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STAIRCASE BASED COMPRESSED AIR GENERATION SYSTEM

Dr. M. Rajagopal

Professor & Head, Department of Mechanical Engineering,

Er. Perumal Manimekalai College of Engineering, Hosur, Tamilnadu, India

Abstract: Some forces exerted on the steps while the people climbing up or down in the staircase due to the weight of the human body. These forces on the steps are generally wasted. The mechanical energy of the foot step that is exerted by people during climbing up or down the step is utilised to operate the air pump to produce the compressed air, and this is stored in the compressed air storage tank. In the present work, the stair case setup is developed which contains three steps and the air pumps are attached under the last two steps. The outlet of each pump is connected to the air storage tank. The open coil helical springs are attached to the steps for retaining the steps in their original position. The setup is experiment by the person walking on the stair case, and the number of steps for each 1kg/cm^2 pressure rise in the storage tank is determined up to the pressure of 5kg/cm^2.

Key Words: Staircase, Compressed air Storage, Air pump, Waste Energy Recovery

1. INTRODUCTION

A large amount of energy is wasted when people step on the floors by the dissipation of heat and friction every time a man steps up using stairs. There is a great possibility of tapping this energy and producing compressed air by making every staircase as a compressed air producing unit. The objective of the present work is to produce compressed air using the foot step stair casing while a person is walking on it. Compressed air is produced using piston pumps which are attached under the stair case. Compression springs are also attached under the stair case to bring the steps in the stair case in their original position.

Prabhavathi et al. have done the foot step power generation system. The energy can be generated by running or walking step on the tiles. The generated energy will be stored and then use it for homely purpose. This system can be place at homes, schools, colleges, where the human move around the time. When people walk on the floor or that of tiles, electrical energy is generated by using people weight. The control mechanism operate piezoelectric device, this piezoelectric device convert mechanical energy into electrical energy. When there is some oscillation, force exert by foot on floor or tiles. It can be used for charging devices e.g. laptop, mobile, etc.

Vinodpuri Goswami et al. have done the work on footstep power generation using piezoelectric material. In this work, they were harvesting energy with the help of piezoelectric material. They have used piezoelectric materials in order to harvest energy from people walking and generating vibration in piezoelectric so that energy can be generated. When people walk on the steps, power is generated by using the weight of the person. It can produce energy from vibration and pressure like people walking (footstep pressure). It can be used to charge devices such as mobile phones, laptops, etc.

Shivendra Nandan and Rishikesh Trivedi have done the study on mechanical footstep power generator. In this work the simple drive mechanism such as rack and pinion assembly and chain drive mechanism is used for generating power by utilization of force which is obtained during the walking on

steps is converted in to electrical energy with the help of mechanical systems. The generated power is stored by means of battery and this is used for activating the connected loads. This is one of the compact and efficient systems for generating electricity which can be easily installed in many regions.

Ramesh Raja and Sherin Mathew have done the experimental work on Power Generation from Staircase (Steps). Power can be generated through people are stepping on the stairs. A special mechanical arrangement such as crankshaft mechanism is employed on the stair case. This arrangement converted the foot power applied on stairs, as a rotary motion. This rotary motion is used to generate efficient electricity.

Shubham et al. have done the review work on power generation by staircase to convert potential energy of human footsteps into electrical energy. In this review work, it consists of a setup consisting of mechanism to compressed air in foot pumps through human footsteps energy thus converting it into compressed air. This compressed air is then stored in the air tank of sufficient pressure, then this compressed air gets impacted on turbine coupled with D.C. generator through a high pressure nozzle. The D.C. generator generates D.C. voltage which gets stored in battery. This D.C. voltage gets converted into A.C. voltage by an inverter circuit.

The compressed air is stored, and it can be used for many works. Compressed air can be obtained while walking on certain arrangements like foot paths, stairs, flat forms, and these systems can be installed elsewhere specially in the dense populated areas.

2. STAIRCASE BASED COMPRESSED AIR GENERATION SETUP

The components of the setup consist of three steps stair-case, air pump and the compressed air storage vessel. The line diagram of the foot step based compressed air storage system is shown in Figure 1. Staircase steps and its support are made of mild steel square pipe of size 25.4 mm × 25.4 mm. Three steps are attached in a single frame in which the first step (bottom) is in idle state and other two steps are used to operate the air pumps to compressing the air when a person is walking on it. Air Pumps of diameter 7 cm and stroke length of 15 cm are attached under the second and third stairs which are used for foot pressing, and the compressed air is produced in each stroke/or each foot pressure. The inlet sucks the air and the piston compress the air when the person stepping on the stairs. The compressed air is then released through the discharge valve. Two numbers of open coil helical spring of 40 mm outer diameter are attached under the steps for retaining the steps to their original position after a person walks on it.

