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Design and Fabrication of Electric Bicycle

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ABSTRACT

The main gist of this paper is to give the exact view by bridling the various sources of energy available to mankind. In today's modernized world travelling is very essential for human beings in order to protract in this world and to do so his travelling should be done in minimum possible way. This paper details about the electric bike which runs on the battery thereby providing voltage to the motor. This paper compromises with design and fabrication of electric bicycle which makes use of electric energy as the primary source and solar energy is possible by attaching solar panels. There is a provision for a charging the battery by ejecting it from main system. The electrical power generated bicycle replaces the conventional bicycle which is manually driven. Another it could be the option to the petrol run vehicles as it is pollution free.

Keywords : Electric bicycle, Battery, Motor, Belt drive, Environment

I. INTRODUCTION

An electric bicycle is also known as an e-bike. It is integrated with electric motor. Many kinds of e-bikes are available worldwide, from e-bikes that only have a small motor to assist the rider's pedal-power to somewhat more powerful e-bikes. It reduces the human effort along with increasing the efficiency. It is eco-friendly vehicle and helps in conserving petroleum. It is not available in affordable cost. Electric bicycles are good for the environment as they use electric power along with human power. Electric bicycles were documented within various US patents. Bolton et al. (1895) was granted US patent 552271 for a battery powered bicycle with "6 pole brush and commutator direct current hub motor mounted in the rear wheel".

There were no gears and the motor could draw upto 100A from a 10 volt battery. Libbey et al. (1897) of Boston invented an electric bicycle US patent 596272 that was propelled by a "double electric motor". The motor was designed within the hub of the crankset axle.

The model was later re-invented and imitated in the late 1990s by Gaint Lafree e-bikes. Steffens et al. (1898) a rear wheel drive electric bicycle, which used a driving belt along the outside edge of the wheel, was patend. Also, the US patent 627066 by Schnepf et al. (1899) depicted a rear wheel friction "roller wheel" style drive electric bicycle. Schnepf's invention was later re-examined and expanded in Wood et al. (1969) with his US patent 3431994. Wood's device used 4 fractional horse power motors connected through a series of gears. Torque sensors and power controls were developed in the late 1990s. T. Yutky of Japan filed a patent in 1997 for such a device. In 1992 Vector Services Limited offered and sold an e-bike dubbed by Zike. The bicycle included NiCd batteries that were built into a frame member and included an

850g permanent magnet motor. Despite the Zike, in 1992 hardly any commercial e-bikes were available.

Production grew from 1993 to 2004 by an estimated 35%. By contrast, according to Gardner, in 1995 regular bicycle production decreased from its peak 107 million units. Some of the less expensive e-bikes used bulky lead acid batteries, whereas newer models generally used NiMH, NiCd and Li-ion batteries which offered lighter, denser capacity batteries. Performance varies however in general there is an increase in range and speed with the later battery types. By 2001 the terms e-bike, power bike, pedelec, pedal-assisted and power-assisted bicycle were commonly used to refer e-bikes. The terms "electric motorbike" or "e-motorbike" refer to more powerful models that attain upto 80km/h.

In a parallel hybrid motorized bicycle, such as the aforementioned invention by Libbey (1897), human and motors inputs are mechanically coupled either in the bottom bracket, the rear wheel or the front wheel whereas in a (mechanical) series hybrid cycle, the human and motor inputs are coupled through differential gearing. In an (electronic) series hybrid cycle, human power is converted into electricity and is feed directly into the motor and mostly additional electricity is supplied from a battery. By 2007 e-bikes were thought to make up 10-20 percent of all two-wheeled vehicles on the streets of many major Chinese cities. A typical unit requires 8 hours to charge the battery, which provides the range of 25-30 miles at the speed around 20km/h.

This study focused for making an assembly for electric cycle having different components such as pulley, motor, belt-drive etc. Energy crisis is one of major concerns in today's world due to fast depleting resources of petrol, diesel and natural gas. It is proposed the solutions for all these perilous problems. The electric bicycle which works on the battery that is power by the motor is the general mode of transport for a local trip. E-bikes use rechargeable batteries, electric motors and some form of control. There are two distinct types of controllers design to match either a brushed motor or brushless motor. Brushless motors are becoming common as the cost of controllers continues to decrease. The solar panels can be alternative source for this by adding it to the system. The electric bicycle which will be running on battery, the power is supplied by the motor, thereby supplying this power to drive the other gear components.

