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Semi Automatic Bicycle using Fly Wheel Mechanism

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Abstract:*Self-loader* ***bike is a system for recovering the motor vita lity of the moving vehicle from the wheel put away and putting it as rotational vitality under braking in the flywheel Lot of kinetic energy is lost when a bicycle is applied brake. This loss in kinetic energy is recovered using flywheel and it stores the required energy. As per the requirement, the bicycle rider may descend or ascend the usage of energy. The flywheel increases the most intense acceleration and reduces pedal strength by 20 percent. During a drive, speeds are in the range between 15.5 and 25 km / h. The speed of the typical bike is 15.5 km/h. We are trying to increases its speed to 20km/hrby using flywheel and increase the bicycle efficiency.***

Keywords: **Bicycle, Kinetic energy, Flywheel.**

I. INTRODUCTION

Electric SEMI-AUTOMATIC BICYCLE frameworks based on batteries require different vitality transformations with corresponding productivity misfortunes.

II.METHODS AND MATERIALS

What information should be collected and assessed to conform our understanding of the problem? From a technical point of view, we think the problem is that 99% of the rider's energy is transferred to the wheel.

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The gearing mechanism decreases the energy. shaft drive by 1 to 7% by increasing the energyweight of the wheel by 10 to 20%. There is a lack of power in the bike due to braking. Due to age difference speed of the cycle will vary, an elder person can able to travel only less than 10km per hour. But a young good physique person can be able to travel up to 20km per hour.

III.SOLUTION OF THE PROBLEM

There are many things that improving the efficiency of the bicycle:-By reducing the weight of the cycle we can get 10% improvement in the energy, but weight reduction give only negligible amount of energy. Improve a form of aerodynamics improvements. The friction and the balancing cause a little loss to overcome that a suspension systems are used. A flywheel mechanism also can be used to overcome the problems.

IV.THEORICAL INVESTIGATION

From the many solutions we will select a flywheel mechanism Flywheel has an inertia called inertia and is therefore resistant to changes in rotational speed. A flywheel which provides continuous energy when the source of energy is discontinuous. Flywheels are about 80% efficient than any other systems.

V. METHODOLOGY

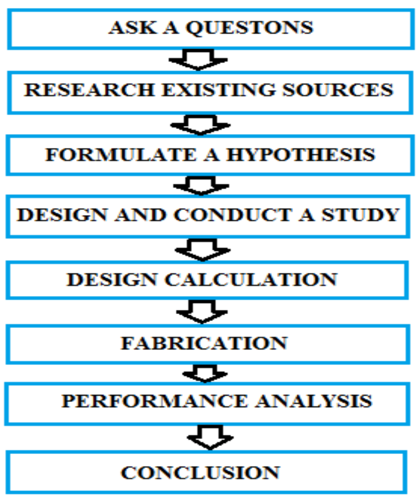


Fig. 1. Methodology Block Diagram

VI. SELECTION OF MATERIALS

A. Factors of the choice of materials

To assess the various product factors:

The material chose must have the essential properties for the proposed application. The different necessities to be fulfilled can be Weight, surface completion, unbending nature, capacity to withstand ecological assault from synthetics, administration life, dependability and so forth.

The following four types of materials ' rule properties have a decisive effect on their selection Physical, mechanical, manufacturing, synthetic

B. Materials of the Components

The table 1 below represents the material of the components:-

TABLE 1 materials of the components

Sl.no	NAME OF COMPONENT	MATERIAL OF THE COMPONENT
1.	Bicycle Frame	Steel
2.	Flywheel	Castiron
3.	Bearing	HSS
4.	Sprocket	Steel
5.	Chain	Plain carbon
6.	Frame	Mild steel
7.	Shaft	Mild steel

C. Bicycle Frame

Saddle height, the distance from the center of the bottom bracket to the reference point on top of the center of the saddle. The following Fig.1 shows bicycle frame.

