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2. PRESS AND PRESS WORK

2.1 INTRODUCTION:
Products made through the sheet metal processing include automobile bodies, utensils, electronic components, electrical parts, aerospace parts, refrigeration and air conditioning parts etc. Sheet metal is generally considered to be a plate with thickness less than about 5 mm. Articles made by sheet metal work are less expensive and lighter in weight. Sheet metal forming work started long back 5000 BC. As compared to casting and forging, sheet-metal parts offer advantages of lightweight and versatile shapes.

Sheet Metalworking Terminology:
• “Punch-and-die”— Tooling to perform cutting, bending, and drawing
• “Stamping press”— Machine tool that performs most sheet metal operations
• “Stampings”— Sheet metal products

➤ MATERIALS USED IN PRESS WORK

GALVANISED IRON
Zinc-coated iron is known as "galvanised iron". This soft steel sheet is popularly known as GI sheet.
Applications: pans, buckets, furnaces, heating ducts, cabinets, gutters, etc. are made mainly from GI sheets.

STAINLESS STEEL
This is alloy of steel with nickel, chromium, and traces of other metals. It has good corrosive resistance and can be welded easily.
Applications: fuel tanks, rims, bus bodies, canneries, dairies, food processing and chemical plants, kitchen wares, etc.

COPPER
Copper sheets are available either as cold-rolled or hot-rolled sheets.
Application: Radiators, bearings, brakes, Gutters, expansion joints, roof flashing and hoods are some of the common examples of copper sheet.

ALUMINIUM
Aluminium cannot be used in pure form, but is used with a very small amount of copper, silicon, manganese and iron.
Applications: Engine block, engine head, piston, Household appliances, refrigerator trays, lighting fixtures, windows, in the construction of airplanes.

TIN PLATE
Tin plate is sheet iron coated with the tin to protect it against rust.

Applications: Oil can for automobiles, Roofs, food containers, dairy equipments, furnace fittings cans and pans.

Q. What is working principle of press?
The press is a metal forming machine tool designed to shape or cut metal by applying mechanical force or pressure. The materials are sheared or formed between punch and die.

➢ CLASSIFICATION OF PRESS

According to design of frame:
1) Bench
2) Gap
3) Inclinable
4) Arch
5) Straight side
6) Horn
7) Pillar

According to method of applying power to ram:
1) Crank
2) Cam
3) Eccentric
4) Power screw
5) Knuckle joint
6) Rack and pinion
7) Toggle
8) Hydraulic
9) Pneumatic

➢ MAJOR PARTS OF FLY PRESS

![Diagram of Fly Press]
Q. Which are the major parts of the mechanical press? And describe their functions.

**Base:** The base is the supporting member of the press and provides arrangement for tilting and clamping the frame in an inclined press.

**Frame:** All presses except the straight side type have "C" shaped frame to take up the vertical thrust of the ram.

**Bolster plate:** The bolster plate is a flat plate fitted on the base for supporting the die block and other accessories of the press.

**Ram:** The ram is the reciprocating member of the press that slides within the press and guides and supports the punch at its bottom end.

**Pitman:** The pitman is the connecting rod in a crank or eccentric driven press. The position of stroke of the ram can be changed by altering the length of the connecting rod.
Crank, eccentric or other driving mechanism: The rotary movement of the motor is converted into the reciprocating movement of the ram by crank and connecting rod, eccentric and connecting rod, or many other mechanisms.

Fly wheel: The fly wheel is mounted at the end of the driving shaft and is connected to it through a clutch. The energy is stored up in the flywheel during idle periods and it is expended to maintain the constant speed of the ram when the punch is pressed into the work. The fly wheel is directly coupled with the electric motor.

Clutch: The clutch is used for connecting and disconnecting the driving shaft with the fly wheel when it is necessary to start or stop the movement of the ram.

Brakes: The brakes are used to stop the movement of the driving shaft immediately after it is disconnected from the fly wheel.

PRESS SIZE OR SPECIFICATION:

The size of a press is designated by its maximum capacity of applying load on a piece of a blank, and it is expressed in tonnes. The capacity of mechanical press varies from 5 to 4000 tonnes. The specially designated hydraulic presses may have the capacity as large as 50000 tonnes. Size of press depends on the following factors.

