ACTUATING SYSTEMS (MTS 231)

ELECTRIC GENERATOR

PROJECT REPORT

GROUP MEMBERS:

- Mohamed Nalim Reg # 398504
- Muhammad Waseem Irfan Reg # 394774
- Saad Ahmed Reg # 398332
- Adil Ali Reg # 373073

Submitted to: LE Hafiz Umar Aslam

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PROJECT TILE:

Electric Generator.

REQUIRED THINGS:

- DC Motor (used as mechanical energy source)
- Strong Permanent Magnet
- Small PVC Pipe
- Cardboard
- Pen Cover
- Commutator
- Connecting Wires
- Copper Wires

INTRODUCTION:

The mini electric generator is a device that converts mechanical energy into electrical energy. It typically uses a generator for electricity production and a mechanical energy source for movement for the generator. This device is often used to teach the principles of energy conversion and electrical energy generation. In this course project, we have designed and constructed a miniature electric generator by using a DC motor as a mechanical energy source to power small DC devices.

METHODOLOGY:

In the construction procedure of this miniature electric generator, we have made use of many types of scrap material. The actual procedure in which we have constructed this generator is as follows:

•We cut out a large piece of cardboard and used it to make a base for our entire mini electric generator contraption.

•Then we used another circular piece of cardboard and used attached it to the base to place magnets inside it and established a stable and radial magnetic field.

•We took a DC motor to be used as the mechanical energy source of our contraption.

•We took a commutator from a discarded DC motor and attached it to the armature we constructed.

•We constructed the armature by using a piece of PVC pipe, cutting it in such a way that it resembles a three loop armature and we wound copper wires around the armature frame to make the three loop armature.

•Then we used the pen casing to be used as the shaft that would connect the DC motor with the generator.

•We also had connected the DC motor to a power supply to power it and then the DC motor powers the generator.

CALCULATIONS:

- Commutator Segments:
  The number of commutator segments used in our design is 3. The commutator segments are responsible for reversing the current flow in the coils, ensuring a continuous output of electrical energy.

- Coils:
  We have incorporated 3 coils in our electric generator. Coils are essential components that generate the magnetic field necessary for the conversion of mechanical energy to electrical energy.

- Conductors:
  Considering that each coil consists of multiple conductors, we have a total of 3 conductors. Conductors play a vital role in facilitating the flow of electrical current within the generator.

- Parallel Paths:
  Each loop in our generator has 150 parallel paths. Parallel paths increase the overall output current of the generator, thereby enhancing its efficiency and power output.

- DC Motor RPM:
  Instead of relying on mechanical torque, we have connected a DC motor capable of producing 60,000 revolutions per minute (RPM). The high RPM of the motor ensures a rapid rotational motion, providing the necessary mechanical energy input for electricity generation.

- Poles:
  We used wo poles here in our case which is two permanent magnets with one north pole and one south pole.

- Simplex Wave Winding:
  We have employed a simplex wave winding configuration for our generator. In this winding arrangement, each coil is connected in series with adjacent coils, forming a continuous loop. This configuration enables a smooth and efficient distribution of electrical current throughout the coils.

- Commutator pitch:
  Distance between commutator segments to which two ends of same coil connected. Here our commutator pitch is 2.

These calculations highlight the key parameters and design choices incorporated into our electric generator. They serve to provide a quantitative understanding of the various components and their roles in achieving optimal energy conversion and electrical energy generation.

$$\text{commutator pitch } (Y_c) = \frac{2(c \pm 1)}{p}$$

; where $c \Rightarrow$ Number of coils.

$p \Rightarrow$ Number of poles

DISCUSSIONS:

There are several ideas for improving the analyzed design of the robotic arm. One approach could be to incorporate sensors and feedback mechanisms into the design, allowing for more precise control over the arm's movements and can fix the motors to perform automatically. This could also enable the arm to automatically adjust its movements based on the weight and position of the object being lifted. Additionally, implementing a more lightweight and durable material, such as carbon fiber or titanium, could improve the overall efficiency and longevity of the arm. Another potential improvement could be to incorporate more degrees of freedom into the arm, allowing it to move in a wider range of directions and perform more complex tasks. Finally, incorporating machine learning algorithms could enable the arm to learn and adapt to different tasks over time, further increasing its versatility and usefulness.

CONCLUSION:

While theoretical values are calculated using mathematical models or formulas. Therefore, there are some discrepancies between the two due to various factors such as measurement error, material properties, and assumptions made in the theoretical calculations. Additionally, experimental values are subject to external factors that may not have been accounted for in the theoretical calculations. And also practical values doesn’t consider the assumptions that we made. However, a good comparison will take into account the sources of error and uncertainties associated with both sets of values and identify any discrepancies that may require further investigation or refinement of the theoretical model. Ultimately, a good understanding of the comparison between experimental and theoretical values will lead to improved accuracy and reliability in future designs and analyses.

REFERENCES:

We followed a YouTube video to make our generator. The video linked,

(https://youtu.be/Scaggwv8Cms)

likely served as a guide and source of inspiration for the project. By following the steps outlined in the video, we was able to build a functional electric generator that met our desired specifications.

Appendices:

Figure 1 (Armature frame)

Figure 2 (Complete armature)

Figure 3 (completed mini generator contraption)