

# Electromagnetic Punching Machine

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**Abstract-**Punching Machine is one of the principle machines in paper cutting industry & sheet metal industry. It is mainly used as the name indicates to cut strips. So we are going to make a machine for punching industries and make it multipurpose & should be used to cut the card board, asbestos sheets, papers, foam, and thin plastic sheets. The machine is simple to maintain, easy to operate. Hence we tried our hands on Electromagnetic Punching Machine. Electromagnetic Punching Machine is working on the principle of electromagnetic. This type of punching machine is used to punch basically card board, asbestos, sheets, papers, foam, and thin plastic sheets. Punching is depend on feed rate which done manually.

## 1. INTRODUCTION

The project work assigned here with us is of building a multipurpose m/c that is capable of different small operation. Also it is pre-assigned work to furnish the same m/c along with an automation unit as previously mentioned. As simple layout and tricky operational enables this type of m/c to work practically at low cost, low maintenance, low capital investment in less space. It may be forecasted that in future this m/c may have its unparallel place in the industry mentioned previously.

## 2. LITERATURE REVIEW

Punching Machine is one of the principal machines in paper cutting industry & sheet metal industry. It is mainly used as the name indicates to cut strips. So we are going to make a machine for "PUNCHING INDUSTRIES" and make it multipurpose & should be used to cut the card board, asbestos sheets, papers, foam, thin plastic sheets. The machine is simple to maintain, easy to operate. Hence we tried our hands on "automatic punching machine." Automatic punching machine is working on the principle of electromagnetic. This type of punching machine is used to punch basically card board, asbestos, sheets, papers, foam, and thin plastic sheets. Punching is depend on feed rate which done manually. The Greatest challenge faced by an engineer is to overcome the energy wasted due to friction in any mechanical process. In a conventional punching process, mechanical or hydraulic force is used to operate the punch which involves large amount of metal to metal contact in the drive system components, as well as inaccuracy in the control of the punching forces at the micro level. This paper introduces the basic construction of an electromagnetic assisted punching machine to carry out the punching operation. After successful fabrication, the set up was tested and the punching force produced was validated. [1]

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Conventionally in various manufacturing industries punching operation is carried out manually or by means of a machine. These machines are mechanical, pneumatic or hydraulic. These machines are costlier for manufacturing,

installation and for maintenance also. Along with the running cost of these types of machines is also high. An electromagnetic punching machine proves itself better against these machines in respect with above said points. this research is about building a working prototype of above electromagnetic punching machine. In this machine punching operation is carried out on very thin Aluminum sheet or other soft material sheets. [International Engineering Research Journal (IERJ), Volume 2 Issue 7 Page 2417-2422, 2017 ISSN 2395-1621][2]

Punching Machine is one of the principle machines in paper cutting industry & sheet metal industry. It is mainly used as the name indicates to cut strips. So we are going to make a machine for "S I INTERPACK" and make it multipurpose & should be used to cut the card board, asbestos sheets, papers, foam, thin plastic sheets. The machine is simple to maintain, easy to operate. Hence we tried our hands on "automatic punching machine." Automatic punching machine is working on the principle of electromagnetic. This type of punching machine is used to punch basically card board, asbestos, sheets, papers, foam, and thin plastic sheets. Punching is depend on feed rate which done manually. Keywords: Coils, Current, Electromagnet, Punching Die, Springs. [Mechanical Department, Guru Gobind Singh Polytechnic, Nashik, Maharashtra, (India)][3]

This paper represents the Fabrication with Design of Electromagnetic Punching Machine The objective of this project work is to design a prototype machine of punching system using electromagnetic principle. This system is designed to cut soft materials i.e. Aluminum. C Cross sectional Beams are used to design the frame. Punch with different Punching die is considered in this project work. Coils are used for storing energy which are of wire diameter 2mm. Experimental Test is conducted to study its performance. The test results shows that, these types of machines can be implemented in all Small scale industries which results into control of accuracy of parts and Power Consumption. Prof. Fodase G. M [2] The author focuses on development of electromagnetic multipurpose Punching machine. These types of machines are developed for applications like paper cutting industry and sheet metal industry. Crank lever mechanism is used in collaboration with Solenoid circuit to perform the punching operation. These types of machines results into Better product quality and low amount of wear due to less metal to metal contact. Kundan Kumar [3] This paper develop Design and Fabrication of Auto Roll Punching Machine. The Project is based on principle of rolling mechanism using chain drive, CAM, Punches, Hoses and motor. CAM converts rotary motion to linear motion of the tool and this helps in punching operation. Thus the project work reduces manpower and production time. Mr. M.S. Wani, Shubham Jagtap, Saurabh Kothawade [4] Author has used the principle of Electromagnetism to create a force which is used to cut a strip. They have made this machine for 'SI Inter pack'. This machine is used to cut the cardboard, Asbestos sheet, Foam, etc. This setup helps to improve the accuracy. In this setup, Electric current is passed to coils which leads to attraction of punch and ultimately punching operation. This is used to minimize the friction effect and reduce manpower. [ISSN

