

Electrical Power Generation from Revolving Door

Mr. Shivakumar R.V⁽¹⁾, Mr. Mohd Zaid⁽²⁾, Mr. Siddhant Kumar Singh⁽³⁾, Mr. Saurabh Yadav⁽⁴⁾ and, Mr. Mohammad Anas⁽⁵⁾

(1) Assistant Professor, (2) Student Department of Mechanical Engineering
JSS Academy of Technical Education Noida

Abstract: Menial world requires a lot of energy in different phases to run their livelihood. So this factotum describes the conversion of muscular energy into mechanical energy which can be again converted into useful electrical energy. The renewable energy and some unconventional source of energy also provide reinvigorate economy for climate stabilization and reduce the consumption of fossil fuel. The main goal of this project is to design & fabricate a miniature revolving door which can generate energy by amplifying the initial RPM of door shaft that harnesses human motion and change it as electricity.

Keywords: Energy Generation, Dynamo, Gear, Pinion, Revolving Door.

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I. Introduction:

All aspects of life are surrounded by energy, the ability to harness it and use it for constructive ends as economically as possible is the challenge before mankind. Energy produced from the conventional sources like coal, natural gas, furnace oil, high speed diesel, etc., are responsible for producing gases like CO₂, NOX, SOX, etc. that causes global warming. Also, its sources are consumed much faster than nature can create them. Beside conventional sources of energy, there exist many alternative renewable energy sources. The interest in this field of study comes from the undesirable effects of pollution, both from burning fossil fuels and from nuclear waste byproducts. The possible renewable energy sources are solar, wind power, geothermal, tidal and hydroelectric. In 2030, the world energy consumption will be 721.5 quadrillion. It is a challenge to meet up such huge amount. Also environmental pollution creates problems because of the excessive use of fossil fuel. Renewable energy such as solar energy, wind energy, energy generation from vibration by using piezoelectric materials seems the best solution to overcome this problem.

However, revolving door can be used as a new source of energy. That not only saves energy, but also generates energy with every person passing the door. The door uses a generator that harvests the kinetic energy when the door spins and a battery to store the energy and provides a consistent supply for the low energy LED lights. The objective of this project is to construct a revolving door model and to develop a mechanism to increase the speed of the shaft connected to DC motor and to store and find out the energy generation per revolution.

II. Literature Review

Aniket M. D. et al., The energy which is going waste one or the other way can be utilized to generate power using simple mechanism. As today's world is completely dependent on different types of energies and these energies are going to disappear or exhaust one or the other day so we need to use free energy in order to run our basic appliances which require electricity for its working. The power generation of this designed revolving door depends on shaft RPM of the door and frequency of people passing through the door. By this arrangement, the maximum output power is obtained about 4 volts at 23 RPM. If it is employed in places of high people movement with proper designing it is possible to generate sufficient power from it.

M. M. Rashid et al., for harvesting energy it has the basic mechanism of a revolving door, consists of a centre shaft with three to four door panels hanging on it. The shaft rotates around a vertical axis within an enclosure. Harnessing energy from revolving doors will not impact the force applied by the user. It is because the currently used revolving doors are also applied with gearing and highly viscous fluid which dampens their spin. Kinetic energy is dissipated in these systems so the door spins within a relatively predictable range of speeds. The difference in this concept is that it would replace the existing mechanisms (fluid or gears) with the internal resistance of a generator. So the energy transferred by people into the door isn't dissipated. Rather, it is captured and converted into useful electrical energy.

Bisoyi B, Das BAs energy is an important factor to sustain industrial growth and standard of living of a country and is relatable to the per-capita energy consumption. The conventional energy sources are diminishing vigorously and in nearby coming era the world will have to depend on non-conventional sources for generation of power. Various types of non-conventional sources are available like solar energy, wind energy, biogas etc. In this method the energy is harvested from human without effecting ecosystem and convert electrical energy with the help of shaft. This shaft is connected to the electric dynamo and it produces electrical energy proportional to persons, more will the people more will be the energy produced.

