

# HUBLESS WHEEL BICYCLE WITH GEAR TRAIN DRIVE MECHANISM

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## ABSTRACT

*The construction of Hubless wheel bicycle with gear train drive mechanism is designed to convert the human muscle power through pedaling work in to the mechanical work. The system is assembled with the combination of pedals, shafts, one small size alloy wheel and one large size Hubless wheel which is function as driving wheel. The pedal and shaft are receiving the human effort and convert in to rotational mechanical motion. This rotational motion is transmit up to the driving wheel via the spur gear drive train. The gear drive train is the combination of four stages of gear pair. These gear pairs not only transmit the power but also improve the gear ratio step by step. The gears and pinions of drive train are fixing with the bicycle body by using deep groove ball bearings. The last spur gear in the gear train is coupled with the driving wheel through the Hubless mechanism which also performs the holding function of driving wheel. The front wheel is small in size as compared to drive wheel and it only perform the system balancing function without actually participate in driving and driven mechanism.*

*This system has ability to reduce the fatigue on bicycle rider by improving the power transmission efficiency and by extending the maximum limit of bicycle speed.*

**Keywords:-***Hubless bicycle, Gear train drive, Rider fatigue, Efficiency, Gear ratio and Bicycle speed.*

## INTRODUCTION

Today India is the second largest country in the world according to the population. India is the large market for all types of vehicles but up to till large numbers of peoples are deprived from good transportation system. There are large number of citizens are located in rural area where modern transportation facilities are not useful due to the poor condition of roads and their networks. Today the cost of the fuels is also increases very rapidly. There are several pollutants are emitted into atmosphere by these fossil fuel operated vehicles and day to day this problem becomes very critical. So, we have a need of the transportation vehicle which is able to provide service without the consumption of fossil fuels to prevent the emissions of pollutants. It should also able to conduct the goods where proper provision of road network is unavailable. Bicycle is essential to save the natural resources and it also help to keep the environment clean. There are different types of the bicycle available to provide service to customers. But there is the need to give an alternative to conventional bicycle to overcome different drawbacks.

To overcome these drawbacks and to improve the quality of service we develop new mechanism which fulfills the need of customer.

## PROBLEM DEFINITION

Usually the bicycle which works on chain drive mechanism is commonly designed with 44 teeth's sprocket head or drive and 18 teeth sprocket tail. This combination is used to achieve the gear ratio up to 2.44. There is the requirement of large size head sprocket at drive to increase the number of tooth to improve the gear ratio. This large size sprocket is not unique and compact. Some models uses different sizes sprocket tails and they are interchanged by using shifter mechanism. But this shifter mechanism has intricate structure and complex working. Hence proper method of gear ratio improvement is required.

The power transmission efficiency of chain drive is affected due to chord effect in chain. Maximum achievable efficiency of chain drive is up to 70%. Lubrication is essential maintenance for chain drive to avoid the friction and control the noise level.

The less efficiency of conventional bicycle is main cause of the extra fatigue on rider. Also due to the less gear ratio used in conventional bicycle affects on the amount of the distance covered by bicycle. So in order to solve these drawbacks Hubless Bicycle with Gear train Drive mechanism is proposed.

The Hubless bicycle with gear train mechanism should be fulfilling the following objectives.

- Transmission of power through high efficient drive mechanism.
- Less fatigue on rider.
- Maximum gear train effectiveness.
- Maximum speed of bicycle up to 1100 rpm.
- High load carrying capacity.
- Decrease System weight.
- Environment Friendly.

## CONSTRUCTION AND WORKING

It is operated on human muscle power. To develop the torque at shaft, the rider applies force on pedals. Shaft has function to pick the torque and convert it in to rotational motion. As to perform the main function this input rotational power must be supplied up to driving wheel. In this system spur gears and spur pinions drive train is used to replace this chain drive.

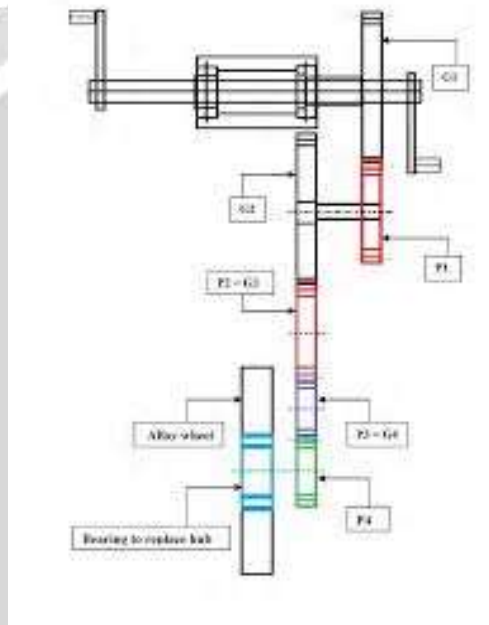
There are four stages of gear pair are assembled in a train to form the drive mechanism. In stage -1 gear pair 44 teeth's spur gear transmit power to the 24 teeth's spur pinion. If we consider that the rider able to rotate the pedal at 60 rpm then by using the gear ratio of stage -1 pinion is rotate at 110 rpm.