A compressed air storage vessel (Diameter: 15 cm; Length: 25 cm) is made of mild steel sheet of 2mm thick used for storing compressed air, and it is kept at the bottom of the third step of a stair case. The maximum pressure withstanding capacity of the vessel is 7bar. A pressure gauge of 0 to 10 kg/cm^2 capacity is fitted with this vessel for monitoring the air pressure. A relief valve made of brass is fitted with the vessel and used to relieve the excess pressure.

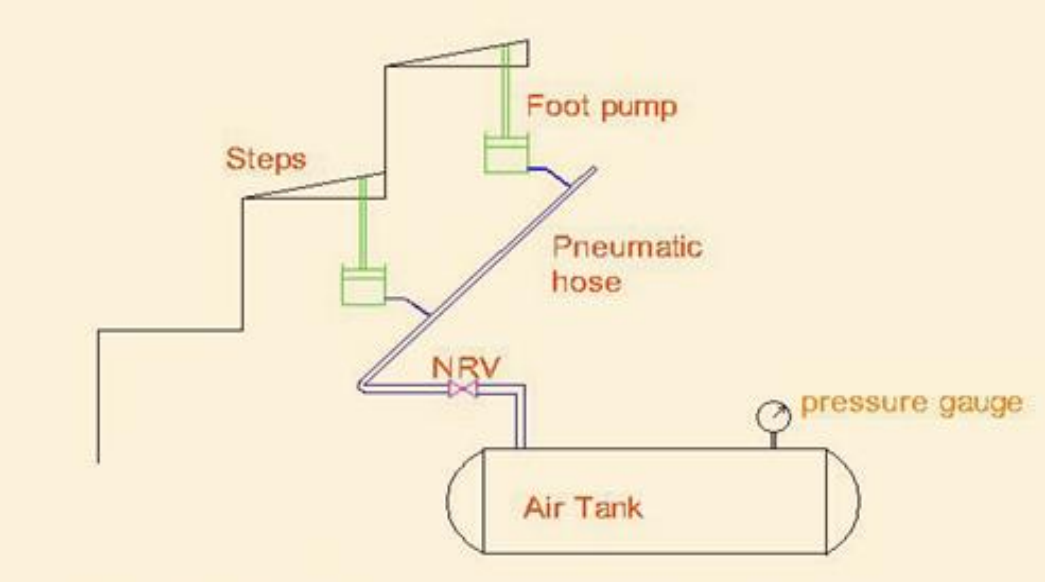

Figure 1 Line diagram of the staircase based Compressed air generation system

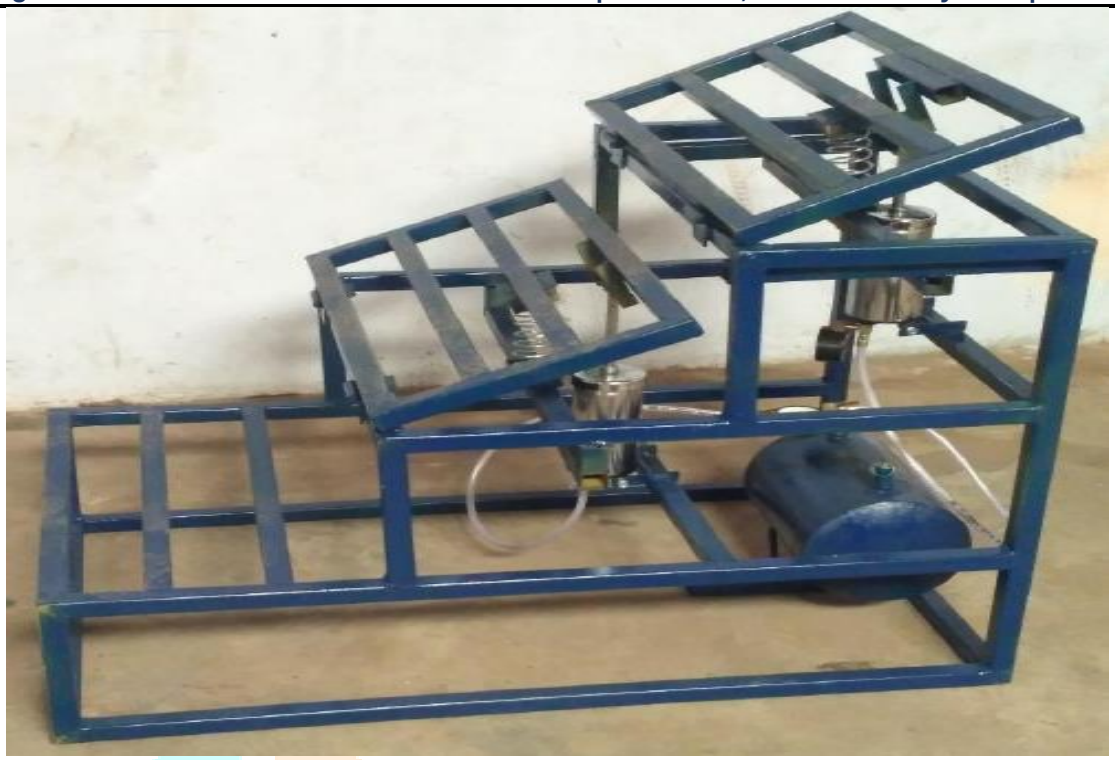

Figure 2 Photographic view of the staircase based compressed air generation setup

Pneumatic air hose made of polyurethane is used to connect air pumps and the compressed air storage vessel with a maximum withstanding pressure 10 kg/cm^2. One end of the hose is connected to the outlet of the air pump and the other end is connected to the inlet of the air storage vessel. The photographic view of the foot step based compressed air storage setup is shown in Figure 2.

3. WORKING PRINCIPLE

In the present setup consists of three steps staircase in which one is ideal and the other two steps are used to operate the air pumps. The air pumps and the open coil helical springs are attached under these two steps. A person walking on the steps is pressed against spring pressure due to human weight, and it is deflected from an inclined position to a horizontal position. The piston in the pump is moving in the downward direction due to the movement of the step and compresses the air which has already sucked in the pump cylinder. The compressed air is sent to the storage vessel through the hosepipe. The springs are used to return the steps to their initial position by lifting or removing a person's foot on it. Then the piston in the pump is moving in the upward direction, and the pumps suck the outside air into the cylinder due to the upward movement of the piston.

4. EXPERIMENTAL TRIALS AND DISCUSSION

The trials were obtained by walking two persons of their body weight 50kg and 65kg respectively on the steps separately until the tank pressure reaches 5kg/cm^2. The number of strokes for each 1 kg/cm^2 pressure rise in the storage vessel is observed using a pressure gauge by each person walking on the stairs.

The testing results are presented in this section using the trials obtained by walking two people on the stair-case separately. Figure 3 shows the number of strokes of the person (weight 50kg) walking on the stairs for each 1 kg/cm^2 rise in pressure in the storage vessel. It is seen from the figure that the air pressure in the storage vessel increases linearly with respect to the number of strokes on the stairs by the person.

