"BATTERY OPERATED AND SELF CHARGING BICYCLE"

Mansuri Mo.Sohil J.[1], Mansuri Naim I.[2], Panchal Tushhar B. [3], Patel Krutik R.[4] , Mr. Lalit D. Patel [5]

[1,2,3,4]*Student of Mechanical Engineering at Samarth College Of Engineering And Technology Himatnagar, Gujarat, India*

[5]*Assistant professor of mechanical engineering department at Samarth College Of Engineering And Technology, Himatnagar, Gujarat, India*

ABSTRACT

The main aim of this review paper is to present the idea of harnessing the various energy and use it in today's existence of human life. For human being travelling has become vital.in order to sustain in this fast forward world he must travel from place to place. It is very important that time taking for travelling should be less, also it should be economical and easily available. With the fast depleting resources of petrol and diesel, there is need to find intermittent choice. Taking all this into account, a shift away from conventional based fuels to using a renewable sources of energy is a must. Electric bi-cycle which will be driven with the help of battery and thus provide required voltage to the motor. The focus of this report is to system design of this electric bi-cycle. Therefore the manufacturing of such bi-cycle is indispensable.

Keyword: *Bicycle, Battery, Chain Drive, Throttle, Controller*

1. INTRODUCTION:

- Bike were introduced in the late nineteenth century in Europe, and by the mid 21st century, more than 1 billion have been made around the world. These numbers far outperform the amount of cars, both out and out and situated by the amount of individual models delivered. They are the rule systems for transportation in different districts. They in like manner give a common sort of delight, and have been balanced for use as adolescents' toys, general wellbeing, military and police applications, dispatch organizations, bicycle hustling and bicycle stunts.
- The major shape and setup of a common upright or "security bike", has changed nearly nothing since the primary chain-driven model was produced around 1885. These have considered an increase of specific blueprints for a few sorts of cycling.
- The bicycle's creation has enormously affected society, both as far as culture and of propelling present day mechanical strategies. A few segments that in the long run assumed a key part in the advancement of the car were at first concocted for use in the bike, including metal rollers, pneumatic tires, chain-driven sprockets and strain spoked wheels.

1.1 TYPES OF BICYCLES

- According to function
- According to number of wheels
- According to type of steering
- According to number of riders
- According to sport
- According to rider position

- According to means of propulsion
  - According to gearing

2.DESIGN

A. Dc Motor:-

The motor is having 250 watt. capacity with maximum 2700 rpm. Its specifications are as follows:

Voltage Rating:- 24 Volts Cooling: Air :- cooled Bearing :- Single row ball Current Rating:- 14amp

Figure 1:- D.C. Motor

B. Frame:

The Frame is made up of M.S. along with some additional light weight components. The frame is designed to sustain the weight of the person driving the unit, the weight of load to be conveyed and also to hold the accessories like motor.

Also it should be design to bear and overcome the stresses which may arise able to due to different driving and braking torques and impact loading across the obstacles. It is drilled and tapped enough to hold the support plates.

Figure 2: Frame

C. Battery:

The battery also acts as a condenser in a way that it stores the electric energy produced by the generator due to electrochemical transformation and supply it on demand. Battery is also known as an accumulator of electric charge. This happens usually while starting the system.

