IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE)
e-ISSN: 2278-1684,p-ISSN: 2320-334X, Volume 12, Issue 2 Ver. II (Mar - Apr. 2015), PP 45-49
www.iosrjournals.org

Shaft Driven Transmission In Velocipede

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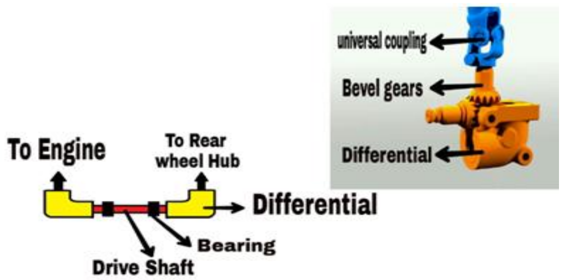
Abstract: *The purpose of this investigation was to determine the power transmission from engine to rear wheel hub,through a new power transmission mechanism called shaft driven mechanism. Basically in two wheelers, the energy transmitted by chain sprocket and gear teeth mechanism. But inchain& sprocket case of transmission only 81% of power is transmitted to the wheel, where remaining 19% of the energy is lost in form energy loses (traction in gears and less tension in chain). And in this case, regular lubrication is required in chain transmission. Regular watering over chain will reduce the viscosity of the lubricant of the chain.Conversely , the chain may get damaged. This avoid the usage of chain and sprocket method of transmission. Dynamic two-wheelers claims that a drive shaft two-wheelers can deliver 94% efficiency and it has more consistent performance.The engineering of interests discussed are related to the design and methodology of Shaft and Bevel gears.*

Keywords: *Bevel gears, Drive shaft, chain and sprockets, Power transmission and MS Steel.*

I. Introduction

The first shaft drives for two wheelers appear to have been invented before 1900s.Hersketch a two wheeler that uses shaft to pass on its power from engine to the rear wheel. This shaft type transmission is existing in bicycles. But in bicycles, due to low man-power given in the pedal just bevel gears are roughly used. But here a new type of differentials are used both sides with a universal coupling at middle. The use of bevel gears inside the differentials allows the axis of the drive torque from engine to be turned through 90°. [1]The drive shaft has the same set up near the rear wheel hub. The Drive shafts are carriers of torque; they are focus to torsion and shear stress, which represents the dissimilarity between the input force and the load.Fig 1. Components of Shaft Drive in Two-Wheeler.



II. Literature Review

A shaft-driven two wheeler is a tandem that uses a cardan shaft as an alternative of a chain to transmit power from the engine to the wheel. But were mostly supplanted by chain-driven tandem due to the cog ranges possible with sprockets and derailleur. Freshly, due to advancements in internal cog knowledge, a small number of up-to-the-minute shaft-driven two wheelers has been introduced.

Shaft-driven bikes have a large Bevel cogs where a conventional bike would have its chain ring. This meshes with an additional bevel cog mounted on the drive shaft. [2]The use of bevel cogs allows the bloc of the drive torque from the engine to be crooked through 90 degrees. The drive shaft then has another bevel cog near the rear wheel hub which meshes with a bevel gear on the hub where the rear sprocket would be on a predictable bike, and cancelling out the foremost drive torque change of axis.

Shaft drive is as close to maintenance-free as any motorcycle drive system can be. With the exception of the very popular, belt drive touring models, you will seldom find dedicated sport-touring or luxury touring bikes without that alloy case in the rear wheel hub, despite the additional cost, weight and complexity.[3] The 90-degree change of the drive plane that occurs at the substructure cohort and again at the rear hub uses bevel cogs for the most well-organised concert though other mechanisms could be used. The drive shaft is often mated to a hub cogs which is an internal cog arrangement housed inside the rear hub.

III. Comparison Of Shaft Vs Chain

Belt drive is, first and foremost,whose usually affluent owners like its nearly maintenance free regimen and smooth power transmission. Not having chain fling sure makes keeping all that chrome shiny a lot easier, too. Shaft drives operate at a very unswerving rate of good organisation and concert, devoid of adjustments or safeguarding, though lower than that of a suitably adjusted and lubricated chain.Shaft drives are classically more multifarious to disassemble when repairing flat rear tires and the industrialised cost is on average elevated.

