

Can crusher machine using scotch yoke mechanism

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ABSTRACT: Nowadays in India, recycling is one of the areas which is rapidly increasing day by day. The amount of waste coming is in a tremendous quantity. Aluminium cans and Tin plate cans are one of the important product which is being recycled on an increasing scale. For carrying out this recycling can crushers are used. For recycling of these cans, manual operation is being carried out in industries, which is a time consuming process and ultimately it leads to the reduction of production rate. In order to crush the cans in a less time, we are designing a can crusher machine using scotch yoke mechanism having multi or two side crushing ability. A can crusher machine is used for crushing aluminium soda cans for recycling purpose and also for easy storage in recycling bins. The scotch yoke mechanism converts the rotating motion into reciprocating motion, this is the principle which we are using in our can crusher.

Keywords : scotch yoke mechanism, rigid construction at low cost, electric supply.

I. INTRODUCTION

Aluminium can recycling is the process by which scrap aluminium can be reused in products after its initial production. The process involves simply re-melting the metal, which is far less expensive and energy intensive than creating new aluminium through the electrolysis of aluminium HYPERLINK "http://en.wikipedia.org/wiki/Aluminium_oxide" oxide (Al_2O_3), which must first be mined from bauxite ore and then refined using the Bayer process. Recycling scrap aluminium requires only 5% of the energy used to make new aluminium. For this reason, approximately 31% of all aluminium produced in the United States comes from recycled scrap.

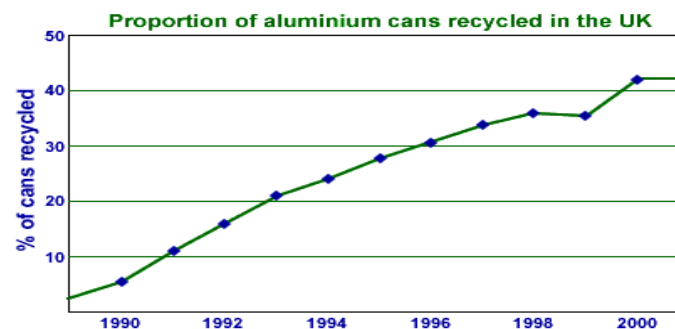


Fig. existing increasing % of cans recycled in uk

In today scenario our country is facing huge difficulty in recycling of soft metal like (aluminium cans).now a days it is becomes the backbone of industrial activity to delivery their product to there 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.

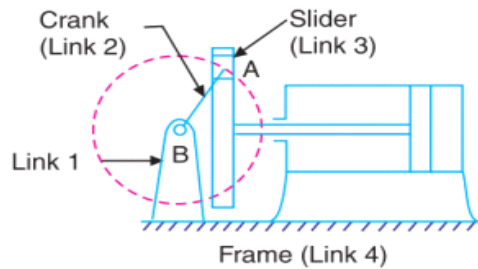
In order to solve this problem we are designing can crusher machine using scotch mechanism having multi(two side) crushing ability. The main advantages is that even unskilled person can easily handle it and we can achieve multi crushing ability at a low cost.

1.1 Definition of can crusher

A can crusher is a device used for crushing aluminum soda 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 can crusher gives you extra space by flattening either single or multiple cans.

1.2 Concept of mechanism

The Scotch yoke is a reciprocating motion mechanism, converting the linear motion of a slider into rotational motion or vice-versa. The piston or other reciprocating part is directly coupled to a sliding yoke with a slot that engages a pin on the rotating part. The shape of the motion of the piston is a pure sine wave over time given a constant rotational speed.



This mechanism is used for converting rotary motion into a reciprocating motion. The inversion is obtained by fixing either the link 1 or link 3. In Fig, link 1 is fixed. In this mechanism, when the link 2 (which corresponds to crank) rotates about B as centre, the link 4 (which corresponds to a frame) reciprocates. The fixed link 1 guides the frame.

II. WORKING

Now as the motor rotates the motor is having a smaller pulley connected to its shaft, the smaller pulley through the belt is connected to secondary pulley which rotates it.

There is another pulley which is connected to the main pulley through belt which also rotates it. 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 disk rotates the collar also moves with it which moves the slotted plate left and right and the rods which are connected to the slotted plate also start to reciprocate and the pads connected to the rods crush the cans when the cans comes in the slot on the two extreme corners of the stand

The crushed cans once crushed will pass through the rectangular slots provided and go into the waste bins. 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.

By using Scotch Yoke Mechanism we have successfully made a can crusher.

