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Development in Energy Harvesting System Using Escalator & Four Way Door Mechanism

Prawesh Meshram, Akshay Kasurkar, Prof. P. V. Pullawar

B.E. Student, Department of Electrical Engineering,J.C.O.E.T. Engineering College, Yavatmal, Maharashtra, India
B.E. Student, Department of Electrical Engineering, J.C.O.E.T. Engineering College, Yavatmal, Maharashtra, India
Assistant Professor, Department of Electrical Engg, J.C.O.E.T. Engineering College, Yavatmal, Maharashtra, India

ABSTRACT:This paper were analyzes the possibility of implementing energy-generating using revolving doors in the mall at which number of people came for their entertainment and for daily needs etc. Nowadays it's like a common thing that to buy smallest product people used to visit the mall as every facility are available there. So in that case most of the time it is happened with owner that he has to face the problem of billing the electricity the economic impact results in a net savings in the operational costs of the building. The objectives of this paper are to design and fabricated of a prototype revolving door which can generate energy using dc by amplifying the initial rpm of door shaft. Personal observations made on mall that has 2 main entry gates and inside also 4 different entry gates for various departments around 5000 people were entering and leaving to mall from morning to evening using these gates sparked our curiosities about revolving door usage on mall. A human pushing on a door increases the rotational kinetic energy of the door.This energy is a result of the inertia of the door and its angular velocity. Different data are taken by applying various conditions despite the rpm in practice. The prototype can produce 4 volts and the total output depends on frequency of people passing through the door. The generated power is store in the batteries which is use to light up the lamps inside the mall also used to drive the motor of escalator which also generate the electricity using dc generator. By this arrangement, the minimum output power is obtained from door nearly 0.84 watts in one revolution and the maximum output power is found about 252 watts in single day and from escalators is 150watts in a day.

KEYWORDS: Energy generation, Gear, Motor, Revolving door.

I. INTRODUCTION

The shopping mall and the airport is the place where there is always a huge traffic of customers coming and going out. The gate never stops moving so there is also a possibility and a chance to generate electricity from the gate based moving mechanism. In many malls there is push gate that means whenever anyone has to enter they have to push the door and the gate opens and it reverse comes through the help of air pressed cylinders attached on the gate for reverse back automatic close of the gates. This leads to loss of mechanical force. And in many other shopping malls there is sensor attached to the doors and they are called infrared sensors when any one enters the sensor detects that someone is coming near the door and the infrared sensor automatically open the door and when the person passes through the door the sensors then close the door automatically this also leads to wastage of electricity because the electricity is used to run the infrared sensors circuit.

We can overcome these losses and can convert mechanical force to electrical energy and the electricity charged through the doors can be stored in the battery. We can also use this technology in railway or airports also where there is huge traffic of people within seconds coming and going. Meanwhile the escalators consist of high voltage three phase motor of high speed and high torque hence large amount of electricity is required to run this. This can be minimizing by the use of dc motor with gear system at the top side and on the other hand we can use the dc generator with the gear system which further generate the electricity.

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II. DESIGN

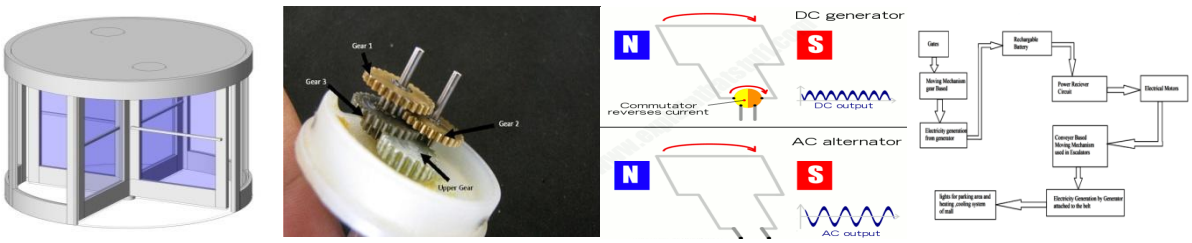
Before starting the design of the prototype, itshould be decided to whether the door needs to have threepanels or four panels. For a user to enter from one side andexit from another for a four panel of door, the door needs tobe rotated at least 180 degrees. As in the case of the three panel door, the user needs to rotate the door which at least 120 degrees to enter from one side and exit from the other. Theoretically, more will rotation gives us more torque in the shaft. Therefore, this design of the revolving door is chosen to be four ofpanels. The rotation comparison between three and four panel type design is given in figure-1

a) b)

