DESIGN AND FABRICATION OF DISPOSAL OF FAECAL MATTER FROM THE TRAINS

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ABSTRACT

The aim of the current project is to keep the Indian Railway platforms clean and tidy. For this, we have designed and constructed a mechanical device which acts as an efficient problem solving technique to many sanitary problems. This project incorporates principles of Mechatronics i.e. mechanical and electronic components. It comprises of Container to store the fecal matter, door which closes and opens based on the inputs, DC Motors, inlet pipe and various circuit connections. The main power supply is from DC batteries even though power can be generated from Solar Panels by making use of solar radiation. The device is semi-automated and the main controls are provided to the loco pilot. The opening and closing of the door of the device depends on the speed at which the train is moving.

As the devices are semiautomatic, the loco pilot controls the mechanism by choosing proper dumping spots with the aid of GPS Technology. The fabrication of the device is simple and minimalistic which works efficiently as per real time demands.

Keywords: DC Motor, Solar radiation, Semi-Automatic, GPS.

1. INTRODUCTION

In the recent days, we have witnessed many situations in which the government and private sectors haven't properly maintained their premises. The best example which we come across is the untidy premises at the Indian railway platforms. Usually these railways platforms are unhealthy due to the spillage of junk and waste from the trains. These can be easily removed. But the problem arises when fecal matter from the trains are dumped and scattered haphazardly from the train at the railway platform. This induces nasty, unbearable smell. So here, in the project we have found out a way to easily store and dump the fecal matter on the outskirts of the city. This clearly enables us to maintain a stink proof and garbage proof railway platform

Fig 1.1: Dirty track at railway station

2. METHODOLOGY

2.1 Material and Equipment used

A non-corrosive/ high quality plastic container of suitable size, an ac motor, a speedometer, few screws, nut and bolts, well insulated wires and few plastic transparent buttons.

2.2 Principle

Here, in our setup, we are using several principles like that of ac motor, series connection etc. but there is no specific highlighting principle involved.

2.3 Preparation and working of the setup

The circuit which is shown in fig 3.1 describes the majority portion of the working. So, here are a few circuits and their explanation.

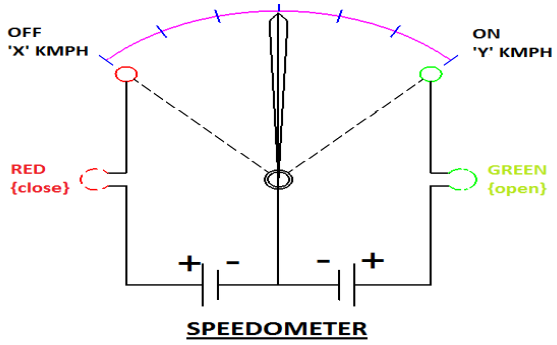

Fig2.1: Speedometer

The circuit shown in the fig 2.1 represents a customized speedometer specially prepared for this setup. When the train accelerates up to 25kmph, the speedometer needle touches the right side ON barrier. This opens the container and fecal matter is flushed out. When the train slows down below 24kmph, the speedometer needle touches the left side 'OFF' barrier. At the 'ON' condition, the green light switches on in the plastic button. This red light indicates the operator to close the container.

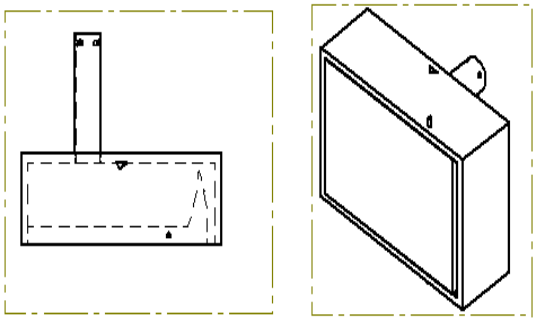

Fig 2.2: Front view of container

Fig 2.3: Isometric view of container

The concept involved in the above process is pretty simple one. After the commode is flushed, the fecal matter enters the inlet passage shown in the fig2.2 From there, it falls down on the bottom plate shown in fig 2.3 Here the bottom plate can rotate about it axis and is fixed to a spring to come back and maintain its initial state. The oval wheel also rotate up to 30 degrees. When it reaches the vertical state of 30 degree, the bottom plate is lowered. This enables the fecal matter to flow out easily. Later, the oval wheel reaches back to the horizontal position and the bottom plate shuts back(2-3).

