

## SMITHY FORGING SHOP

INTRODUCTION : Smithy is manufacturing process in which metals are processed to get the desired size and shape by applying mechanical force or by heating the metal and then applying smaller amount of force.

Blacksmithy or hand forging is an ancient trade. It is employed only for relatively small components. Nowadays, machines are also used in forging the components where huge force is to be applied.

Heating of metal is done in open fire or hearth (it is like a small furnace). The fuel used for furnace may be coke/coal or charcoal.

TOOLS USED : i) Supporting tools

ii) Striking tools

iii) Holding tools

iv) Cutting tools

v) Finishing and shaping tools

### i) Supporting tools

Anvil : ① It is used as a support while hammering is performed.

② It is used as a support. It is made up of wrought iron or cast iron.

③ Top surface of anvil has some square and other round shaped holes. This is used when the ~~hot~~ hot pieces are inserted into them to get the desired shape in particular. It is used for bending operation.

④ Round hole is called principal hole, is used for bending small

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workpieces and a handle hole is used to hold square shank tools like hardies, swages and fullers.

Swage block: ① It is also a supporting tool of forging shop.

- ② It is made up of Cast Iron or Cast Steel.
- ③ It is used for squaring, sizing, heading, bending and forming operations.
- ④ It may be used either flat or edgewise in its position.
- ⑤ For general application, width of swage block is 0.25 m or slightly more than 0.25 m.

### iii) Striking tools

Hand Hammers: ① Three types of Hand Hammers are :

- ② a) Ball Peen Hammer b) Straight Peen Hammer c) Cross Peen Hammer
- ② Weight of such hammers vary from 0.5 kg to 2 kg. Hammer heads are made up of cast steel and ends are hardened and tempered.

Sledge Hammer: It has flat ends on both sides. The weight varies from 4.5 to 5.5 kg for ordinary work and around 9kg for heavy work, handle is about 1 metre long. Handle is made up of either cast iron or wood.

### iv) Holding Tools

Generally tongs are used for holding purpose. It is made up of Mild Steel. 4 types of tongs are i) Flat tong ii) Gad Tong iii) Ring tong iv) Straight lip fluted Tong

### v) Cutting Tools

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It is used for cutting and necking metals prior to breaking. Cold Chisel : It is made up of tool steel with a cutting angle of about  $60^\circ$  and its edge is hardened and tempered.

Hot Chisel : It is made up of low carbon steel and has a cutting angle of  $30^\circ$ . Its edge does not require hardening.

### Finishing and Shaping Tools :

These tools are used to give desired forms and shapes.

Swages : Swages are used for work which has to be reduced and finished to round, square or hexagonal form. It is made of high carbon steel. The swages may be in separate top and bottom halves.

Flattener : The flatter is used after the job has been forged into shape with a hammer and the hammer marks can be seen on the job surface. Flatter is used to achieve better surface finish especially when the surface area is large. It is used to provide smoothness and accuracy to the job or work.

Fullers : Fullers are a set of the tools, the top tool and the heating tool. The top tool is provided with a handle and bottom tool has a square shank which fits into the square hole of the anvil. Fullers are used to form grooves. They spread the metal and can reduce the thickness of the workpiece.

Set Hammers : A set hammer is used for finishing off surfaces to a good smooth surface in restricted area such as corners, undercuts. It is useful for working hot metal and forcing it.

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into corners and narrow places.

**Punch:** It is used for making holes in the heated component. Holes of any shape such as round, oval or square shapes may be made with punches of different shapes.

**Drift:** After punching, the drift can be employed to enlarge this hole to a particular shape and size.

### COMMON SMITH FORGING OPERATIONS

So many operations can be carried out by means of heating the work pieces and hammering operations.