Fig 1: a) Rotation Comparisons Between Three and Four Way Panel Design b) Design of Four Way Door

III.CONSTRUCTION OF PROTOTYPE

The design of the prototype was made using AutoCAD and is depicted. The material of the outer frame and the material for the revolving door is chosen to bemetal plates with thickness 3mm. The purpose for material selection is to enhance the capability of the rotating door another reason for the material selection is the availability of the material itself. The compartment below the revolving dooris designed as housing for the gear mesh and the dc generator. The rechargeable batteries are connected with dc generator to store the power. This generated power is been utilized for heating and cooling arrangement inside the mall also inner lamps can light up using this generate power. Anther prototype is of escalators in which we were using dc motor at the top side and one dc generator at the bottom side both machines provided with the gear box to increase the rpm and torque. The three phase motor is to be used inside the escalators because they possess high torque and more rpm as compare to dc motors. So to increase the torque and rpm we are using the gear system attached with the dc motors and generator the constructional block diagram is as shown below
Fig 2



a) b) c) d)

Fig: 2 Constructional Parts: a) Rotating Door b) Gear Box c) Working of DC Generator d) Block diagram of Prototype

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a) **Gates:** the material used for the fabrication of gates is of fibers or plastics which is quite strong and convenient to rotate for the single person. We can also use the metal plates also as per the budget of mall and it is also depend on the number of person entering in the mall or railway of airport where number of people are entering and leaving in single day

b) **Gear box:** a gear or cogwheel is a rotating machine part having cut teeth, or cogs, which mesh with another toothed part to transmit torque, in most cases with teeth on the one gear being of identical shape, and often also with that shape on the other gear. Two or more gears working in a sequence (train) are called a gear train or, in many cases, a transmission; such gear arrangements can produce a mechanical advantage through a gear ratio and thus may be considered a simple machine. Geared devices can change the speed, torque, and direction of a power source. The most common situation is for a gear to mesh with another gear; however, a gear can also mesh with a linear toothed part, called a rack, thereby producing translation instead of rotation.

c) **DC generators**: Just as a simple dc electric motor uses direct current (DC) electricity to produce continual, rotary motion, so a simple dc generator produces a steady supply of direct current electricity when it spins around. Like a dc motor, a dc generator uses a commutator. It sounds technical, but it's just a metal ring with splits in it that periodically reverses the electrical contacts from the generator coil, reversing the current at the same time. As we saw up above, a simple loop of wire automatically reverses the current it produces every half-turn, simply because it's rotating, and the commutator's job is to cancel out the effect of the coil's rotation, ensuring that a direct current is produced.

IV. WORKING PRINCIPLE

The gate in the shopping mall can be used for generating the electricity. The gear box will be attached to the gate and the generator will be attached. When the customer or any person will push the gate the electricity will be produced through the generator attached with the gear base mechanism. The electricity generated from the mechanism will be stored in the rechargeable battery and the rechargeable battery will be used for supplying the electricity to the electrical appliances that is the lights in the shopping malls. The switching circuit will be attached for puttying on the lights.
After that when the customer will come in the shopping mall. When the customer will come near the stairs the transmitter circuit will send the frequency and the receiver circuit will receive and the conveyor belt mechanism will start rotating and the customer will move on the stairs. In this way when the customers will move away from the stairs the conveyor belt will stop.

The mechanical power is given to the door by number of persons passes through it. In that case the dc generator attached with the door covert the mechanical power into the electrical power. The gear arrangement is to beused with the generator to increase the rpm of generator so that maximum amount of power will generate. This generated power is stored in the number of batteries which can be used for the heating and cooling arrangement in the mall. Here one of these supply is given to the circuitry which triggers the infrared sensor in the escalator who work automatically when person come closed to escalator. This circuitry is attached with the dc motor. Through the shaft this dc motor is coupled with dc generator.

