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Design and fabrication of chainless bicycle

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ABSTRACT

The development of the chain drive helped make the bicycle that we know today possible. The chain drive eliminated the need to have the cyclist directly above the wheel. Instead the cyclist could be positioned between the two wheels for better balance. More recently, bicycles with a shaft drive have been developed and it is slowly changing the bike industry.

They both have unique advantages and can produce nearly the same efficiency. This paper illustrates the characteristics of the two alternate drive mechanisms, chain drive and shaft drive. After carefully examining the two alternatives, the conventional shaft drive was selected for the project.Typically gears are sealed inside a housing that is attached to the main shaft. The number of the shaft drive manufacturers is increasing and public interests are growing as well. It is slowly changing the bike industry.

Keywords: Introduction, Components, Design of Bevel Gear & Shaft

INTRODUCTION

The shaft drive has been developed more recently and only few companies are manufacturing those types. The shaft drive uses a shaft instead of a chain to transmit power from the rider's legs to the wheels. Typically gears are sealed inside a housing that are attached to the main shaft. The number of the shaft drive manufacturers is increasing and public interests are growing as well. It is slowly changing the bike industry. The engineer is constantly conformed with the challenges of bringing ideas and design into reality. The design of bevel gear produces less vibration and less noise than conventional straight-cut or spur-cut gear with the straight teeth. The shaft drives only needs periodic lubrications using a grease gun to keep the gears running quite, smooth and efficient transfer of energy from the pedals to the rear wheel. 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 sprocket would be on a conventional bike, and cancelling out the first drive torque change of axis [1].

It is attractive in look compared with chain driven bicycle. An automotive drive shaft transmits power from the engine to the differential gear of a rear wheel drive vehicle. The drive shaft is usually manufactured in two pieces to increase the fundamental bending natural frequency because the bending natural frequency of a shaft is inversely proportional to the square of beam length and proportional to the square root of specific modulus which increases the total weight of an automotive vehicle and decreases fuel efficiency.

So, a single piece drive shaft is preferred here and the material of it is considered to be Titanium

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alloy because of its high strength and low density [2].

Drive shafts are carriers of torque and are subject to torsion and shear stress, equivalent to the difference between the input torque and the load. They must therefore be strong enough to bear the stress, whilst avoiding too much additional weight as that would in turn increase their inertia [3.]

COMPONENTS

Drive shaft

A shaft is a rotating machine element which is used to transmit power from one place to another. The power is delivered to the shaft by some tangential force and the resultant torque (or twisting moment) set up within the shaft permits the power to be transferred to various machines linked up to the shaft.

In a chainless cycle, a drive shaft takes over the role of the chain. The pedals are connected to the drive shaft by gears, allowing the drive shaft to transfer power from the pedals to the rear wheel. The power from the drive shaft then spins a shaft rod that propels the rear wheel, providing the cycle with power. The drive shaft connects to a hub transmission that replaces the stacked gears found on a conventional bicycle. This transmission is factory-lubricated and sealed permanently [4].

Bevel Gear

Bevel gears are gears where the axes of the two shafts intersect and the tooth-bearing faces of the gears themselves are conically shaped. Bevel gears are most often mounted on shafts that are 90 degrees apart, but can be designed to work at other angles as well. The pitch surface of bevel gears is a cone.

The elements of the cones intersect at the point of intersection of the axis of rotation. Since the radii of both the gears are proportional to their distances from the apex, therefore the cones may roll together without sliding. The elements of both cones do not intersect at the point of shaft intersection [5].

