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Motorized Beverage Can Crusher

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Abstract

The study of manufacturing was very important in order to carried out this project to ensure that student understand on what are needs to do. This project is about designing and fabricating the Recycle Bin Tin Can Crusher to helps people easy to crush the tin and bring anywhere. This project involves the process of designing the crusher using considering forces and ergonomic factor for people to use. After the design has complete, it was transformed to its real product where the design is used for guideline. These projects also require ensuring the safety for indeed of publishing. Methods and process involve in this project for instance joining using welding and cutting process. In this project, development of a recycle bin tin can crusher so the tin can might crush as flat and look as symmetrically as possible and inserted the bin. The designs area environment friendly and use simple mechanism properties such as fulcrum system. The design is done so that the knowledge of designing, mechanism and forces. 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. After all process had been done, this crusher may help us to understand the fabrication and designing process that involve in this project.

I. INTRODUCTION

The sole purpose of this project is to understand the fundamental knowledge of design and mechanism by using fulcrum system and a simple mechanism property. A mechanical tin can crusher is basically one of the most aid able machines. It helps to reduce the pollute environment of this world. Thus helps create a better place to live in. apart from that, this tin can crusher can actually be the future mode of recycles apart from the recycle bins. It can be placed everywhere, in the park, houses, even incars. Using a similar type of a design from the diagram below, but with the added a bin bellow the tin can crusher concept of recycling can be apply.This project interest and expose me the field of mechanism and design engineering.

To design the mechanical part of a tin can crusher and to fabricate the mechanical part of the system is the step to learn mechanical engineering. In this project, development of a recycle bin tin can crusher so the tin can might crush as flat and look as symmetrically as possible and inserted the conveyer belt Recycling plays a very important role to save our natural resources, as all we know we have limited natural resources. Now days, all packaging materials available are made up of recycling material only like paper, Aluminum, etc. and also we have a different recycling processes for material like plastic polymers.

Literature Survey

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.Can is 100% renewable this means that can you take to your local recycling centre today becomes a new aluminum can.There are no waste products in the process of making a 100% renewable resources and one of the best things can recycle.You might be surprised to know that within 60 days an aluminum can is able go from your recycling center and becomes a brand new can to be used by consumer.

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The title development of Motorized recycle bin tin can crusher requires an amount of good understanding on the knowledge of the science. Therefore, executing a research is necessary to obtain all the information available and related to the topic. The information or literature reviews obtained are essentially valuable to assist in the construction and specification of this final year project. With this grounds established, the project can proceed with guidance and assertiveness in achieving the target mark.

II.MATERIAL SELECTION

Factors considered for material selection

- Cost of Material
- Weight of the Materials
- Welding and forming ability of the Material

We have used mild steel to build all the components. Mild Steel used in sheet metal work has low carbon content. They are commonly categorized as either "hot rolled" or "cold rolled". Cold rolled steel sheets offer outstanding properties, including easy formability, a smooth, clean surface, material consistency, accuracy in thickness and are available in a wide variety of thickness. One main advantage of cold rolled steel is the ease of resistance spot welding. They are used in precision sheet metal applications, automobiles, appliances, furniture and many others

Material Used

sl. no	items	quantity	size	material
1.	disc	1 nos.	560 mm dia	mild steel
2.	connecting rod	1 nos.	350 mm	mild steel
3.	piston	1 nos.	68 mm dia	mild steel
4.	spur gear	1nos	_	mild steel

Components of Motorized Can Crusher

The following are the components of Motorized Can Crusher.

1. Base
2. DC Shunt Motor
3. Chain Sprocket
4. Spur Gear
5. Disc
6. Piston and Connecting Rod
7. Crushing Unit

Component Details

Base

It is the stationary and rigid part of the machine. Since the machine consists of the rotating parts which often produces vibrations when the rate of excessive vibrations produced by the rotating parts of the machine. It also provides the rigid support to the rotating part of the machine.