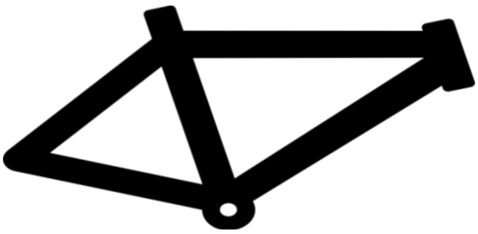


Fig. 2. Bicycle Frame

D. Flywheel

A flywheel is a vitality stockpiling gadget. It take in mechanical vitality and serve up as a repository, putting away vitality all through the period when the stockpile of vitality is more than the prerequisite and discharges it during the period when the necessity of vitality is more than the inventory.

Fig. 3. Flywheels

E. Sprocket

The rod attaches the flywheel mechanism to the rest of the bike. It is connected by a chain to the crank . Also, when in the default gear ratio, the sprocket will have a caliper attached to it to engage the tooth gear. This is a part of the shelf, but to attach the calliper the sprocket is a figure5. It's going to need holes in it.

Fig. 4. Sprockets

F. Chain

A bicycle chain is a roller chain that transfers power from pedals to a bicycle's drive wheel and thus propels it. Many bicycle chains are made of alloy steel or flat wood..The chain drive in figure 5.4 is shown below

Fig. 5. Chain Drive

G. Extended Solid Axle

This is the component on which the entire system of flywheels rests**.** While there are hollow bike axles off - the-shelf, this part needs to be customized because the gear of the tooth needs to be able to slide freely between the shelf off part and a custom unthreaded hollow shaft.A connector could be used, but this is an unnecessary complication.**.** The internal diameter is 9 mm, the true axis .The actual axle will be long enough to be used as the axle of the bike, but for the 3d model it will only have to be long enough for the 12 cm long flywheel system. The extended solid axle is shown below in figure 5.5.

Fig. 6. Extended Solid Axle

H. Ball Bearing

The bearing form used will be number 6006, with an outer diameter of 30 mm, an internal diameter of 10 mm, and a length of 13 mm.

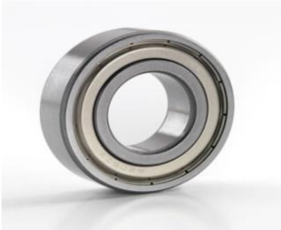


Fig. 7. Ball Bearings

I. Clutch

To regulate the power transmission and discharge from the flywheel, a grasp must be provided..The clutch mechanism in figure 5.7 is shown below

Fig. 8. Clutch Mechanism

VII.FABRICATION PROCESS

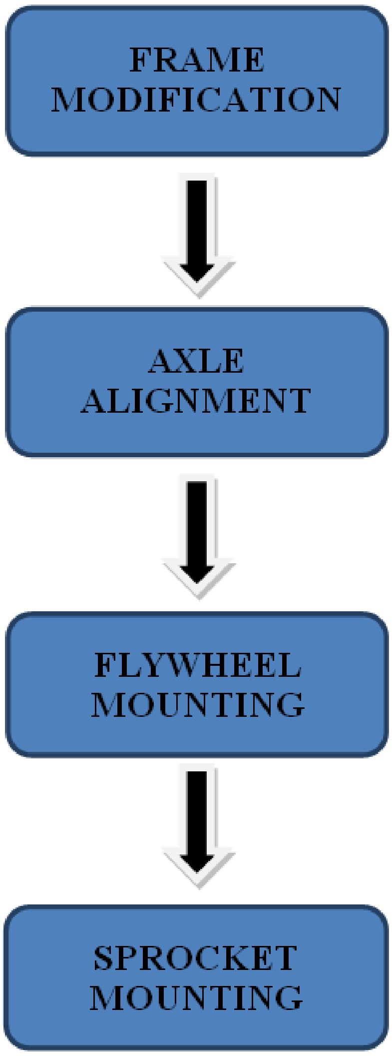
A. Frame Modification

Edge mounting is the essential assembling in the flywheel bike. Steel tubes are utilized as the edge structure, they are joined by welding .One finish of the casing is to the facing completion of the bike (underneath the handle) and opposite end is associated close to the back sprocket. The casing is spot welded to bike. Anyway certain contemplations are made so the geometry of the edge doesn't prevent the riding solace of the drive.The outline adjustment figure is demonstrated as follows

Fig. 9. Frame Modification

onsidering the internal measurement of the metal ball and via completing shaft plan the breadth of shaft is chosen. In this way appropriately shaft and the related shaft bolster structure on the casing is produced..

