ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Fabrication of Bicycle without an Chain

Pandith
Department of Mechanical Engineering
Lords Institute of Engineering and Technology,
Hyderabad.

S.Suneer Basha
Department of Mechanical Engineering
Lords Institute of Engineering and Technology,
Hyderabad.

N.Naresh Yadav
Department of Mechanical Engineering
Lords Institute of Engineering and Technology,
Hyderabad.

M.Ujwal Kumar
Department of Mechanical Engineering
Lords Institute of Engineering and Technology,
Hyderabad.

S.Rama Rao
Department of Mechanical Engineering
Lords Institute of Engineering and Technology,
Hyderabad.

A.Sai Prasad
Department of Mechanical Engineering
Lords Institute of Engineering and Technology,
Hyderabad.

ABSTRACT

This project is developed for the users to rotate the back wheel of a two wheeler using propeller shaft. Usually in two wheelers, chain and sprocket method is used to drive the back wheel. But in this project, the Engine is connected at the front part of the vehicle. The shaft of the engine is connected with along rod. The other side of the long rod is connected with a set of bevel gears. The bevel gears are used to rotate the shaft in 90^o angle. The back wheel of the vehicle is connected with the bevel gear (driven). Thus the back wheel is rotated in perpendicular to the engine shaft. Thus the two wheeler will move forward. According to the direction of motion of the engine, the wheel will be moved forward or reverse. This avoid the usage of chain and sprocket method.

1-INTRODUCTION

A shaft-driven bicycle is a bicycle that uses a drive shaft instead of a chain to transmit power from the pedals to the wheel arrangement displayed in the followingfig1.1 Shaft drives were introduced over a century ago, but were mostly supplanted by chain-driven bicycles due to the gear ranges possible with sprockets and derailleur. Recently, due to advancements in internal gear technology, a small number of modern shaft-driven bicycles have been introduced. Shaft-driven bike have a large bevel gear where a conventional bike would have its chain ring.

This meshes with another bevel gear mounted on the driveshaft which is shown figure

Fig1.Replacementof chain drive bicycle with driveshaft

The use of bevel gears allows the axis of the drive torque from the pedals to be turned through 90 degrees. The drive shaft then has another bevel gear near the rear wheel hub which meshes with a bevel gear on the hub where the rear sprocket would be on a conventional bike, and cancelling out the first drive torque change of axis.

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Fig2.Shaft drive for bicycle

1-1 Use of drive shaft

The torque that is produced from the pedal and transmission must be transferred to the rear wheels to push the vehicle forward and reverse. The drive shaft must provide a smooth, uninterrupted flow of power to the axles. The drive shaft and differential are used to transfer this torque.

1-2Functionsofthe Drive Shaft

(1)First,itmusttransmittorquefrom thetransmissiontothefootpedal.

(2)During theoperation,itisnecessary to transmitmaximum low-geartorque developedbythepedal.

(3)Thedrive shaftsmustalsobecapableof rotatingatthe veryfastspeedsrequiredby thevehicle.

(4) Thedrive shaftmustalsooperate through constantlychanging anglesbetweenthe transmission,thedifferentialandtheaxles.

2- PROCEDURE

2-1 LITERATUREREVIEW

The firstshaftdrivesforcyclesappeartohave beeninventedindependentlyin 1890in the United StatesandEngland.The Drive shaftsare carriersoftorque;theyare subjecttotorsionand shearstress,which representsthedifference betweentheinputforce andtheload.Theythus needtobestrongenoughtobearthe stress, withoutimposing toogreatan additional inertia byvirtue oftheweightofthe shaft.Most automobiles today use rigiddriveshafttodeliver powerfrom atransmissiontothewheels.Apair ofshortdriveshaft iscommonlyusedtosend powerfromacentraldifferential,transmission, ortransaxietothe wheels.

2-2 COMPONENTSOFBICYCLE

Fig4.componentsofshaft driven bicycle

2-2-1Paddle

Abicyclepedalisthepartofabicyclethatthe riderpusheswiththeirfoottopropelthe bicycle. Itprovidesthe connectionbetweenthecyclist'sfootorshoeandthecrankal lowingthelegto turnthebottombracketspindleandpropelthe bicycle's wheels. Pedals usuallyconsistof aspindlethatthreadsintotheendofthecrank andabody,onwhichthefootrests oris attached,thatisfreetorotateonbearings with respecttothe spindle.Part attachedtocrankthat cyclistrotatetoprovidethebicyclepower; it consistsof threesegments asshownin figure.

2-2-2Fender

Pieceofcurvedmetalcoveringapartofwheel toprotectthecyclistfrombeingsplashed.

2-2-3Front Brake

Mechanism activated bybrakecable compressing a calliper of return springs. It forcesapairofbrakepadsagainstthesidewalls tostopthebicycle.

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

2-2-4 Hub
Centre partofthewheelfromwhichspoke radiate,insidethehubare ballbearingsenabling torotatearoundinaxle.

