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Design and Fabricatoin of Automated Can Crushing Machine

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ABSTRACT: This project is to in order to recycle the cans. It will also reduce the human effort needed and the time consumed thereby making the process more efficient and faster. The main aim of this project is to fabricate a can crusher machine to reduce the volume of the cans thereby making it easy to transport the cans for the recycling purposes. Now-a-days large amount of cans has been used in hotels, bakeries etc... Therefore a huge space has been required for storing and dumping these used cans. Here we are using the slider crank mechanism to convert the rotary motion into the linear motion, thereby crushing the cans with the help of a piston. The main advantage this machine was that it was double sided, it means that we can crush cans during both the forward and backward stroke of the piston; hence the efficiency will be twice of the ordinary one.

Keywords: Double Sided,Automated,Crushing Machine

I. INTRODUCTION

In today's lifestyle most of the food items are packed in cans. Cans have become one of the unavoidable things in our day to day life. Commercial establishments such as cafeteria and bars have to deal with these leftover cans. Storage is often a problem and these cans occupy a large amount of space, thereby increasing total volume of trash. The transportation cost is also high for transporting such a large volume These cans are usually made up of aluminium.The cans are cylindrical in shape. The basic dimensions of a coke can were- 4.83 inches high, 2.13 inches in diameter at the narrowed top and 2.60 inches throughout the rest of a cylindrical can.

The main purpose of this project is to get good knowledge of design and fabrication. The design is both environmental and user friendly and uses the simple mechanism such as slider crank mechanism. In order to reduce the volume of waste, we planned to create a can crushing machine that will reduce the volume of aluminium cans by approximately eighty-five percent. The machine can be used at any place, where the amount of waste is high such as malls, restaurants, canteens etc... The main advantage of the machine is that it does not require any skilled labour. It requires a labour support only for the process of loading and unloading of the cans.

This machine comprises of two major sub units, the first sub units consists of the major parts such as the motor, flywheel and the second sub unit is the major unit where the can has been crushed, it consists of the piston for crushing the cans and the cans to be crushed has been placed orderly in a row like setup. Below this unit a basket like setup has been arranged in order to collect the crushed cans.

II. COMPONENTS DETAILS

2.1. FRAME

A frame is the most important structure of a machine to which all other components have been attached, comparable to the skeleton of an organism. Here we use the plywood because of its greater strength and dimensional stability. Other components have been attached to the plywood with the help of the bolts and nuts. The basic dimensions of the plywood are as follows: Length = 91cm, Width = 91cm, Height = 0.6cm**.**

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Table No-1.List of components and its Specifications

S.NO	COMPONENT	L x W x H (cm)	DIA (cm)	POWER	RPM
1.	Motor			0.75 kw	1000
2.	Fly Wheel		5		
3.	V Belt	L = 300			
4.	Connecting Rod	L = 30			
5.	Piston	L = 35	Outer = 5 Inner = 2		
6.	Base (Plywood)	L = 91 W= 91 H = 0.6			

2.2.MOTOR

An electric motor is an electrical device that converts the electrical energy into the mechanical energy. The motor used here was a DC motor. A DC motor is any of a class of rotary electrical motors that converts direct current electrical energy into mechanical energy. The most common types rely on the forces produced by magnetic fields. DC motors were the first form of motor widely used, as they could be powered from existing direct-current lighting power distribution systems. A DC motor's speed can be controlled over a wide range, using either a variable supply voltage or by changing the strength of current in its field windings. Small DC motors are used in tools, toys, and appliances. Larger DC motors are currently used in propulsion of electric vehicles, elevator and hoists, and in drives for steel rolling mills.

SPECIFICATION: 12V DC motor

2.3. V BELT

A belt is a loop of flexible material used to link two or more rotating shafts mechanically, most often parallel. Belts may be used as a source of motion, to transmit power efficiently or to track relative movement. Belts are looped over pulleys and may have a twist between the pulleys, and the shafts need not be parallel.

In our project v-belt has been used. The V-belt acts as a transmission belt. Connecting the v-belt pulleys, it transmits the force from motor to the ancillary components. In our project it connects the motor and the flywheel. SPECIFICATION: Length of the belt = 300cm

2.4. FLYWHEEL

A flywheel is a mechanical device specifically designed to efficiently store rotational energy (kinetic energy). Flywheels resist changes in rotational speed by their moment of inertia. The amount of energy stored in a flywheel is proportional to the square of its rotational speed and it's mass. Flywheels are used in reciprocating engines because the active torque from the individual pistons is intermittent. SPECIFICATION: Dia of the flywheel = 5cm

2.5. CONNECTING ROD

Connecting rod is used to transfer the load from the slider to the piston and it should be able to bear the high load. It should be strong enough to bear this high load. This part plays an important role in transferring the load. The connecting rod is connected between the flywheel and the piston which facilitates the working of the machine. The connecting rod is very much essential since it acts like a backbone of the device.SPECIFICATION: Length of the connecting rod = 30cm

2.6. PISTON ROD

It is the major component of this machine. It is used to crush the can with the help of the load transferred from the flywheel through the connecting rod. In this machine, the piston rod used was a double headed one. So, when the motor rotates the piston rod has been actuated both forward and backward. The cans have been placed near both the ends of the piston rod and due to the piston movement with heavy load the cans has been crushed and thus the volume of the cans has been reduced. As the piston rod used was a double

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headed one , in a single rotation of the flywheel two cans have been crushed. SPECIFICATION:

Length of the piston rod = 35cm, Outer dia of the piston rod = 5cm, Innerdia of the piston rod = 2cm

2.7. CAN HOLDER AND COLLECTOR

As the name suggests it has been used to hold the cans. It is made up of sheet metal. Its cross section is of shape. It can holdup to 5 cans. It is attached to the frame with the help of bolt and nuts.The collector used here was a plastic bucket. The crushed cans are made to fall into these baskets. It can hold a maximum number of crushed cans. It is placed directly below the crushing area.

