

Fabrication of Chainless Bicycle

Vinoth Kumar.S¹, Pravin Kumar.M², Sivanantha Selvan.C³, Soundar.R⁴ SundraMoorthy.M⁵

¹ Assistant Professor Department of Mechanical Engineering V.S.B Engineering College, Karur

^{2,3,4,5} Final year Department of Mechanical Engineering V.S.B Engineering College, Karur

Abstract— The conventional bicycle employs the chain drive to transmit power from pedal to the rear wheel and it requires accurate mounting & alignment for proper working. The least misalignment will result in chain dropping. So this problem can be overcome by introducing the shaft drive system. This project includes design and fabrication of shaft driven bicycle. In this project, two spiral bevel gears are used at the pedal side and two straight bevel gears are used at rear wheel side. The drive shaft has two gears mounted one at each end. One is spiral bevel pinion at pedal end and one is straight bevel pinion at the rear wheel end. The use of bevel gears allows the axis of the drive torque from the pedals to be turned through 90 degrees. The bevel gear at the rear end of drive shaft then meshes with a bevel gear rear wheel hub where the rear the flywheel unit would be on a conventional bicycle and canceling out the first drive torque change of axis.

Index Terms: Bevel gears, drive shaft, shaft driven bicycle.

1.INTRODUCTION

The Shaft driven bicycle has a drive shaft which replaces a chain drive to transmit power from the pedals to the wheel. The arrangement for shaft driven bicycle. Shaft drives were introduced over a century ago but were mostly supplanted by chain-driven bicycle 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 bikes have a large bevel gear where a conventional bike would have its chain ring. This meshes another bevel gear mounted on the drive shaft. The use of bevel gears allows the axis of the drive torque from the pedals to be turned through 90 degrees.

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 the conventional bike and cancelling out the first drive torque change of axis. The design of bevel gear

produces less vibration and less noise than conventional straight cut gear.

1.1 Use of drive shaft

The torque that is produced from the pedal and transmission must be transferred to 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.

1.2 Functions of the drive shaft

1.First, it must transmit torque from the transmission to the foot pedal.

2.During the operation, it is necessary to transmit maximum low-gear torque developed by the pedal.

3.The drive shaft must also be capable of rotating at the very fast speeds required by the vehicle.

4.The drive shaft must also operate through constantly changing angles between the transmission, the differentials and the axle.

2. LITERATURE REVIEW

The first shaft drives for cycles appear to have been invented independently in 1890 in the United States & England. In those days manufacturing of bevel gears was not so precise and cost effective; therefore it was not possible to replace chain drive shaft driven gear system. In shaft drive at both ends of shaft pair of spiral gears is used. Most familiar application of the spiral bevel gear is in automobile differential, in which the direction of drive from the drive shaft must be turned 90 degrees to drive the wheels of the vehicle. The shaft drive bicycle has more efficiency than conventional chain drive bicycle. Moreover, the application of chain drive leads to underutilization of human effort due to the fact the maximum transmission of the bicycle chain remains below 70 per cent due to polygon effect in chain sprocket

drives. Thus there is need to replace conventional chain drive using the spiral bevel gear arrangement. In a shaft driven bicycle, a drive shaft is used instead of a chain to transmit power from the pedals to the wheels. The drive shafts carry of torque. The steel drive shaft satisfies three design specifications such as torque transmission capability, buckling torque capability & natural frequency in bending mode. The shaft drive increases power transmission efficiency.

3. COMPONENTS

3.1. Bevel gear



A bevel gear is shaped like a right circular cone with most of its tip cut off. When two bevel gears mesh, their imaginary vertices must occupy the same point. Their shaft axes also intersect at this point, forming an arbitrary nonstraight angle between the shafts. The angle between the shafts can be anything except zero or 180 degrees. Bevel gears with equal numbers of teeth and shaft axes at 90 degrees are called mitergears.

3.2 Drive shaft

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. Shaft drives were introduced over a century ago but were mostly supplanted by chain-driven bicycle 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.

3.3 Bearing

For the smooth operation of the shaft, the bearing mechanism is used. To have very less friction loss the two ends of the shaft are pivoted into the same dimensions bearing.

Merits of drive shaft

- 1.They have high specific modulus and strength.
- 2.Reduced weight.
- 3.Due to the weight reduction, energy consumption will be reduced.
- 4.They have high damping capacity hence they produce less noise and vibration.
- 5.They have good corrosion resistance.
- 6.Lower rotating weight transmits more of available power.

