International Journal of Research in Engineering, Science and Management
Volume 6, Issue 4, April 2023
https://www.ijresm.com | ISSN (Online): 2581-5792

Design and Fabrication of Bicycle Using Bevel Gear

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***Abstract*: Shaft driven bicycle is a bicycle that uses a shaft drive instead of a chain which contain two set of bevel gear at both the ends to make a new kind of transmission system for bicycle for getting high reliability system, and more safe system. This project is developed for the users to rotate the back wheel of a two-wheeler using propeller shaft. Usually in two-wheelers bicycle, chain and sprocket method is used to drive the back wheel. Shaft-driven bicycle have a large bevel gear where a conventional bicycle 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 bicycle and cancelling out the first drive torque change of axis.**

***Keywords*: bevel gear, fabrication of bicycle.**

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. 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 bicycle have a large bevel gear where a conventional bicycle would have its chain ring. This meshes with another bevel gear mounted on the drive shaft replacement of 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 bicycle 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 or spur-cut gear with the straight teeth. The shaft drives only needs periodic lubrications using a grease gun to keep the gears running quiet, smooth and efficient transfer of energy from the pedals to the rear wheel. It is attractive in look compared with chain driven bicycle.

2. Construction

The bicycle setup is fabricated with help of MS tubes and channels with the help of metal cutting and metal joining process called welding. Two wheels are mounted to the frame in which one is at front and other one at rear side. The bevel gear is coupled to the rear wheel with the help of shaft. Another pair of bevel gear is connected with crank wheel which is powered by the means of pedal. This pair is coupled with the pair of bevel gear which is attached at the rear end with the help of shaft, which is rigidly mounted with the help of bearing which is attached to the bicycle frame.

3. Working Principle

When the driver applies linear force on the pedal, due to this rotary motion is experienced by the bevel gear which is directly mounted to it with help of shaft. The bevel gear actuates to transmit power to the meshed gear. The obtain rotation actuates the rear wheel with the help of shaft which is connected between driven and driver bevel gears. Due to the rotation of rear bevel gear, the back wheel gets powered and helps for the displacement of total bicycle setup.

4. Components of Bicycle

A. Frame

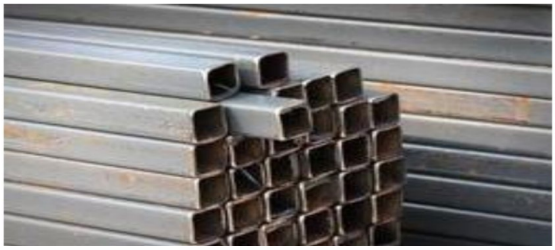

Fig. 1. Frame

The metal frame is generally made of mild steel bars for machining, suitable for lightly stressed components including studs, bolts, gears and shafts. It can be case-hardened to improve wear resistance. They are available in bright rounds, squares and flats, and hot rolled rounds suitable machining allowances should therefore be added when ordering. It does not contain any additions for enhancing mechanical or

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machining properties. Bright drawn mild steel is an improved quality material, free of scale, and has been cold worked (drawn or rolled) to size. It is produced to close dimensional tolerances. Straightness and flatness are better than black steel. It is more suitable for repetition precision machining. Bright drawn steel has more consistent hardness and increased tensile strength. Bright steel can also be obtained in precision turned or ground form if desired.

B. Shaft

Fig. 2. Shaft

Shaft is a common and important machine element. It is a rotating member, in general, has a circular cross-section and is used to transmit power. The shaft may be hollow or solid. The shaft is supported on bearings and it rotates a set of gears or pulleys for the purpose of power transmission. The shaft is generally acted upon by bending moment, torsion and axial force. Design of shaft primarily involves in determining stresses at critical point in the shaft that is arising due to aforementioned loading. Other two similar forms of a shaft are axle and spindle. Axle is a non-rotating member used for supporting rotating wheels etc. and do not transmit any torque. Spindle is simply defined as a short shaft. However, design method remains the same for axle and spindle as that for a shaft. Standard sizes of Shafts Typical sizes of solid shaft that are available in the market are, up to 25 mm 0.5 mm increments 25 to 50 mm 1.0 mm increments 50 to 100 mm 2.0 mm increments 100 to 200 mm 5.0 mm increments Hot-rolled plain carbon steel. These materials are least expensive. Since it is hot rolled, scaling is always present on the surface and machining is required to make the surface smooth. Since it is cold drawn it has got its inherent characteristics of smooth bright finish. Amount of machining therefore is minimal. Better yield strength is also obtained. This is widely used for general purpose transmission shaft.

