FORGING

Forging a process in which material can to be 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 either in hot or cold state. When forging is done cold, processes are given special names. Therefore, the term forging usually mean 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 – die hammer forging
2. Impression – die drop forging
3. Press Forging
4. Upset Forging
5. Swaging
6. Rotary Forging
7. Roll forging

The forging process evolved from the manual art of simple blacksmithing. The special tools that a blacksmith use are various kinds of dies, swages and fullers. Modern forging uses machine driven impact hammers or presses which deform the work piece by controlled pressure. The forging process is superior to casting in that the parts formed have denser microstructures, more defined grain patterns, and less porosity, making such parts much stronger than a casting. Forgings usually have great strength, as compared with other methods of producing products.

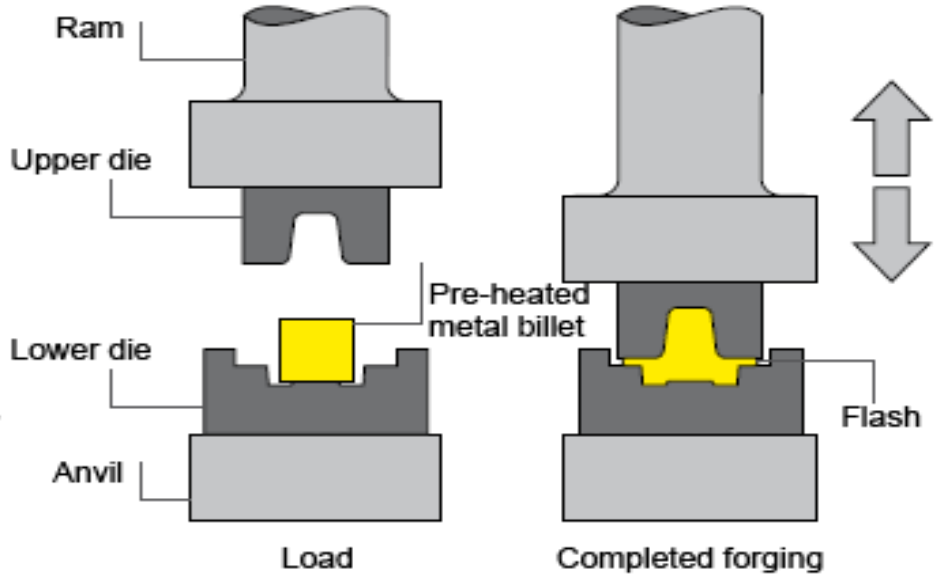

Fig.8 forging processes

Forging Operations

Forging is the oldest metal working process. Because it just requires heating and hammering of metals, man found it easy. The following forging operations are performed.

1- Drawing down or swaging**:** The process of increasing length and decreasing cross sectional area of the metal is known as drawing. The compressive force (hammering or pressing) are applied perpendicular to the length axis of the metal piece.

2- Upsetting**:** It is just reverse of drawing. The cross-sectional area of the work piece is increased and length decreases. For it, the compressive forces are applied along the length axis of the metal piece.

3- Coining (closed-die forging): are making of coins, where the slug is shaped in a completely closed cavity, is an example of closed-die forging. To produce the fine details of a coin, high pressures, and sometimes several operations are needed, while lubricants are not used because they can prevent reproduction of fine die surface details.

4- Heading (open-die forging): Heading is an example of open-die forging. It transforms a rod, usually of circular cross-section, into a shape with a larger cross-section. The heads of bolts, screws, and nails are some examples of heading.

5-Punching: It is the process of making holes by using punch over or hardy hole on an anvil

6- Hubbing: It is a piercing process where the die cavity produced is used for subsequent forming operations. To generate a cavity by hubbing, a pressure equal to three times the ultimate tensile strength of the material of the workpiece is needed.

7- Cogging: Also called drawing out, successive steps are carried to reduce the thickness of a bar. Forces needed to reduce the thickness of a long bar are moderate, if the contact area is small.

8- Fullering and Edging: It is an intermediate process to distribute the material in certain regions of the workpiece before it undergoes other forging processes that give it the final shape.

9- Roll Forging: A bar is passed through a pair of rolls with grooves of various shapes. This process reduces the cross-sectional area of the bar while changing its shape. This process can be the final forming operation. Examples are tapered shafts, tapered leaf springs, table knives, and other tools.

10- Skew Forging: It is similar to roll forging but used for making ball bearings. A round wire is fed into the roll gap and spherical blanks are formed continuously by the rotating rolls.