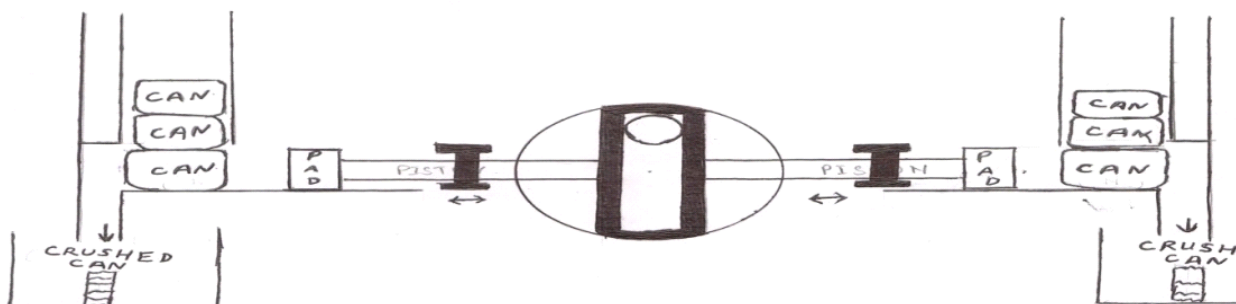


Fig.Design of Can Crusher Machine

III. DESIGN AND CONSTRUCTION

3.1 Pulleys and Shafts

The can crusher consists of four pulleys, two of which are smaller pulleys having the same diameter of 81 mm and there are two bigger pulleys one of them is connected to the main shaft having a diameter of 11 inches and the other pulley having a diameter of 9 inches which is connected to the secondary shaft.

Now there are two shafts, one is the main shaft having diameter of 28 mm which is connected to the Scotch Yoke Mechanism. This shaft is supported by two pedestal bearing which are supported on two horizontal angle bars.

The other shaft is the secondary shaft having a diameter of 38 mm which is used speed reducing by using pulleys which are connected on one of its end. There are two pillow bearings which supports this shaft.

3.2 Mechanism:

Now coming on to the mechanism as described earlier that it is a Scotch Yoke Mechanism. It consist of circular disk having a diameter of 310 mm which is having a hole of 13 mm thickness so that the collar which will be supporting the slotted plate can enter into the hole. The disk is made up of mild steel.

The collar is also made up of mild steel. The collar is having four different diameter, the collar is threaded on one of its end to which a nut is fixed. This collar is inserted in the hole provided in the circular disk.

There is a slotted plate which is supported by the collar. The slotted plate is having a slot of 48 mm thickness. The length of the slotted plate is 304 mm. The slotted plate consist of two internal threading on its left and right side so that the two pistons having reciprocating motion can be attached.

The two pistons/rods having a length of 380 mm and diameter of 22 mm are threaded on one of its end the threaded part enters the internal threading of the slotted plate.

The other end of the rod is connected to the pads which crush the cans.

The pads are mild steel pads having thickness of 26 mm and diameter of 88 mm.

3.3. Frame and other parts:

The stand which supports the complete assembly is made up of angle bars.

The stand is 4*2 feet in size.

The stand has been made by welding each angle to one another.

The portion of the stand which is coming on the side of mechanism consist of two mild steel plates having length of 155 mm and breadth of 134 mm and a thickness of 13 mm. On these plates the pad strikes the can.

On the two extreme corners there are two slots provided so that the crushed cans can go to the waste bins.

IV. CALCULATION AND EQUATIONS:

Main Pulley speed :

$$N_1 = 1425 \text{ R.P.M}$$

$$N_2 = ?$$

$$D_1 = 225 \text{ mm}$$

$$D_2 = 275 \text{ mm}$$

$$N_2/N_1 = D_1/D_2$$

$$N_2 = 1165.90 \text{ R.P.M}$$

Secondary Pulley Torque :

$$\text{Power} = 736 \text{ watts}$$

$$P = 2 * \pi * N_1 * T_1 / 60 * 10^3$$

$$T_1 = 4.93 * 10^3 \text{ N-mm}$$

$$T_1 = \pi / 16 * f_s * d_1^3$$

$$f_{s(\text{ind})} = 1.14 \text{ N/mm}^2 < f_{s(\text{perm.})} = 34 \text{ N/mm}^2$$

Therefore, Design is Safe

Main Pulley Torque :

$$\text{Power} = 736 \text{ watts}$$

$$P = 2 * \pi * N_2 * T_2 / 60 * 10^3$$

$$T_2 = 6.77 * 10^3 \text{ N/mm}^2$$

$$T_2 = \pi / 16 * f_s * d_2^3$$

$$f_{s(\text{ind})} = 1.39 \text{ N/mm}^2 < f_{s(\text{perm.})} = 34 \text{ N/mm}^2$$

Therefore, Design is Safe

For Load Calculation :

$$F_1 = 4P / \pi d^2$$

$$P = 353 \text{ KN}$$

Motor:

$$\text{Power HP} = 1$$

$$\text{R.P.M.} = 1425$$

$$\text{Cycle} = 50$$

$$\text{Volt} = 230 \text{ volt}$$

V. CONCLUSION

Advantages

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

Applications

1. It can be used in scrap industries for crushing cans.
2. It can be used in multiplexes, malls ,and in places where there is a lot of use of cans .

Testing and Result

Following table shows the tests which were carried out on the Can Crusher and the following results were obtained :

Sr.no	No. of cans	Time Required To Crush the Can		Mean sec
		L.H.S sec	R.H.S sec	
1.	2	1.70	1.75	1.72
2.	2	1.65	1.69	1.67
3.	2	1.57	1.59	1.58
4.	2	1.55	1.65	1.6
5.	2	1.70	1.69	1.71
6.	2	1.72	1.70	1.71
7.	2	1.59	1.54	1.56
8.	2	1.77	1.70	1.73
9.	2	1.70	1.75	1.72
10.	2	1.59	1.61	1.60

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