INDIAN INSTITUTE OF TECHNOLOGY PATNA

ME110: Mechanical Workshop

Lathe and Milling Machine

3.45

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1701ME04

CONTENTS

OBJECTIVE :— To make cylindrical bolt with a hexagonal shaped head with the help of lathe machine and Milling machine.

TOOLS USED:—

1. Vernier Callipers :- It is a measuring instrument consisting of an L-shaped frame with a linear scale along its longer arm and an L-shaped sliding attachment called the vernier scale.

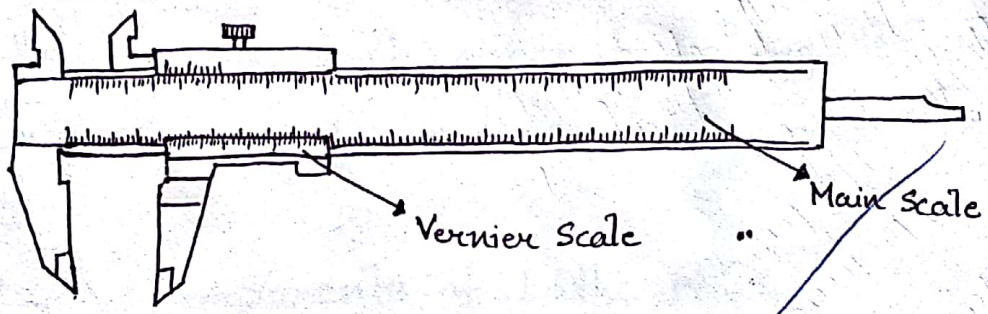


Fig: Vernier Callipers

2. Lathe Machine :- The lathe is one of the oldest machine tools used in any workshop, the most important and is used for most of the general purposes.

The main function of a lathe is to remove metal from a piece of work to give it the required shape and size. This is accomplished by holding the

