DESIGN AND FABRICATION OF LUNATIC HUBLESS WHEEL BICYCLE

S.Mohindar[1], M.Vinoth Kumar[2], A.Tamil Arasu[3], S.Tamizhmaran[4], R.Tarun[5], B.Tilak[6]

[1,2]*Assistant Professor, Mechanical, TJS Engineering College, TN, India*

Email: mohindar88@gmail.com

[3,4,5,6] *UG Scholar, Mechanical, T.J.S Engineering College, TN, India*

Email: tamilarasu10111996@gmail.com

.

Abstract

Lunatic is a compact urban bicycle concept exploring the combination of different tyre sizes a toothed belt drive and hubless rear wheel as a unique working prototype. The design aims to combine benefit of both wheel sizes for a balance of speed ,size and ride quality. Lager wheels travel faster are more stable and give comfortable ride while small wheels are light compact and more maneuverable. But small wheeled bikes takes up less space and are very maneuverable.Belt drives are clean quiet and maintenance free and hubless wheel creates extra space….. Big wheels are very stable due to gyroscopic effect of larger wheel. By using belt drive it replaces the drawbacks made by using a chain drive for transmission of power from driver to driven. By using toothed belt pulley it increase the efficiency of power transmission Which intently reduces the work and gains energy

- **Keywords:** wheel and toothed belt drive.

Introduction

The bicycle has come a long way since the kernel of its invention in 1817. One of the most interesting innovations in cycling over the past few years has been the hubless, spokeless wheel and a particularly compelling new iteration of it comes from British designer Luke Douglas**.**Lunatic is a compact urban bicycle that uses a combination of different wheel sizes, a toothed belt drive and a hubless rear wheel to harness the power of the gyroscopic effect for a faster, more efficient ride. The small front wheel offers the maximum space-saving benefits possible without folding, while the large rear wheel provides more contact with the road, offering the stability of a hybrid. A centreless wheel (also known as a hubless wheel, spokeless wheel, orbital wheel, or rim-rideris a wheel with no center.More specifically, the hub is actually almost as big as the wheel itself. The axle is hollow, following the wheel at very close tolerances. The hubless wheel was invented by Franco Sbarro (who has built a variety of working hubless wheel vehicles, including at least twomotorcycles and a car, the 1989 Sbarro Osmos), and patented by Globeholding of Geneva

Although hubless wheels are striking in appearance, their numerous practical disadvantages have precluded their widespread use as an alternative to conventional wheels. They are difficult and expensive to manufacture, requiring a great deal of precision machining, and

the design leaves the bearings and other mechanical parts largely exposed to the elements. The drive system is especially problematic since a conventional axle and CV joint cannot be used; options include using chain or belt drive. Another solution, developed by Sbarro, is to house the entire propulsion system inside the wheel itself.

Components and Description

Gear

A gear or cogwheel is a rotating machine part having cut teeth, or cogs, which mesh with another toothed part to transmit torque. Geared devices can change the speed, torque, and direction of a power source. Gears almost always produce a change in torque, creating a mechanical advantage, through their gear ratio, and thus may be considered a simple machine. The teeth on the two meshing gears all have the same shape. Two or more meshing gears, working in a sequence, are called a gear train or a transmission. A gear can mesh with a linear toothed part, called a rack, thereby producing translation instead of rotation.

Spur Gear

Spur gears or straight-cut gears are the simplest type of gear. They consist of a cylinder or disk with teeth projecting radially. Though the teeth are not straight-sided (but usually of special form to achieve a constant drive ratio, mainly involute but less commonly cycloidal), the edge of each tooth is straight and aligned parallel to the axis of rotation. These gears mesh together correctly only if fitted to parallel shafts.

Toothed Belt

A belt is a loop of flexible material used to link two or more rotating shafts mechanically, most often parallel. Belts may be used as a source of motion, to transmit power efficiently, or to track relative movement. Belts are looped over pulleys and may have a twist between the pulleys, and the shafts need not be parallel.

In a two pulley system, the belt can either drive the pulleys normally in one direction (the same if on parallel shafts), or the belt may be crossed, so that the direction of the driven shaft is reversed (the opposite direction to the driver if on parallel shafts). As a source of motion, a conveyorbelt is one application where the belt is adapted to carry a load continuously between two points.