A fundamental concern with two-wheeler shaft-drive systems is the prerequisite to transmit the torque of the rider through bevel cogs with much smaller radii than typical two-wheeler sprockets.[4] This requires both high quality cogs and heavier frame assembly.

Since shaft-drives require cogs hubs for shuddering, they gain the advantage that cogs can be shifted while the bicycle is at a complete stop or moving in reverse, but internal hub geared bikes typically have a more classified cog range than analogous derailleur-equipped bikes.

Most of the reward claimed for a shaft drive can be realised by using a fully together with this chain case. Some of the other issues addressed by the shaft drive, such as fortification for clothing and from entrance of dirt, can be met through the use of chain guards.[5] The reduced need for alteration in shaft-drive bikes also applies to a analogous extent to chain or belt-driven hub-geared bikes. Not all hub cogs systems are shaft companionable.

IV. Components Of Two- Wheeler

ABevel cog or Gears is a mechanical device often used in transmission systems that allows rotational force to be transferred to another cog or device. The pitch surface of bevel cogs is a cone. Two significant concepts in gearing are pitch surface and pitch angle. The pitch surface of a cog is the fantasy toothless surface that you would have by averaging out the peaks and valleys of the individual teeth. [7]The pitch surface of an ordinary cog is the shape of a cylinder. The pitch angle of a gear is the angle connecting the face of the pitch surface and the axis. Bevel cogs are widely used because of their appropriateness towards transferring power between nonparallel shafts at almost any angle or speed. This smooth transmission of power along the gear teeth helps to diminish clamour and pulsation that increases exponentially at elevated speeds.[11]

Cardan shaft or Drive shaft is a mechanical module for transmitting torque and rotation, habitually used to connect other components of a drive train that cannot be connected honestly because of distance or the need to allow for relative movement connecting them. **Double Cardan joint drive shaft** partially overcomes the problem of jolting rotation. This Arrangement uses two U-joints joined by an intermediates shaft, with the second U-joint phased in relation to the first U-joint to cancel the flexible angular velocity. In this Arrangement, the angular velocity of the Cardan shaft will match that of the driving shaft, providere that both the driving and the driven shaft are at equal angles with respect to the intermediates shaft (but not necessarily in the same plane) and that the two universal joints are 90 degrees out of phase. This congregation is commonly employed in rear wheel drive vehicles, where it is known as a cardan shaft or propeller shaft.[11]

V. Discussion

Drive Shaft transmission has good strength, it effortlessly absorbs vibration loads from sudden.It has low weight when compared with chain and sprocket.Due to low weight, there will less power loss .It is against corrosion.Easy to service (requires cleaning and retensioning).But, noise at low speed due universal coupling, applying lubrication in the universal coupling will give at elucidation. Gear pitch circle is not coincide due to vibration, adjusting the position of Bevel cogs in the differential will give solution. Gear loads were calculated based on geometry of the spiral bevel gear teeth and bearing support structure. Fatigue analysis was then conducted at the most critical sections of the gear.

VI. Design And Methodology

We are concerning to use mild steel in bevel cogs and drive shaft mechanised development. The mechanical properties are follows below in the Table 1. [10]

S.No.	Mechanical Properties	Units	Mild Steel
1.	Youngs Modulus	GPa	210
2.	Poission’s Ratio	-------	0.29
3.	Density	Kg/m^3	7850

4.	Ultimate Stress	MPa	380
5.	Yield Stress	MPa	200
6.	Braking strain	%	25
7.	Fracture Toughness	MN $m^{-3/2}$	140
8.	Thermal Expansion	10^{-6}/C	14
9.	Shear Modulus	GPa	76

