

# Design and Fabrication of Automatic Can Crusher and Vending Machine.

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**Abstract**— Swacha Bharat Abhiyan is a cleanliness campaign run by the Government of India, which started on 145th birth anniversary of the great person Mahatma Gandhi. The main aim of the project is to contribute towards the cleanliness drive. Our Proposed machine is a cam and follower based can crusher mechanism which is integrated with a vending mechanism which dispenses a token or a discount coupon in exchange of a can recycled using the machine. The main purpose of the vending mechanism is to attract a number of beverage consumers to recycle their can for exchange of discount coupon, the coupon can be discount on next purchase of beverage or discount on bus or movie ticket depending upon the company which will install this machines. Initially the machine can accept only cans but with further modification it would be able to accept various other types of beverage containers too like plastic bottles. The machine would be installed at various locations like parks, mall's, stadiums, bar's and various public places.

**Keywords**—Cam and follower, Vending Mechanism, Can (beverage tin's).

## I. INTRODUCTION

In 1972, approximately 26,500 tons of aluminium cans were recycled and today that number is estimated to be as high as 800,000 tons. Even though the billions of cans recycled around the world, there are still billions of aluminium cans every year that are being disposed of roadways and in trash cans. This attributed to that recycling still facing some difficulties. Besides, sorting is a time consuming and costly process. One of other difficulties of recycling aluminium cans is the necessity to reduce costs of shipping of these cans due to transportation of huge cargo. This problem could be solved using can crusher.

The proposed machine will crush the can approximately by 75%, thus facilitating more number of can's to be stored in one place and thereby reducing the transportation cost. As it would be installed at various locations the cans would be automatically segregated from other trash thus saving time and money of the respective company.

The design is environment friendly and uses simple Mechanical system like a cam and follower and electronic components like PLC, proximity sensor, relay, overload relay, HMI, SMPS and contactor.

## II. LITERATURE SURVEY

The development of recycling tin can crusher requires an amount of good understanding of the knowledge of the design, analysis and fabrication. Therefore, executing a research is necessary to obtain all the information available and related to topic. The information or literature reviews obtained are essentially valuable to assist in the construction and specification of this project. With this basis established the project can proceed with guidance and assertiveness in achieving the objective of purpose.

The previously used can crusher mechanism are:[1]

- Manual Can Crusher Machine
- Hydraulic Can Crusher Machine
- Pneumatic Can Crusher Machine
- Geared Can Crusher Machine
- Scotch Yoke Can Crusher Machine
- Slider Crank Can Crusher Machine

But each of the listed mechanism had its own draw back like the manual can crusher requires human power to operator and operator gets fatigue after some time. The Hydraulic and Pneumatic mechanism requires compressor and oil pump so the system becomes bulky. The geared crusher mechanism is quite complex and the scotch yoke and slider crank mechanism gets weaker at linkages due to excessive pressure applied and may break.

But cam and follower is better because: [8]

- Both in slider crank and cam-follower mechanisms higher pair is form so there is negligible difference in power loss in friction and work done.
- By linkages, we had approximate function generator but by using this cam-follower mechanism we can have exact function generator.

## III. DESIGN OF EXPERIMENTAL MODEL

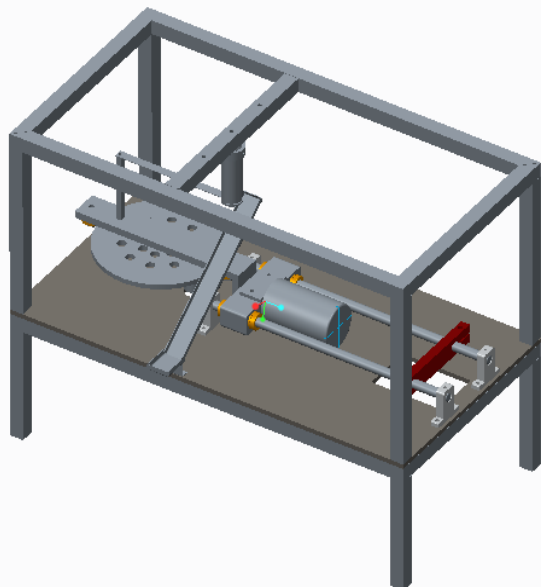
### A. Crusher Mechanism

A can requires approximately 25kg's of force to deform up to 75% by its size. A three phase or a single phase motor is used which can generate enough torque to compress the can.

The motor is connected to a circular eccentric cam which rotates and pushes a plunger which slides on a linear rod with the help of linear bearings. The stroke length is calculated by measuring the length of can in normal condition and length on can in compressed condition.

A circular cam is used instead of an elliptical cam as there is no spring back action to bring the plunger in rest position and in such condition if an elliptical cam is used it may ram on the follower mechanism and can create unpleasant sound.

Two proximity sensors are used; the first one detects the can when it is inserted which actuates the motor and the other proximity sensor is fixed under the cam which stops the motor after one complete revolution of the circular cam.



**Figure 1: 3D Concept of Crusher**

### B. Vending Mechanism

The main purpose of the vending mechanism is to dispense a coupon or a token in physical or a digital form, so as to attract a number of people and to encourage them to recycle. Two types of vending mechanism are proposed by taking into consideration the type of output required:

- 1) PLC based vending mechanism.
- 2) Relay based vending mechanism.

