Fabrication and Testing of Non-Conventional Solar Vehicle

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***Abstract*:-The locomotive in our country mainly runs on electrical energy or by conventional resources such as petrol, diesel, coal etc. So with the help of solar energy we can run the locomotive or any vehicle.**

Composition of two different drives based locomotive that is solar power and conventional drive system is possible. Here the solar energy is converted in to the electrical energy by using solar panels and then used for the needs. Revolutionary changes have taken place in the life of the mankind since human beings acquired the capability of walking upright.

In solar power locomotive solar panels are fitted on the roof of locomotive. The battery gets charged by solar energy and power is transmitted to the drive mechanism. Now we can measure the speed and efficiency of locomotive. Here we are going to use hydrogen peroxide as energy to run the train when solar energy isn't available.

I. INTRODUCTION

A non-conventional solar train which works with the help of solar energy efficiently and saving electrical energy and making maximum use of solar energy.

The trains in India are mainly driven by conventional power sources. So to save conventional sources we can use non-conventional sources such as solar energy for trains.

The solar energy is absorbed by solar panels fitted on the roof of the train. The energy gets stored in the battery available in the system.

When solar energy is not available we are going to run the train with the help of Hydrogen Peroxide.

The solar energy is generated by solar panels on upper part of the train such that the energy is conserved and used irrespective of the motion of the train.

Solar energy based locomotive works efficiently and effectively such that loss of energy can be decreased.

Sometimes it is not possible to use solar energy, so in such circumstances we can use other energy sources such as Backup D.G. set, Fuel cell, Flywheel, Use of hydrogen peroxide powered engine, etc.

II. LITERATURE REVIEW

Solar Energy Train

The utility model belongs to a solar energy train, and solar-cell panels are installed at the top of each train coach. Ceiling area of each train coach is large so that when the solar-cell panels are installed in all the train coaches, the solar-cell panels can generate enormous electric energy due to lighting effect. The electric energy can supplement partial electricity consumption of the train and reduces electric power consumption, and accordingly reduces transportation cost of the train and ticket price of high-speed trains, increases passenger load factor.

The utility model relates to a solar energy self-generation train which comprises a carriage, wheels, solar panels and accumulator jars, wherein the solar panels are installed on the top of the carriage of the train, which can absorb solar energy in nature and transform the solar energy into direct current power to be stored in the accumulator jars for the lighting of the carriage of the train while the train travels.

The solar energy self-generation train has developed the technical characteristics of saving electric power consumption of the train, has high efficiency, energy conservation and environment protection.

A solar energy vehicle which comprises a vehicle body, a lifting bracket, a rotating device, and a solar panel, wherein the lifting bracket is fixedly mounted at the top of the vehicle and can ascend to the outer part of the top of the vehicle; the rotating device is mounted on the bracket and can automatically rotate to track the sun; the solar panel is mounted on the rotating device and can be unfolded telescopically; the telescopically-unfolded solar panel is in transmission connection with a drive motor through a transmission mechanism.

According to the utility model, when the vehicle is moving, the solar panel can be folded to be stored in the vehicle top, so that the area is reduced and the resistance is reduced, the attractiveness in appearance and the driving safety are not influenced.

When the vehicle stops, the solar panel can be fully unfolded, and the area of the solar panel is enlarged to three times of the area of the vehicle top, so that the receiving area of the solar panel is enlarged; besides, the solar panel is vertical to the sunshine, and tracks the sunshine, so that the electricity generating capacity of solar energy is improved.

Hydrogen peroxide fuel cell Passage the molecular hydrogen to a reaction region is impeded with a proton exchange membrane and passage of the hydrogen peroxide to the reaction region is impeded with an ion-selective arrangement.

Electric potential is generated between the anode and the cathode to provide electric power from a reaction of the hydrogen ions and the hydroxyl ions in the reaction region. In one variation, a regeneration technique is also provided.

III. MAIN PARTS OF TRAIN

3.1 Battery:-

Here battery is used to store energy that is obtained from the solar panels available on the roof of the train. We are going to use 2 batteries of (6V 10Ah) in the project model.