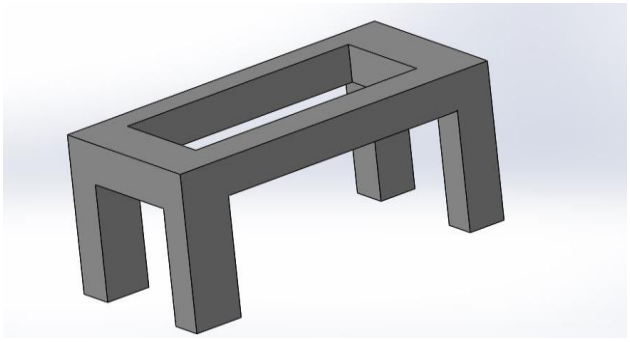

Fig1: 3D drawing of base

Disk

The disk is that rotating element of the mechanism which converts the rotating motion into sliding motion. The dick is the main part of the mechanism. It is made of the Mild steel

Rotary motion to translator motion

The conversion from rotary motion of the disk to the translator motion of the piston and connecting rod is achieved by placing an eccentric point on the disc shown below.

Fig 2: 3D Drawing of Disk

Hence we can say that rotation of disk produces revolution of eccentric point which forces the piston forward and backward by the mean of connecting rod

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and connecting rod, hence stock is produced by the piston.

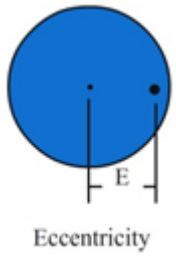

Fig 3:Eccentricity of disk

Specifications of disk:

- Radius of the disk (r) = 28cm
- Thickness of disk (t) = 5mm
- Material used for the disk is mild steel

Connecting Rod

The connecting rod is that element of the mechanism which transfer motion from one end of the connecting rod is connected to the slide piston while the other end is connected to the disk. The material used for connecting rod is Mild Steel.

Calculating the Length of Connecting Rod

The length of connecting rod should never be less than the diameter of the stroke length generated by the disk is equal to twice the radius of the disk i.e., diameter.

The second factor that matters for the length of the connecting rod is the distance between the rotating part and the sliding part. In our case it's the distance between the disk and the end of the sliding piston so the total length of the connecting rod is the sum of the distance between end of the sliding piston and the disk eccentric point and the diameter of the disk.

Fig 4: Connecting rod

Specifications of Connecting rod

- Length of connecting rod (l) = 35cm
- Radius of the disk® = 28cm
- Material used for the connecting rod is the Mild steel
- Thickness of the disk is (t) = 5mm

Spur Gear

Spur gears are the most common type of gears. They have straight teeth, and are mounted on parallel shafts. Sometimes, many spur gears are used at once to create very large gear reductions.This is because the spur gear can be really loud. Each time a gear tooth engages a tooth on the other gear, the teeth collide, and this impact makes a noise. It also increases the stress on the gear teeth.To reduce the noise and stress in the gears, most of the gears in your car are helical.

Fig 5: 3D Drawing of Spur Gear

Motor

In any electric motor, operation is based on simple electromagnetism. A current-carrying conductor generates a magnetic field; when this is then placed in an external magnetic field, it will experience a force proportional to the current in the conductor, and to the strength of the external magnetic field

The main types are DC motors and AC motors, the former increasingly being displaced by the latter. AC electric motors are either asynchronous or synchronous

Sprocket and chain

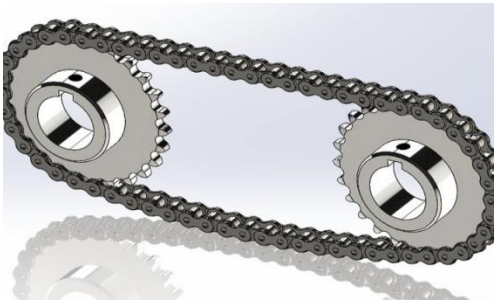

Fig 6:3D Designing of sprocket and chain

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A sprocket or sprocket-wheel is a profiled wheel with teeth, cogs,or even sprocket that mesh with a chain,track or other perforated or indented material. The name 'sprocket' applies generally to any wheel upon which radial projections engage a chain passing over it. It is distinguished from a gear in that sprockets are never meshed together directly, and differs from a pulley in that sprockets have teeth and pulleys are smooth.

Battery

There is a limited number of molecules in any charged battery available to react, there must be a limited amount of total electrons that any battery can motivate through a circuit before its energy reserves are exhausted. Battery capacity could be measured in terms of total number of electrons, but this would be a huge number.