C. Bearing

Fig. 3. Bearing

Ceramic bearing balls can weigh up to 40% less than steel ones, depending on size and material. This reduces centrifugal loading and skidding, so hybrid ceramic bearings can operate 20% to 40% faster than conventional bearings. This means that the outer race groove exerts less force inward against the ball as the bearing spins. This reduction in force reduces the friction and rolling resistance. The lighter balls allow the bearing to spin faster and uses less energy to maintain its speed. The ceramic balls are typically harder than the race. Due to wear, with time they will form a groove in the race.

This is preferable to the balls wearing which would leave them with possible flat spots significantly harming performance. While ceramic hybrid bearings use ceramic balls in place of steel ones, they are constructed with steel inner and outer rings; hence the hybrid designation. While the ceramic material itself is stronger than steel, it is also stiffer, which results in increased stresses on the rings, and hence decreased load capacity. Ceramic balls are electrically insulating, which can prevent 'arcing' failures if current should be passed through the bearing. Ceramic balls can also be effective in environments where lubrication may not be available (such as in space applications).

D. Bevel Gear

Fig. 4. Bevel gear

Two important concepts in gearing are pitch surface and pitch angle. The pitch surface of a gear is the imaginary toothless surface that you would have by averaging out the peaks and valleys of the individual teeth. The pitch surface of an ordinary gear is the shape of a cylinder. The pitch angle of a gear is the angle between the face of the pitch surface and the axis of less than 90 degrees and therefore are cone shaped. This type of bevel gear is called external because the gear teeth point outward. The pitch surfaces of meshed external bevel gears are coaxial with the gear shafts; the apexes of the two surfaces are at the point of intersection of the shaft axes. Bevel gears that have pitch angles of greater than ninety degrees have teeth that point inward and are called internal bevel gears. Bevel gears that have pitch angles of exactly 90 degrees have teeth that point outward parallel with the axis and resemble the points on a crown.

E. Pedal

The pedal is the part of a bicycle that the rider pushes with their foot to propel the bicycle. It provides the connection between the cyclist's foot or shoe and the crank allowing the leg to turn the bottom bracket spindle and propel the bicycle's wheels. Pedals usually consist of a spindle that threads into the end of the crank and a body, on which the foot rests or is

attached, that is free to rotate on bearings with respect to the spindle pedals were initially attached to cranks connecting directly to the driven (usually front) wheel. The safety bicycle, as it is known today, came into being when the pedals were attached to a crank driving a sprocket that transmitted power to the driven wheel by means of a roller chain.

Fig. 5. Pedal

F. Cycle

Fig. 6. Cycle

A bicycle, often called a bike or cycle, is a human-powered, pedal-driven, single-track vehicle, having two wheels attached to a frame, one behind the other. A bicycle rider is called a cyclist, or bicyclist. Bicycles were introduced in the 19th century in Europe and as of 2003, more than 1 billion have been produced worldwide, twice as many as the number of automobiles that have been produced. They are the principal means of transportation in many regions. They also provide a popular form of recreation, and have been adapted for use as children's toys, general fitness, military and police applications, courier services and bicycle racing. The basic shape and configuration of a typical upright or "safety bicycle" has changed little since the first chain-driven model was developed around 1885. But many details have been improved, especially since the advent of modern materials and computer-aided design. These have allowed for a proliferation of specialized designs for many types of cycling. The bicycle's invention has had an enormous effect on society, both in terms of culture and of advancing modern industrial methods. Several components that eventually played a key role in the development of the automobile were initially invented for use in the bicycle, including ball bearings, pneumatic tires, chain-driven sprockets, and tension-spoked wheels.

G. Wheel

A ring-shaped vehicle component that covers the wheel's rim to protect it and enable better vehicle performance. Most tires, such as those for automobiles and bicycles, provide traction between the vehicle and the road while providing a flexible cushion that absorbs shock. The materials of modern pneumatic tires are synthetic rubber, natural rubber, fabric and wire, along with carbon black and other chemical compounds. They consist of a tread and a body.

H. Advantages

- Drive system is less likely to become jammed.
- The use of a gear system creates a smoother and more consistent pedaling motion.
- Lower maintenance.
- Efficiency is more as compared to conventional bicycle design.
- High durability.
- Low cost of ownership when manufactured in large scale.

I. Applications

- It is used for racing purpose.
- Also used for off-road riding.
- For cycling.
- For public and bicycle rental purpose.

5. Conclusion

The work was aimed to reduce the wastage of human power (energy) on bicycle riding which employs drive shafts; in generally it is achieved by using light weight drive shaft with bevel gears on both sides designed on replacing chain transmission. One-piece drive shaft for rear wheel drive bicycle have been optimally designed and manufactured for easily power Transmission. The drive shaft with objective of minimization of weight of shaft which was subjected to the constraints such as torque transmission, torsion buckling capacity, stress, strain, etc. The torque transmission capacity of the bicycle drive shaft has been calculated by neglecting and considering the effect of centrifugal forces and it has been observed that centrifugal force will reduce the torque transmission capacity of the shaft.

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