We can obtain 14watts power from solar panels so 12watts energy can be stored in the battery. There would be 2 watts power loss when energy is stored in battery from the solar panels

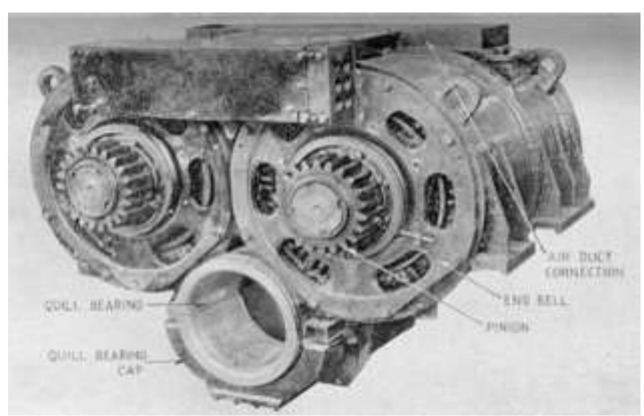
3.2 Solar Panels:-

Solar panels are fitted on the top of the train so solar energy can be consumed from sun. We can obtain 14watts power from the solar panels. The power obtained from the solar panels is stored in the battery.

3.3 Drive Control:-

The power stored in battery is transferred to the drive control and driver controls the drive control of the train. The drive inputs are given in the drive control of train.

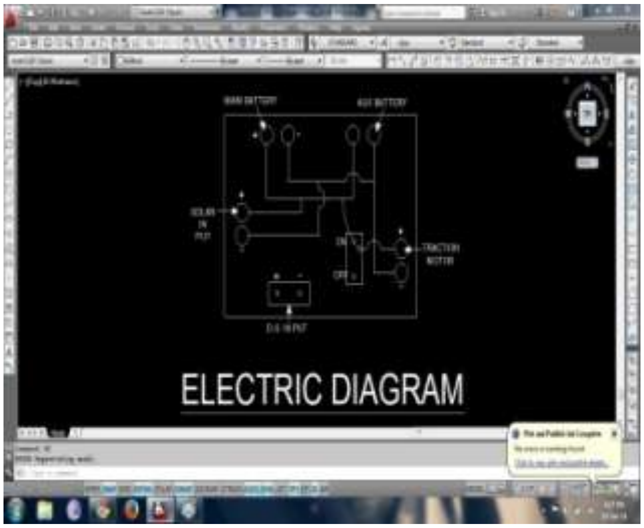
3.4 Traction Motor:-



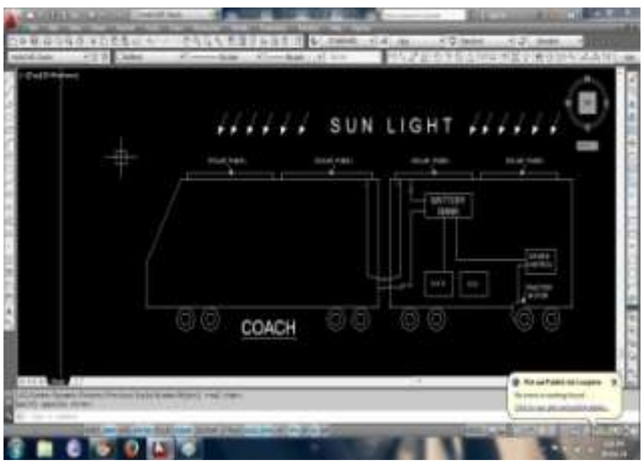
The traction motor is of 12V.Traction motor is used to drive the train and gives motion to the wheels of the train.

IV. DESIGN OF SOLAR TRAIN

4.1 Electric diagram:



4.2 Design of engine and coach.



V. CALCULATIONS FOR TRAIN

Tractive effort:-The force which a locomotive can exert when pulling a train is called its tractive effort, and depends on various factors. For electric locomotives, which obtain their power by drawing current from an external supply, the most important are:

WEIGHT:- The adhesion between the driving wheels and the track depends on the weight per wheel, and determines the force that can be applied before the wheels begin to slip;

SPEED:- Up to a certain speed, the tractive effort is almost constant. As speed increases further, the current in the traction motor falls and hence so does the tractive effort.

