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REVIEW ON DESIGN AND FABRICATION OF CAN CRUSHING MACHINE

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ABSTRACT—The project is about fabrication of mechanical crusher which would help to crush the used juice cans, paint cans and punched sheet metal waste. This paper aims To design a crusher that could be installed anywhere and would aid crush of used wastes. This paper involves the process of designing the crusher considering forces required for crushing and ergonomic factor that an operator needs. The design of this machine is such that it would require optimum load to crush metals and will not strain the user or operator. After the completion of design process, it is manufactured and transformed into a machine that would help in waste management. The crushing of used cans will also ensure that the cans are not used beyond -life of the metals. Therefore this paper will prove to be a useful asset in many ways. We have designed the crushing machine. The crusher is designed based in the simple principle or a mechanism which is Crank and Slotted Lever Mechanism where the rotary motion from the motor is converted into reciprocating motion by the crank which is in-turn connected to the piston that crushes materials. The Designed components were then assembled and analyzed using analysis software and the required dimensions of the crusher for performance have been found. These data's were then transformed into a real time model by manufacturing it the designed crusher was then checked and the crusher effectively crushed all the components with ease and with reduced human effort.

Key Words: crusher unit, crank disk, hollow cylinder

I. INTRODUCTION

The main purpose of the project is to get knowledge of design and fabrication. The design is an environment friendly and uses simple properties such as mechanical single slider. The design is done so that knowledge of designing, mechanism and forces analysis are increased. In order to reduce the waste, we planned to create a can crushing machine that will reduce the volume of aluminum cans by approximate eighty percent. This machine primarily used to save space and for recycling. It can be placed anywhere in park, restaurant, canteens, etc. in today's life most of the food items are packed in canned. Cold drinks and other beverages are also comes in cans. 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. Thus this machine will help to recycle and maintain eco-friendly environment also. This project involves the process of designing the different parts of the crusher machine considering the forces and ergonomic factor for people to use. This project mainly about generating a new concept of can crusher that would make easier to bring anywhere and easier to crush cans. After design has completed, it was transformed to its real product where the design is use for guidelines.

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 . It can be placed everywhere, in the park, houses. Using a similar type of a design from the diagram below, but with the added a bellow the tin can crusher concept of recycling can be apply. Therefore, as a student of mechanical engineering of University Malaysia Pahang, 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.

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 flattening

of cans". This project consists of designing and fabrication of an automatic can/bottle crusher machine. In order to reduce the waste, we planned to create a planned to create a can crushing machine that will reduce the volume of aluminum cans by approximate eighty percent. beverages are also comes in cans. 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 project involves the process of designing the different parts of the crusher machine considering the forces and ergonomic factor for people to use. This project mainly about generating a new concept of can crusher that would make easier to bring anywhere and easier to crush cans.

Now a days it is becomes the backbone of industrial activity to delivery their product to their customer. For crushing of cans manual operation is carried out which is time consuming and also fatigue to operator. Also various machines are available like hydraulic, pneumatic, and mechanical type machines but these machines are very costly, large in size, requires attention of operator. In order to solve this problem we are designing can crusher machine by using slider-crank mechanism having multi (two sides) crushing ability. The main advantages are that even unskilled person can easily handle it and we can achieve multi crushing ability at a low cost. In order to reduce the waste, we planned to create a cancrushing machine that will reduce the volume of aluminum cans by approximate 75 percent by which transportation volume will increase and transportation cost will reduce.

Various stress factors were also considered and suitable tolerances and factor of safety was accordingly employed to reduce chances of failure and increase the life and durability of the machine. Care was also taken to ensure minimum or negligible slipping of the belt to achieve maximum efficiency.