Typical smith forging Operations are : ① Upsetting/Jumping  
 ② Drawing down ③ Setting down ④ Punching & drifting  
 ⑤ Bending ⑥ Forge welding ⑦ Cutting ⑧ Fulleing

1. **Upsetting:** It is the process of increasing the thickness of the job and reduce the length by the application of hammering operation.
2. **Drawing down:** It is the operation of increasing the length of the bar or job by reducing the thickness.
3. **Setting down:** It is the process of local thinning down of the work piece by hammering.
4. **Punching and drifting:** It is the process of making holes on the workpiece. After punching, hole can be enlarged by hammering a tapered drift into the hole until the required bore size is reached.
5. **Bending:** It is one of the main operations to bend the workpieces as we required. It is carried out on the anvil by hammering.

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6. Forge Welding : It is one of the method of joining the metals or bars by heating and hammering.
7. Cutting Off : Cutting off is a form of chiselling operation whereby a long piece of stock is cut into several specified lengths.
8. Fullering : It is one of the process of spreading the metal along the length of the bar of workpiece by hammering and in which the job is kept b/w fullers.

### TYPES OF FORGING

Based on machine used for operations, forging is classified into three types :

- i) Hand Forging : In which the metals are processed to get the desired shape and size by striking it with a hammer is called hand forging or smithing or blacksmithing.
- ii) Machine Forging : In which the process of forging is carried out by using forging machine is called machine forging.
- iii) Drop Forging : In which the top die is raised to certain height through mechanical device and dropped it to hit the hot metal piece kept at bottom die. Wrench and other tools are made by drop forging.

Based on temperature prevailing in the operations, forging is classified into two types :

- i) Cold Forging : It is the process of making desired shape of the metal by hammering but without heating is called cold forging. But it is applicable only on soft metals.

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(ii) Hot Forging : It is the process of making desired shape of the metal by hammering the metal after heating is called hot forging. Using this process, hard materials can also be forged.

### APPLICATIONS OF SMITH FORGING,

- i) It is used to fabricate components like bolts, nuts, hooks, keys, tongs, wrenches, springs etc.
- ii) It is also used to fabricate agricultural tools and ~~links~~ links used in various mechanisms.

### ADVANTAGES OF SMITH FORGING

- i) The smith forging components have high strength and give great resistance to impact and fatigue loads.
- ii) It improves the grain structure of the metal so that its mechanical properties are also improved.
- iii) Better surface finishing can be easily achieved.
- iv) Raw material loss is almost nil.

### DISADVANTAGES OF SMITH FORGING

- i) It is very difficult to achieve the accurate dimensions and tolerances.
- ii) Some metals may break while forging.
- iii) There is some limitation to achieve the shape and size of the job.

### SMITH FURNACE

Open Hearth furnace is generally used for blacksmithing applications.

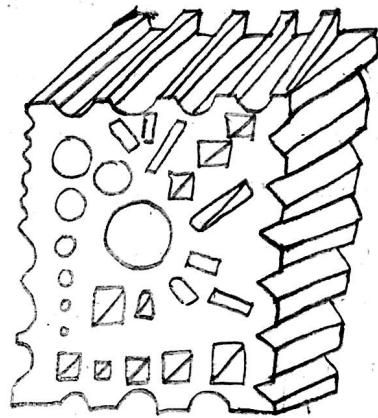
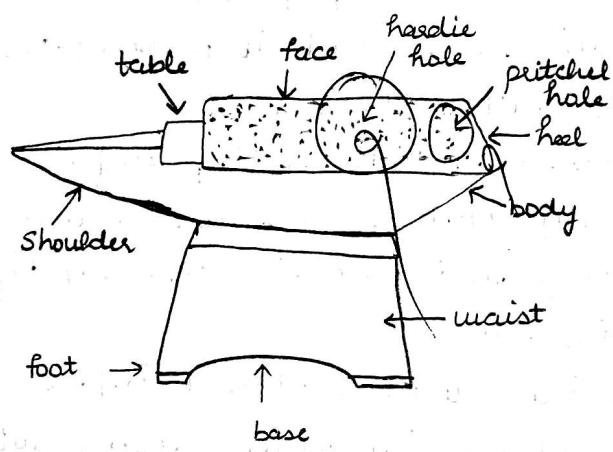
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Page No. 16

