POWER GENERATION USING PERMANENT MAGNETIC GENERATOR THROUGH BRAKING SYSTEM FOR TWO-WHEELER.

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Abstract: In contrast with the past, lot of companies are trying to make a successful electrical vehicle but they cannot. The main elements of electrical vehicles are the battery and their charging systems. We have tried to increasing the source of battery charging in two-wheeler. This paper gives the clear understanding of Permanent Magnet Generator system used in two-wheeler to charge the battery with the help of braking system. By using magnets and stator coil setup which assembled in rear wheel of two-wheeler. When brake applies the permanent magnet generator system activates and will produce electrical energy used to charge the battery. The Permanent Magnet Generator is light in weight, easy to handle and low cost, hence it has wide application in two wheelers.

Index Terms - **Braking, Permanent Magnetic Generator (PMG), Rear wheel, Battery charging.**

I. INTRODUCTION

In the society, the word energy is used as a synonym of energy resources, and most often refers to substances like fuels, petroleum products and electricity in general. These are sources of usable energy, in that they can be easily transformed to other kinds of energy sources that can serve a particular useful purpose. The world however is facing a crisis in energy resulting in low supply, increasing costs and a great inconvenience to those who depend on electricity for their heating, ventilation and water supply. Permanent magnet generator has been used for wind turbines for many years. Many types of generator concepts have been and proposed to convert wind power into electricity. Permanent magnet generators are highly efficient, robust and reliable. There is no need of external excitation. The field winding losses are eliminated from the rotor. The availability of high energy density magnets such as neodymium-iron-boron (ndfeb) allows the design of a generator required by direct coupled saws. In electromechanical energy conversion, employing generators and motors play a crucial role in energy consumption and production. For this reason, the improvement of efficiencies in generators and motors is more crucial in the battle against climate change and increasing energy requirements. Electromechanical power conversion based on permanent magnet technology is inevitably when energy efficient solutions for generating and motoring are considered. Sophisticated energy conversion technologies with permanent magnets also make it possible to create a new conversion instruments for competitive distributed energy technology. Permanent magnet has been used industrially since the invention of the first carbon steel permanent magnet materials in the beginning of the 20th century. Permanent magnet motors are a well-known class of rotating and linear electric machines used in both motor and generator. Permanent magnet machine has been used for decades in applications where simplicity of structure and a low initial cost were of primary importance. One of the most efficient ways of recovery of energy lost during braking mechanism of vehicles is power generation through braking system. In this braking system, the energy lost in form of heat during braking is stored in the form of electrical energy in batteries by using permanent magnet generator.

II. METHODOLOGY

In this arrangement only one magnet plate and stator coil is used for power generation. A two wheeler bike is used. The Permanent Magnet Generator is mounted on the rear wheel of bike. The coil is mounted at some distance from the PMG. The stator plate is stationary and two coils are mounted on it. The fabrication of permanent magnet generator (PMG) is performed on the alloy wheel and it is made to rotate at the same speed as that of the vehicle. While the stator coil is stationary, the number of turns of coil is selected when brakes are applied and disconnect from it when brake is released. It is mounted near on the axle on which the shock – ups are mounted, thus it will moves along with the wheel when vehicle came across obstacles or improper road surfaces. Also the two terminals are taken from the stator coils which are further connected to rectifier. The rectifier is cooled by providing fins at its outer surface by natural air circulation. Mechanism will come into action only during braking of the vehicle. Thus energy during braking system is recovered to some extent which is either lost in the form of heat.

III. ENERGY CONVERSION MECHANISMS

A Permanent Magnet Generator can be used to convert the mechanical energy pulse to electric form with the help of the electromagnetic effect .Thus converting the magnetic form of energy into electrical forms is not plausible. The Permanent Magnet Generator stator contains 2 coils of copper wire. The coils will be wound on a plywood coil former. The former is mounted on the end of a crankshaft, between cheek pieces.

