

Design and Fabrication of Automatic Can Crusher

¹Kunal Sontakke, ²Harshil Yadav, ³Chetan Wakchaure,
⁴Pradeep Samere, ⁵Prof.K.P Agte

^{1,2,3,4,5} Department of Mechanical Engineering, Savitribai Phule Pune University, Pune

Abstract: A can crusher is a device used for crushing aluminum cans for easier storage in recycling bins. While most recyclers don't require you to crush cans, if you do recycle a lot, your normal bin may fill up quickly. The crusher gives you extra space by flattening either single or multiple cans. This project is about designing and fabricating the Recycle Bin Tin Can Crusher to help people to crush the tin and aid easier transportation. This project involves the process of designing the crusher considering forces and ergonomic factors for easier handling. After the design was complete, it was transformed to its real product where the design is used for guideline. These projects also require ensuring the human safety. Methods and process involve in this project are joining using bending, welding, drilling, and cutting process. This project is mainly about generating a new concept of tin can crusher that would make easier to bring anywhere and easier to crush the tin.

Keywords: DCV, FCV Compressor, Cans, Double acting cylinder, Hopper, Electric Motor, IC's

1. Introduction

This project consists of designing and fabrication of an automatic can crusher machine. A can crusher can be defined as a device used for crushing aluminum cans or plastic bottle for easier storage in recycling bins thereby giving you extra space by crushing of cans. The main aim of the project is to reduce the scrap. In order to reduce the waste, we planned to create a can crushing machine that will reduce the volume of aluminum cans by approximate 75 percent by which transportation volume will increase and transportation cost will reduce. We can crush Cold drinks can and other beverage cans by using this machine. Commercial establishments like cafeteria and bars, have to deal with leftover cans. Storage is often a problem and cans consume lot of space, thereby increasing total volume of trash. The transportation cost is also high for moving such a huge number of cans. This machine will help to recycle and maintain eco-friendly environment also. In this design it uses 5/2

DCV's, FCV, Two single acting cylinders one for pushing and other for crushing, a frame, hoses & connectors. Arduino, relay & ultrasonic sensor. Its frame is of vertical type which can be placed on wall. In 2004, 60 billion aluminum cans were land filled, littered or incinerated, that's 10 billion more than were wasted in 2002. This is enough cans to fill the Empire State Building twenty times. It is also a quantity equivalent to the annual production of three to four major primary aluminum smelters. The energy required to replace just these aluminum cans wasted in 2001 was equivalent to 16 million barrels of crude oil, enough to meet the electricity needs of all homes in Chicago, Dallas, Detroit, San Francisco and Seattle etc. During the time it takes you to read this sentence, 50,000 more 12-ounce aluminum cans are made. Americans throw away 25,000,000 aluminum beverage cans every hour. Thus this crusher machine will help to recycle them and maintain an eco-friendly environment.

2. Literature Survey

We studied that Can recycling is very important part of any family and community recycling program. Aluminum recycling is one of the easiest things you can do to help the environment. Recycling of can began a long ago and started to become common in early 1970's. Can is 100% renewable. This means that we can recycle a new can from used can. Just we have to crush the used can and we have to transport them to the factory. Because of crushing of cans its transportation cost will reduce and less space is required to store them. You might be surprised to know that within 60 days an aluminum can is able to go from your recycling center and becomes a brand new can to be used by consumer.

2.1 Machine

A crusher is a machine designed to reduce large solid material object into a smaller volume or

pieces. Crusher reduces the size or change the form of waste material so they can more easily disposed or recycles.

2.2. Pneumatic system

Pneumatics is a section of technology that deals with the study and application of pressurized gas to produce mechanical motion. Pneumatic system, which are used extensively in industry and factories are commonly plumed with compressed air or compressed inert gases.

3. Pneumatic Circuit

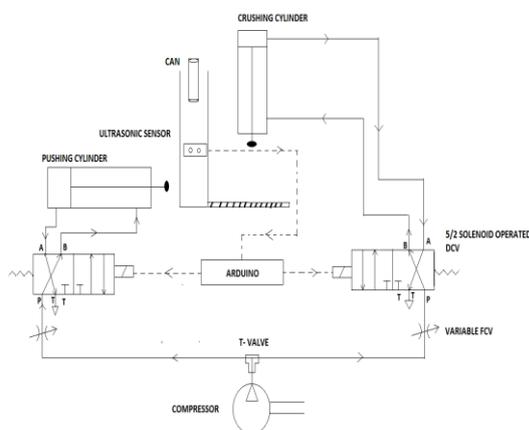


Figure 3.1. Neutral position of Pneumatic Circuit.