- Bed area
- Dimensional size:
  - Enough space to accept the tool.
  - Length of stroke of the punch.
  - Opening to push the sheet in.
- Force required to enable the stroke.
- Speed of the machine.

Shut height of the press:

In a press machine, there is a maximum height of the die that can be installed. If this maximum height is exceeded, it is not possible to install the die in the press machine. There are two methods of expressing this height, namely, die height and shut height.
These are explained using following Fig. When the slide is at the bottom dead center position and the slide adjustment screw has been raised to the topmost position, the distance from the bottom surface of the slide to the surface of the bolster plate is called the "die height". When the bolster plate is removed from the press machine, the surface on which the bolster plate was is called the "head surface", and the "shut height" is the distance from this head surface to the bottom surface of the slide.

2.2 PRESS TOOLS

The general nomenclatures of tools used in presses are called **dies and punches**. The term die is also sometimes used to denote the entire press tool including a punch.

A punch is that part of the press tool which enters into the cavity formed in the die section.

A die is that part of the press tool which has an opening or cavity to receive the punch.
PARTS OF STANDARD DIE SET

DIE ACCESSORIES

The die accessories are used in conjunction with the dies and punches for systematic operation, correct location, and removal of finished products. The following are the different die accessories.

Stops: The stops are used for correct spacing of the sheet metal as it is fed below the punch to give the greatest output in given length of the plate. Button stop and lever stop.

Button stop: The button stop illustrated in Fig. is the simplest of the designs. A small pin or a button 2 is fixed to the die block 4 at a measured distance from the punch axis. After the end of each cut, the plate 3 is lifted and pushed aside till the edge of the next slot bears against the button 2. This makes the accurate spacing. The button stop is used in hand presses and in slow acting power presses.
Fig. Button Stop

Pilots: The pilot illustrated in Fig. enables the correct location of the blank when it is fed by mechanical means. The pilot enters into the previously pierced hole and moves the blank to the correct position to be finally spaced by the stops. The pilots are fitted to the punch holders.

Fig. Pilot

Strippers: The main function of the stripper is to strip or discard the workpiece from the punch or the die after the end of the cutting or forming operations. Fig. illustrates a stripper attached to the punch holder. The stripper plate 3 is connected to the holder by means of two helical springs 2. The punch 1 passes through a hole in the stripper 3. When the punch descends to cut or form a material placed on the die block, the stripper plate 3 bears against the blank and holds it down by the spring pressure. In the upward stroke of the punch, the blank is stripped off from the punch cutting...
edge and prevents it from being lifted along with the punch by the stripper plate.

**Fig. Stripper**

**Knockout:** The knockout is also a type of stripper which forces the cut blank out of the die. Fig. illustrates a knockout fitted on an inverted blanking die. As the die holder 2 descends, the plate 4 is sheared and the blank rests on the knockout plate 5. The position of the knockout plate is depressed due to the spring compression. As the plunger moves in the upward stroke, the knockout plate 5 ejects the blank 4 out of the cutting edges.

**Fig. Knockout**

**Pressure pad:** As the punch 1 moves downward, the pressure pad which is a plate actuated by spring tension 2, bears against the metal 3 being
drawn out on the die face 4 with sufficient pressure. This result in ironing of the metal as it plastically flows between the punch and the die, and eliminates wrinkling in the process of being drawn out to the shape required. A spring plunger 5 acting from the bottom of the plate serves the same function as a pressure pad by maintaining a flat bottom surface of the cup.

![Diagram of Pressure Pad](image)


**Fig. Pressure Pad**

**Q. Describe various drive mechanisms.**

**Eccentric drive:** The eccentric drive mechanism, illustrated in **Fig. a** is used in presses for shorter length of stroke of the ram. The working is similar to a crank and connecting rod mechanism.

**Crank and connecting rod:** The crank and connecting rod mechanism illustrated in **Fig. b,** is the simplest and most common method of driving the ram. For multiple propose die, a double crank may be used.
**Cam drive:** The cam drive illustrated in Fig. c is used to give a specific type of movement to the ram. The ram remains idle for some period at the bottom of the stroke.