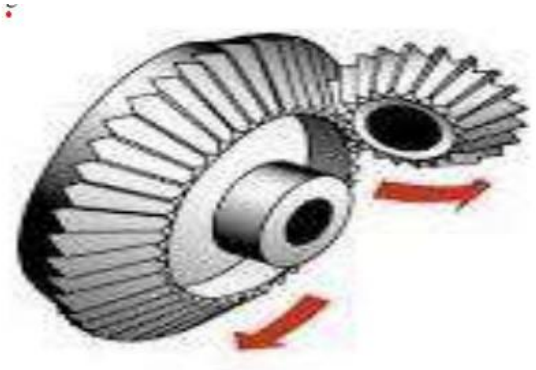

Fig.1 Bevel Gear

Bearings

A bearing is a machine element that constrains relative motion and reduces friction between moving parts to only the desired motion. The design of the bearing may, for example, provide for free linear movement of the moving part or for free rotation around a fixed axis; or, it may prevent a motion by controlling the vectors of normal forces that bear on the moving parts. Bearings are required for the front and rear axles

Fig.2 Bearing

MATERIAL

Table.1 Materials of Components

Sl. No.	Part Name	Material
1	shaft	en-8
2	pedestal bearing	cast iron
3	bevel gear set	alloy steel
4	cycle	std
5	small bevel gear	alloy steel
6	ratchet	std
7	frame	ms
8	ms plate	mild steel
9	universal joint	alloy steel
10	rod	mild steel

DESIGN OF BEVEL GEAR AND SHAFT

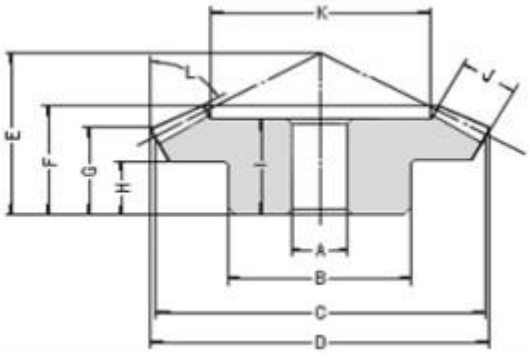

Fig.3 Gear Specification

Bevel Gear

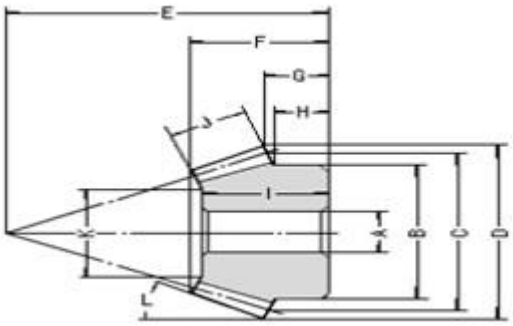

Fig.4 Dimension of Pinion Gear

EXPERIMENTAL SETUP

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.

Fig.5 Completed Fabricated Model

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.

Fig.6 Bevel Gear Model

Thus the terms Drive Shaft and Propeller Shafts 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

GEAR SPECIFICATION

Table.2 Specification of Gears

Module m	No. of Teeth z	Bore AH7	Hub Dia. B	Pitch Dia. C	Outside Dia. D
4	40	20	70	160	162.34
	20	20	60	80	89.62

Table 3 Dimensions of Gears

Total Length	Hub Width	Length of Bore	Face Width	Slant Height	Holding Surface Dia.
F	H	I	b	L	K
53.92	28	45	28	90	102.3
66.92	35	62			42.78

WORKING PRINCIPLE

In above figure.5 the input revolution is given by simple paddling to input of bevel gear shaft.

The transmission is completed by two bevel gear in paddling unit then offset transmission free wheel arrangement it makes paddling free in reveres paddling, shaft is attach with rear wheel by means of two bevel gear and thus transmission is completed.

RESULTS AND DISCUSSIONS

Less jammed as compared to chain drive. The rider cannot become dirtied from chain grease or injured by the chain from "Chain", which occurs when clothing or even a body part catches between the chain and a sprocket. Lower maintenance than a chain system when the drive shaft is enclosed in a tube More consistent performance. Efficiency may increase if we are using aluminium material.

CONCLUSION

Instead of chain drive shaft and bevel gear for rear wheel drive bicycle have been optimally designed and manufactured for easily power transmission. The drive shaft with the objective of minimization of weight of shaft which was subjected to the constraints such as torque transmission , torsion buckling capacity , stress, strain , etc. The results obtained from this work is an useful approximation to help in the earlier stages of the development, saving development time and helping in the decision making process to optimize a design.

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