball b rotating the speed-setting spindle knob(4)



Actual Single Ball Traction Drive

Speed setting is permissible both at rest and in motion. In the upper adjustment position, ratio of 3:1 reduction is created between input and output shaft. In the lower adjustment position the ratio is 1:3 increases. The total speed range covered is 9:1. For a speed range of 6:1, higher input horse power is possible since the output horse power is determined by the lower output speed. The movement of the transmission ball is positively controlled when adjusting for high or low speeds. When adjusting to the lower speeds, the transmission ball takes up a position against the speed setting spindle because of its tendency to move toward the middle of the higher cones. Power must be transmitted through the unit only in the direction shown by the arrow on the outer housing. In the case of very low input speeds, a minimum amount of load must be applied at the output shaft to achieve the desired output speed. The drive may be used in any, mounting position and can be made hermetically sealed

Outcomes:

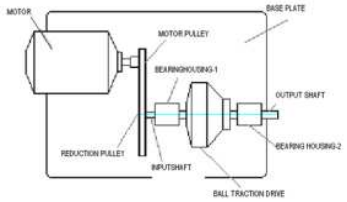
Following are the expected outcomes of traction drive:

- Step less or infinitely varying speed will possible.
- Wide range of speed variation i.e. (Nmax - Nmin) will possible.
- Shifting from one speed to another will be shock les
- Minimum number of controls for speed changing.

- Power transmission will be properly balanced.
- There will be easy to maintain proper pressure between contact surfaces, thereby resulting in trouble free operation.
- Multiple speeds can be obtained.
- Infinitely variable speed will be available over a given range.
- Ease of operation; the speed changes will be gradual, without any shock.

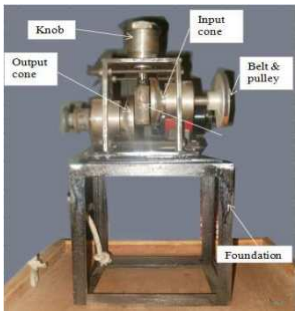
Experimentation (Experimental Setup)

1. After assembly of traction drive testing and experimentation carried out.
2. Working trials of test rig to check working as per requirement of industry specification.



Layout of Test Rig

The above fig. shows the layout of experimental set up (Test Rig) which is used for testing purpose. Layout consist of motor pulley, reduction pulley input shaft, bearing housing and ball traction drive assembly. Power given from motor to pulley, pulley is attached to motor shaft and connected to reduction pulley by belt drive. Reduction pulley connected to input shaft. In-between input shaft and output shaft single ball traction drive is connected.



Actual Test Rig

Performance Testing:

Performance testing of this single ball traction drive consists

1. Test & Trial on Drive using Test trig.
2. Plot Performance Characteristic Curves ;
   a) Torque Vs Speed
   b) Power Vs Speed
   c) Efficiency Vs Speed

Testing procedure:

1. Start the motor.
2. Set motor at operating speed of 4000 rpm .
3. Measure the speed of input pully using Optical Tachometer.
4. Using rope brake arrangement, measure the output pully speed when 200gm load is applied.
5. Add the weight gradually by 200gm to 1200gm and measure the output pully speed at each applied load using Optical Tachometer.
6. Calculate the input power and output power at each applied load.
7. Plot the graph for Torque Vs Speed, Power Vs Speed, Efficiency Vs Speed.
8. Do the same procedure, for different position of knob at various speed conditions.

Formulas for Testing

Torque (T) = w x r = mg x r N-m

Where,

w= weight

r=radius of small pulley

Power = (2 x π x N x T) / 60 watt

Where,

N= speed in rpm

T =Torque in N-m

Efficiency = Output Power /Input Power

Efficiency $_1$ = P1 /P

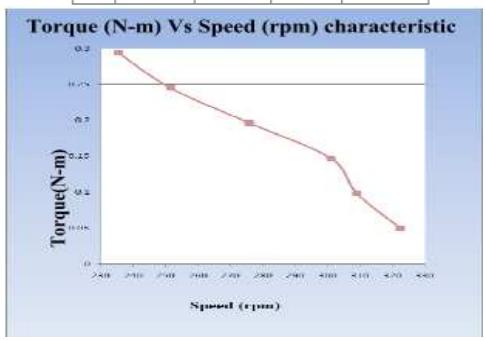
P1=Output Power

P =Input Power

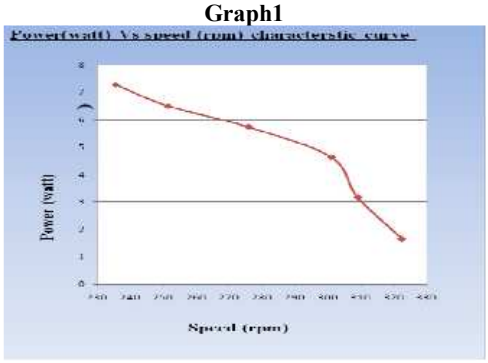
For Better Result carry out testing considering Two Speed Condition low speed and high speed.