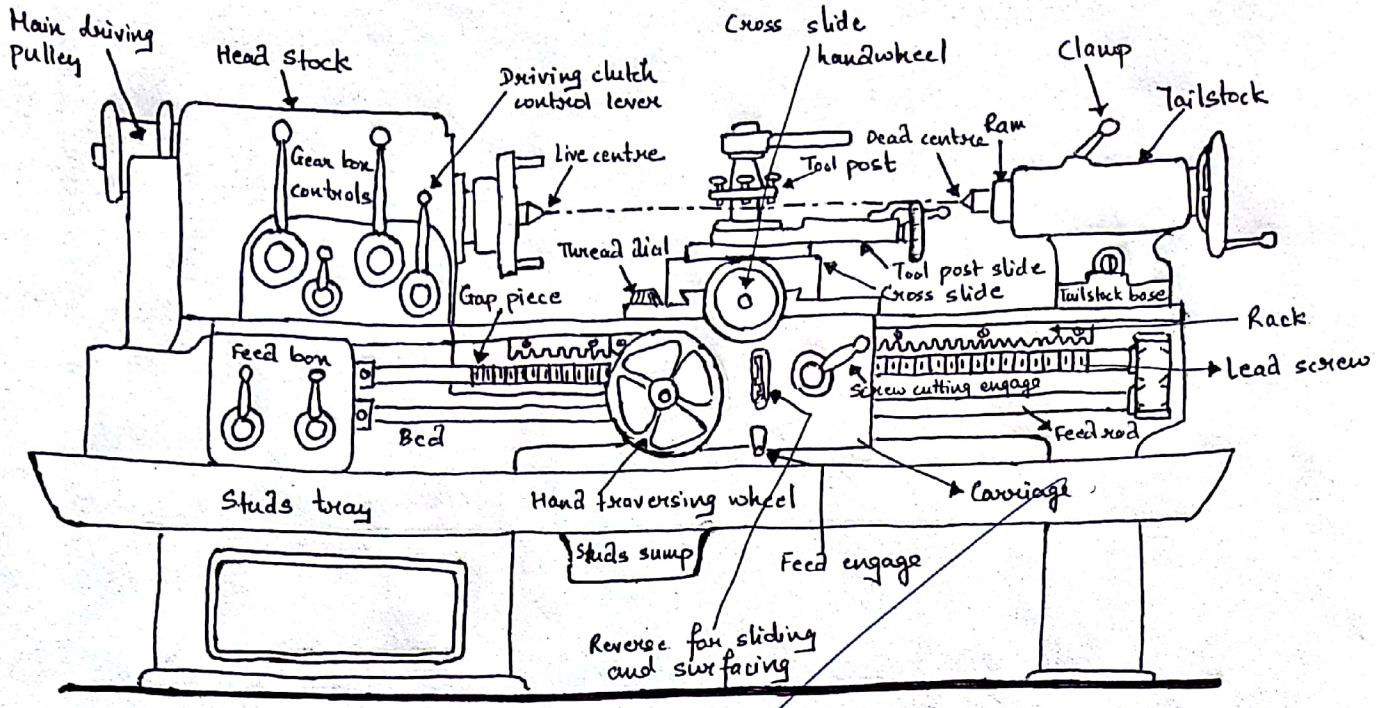


Fig: The LATHE Machine

work securely and rigidly on the machine and then turning it against cutting tool which will remove metal from the work in the form of chips.

→ Major Components of Lathe Machine

a) The Bed :- The lathe bed forms the base of the machine. The headstock and the tailstock are located at either end of the bed and the carriage rests over the lathe bed and slides on it. The bed should have high compressive strength, should be wear resistant and absorb vibration. Therefore, cast iron alloyed with nickel and chromium forms a good material suitable for lathe bed.

b) The Headstock :- The headstock is secured permane-
-ntly on the innerways at the left hand end of the lathe bed, and it provides mechanical means of rotating the work at multiple speeds. It comprises essentially a hollow spindle and mechanism for driving and altering the spindle speed. All the parts are housed within the headstock casting. Headstock is also made by cast iron.

c) Tailstock :- The tailstock is located on the innerways at the right hand end of the bed. This has two main uses:-

i) it supports the other end of the work when it is being machined between centres
ii) it holds a tool for performing operations such as drilling, reaming, tapping, etc.

d) Carriage :- The carriage of a lathe has several parts that serve to support, move and control the cutting tool. It consists of following parts:-

i) saddle
ii) cross-slide
iii) compound slide
iv) tool post
v) apron

e) Lead Screw :- It is a long threaded shaft used as a master screw, and is brought into operation only when threads have to be cut.

f) The tool post :- This is located on the top of the carriage to hold the tool and to enable it to be adjusted to a convenient working position.

g) Chuck :- A chuck is one of the most important devices used for holding and rotating a piece of work in a lathe. There are different types of of chuck but most used are four jaw independent chuck and three jaw universal chuck.

3. The Milling Machine :- A milling machine is a machine tool that removes metal as the work is fed against a rotating multipoint cutter. The cutter rotates at a high speed and because of the multiple cutting edges it removes metal at a very fast rate.

This is superior to other machines as regards accuracy and better surface finish, and is designed for machining a variety of tool room work.

The principal parts of a milling machine are :-

i) Base
ii) Column
iii) Knee
iv) Table
v) Overhanging arm
vi) Front brace
vii) Spindle
viii) Arbor

Milling is an interrupted cutting operation in which the teeth of the milling cutter enters and executes

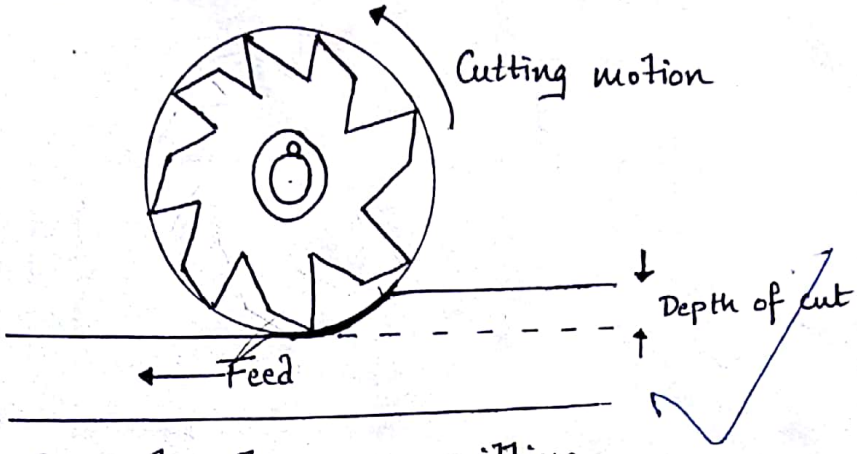
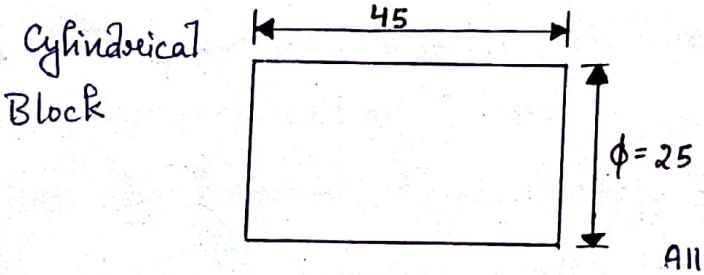