### SAFETY PRECAUTIONS FOR SMITHY

1. Work slow and always be aware of the audience.
2. Always wear your safety glasses and if possible have your viewers also.
3. Wear an apron not only it could negotiate but it could prevent injuries.
4. Talk about safety and be warned of sparks, sharp edges and hot items. No matter how sincere he/she is don't let others pick up holes or pieces you are working on.
5. Keep all the hot pieces (cut-offs etc.) under the forge and away from people. It maybe best off to quench all pieces to be on the safe side.
6. Have a first-aid kit handy, you never know when you might burn or cut yourself.
7. Forge welding is always fascinating to watch, but can be very dangerous. It is best not to forge weld if possible.
8. When using hardy, never cut off completely through stuck. Use tongs to break end off.



### ANVIL-TOOL NOMENCLATURE

### SWAGE BLOCK



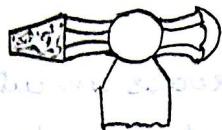
For the left hand, the anvil is held with the face towards the body.

The right hand holds the hammer with the head towards the body.

The hammer is held with the head towards the body.

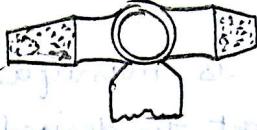
Left hand

Right hand



The diagram illustrates three types of peen hammers:

- Ball Peen Hammer:** Shows a hammer with a spherical peen (flat face) at the end of one handle.
- Straight Peen Hammer:** Shows a hammer with a rectangular peen at the end of one handle.
- Cross Peen Hammer:** Shows a hammer with a rectangular peen at the end of one handle and a spherical peen at the end of the other handle.