B. Flow Chart



VIII.DESIGN CALCULATION

A. Chain Calculation

Determine of the Transmission Ratio

STEP 1

$I = \frac{z_2}{z_1} = \frac{30}{15} = 2$

I= 2 ---(DDB page no:7.74)

$I = \frac{N_1}{N_2} (N_1 = 200)$

$2 = 200/N_2$

N_2=100 rpm

STEP 2

Z_1 - Number of sprocket teeth = 15

Z_2- Number of sprocket teeth = 30

STEP 3

We Know That

Centre distance(a_0)=(30to50)p

Assume a_0=500mm(centre distance)

Max pitch=a_1/30=500/30=16.66mm

Min pitch=a_2/50=500/50=10mm

Referred pitch=12.7mm ----------------------------(DDB page no 7.74)

STEP 4

Selection of chain

Assume (simple chain) roller chain
R&B denote simple chain---- --------------------(Chain no 82-1 R1224)
Roller diamax(Dr)=7.75mm
Pin body diamax(Dr)=2.40mm
Weight per meter =0.28kgf

STEP 5
Calculation of the full driving load
Chain's side (p_t)
(1) Force tangential (p_t)

$$(p_t)=1020\frac{N}{V}$$

N- transmit power in kW=2.5kw
V -chain velocity in m/s
V=Z1PN1/60×1000
=15×12.7×200/60×1000
V=0.635m/s
p_t=1020N/V=1020×2.5/0.635
p_t=4015.74N
(1) Centrifugal tension(T_c)
T_c=mV²
M=0.28kg/m
=0.28(0.635)²
T_c=0.112903N
(2) Tension due to decrease (p_s)
p_s=K.W.A
K=4 -------------------------------(in DDB table 4.6 page no 7.78)

Position of chain drive
Up to 40º k=4
W=m g=0.78×9.81
W =7.65N
p_s=4×7.65×0.5
` p_s=15.3N
(4) Total load (p_t)
p_t=4015.74+0.112903+15.3
p_t=4031.15N

(5) Calculation of service factor (k_s)
Ks=k1.k2.k3.k4.k5.k6---------------------------(DDB Page no 7.76)
K1=1.25(variable load)
K2=1.25(fixed center distance)
K3=1
Ap=ao/p ap<25p
Ap=500/12.7 39.37<25×12.7
39.37 39.37<317.5
K4=1
K5=1.5
K6=1
K5=1.25×1.25×1×1×1.5×1
K5=2.34375

STEP 6
Calculation of design load
Design load=p_t×k_s
=4031.15×2.34375
=9448.0078N

STEP 7
Calculation of working factor of safety (FOS)
FOS=breaking load (Q)/design load
=1000/9448.0078
FOS=1.05
Calculation of chain length (L)
Number of links (lp)=2ap+(Z1+Z2/2)+[(Z2-Z1)/2∏]²/ap
Ap=ao/p=39.37
=2×39.37+(15+30/2)+[(30-15)/2π]²/39.37
=78.74+22.5
101.38≅100
Actual length of chain (L) =lp×p
=100×12.7
Length of the chain =1270mm