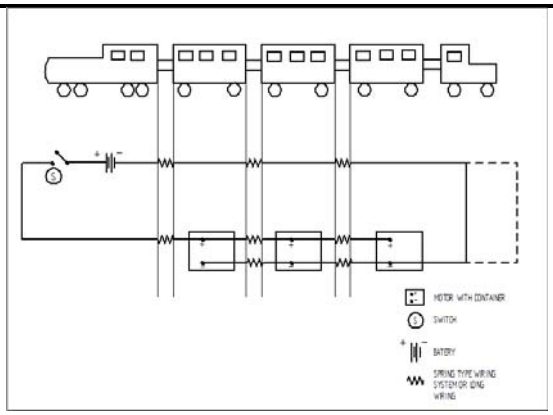

Fig2.4: Circuit diagram of spring type wiring system

When the train accelerates, say above 25 kmph, the green light is switched on by the operator.so, the circuit gets completed. The current flows from the positive end of the battery to all the containers. So, the bottom plate of the container opens and the fecal matter is disposed out. This makes sure that the fecal matter is disposed away from the railway platform at a distance.

When the train slows down, say below 24kmph, the red light is switched on by the operator. So, the circuit gets cut and the circuit is not completed. The circuit can't flow from the battery to any of the containers. The bottom plate of the container shuts back and comes to its initial position. So, the fecal matter gets stored in. this makes sure that the fecal matter is not left out to fall on the railway platform or anywhere nearby to the railway platform(1-3).

NOTE:

Here a spring type wiring system shown in fig 2.4 has to be used in between the wagons since the wagons will be moving to and fro continuously.

3.1 Experimental set up

1. Installation of working device is below the train, specifically underneath the toilets.
2. The installation of device includes use of 'L' or 'Z' shaped clamps shown in fig 5.1 provided with nuts and bolts.
3. As per the prototype dimensions, it may require usage of four 'Z' shaped clamps. (Model may require less or more clamps).
4. As per the survey results, it is concluded that a minimum of 30 to 40 liters of fecal matter can be stored in the storage tank.
5. The prototype consists of one DC motor, guide ways and microcontroller.

6. The space availability under the train to install the device is shown in Fig 3.2 and Fig 3.3.

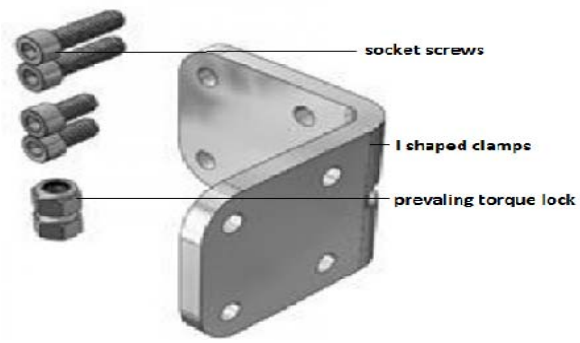

Fig 3.1: 'L' shaped clamps

SPECIFICATIONS OF THE PROTOYPE

A Dc motor of capacity 6V and a battery of 12V are required for the prototype.

Table 7: Specifications of Prototype

1.	Length of the container	40 cm
2.	Breadth of the container	30 cm
3.	Height of the container	25 cm
4.	Length of the operating door	50 cm
5.	Breath of the operating door	31 cm
6.	Height of the operating door	2 cm
7.	Diameter of the inlet pipe	2 cm
8.	Height of the inlet pipe	6 cm
9	Volume of the container	30000 cm^3

3.3 Parts of the Prototype

Fig 3.2: Bottom view of disposal pipe

1. Water tank
2. DC motor
3. Connecting bush
4. Guide rods
5. Screw rod
6. Water inlet pipe and
7. Opening/closing of door.

Fig 3.3: Bottom view of train toilet

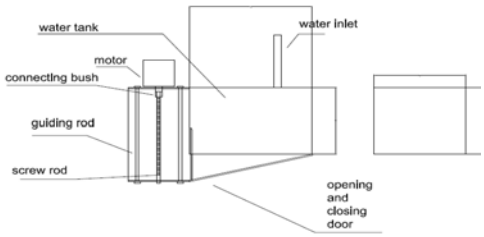

Fig 3.4: Sketch of prototype

3.4 Sources of energy

1. Electrical energy is used to run the device which is supplied from the battery which is pre-installed in the train of each wagons.
2. Alternative source of energies are solar energies shown in fig 3.5 mechanical energy and wind energy.
3. The electrical energy is being harvested from the solar panels which are installed on the wagon.
4. The storage batteries are installed in order to store solar energy which will be helpful during non-sunny days.
5. If needed dynamos are installed on the train wheels to harvest the electrical energy.