III. SLIDER CRANK MECHANISM

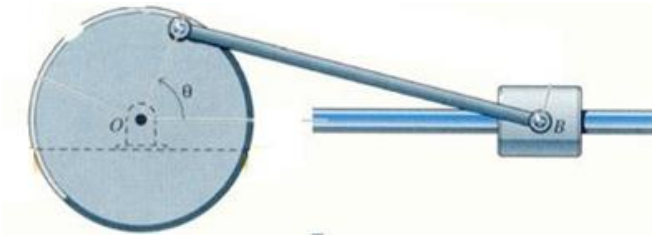

Fig 7: 3D drawing of slider crank

The main parts in the slider crank mechanism are the crank, connecting rod and piston. The Main purpose of the slider rank mechanism is it converts the rotating motion of the disk to the sliding movement or reciprocating motion. The Slider crank is one of the most used systems in the mechanical field. The disk is connected to the connecting rod with primitive joint. The connecting rod is connected to the sliding block with revolute joint and the slider block is connected with translational joint allowing to and fro motion of the block in one direction i.e., X-Direction.

Description of Joints

Joints	Revolute Joint	Translational Joint	Primitive Joint	Fixed Joint
No. of	2	1	1	2

Number of Moving Parts and Moment

S. No	Moving Parts	Revolute Joint	Translational Joint	Prismatic Joint	Moment
1.	2	1	1	1	1

Crushing Unit Of Can Crusher

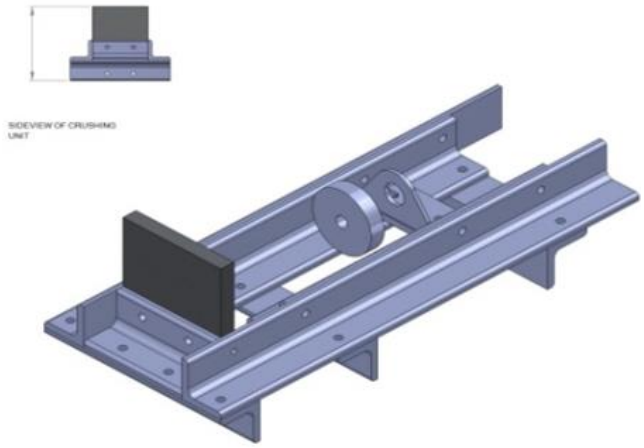

Fig 8: 3D Drawing of crushing unit

Can crushing unit is that part of assembly where the piston is used to force.so that it cn compress into small pieces.

The crushing unit consists of two parts

The Fixed or Rigid assembly.

The Sliding unit.

SPECIMEN CALCULATIONS

Volume of Uncrushed Can

Can Dimensions:

65 mm in diameter

32.5 mm in radius

Height=124 mm.

Volume of uncrushed can

V =πr2h

=π x 32.5 x32.5 x124

= 411.47 x103 mm3

Volume of crushed can:-

Can has been reduced by 70%.

Volume of crushed can

V = πr2h x 0.3

= π x 32.5 x 32.5 x 124 x 0.3

= 123.44 x 103 mm3.

The Force required to crush a can, F=6kg (experimentally)

We know that,Area of a can,

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A=πD^2/4
Where, Diameter of can,
D=6.5mm
=0.065m
Area of can, A=πD^2/4
A=(π×0.065×0.065)/4
A=3.31×〖10〗^(-3) m^2
When we apply the force to the can, the pressure is defined as the force applied divided by the area of application
Therefore,
Pressure =(force)/area
=(6×9.8066)/(3.31×〖10〗^(-3))
N/m^2 Where [1kg= 9.8066N]\
= 17.776×〖10〗^(-3) N/m^2
Shaft power of the disk
P =2πNT/60 Nm/s
where,
N=speed of crank (rpm)
T= torque (N-M)
We know that to calculate torque,
Torque=Force×Radius=F×R
Where,
R is the radius of disk
Therefore,
T = 58.84×0.28
= 16.475 (N-m)
Therefore,
Shaft power of the disk
P =2πNT/60
=(2×π×15×16.475)/60
P =25.879w
Output Power of Motor,
P=2πNT/60
where,
N =speed of motor shaft
=130 rpm
T = torque of motor
Given in specification of motor as 0-9 N-M
Therefore,
P =2πNT/60
=(2×π×130×9)/60
=122.52 W
The speed of the motor remains same all along the shaft (rpm). Then the product of shaft torque Tsh and the angular speed is called the power available at the shaft i.e., net output of motor