B. Flywheel Calculation

Let m=mass of the flywheel rim in kg
E=P×$\frac{60}{N}$=250×10^3×60/200
E=75000N-m
Max Fluctuation Energy
ΔE=0.15E=0.15×75000N-m
ΔE=11250N-m
.Since the velocity variation is 1% either way from the mean, the total velocity fluctuation is = 2% mean velocity = 0.02N and the coefficient of velocity = 0.02
Velocity of the flywheel
V= $\frac{\pi dn}{60}$=$\frac{\pi\times4.5\times200}{60}$
V=47.80m/s
We know that, the highest energy fluctuation (almostΔE)
ΔE=m
11250=m(47.80)²×0
m=$\frac{11250}{47.80}$=5.03kg
2) Cross sectional dimension of the flywheel.
b=width 2h
Cross sectional area of rim,
A=b*h=2h×h=2
We know that mass of the flywheel (m)
m=A×πD×q(q=6800kg/)
m=2×πD×q (q=7200kg/)
5.03=2×4.5×6800×π
h=5.11×m
h=5.11××1000
h=5.11mm
b=2h
b=2×5.11=10.22mm
3) Diameter and length of hub
d=diameter of the hub
We know that mean torque transmitted by the shaft
T=250×60/2πN=250×60/2π×200
T=11936.62N-m
Assume that the max torque transmitted by the shaft is twice the mean torque
T=π/6×τ=144mm
The diameter of the hub (d)= (twice the diameter of the shaft) length of hub (l) = width of the rim(b)
d=2+(2×144)=288

=290mm

b=10.22mm

5) Dimensions of key

The standard rectangular sunk key element for a pole with a diameter of 144 mm is as follows

Widthofkey (w)=40mm-----------------(DDBNo.5.1)

Thickness of key (t) =25mm

Give us now a chance to check the all out worry in the edge which ought not be more prominent than 14Mpa

we realize that complete worry in the edge =15536912

Ball Bearing:

We know that L= 288

From equation (L) =288

C=P×L= 1000 × 288

C=6603.85 N

Alternatively it can be found by using graph in fig 5.8 or PSG DB 4.6 (for 6000hrs and 1250rpm draw horizontal and vertical lines which will meet at C/P ratio 7.61)

C/P=7.61

C=7.61×P=7.61×10000 = 76100 N

Flywheel:

Diameter of flywheel (d) = 450mm=4.5m

Mass of the flywheel (m) = 15Kg

(N=8000rpm)

Velocity of flywheel

$V = \frac{\pi DN}{60} = \frac{\pi \times 4.5 \times 806}{60} = 188.4$ m/s

E, energy = $\frac{1}{2} m v^2 = \frac{1}{2} \times 5 \times (188.4)^2$

E=88,736.4 J

C. Design Of Bearing

LOAD (P) = 5000N

Life (L_H) = 3000hr

Speed (n) = 150rpm

Calculation:

We know that (L)=$60nL_h/10^6$

=$60*150*3000/10^6$

L=27million revolution

We know that (L) =$(C/P)^b$

(b=3 for ball bearing)

(c/p) ratio taken from --------------------(DDB book is 3.36)

(c/p)=3.36

C=3.36*5000=33600N

Greater value c is taken for safe design.

D. Kinetic Energy Calculation

E=1/2 $I\omega^2$

Where,

I=Moment of inertia

ω=angular velocity rad/sec

formula:-

I=πD/64

ω = πDN/60

Where,

D-diameter of flywheel in 200mm

N-speed in 1500 rpm

Therefore kinetic energy E= 308.505Joules

E. Conventional Bicycle Performance Calculation

It means without flywheel attachment

i) Average speed:-

Speed= distance/time

Distance =15.5 km

Time=1hr

Speed= 15.5kmh

F. Flywheel Bicycle Performance Calculation

It means with flywheel attachment

i) Average speed:-

speed = distance/time

distance = 17.5km

time= 1hr

speed= 17.5kmh

IX.ANALYSIS

A. Weight And Performance

Vitality space limits increase with weight increase but restriction is the speed of the flywheel. The execution of the framework is also legally linked to the put away vitality. A diagram can be plotted between execution and weight in this way. Ideal esteem lies in the 5 and 8 kg range somewhere.

