Electricity From Footsteps

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Introduction

Walking is the most common activity in day to day life. When a person walks, he loses energy to the road surface in the form of impact, vibration, sound etc, due to the transfer of his weight on to the road surface, through foot falls on the ground during every step. This energy can be tapped and converted in the usable form such as in electrical form.

In order to develop a technique to harness foot step energy, a foot step electricity generating device was developed in the Reactor Control Division, BARC. This device, if embedded in the footpath, can convert foot impact energy into electrical form. The working principle is simple. When a pedestrian steps on the top plate of the device, the plate will dip down slightly due to the weight of the pedestrian. The downward movement of the plate results in rotation of the shaft of an electrical alternator, fitted in the device, to produce electrical energy. The top plate reverts back to its original position due to negating springs provided in the device.

If such devices are embedded in places where there is continuous human traffic such as in city malls, railway platforms, city footpaths etc., the electricity generated from these devices can be used for street lights.

The device developed at the Reactor Control Division is shown in Fig. 1. The device was tested and it was demonstrated that the energy generated by this device can be stored in a 12 V lead acid battery. A 100 watt, 230 volt bulb was connected to the battery through an inverter. The device was operated by persons walking over to it. The bulb automatically lights up when the battery reaches its full voltage. The bulb remained lighted till the battery was exhausted. However, if there is continuous movement of pedestrians over the device, the bulb can be kept lighted continuously.

Fig. 1: Foot Step Electric Converter Device
Operation

The working of the Foot Stop Electric Converter (FSEC) is demonstrated in photographs in Fig. 2. The right side photograph shows the foot touching the top plate without applying weight. The left side photograph shows the foot when full weight of the body is transferred to the top plate. A 6 W, 12 V bulb connected to the output of the alternator glows, to indicate the electric output when foot load is applied. The unit is designed to generate full power pulse when actuated by a person weighing nearly 60 kg. An experimental plot of voltage vs time was generated, by using an oscilloscope. Using voltage data and the load (a resistor), a typical plot of power vs. time was generated. The plot is shown in Fig. 3.

Energy storing

The power generated by the foot step generator can be stored in an energy storing device. The output of the generator was fed to a 12 V lead acid battery, through an ac-dc converter bridge. Initially, the battery was completely discharged. Then, the FSEC was operated by applying foot load and energy was stored in the battery. A 100 W, 230V bulb was connected to the battery through an inverter. The arrangement is shown in Fig. 4. The duration of lighting, the bulb for number of footsteps and corresponding energy stored, are given in Table 1.

The main objective of developing the FSEC was to demonstrate the technology of harnessing
energy from human walk. However, multiple unit clusters may be more useful for producing useable power. A single cluster with 5 FSEC devices was developed for experimental purpose.

### Multi FSEC unit platform

A cluster of 5 FSEC devices mounted on a wheeled platform was developed. A view of the internal components of a typical FSEC device used in the cluster is shown in Fig. 5. The electrical output of all five FSEC devices is stored in 2 batteries provided in the platform. An electronic digital energy meter is fitted on the platform. The energy generated in each of the five FSEC units fitted in the mobile platform is integrated and displayed on the energy meter. The energy meter shows a total integrated value of electrical energy in KJ generated in all FSECs fitted in the platform.

### Table 1: Energy Storage by Foot Steps

<table>
<thead>
<tr>
<th>No. of foot steps</th>
<th>Duration of lighting a 100 watt 230 Volt bulb (s)</th>
<th>Total energy (J)</th>
<th>Energy /step (J)</th>
</tr>
</thead>
<tbody>
<tr>
<td>250</td>
<td>6</td>
<td>600</td>
<td>2.4</td>
</tr>
<tr>
<td>500</td>
<td>12</td>
<td>1200</td>
<td>2.4</td>
</tr>
<tr>
<td>750</td>
<td>18</td>
<td>1800</td>
<td>2.4</td>
</tr>
<tr>
<td>1000</td>
<td>25</td>
<td>2500</td>
<td>2.5</td>
</tr>
</tbody>
</table>

**Fig. 4:** Storing Device for Foot Step Electric Energy
(a) Bulb on (after charging battery)
(b) Bulb off (before charging battery)

**Fig. 5:** Internal View of the FSEC Mechanism
The platform is shown in Fig. 6. The platform is provided castor wheels, and can be placed at any public place where there is continuous movement of people. This unit is designed for persons weighing 50 Kg and above. However, persons below 50 kg weight can also operate but the power produced will be low. The unit is fitted with two 12 V, 26 AH lead acid batteries for storing the output energy from this unit. Also, an inverter is provided to convert 12 V DC from battery to 230 V AC supply for general use.

When a person walks over to the platform, the reading on the energy meter was observed to be incremented by 3-5 J per step, depending on the weight of the person. The output may be further increased by increasing the efficiency of the FSEC device. As millions of people are on the move in cities, significant amount of electricity can be generated by installing these devices at places where public walk through.

The economic viability aspects of these units will be studied, after sufficient data is collected. There is a plan to put the platform for public use, for testing and collecting data.