Table-1. General specifications of generator

Output voltage	5v-24 v
Output current	1500ma
Speed	120rpm
Maximum load	20 watts
Weight	490 grams

Table-2. General specifications of the gears

Contents	Driver gear	Driven gear
Material	Steel	Steel
Number of teeth	100	20
Ratio	5	1
Bore diameter	15	8
Hub diameter	60	24
Pitch ratio	150	30
Outside diameter	153	33

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V. ENVIRONMENT IMPACT& ADVANTAGES

The technology of the revolving door**,** even without an electromechanical generator**,** would be very beneficial for any new building as the result of savings incurred from lowered heating and cooling costs. While there were some problematic issues, such as the need for more materials to store and distribute the electricity, the environmental and theenergy saving benefits far outweigh the problems that arise. By retrofitting an already sustainable system, the revolving door, with an electromechanical generator, the positive environmental impact is increased, thus making this technology an ideal replacement for at least some of the entrances in the new sub. The Generator of the revolving door will not create an abundance of energy in a stand-alone system. However, with the use of one or more revolving doors, this technology will greatly reduce total Energy usage at the sub, which will help ubc attain the 20% renewable energy resources goal And achieve the lead platinum certification.

VI. ADVANTAGES & DISADVANTAGES

ADVANTAGES

- The electricity will be generated free of cost.
- The shopping malls lights and the staircase can be moved easily without much effort.
- The stair case will run on dc power generated by the mechanism as the gear box attached in the stair case works on dc voltage of 12volt.
- The gear based system generates high torque for the automatic stair case to move easily.
- There i no need for the three phase supply for the moving the stair case.
- The stair case will be attached and when the customer comes near the stair case the machine will start functioning automatically and the electricity will be generated and when the customer has moved out of the stair case the stair case will stop.
- The electricity will be generated for the parking area.

DISADVANTAGES

- The three phase appliances will not work say for air-condition but it can be overcome by using inverter which will supply three phase ac voltage of 230 volt in future

VII. RESULTS AND DISCUSSIONS

Observations

For escalator
When person 1 is passes from the platform
Number of revolutions obtained = 1
Average output voltage = 4 v
Average output current = 0.1amp
When escalator performs its 1st revolution
Avg. Output power = 4 V x 30 mA
= 0.12 watt.
If this escalator works for 10 hours in a day then it surely save 70 % of electricity out of total electricity required for it.

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Total power generation from rotating door

When 1 person passes from the platform,
Number of revolutions obtained = 1
For 1 revolution, electricity generated = 12 v, 0.1 amp
∴for 1 rev. = 12 v x 0.07 amp = 0.84 w
Consider that in one minute 5 persons passing through the platform = 0.84 x 5
= 4.2watt
∴In 1 hour = 4.2 x 60min = 252 watt
Consider that in one day, door is worked for 16 hours
∴Power generated in a day = 252 x 16
= 4032 watt
= 4.032 kw.
It is sufficient output energy and can be further optimized by using a higher gear reduction ratio and a generator with higher
Efficiency. It should also be noted that this energy is generated using a small scale model.Therefore, a full scale model of a revolving door will definitely account for
Higher power output. In the following section, a case study is performed based on the prototype output energy data.

VIII. CASE STUDY FOR IMPLEMENTATION

It was found that the shopping mall 'ETERNITY' is Nagpur's one of largest shopping mall. The average number of people entering the mall during a weekday is between 4000 to 8000. The average number of people on a weekend 5500. The mall operates from 8 am to 12 pm. Therefore, the door can be used for 16 hours. The average time to open the door is 2 seconds. It is noted that thedoor can rotate a maximum of 6000 times in a day.

Total energy produced in day = 0.84 x6000
= 5040 watt
=5.04 kilowatt

Energy produced yearly = 365 X 5.04
= 1839.6 kilowatt

IX. CONCLUSION

In this world where there is a much lack of electrical power supply, this research will helpful to resolve the power crisis to some extent. This paper is depending on harvesting human energy while using revolving door. The power generation of this designed revolving door depends on shaft rpm of the door and frequency of people passing through the door.The purpose of this research paper is to extract green energy from revolving door this research is connected as case to eternity mall Nagpur. Where near about 5000 to 6000 people entering and leaving from morning to evening by the use of door. When each and every people is being to use the revolving door energy generation increase due to the rotation of door.The test results of the final prototype designShows that 0.84 watt of energy can be harvested from
One push of the door. This results in 4.032 kW on single day assuming the door is implemented in a busy shopping mall.

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