2-2-5 Bevelgear
Akindofgearinwhichthe twowheelsworking togetherliein differentplanesand havetheirteeth cutatrightanglestothesurfacesoftwo cones whoseapicescoincidewith the point wheretheaxesof the wheelswouldmeet.

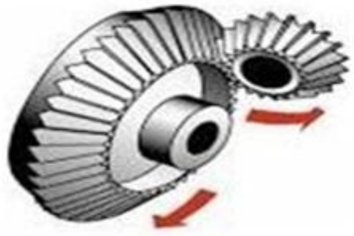

Fig5. BevelGear

2-2-6DrivenShaft
Ashaft-driven bicycleis abicyclethat uses adriveshaftinsteadofachaintotransmitpower from thepedalstothewheel.Shaftdriveswere introducedoveracentury ago,butweremostly supplanted by chain-drivenbicyclesdueto the gear ranges possible with sprockets andderailleurs.Recently,duetoadvancements in internalgeartechnology,asmallnumberof modernshaft-drivenbicycleshave been introduced.

2-2-7MeritsofDrive Shaft
(1) They have high specific modulusand strength.
(2)Reducedweight.
(3)Duetotheweightreduction, energy consumptionwillbereduced.
(4)Theyhave high dampingcapacity hence theyproducelessvibrationandnoise.
(5)Theyhavegoodcorrosionresistance.
(6)Greater torque capacitythan steel or aluminiumshaft.
(7)Longerfatiguelifethansteeloraluminium shaft.
(8) Lower rotating weight transmits more of availablepower.

2-2-8SelectionofBevelGear
Bevelgearsaregearswheretheaxesofthetwo shaftsintersect andthetooth-bearingfaces of the gearsthemselves are conicallyshaped.The pitchsurfaceof bevel gears is a cone. Twoimportant concepts in gearing arepitch surfaceandpitch angle. The pitch surfaceofagearistheimaginary toothless surfacethatyouwouldhavebyaveragingout thepeaks andvalleysof the individualteeth. The pitch surface of an ordinary gear isthe shapeofacylinder.The pitchangleofagearis the angle betweentheface ofthe pitchsurface andtheaxis.Themostfamiliarkinds ofbevel gearshave pitchanglesoflessthan90degrees and therefore are cone-shaped. This typeof bevel gear is calledexternalbecause thegear teeth point outward.The pitch surfaces of meshedexternalbevelgearsare coaxialwiththe gearshafts;the apexesof the twosurfacesare at thepointof intersectionof theshaft axes

3- EQUATIONS
MassMomentofInertia(I) $=MR_2/2$

GearPitch (P)=MT/2

Power(P) $=2\pi NT/60$

Max.ShearStress(τ_{max})$=TR_o/J$

Bendingmoment(M) =EI /R

$$T = \frac{J_T}{r}\tau = \frac{J_T}{\ell}G\theta$$

4- HELPFUL HINTS
4.1Selectionofbevelgear

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

4.2SelectionofDrive shaft

4.3Placingofbevelgear

4.4Testingand correction

MechanicalpropertiesofCast iron

S. No	Mech.Properties	Symbol	Units	Cast Iron
1.	Youngs Modulus	E	GPa	105.0
2.	ShearModulus	G	GPa	36.75
3.	PoissonRatio	ν	------	0.23
4.	Density	ρ	Kg/m3	7209
5.	YieldStrength	S_y	MPa	130
6.	ShearStrength	S_s	MPa	169

5.4DesignCalculations

InnerDiameterof shaft(d_i) =0.026m

OuterDiameterofshaft(d_o) =0.028m

Lengthofshaft(L) =0.335m

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

5.3TransmissionofTorque

Action and reactionmy friend.Ifaperson does notturnthe pedalthenhewillstandonitandso themaximumtorquewill=(bodymassofthe

=0.008*16/2

=0.128/2=0.064m

Module(m)=0.008m

MassMomentofInertia(I) $=MR_2/2$

$=4*0.014_2$

Numberofteeth=16

Power(P) =2πNT/60

= (2πx110x197.2)/60

=2271.5watts

ShearStress(r)=Tρ/J

$= (197.2)(7209)/1.548X10_{-8}$

$=9.18X10_{13}N/m_4$

Max.ShearStress(r_{max})=TR_o/J

$= (197.2)(0.014)/(1.548x10_{-8})$

$=17.83X10_7$

Bendingmoment(M) =EI /R

WhereE=Youngsmodulus

I =MomentofInertia

R=Radius(R_o)

M = (105X0.0039)/0.014

=29.25

Rateof twist =T/GJ

$=197.2/(36.75)(1.548X10_{-8})$

$=3.46X10_8$

ShearStrain =ρ(rateoftwist)

$=7209X3.46X10_8$

$=2.49X10_{12}$

ϴ =TL/GJ

$= (197.2)(0.335)/(36.75)(1.548X10_{-8})$

$=66.06/(5.68X10_{-7})$

$=1.163X10_9$

Torsionisthetwistingofanobjectdueto an applied torque.Itisexpressedinnewtonmetres(N•m),Insectionsp erpendiculartothe torque axis,the resultantshearstressin thissectionis perpendiculartotheradius.

