MEM Cycle (Mechanical To Electrical And Electrical To Mechanical Cycle)

Kumar R[1],Santosh pawan kumar[2]
[2] Assistant professor
[1, 2] CiTech, K R Puram, Bangalore, Karnataka, India

Abstract- *This paper presents the design and fabrication of MEM CYCLE (Mechanical to electrical and electrical to mechanical cycle) model, recent days the fuel cost goes on hike day by day, the government is supporting the alternating fuel bikes to avoid the depletion of fuels and avoid environment air pollution finally global warming and this makes the idea and improving the existing electric bikes. In our project we designed the prototype model and fabrication of MEM cycle which works on 24 volts lead acid battery, we used 250 watts BLDC hub motor and a dynamo of the same capacity with fly wheel energy storing mechanism, so that regeneration of electrical energy. it is the dual powered weightless cycle works on electric motor and pedaling mechanism.*

Keywords- 24V 17AH lead acid battery, 24V 250 Watt BLDC hub electric motor, 20 AH DC controller, etc

I. INTRODUCTION

The present day scenario the fuel cost goes on hike day by day, the government is supporting the alternating fuel bikes to avoid the depletion of fuels and avoid environment air pollution finally global warming.[1] All variants of the bicycle over these years have subconsciously promoted the recreational use of bicycle and very less as a mode of transport. The most obvious reason for this is the comfort of the rider, time of travel, distance that can be covered that people get from fuelled vehicles, unlike the otherwise eco friendly bicycle.[3] [4]

MEM cycle is an effort towards just that. It allows the rider to commute in an eco friendly manner along with the reliability of a fossil fuelled vehicle in terms of refueling whenever required. Hence providing best of both towards worlds and to the rider. It is a successful combination of a flywheel, dynamo, batteries and motor and also the first of its kind to have no connection between pedals and the rear wheel. It is among those cycles which claim power generation on the go in addition to which power is being stored in this system.

MEM cycle is different from other flywheel cycles in terms of the following factors:

- This cycle being the first fusion of flywheel, motor and dynamo is also first of its kind to having no connection between the pedal and the rear wheel while still remaining a cycle.
- This cycle can be used as a complete motor driven vehicle as well with the assurance that there is always a backup power unlike most electric vehicles currently.

This project proposes a motorcycle which has dual sources. The motorcycle consists of two working power sources that are pedaling and electrical power driven BLDC 750 watt motor.

II. LITERATURE SURVEY

Aspects of the present disclosure involve an exercise bicycle in an indoor cycling configuration and including a US 9,044,635 B2 3 flywheel in an indoor cycling configuration. The exercise bicycle further includes an adjustable magnetic brake by which a rider may finely tune any resistive forces applied to the flywheel and thereby simulate different riding conditions. The magnetic brake is pivotally coupled with the frame such that magnets provided in a brake arm may be positioned relative the flywheel to induce more or less resistive power on the flywheel. Moreover, the brake arm is pivoted in such a way that normal forces applied to the brake arm by the interaction between the magnets and the flywheel will not pivot the brake arm and inadvertently increase resistance. [2] The exercise bicycle is configured for use by a variety of riders in club environment or for a single or limited number of riders in a home or other personal use environment.

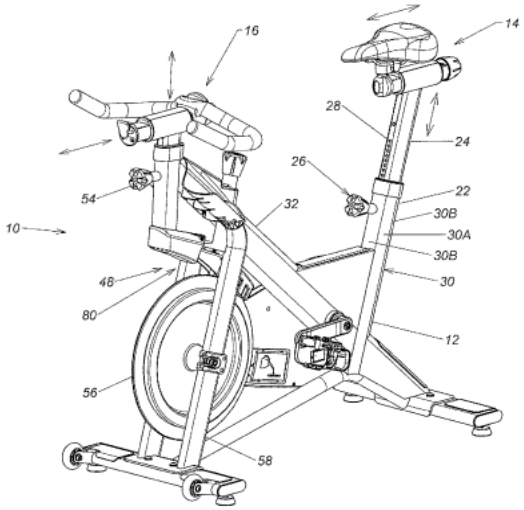

Fig 1 Exercise bicycle with magnetic flywheel

12- Frame
14- Adjustable seat assembly
16- Handlebar assembly
22- Seat tube
24- Pop pin
26- Pin
28- Apertures
30- side walls
32- down tube
48- front forks
52- handlebar post
54- second popping
56- flywheel
58- opposing left fork leg

We used the fly wheel mechanism for the constant mechanical power for regeneration of electrical energy.