4. DESIGN ASSUMPTION

- 1 The shaft rotates at constant speed about its longitudinal axis.
- 2 The shaft has a uniform, circular cross section.
- 3 The shaft is perfectly balanced, i.e. at every cross section, the mass center coincides with the Geometric center.
- 4 All damping and nonlinear effects are executed.
- 5 The stress-strain relationship for the composite material is linear & elastic; hence, Hooke's law is applicable for composite materials.
- 6 Acoustical fluid interactions are neglected, i.e. the shaft is assumed to be acting in a vacuum.
- 7 Since lamina is thin and no out-of-plane loads are applied, it is considered as under the plane stress.

5. WORKING PRINCIPLE

The term Drive shaft is used to refer to a shaft, which is used for the transfer of motion from one point to another. Whereas the shafts, which propel (push the object ahead) are referred to as the propeller shafts. However the drive shaft of the automobile is also referred to as the propeller shaft because apart from transmitting the rotary motion from the front end to the rear end of the vehicle, these shafts also propel the vehicle forward. The shaft is the primary connection between the front and the rear end (engine and differential), which performs both the jobs of transmitting the motion and propelling the front end. Thus the terms Drive Shaft and Propeller Shaft are used interchangeably. In other words, a drive shaft is a longitudinal power transmitting used in vehicle where the pedal is situated at the human feet. A drive shaft is an assembly of one or more tubular shafts connected by universal, constant velocity or flexible joints. The number of tubular pieces and joints depends on the distance between the two wheels.

The job involved is the design for suitable propeller shaft and replacement of chain drive smoothly to transmit power from the engine to the wheel without slip. It needs only a less maintenance. It is cost effective. Propeller shaft strength is more and also propeller shaft diameters less, it absorbs the shock. Because the propeller shaft center is fitted with the universal joint is a flexible joint. It turns into any angular position. The both end of the shaft are fitted with the bevel pinion, the bevel pinion engaged with the crown and power is transmitted to the rear wheel through the propeller shaft and gear box. With our shaft drive bikes; there is no more grease on your hands or your clothes and no more chain and derailleur maintenance. Shaft-driven bikes have a large bevel gear where a conventional bike would have its chain ring. This meshes with another bevel gear mounted on the drive shaft. 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 15 sprocket would be on a conventional bike and cancelling out the first drive torque change of axis. The 90-degree change of the drive plane that occurs at the bottom bracket and again at the rear hub uses bevel gears for the most efficient performance, though other mechanisms could be used, e.g. Hobson's joints, worm gears or crossed helical gears. The drive shaft is often mated to a hub gear which is an internal gear system housed inside the rear hub.

6. MERITS

- 1 Drive system less likely to become jammed, a common problem with chain driven bicycles.
- 2 The rider cannot become dirtied from chain grease or injured by the chain from "Chain bite", which occurs when clothing or even a body part catches between the chain and a sprocket.
- 3 Lower maintenance than a chain system when the drive shaft is enclosed in a tube.
- 4 Dynamic Bicycles claims that a drive shaft bicycle can deliver 94% efficiency, whereas a chain-driven bicycle can deliver anywhere from 75-97% efficiency based on condition.
- 5 Greater clearance: with the absence of a derailleur or other low-hanging machinery, the bicycle has nearly twice the ground clearance.

- 6 Another advantage that may be noticed about the chainless bicycle is that it protects your clothes better. Your footwear and your pants do not get accidentally damaged, and you do not have the same amount of cleaning to do. However, those who are not so crazy about this alternative type of bicycle say that it is enough to choose a bicycle with encased chain, or with chain guards, and the problem is solved.

7. DEMERITS

- 1 A drive shaft system weighs more than a chain system usually 1-2 pounds heavier.
- 2 Many of the advantages claimed by drive shaft's proponents can be achieved on chain driven bicycle, such as covering the chain and gears with a metal or plastic cover.
- 3 Use of lightweight derailleur gears with a high number of ratios is impossible, although hub.
- 4 Gears can be used and wheel removal can be complicated in some designs (as is for some chain-driven bicycles with hub gears).

8. CONCLUSION

The shaft driven bicycle is designed successfully. The bicycle works efficiently and transmits the power from pedal to rear wheel smoothly, but it is requiring slightly more initial torque compare to drive torque. The noise and the vibration of the gear pair are considerably reduced.

This bicycle can be used for racing purpose and off-road riding. As the speed of the shaft driven bicycle is more enough, it can be utilized for generating pedal work.

The result obtained from this work is a useful approximation to help in the earlier stages of the development, saving development time and helping the decision-making process to optimize the design.

The drive shaft with the objective of minimization of the weight of shaft which was subjected to the constraints such as torque transmission, torsion buckling capacity, stress-strain etc. The stress distribution and maximum deformation in the drive shaft are the functions of stacking of the material. The optimum stacking of material layers can be used as the effective tool to reduce weight and stress acting on the drive shaft.

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