FORGING

Forging is a process in which material is shaped by the application of localized compressive forces exerted manually or with power hammers, presses or special forging machines. The process may be carried out on materials in either hot or cold state. When forging is done cold, processes are given special names. Therefore, the term forging usually implies hot forging carried out at temperatures which are above the recrystallization temperature of the material.

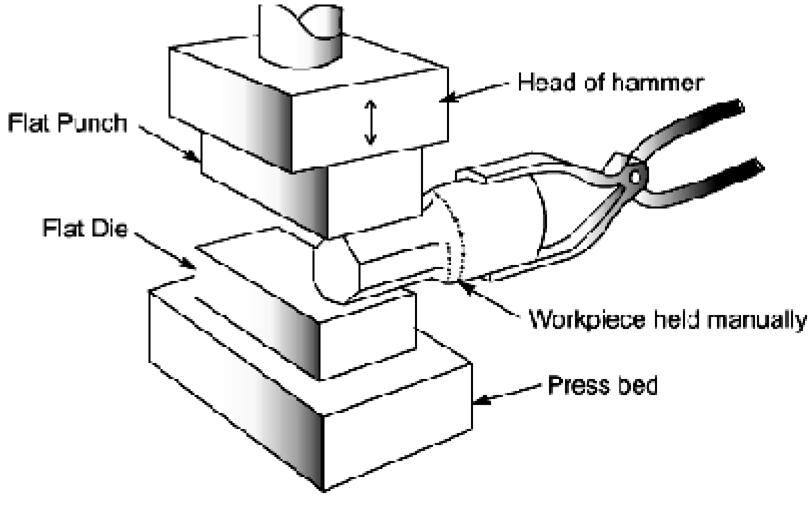
Forging is an effective method of producing many useful shapes. The process is generally used to produce discrete parts. Typical forged parts include rivets, bolts, crane hooks, connecting rods, gears, turbine shafts, hand tools, railroads, and a variety of structural components used to manufacture machinery. The forged parts have good strength and toughness; they can be used reliably for highly stressed and critical applications.

A variety of forging processes have been developed that can be used for either producing a single piece or mass – produce hundreds of identical parts. Some common forging processes are:

1. Open –forging(Smith Forging)
2. Drop forging(Closed die forging0
3. Press forging
4. Upset Forging
5. Swaging
6. Roll forging

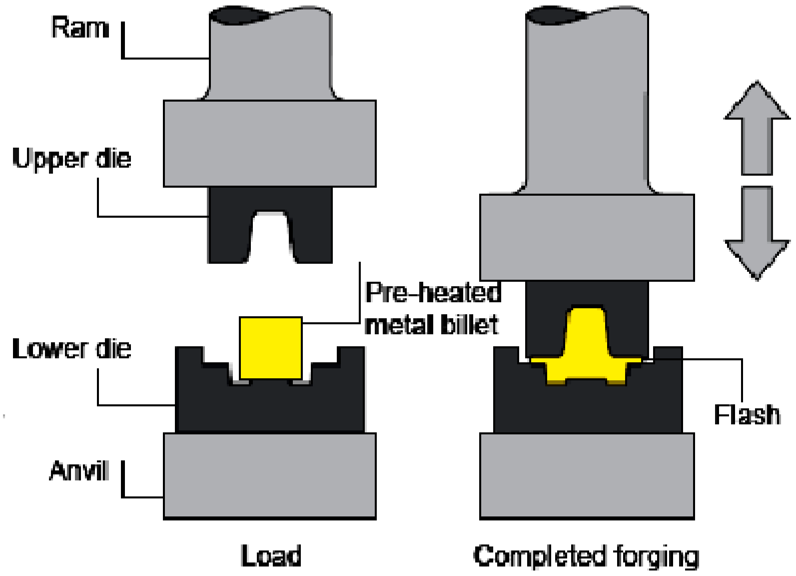
1. Open forging(Smith Forging):

It is the simplest forging process which is quite flexible but not suitable for large scale production. It is a slow process. The resulting size and shape of the forging are dependent on the skill of the operator. Open die forging does not confine the flow of metal; the operator obtains the desired shape of forging by manipulating the work material between blows.



2. Drop forging(Closed die Forging):

The process uses shaped dies to control the flow of metal. The heated metal is positioned in the lower cavity and on it one or more blows are struck by the upper die. This hammering makes the metal to flow and fill the die cavity completely. Excess metal is squeezed out around the periphery of the cavity to form flash. On completion of forging, the flash is trimmed off with the help of a trimming die.

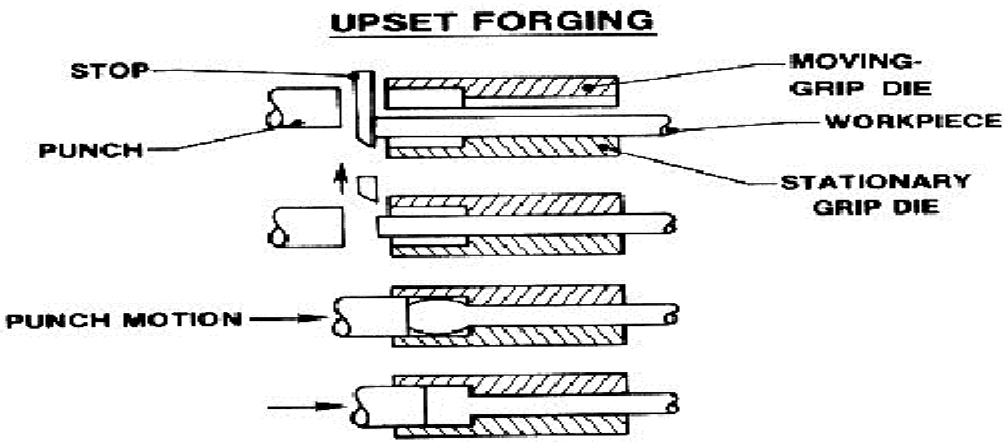


3. Press Forging:

It is mostly used for forging of large sections of metal, uses hydraulic press to obtain slow and squeezing action instead of a series of blows as in drop forging. The continuous action of the hydraulic press helps to obtain uniform deformation throughout the entire depth of the work piece. Therefore, the impressions obtained in press forging are more clean. Dies are generally heated during press forging to reduce heat loss, promote more uniform metal flow and production of finer details. Hydraulic presses are available in the capacity range of 5 MN to 500 MN but 10 MN to 100MN capacity presses are more common.