Stored energy in the flywheel, = 1/2 $I\omega^2$

I - the moment of inertia

ω - rotational velocity (rpm)

Moment of inertia, I =

K is inertial constant (depends on shape)

M is mass of the disc

r-is the radius

Consequently, it correlates directly to the weight of the ring. Exhibition versus weight diagram is appeared in figure 10 and the correlation of weight of customary and flywheel bike appeared in fig.

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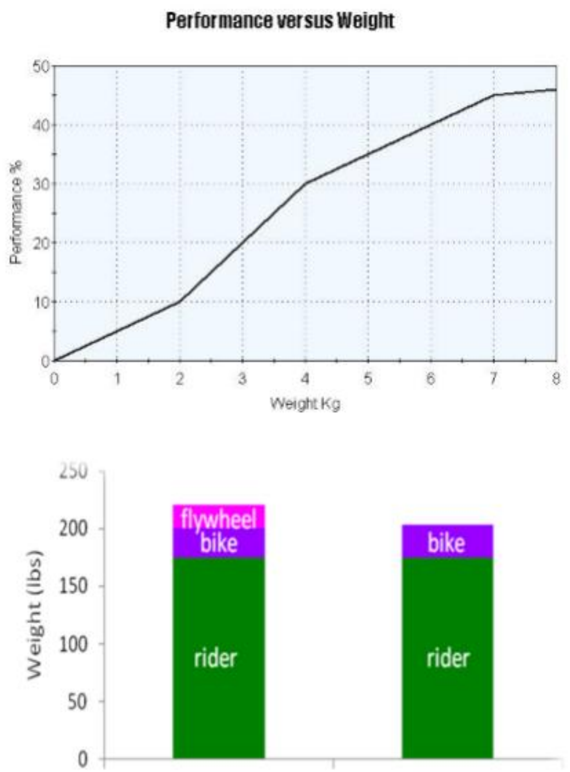

Fig. 10. Performance vs Weight

X. COMPARISION ANALYSIS

The sum of the energy of drag and acceleration is shown in the fig in black. The total input of pedal power is the sum of the pedal power output area. Since, over time, energy is an integral part of control. Therefore, the rider on the flywheel bicycle uses less energy than the rider on the conventional bike. This is shown in figure 11 below.

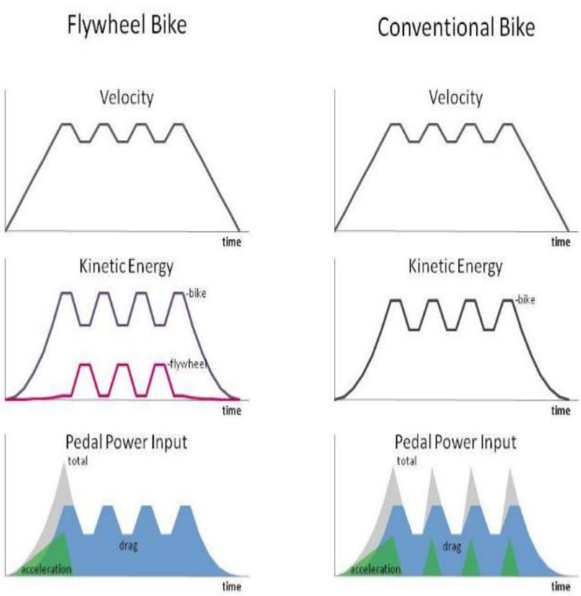

Fig. 11. Comparison analysis

b. Overdrive Test

The experimentation was over again completed by traversing cycle with flywheel joined from 10 m side.

Table 9.1 Traversing Cycle

Number of trials	Distance covered	
	Flywheel engaged	Flywheel disengaged
1	10 meters	11.60 meters
2	10 meters	11.76meters
3	10 meters	11.72meters
4	10 meters	11.86meters

Figure 9.3 Flywheel bicycle

XI. CONCLUSION

It is proven experimentally that the system could recover around 30 percent of energy. Through this methodology, energy savings have further scope for future development. The moving parts are also less so the loss of friction could be minimized as well.

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