4. Design & Calculation

The main aim of this is to study the complete design of Automatic can crusher machine. We have to design pushing and crushing cylinder.

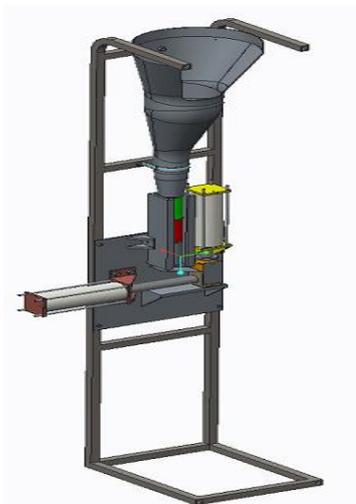


Figure 4.1 Modeling of machine

4.1 Cylinder

The material used for the cylinder is aluminum; it holds a piston and gives direction to a piston. Under vertical cylinder Can is crushed. In horizontal Cylinder Actuator is there it is used to push the can for crushing.

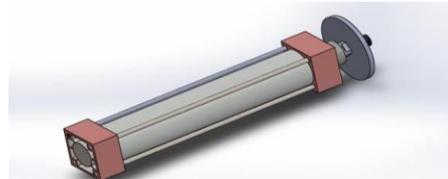


Figure 4.2 Double acting Cylinder

i. Force generated by crushing cylinder

1. Diameter of the cylinder-37.5 mm
2. Diameter of the piston rod-10 mm
3. Operating pressure range-1-9 bar
4. Endurance pressure-10 bar

$$F = P \times A$$

$$A = 3.14 / 4 \times D^2$$

$$A = 3.14 / 4 \times 37.5^2$$

$$A = 1105 \text{ mm}^2 = 1.105 \times 10^{-3} \text{ m}^2$$

$$P = F/A$$

$$6.5 \times 10^5 = F / (1.104 \times 10^{-3})$$

$$F = 717.90 \text{ N}$$

Force during retracting stroke:-

$$P = F / (A-a)$$

$$1 \times 10^5 = F / (1.104 \times 10^{-3} - 7.853 \times 10^{-5})$$

$$F = 102.54 \text{ N}$$

ii. Forces acting on pushing cylinder

1. Diameter of the cylinder-15 mm
2. Diameter of the piston rod- 7 mm
3. Operating pressure range-1-9 bar
4. Endurance pressure-10 bar

Force during extending stroke:- $F = P \times A$

$$A = 3.14 / 4 \times D^2$$

$$A = 3.14 / 4 \times 15^2$$

$$A = 176.625 \text{ mm}^2 = 1.761 \times 10^{-4} \text{ m}^2$$

$$6.5 \times 10^5 = F / (1.761 \times 10^{-4})$$

$$F = 114.465 \text{ N}$$

Force during retracting stroke:-

$$P = F / (A-a)$$

$$1 \times 10^5 = F / (1.761 \times 10^{-4} - 3.848 \times 10^{-5})$$

F = 13.82 N

4.2 Can Holder



Figure 4.3 Can holder

- i. Its Name itself suggest that is holds a can.
- ii. A can holder can hold 3 cans coming from Hopper.
- iii. It is Generally Made of steel Material.
- iv. Its cross section is of C–shape.
- v. We can fix it anywhere using Bolt.

4.3 Hopper

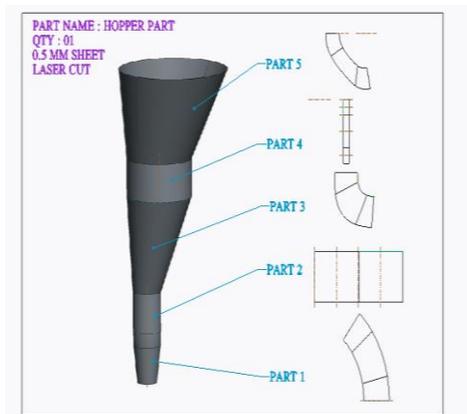


Figure 4.4 Hopper

A hopper in can crusher is used for collecting all the cans thrown at the top. In this design we have made hopper with five parts. It is so designed that if the can is thrown at the top of hopper it will fall vertically downward and the can will be collected at the bottom in a straight position. The can will also not get stuck at the midway of the hopper if two to three cans are thrown simultaneously.