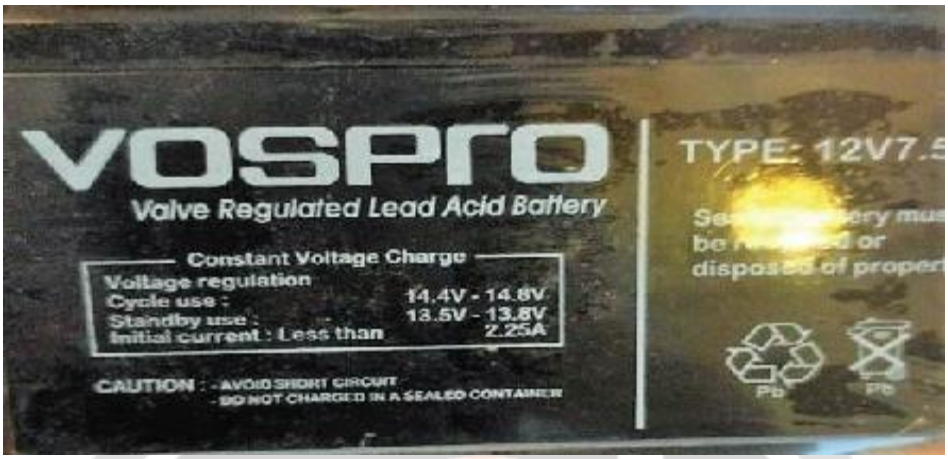


Figure 3: Battery

D. Chain Drive:

– A Chain is an array of links held together with each other with the help of steel pins. This type of arrangement makes a chain more enduring, long lasting and better way of transmitting rotary motion from one gear to another.

– The major advantage of chain drive over traditional gear is that, the chain drive can transmit rotary motion with the help of two gears and a chain over a distance whereas in traditional many gears must be arranged in a mesh in order to transmit motion.

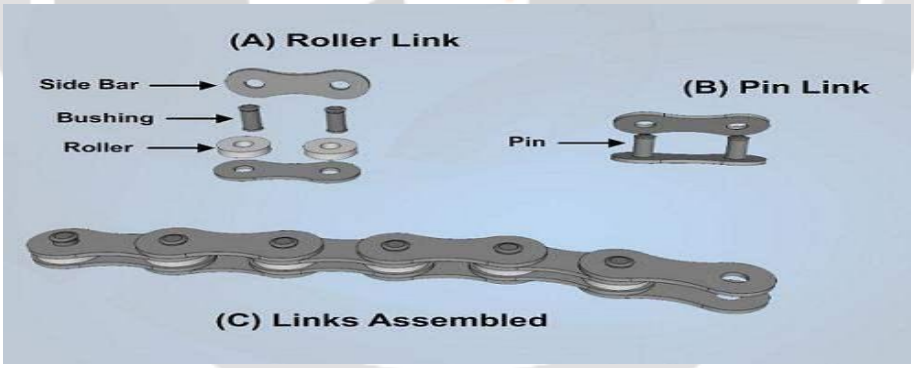
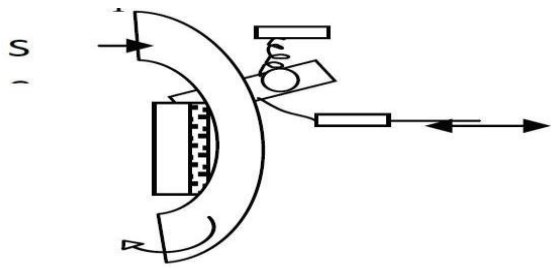


Figure 4: Chain

E. Braking System:

For the braking system it is convenient to use braking system used in band brake system which consist of spring loaded friction- shoe mechanism, which is driven with the help of hand lever.



F.Controller:

As its name suggests, the controller controls the amount of power supplied to the motor. The controller is rated at 36 v and 30 a and was included in the ebike conversion kit. Since the motor is a brushed dc motor, the internal workings of the controller are fairly simple. A delay chip supplies power to the motor at timed intervals, and different coils in the motor are powered each time as the motor turns to align with the permanent magnets in the housing. Note that this controller has a one-way relationship with the battery and motor, meaning that it does not do regenerative braking.