To characterize the power of their locomotives, manufacturers measure tractive effort as a function of speed. Tests are often performed with the locomotive stationary but resting on rollers, thereby avoiding the effects of air resistance and any imperfections in the track.

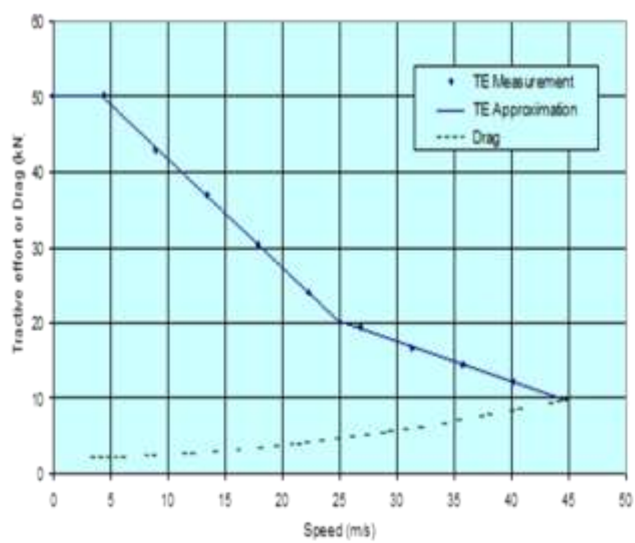
$$
\begin{aligned}
P(v) &= 50000 && [0 \le v < 4.2] \\
&= 56100 - 1440v && [4.2 \le v < 24.9] \\
&= 33300 - 525v && [24.9 \le v < 45],
\end{aligned}
$$

Where P= tractive effort in newtons,

V=speed in meters per second

This is shown as a solid line in the figure.

Figure 1
Tractive effort and drag as a function of speed



5.2 Drag:-

Inevitably, a moving train exerts a drag on the locomotive propelling it. This force, which opposes the motion, comes from a variety of sources, the most important being friction in the axle bearings, air resistance, and resistance from the rail as the wheels roll along it.

Railway operators estimate drag from experiments which measure the force needed to keep a train moving at a constant speed. Polynomials can again be used to approximate the variation of drag with speed, and it is generally agreed in the railway industry that a quadratic function often suffices over the full range, although the coefficients used will vary from railway to railway and with train type. As an example, the drag might be given approximately by:

$$Q(v) = 2000 + 20v + 3.5v$$

Q = drag in newtons, v= speed in m/s.

This is shown as the dashed line in Figure 1.

5.3 Brake Force:-

The brake force available depends on two factors:

1.The adhesion between the rail and the wheels being braked, and2.The normal reaction of the rail on the wheels being braked (and hence on the weight per braked wheel).Generally, it is specified as a fraction (ß, say) of the total weight of the train: A typical value for ß is 0.09

$$B = mgß$$

5.4 Train Dynamics:-

- The dynamics of a train moving with speed v along a track inclined at an angle to the horizontal are determined by the forces shown in Figure 2.
- Here,
- P(v) is the tractive effort of the locomotive;
- Q(v) is the drag;
- B is the brake force;
- mg is the weight of the train;
- N is the reaction of the track.
- By Newton's second law of motion, the acceleration f is given by:

$$mf = P(v) - Q(v) - B - mg \sin \alpha$$

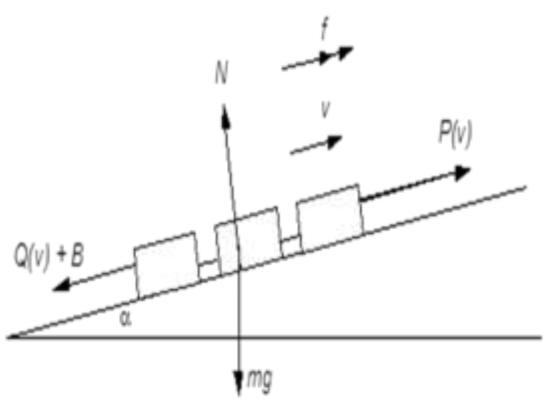


FIGURE 2
Forces acting on train
On a track with inclination

5.5 Braking Distance:-

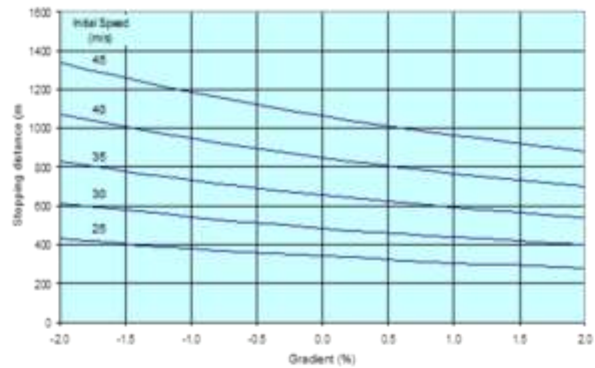


Fig 3 Stopping distance as a function of Gradient for a range of initial speeds

VI. SPECIFICATION AND DATA OF PRESENT TRAINS

Air break.

1200vdc @ 8000Amps (Diesel Electric Multiple Unit).Speed 120 km/hr.

3000 HP Traction motor.

V=1200

Current Amps=8000Amps.

Generator D.C

1400 vdc.

9000 Amps.

Power = 126 MW

VII. CALCULATIONS OF SOLAR TRAINS.

These calculations are applicable on practical model of train only.

7.1 Equations for Calculations:-

POWER required moving a train:-

P= TS/375

Where,P= hp (horse power), T= Tractive effort

S= speed (miles/hr.)

Energy = Force * Distance

Power = Energy / time

Power = Force * (distance / time)

= Force * speed

Typical DC loco HP = T * (speed/308)

Continuous tractive effort:-

T = V * F

Where,

P = power (watt)

V = velocity (m/s)

F= Force (Newton)

Axle Load = Weight/ no of axles.

7.2 Calculations of our model:-

SOLAR PANELS = 20 watts.

BATTERIES = 18 watts

There is 3 watts power loss.

MOTOR POWER REQUIRED = 6 * 2= 12 watts

Battery is of 6 volts.

Speed= 40to60 km/hr.

Current = 0.400 amps

Voltage = 6 volts

VIII. CONCEPT OF HYDROGEN PEROXIDE (H_2O_2)

8.1 Introduction:-

When solar energy isn't available for the train we can make use of hydrogen peroxide to run the train.Hydrogen peroxide is filled up in a container which is concentrated up to 60-98%.

The fluid enters the pump present in the system which passes through a solenoid valve. We can generate gas which is up to 370˚CThe fluid then passes through the Gas generator which contains potassium permanganate pellets in it. Then gas is generated from it and gas goes to turbine. Furtherthere are two pulleys connected to turbine, big pulley and small pulley. Now the generator attached to pulley gets power and we can run the traction motor attached to it.The main exothermal reaction takes place over here:

The overall speed of train is up to 0-10 km/hr.

IX. MAIN PARTS AND DESCRIPTION

9.1 PELTON WHEEL-IMPULSE TURBINE:-

It is impulse, tangential flow, high head and low specific speed turbine.

9.1.1 Main parts:

- Nozzle
- Runner and buckets
- Casing
- Breaking jet
- Penstock

Calculations:-

- Velocity of jet = $Cv\sqrt{2gh}$
  - Where Cv= 0.98-0.99
- Velocity of wheel, u=$Ku\sqrt{2gh}$
  - Where Ku=0.43-0.48
- Angle of deflection Φ=165˚
- Mean diameter, D= $\frac{60u}{\pi N}$
  = 150mm
- No of blades = 4
- Material of turbine = steel
- Speed of turbine, N = 500 rpm

9.2 CENTRIFUGAL PUMP.

9.2.1 MAIN PARTS:-

- Impeller
- Casing
- Suction pipe with foot valve and a strainer.
- Delivery pipe.