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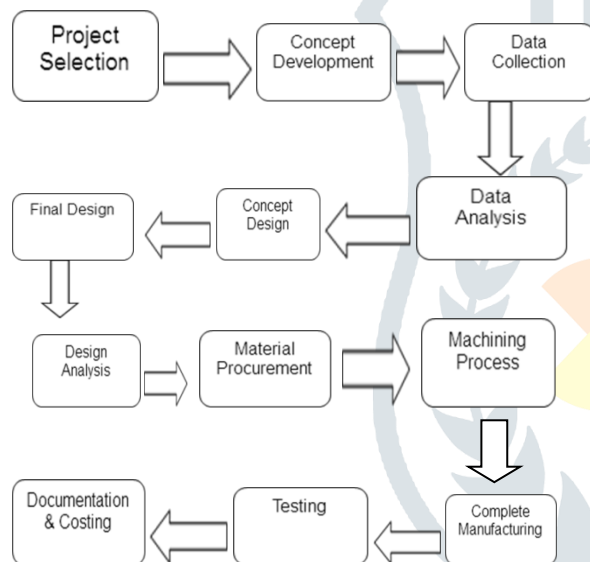
#### 4. PROBLEM STATEMENT

The statement of project is “design of automatic gasket punching machine” for the punching of different sizes of gaskets & card board as per requirements for industry.

The punching is the major operation performed in industry, and to perform this operation in mass number the manpower is require which results in to high cost of production, more time require to complete the operation, affect the accuracy of product so for automation in system we are trying to do a work on new system in punching.

#### 5. METHODOLOGY

As the main problem founded which is regard with quality and times consume to perform the desire operation so to develop the automation machine is best solution to overcome the same problem. These machines will give fully automation production with help of electromagnet. The below flow chart shows the sequential operation/steps that will be performed during the project process.



#### 6. PRINCIPLE OF ELECTROMAGNETIC PUNCHING M/C

An electromagnet is type of magnet in which the magnetic field is produced by a flow of electric current. The magnetic fields disappear when the current ceases. The wire produces loops of magnetic field lines around it. Imagine turning a screw so that it moves into a piece of wood. You have to turn it clockwise and it will move forward in analogy, the current represents the movement of screw and resulting field line direction is the direction of turning. If a wire is wound into a coil, then the field lines add up in such a way as to produce a set of field lines surround the coil in a similar way to those that surrounds a permanent bar magnet.

If further a piece of soft iron is placed inside the coil, the magnetic domain in the iron align with the field lines and they themselves serve as many little bar magnets in the iron, creating a strong bar magnet as long as the current is switch on

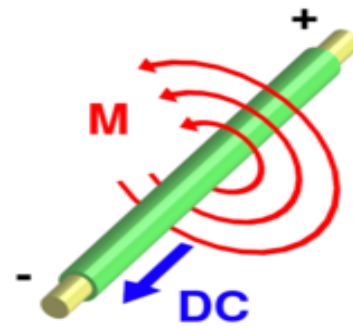


Fig no.1:- Principle of Magnetism

#### 7. WORKING OF ELECTROMAGNETIC PUNCHING MACHINE

At very first the material to be cut is feeder by inlet guide & is taken out of the guide. This is chairing the material with M/ C, wherever the material is to be cut for specific length the mat is needed to be pass out to that particular length & thereafter to be cutter, wherever electric is power supply to electromagnet, electromagnet generates flux with the help of same heavy magnetism is created. This core which is attached at the other end of this is attached a cutter which cuts the mat this is general simple working of punching m/s.