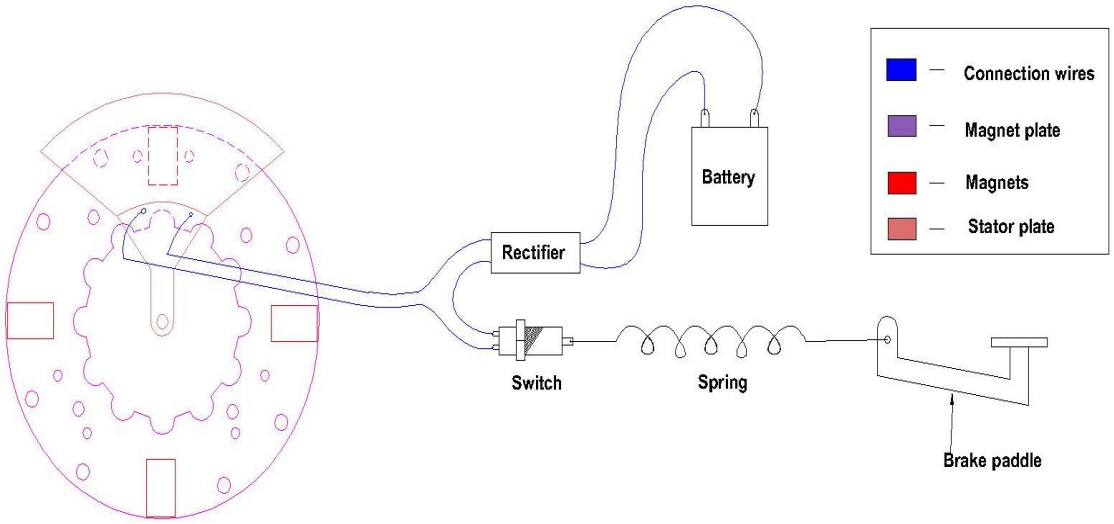

Figure 1 Schematic diagram of coil operating mechanism.

Coils are the very crucial part in design. Number of turns and wire size decides flux linkage and hence the voltage and current developed. The important formula is studied to calculate the voltage developed.

$$E=B \times l \times v$$

B = magnetic field intensity (Tesla)
l = length of coil i.e. No. Of turns (meters) =n × l1
v = speed (m/sec). = 2× π × n × r / 60
It can be converted to,

$$e = B \times 2 \times \pi \times n2 \times r \times l1 / 60$$

n = RPM
r = pitch circle radius of magnets positioned.
L1 = inner length/least length of coil.
Also the number of coils selected by using the following formula,

$$n' = N \times (M / 2)$$

n′ = number of coils
N = phase selected (1Ø or 3Ø)
M = Number of magnets used

Determining the number of turns of coil:

$$n = \frac{DCV * 19}{(A * B * rpm)}$$

Where, A = Area of all magnets.
B = Magnetic strength (flux density) in tesla.
DCV = DC output voltage.
N = number of turns of coils.
A = 40 * 25 * 4 = 0.004 m2 B = 1 tesla
Expected rpm = 100
Expected DC voltage = 7V
Therefore,

$$n = \frac{7 * 19}{(0.004 * 1 * 100)}$$
$$= 333.$$

Hence, the numbers of turns of coil selected are 333 and more. The 7V output is selected because to charge a 6V battery output more than 6V is required. The circular disc type magnet plate is 3mm thick, 134mm inner diameter and 274mm outer diameter. The inner diameter of disc is selected with closer tolerance with outer diameter of the brake drum on which it is mounted. Outer diameter is selected according to stator plate holes provided for increasing heat transfer. Coil former is a setup used to wind coil on the square block. Use of coil former removes any possibility of error or deviations from the desired coil dimensions. It consists of two H-shaped blocks as shown in the figure. Between the two H-shaped blocks is held the rectangular block on which coil is to be wound. The inner hole in coil when it is completely wound should be equal to the magnet size. This in other way implies that the rectangular block to be placed between two H-shaped blocks should be of the magnet size. Its edges are slightly chamfered so that it will not damage enamel of magnet wire while winding the coil. All the three blocks are bolted to a wooden strip which acts as a supporter. Then handle is fixed to the same bolt at the end to facilitate the rotation of the coil former.

Three blocks are fixed to each other by two separate bolts. The slot of 1 mm is provided in the square block at two opposite faces which allows holding coil firmly with cello tape once it is removed from coil former. Now the coil former setup is ready for winding the coils. Initially, all the blocks were made from plywood. A coil was wound and H-shaped blocks were removed. Even though coil was held together with cello tape coil wire at the corners were distorted which would not have permitted to minimize the distance between magnet plate and stator to paper gap. Stator is stationary part in the mechanism. It consists of stator plate. Stator plate is circular in shape and it consists of 2 coils having different number of turns. The following operations are performed on stainless steel

raw material to manufacture the required size plate: Cutting: The rectangular stainless steel plate of dimension 6" × 24" is cut into required shape by using turning operation. Pressing: The center portion of stator plate is pressed into required curve shape by pressing operation. Welding: The final manufactured parts are assembled by using gas welding operation. Grinding: Then the sharp corners are removed by using grinding operation.