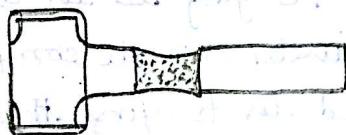


## Straight Peen Hammock



Cross Peen Hammer

## STRIKING



## TOOLS



## Flat tone



## Gad tong

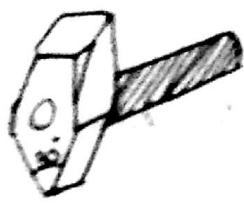


## Ring tong

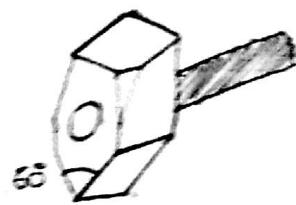


Straight lip  
fluted tong

## HOLDING TOOLS

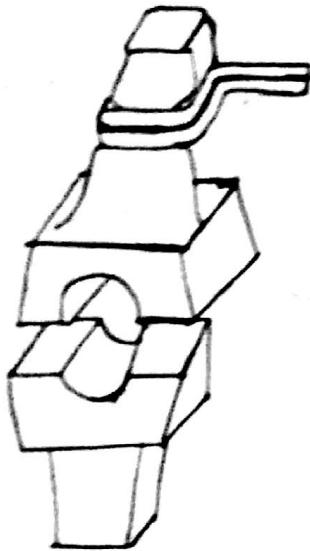


Hot chisel

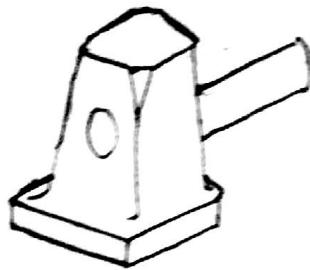


Cold chisel

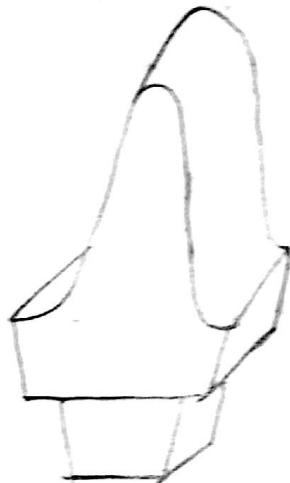
## CUTTING TOOLS



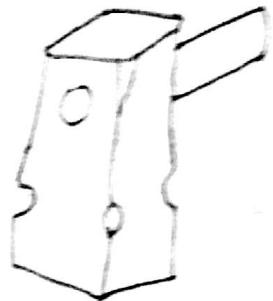
Swages



Flatter



Fuller



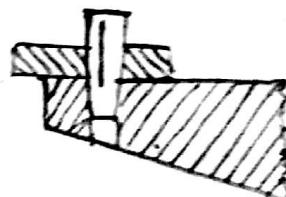
Set Hammer



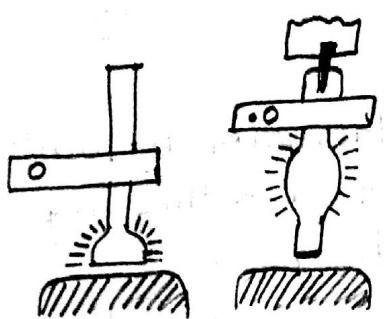
Punch.



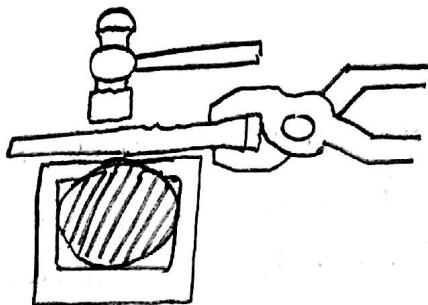
Drift



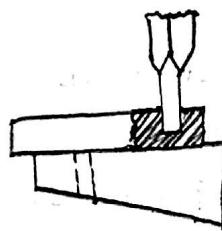
## FINISHING & SHAPING TOOLS



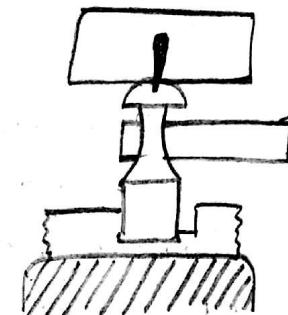
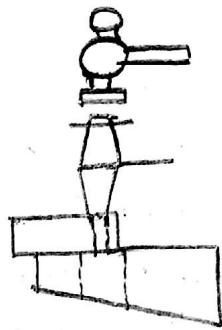
① Upsetting