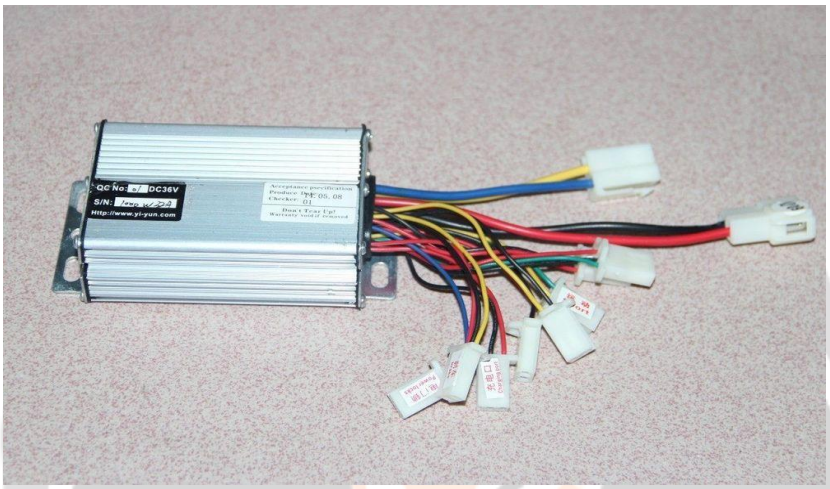


Figure 6: controller

G. Throttle:

The throttle was included in the controller kit. It is a half-twist throttle. Throttles can work in several ways, but the most common and simple way is as follows. Inside the handle is a Hall-effect sensor which can supply some voltage in response to change in magnetic field. As the handle is twisted it changes the Hall-effect sensor's proximity to a magnet, thereby changing the voltage produced by the sensor. This is interpreted by the controller and the power supplied to the motor is varied.

Figure 8: Throttle

3. DESIGN CALCULATION

➢ **Design calculation of Electric Bike**

p= pitch of chain, mm

D=pitch diameter of spocket, mm

z=number of teeth on spocket

γ =pitch angle, degree

V=average speed of chain, m/s

n=speed of sprocket, r.p.m

Z1,Z2=number of teeth on driving and drive sprocket

n1,n2=speed of driving and driven sprocket ,r.p.m

i=speed ratio

M=number of link

C=centre distance between driving and driven sprockets, num

L=length of chain

K=service factor

P=power to be transmitted, kW

Pd=design power, kW

K1=tooth correction factor

K2=multiple strand factor

KW=power rating of simple roller chain, kW

Pmax=max.theoretical power transmission capacity of roller chain, kW

Fb=breaking strength of roller chain, N

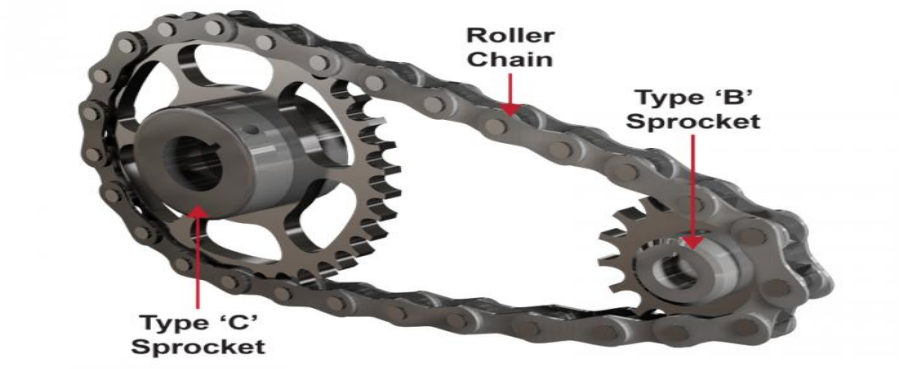


Figure 9: Chain Drive

➢ **BASIC RELATIONS:**

$\gamma = {}^{360}/_{z}$

$D = {}^{p}/_{\sin({}^{\gamma}/_{2})}$

$D = {}^{p}/_{\sin({}^{\gamma 180}/_{z})}$

$i = \frac{n1}{n2} = \frac{z2}{z1}$

L= M.p ,mm

$V = \frac{zpn}{60*1000}$ **,m/s**

%speed variation $= \frac{Vmax-Vmin}{V}$

$P = \frac{Ft*V}{1000}$ **,kW**

Design power (pd):

Pd=Ks.p

Required Power Rating (kW):

$kW = \frac{Pd}{K1*K2}$

$= \frac{Ks*p}{K1*K2}$

Maximum Theoritical Power Roller Chain can Transmit (Pmax):

Pmax = $\frac{Fs*V}{1000}$ **, kW**

➢ **Design of Electric Bike:-**

Here we have used permanent magnet self generating motor with 250 watt power and 2700rpm. The motor runs on 24 volts and 14 amps power source. This motor can reach a peak current during starting equal to 15 amps.