4.4 Arduino

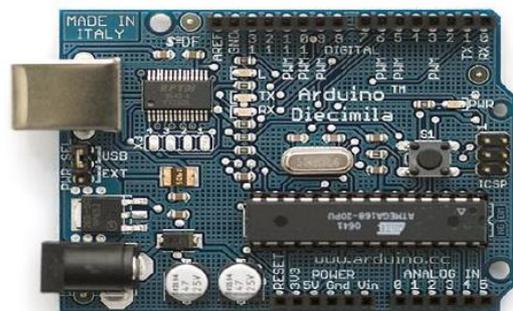


Figure 4.5 Arduino microcontroller

It is used to control overall system. A program is installed in it. It is intelligence part of this system.

4.5 Sensor



Figure 4.6 Ultrasonic sensor

Electric Parameters

Working Voltage DC	5 V
Working Current	15mA
Working Frequency	40Hz
Range	2cm to 400cm
Trigger Input Signal	10uS TTL pulse
Echo Output Signal Input	TTL lever signal and the range in proportion

5. Working:

There are 6 stages of working as shown below:

1. Neutral position

At neutral position both the DCV's are at spring offset position as shown in figure. At

this position both the cylinders are in retracted position.

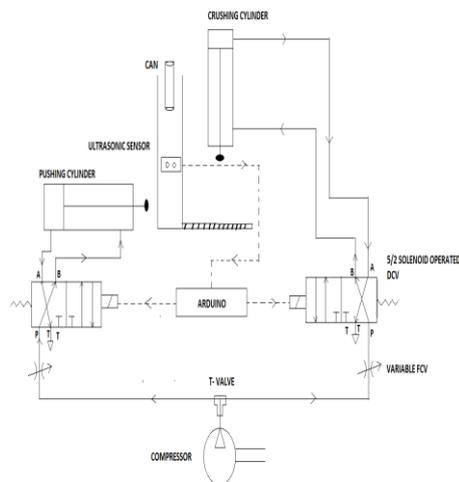


Figure 5.1 Neutral Position

2. Starting of extension stroke of pushing cylinder

At this stage DCV of crushing cylinder is in spring offset position. If we put a can in hopper then at lower end of can holder sensor senses the can and extension of pushing cylinder starts.

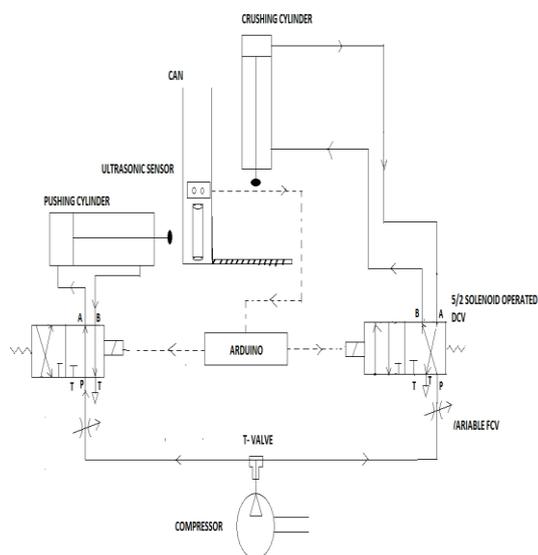


Figure 5.2 Starting of extension stroke of pushing cylinder

3. End of extension stroke of pushing cylinder

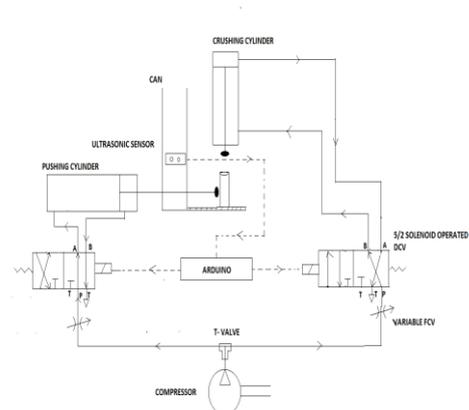


Figure 5.3 End of extension stroke of pushing cylinder

At this stage full extension of pushing cylinder takes place and the DCV of crushing cylinder is in spring offset position. Can is pushed under crushing cylinder.