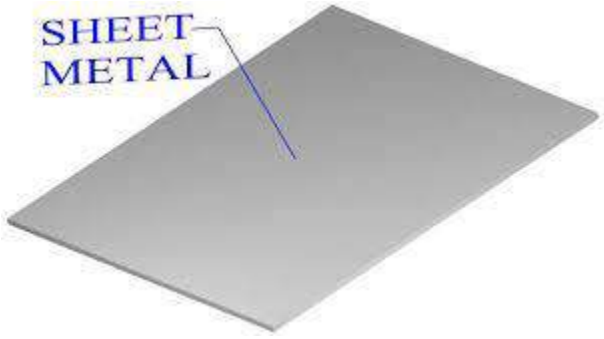
Tubeless tyres

A tyre is a ring-shaped vehicle component that covers the wheel'srim 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 syntheticrubber, naturalrubber, fabric and wire, along with carbonblack and other chemical compounds. They consist of a tread and a body.

The tread provides traction while the body provides containment for a quantity of compressedair. Before rubber was developed, the first versions of tires were simply bands of metal fitted around wooden wheels to prevent wear and tear. Early rubber tires were solid (not pneumatic). Today, the majority of tires are pneumatic inflatablestructures, comprising a doughnut-shaped body of cords and wires encased in rubber and generally filled with compressed air to form an inflatable cushion

Sheet Metal

Sheet metal is metal formed by an industrial process into thin, flat pieces. It is one of the fundamental forms used in metalworking and it can be cut and bent into a variety of shapes. Countless everyday objects are constructed with sheet metal. Thicknesses can vary significantly; extremely thin thicknesses are considered foil or leaf, and pieces thicker than 6 mm (0.25 in) are considered plate. Sheet metal is available in flat pieces or coiled strips.



The coils are formed by running a continuous sheet of metal through a roll slitter. The thickness of sheet metal is commonly specified by a traditional, non-linear measure known as its gauge. The larger the gauge number, the thinner the metal. Commonly used steel sheet metal ranges from 30 gauge to about 7 gauge. Gauge differs between ferrous (iron based) metals and nonferrous metals such as aluminum or copper; copper thickness.

Ball Bearing

A **ball bearing** is a type of rolling-element bearing that uses balls to maintain the separation between the bearing races.The purpose of a ball bearing is to reduce rotational friction and support radial and axial loads. It achieves this by using at least two races to contain the balls and transmit the loads through the balls.In most applications, one race is stationary and the other is attached to the rotating assembly (e.g., a hub or shaft). As one of the bearing races rotates it causes the balls to rotate as well. Because the balls are rolling they have a much lower coefficient of friction than if two flat surfaces were sliding against each other.

Bushing (isolator)

A bushing is a type of vibrationisolator. It provides an interface between two parts, damping the energy transmitted through the bushing. A common application is in vehicle suspension systems, where a bushing made of rubber (or, more often, synthetic rubber or polyurethane) separates the faces of two metal objects while allowing a certain amount of movement. This movement allows the suspension parts to move freely, for example, when traveling over a large bump, while minimizing transmission of noise and small vibrations through to the chassis of the vehicle. A rubber bushing may also be described as a flexiblemounting or antivibration mounting.

Design and Calculation

spur gear design

Actual output speed (gear)

$$n_G = \frac{n_p}{VR}$$

n_P = rotational speed of the pinion

VR = gear ratio

$$VR = \frac{N_G}{N_P}$$

N_G, N_P = number of gear, pinion teeth.