The shaft torque magnitude is always less than the armature torque

Conveyer Belt

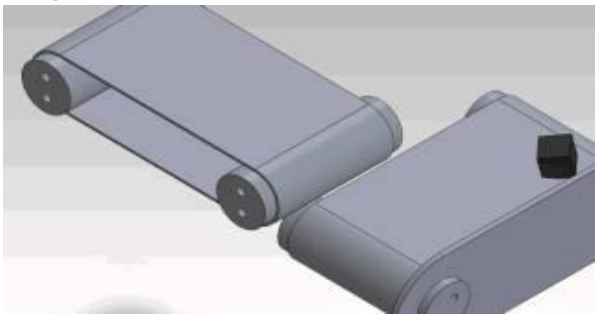

Fig 9:3D drawing of conveyer belt

The word conveys means to move. In the manufacturing industry, conveyor belts are designed to move products from one point to another or through a chain of assembly. Conveyor belts are designed for light and heavy duty applications.

Conveyor belts can transport products either in a straight direction or through directional changes and elevation. The purpose of the belt is to provide controlled movement of the product. Belts are designed in different sizes; systems used to run the belts operate in different.

Fig10: Conveyer belt

Storage Bin

A bin may be used to hold items of supplies and equipment in an individual compartment or subdivision of a storage unit in less than bulk quantities. In this project are bin will be used to store are crushed aluminum cans and recycle water bottles.

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There is a variety of things we can use as a storage bin. The bin is where all the crushed aluminum cans will be deposited after exiting the can crusher.

Fig 11: Storage Bin

WORKING OF CAN CRUSHER

Now as the motor rotates the motor is connected to sprocket and chain which is connected to spur gear shaft, the spur gear is connected to crank .The main purpose of using a spur gear is to reduce the speed. The mechanism used in this can crusher is slider crank mechanism. As the main motor rotates the spur gear reduces the speed which in turn rotates the disk and the whole mechanism starts working.

When the disk rotates the piston also moves with it which moves the slotted plate and the rods which are connected to the slotted plate also start to reciprocate and the pads connected to the piston crush the cans when the cans comes in the slot on the extreme corner of the stand. The crushed cans once crushed will pass through the rectangular slot provided and go into the conveyer belt.From our project we conclude that crushes the cans satisfactorily in very less time and that is why it can be used in mass production. By using slider crank Mechanism we have successfully made a can crusher.

Fig12:Can Crusher

Results after Finishing

After finishing the final product, we crushed he can and we got a flat shaped beverage can and the volume of the can is being reduced to 70%.Hence, by using this motorized can crusher we can crush number of cans easily.

Fig 13: CAN before crushing

Fig 14:after crushing

All these crushed cans are packed and transported to factory for recycling process.

Fig15: Crushed cans for recycling

Advantages and Limitations

Advantages

- Less expensive
- Eco friendly

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By reducing the size huge amount of cans can be transported for recycling.

Easy to handle

Occupy less space.

Easy to fabricate

Limitations

It is not able to crush high strength material cans

It cannot crush the can completely

Applications

The motorized can crusher is used mostly in the following:

Industries

Restaurants

Domestic use in kitchen

Observations

Total number of cans crushed per minute are 15

The reduced volume obtained after crushing the can is 30%

The number of cans that fall into the conveyer belt are 15 per minute

The number of cans that fall into the storage bin are 15 per minute

Future Scope

This paper has various futuristic technologies which are still under R&D and hence it will surely have use in the near future. Most work in the project constrained because of lack of essential resources and their high cost.

With an industrial grade camera this system can become more robust, crushing multiple cans with the help of a strong, rigid and larger can basher, with the help of sensor it is used to sense the cans which fall into the crushing unit and crush the can automatically, adjustable mechanism to accommodate varying can and bottle sizes.Increasing the force of piston, it will crush the thicker Aluminum cans, increasing the speed it will crush more number of cans

CONCLUSION

We learned from this project that designing is not easy job. Many factors have to be considered also the calculations to be repeated many times. This needs a team effort and more experience since we are students for that our project is limited.

We spend in this project more time in each activity from organizing the time table then the project selection. After we selected the project we progressed to model it and calculate many componentsby helping of solid works design. In this project we learned a lot but we still need to learn more and more before us becoming more professional designer. The design activities were so enjoyable and interesting because our project objective will help our country to recycle the cans and gain the benefit in how properly the economy side and environmental side. In our project the main component was the gears design.

In this project, we learned very useful knowledge in designing machines especially the solidworks design. We learned how properly created schedule and take the responsibility of time keeping and activity control.

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