

Review of Press Tools and Importance of Cushion Pin to Improve the Productivity

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Abstract - A large number of industrial as well as Domestic Product are manufactured by using sheet metal. Operation perform on sheet metal are known as sheet metal operation. Thickness of the sheet metal is generally in between 0.5 mm to 6mm. Most of the cases sheet metal operation are perform in cold state. Press tool operation of sheet metal is cheapest, easiest and fastest method to manufacture the components. The sheet metal component is manufactured using different types of press tool. Press tool are used to manufacture particular product in large quantity. Different type of press tool is used to perform different types of operations such as blanking, shearing, piercing, bending, embossing, coining, notching, trimming, shaving, deep drawing, curling, drawing, flanging, perforating etc. When large number of products to be manufacture with in time and to increases the production rate progressive die, Compound Die and Combination Dies are used. Mechanical power press is mostly used to perform these operations. Mechanical power press will have capacity of about 12000 ton. Crank press, rack and pinion press, knuckle joint press, eccentric press etc. These are most common types of mechanical presses. The processed sheet metal components have lots of industrial and domestic application such as in Aircraft and automobile industry, electronics, kitchen appliances, storage cabinets etc. In order to increase the efficiency in the sheet metal forming operation or to increase the productivity Cushion pin plays an important role. Tool life is also increase because of the cushion pin. Die cushions provide consistent force on all parts of a blank during a whole drawing or forming operation. It prevents Scratch, wrinkles and cracks in work piece. It prevents Scratch, wrinkles and cracks in work piece. Work piece handling time also decreases. Cushion pin generally operated by hydraulically or pneumatically. Excellent high carbon alloy steel material like EN31 & EN 8 with case hardening is used for Cushion pins. Because of die cushioning productivity is increased up to 20%.

Key Words: Cushion Pin, Cold working, Forming operation, Press Tools, Power Press, Sheet metal working

1. INTRODUCTION

The sheet metal forming is one of the manufacturing processes which are simplest and easiest method. A large variety of industrial components are manufactured by using sheet metal. thickness of sheet metal is in between 0.5mm to 6mm, anything above 6mm is consider as plate. Because of this sheet metal parts the cost of the product and weight of the components are reduced. The sheet metal working process are mostly coming into a metal forming process category. The sheet metal product has a lot of application like Automobile & aircraft boy parts, domestic appliances, electronics, etc.

All the sheet metal operations such as blanking, sharing, piercing, bending, embossing, coining, notching, trimming, shaving, drawing, curling, flanging, perforating, etc. are carried out with the help of press machine and press tools. Press machine and press tools are considered fastest, easiest, cheapest and most efficient way to form a sheet metal into final product. Press machine has two types manual & Mechanical power press. Mostly Mechanical power press is used in sheet metal operations. Metal working occurs by placing sheet on a bottom die and striking it with a top die(punch). The top die is attached to crankshaft with connecting rod. The rotation of crank shaft is accomplished from motor, flywheel & gear drives. The range of mechanical power press is 10 ton to 12000 ton.

Now a days all mechanical power presses are coming with die Cushion. Cushion pin or die Cushion is one of the important parts of press machine. The cushion pin performs number of functions over entire slide stroke cycle. Because of die Cushion working handling time is reduces. It provides constant force on all part of the blank. It prevents work price from Scratch wrinkles and cracks therefore the quality of product is increased. Because of the above advantages the cushion pin plays an important role to improve the productivity and efficiency during sheet metal working.

2. PRESS MACHINE

Press machine is a sheet metal working tool with a stationary bed (bottom die) & powered ram (upper die) can be driven towards the bed to apply force for various metal forming and cutting operations on sheet metal. The work piece or sheet metal is placed in between bottom die and upper die. Press machines are available in a variety of capacities, power system & frame type.

2.1 Types of Press Machine:

According to the power sourced used the presses are classified into two categories.

- 1) Manually operated presses: - These presses are operated by manual power. Manually operated presses are used to produced parts from thin sheet metal
- 2) Power Presses: - These presses generally driven using a Mechanical power or hydraulic power.



Fig.1: Manual Press Machine



Fig.2: Power Press Machine

2.2 Mechanical Power Press:

Power press is used for manufacturing large quantity not products quickly & economically from cold working process. This is a multi-purpose machine used to shape the metal sheet to be Used for getting the desired shape of the parts to be produced.

