# Design and Fabrication of Electromagnetic Press Machine

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**ABSTRACT**

*In past there was need for to develop machines which helps to reduce the human efforts. These machines fulfill the basic needs of the industries with minimum human efforts. For to survive in today's widely growing and competitive world, the company has to always implement new technologies which will help them to withstand in up growing m. This paper introduces the basic construction of an Electromagnetic assisted Press Machine. In this machine the force is generated by an electromagnetic coil wound around a metal core. Since the proposed design replaces Mechanical or hydraulic drive with an electromagnetic. The setup is capable to control the force generated by an electromagnet with controlling the power supplied. The press machine setup is designed to press thin aluminum sheet up to 5mm. After successful fabrication, the setup was tested and the results obtained after testing the machine shown that the performance of machine is better. It can also perform other functions with accuracy, at low cost and low maintenance.*

*Today's the manufacturing process is quick, so the less time more production will get . The traditional press machines are works on the hydraulic or Pneumatic systems. In these systems the leakage problem is very high and also these systems are more costly. The project work assigned here with us is of building a press machine that is capable to cut/bend sheet of 1/2 mm. Also it is pre-assigned work to furnish the same machine along with an automation unit as previously mentioned.*

*As simple layout and tricky operational enables this type of machine to work practically at low cost, low maintenance, low capital investment in less space. It may be forecasted that in future this machine may have its unparallel place in the industry mentioned previously*

**Keyword**: - *Electromagnet, power supply, bearing, cam and limit switch.*

## 1. INTRODUCTION

Press working may be defined as, a manufacturing process by which various components are made from sheet metal. This process is also termed as cold stamping. The machine used for press working is called a press.

The main features of a press are:

1. A frame which support a ram or a slide and a bed, a source of mechanism for operating the ram in line with and normal to the bed.

2. The ram is equipped with suitable punch/punches and a die block is attached to the bed.

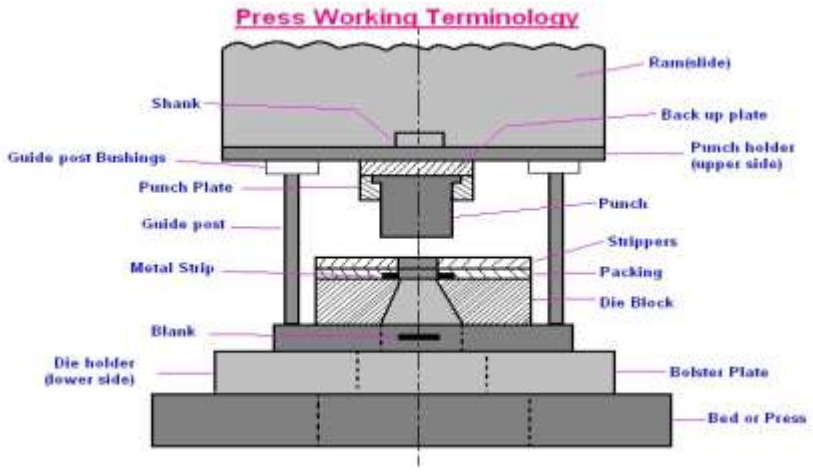


**Fig 1**- Press Work Terminology

3. A stamping is produced by the downward stroke of the ram when the punch moves towards and into the die block.

4. The punch and die block assembly is generally termed as a "die set" or simple as the "die".

## 2. METHODOLOGY

The setup is connected to single phase, 230 volt supply which when get „ON" the power is supply to the electromagnet and the magnetic field is get generated due to this magnetic field the mild steel rod on the electromagnet is get attracted towards the electromagnet and at the same time the push rod is also get in downward direction which creates the punch on material. The punching tool moves towards the die block and punches the surface of the work piece. The tool and work piece then separated by means of returns springs. The springs are initially compressed during the forward stroke. When the electric supply is cut off, the magnetic field ceases to exist and after the electromagnet loses its magnetization, the spring retracts, moving the punching tool away from the work piece and the cycle is completed.

## 3. PROBLEM IDENTIFICATION

**Table 1**- Problem Identifications

| HYDRAULIC | PNEUMATIC |
|---|---|
| Oil leakage | Leakage problem |
| Abnormal noise produced | Abnormal noise produced |
| High fluid temperature. | Condensation |

## 3. CONSTRUCTION AND WORKING

The aim behind to design this machine that is capable to perform small operations on aluminum sheet up to 5mm thick. We used angle bars for making of the frame work. A PVC material pipe issued as a plunger on which we have made an adjustment to attach the tool with the help of screw tightening. With changing the tool and die we can use the same machine to perform various operations like punching, sharing etc. It can be noticed that in fabrication many parts which are near to the electromagnet are non-ferrous materials. It is done so because ferrous material is good conductor of magnetism. To avoid distribution of magnetic flux, non ferrous material is used.