Assume, Mass of Rider =60kg and N=400 rpm.
Inner Diameter of Shaft (d_i) = 0.0504m.
Outer Diameter of Shaft (d_o) = 0.05432m.
Length of Shaft (L) = 0.650m.
Number of teeth (N) = 16.
Gear Pitch= MT/2= (0.008 × 16) ÷ 2 = 0.064m.
Mass moment of Inertia (I) = ×××L ($d_0{}^4$-$d_i{}^4$)
= ××7850×0.650× (0.05432^4-0.0504^4).
= 0.00112 $kg.m^2$.
Polar moment of Inertia (J)= π ($d_o{}^4$-$d_i{}^4$) ÷ 32
=π × (0.05432^4-0.0504^4)÷32
=2.21×10^{-7} $m^{4.}$
Max. Torque on bike is given by = mass of rider ×g×L
=60×9.81×0.650
=382.59 Nm.
Power = 2πNT÷60
= (2π ×400×382.59)÷60
= 16025.8 watts
Shear Stress =T/J
=(382.59 ×7850)÷2.21×10^{-7}= 1.35×10^{13} Nm^{-4}
Max. Shear stress ($_{max}$) = TR_0/J
=(382.59×0.02716)÷2.21×10^{-7}
= 4.70×10^7 Pa.
Bending Moment is the reaction induced in a structural element when an external force or moment is applied to the element causing the element to bend.
Bending Moment (M) = EI/R
= (210 × 0.00112) ÷ 0.0271
= 8.659Nm.

Rate of Twist=T/GJ
=(382.59) ÷ (76×2.21×10^{-7})
= 2.27×10^7
Shear Strain = (Rate of Twist)
= 7850×2.27×10^7
= 1.78×10^{11}
=TL/GJ
= (382.59×0.650) ÷ (76×2.21×10^{-7})
= 1.486 ×10^7 Nm.
Torsion is the twisting of an object due to an applied torque. It is expressed in newton metres (N·m).
Torsion (T) = J_r.G/L
= (2.21×10^{-7}×76×1.486×10^7)÷0.650
= 383.9 Nm.
Deflection (Y_{max}) = ML^2/2EI
= (8.659×0.65^2) ÷ (2×210×0.00112)
= 7.77m.

Max Deflection = [T×d_0/2]/I

$= [8.659\times0.02716]\div o.oo112$
$= 209.980$ [Max Shear stress (T_{max})]
$=(8.659\times0.02716)\div2.21\times10^{-7}$
$= 1.06\times10^{6}$ m.

Torque Transmission Capacity (T) is given by ,
$T=S_s\times\pi\times[(d_0^4-d_i^4)d_0]/16$
$= 380\times\pi\times[(0.05432^4-0.0504^4)0.05432]\div16$
$=9.135\times10^{-6}$ Nm.

VII. Result

S.No.	Parameters	Symbols	Value	Units
1	Gear Pitch	P	0.064	m
2	Moment of Inertia	I	0.00112	Kgm^2
3	Polar Moment of Inertia	J	2.21×10^{-7}	M^4
4	Torque	T	382.59	Nm
5	Power	P	16025.8	Watts
6	Shear Stress		1.35×10^{13}	Pa
7	Max Shear Stress	$_{max}$	4.70×10^{7}	Pa
8	Bending Moment	M	8.659	Nm
9	Shear Strain		1.78×10^{11}	-----
10	Angle of Twist		2.27×10^{7}	
11	Torsion		383.9	Nm
12	Deflection	Y	7.77	M
13	Max. Deflection	y_{max}	1.06×10^{6}	M
14	Torque Transmission Capacity	T	9.135×10^{-6}	N/m

In conclusion, the consequences obtained from this toil is an constructive ballpark figure to help in the prior stages of the progress, saving development time and helping in the pronouncement making procedure to optimise a intend. The drive shaft has served as an unconventional to a chain-drive in two-wheeler for the past century, never fetching very accepted.

Here, we preferred Hollow shaft for the reason that it is stronger, because it has larger diameter due to less heaviness and less bending moment. The stress distribution and the maximum deformation in the drive shaft are the functions of the stacking of material.

The drive Shaft with the goal of minimisation of weight of shaft which was subjected to the constraints such as torque transmission, stress, strain , etc. As opposed to chain drive single piece drive shaft for rear wheel drive two-wheeler have been optimally deliberate and manufactured for easily power transmission.

The solid shaft gives a upper limit value of torque transmission but at equivalent time due to augment in credence of shaft. The stress allotment and the maximum buckle in the drive shaft are the functions of the stacking of textile. The most sympathetic stacking of material layers can be used as the effectual tool to condense weight and stress acting on the drive shaft.

The torque transmission capacity of the drive shaft has been premeditated by neglecting and making an allowance for the effect of centrifugal forces and it has been pragmatic that centrifugal force will diminish the torque transmission capacity of the shaft.

Acknowledgements

First and foremost, I'm yearning to thank Lord Almighty for helping me to do this. I also thank my family and friends who have supported me throughout my life.

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