The spreadsheet computes the approximate number of gear teeth to produce the desired speed from $N_G = N_P \frac{n_{Gd}}{n_P}$ (n_{Gd} = desired output speed). But, of course, the number of teeth on any gear must be an integer, and the actual value of N_G is selected by the designer.

spur gear geometry for full depth involute teeth in the diametral pitch system

- Pitch diameter
  $D = \frac{N}{P_d}$
- Diametral Pitch
  $P_d = \frac{N}{D}$
- Outside diameter
  $D_o = \frac{N+2}{P_d}$
- Addendum
  $a = \frac{1}{P_d}$
- Dedendum
  if $P_d < 20$
  $b = \frac{1.25}{P_d}$
  if $P_d \geq 20$
  $b = \frac{1.2}{P_d} + 0.002$
- Clearance
  if $P_d < 20$
  $c = \frac{0.25}{P_d}$
  if $P_d \geq 20$
  $c = \frac{0.2}{P_d} + 0.002$
- Root diameter
  $D_R = D - 2b$
- Base circle diameter
  $D_b = D\cos\phi$
- Circular pitch
  $p = \frac{\pi D}{N}$
- Whole depth
  $h_t = a + b$
- Working depth
  $h_k = 2a$
- Tooth thickness
  $t = \frac{\pi}{2P_d}$
- Center distance
  $C = \frac{D_G + D_P}{2}$

Bending geometry factor, J, is dependent on the number of teeth of gear for which geometry factor is desired and on the number of teeth in mating gear. Values can be found from AGMA 908-B89(R1995).

Pitting geometry factor, I, is dependent on the tooth geometry and on gear ratio. Values can be found from AGMA Standard 218.01.

calculation of spur gears

Module = Is the ratio of pitch diameter in mm by number of teeth

SPEED RATIO (3:1)

1. Pedaling gear :

Pitch diameter = 180mm

No of teeth = 108

Module = 3/5 mm

2. External gear 1:

Pitch diameter = 60mm

No of teeth = 36

Module = 3/5 mm

3.External gear 2:

Pitch diameter = 160mm

No of teeth = 64

Module = 2.5 mm

4.Internal gear :

Pitch diameter = 480mm

No of teeth = 192

Module = 2.5 mm

Working Principle

The power developed from pedaling is transmitted my means of belt drive from pedaling gear1 to that of external gear mounted in mainshaft Where as when external gear1 rotates while pedaling action then mainshaft rotates where external gear2 mounted to same shaft rotates in direction of rotation of shaft so gear rotates. The external gear2 which meshed with internal gear makes rotation in direction of rotation of shaft then the internal gear is fixed to rearwheel of bicycle when internal gear rotates then wheel rotate in direction of shaft rotation which rotation of wheel produces forward movement of bicycle by this way the power is transmitted from pedaling shaft to rear wheel of bicycle

Application

It is used for transmission of power in bicycle

It can also be applicable in two-wheeler and four wheel drives

ADVANTAGES

It is more efficient when compare with normal bicycle

It replaces chain drive to that of belt drive

Reduce space and size which make it compact when compare with normal bicycle

Use of gears which increase the transmission power and torque

By use of nylon material for making of gear it does not require lubrication

Nylon is of wear and tear property

Nylon reduces weight capacity when compare with mild steel material

DISADVANTAGES

It does not have any suspension system which make it less dis-comfort

At time of sloppy roads due to high power required to transmit belt may tear

LIST OF MATERIALS

S.NO	MATERIALS	MATERIAL TYPE	MATERIAL TYPE
1	INTERNAL GEAR	NYLON	1
2	EXTERNAL GEAR 1	NYLON	1
3	EXTERNAL GEAR 2	NYLON	1
4	PEDALING GEAR	NYLON	1
5	TOOTHED BELT	RUBBER FABRIC	1
6	SUPPORTING BUSHES	NYLON	4
7	SHEET METAL	STEEL	1
8	SHAFT	MILD STEEL	1
9	TUBELESS TIRES	RUBBER	2
10	BALL BEARING	STEEL	4

Conclusion

This project has provided us an excellent opportuinity and experience to use our limited knowledge .we gained a lot of pratical experience regarding ,planning designing drawing purchasing computing and machining while doing this project work we feel the project work is a good solution to bridge the gates between institution industries

We are proud thatwe have completed the work with the limited time successfully the cycle is working with satisfactory condition we are able to understand the difficulties in maintaining the tolerance and also quality we have done to our ability and skill ,making maximum use of available facilities

In conclusion remarks of our project work ,let us add afew more lines about our impression to project workThe chief advantage of our system is that power transmission is high when compare with other bicycle and reduce size &space which make it compact

References

P.S.G.Design Data Book, Faculty of Mechanical

Engg; P.S.G.Tech., M/S DPV Printers, 2000.

Photography