The major parts of the Power press are as follows

- 1) Frame: frame consists of main body of the press machine. Generally, column shaped frame is used. It houses supports for ram, control and driving mechanism.
- 2) Bed: It is a part of Frame; it is supports member for bolster plate and bottom die. It allows the scrap or blank to fall down.
- 3) Bolster Plate: It is mounted on bed; bolster plate is used for mounting the press tool and press tool accessories. It Supports the die assembly and die Cushion. the die assembly and die Cushion.



Fig.3: Bolster Plate

4) Ram(slide): Ram is a main operating part of press, which reciprocate to & fro within guideway with prescribed stroke length. At the bottom side of ram punch is attached to process the work piece.

5) Knock out: It is a mechanism operating on the upstroke of press which ejects work piece or blank from press tool.

6) Flywheel: Flywheel is an energy storing device. It maintained the constant speed of ram when punch is pressed against the work piece.

7) Cushion pin: It is a press accessory located within the bolster plate for producing an upward force or motion & is actuated by hydraulically, pneumatically or using springs or a combination of all these.



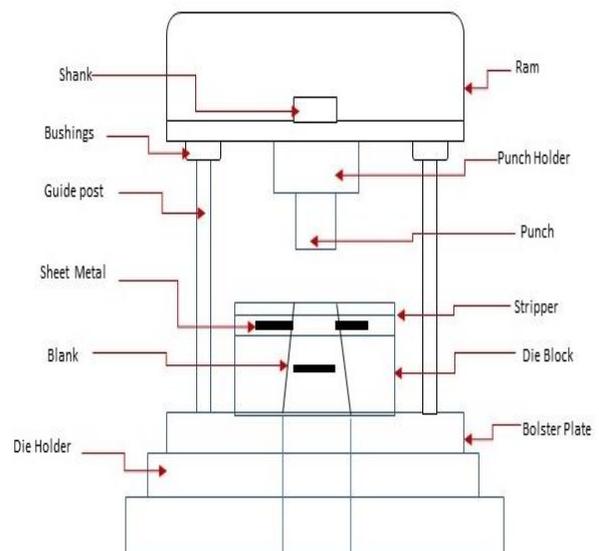
Fig.4: Cushion Pins in Bolster

8) Driving mechanism: There are different types of mechanisms to drive the ram by transforming power from motor to ram, mechanism like cylinder and piston arrangement in Hydraulic press & crankshaft arrangement in mechanical press.

9) Brakes: Brakes are very urgent in any mobile system. Generally, two types of brakes are used normal brake, which can bring the driven shaft to rest quickly after disengaging it from flywheel.

10) Strip guides: It help to guide the strip into the press tool to perform the operation Press tools and press tool operations.

Fig.5: Press Machine Terminology



3. SHEET METAL PRESS TOOLS AND OPERATIONS:

Press tools are used to perform different operations on sheet metal. The press tool consists of punch, die, stripper's, punch plate, ejector pin, backup plate and many more components. Press Tool has 3 parts,

1st Part: - Die or upper shoe or cavity which is fixed on Ram of press which is driving by connecting linkages of mechanical press and this driven by flywheel.

2nd Part: - Blank holder has moving as driven by cushion pins which has fix pin Diameter and equal length. And having same Stoke length. Technically called Cushion above bolster.

3rd Part: - Tool is fixed on lower bed of press having cushion pin holes in that cushion pin is placed as per die layout.

3.1 Types of Sheet Metal Cutting Press Tools.

1) **Blanking tool:** - When a component is produced with a single punch and die as the entire exterior profile is cut in one stroke, the tool is called a blanking tool. The operation performed using blanking tool is known as blanking operation. The outer area of sheet metal remaining after blanking is called as scrap and the blank is desired product.

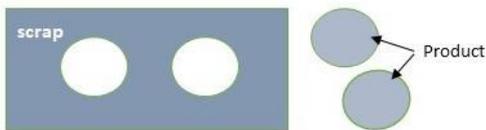


Fig.6: Blanking Operation

2) **Piercing Tool:** - It produces holes or internal features on metal sheet. Piercing Tool is also known as punching tool. The outer area of sheet metal remaining after piercing is desired product and the blank is scrap.

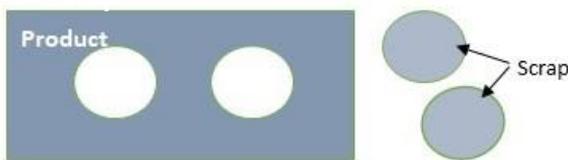


Fig.7: Piercing Operation

3) **Trimming Tool:** - After drawing and other operations flat sheet metal edges are left, because of uneven metal flow. This irregular and uneven edges are trimmed or cut using trimming tool.