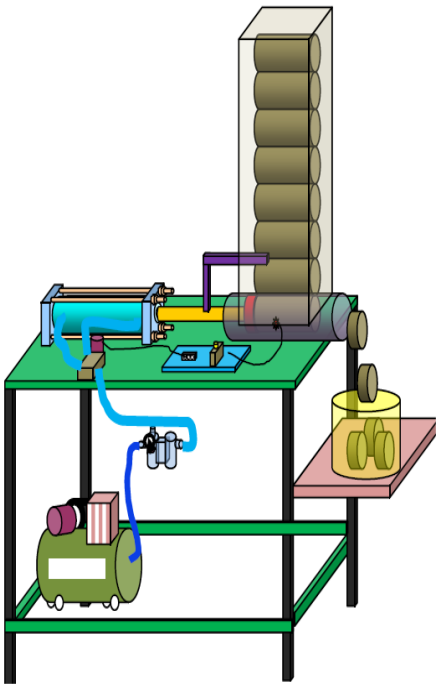


Fig. 1 Design of can crusher machine

1.1 Type of can crusher

Fig. 2 Several tin can crusher

1.2 Crusher

A crusher is a machine designed to reduce large solid material objects into a smaller volume, or smaller pieces. Crushers may be used to reduce the size, or change the form, of waste materials so they can be more easily disposed of or recycled, or to reduce the size of a solid mix of raw materials (as in rock ore), so that pieces of different composition can be differentiated. Crushing is the process of transferring a force amplified by mechanical advantage through a material made of molecules that bond together more strongly, and resist deformation more, than those in the material being crushed do. Crushing devices hold material between two parallel or tangent solid surfaces, and apply sufficient force to bring the surfaces together to generate enough energy within the material being crushed so that its molecules separate from (fracturing), or change alignment in relation to (deformation), each other.

The earliest crushers were hand-held stones, where the weight of the stone provided a boost to muscle power, used against a stone anvil. Querns and mortars are types of these crushing devices.

1.3 Types of Crusher

The most common types of crusher these days are basically used for help people. The design of these types enable them to crush follow the types of crusher and then crush as look as possible or destroy. These crusher types are jaw crusher, gyratory crusher and impact crusher.

1.3.1 Jaw Crusher

A jaw or toggle crusher consists of a set of vertical jaws, one jaw being fixed and the other being moved back and forth relative to it by a cam or pitman mechanism. The jaws are farther apart at the top than at the bottom, forming a tapered chute so that the material is crushed progressively smaller and smaller as it travels downward until it is small enough to escape from the bottom opening. The movement of the jaw can be quite small, since complete crushing is not performed in one stroke. The inertia required to crush the

material is provided by a weighted flywheel that moves a shaft creating an eccentric motion that causes the closing of the gap. Single and double toggle jaw crushers are constructed of heavy duty fabricated plate frames with reinforcing ribs throughout. The crusher's components are of high strength design to accept high horsepower draw. Manganese steel is used for both fixed and movable jaw faces. Heavy flywheels allow crushing peaks on tough materials. Double Toggle jaw crushers may feature hydraulic toggle adjusting mechanisms.

Figure-3 Jaw crusher

1.3.2 Gyratory Crusher

A gyratory crusher is similar in basic concept to a jaw crusher, consisting of a concave surface and a conical head; both surfaces are typically lined with manganese steel surfaces. The inner cone has a slight circular movement, but does not rotate; the movement is generated by an eccentric arrangement. As with the jaw crusher, material travels downward between the two surfaces being progressively crushed until it is small enough to fall out through the gap between the two surfaces. As an example, a Fuller-Traylor gyratory crusher features throughputs to 12,000 TPH with installed powers to 1,300 HP.

Fig. 4 Gyratory crusher

1.3.3 Impact Crushers

Impact crushers involve the use of impact rather than pressure to crush material. The material is contained within a cage, with openings on the bottom, end, or side of the desired size to allow pulverized material to escape. This type of crusher is usually used with soft and non-abrasive material such as coal, seeds, limestone, gypsum or soft metallic ores.

Fig. 5 Impact crusher

CYLINDER

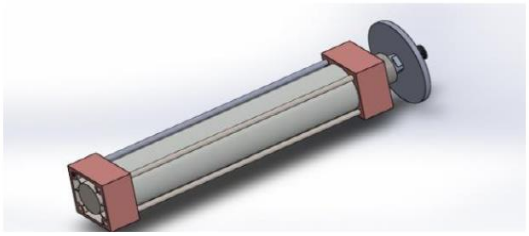
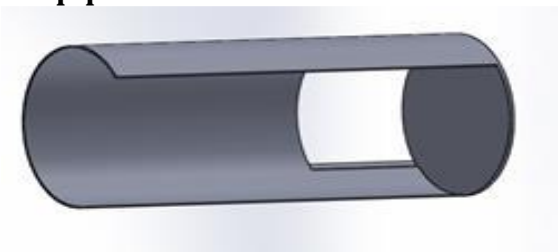


Fig. 7 Cylinder

The material used for the cylinder is aluminum, which is having specification of 50 diameter, 100mm in length and Permissible load (ft.) 180N/mm2. We have selected 50mm diameter cylinder so as to get proper force intended on can and
it get crushed ,here is the calculation carried out
The outer diameter of the cylinder,
Outer diameter Do = Di + 2 (t)
= 50 + 2 (3)
= 50 + 6
= 56 mm
Therefore, Force generated by cylinder
F = P x A
A = 3.14 / 4 x D^2
A = 3.14 / 4 x 50^2
A = 1964 mm^2
F = 2.45 x 1964 = 4808 N = 490 kg

Hollow pipe



3

This component is made up of mild steel and it is used when cans are put in a rectangular box after which it holds the cans and main important factor is to grip it and get it crushed one by one. To design this component mild steel is taken on which design is marked then it is cut by hack saw machine according to the marked then this pipe structure is faced from both the ends. Gas cutting is done on the rectangular pipe using gas cutter. Then welding is done on the rectangular face.