**Knuckle joint drive:** The knuckle joint drive illustrates in Fig. d has a high mechanical advantage near the bottom of the stroke. The presses fitted with knuckle joint drive are used for squeezing or coining operation.

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- **Cam drive:** 1. Cam, 2. Ram
- **Knuckle joint drive:** 1. Knuckle joint, 2. Ram

**TYPES & CONSTRUCTION OF DIES**

- Simple
- Follow or progressive
• Combination
• Compound

SIMPLE DIE:
In a simple die, only one operation is performed at each stroke of the ram. All the press operations explained later are carried out in simple die.

PROGRESSIVE DIE:
A progressive die performs two or more operations on a sheet-metal coil at two or more stations with each press stroke. The part is fabricated progressively. The coil is fed from one station to the next and different operations (e.g., punching, notching, bending, and blanking) are performed at each station.
**COMPOUND DIE:** In a compound die two or more cutting operations are accomplished at one station of the press in every stroke of the ram. Fig. illustrates a compound blanking and piercing die.

![Compound Die Diagram](image)

**COMBINATION DIE:** In a combination die, both cutting and non-cutting operations are accomplished at one station of the press in every stroke of the ram. Fig. illustrates a combination blanking and drawing die showing different stages of the operation.

![Combination Die Diagram](image)

**Combination die**
2.3 PRESS OPERATIONS

1. Shearing operation: The shearing operation between a punch and a die is illustrated in Fig. As the punch descends upon the workpiece, the pressure exerted by the punch causes the metal to be deformed plastically in the die.

a. Piercing: The piercing is the operation of production of hole in a sheet metal by the punch and the die. The materials punched out to form the hole constitute the waste.

b. Punching: The punching operation is similar to the piercing operation. While punching the formation of the hole is the desired result. The difference between the punching and the piercing is that in the case of punching a cylindrical hole is produced, whereas in the case of piercing the hole produced may be of any other shape.

c. Blanking: The blanking is the operation of cutting of flat sheet to the desired shape. The metal punched out is the required product and the plate with the hole left on the die goes as waste.
d. **Cutting off:** Cutoff is a shearing operation in which blanks are separated from a sheet-metal strip by cutting the opposite sides of the part in sequence, as shown in Figure.

e. **Parting:** cutting a sheet-metal strip by a punch with two cutting edges that match the opposite sides of the blank, as shown in Figure. Parting is less efficient than cutoff in the sense that it results in some wasted material.
**f. Perforating:** Perforating involves the simultaneous punching of a pattern of holes in sheet metal, as in Figure. The hole pattern is usually for decorative purposes, or to allow passage of light, gas, or fluid.

![Perforating Diagram](image)

**g. Notching:** The notching is the operation of removal of the desired shape from the edge of a plate. The operation is illustrated in Fig. The punch and the die set up are similar to the piercing or punching operation.

![Notching Diagram](image)

**h. Lancing:** The lancing is the operation of cutting a sheet metal through part of its length and then bending the cut portion. The operation is illustrated in Fig.

![Lancing Diagram](image)
2. Bending operation: The bending operation is illustrated in Fig. While bending, the metal is stressed in both tension and compression at the two sides of the neutral axis beyond the elastic limit but below the ultimate strength of the material.

![Bending Diagram]

a. Angle bending: The angle bending is the operation of bending a sheet metal to the sharp angle. The punch and the die are shaped to the desired angle. The punch and the die are shaped to the desired angle, taking into consideration the effect of spring back. The angle bending operation is illustrated in Fig.

![Angle Bending Diagram]

3. Drawing operation: The drawing is the operation of production of cup shaped parts from flat sheet metal blanks by bending and plastic flow of the metal. The operation is also known as cupping. The drawing operation is illustrated in Fig.
4. **Squeezing operation**: The different squeezing operations are described below:

**a. Coining**: The coining is the operation of production of coins, medals or other ornamental parts by squeezing operation.

**b. Embossing**: The embossing is the operation of giving impressions of figures, letters or designs on sheet metal parts. The punch, or the die, or both of them may have the engravings which are marked on the sheet metal by squeezing and plastic flow of the metal.
\( F \)