4) **Sharing Tool:** - Basically sharing tool is used for metal sheet cutting. We will only maintain the length of work piece in sharing by separating material into two parts.

5) **Notching Tool:** - It is one of sharing tool, the tool used in notching process normally has two blades set at an angle of 90 degree to each other. During notching operation, outside edge from metal sheet are cut by using multiple share blades. It removes material from outside of the work piece.

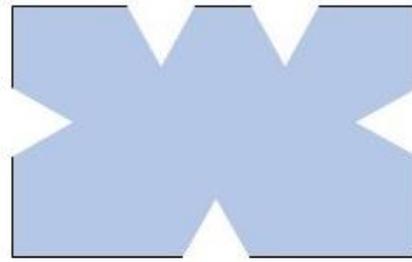


Fig.8: Notching Operation

6) **Perforating Tool:** - It is similar to piercing tool, in perforating operation multiple holes or slots which are very small & close together are cut in the work piece.

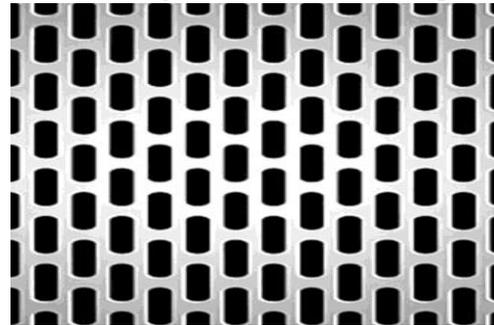


Fig.9: Perforating Operation

3.2 Types of Sheet Metal Forming Press Tools.:

1) **Bending Tool:** - Using bending Tool straight sheet metal is transformed into a curved form. There are number of different types of bending such as

1. Edge Bending
2. Channel Bending
3. U-Bending
4. V-Bending
5. Off set Bending, etc.

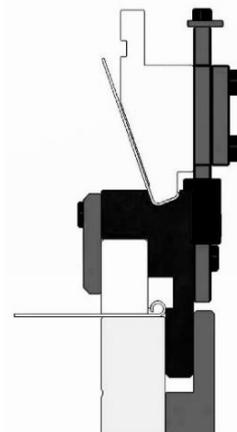


Fig.10: Bending Operation

2) **Embossing Tool:** - With the help of embossing tool, a specific shape is produced on the sheet metal. Embossing

is a shallow forming operation. Work piece is deformed in between male and female die surface.



Fig.11: Embossing Operation

3) **Coining Tool:** It's also referred to as squeezing tool. Usually, coining operation is performed in a closed die during which the metal is forced to flow and fill the form and profile of the die. In coining two different shapes are produced on metal sheet.

4) **Curling Tool:** - It is a metal forming tool. Curling is performed to eliminate the Sharp edges and increases the M.I. near the curled edge. In curling the edge of the sheet metal product is form into hollow ring.

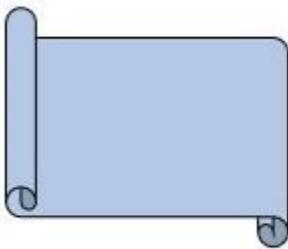


Fig.12: Curling Operation

5) **Flanging Tool:** - Using flanging tool the edges of the sheet metal are bend into 90 degree. It is much similar to bending and drawing operation.

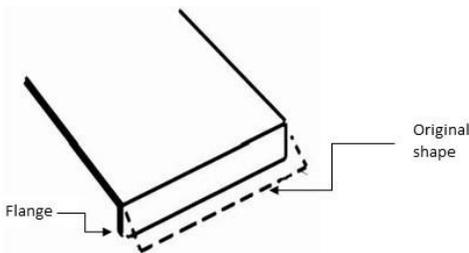


Fig.13: Flanging Operation

6) **Drawing Tool:** - Drawing tool transform the flat sheet metal into cup or shell type product.

- 1) **Shallow Drawing:** - when the height of the drawn product is less than half of its diameter the drawing operation is known as shallow drawing.
- 2) **Deep Drawing:** - for product which have a height greater than half diameter it is necessary to make specific provision to confine the metal in order to prevent excess wrinkling of the edges, such operation is called deep drawing.