Forshaftsofuniformcross-sectionthetorsion is:

$$T = \frac{J_T}{r}\tau = \frac{J_T}{\ell}G\theta$$

J_T=J_{zz}forconcentric circulartubes

$r$isthe distancebetweentherotational axis

ℓisthelengthof the objectthetorque is beingappliedtoorover.

θistheangle oftwistin radians.

Gistheshearmodulusormore commonlythemodulusofrigidity(GPa),

$r_o$outerradius

Torque transmission capacity,

$T=S_s x\pi[(d_{o4}- d_{i4})d_o]/16$

$T=360X\pi[(0.028_4- 0.026_4)0.028]/16= 3.12X10_{-7}$ N/m

TensionalBucklingCapacity=(txL_2t) / $\sqrt{1 \quad \mu 2}r_3$

$=(0.003x0.335_2x0.003)/\sqrt{(1-0.23_2)}.2x0.014_3$

$=(1.01x10_{-6}) /(\sqrt{0.947}(5.48x10_{-6})$

$=3.71X10_{-4}m$

BendingVibrationFrequencyisgivenby,

$F_{vb}=(\pi p_2/2L_2)\sqrt{(EI_x/m_i)}$

$= [(7.73X10)/(2X0.335)].\sqrt{(105X0.0039)}/0.204$

$= (0.0344).\sqrt{2.007}$

=1.4166*0.0344

=0.0487

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

RESULT

S.no	Parameter	Symbol	Units	Value
1.	GearPitch	P	m	0.06
2.	Momentof	I	$Kg.m^2$	0.00
3.	PolarMoment ofInertia	J	m^4	1.54 8X
4.	Torque	T	Nm	197.
5	Power	P	Watts	2271
6	ShearStress	τ	Pa	9.18 X
7	Max.Shear Stress	τ_{max}	Pa	17.8 3X
8	Bending	M	N-m	29.2
9	ShearStrain	Ø	----	2.49 X
10	Angleoftwist	ϴ	^0c	66.6
11	Torsion	ϴ	Nm	1974 .9
12	Deflection	y	m	4.00 8
13	Max.Deflection	y_{max}	m	105
14	Torque Transmission	T	N/m	3.12 $x10^{-7}$
15	Tensional	T_C	m	3.71

The presentedworkalsodealswithdesign optimization i.e. convertingrotary motion in linearmotionwithaidof twobevelgears.Insteadofchaindriveone piecedrive shaftfor rear wheel drive bicyclehavebeen optimally designed andmanufactured foreasily power transmission.

Thedriveshaftwith theobjectiveof minimizationofweightofshaftwhich was subjected to theconstraintssuch astorque transmission,torsion buckling capacity,stress, strain,etc. The torque transmissioncapacityofthe bicycle drive shaft has been calculatedby neglecting and considering theeffectof centrifugalforces andithasbeenobserved thatcentrifugalforce will reduce the torque transmissioncapacityof theshaft.Thestressdistributionand themaximum deformationinthedriveshaftarethefunctions of the stacking of material. The optimum stackingofmateriallayerscanbe usedasthe effective tooltoreduceweightandstressacting onthe driveshaft.

Thedesignofdriveshaftiscritical asitis subjected to combinedloads.Thedesignerhas two options for designing the drive shaft whethertoselectsolidorhollowshaft.Thesolid shaftgivesamaximumvalue oftorque transmissionbutatsame timeduetoincreasein weightofshaft, Foragivenweight,the hollow shaftisstronger because ithasa biggerdiameter duetolessweight&lessbendingmoment

The resultsobtainedfromthisworkisan useful approximationtohelpintheearlierstagesofthe weightdrive shaftwith bevelgearsonbothsides designedonreplacingchaintransmission.

6- CONCLUSION

Firstlythe projectwere unable tobe completed with the drive shaft dueto various problems around circumference of thebicycle ,later on thiswasrealized to run successfully withtwo bevelgearsatbothendof the driveshaft.Thepresented work was aimed toreducethe wastageof human power (energy) on bicycle ridingor anymachine,whichemploysdrive shafts;ingeneralitisachieved by usinglight development,saving developmenttimeand helpingin thedecisionmaking process to optimizeadesign.Thedrive shafthasservedasanalternativetoa chain-drive in bicycles for the past century, neverbecomingverypopular.

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

REFERENCES

[1] Rastogi, N. (2004). Design of composite drive shaftsforautomotive applications. Visteon Corporation,SAEtechnicalpaper series.

[2] Design and Analysis of a PropellerShaftofaToyotaQualisby “Syed Hasan”.

[3] A.M.Ummuhaani and Dr.P.Sadagopan “Design,FabricationandStressAnalysisof a CompositePropellerShaft,2011-28-0013.

[4] Rangaswamy.T.; Vijayrangan, S. (2005).Optimal sizing and stacking sequence of composite drive shafts.Materialsscience, Vol.11 No2, India.