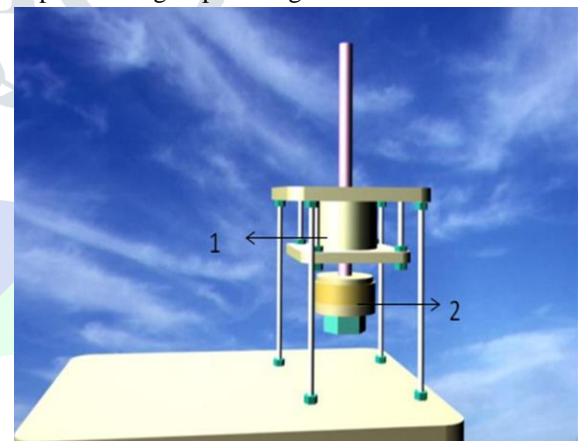


Fig no.2:- Electromagnet

As it turns out, the electromagnetic force is the one responsible for practically all the phenomenon one encounters in a daily life with the exception of gravity, roughly speaking all the forces involved in interaction between atoms can be traced to the electromagnetic force acting on the electrically charged protons and electrons inside the atom. These include the forces we experience in “pushing or “pulling ordinary material objects, which come from the intermolecular forces between the individual in our bodies and those one in the objects. It also includes all forms of chemical phenomenon.

#### 8. DESIGN

##### CALCULATION OF ELECTROMAGNETIC FORCE

Force on ferromagnetic materials

Computing the force on ferromagnetic materials is, in general, quite complex. This is due to fringing field lines and complex geometries. It can be simulated using finite element analysis. However, it is possible to estimate the maximum force under specific conditions. If the magnetic field is confined within a high permeability material, such as certain steel alloys, the maximum force is given by:

$$F = \frac{B^2 A}{2\mu_0}$$

Where:

- F** is the force in Newton
- B** is the magnetic field in teslas
- A** is the area of the pole faces in square meters
- $\mu_0$  is the permeability of free space

A is the area of electro magnet having diameters,  
 External diameter  $d_1=7\text{cm}$ ,  
 Internal diameter  $d_2=4\text{ cm}$ .

Hence area,  $A=3.14/4(d_1^2-d_2^2) =2.591 \times 10^{-3}\text{m}^2$

Putting the values in above equation we get,

Force (F) = **132.86** Newton. (For single magnet)

Total magnetic force  $F = 2X 132.86$   
 $= \mathbf{265.73}$  Newton.

**8.1 DESIGN OF SPRING:**

$F_1=265.73\text{N}$

Assume-Additional weight of punch & M.S plate with Die extension road is  $5\text{kg}=5 \times 9.81=49.05\text{N}$

Total Force= $265.73+49.05=314.78\text{N}$

Assume,

Weight on spring is maximum 350N will divide by % other return spring so for each spring Design force on each spring

$$F = 350 \div 4 = 87.5$$

$$F_{\text{max}} = F = 88\text{kN}$$

Maximum deflection of each spring 25mm

Spring index  $C = D \div d = 20 \div 2 = 10$

D=dia of Spring

d=dia of wire

maximum permissible shear stress for steel material as 400 N/mm<sup>2</sup>

Modulus of rigidity Assume 85 GN/m<sup>2</sup>

$F_{\text{max}}=88\text{N}$

$\delta=25\text{mm}$

$C=10$

$Z=400\text{N/mm}^2$

$G=85 \times 10^3 \text{ n/mm}^2$

Wire diameter-

$$\text{Wahl factor, } K_w = \frac{4C-1}{4C-4} + \frac{0.615}{C}$$

$$= \frac{(4 \times 10) - 1}{(4 \times 10) - 4} + \frac{0.615}{10}$$

$$K_w = 1.145$$

Shear Stress induced  $Z = K_w(8F_{\text{max}}C/\pi d^2)$

$$400 = 1.145(8 \times 88 \times 10 / \pi \times d^2)$$

$$d = 3\text{mm}$$

Assume wire dia.