Fig: Conventional, or up milling

the work during each revolution. The tool material and cutter geometry must be designed so as to withstand high force.

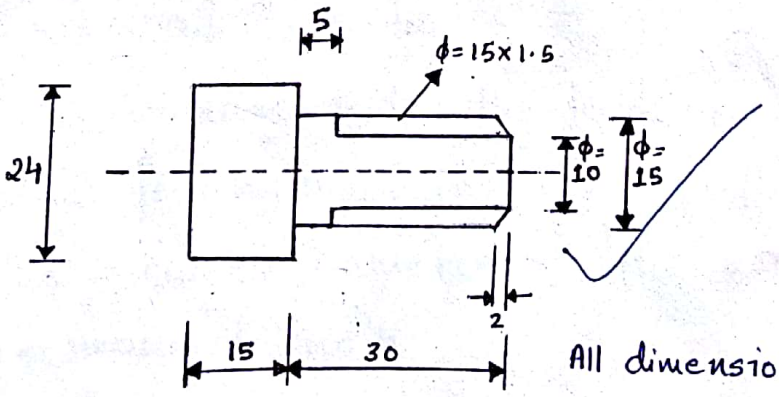
LAYOUT :-

1. Initial Work piece



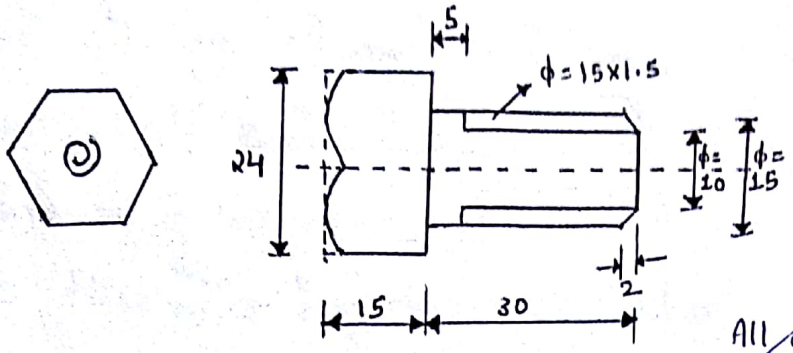
All dimensions are in mm.

2. After the Lathe job



All dimensions are in mm.

3. After Universal Milling Job

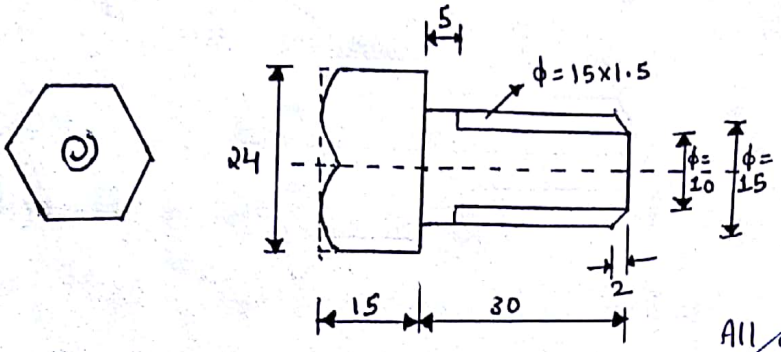


All dimensions are in mm.

PROCEDURE:-

1. A small cylindrical aluminium block of diameter 25mm and 55mm length is taken.
2. Hold the workpiece in the chuck properly.
3. Tighten the hold of the chuck on workpiece with the key.
4. Hold the single point cutting tool in the tool point.
5. Select the appropriate RPM for the job.
6. Do the facing operation manually with a cross feed. This has to be done to completely flat the surface.
7. Do the straight turning with the help of the longitudinal feeding mechanism. Select the proper feed and depth of cut as per the instruction. We get the required diameter.
8. Do the step turning with the help of lateral and longitudinal feeding mechanism. This has to be done to get the required diameter of the bolt head and also the required length.