2.8. SLIDER CRANK MECHANISM

A slider-crank linkage is a four-link mechanism with three revolute joints and one prismatic, or sliding, joint. The rotation of the crank drives the linear movement the slider, or the expansion of gases against a sliding piston in a cylinder can drive the rotation of the crank. There are two types of slider-cranks: in-line and offset. An in-line slider-crank has its slider positioned so the line of travel of the hinged joint of the slider passes through the base joint of the crank. This creates a symmetric slider movement back and forth as the crank rotates. If the line of travel of the hinged joint of the slider does not pass through the base pivot of the crank, the slider movement is not symmetric. It moves faster in one direction than the other. This is called a quick-return mechanism.

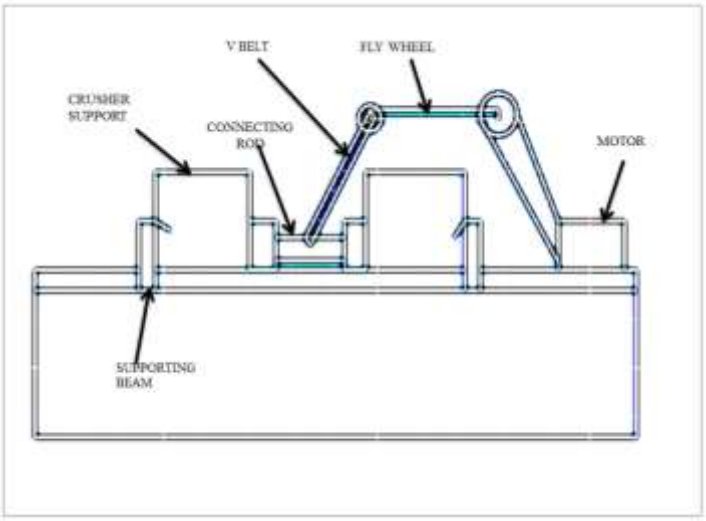

Figure-1. Schematic Diagram of Automated Can Crushing Machine

In the two types of slider crank mechanism available, in this project we are using the offset slider crank mechanism, as we need the force to be distributed properly in both the forward and backward strokes of the stroke for crushing two cans at a single rotation of the wheel. Hence the offset type has been selected.

3. DesignCalculations

1. Force required for crushing a can

Diameter of a can =70mm

P = 750W, N = 1000 rpm,

$P = (2\pi NT) / 60$

$104.7T = 750$

$T = 7.16$ Nm

$T = F \times r$

$7.16 = F \times 0.035$

$F = 204.57$ N

2. Amount of torque produced by the motor:

N = 1000 rpm

Torque, T = F x r

T = Force on the piston x Radius of the piston

$T = 981.25 \times (d/2)$

$T = 981.25 \times 25$

$T = 24.53$ Nm

To find w:

$w = (2\pi N) / 60$

$= 104.7$ rad/s

3. Force transmitted from the flywheel to connecting rods:

L = 300mm

= 0.3m

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Ratio of length of the connecting rod and flywheels = L / r

= 0.3 / 0.025

= 12

F =mw2 r ($\cos^0$ + ($\cos 2^0$) / n)

Assuming the mass of flywheel = 75 kg and ^{0} = 60

F = 75 x (104.7)2 x 0.025 x (cos60 + (cos120) / 12)

= 9.42 KN

4. Force produced on the piston

Diameter of the piston rod = 50 mm

F = P x A

A= (π/4) x d^2

A = 0.785 x $(0.05)^2$

= 1.9625x 10^{-3} m^2

Endurance Pressure Angle

Assume P = 1 to 9 bar

1 bar = 10^5 N/m^2

Let us assume that P = 5 bar

F = 5 x 10^5 x 1.9625 x 10^{-3}

Force produced on the piston (F) = 981.25N

5. Force exerted on the can by the piston during the forward stroke:

Piston rod's outer diameter = 50mm

Piston rod's inner diameter = 20mm

F = PπA

F = Pπ ($d_1^2 - d_2^2$) / 4

Assume, P = 5 x 10^5 N/m^2

F = 5 x 105 x π (0.052 – 0.022) / 4

F = 824.66 N

Table No-2Advantagesof electrically operatedcrushing machine over manually operated .

PARAMETERS	MANUALLY OPERATED	ELECTRICALLY OPERATED
Volume reduction of cans	**65%**	**85%**
No. of cans crushed in one minute	**10**	**20**
Time consumption	**More**	**Less**
Cost of fabrication	**Less**	**High**
Efficiency	**Less**	**High**
Human effort	**Required**	**Not required**

III. CONCLUSION

The automated can crushing machineis successfully designed and fabricated .Both aluminium and plastics can be crushed using this fabricated machines.I is very simple in design and easy to use Can Crusher machine withlow cost of construction and easily movable from one place to another.

- Thus reduce the volume of the cans at least 70%.
- In addition to this , it can crush the can during both the strokes, it will crush a can during the forward stroke and will crush another can during the return stroke.
- By crushing 2 cans in a single rotation of the flywheel, the productivity can be increased thereby crushing a large number of cans when compared with a ordinary can crushing machine.

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