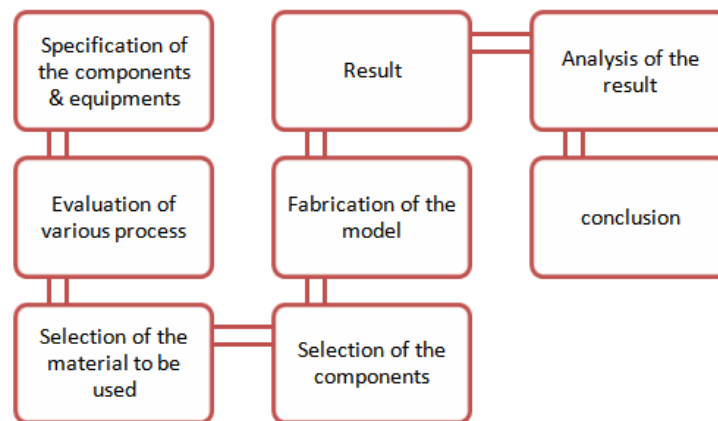
The main objectives of this research work are:

- 1• To fabricate a model of a revolving door.
- 2• To find an inexpensive solution for the generation of electric power in a local community.
- 3• To fabricate a scale-down model of a revolving door there is some limitation while working on this research. The model is a scaled-down version so it can generate voltage only up to 12V only and the fabricated setup is 1/3rd of the actual model so, an average size person cannot pass through it.

Problem Statement:

To produce energy generally fossil fuel are burnt which causes pollution therefore we have to move towards more clean energy generation methods with the help of this project we are producing energy that is clean with the help of human effort. But the contradiction is that the lead acid battery we are going to use is hazardous to nature when disposed off. The CO₂ footprint cannot be reduced to zero.

III. Methodology



Working:

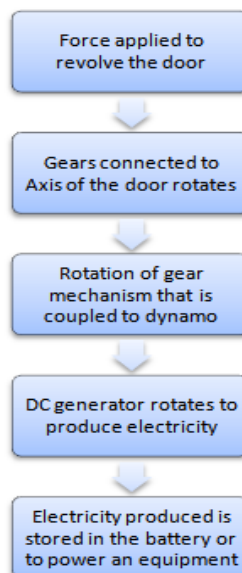
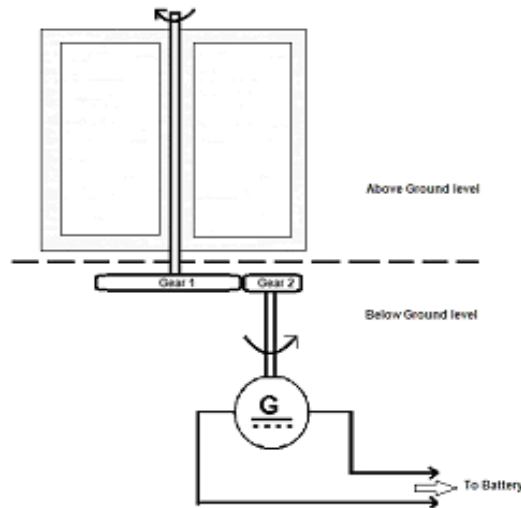


Fig (a): Force flow diagram

The main part of the model consists of:-

1. Revolving door
2. Gear reduction system, and a
3. Generator

The revolving door is constructed to produce energy through gear, pinion and generator arrangement. So it divides the system into two parts. One is the typical revolving door part which is above the ground level and energy generation and storage part which is below the ground level. The advantage of the later part to stay below the ground level is to minimize Noise. The Figure below displays the working of revolving door.



Fig(b): 2D frame

In the experimental set up, four parts spinning door will be used which is made of steel. The purpose for material selection is to ensure that the frame is able to support the door by making the door lighter than the frame. Another reason for the material selection is the availability of the material itself. The parts are framed by thin mild steel bars and joined by a screw. These bars are welded to a rod acting as the central axis of the door.