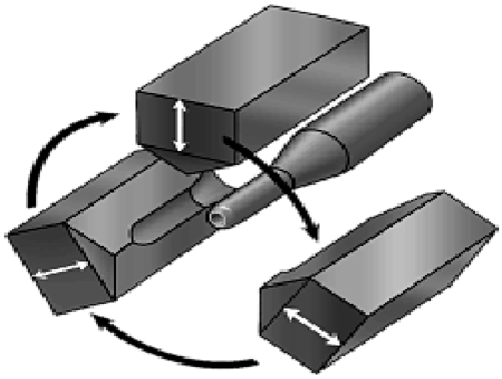
4. Upset Forging:

Upset forging involves increasing the cross – section of a material at the expense of its corresponding length. Upset – forging was initially developed for making bolt heads in a continuous manner, but presently it is the most widely used of all forging processes. Parts can be upset – forged from bars or rods up to 200 mm in diameter in both hot and cold condition. Examples of upset forged parts are fasteners, valves, nails, and couplings. Upsetting machines, called up setters, are generally horizontal acting.



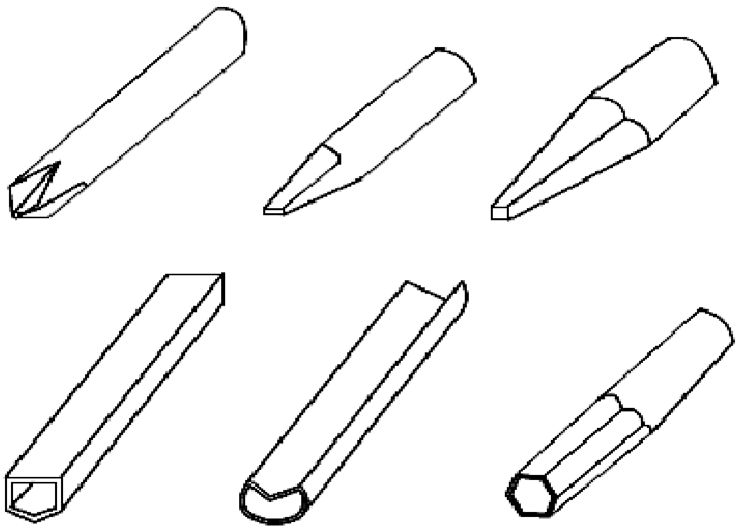
5. **Swaging:**

In this process, the diameter of a rod or a tube is reduced by forcing it into a confining die. A set of reciprocation dies provides radial blows to cause the metal to flow inward and acquire the form of the die cavity. The die movements may be of in – and – out type or rotary. The latter type is obtained with the help of a set of rollers in a cage, in a similar action as in a roller bearing. The work piece is held stationary and the dies rotate, the dies strike the work piece at a rate as high as 10 - 20 strokes per second.



Screwdriver blades and soldering iron tips are typical examples of swaged products. Fig shows these and other products made by swaging.

Typical parts made by swaging.



6. **Roll forging:**

This process is used to reduce the thickness of round or flat bar with the corresponding increase in length.
Examples of products produced by this process include leaf springs, axles, and levers.

The process is carried out on a rolling mill that has two semi – cylindrical rolls that are slightly eccentric to the axis of rotation. Each roll has a series of shaped grooves on it. When the rolls are in open position, the heated bar stock is placed between the rolls. With the rotation of rolls through half a revolution, the bar is progressively squeezed and shaped. The bar is then inserted between the next set of smaller grooves and the process is repeated till the desired shape and size are achieved.

FORGING DEFECTS

Though forging process give generally prior quality product compared other manufacturing processes. There are some defects that are lightly to come a proper care is not taken in forging process design.

A brief description of such defects and their remedial method is given below.

A. Unfilled Section:

In this some section of the die cavity are not completely filled by the flowing metal. The causes of this defect are improper design of the forging die or using forging techniques.

B. Cold Shut:

This appears as small cracks at the corners of the forging. This is caused mainly by the improper design of die. Where in the corner and the fillet radii are small as a result of which metal does not flow properly into the corner and the ends up as a cold shut.

C. Scale Pits:

This is seen as irregular deputations on the surface of the forging. This is primarily caused because of improper cleaning of the stock used for forging. The oxide and scale gets embedded into the finish forging surface. When the forging is cleaned by pickling, these are seen as deputations on the forging surface.

D. Die Shift:

This is caused by the miss alignment of the die halve, making the two halve of the forging to be improper shape.

E. Flakes:

These are basically internal ruptures caused by the improper cooling of the large forging. Rapid cooling causes the exterior to cool quickly causing internal fractures. This can be remedied by following proper cooling practices.

F. Improper Grain Flow:

This is caused by the improper design of the die, which makes the flow of the metal not flowing the final interred direction

G. Fins:

These are small projections on the pieces of loose Meta protruding outside the forged surface they occur mainly at parting planes of the dies possible cause is more amount of metal then required.