Figure 2 Actual photograph of Stator Coil

The magnet plate must be flat, not warped. It is not easy to cut the outer circle without warping the plate. The circular disc type magnet plate is 3mm thick and other dimensions of the disc are,

Inner Diameter (I.D.): 134mm

Outer Diameter (O.D.): 274mm

The inner diameter of disc is selected with closer tolerance with outer diameter of the brake drum on which it is mounted. Outer diameter is selected according to stator plate.

The actual magnet plate is obtained by using the following manufacturing processes:

Turning: The raw material is first cut into circular shape of required dimensions by using turning process.

Shaping: It is used to manufacture the slots on plate for the fixation of magnets. The slots are made of grooves of dimensions of the magnet.

Milling: The grooves are further cut to close tolerances on milling machine.

Facing: The extra thickness of the magnet plate is removed by using the facing operation.

Grinding: It is the final operation performed on the magnet plate to remove the sharp edges and unwanted material from the plate.

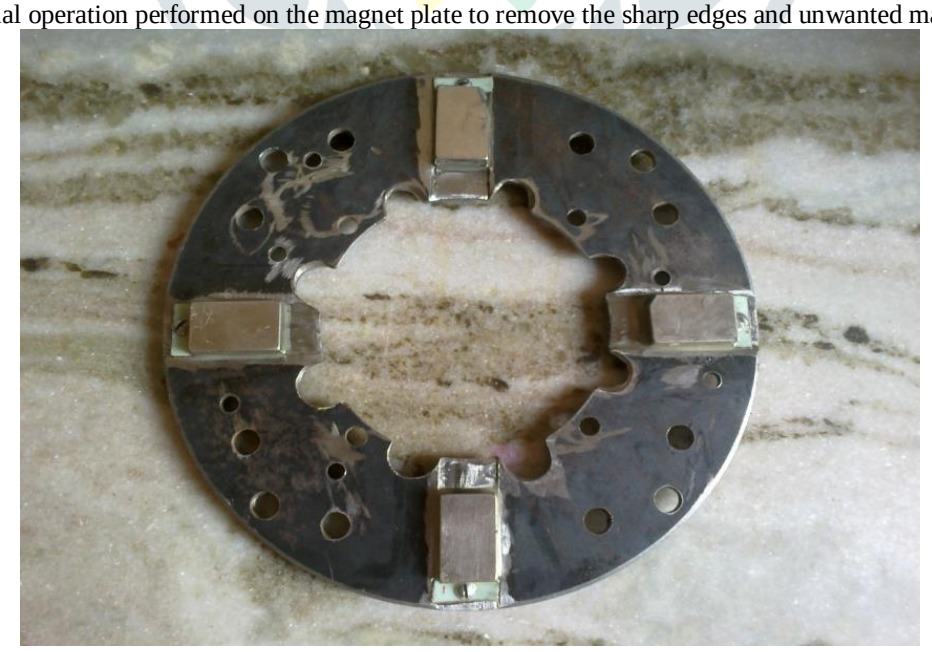

Figure 3 Actual photograph of Magnetic Plate

IV. RESULT

4.1 For 925 turns:

Table 1 Results for 925 Turns

Speed (KMPH)	Voltage (with no load)	Voltage (with load)	Current / Coil (mA)
10	10	7	20
15	12	8	22
20	15	10	26
25	18	12	29

4.2 For 1100 turns:

Table 2 Results for 1100 Turns

Speed (KMPH)	Voltage (with no load)	Voltage (with load)	Current / Coil (mA
10	12	10	22
15	13	11	27
20	17	13	27
25	20	16	30

4.3 For series combination:

Table 3 Results for Series Combination

Speed (KMPH)	Voltage (with no load)	Voltage (with load)	Current / Coil (mA
10	13	11	32
15	18	16	50
20	23	21	60
25	27	24	71

V. CONCLUSION

Stronger magnets of N47/50 grades are also available that produce field strength three times more than those used. It can still improve the performance. Using more number of turns can produce more voltage and increase resisting torque which in turn increases braking capacity, generating more power at improved efficiency. Also for more effective braking torque, a coil of lower gauge size can be selected which can carry more current.

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