III. DESIGNOF MEM CYCLE

1. Assembled 3D CAD drawing

The prototype model is prepared in solid edge software advanced version, with proper proportions are shown below.The Fig.2 shows the assembled right view of the cycle. The transmission from pedal to flywheel can be seen in the figure.Fig. 3 shows the left view of the assembled model, the flywheel frame to mount flywheel, battery frame to accommodate batteries and the dynamo placement can be seen.

Fig 2Assembled model, right view

Fig 3 *Assembled view, left view*

2. The Transmission system

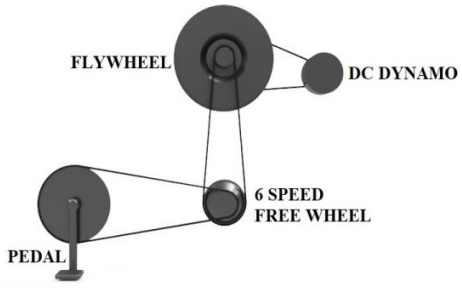

Fig 4 *Schematic of transmission, front view*

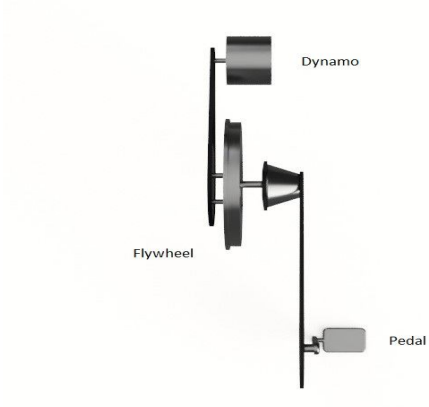

Fig 5*Schematic of transmission, top view*

Fig.4 shows the basic transmission system adapted in the following project. The power expended by the rider at the pedals is transmitted to dynamo through flywheel by chains. Freewheels have been used to allow single direction rotation. Fig.5shows the chain connections between pedal, flywheel and the dynamo.

IV. SELECTION OF MATERIALS

1.Bicycle

Fig 6*Hercules rebellio 619 model bicycle.*

Specifications:

Brand Name: Hercules
Frame Size: 20 Inches
Brake Type: V Brake
Model Number: Rebellio 619 26"
Frame Material: Steel

2. Flywheel

Fig 7 Flywheel.

Specification:
Mass: 8kg
Diameter: 256.5 mm

3. Dynamo

Fig 8 Flywheel.

Specificationof Dynamo:
Output Power: 250W.
Supply Voltage: 24V DC.
Speed: 2650 RPM.
No load speed: 3000RPM.
Full load Current: ≤13.7A.
No load Current: ≤2.2A.
Weight: 1.92 Kg.
Rated Torque: 0.80N-m (8 Kg-cm).
Stall Torque: 5 N-m (50 Kg-cm).
Efficiency ≥ 78%.

4. Batteries

Specification:
Rating: 12V 17Ah

Type: Sealed lead acid
Quantity used: 4 numbers

Fig 9 Dry lead acid rechargeable battery.

5. Hub motor

Specification:
Rating: 24V 250W
Position: front wheel

Fig 10 Hub motor.

V. FABRICATION

1. Flywheel Frame:
Two, 3mm thick rectangular plates of dimensions 460*192 mm were bought and holes were drilled

2. Components of flywheel assembly.

3. Freewheel with hub.

4. Flywheel axle.

5. Flywheel assembly.

6. Dynamo assembly.

VI. TESTING AND CALCULATIONS

Theoretical calculations:

- The following calculations are done based on an average cycling speed of 60 rpm and z1= 44, z2= 14, z3= 28, z4= 18, z5= 48, z6=16 are the

$$N1 = 60\ rpm$$

$$\frac{N1}{N2} = \frac{z2}{z1}$$

$$\frac{60}{N2} = \frac{14}{44},\ N2 = N3 = 188\ rpm$$

$$\frac{N3}{N4} = \frac{z4}{z3}$$

$$\frac{188}{N4} = \frac{18}{28},\ N4 = N5 = 292\ rpm$$

$$\frac{N5}{N6} = \frac{z4}{z3}$$

$$\frac{292}{N6} = \frac{16}{48},\ N6 = 876\ rpm$$

Where,

N1 - speed at pedal (rpm)N2, N3 - speed at rear wheel (rpm)
N4, N5 - speed at flywheel (rpm)N6 - speed at dynamo (rpm)
z1 - number of gear tooth at the crankz2, z3 - number of gear tooth at rear wheel
z4 - number of gear tooth of the free wheel
z5 - number of gear tooth of chain wheel at the flywheel
z6 - number of gear tooth at dynamo