9.2.2 LOSSES:-

- Hydraulic losses
- Mechanical losses
- Leakage losses

9.2.3 EFFICIENCES:-

- Mechanical efficiency
- Manometric efficiency
- Volumetric efficiency
- Overall efficiency

9.2.4 SPECIFICATIONS:-

- Diameter of pump,
  D = 150mm
- No of blades = 4
- Speed of pump ,
  N= 500 rpm

9.3 GAS GENERATOR:-

There pellets present in the generator where hydrogen peroxide reacts with the atom is used to convert the hydrogen peroxide pellets of potassium permanganate. The temperature of steam generated is of 370˚C in gas generator.

9.4 SHAFTS:

Shaft is used to connect turbine and pump.

Dimensions:-

Diameter = 100mm

Length = 200mm

9.5 PULLEYS:-

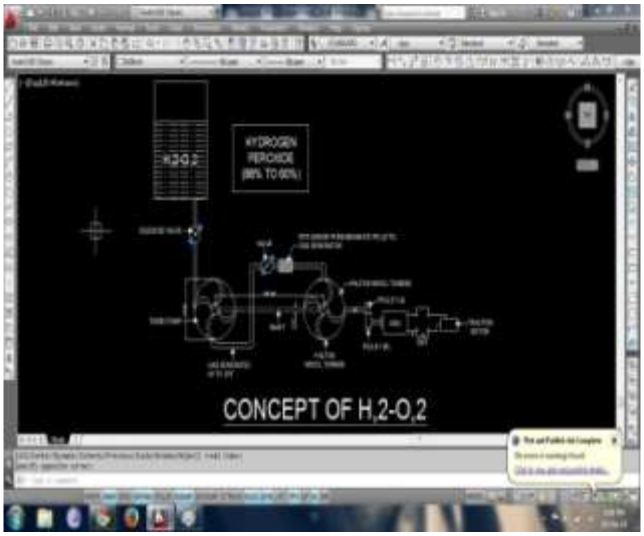
Two pulleys are used over here,

Big pulley of diameter, d1 = 70mm

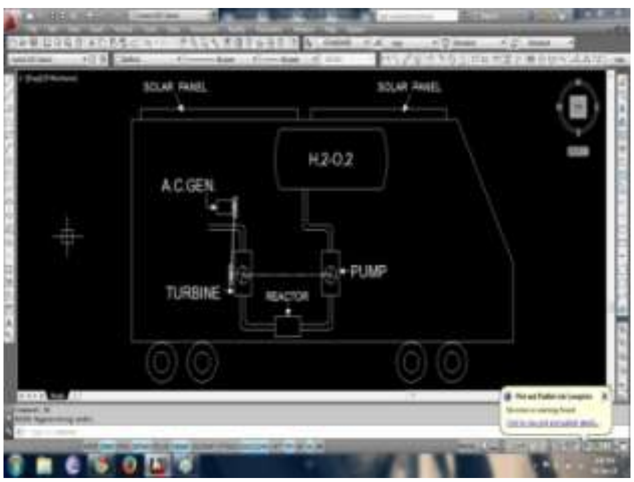
Small pulley of diameter, d2 = 30mm

X. DESIGN

10.1 Design with concept of hydrogen peroxide.



10.2 Design of hydrogen peroxide in train



XI. MAIN DESIGN OF MODEL

XII. CONCLUSION

A solar energy based train is designed which saves almost conventional sources of energy. Solar train is pollution free and eco- friendly Maximum use of solar energy can be done. Hydrogen peroxide can be used to run the trains when solar energy isn't available.

We can conclude that solar train is a modern and modified concept. We can get efficiency, better speed, and better facilities with the help of solar train and train running with the help of hydrogen peroxide.

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