P = 2 x 3.14 x N x T /60 250

= 2 x 3.14 x 2700 x T /60 T

= 0.88464N m

= 884.64 N-mm

Reduction in chain drive R chain = 18/09

= 2:1

Torque at wheel shaft = T x R chain

= 884.64 x 2

= 1769.28 N.mm

Speed of wheel shaft = 2700 /2

= 1350 rpm

A. Designing of Shaft Bending:

The force which develops across a specific cross section of the shaft, it generates stress at that point of cross section that are subjected to maximum loading. This internal or resisting moment gives rise to the stress called as bending stresses.

Torsion:

When the shaft which is twisted by the couple such that the axis of that shaft and the axis of the couple harmonize, that shaft is subjected to pure torsion and the stresses generated at the point of cross section is torsion or shear stresses.

Combined Bending and Torsion:

In actual practice the shaft is subjected to combination of the above two types of stresses i.e. bending and torsion. The bending stresses may occur due any one of the following reasons:

1) Weight of belt1.
2) Pull of belts2.
3) Eccentric Mounting of shafts/gears3.
4) Misalignment of shafts/gears4.

On contrary, the torsional movement occurs due to direct or indirect twisting of the shaft. Hence at any given point on crosssection of the shaft, the shaft is subjected to both bending and torsional stresses simultaneously. Following stresses are taken in consideration while designing the shaft:

1. Shaft Design

T = 36000 N mm

T = 3.14 / 16 x σs x d3

Fs allowable = 80 N/mm2

6820 =3.14 x σs x d3/16

σs = 34.73 N/mm2

Material = C 45 (mild steel)

σ ut = 320 N/mm2 ---------- PSG design data book.

Factor of safety = 2 σt

= σb

$= \sigma ut / fos$

$= 320/2$

$= 160 N/mm2$

$\sigma s = 0.5 N/mm2$

$\sigma t = 0.5 \times 160$

$= 80 N/mm2$

σs is less then allowable so our shaft design is safe.

2. Design of Sprocket and Chain for Electric Bike

We know, Transmission ratio = Z2 / Z1

= 18/09

= 02

For the above transmission ratio number of teeth on pinion and the number of teeth sprocket is in the range of 21 to 10, so we have to select number of teeth on pinion sprocket as 09 teeth.

So, Z1 = 09 teeth

B.Selection of Pitch of Sprocket:

The pitch is decided on the basis of RPM of sprocket. RPM of pinion sprocket is variable in normal condition it is = 2700 rpm.

For this rpm value we select pitch of sprocket as 6.35mm from table.

P = 6.35mm

Calculation of minimum center distance between sprockets.

Transmission ratio = Z2 / Z1

= 18/9

= 2.

which is less than 7 Dia. of small sprocket,

Periphery = π × dia. Of sprocket

=11 × 6.25

= π × D D

= 09 × 6.25 / π D

= 17.9140 mm Dia. of sprocket

Periphery = π × dia. Of sprocket

=18 × 6.25

= π × D D

= 18× 6.25/ π D

= 35.8280 mm.

So from table, referred from PSG Design Data book

The minimum centre distance between the two sprocket = C' + (80 to 150 mm)

Minimum Center Distance = 76.5 + (30 to 150 mm)

Minimum Center Distance = 170 mm

C. Calculation of Values of Constants K1 K2 K3 K4 K5 K6 – (with help of PSG Design Data)

Load factor K1 = 1.25 (Load with mild shock)

Distance regulation factor K2 =1.25(Fixed center distance) Center distance of sprocket factor K3 =0.8

Factor for position of sprocket K4 = 1 Lubrication factor K5 = 1.5 (periodic) Rating factor K6 = 1.0 (single shift)

D. Calculation of Value of Factor of Safety

For pitch = 6.35

& speed of rotation of small sprocket = 2100 rpm Factor of Safety for this drive = 8.55

Calculation of Allowable Bearing Stress:

For pitch = 6.35

& speed of rotation of small sprocket = 2100 rpm Allowable Bearing stress in the system = 2.87kg / cm2