- Discharging time of batteries:

Current required by hub motor:

$$I = \frac{P}{V} = \frac{250}{24} = 10.4\ amps$$

Discharge time:

$$Td = \frac{Ah(\ battery)}{I(\ motor)} = \frac{17}{10.4} = 1.6\ hrs$$

- Charging of batteries:

Current generated by dynamo:

$$P = \frac{(2 \times \pi \times N \times T)}{60}$$

$$350 = \frac{(2 \times \pi \times 2700 \times T)}{60}$$

$$T = 1.23\ N - m$$

$$P = \frac{(2 \times \pi \times 876 \times 1.23)}{60} = 112W = I \times V$$

$$I(\ dynamo) = \frac{112}{24} = 4.6\ amps$$

Charging time:

$$Tc = \frac{Ah}{I(\ dynamo)} = \frac{17}{4.6} = 3.7\ hrs$$

It takes 3.7 hrs to charge completely i.e. 100%, therefore, battery is charged to 27% in 1 hour.

Taking standard readings, fully charged 17Ah battery would give a mileage of 24 kms, thus a 27% charged battery would give a mileage of 6.5 kms, thus extending the distance that can be covered.

VII. WORKING PRINCIPLE AND FINAL ASSEMBLED MODEL

In the following project, MEM basically stands for Mechanical to Electrical and back to Mechanical i.e., initial mechanical energy supplied by the rider is converted to electrical energy by the dynamo which again is converted into Mechanical energy by the motor. Hence the project is based on the "conservation of energy" on the whole, stating "energy can neither be created nor be destroyed, it can only be converted from one form to another". For these conversions, MEM cycle is incorporated with a flywheel, a dynamo and a dc motor as its main energy conversion elements.

Dynamo assembly:

The dc motor bought to be used as dynamo for the project had an inbuilt gear of 11 teeth. Considering the gear ratios required, a gear of 16 teeth was attached after removing the existing gear. The dynamo base is attached to a metal structure of dimension 130*100*76 mm in order to be able to fix it to the rectangular base plate. The gear of the dynamo is to be perfectly aligned to the chain wheel of the flywheel assembly in order to transmit the power from flywheel to dynamo with the help of chain.

Power transmission:

The power transmission from pedals to flywheel and further from flywheel to the dynamo is all done by roller chains. A total number of 3 chains are used in the following project. First chain transmits muscle power of rider to the rear wheel, second chain transmits power from rear wheel chain wheel to the flywheel and the third chain transmits rotational energy of flywheel to the dynamo.

Electrical assembly:

Electrical assembly consists of the hub motor, motor controller, electric brakes, dynamo and the batteries. It includes all the necessary connections between batteries, dynamo and the hub motor. [4]

The dynamo is connected in series with a diode in its positive terminal and further connected to the batteries. Diode blocks the backflow of current, thus enabling the use of motor as a dynamo hence charging the battery.

The three batteries are connected in series so as to add up the voltages to obtain 24V of output. The 24V is supplied to the motor controller from where power is supplied to the hub motor.[3]

The DC motor controller is connected to hub motor, led indicator, power supply, electric brakes and throttle.

The MEM cycle After all the electric connections and mounting of all parts , it was time to finish up the bike by fixing small elements like seat, accelerator, mudguards, etc. After all parts were assembled, we tested every single aspect of the bike to know if any changes were required and error proof the bike.

Elements like speed, pick-up, comfort and charging were tested.

(a)

(b)

Fig 11 (a) & (B)*Assembled view of MEM cycle.*

VIII. CONCLUSION

Successful fabrication of pedal assistance MEM cycle, the charging time of the battery pack is 4-6 hours, the cycle a gives 50 plus Kms per charge without pedaling at the speed of 30 KMPH without peddling.

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