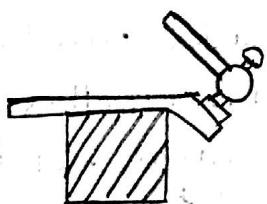
② Drawing Down



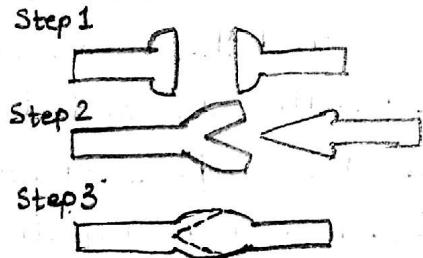
③ Drifting and Punching



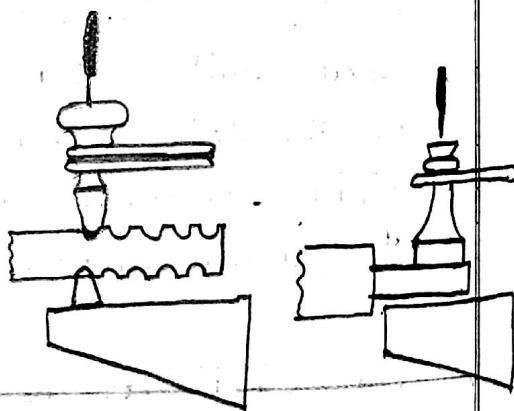
④ Set Down



⑤ Bending



⑥ forge Welding



⑦ Fullering

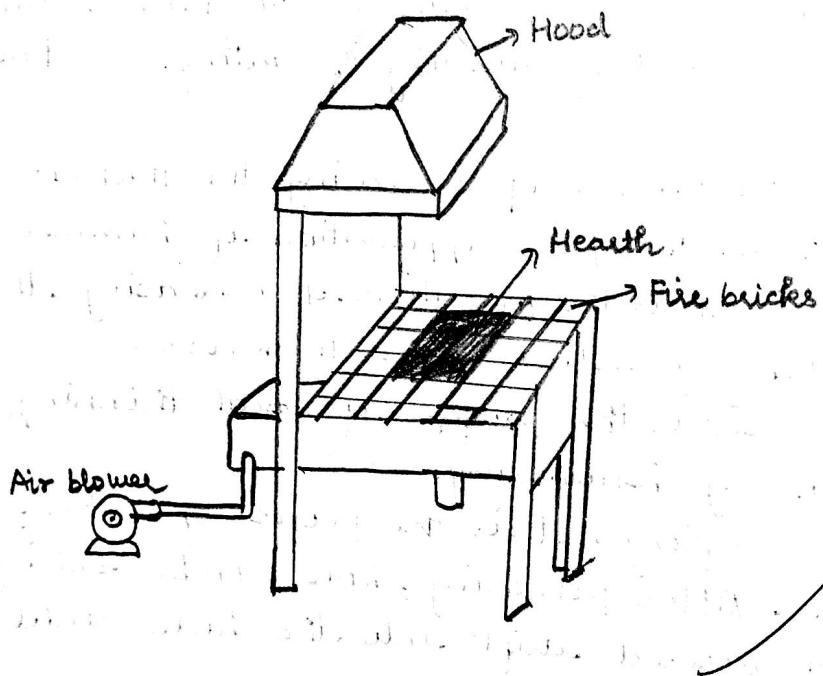
## SMITH FORGING OPERATIONS

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## FORGING TEMPERATURES FOR DIFFERENT METALS

Metal / Alloy	Forging Temperature (°C)	
	Starting	Finishing
1. High Carbon Steel	1150	825
2. Aluminium and Magnesium alloys	500	350
3. Mild steel	1300	800
4. Copper, Brass and Bronze	950	600
5. Medium Carbon Steel	1250	750
6. Wrought Iron	1275	900

### SMITH FURNACE



JOB - 01

- ① AIM : To make a chisel from a square headed rod.
- ② MATERIALS REQUIRED : Square headed rod
- ③ TOOLS REQUIRED : (1) Blacksmith furnace (2) Tongs (3) Anvil  
 (4) Tapering one end (5) Finishing tools (Flattener etc.)
- ④ SEQUENCE OF OPERATION : (1) Heating (2) Hammering  
 (3) Forming octagonal shape. (4) Tapering one end (5) Finishing  
 (6) Checking (7) Cooling
- ⑤ WORKING STEPS :
  1. First, half length of bar stock was heated.
  2. The heated end is put on the anvil, by holding the other end by tongs.
  3. Hammering was carried out convert the square head to an octagonal headed bolt. The same operations were repeated on remaining half of bar length.
  4. Now, the end of octagonal bar was heated.
  5. Forging to flat taper was done by hammering any two opposite faces.
  6. The chisel was turned a quarter turn, and the narrow sides were hammered to make them parallel.
  7. The blows were altered, four or five on the wider surface, then four or five on the narrow surface, until the chisel is in desired shape. The chisel was held in vertical and hammered on one end for finishing.

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Expt. No. \_\_\_\_\_

Date \_\_\_\_\_

Page No. 18

8. After the chisel was formed, heat treatment involving annealing and hardening was performed.

⑥ RESULT: The desired chisel is obtained.



Chisel (flat on one end) and  
chisel (point) on other end

Fig 9