Testing at speed of 332.5 rpm (low speed)

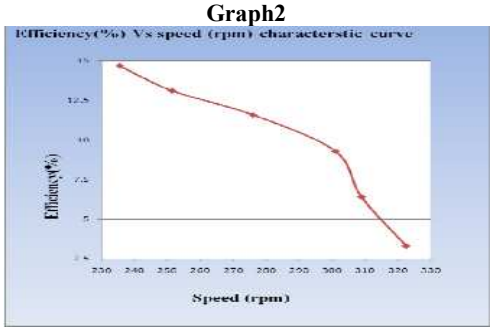
Sr. No	Average speed	Torque	Power	Efficiency
1.	322.5	0.0490	1.656	3.3
2.	309	0.0981	3.174	6.4
3.	301	0.1471	4.638	9.3
4.	275.9	0.1962	5.742	11.59
5.	251.5	0.2452	6.497	13.11
6.	235.5	0.2943	7.273	14.68



Graph1



Graph2



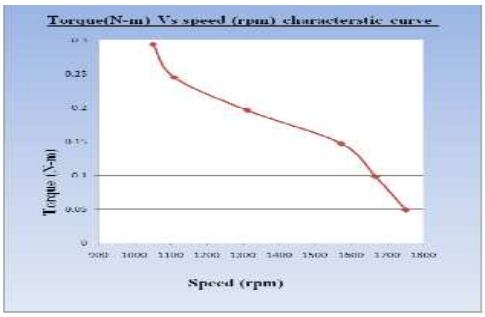
Graph3

1. From Graph 1 shows that as speed increases torque decreases
2. From Graph 2 shows that as speed increases power decreases.
3. From Graph 3shows that as speed increases efficiency decreases.

Testing at high speed at speed of 1751.5 rpm.

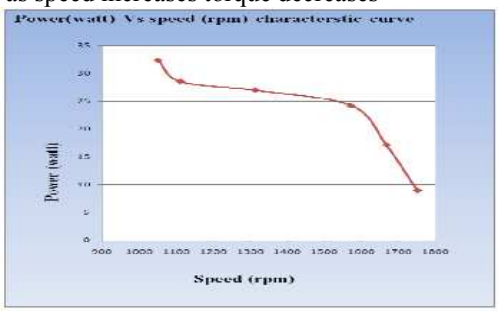
Result Table

Sr No.	Average speed	Torque	Power	Efficiency
1.	1751.5	0.04905	8.996	20.83
2.	1668	0.09810	17.135	39.84
3.	1572	0.14715	24.223	56.33
4.	1312.5	0.1962	26.966	62.70
5.	1110	0.24525	28.507	66.28
6.	1050	0.2943	32.36	75.26



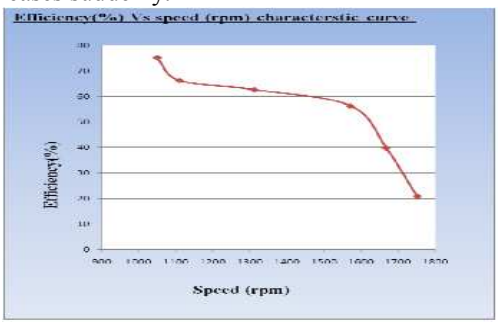
Graph.4

Graph 4 represents that at low speed torque is high and as speed increases torque decreases



Graph.5

Graph 5 shows that the low speed power is increases with decrease in speed which is inversely varies with speed. Speed range of 1100 rpm to 1600 rpm it slowly decreases and after that as speed increases power decreases suddenly.



Graph.6

Graph 6 shows that at low speed efficiency is high and as speed increases efficiency decreases, which is inversely varies with speed from speed range of 1100 rpm to 1550 rpm it slowly decreases and after that as speed increases efficiency decreases suddenly.

CONCLUSION

- Power transmission system is very important in industrial application. To carry out various production works at various speed, we require the stepless, shockless speed variation. Therefore it is necessary to design and develop the power transmission system in compact size, most efficient with minimum cost.
- From testing result conclude that the drive is nearly 75% efficient at high speed. Using single ball traction drives, stepless and varying speed can be possible.
- Single ball traction drive is also used in running condition that's why it is comfortable to vary the speed during the work. No any shock and jerk during speed changing so continues production possible.
- Speed reduction from 5:1 easily possible. Speed ratio 1:4 possible. No any gear shifting or shifting belt from one pulley to another required while changing speed all speed change possible by only changing position of knob i.e. rotating knob in clockwise and anticlockwise direction.
- From Graphs shows that the low speed Power, Torque Efficiency increases and decrease as speed increases which is inversely varies with speed.

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