3. After Universal Milling Job



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8. Do the step turning with the help of lateral and longitudinal feeding mechanism. This has to be done to get the required diameter of the bolt head and also the required length.

9. Do the thread cutting operation with the help of thread cutting tool. This time the feed rod has to be disengaged and lead screw has to be engaged with half nut of the apron.

This is a completely automatic process. The principal is that the longitudinal feed of the tool should be equal to the pitch of the thread to be cut per revolution of the work piece.

Here,

$$\frac{\text{driver teeth}}{\text{driven teeth}} = \frac{\text{leadscrew turn}}{\text{spindle turn}} = \frac{\text{pitch of screw to be cut}}{\text{pitch of leadscrew}}$$

10. Milling Operation:-

a) Hold the job tightly on the dividing head.

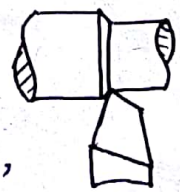
b) Select the proper RPM and feed.

c) Do the up-milling operation and cut one side of the hexagonal head.

d) Turn the workpiece 60° by turning the index plate $6\frac{2}{3}$ revolutions and make the other cut. Repeat this process 5 times.

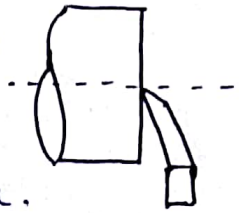
OPERATIONS PERFORMED

1. Straight turning:- It is a process in which excess material from the workpiece is removed by turning the workpiece straight, rotating about the lathe axis, and the tool is fed parallel to the lathe axis. This produces



a cylindrical surface by removing excess metal from the workpiece.

2. Facing:- It is the operation of machining the ends of a workpiece to produce a flat surface square with the axis. This is also used to cut the work to the required length.



3. Step turning:- Similar to the straight turning operations. It is done to obtain stepped cylindrical surface.

4. Thread cutting:- It is a process of creating screw thread on the workpiece. The principle of thread cutting is to produce a helical groove on a cylindr-ical surface by feeding the tool longitudinally automatically when the job is revolved by a chuck.

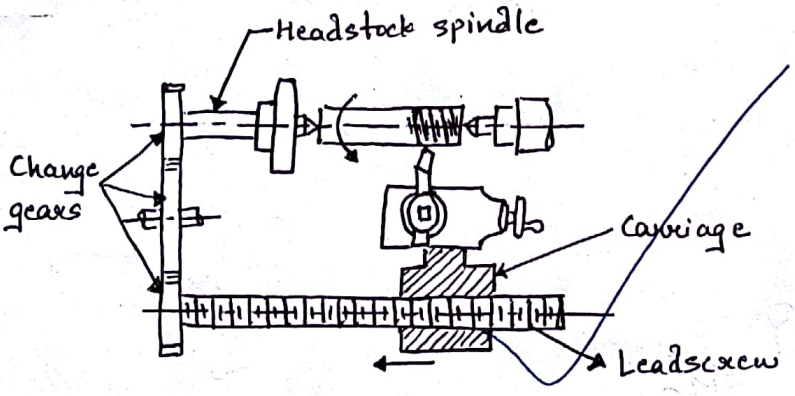


Fig: Principles of thread cutting

5. Indexing:- It is the operation performed by the milling machine in which the periphery of the workpiece is divided in any no. of points. The necessary

formula for obtaining Inden Crank movement is:-

$$\text{Inden Crank Movement} = \frac{40}{N}$$

here, N = no. of divisions required

in this case N = 6.

RESULT :- In the end we get the cylindrical bolt with hexagonal shaped head with the required dimensions.

SAFETY/PRECAUTIONS :-

1. Avoid body contact with any running part of the machine as it may cause injury.
2. Always give feed after accurately calculating the least count of the feeding mechanism.
3. Avoid parallax while taking reading in vernier callipers.
4. Do not make deep cuts in one attempt as it may damage the tool and workpiece may develop cracks and there will be rough finish.
5. Use coolant/water regularly on running tool/workpiece regularly while the cut is being made.
6. Do not clean the machine parts with hands. Use brush to remove metal chips.