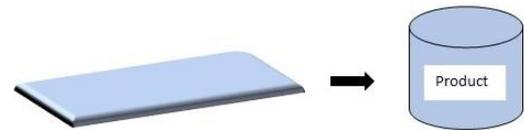


Fig.14: Drawing Operation

4. SHEET METAL DIES:

When large number of products to be manufacture with in time and to increases the production rate progressive die, Compound Die and Combination Dies are used.

Table 01: Comparison Between Progressive, compound & combination dies.

Sr. No.	Feature	Progressive Die	Compound Die	Combination Die
1	Type of operation performed	Cutting operations only	Cutting operations only	Both Cutting and Forming Operations
2	Number of operations in one stroke	Two or more	More than one	More than one
3	Number of operations per station	One or Two	One or Two	Two or more
4	Cost	Costly	Cheaper	Costly
6	Example	Only one cutting operation like blanking, punching, etc.	Blanking & punching	Deep Drawing & Trimming

5. DIE CUSHIONING & CUSHION PIN

Die Cushion or Cushion pin is a press accessory. Which improve the productivity, quality of the product and overall Production efficiency. It has considerable influence on part quality. When ram forced is hit on blank holder, then cushion pin will operate on cushion pressure which moves up and down with fixed stroke. As per part geometry cushion above reading is fixed and its operating cushion pressure is also fixed. Once part is getting ready.



Fig.15: Cushion Pins

5.1 Function of the Cushion Pin

Cushion pin provide consistent force on all part of blank during operation, so it prevents the sheet form folds, crack, scratch and uncontrolled movement of metal.

Cushion pin also act as a shock absorber, to dissipate the high energy when ram hit the lower die. After completion of operation ram return to its initial position, the finished component can be ejected by cushion pin and create a space for next one. Generally, Spring, rubber, hydraulic cylinder, pneumatic cylinder or nitrogen cylinder are used to apply a blank holder force. Each Cushion pin has its own load cell to measure the blank holder force.



Fig.16: Cushioning

5.2 Cushion Pin material

Excellent high carbon alloy steel material like EN31 &EN 8 with case hardening is used for Cushion pins.

Table-2: Properties of Cushion Pin Material.

Properties	EN 31	EN8
Density(kg/m ³)	7900	7800
Tensile strength (N/mm ²)	750	650
Yield strength(N/mm ²)	460	530
Hardness	60 HRC	35 HRC
Modulus of elasticity (MPa)	215	190
Elongation	30%	16%
Carbon%	0.8-1.10	0.35-0.45
Si%	0.1-0.3	0.1-0.3
Mn%	0.3-0.7	0.5-1.0

5.3 Importance of Cushion Pin

- 1) Cushion pin helps to provide consistent and constant force on all part.
- 2) Impact energy of ram is absorbed, so it prevents the die assembly from heavy impact load.
- 3) Because of Cushion pin tool life is also increase.
- 4) Adjusting the blank holder is possible.
- 5) It prevents the part from crack, scratch, wrinkle and uneven metal flow.
- 6) Quality of product increased by 25-30%

- 7) Cushion pin ejects the part after completion of operation, so work handling time is reduced.
- 8) Power consumption decreases.
- 9) Die changing time reduces.

Because of all above importance of cushion pin, it helps the sheet metal manufacturing industry to increase the productivity up to 15-20% & to produce the defect free products.

6. CONCLUSIONS

Sheet metal working is cheapest, easiest and fastest manufacturing process as compared to other manufacturing processes. Mostly sheet metal operations are performed using mechanical power presses and hydraulic presses. To manufactured particular product different types of Press Tool operations are performed, to did these operations are different types of press tools and dies are used. The press tool operations are likely metal cutting and metal forming operations. Blanking, piercing, perforating, trimming, sharing, etc. are metal cutting operations. And bending, curling, flanging, drawing, coining, embossing, flanging, etc. are metal forming operations. To perform multiple operations in one stroke of ram different types of dies such as progressive, compound and combination dies are used.

Die Cushion or Cushion pin is one of the important press accessories. It has considerable influence on part quality because it prevents part from lot of defects during operation. Hydraulic fluid or air or nitrogen is generally used to operate the Cushion pins. Cushion pins are made up of high strength alloy steel EN 31, EN 8, etc. with case hardening. Because of Cushion Pin assembly tool life increases. Quality of the product is increased by 25-30%. Cushion Pin ejects the part once the operation is completed. It reduces the work handling time. Cushioning did the number of functions during press tool operation; therefore, production rate is increased up to 20%.

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