II. DESIGN AND MODELING OF THE ELECTRIC BICYCLE

DATA:

Pr = 1200W,N1 = 5200rpm, V = 60km/h

N2 = 568rpm, C = 260mm

(Pr = Rated power of motor, N1 = Speed of small pully, N2 = Speed of larger pully, C = Centre distance between two pully)

1) Design Power of Belt

Pd = Pr*K1*K0 ---------- (K1 = 1.1, K0 = 1)

Pd = 1200*1.15*1.1= 1518W

(K1 = Load factor of belt, K0 = capacity coefficient of inclination of belt)-----(T-XV-3, T- XV-2,)(Design data book B.D. Shiwalkar)

2) Belt tension (F1-F2)=Pd/Vp

Vp = 55m/sec (Given)

F1-F2 = 1518/55 = 27.6---------- (i)

Vp = n*D1*N1/60D1 = 202mm

D2 =18mm, D2 = 20mm, F2 = 20.59N

(F = Force of pully, Pd = Design power, Vp = belt velocity, D1&D2 = Diameter of small &larger pully)

3) Belt Tension Ratio F1/F2 + e^{Uo}

U = 0.35

0= n-D2-D1/C0 = 2.4F1/F2 = 2.34F2-F2 = 27.6

(u= coefficient of friction between belt & pully, 0 = angle of lap on smaller pully)---------- -------- (T-XV-1)(B.D. Shiwalkar)

F1 = 48.19N

4) Belt Dimensions

a) Steady state Si = Fi/b*tSi = 1.5MPa Fi = 17.19N

1.5 = 17.19/b*t*= 11.46

b) Dynamic Condition b*t = F1/Sd-Sf

Sd = 1.125

Scf = PvA2*10A-6

P = 1250 kg/mA3

Scf = 1.25*55A2*10A-6Scf = 3.78*10A-3 MPa

b*t = 48.19/1.125-3.78*10A-3

b*t = 42.9

t = 0.02*D

t = 4mm

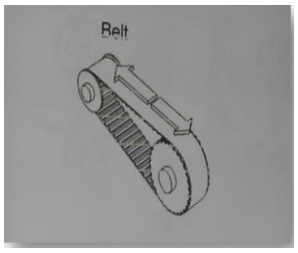
b = 10mm

Sd = Design stress of belt, Scf = Centre stress, p = density of belt, b = width of belt, t = thickness of belt)

(a)

(b)

Figure 1: (a) BLDC motor, (b) VESC



(c) Belt

(d) Large Pully

(e) Small Pully

III. RESULT

An Electric bicycle designed, fabricated and driven successfully. The different components are 24 V brushless DC motor, toothed belts, 3D printed pulleys. A bicycle is manufactured in Rs. 19,800, while the cost of bicycle is start from 1 lakh.

IV. CONCLUSION

With the increasing consumption of natural resources of petrol, diesel it is necessary to shift our way towards alternate resource like the electric bike and others because it is necessary to identify new way of transport. Electric bike is a modification of the existing cycle by using electric energy and also solar energy if solar panel are provided, that would sum up to increase in energy production. Since it is energy efficient, electric bike is cheaper and affordable to

anyone. It can be used for shorter distances by people of any age.

It can be contrived throughout the year. The most vital feature of the electric bike is that it does not consume fossil fuels thereby saving crores of foreign currencies. The second most important feature is it is pollution free, eco-friendly and noiseless in operation. For offsetting environmental pollution using of on-board electric bike is the most viable solution. The operating cost per/km is very less and with the help of solar panel it can lessen up more. Since it has fewer components it can easily dismantled to small components, thus requiring less maintenance.

With the help of this research on e-bike may be the solution to our problems which we are experience now a days like traffic congestion, parking difficulties and pollution from fossils fueled vehicles.

V. REFERENCES

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[2]. Mattews Steffens et al(1898) a rear wheel drive electric bicycle, which used a driving belt along the outside edge of the wheel
[3]. W. Libbey et al(1897) of Boston invented an electric bicycle US patent 596272 that was propelled by a “double electric motor”.