The second stage gear pair receives power from stage-1 pinion which is fixed on the same shaft of stage-2 gear. Again in stage -2 the no. of teethes on gear are 44 & no. of teeth on pinion are 24. So the input revolution of 110 rpm in stage -2 is converted in to 202 rpm.

The 202 rpm received by idler pinion having 18 no. of teethes from stage-3 gear having 24 numbers of teethes. So the 202 rpm converted in to 270 rpm. This 270 rpm from 18 no. of teeth's idler gear is supplied to 18 teethes wheel pinion. So at the end of gear train 270 rpm output speed is achieved by taking 60 rpm input speed from pedal shaft via gear train. This rotational power is provided to the alloy Hubless wheel through the ball bearing. This ball bearing able to sustain high load with very less maintenance compared to conventional hub. This Hubless wheel also made the design unique and compact. Overall gear ratio produced by drive mechanism is about 4.5. Thus system is able to convert the 60 rpm input speed in to 270 rpm at drive wheel as output speed.

**TABLE I:- GEAR STAGE DETAILS**

Gear Stage	Gear		Pinion	
	No. of Teeth	Speed of Gear (rpm)	No. of teeth	Speed of Pinion (rpm)
1.	44	60	24	110
2.	44	110	24	202
3.	24	202	18	270
4.	18	270	18	270



## CONSTRUCTIONAL FEATURES

### 4.1 Pedal and Lever

Two pedal livers of 120 mm length and having cross section of 25\*10 mm are used to receive the force from rider through pedal. These are able to sustain the foot of rider.

### 4.2 Driving Shaft

The minimum section diameter on input shaft is kept about 14mm and at this smallest section of the main shaft lobe plate is mounted.

### 4.3 Drive Train

The Four stages Gear Train is locate on frame by using bearings. All gears and pinions used in the train are of spur types having module 3 mm and face width 30 mm. The used bearings are of single deep grooved ball bearing of series 60.

#### 4.4 Rear Hubless Wheel

This wheel uses single row deep groove ball bearing to sustain the entire load of wheel and rider. Use of Hubless nature of wheel made the design compact, unique with extra free space availability. It also plays the role of linkage between gear train and rear wheel.

#### 4.5 Front Wheel

The front wheel is made of alloy type. In this system conventional method of use of same size wheel is replaced by the use of small size of front wheel. As only the rear wheel is participated in driving function and not the front wheel. Front wheel is used for balancing the structure so reduction in size of front wheel is made good in order to reduce the system weight without any affect on bicycle performance.

#### 4.6 Assembled Model

The different Functional parts and mechanisms are assembled systematically to form the finished required system of bicycle.

### ADVANTAGES AND LIMITATIONS

#### 5.1 Advantages

- Power transmission efficiency of the drive mechanism can be improved and hence fatigue on rider reduces.
- Gear train effectiveness is improved up to 1.8 times of conventional bicycle.
- The weight of the bicycle is reduced. The load carrying capacity & service life of wheel bearing mechanism is more compared to the hub.
- Due to compact and unique design of Hubless wheel more free space is available.
- The maximum speed limit of drive mechanism is improved.
- Generation of Noise and friction is minimized so lubrication is also required in less quantity.
- The operation is pollution free and eco-friendly.

#### 5.2 Limitations

- Initial cost is high.
- The weight of the gears drive train is more compared to chain drive but it may be lowered by use of high strength light weight materials like aluminum.

### APPLICATIONS

- All types of bicycles like racing bicycles, children's bicycle or handicapped tricycle may use this system.
- Motorcycles may also implement these modifications successfully.

### I. RESULTS

The results are calculated by taking the readings of required parameter during its working and using theoretical methods. The output results are compared with the conventional model's output.

### CONCLUSION

The main objective of our project is to reduce the fatigue on bicycle rider, to improve the efficiency of transmission system and lowers the weight of the system. By improving the design and mechanisms we are able to achieve the goal.

This system also helps to reduce maintenance, to improve the load carrying capacity and also lowers the generated noise level. From the total works experience it has been seen that, this system plays an important role for the more utilization of bicycle.

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