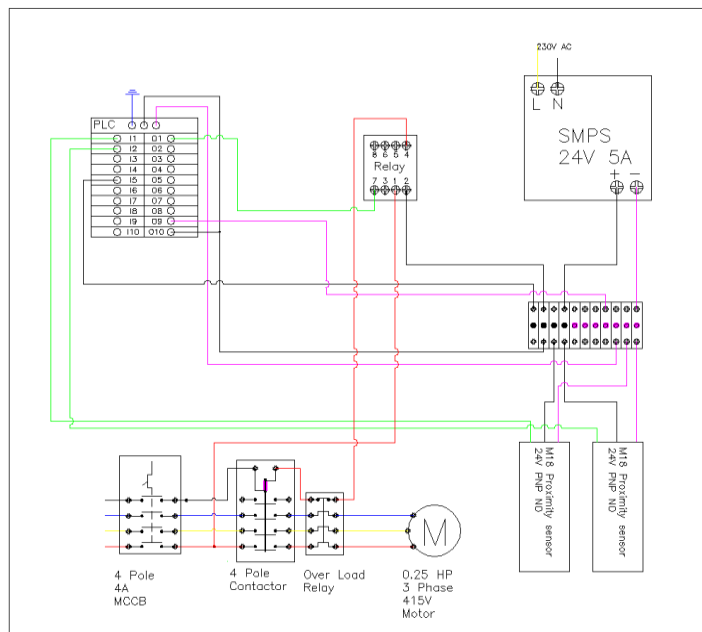
#### PLC Based Vending Mechanism:

In this mechanism the output of the proximity is given to the PLC, after which the PLC gives input to motor and another input is given to a HMI/printer to print coupon.

The Features and advantages of this mechanism are as follows:

- Multiple outputs can be given like coupon with different number or different kind of tickets.
- Fast and accurate
- Long Life.

The only disadvantage is it is costly as compared to Relay based system due to high cost of PLC and HMI.



**Figure 2: Circuit Diagram for PLC Based System**



**Figure 3: Output of PLC Based system**

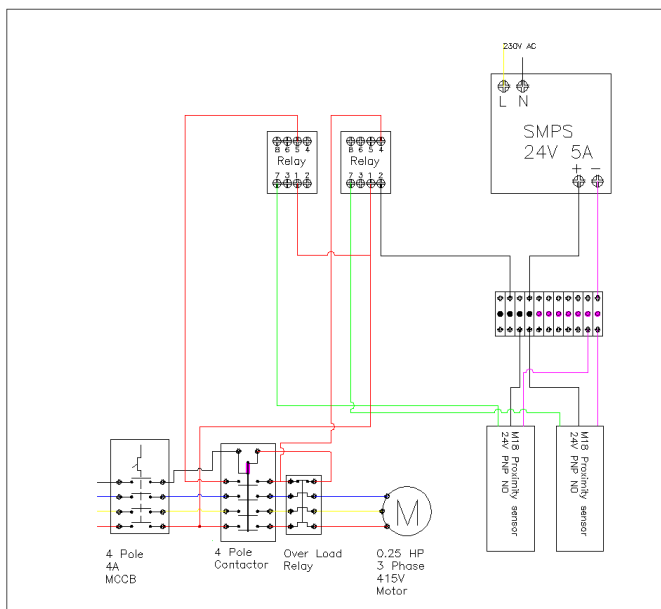
#### Relay Based Vending Mechanism:

In this mechanism when the can is inserted and detected the output of proximity is given to relay, which after receiving the output of proximity actuates the motor, the other proximity is fixed under the cam which stops the motor after one complete revolution of cam.

The mechanism utilizes the linear motion of the crushing plunger to dispense the tokens (plastic Coins).

The features and advantages of this mechanism are as follows:

- Only a single dedicated output is give like a plastic token.
- Cheaper than PLC based system.



**Figure 4: Circuit Diagram for Relay Based System**



**Figure 5: Output for Relay Based System (Token Vending)**

#### IV. RESULTS

After carrying out the trials it was observed that:

1. The cam and follower mechanism is more efficient than previous crushing mechanisms used.

2. It was observed that the crusher was giving more precision and efficiency in crushing operation as compared to Previous Crushing system.
3. The desired objectives were achieved with maximum elimination of the drawbacks of the previous system.
4. This also reduced the operation time. The labor cost was reduced. The damages caused during manual crushing were also eliminated.
5. Volume of the can is reduces up to 75% by using Cam Follower.
6. After crushing the cans minimum storage area is required for storage of the crushed cans.
7. Total process of crushing is Automatic, no manual supervision is necessary for whole process.
8. Vending mechanism is introduced in project marketing and to create public.
9. The PLC program can run in single or continuous mode. Optimization of layout and cycle time of the operation can be made possible.
10. When the machine was installed in college canteen it was observed that almost 85% of the students used the machine instead of the trash can.



**Figure 6: Manufactured Model**

#### V. FUTURE SCOPE

1. The machine can be further modified to accept plastic bottles
2. Photo sensor can be used to separate cans and bottles Counter can be used to count the number of bottles/cans according to their brand.
3. Can also make use of other power source like hydraulic cylinder, Pneumatic cylinder instead of motor.

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4. Serial interface printer can be used instead of Digital display for printed physical coupon in PLC based system.
5. The machine can be interfaced with the company main computer so that they will come to know which machines are full and need to be emptied.

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