4. Return stroke of pushing cylinder

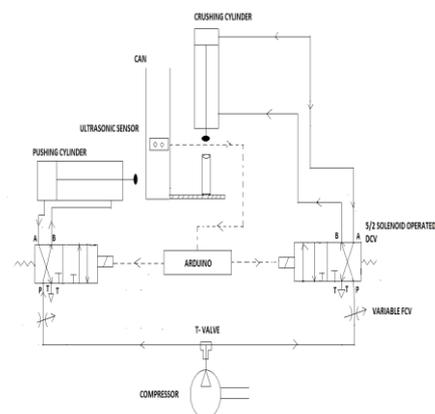


Figure 5.4 Return stroke of pushing cylinder

Then the return stroke of pushing cylinder takes place. Still the DCV of crushing cylinder is in spring offset position and at this stage DCV of pushing cylinder is also in spring offset position.

5. Extension stroke of crushing cylinder

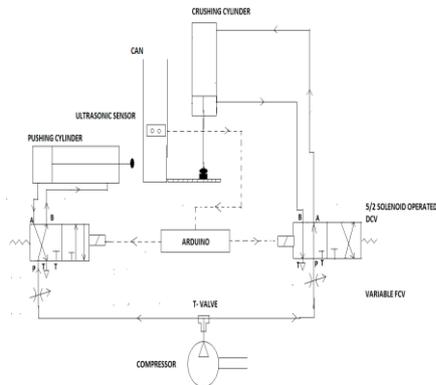


Figure 5.5 Extension stroke of crushing cylinder

At this stage the DCV of the pushing cylinder is in spring offset position and the extension of crushing cylinder takes place. Due to pressure around 6.5 bar, the piston plate crushes the can.

6. Return stroke of crushing cylinder (Neutral position)

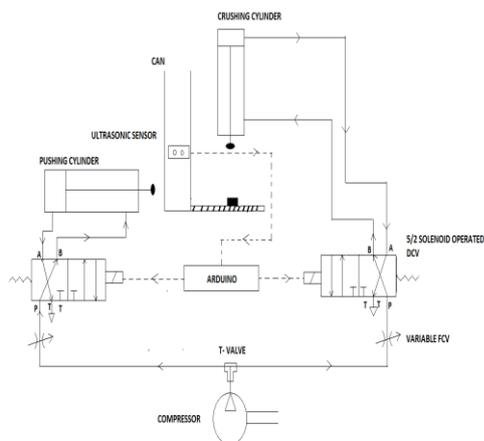


Figure 5.6 Return stroke of crushing cylinder (Neutral Position)

This is the last stage. At this stage both the DCV's again came back to spring offset position and neutral position is achieved. In this way total working of system takes place

6. Conclusion

Using this project we can dispose more number of cans in less space. Also energy required for recycling the crushed can will be less as compared to cans which are not crushed. The transportation cost for this will also be less.

7. Acknowledgements

We would like to express our sincere thanks and gratitude to our internal guide Prof. K.P.Agte, Department of Mechanical Engineering, Smt.Kashibai Navale College of Engineering, Pune for valuable suggestions and pains taken in supervising our work despite her busy schedule.

We are also grateful to Dr. A.P. Pandhare, Head Department of Mechanical Engineering for providing moral support and guidance. Our sincere thanks are also due to all the faculties of Mechanical Engineering Department for suggestions and motivation.

8. References

- [1] Design and development of an economic autonomous Beverage cans crusher A. Elfasakhany^{1, 2 *}, j. Marquez², e.y. rezola², j. Benitez ², volume 3, issue 3, September - December (2012), pp. 107-122.
- [2] Mr. Che Mohd Akhairil Akasyah B Che Anuar Faculty of Mechanical Engineering in University Malaysia Pahang in the year Nov.2008 in his project report entitled "Development of the Can Crusher Machine".
- [3] Zulkifli, M., 2008. Design of a Recycle Bin Tin Can Crusher, Faculty of Mechanical Engineering, Malaysia Pahang Univ. Report.
- [4]]Cao Jinxi, Qin Zhiyu, Rong Xingfu, Yang Shichun presents a paper on " Experimental Research on Crushing Force and its Distribution Feature in Jaw Crusher " 2007 Second IEEE Conference on Industrial Electronics and Applications. 1-4244-0737-0/07/\$20.00 © 2007 IEEE.
- [5] Design Consideration in an Automatic Can/Plastic Bottle Crusher Machine Vishal N. Kshirsagar¹, Dr. S..K Choudhary², Prof. A.P Ninawe² ¹Research Scholar (M.Tech Pursuing, M.E.D), KDK College of Engineering, Nagpur, Maharashtra, India ² KDK College of Engineering, Nagpur, Maharashtra, India, Volume 2, issue 4, June-July, 2014 Issn 2091-2730.