Table -1 Material Properties

Chemical composition (Ideal analysis to meet the majority of grades listed above)	
Carbon	0.16-0.18%
Silicon	0.40% max
Manganese	0.70-0.90%
Sulphur	0.040% Max
Phosphorus	0.040% Max

Mechanical properties in cold drawn condition		
Max Stress	400-560 n/mm²	dependent on ruling section
Yield Stress	300-440 n/mm² Min	dependent on ruling section
0.2% Proof Stress	280-420 n/mm² Min	dependent on ruling section
Elongation	10-14% Min	dependent on ruling section

FRAME

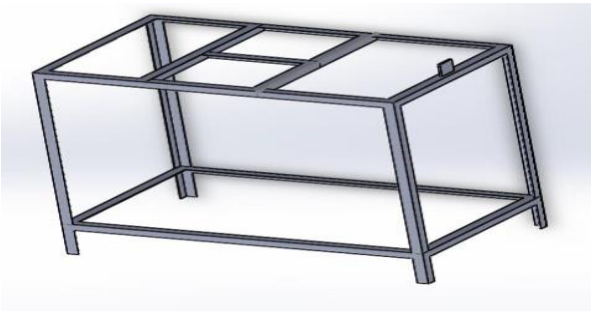


Fig. 9 frame

We have selected standard L section frame of material mild steel. The frame is supported due to possibility of vibration are more. Therefore, for foundation purpose pad plates are provided in between two legs a support of angle is given to avoid splitting of edge. Hinge of male type is fabricated and female is welded in frame and slotted plate known as table plate welded with male hinged accept on frame. Below the table plate toe angle are welded on legs. On this „S" shaped brackets are mounted, these brackets are used as bearing housing. In this brackets bearing are fitted. Bearing arbor is fitted which is main part of the machine and whole accuracy depends on it. The shaft is made according to IS-C-45 on center lathe machine in workshop and alignment of the shaft is supported between the center lathes during fabrication.

MOTOR

An electric motor is the main source of the project. Motor converts electrical energy into mechanical energy. To supply a mechanical energy through a rotary motion to the crank.

Fig. 10 Motor

Specification Type:
single phase induction motor Horse power: 1/2 Speed: 960.
Kind of Motors Squirrel - Cage Induction Motors (SCIM)
Design Standards IEC 60034, IEC 60072
Voltages 230V, 400V, 690V, 265V, 460V
Frequency 50Hz or 60Hz
Output Range 0.37 kW ~ 315 kW (50Hz) or 0.43 kW ~ 362 kW (60Hz)
R.P.M. (Syn.) 3000 ~ 750 R.P.M. (2 ~ 8 Poles) or 3600 ~ 900 R.P.M. (2 ~ 8 Poles)
Time Duty Continuous.S1 , S.F.: 1.0
Frame Nos. 80M ~ 315D
Protection Enclosure Totally Enclosed (IP 55)
Cooling Method Self External Fan, Surface Cooling (IC 411) .

CRANK DISC

Fig. 11 CRANK DISC

Crank disc is used to convert rotary motion from the source of electric motor to convert reciprocator momentum through connecting rod. It is drilled eccentrically to connect connecting rods. It is made up mild steel with diameter 200 mm and thickness 3mm.

Table -2 Material Properties

Mechanical Properties Tensile and Yeild Strength	
Tensile strength [Mpa]	400-550
Yeild point, min, [Mpa]	250
Elongation in 8 in. [200], min, %	20
Elongation in 2 in. [50], min, %	23

ANGLE PLATE

L - Angle plate is plate is used construct base of the stand. All the parts are mounted on them structure. It is made of mild steel with thickness of 3mm and width of 1(1/2) ×1(1/2) inches.

Grades of Carbon & Alloy Steel Also known as mild steel, it is a low-cost material that is easy to shape. While not as hard as higher-carbon steels, carburizing can increase its surface hardness.

Fig. 12 ANGLE PLATE

Medium Carbon Steel – Composition of 0.29%-0.54% carbon, with 0.60%-1.65% manganese.