The compartment below the revolving door is designed as housing for the gear mesh and the generator. As people use the door, the integrated gears connected to the central axis of door revolve. Due to the gear ratio the rotation given to door has increased by 4 times, which is applied to the motor shaft. A generator coupled with the integrated gears produce electricity, a rechargeable battery is used to store the energy.

Design, Fabrication and Testing:

The theoretically determined dimensions of the setup are:

- Diameter of the door shaft =34cm
- Length of door shaft =130cm
- Diameter of the door panel=53cm
- Height of door panel =119cm
- Gear box height =35cm
- Gear box length =60cm



Mohd Zaid (Student)



Mohammad Anas (Student)



Mohd Zaid (Student)



Fig (c): Revolving Door



Fig (d): Dynamo



Fig (e): shaft

In average, about 20 people enter in crowded mall per minute so, the RPM will be 10. A six gear compound gear train is connected at the bottom of the shaft whose specifications are:

List of Components Required:

1. Dynamo

Material of yoke = mild steel

Quantity = 1

2. Battery

Voltage = 12v dc

Material = plastic

Type = lead acid battery

Quantity 1

3. Spur Gear

Gear 1:

Dia of gear = $\text{Ø}125.3\text{mm}$

No of teeth =96 no

Thickness of the gear =10mm

Gear 2:

Dia of gear = $\text{Ø}31.5\text{mm}$

No of teeth =24 no

Thickness of the gear =10mm

4. Base Frame

Length of frame =470mm

Height of frame =124mm

Weight=15kg

5. Revolving Door

Length of door =200mm

Height of door =600mm

Weight of each panel=5kg

Raw Material for Revolving door:

The materials used in the construction of a revolving door consist of aluminum extrusion, steel tubes, machined steel hardware pieces designed to attach the doors to the structure.

Material Selection for Spur Gears:

A lot of materials can be used for gear manufacturing but there are about three material which are mostly used by the manufacturer for the gear manufacturing and those three materials are as follow

- 1.ASTM A36 Steel
- 2.Molybdenum Steel
- 3.Bronze

Out of the three materials mention above ASTM A36 Steel seems to be the best as it has highest tensile strength with good ductility and excellent wear resistance. ASTM A36 Steel has lowest cost per pound, embodied energy and CO₂ footprint with respect to the other three two materials. ASTM A36 Steel required more energy while machining as compared to the other two.

IV. Result and Discussion:

The total power generated with one rotation of the door is found to be 0.114 watts. So for a complete rotation of the door, there should be an entrance of 4 people. We have taken a case study of a multinational shopping market i.e. Walmart. According to the data provided from the website of Walmart, every day 3500-4000 people shop in Walmart. Let's us take 4000 people as visitors. So, if this door is installed there. These visitors open and close the door. So each person makes a half-turn of the door. So 4000 people will make 2000 turns. So the total power generated per day will be 228 watts. So the power generated per year will be 0.83 MW. But the real system will be three times bigger in size i.e. roughly produce three times more energy. So it will generate roughly 2.5 MW of electricity.

Future Scope:

Due to the effect of global warming, various countries and governments are figuring out ways to minimize pollution, so the need for non-conventional sources of energy is increasing. Power generation in this way is a method of clean energy generation. The setup is not complex and does not require a huge amount of space and can be used in places like big corporate buildings to small houses to harness energy from this mechanism.

V. Conclusion

This project is made with a thought that it provides Green Energy and helps contribute to reducing global warming. With Smoother and noiseless operation by the medium of the revolving door design, Gear, pinion and motor mechanism are used as an energy generation part.

The comparative gain that can be accomplished is the utilization of wasted human energy in doing routine work; this innovation has made it more desirable. This project is designed with the hope that it is very much economical and helpful to many industries, workshops, Institutes, Corporate, etc. This project helped us to know that the energy generated can be done from so many places that we encounter daily.

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