Mean coil diameter

$C = D/d$

$$D = Cd = 10 \times 3$$

$$D = 30\text{mm}$$

No of coil

Spring stiffness,  $K = F_{\text{max}}/\delta_{\text{max}}$

$$= 88/25$$

$$= 3.52$$

$$K = Gd/8C^3n$$

$$3.52 = 85 \times 10^3 \times 2.53 / (8 \times 10^3)$$

$$n = 8 \text{ turn}$$

Assume Square & Ground end

Total no of Coil  $n' = n + 2$

$$= 8 + 2$$

$$n' = 10$$

Spring Length & Pitch

$$\text{Solid Length } L_s = (n+2) \times 2$$

$$= (8+2) \times 2$$

$$L_s = 20\text{mm}$$

Free length =  $L_s + \delta_{\text{max}} + (n'-1) \times 7$

$$= 20 + 25 + (10-1) \times 7$$

$$L_f = 378\text{mm}$$

Assume Clearance of 7mm between adjacent coil

$$L_f = Pn + 2d$$

$$378 = P \times 8 + (2 \times 2)$$

$$P = 11.81\text{mm}$$

**8.2. DESIGN MODEL**

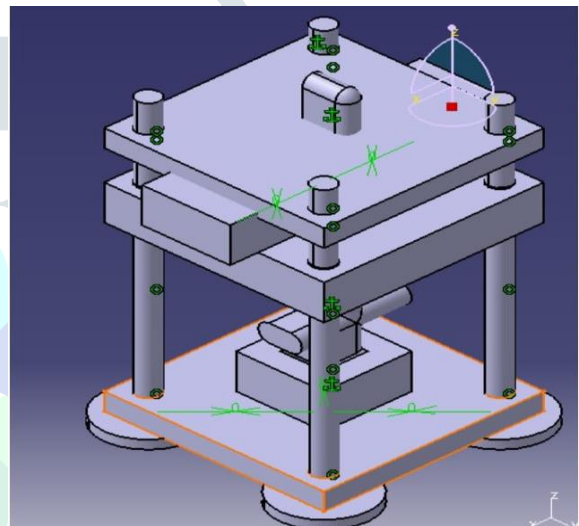


Fig no.3 :- Model of Electromagnetic punching machine

**8.3. SELECTION OF PARTS**

Part Name:-shaft

Part size :-  $\text{Ø}20 \times 420 \text{ mm}$

Part WT :- 1 kg

Part Qty :- 1

Part Material: - M.S.

Sr. No	Operation	Machine	Tool	Time
1	Cutting the material as required size	Power Hack m/c	Hacksaw Blade	10 min
2	Make a one side M12 thread	Lathe m/c	threading Tool	10 min
3	Facing side ends	Lathe m/c	Turing Tool	5 min

**Part Name:** - upper Plate  
**Part size** : - 250X250X6 mm  
**Part Qty** : - 1  
**Part Wt** : - 2 kg

Sr .No	Operation	Machine	Tool	Time
1	Cutting the material as our required size	Gas cutter	Gas nozzle	15 min
2	As in center M20 drill	Drilling machine	Drilling Bit 20mm	15min
3	Drilling four hole	Drilling machine	Drilling bit 10mm	15 min

**Part Name:** - lower Plate  
**Part size** : - 250X250X4 mm  
**Part Qty** : - 1  
**Part Wt** : - 2 kg

Sr .No	Operation	Machine	Tool	Time
1	Cutting the material as our required size	Gas cutter	Gas nozzle	15 min
2	As in center M20 drill	Drilling machine	Drilling Bit 20mm	15min
3	Drilling four hole	Drilling machine	Drilling bit 10mm	15 min

**Part Name :-** punch Die plate  
**Part size** : - 120X120X4mm  
**Part Qty** : - 1  
**Part Wt** : - 0.5 kg

Sr .No	Operation	Machine	Tool	Time
1	Cutting the material as our required size	Gas cutter	Gas nozzle	15 min
2	Grinding the faces of tool	Grinding m/c	Grinding Tool	15min
3	Welding the tool	Arc Welding	Welding torch	15min

## 9. APPLICATIONS

- 1) Punching of foam for packaging accessories.
- 2) Punching card board from 1mm to 5mm.
- 3) It can be used to punching the asbestos sheet for gasket sheet.
- 4) It is used to punching a plastic sheets and paper.

## 10. FUTURE SCOPE

The project included very simple type of Machine parts requiring very less component than conventional machinery. As work was successful studying & completing the results of this automatic electromagnetic punching m/c with solving other types of conventional punching machine problems associated with machine that can be implemented from higher to lower units cost. Its lowermost requirement of maintenance can again be beneficial for keeping cost

down. This machine runs on electricity only during punching operation. This few out of very large no of rows can project this m/c across the investment

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