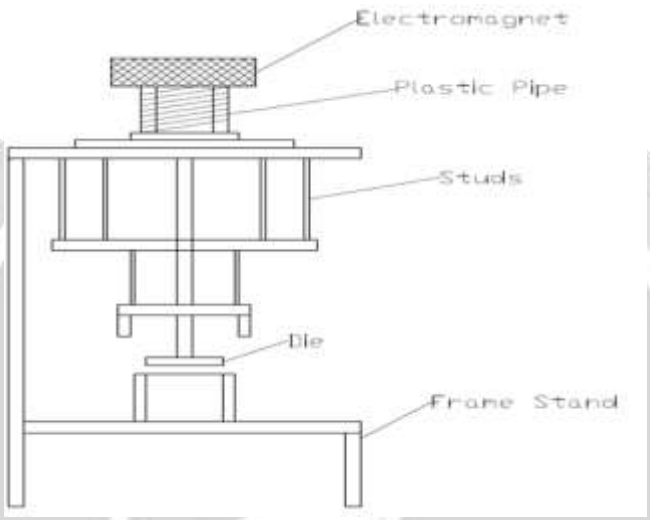


**Fig 2-** Schematic Diagram of Electromagnetic Press Machine

## 4. COMPONENTS

**Fig 3-** Electromagnet

**Fig 4-** Spring

**Fig 5**- Bush

**Fig 6**- Frame

## 5. DESIGN CALCULATIONS

If the magnetic field is confined within a high permeability material like certain steel alloys, the maximum force is given below,

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

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

$\mu_o$ is the permeability of free space.

**In the case of free space (air),**

$$\mu_o = 4\pi \times 10^{-7} H.m^{-1}$$

**In a closed magnetic circuit:**

$$B = \frac{\mu NI}{L}$$

Where:
N is the number of turns of wire around the electromagnet,
I is the current in amperes &
L is the length of the magnetic circuit.

Based on the above formulas we design electromagnet for our prototype model considering:
No. of turns on electromagnet (N) =1000, (20 gauge wire)
Current supplied (I) = 20amp
Length of electromagnet (L) =70 mm=0.07m

So using,

$$B = \frac{\mu_o NI}{L}$$

$$B = \frac{4\pi \times 10^{-7} \times 1000 \times 20}{0.07}$$

$$B = 0.359 wb/m^2$$

force on the piston is given by,

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

Where A is the area of electro magnet having diameters,
External diameter D=70 mm=0.07m
Internal diameter d=40 mm=0.04m

Hence area $A = \frac{\pi}{4} \times (D^2 - d^2)$

$$A = \frac{\pi}{4} \times (0.07^2 - 0.04^2)$$

$$A - 2.592 \times 10^{-3} m^2$$

Putting the value of A in above force equation we get,

Force $F = \frac{0.359^2 \times 2.592 \times 10^{-3}}{2 \times 4\pi \times 10^{-7}}$

F = 132.91Newtons

**Spring Calculations:**

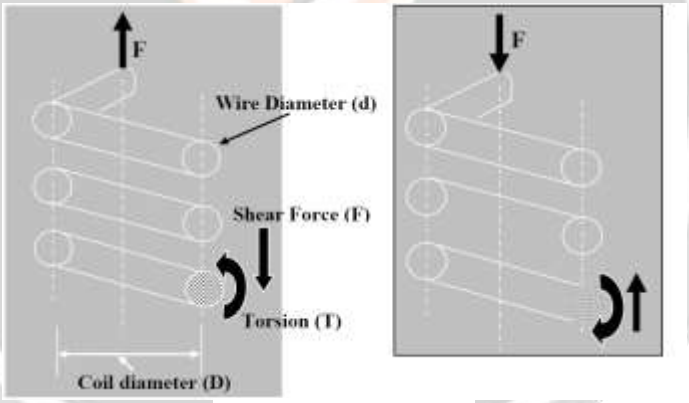


**Fig 7-** Design of Spring

**Where**

**Di** = Diameter of spring wire

**Do**=Diameter of spring coil

**W** = Axial load on spring

**G** = Modulus of rigidity

**C** = Spring Index = D/d

**P** = pitch of the coil

**δ** = deflection of the spring.

**1. Shear Stress of the spring:**

Total Resultant Stress of spring **(τ)** = $\tau_1 + \tau_2$

Where,

$\tau_1$ = Tensional shear stress

$\tau_2$ = Direct shear stress

$$\tau_1 = \frac{8 \times w \times D}{\pi \times d^2}$$

$$= \frac{8 \times 3 \times 30}{\pi \times 3^2}$$

= 25.44 MPa

$$\tau_2 = \frac{4w}{4d^2}$$

$$= \frac{4 \times 3}{4 \times 3^2}$$

= 0.33 MPa

$$\tau = \tau_1 + \tau_2$$

=25.44+0.3= 25.77 MPa

**2. Deflection of spring:**

$$\delta = \frac{8 \times w \times c^3 \times n}{G \times d} = \frac{8 \times 132.91 \times 3^3 \times 8}{84 \times 10^3 \times 3}$$ = 0.911mm

## 6. Advantages

1. It is portable.
2. It is compact, less floor space is required.
3. Variety of operations can be performed by changing the tool and die.
4. No need of skilled labor.
5. Running cost is low.

## 7. Disadvantages

1. Initial cost is high.
2. Operations cannot be performed on hard and thick materials.
3. Stroke length is fixed.

## 8. Conclusion

This project is successfully completed with the development of automated press machine. This machine useful for the industry to increase the efficiency by reducing manpower involvement. After making actual working model we got the following list of conclusions:

- This machine useful to increase efficiency by reducing manpower involvement.
- It is compact so less fool space is needed for installation.
- It requires low maintenance because there is no leakage problem of working medium.
- Easy operation with high rate of production.
- Semi skilled operator can easily operate the machine.

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