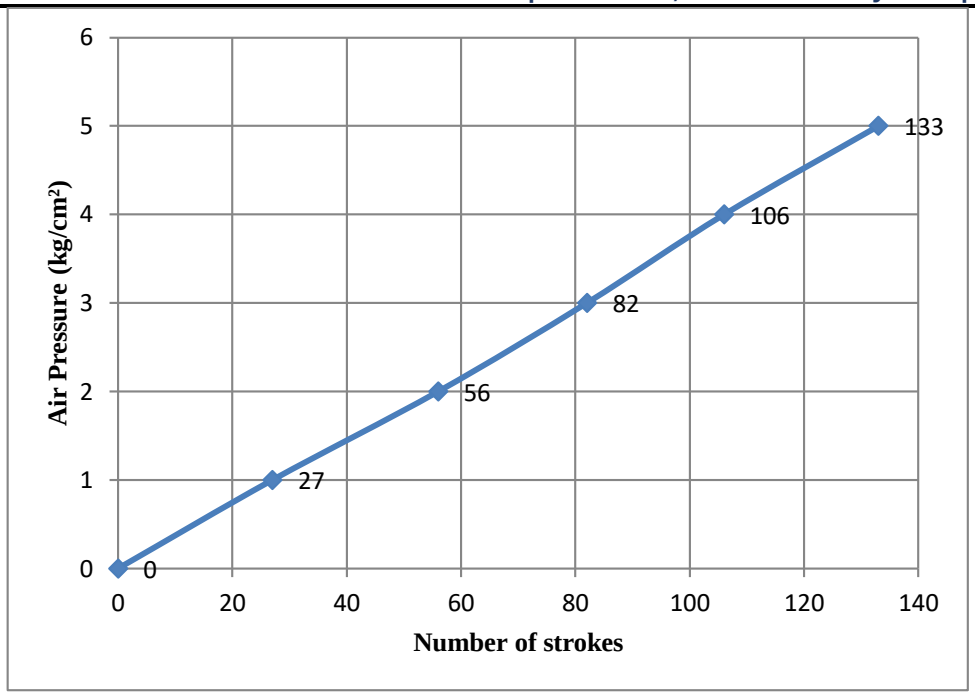

Figure 3 Variation of air pressure in the storage vessel with respect to number of strokes of the person (50 kg) walking on the staircase

Similarly, Figure 4 shows the number of strokes of the person (weight 65kg) walking on the stairs for each 1 k kg/cm^2 rise in pressure in the storage vessel. It is seen from the figure that the air pressure in the storage vessel increases with respect to the increase in the number of strokes on the stairs by the person. It is construed from the Figures 3 and 4 that there is not much difference in the number of strokes to raise the air pressure in the storage vessel with person's weight on the stair case.

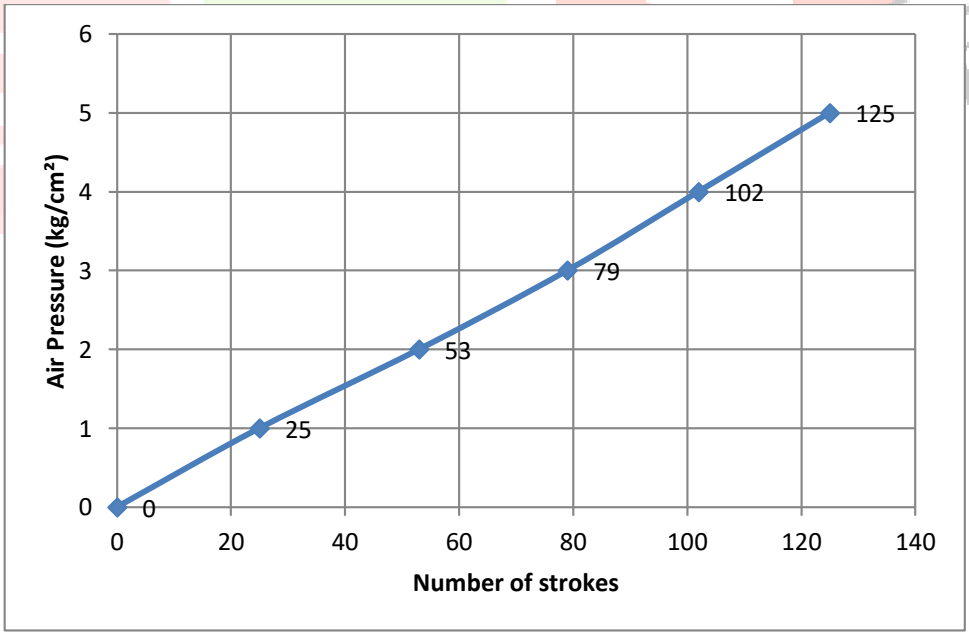

Figure 4 Variation of air pressure in the storage vessel with respect to number of strokes of the person (65 kg) walking on the staircase

5. CONCLUSION

In the present work, a staircase based compressed air generation system is developed. This setup contains an air pump, springs, and a Storage tank. A person climbing on the staircase, the steps of the stairs are pushed down against the spring pressure due to the weight of the person, which compresses the air in the air pumps. The compressed air delivered into the storage vessel through an air tube. The setup is tested by two different people climbing on the Steps. It is construed from test trials that there is not much difference in air pressure increase in the storage vessel with respect to the person's weight.

Advantages

- Highly efficient in more crowded places.
- This process depends on human resources which are available in plenty in our country, which makes our country a favorable place for this project.
- Simple in Construction.
- Pollution free.
- Waste energy recovery.

Applications

- Railway, subway stations
- Roads
- Temples
- Bus stands, air ports, shopping malls, markets

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