=2.87 * 981/100

=28 N /mm2

1. Calculating Maximum Tension on Chain

Maximum torque on shaft = Tmax

T2 = 6820 N-mm

Where, T1 = Tension in tight side,

T2 = Tension in slack side,

O1, O2 = center distance between two shaft

Sin = R1 - R2 O1O2

Sin = 65.65 - 10.9

170 Sin = 0.33

= 18.78

TO FIND = (180 –2) X 3.14/180

= (180 –2*18.78) X 3.14/180

= 2.48 rad

According to this relation, **T1/T2 = eμθ**

T1/T2 = **e**0.35 x 2.48 **T1**

= 2.38**T2**

We have,

T = (T1 – T2) X R 6820

= (2.38 T2 – T2) X 65.65 T2

= 75.27 N

T1= 2.38 X 75.27 T1

= 179.16 **N**

So tension in tight side = 179.16 N

We know,

Stress = force / area x 2

Stress induced = 179.16/ (3.14 * 32 / 4) x 2 Stress induced = 12.67 N /mm2

As induced stress is less than allowable stress =28N /mm2 design of sprocket is safe.

4. CONCLUSIONS:

With the expanding utilization of regular assets of petroleum, diesel it is important to move our way towards exchange assets like the Electric bicycle and others since it is important to distinguish better approach for transport. Electric bicycle is an alteration of the current cycle by utilizing electric vitality and furthermore sunlight based vitality if sun powered boards are given, that would aggregate up to increment in vitality generation. Since it is vitality proficient, electric bicycle is less expensive and reasonable to anybody. It can be utilized for shorter separations by individuals of all ages. It can be devised consistently. The most crucial component of the electric bicycle is that it doesn't devour non-renewable energy sources in this manner sparing crores of outside monetary standards. The second most critical element is it is sans contamination, eco – well disposed and quiet in operation. For counterbalancing ecological contamination utilizing of on – board Electric Bicycle is the most feasible arrangement. It can be accused of the assistance of AC connector if there is a crisis. The Operating expense per/ km is less and with the assistance of sun powered board it can reduce up more. Since it has less segments it can be effectively destroyed to little segments, along these lines requiring less support.

5. ACKNOWLEDGEMENT:

"Optimism Is The Faith That Leads To Achievement. Nothing Can Be Done Without Hope and Confidence - Helen Keller"

On the very outset of this report, I would like to extend my sincere and heartfelt obligation towards all the personages who have helped me in this endeavor. Without their active guidance, help, corporation and encouragement, I would not have made head way in the project.

First and foremost, I would like to express my sincere gratitude to my project guide , Asst.prof.

Lalitbhai D. Patel .It has been a great pleasure for me to get an opportunity to work under him and complete the present work successfully.

We wish to extend my sincere thanks to Asst. prof. Sanket T. Gandhi, Head of our Department, for approving our project work with great interest.

We would also like to thank Dr.Paras kothari, Principal of our institution for giving me moral guidance.

We wish to express my heartiest regards to my parents for their guidance and moral support.

We are thankful to Asst.prof.Sunil J.Patel for giving me guidance in the process and opportunity to carry out experiments in his company.

We are also like to thanks to all Mechanical Engineering Department of Our college. Because more guidance about Our project. And also helpful for support.

6. REFERENCES:

[1]Aikenhead, G.S.,"Bicycle Applications for On-Board SolarPower Generation", pp. 9-10, 2011.

[2]Barve, D. S.,"Design and Development of Solar Hybrid Bicycle", International Journal of Current Engineering and Technology, pp. 377-380, 2016.

[3] Barve, D. S.,"Design and Development of Solar Hybrid Bicycle", International Journal of Current Engineering and Technology, pp. 378-379, 2016.

[4] Barve, D. S.,"Design and Development of Solar Hybrid Bicycle", International Journal of Current Engineering and Technology, pp. 380, 2016.

[5] FOGELBERG, F.,"Solar Powered Bike Sharing System", Goteberg,Sweden: Viktoria Swedish ICT, 2014.

[6] FOGELBERG, F.,"Solar Powered Bike Sharing System with", Goteborg, sweden: Viktoria Swedish ICT, 2014.

[7] GOODMAN, J. D.,"An Electric Boost for Bicyclists", The New York Times, 2010.

[8] Prof. Palak Desai, P. D.,"Design And Fabrication Of Solar TRI Cycle", International Journal of Engineering Sciences & Research, pp. 664, 2016.

[9] T.Bhavani,"Novel Design of Solar Electric Bicycle with Pedal", International Journal & Magazine of Engineering,pp.108,2015.