Fig 3.5: Solar panels arranged on train

Steps involved in dumping of fecal matter from the train:

1. The device is installed in such a way that the door of the storage tank is opposite to the train movement so that when the train accelerates, the fecal matter is dumped smoothly.
2. As the train approaches platform, it slows down. The speedometer glows red light which alerts the locomotive driver to close the door of the container.
3. As a result, it stores fecal matter without being dumped on the platform if any person uses the toilet.
4. As the train departs platform, it picks up speed and after reaching certain speed, green light glows.
5. The driver has to open the door of the container by electrical switches.
6. The stored matter gets dumped.
7. The cycle repeats.

4.0. ADVANTAGES AND LIMITATIONS

We can easily make out many advantages by implementing the project in a proper way. Some of the pros are mentioned below.

1) This method helps in keeping the railway platform clean and tidy
2) Corrosion of the railway tracks near the railway platform can easily prevent. This prevents the derailing of trains.
3) Chemical treatment at the railway station can be avoided to the maximum extent which in turn conserves water and prevents soil pollution.
4) It considerably prevents foul smell and a stinky odor which arises on the platform.
5) The biggest advantage of this setup is that it is one time investment process and this whole setup is totally economical for "Indian Usage'' purposes.

Limitations

The main disadvantage from this plan is that it is suitable only for only trains in the ' Third World Nations' like India, Pakistan, Bangladesh, Bhutan and Myanmar. This method can't be implemented in the European and the American continents as they already have a well-equipped and a sophisticated railway sanitary system. As this is a one-time installation process, any damage to the device in future implies more maintenance charges and complicated repair works(4-6).

SUMMARY

5.0 RESULTS AND DISCUSSIONS

Implementation of this working model results in proper maintenance of railway platforms. The shape and dimensions of the clamps are designed in such a way that they can withstand the stresses, strains and formation of possible physical changes in a model due to motion of the train. Further, the installation of the device does not cause malfunctioning of other systems of the train. It is an advanced system which uses storage batteries in order to provide sufficient power during unavailability of the original power source. Since, here, in this project we are making use of electricity as main power source, it does not affect the fuel consumption. These devices are connected through circuits and the main controls are given to the loco pilot. The operation is kept simple as it requires tapping of one or two buttons only. The whole operating mechanism involves usage of DC Motors which is sufficient to overcome the frictional losses and other losses. The safety factor of this device is that it is made up of composite material which prevents itself from rusting and other environmental factors. After considering all the results of the survey, the final Prototype is manufactured with optimal cost and high efficiency. By obtaining energy from the solar panels, the fuel consumption can be reduced to a larger extent(4-5).

5.1.Cost Estimation

Welding, frame construction, design, fabrication, travel, painting, survey analysis and data collection and other activities cost around ₹18,000. When it comes to mass production, we need not require all the processes. As a result, cost gets reduced to below ₹10,000.

Images of the prototype are shown below:

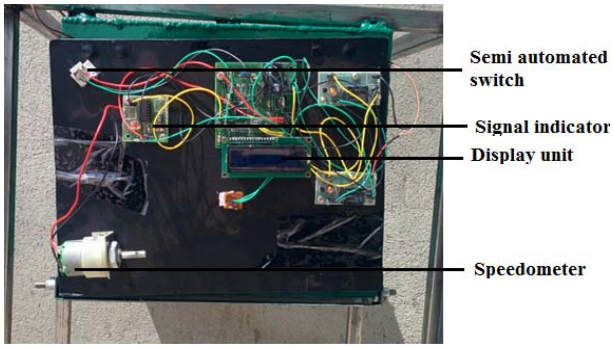

Fig 3.6

Isometric View

Fig 3.7

Front view of the Prototype

Fig 3.8

6.0. CONCLUSIONS

Viewing from overall experimental results the following conclusions are made

The Project fulfills the purpose of maintaining the railway platforms clean and tidy by avoiding disposal of fecal matter at the platforms. As a result, people waiting at the platforms won't face difficulties like nasty and unbearable smell. The installed model is comparatively simpler in design and requires less maintenance. This methodology is superior to Chemical Treatment, Composting Toilets and Biological Toilets. This is an Eco-friendly project which is very much appreciated. Also, Solar Energy can also be used as alternative power source by installing Solar Panels on the train. This is just a preview of our project on the disposal of fecal matter from the trains. More importantly this project can be proposed under "Swachh Bharath Mission" in the near future.

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