HOLLOW PIPE

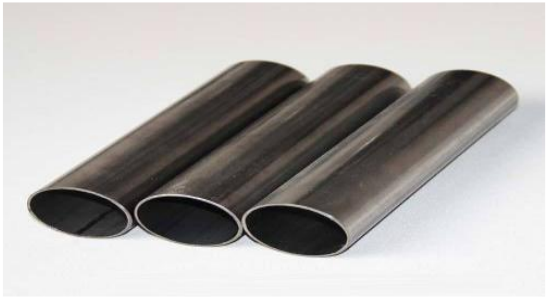


Fig. 13 HOLLOW PIPE

Hollow pipe is an act has a slider to move piston inside the cylinder through forward and backward motion to crush tins. It is made up of GI metal with thickness of 3 mm and diameter of 7 mm.

SHAFT

Fig .14 SHAFT

Shaft is used to transmit power to crank disc which is welded at the one end of it. It is made up mild steel with diameter 20mm and length of 600 m.

Table -3 chemical composition

Chemistry of Crankshaft Alloys
Nominal Percentages of Alloying Elements

Material	AMS	C	Mn	Cr	Ni	Mo	Si	V
4340	6414	0.40	0.75	0.82	1.85	0.25		
EN-30B		0.30	0.55	1.20	4.15	0.30	0.22	
4330-M	6427	0.30	0.85	0.90	1.80	0.45	0.30	0.07
32-CrMoV-13	6481	0.34	0.55	3.00	<0.30	0.90	0.25	0.28
300-M	6419	0.43	0.75	0.82	1.85	0.40	1.70	0.07
Key:	C = Carbon		Mn = Manganese			Cr = Chromium		
	Ni = Nickel		Mo = Molybdenum			Si = Silicon		
	V = Vanadium		AMS = Aircraft Material Spec Number					

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.

Gear specification

Spur Gears is a cylindrical shaped gear with straight line tooth traces

PCD: 40 mm to 1000 mm

Module: 1.5 – 10

Fig. 15 Spur gear

Crushing Unit of Can Crusher

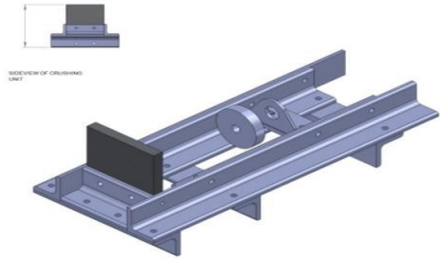


Fig. 16 Crushing Unit

Crushing unit is that part of assembly where the piston is used to force. so that it can compress into small pieces. The crushing unit consists of two parts.

WORKING

When the motor starts rotates the motor shaft is having a smaller pulley connected to its shaft, the smaller pulley through the belt is connected to secondary pulley. Which is connected to the main pulley? As the main pulley rotates it also rotates the main shaft which in turn rotates the disk and the whole mechanism starts working. When the disc rotates the connecting rods also moves with in the circular hollow pipe acts has slotted in horizontal direction to moves the piston forward and backward direction through connecting rods which are connected to the piston also start to reciprocates in both directions at the one end (TDC) of circular hollow pipe a strong material is welded to crush the cans with effectively. Two circular hollow pipes are welded on the horizontal frame one is at the left side and another one is at the right side. When the cans comes in the slotted top dead end on the two extreme corners of the both circular hollow pipe. Left side part piston is at the top dead end (TDC) angle of the cycle is 00 and another right part piston is at the bottom dead end (BDC) angle of the cycle is 1800 at initial position. When crank rotates the connecting rods also rotates first half cycle angle reaches to 1800. When the left side piston moves backward direction and the right side piston moves forward direction. To crush the cans reciprocating towards the top dead end (TDC) in the forward direction and right side part piston moves towards the bottom dead end (BDC) in backward direction. Once crushed will pass through the hollow space is provided between top dead end and go into the waste bins directly. Another half cycle takes angle reaches 3600. In these each cycle of rotation of disc crush two cans one by one. Therefore process is repeatedly continuous to crush the cans on both the cylinders one by one. From our project we conclude that it crushes the cans satisfactorily in very less time and that is why it can be used in mass production.

ADVANTAGES AND LIMITATION ADVANTAGES

1. Saves time since it has a multi-crushing ability.
2. Less labor cost.
3. Crushing is done at very low cost.
4. Scrap recycling industries will not have to invest much on crushing of the cans.

LIMITATION

- Required can is in good manner
- Crushes only single can at a time
- is not able crush high strength material cans
- It can't crush the can completely

SUMMERY / EXPECTED OUTCOME

- In this project, we designed the mechanical can crusher manually and generated. in 3d model by using pro*9 design software the pneumatic can crusher was fabricated. from all the results obtained, the design was practically done safe to operate
- Reduce the volume of the can and also in less force required to crush the can.
- By using automation crushing capacity per hour is increases.
- By automation less human effort required.

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