

MODULE 4

LOCATING AND CLAMPING METHODS

- ✓ **Jigs and fixtures** are the economical ways to produce a component in mass.
- ✓ These are special work holding and tool guiding device.
- ✓ Quality of the performance of a process largely influenced by the quality of jigs and fixtures used for this purpose.
- ✓ The main purpose of a fixture is to locate and in the cases hold a workpiece during an operation

A jig differs from a fixture - it guides the tool to its correct position or towards its correct movement during an operation in addition to locating and supporting the workpiece.

An example of jig is when a key is duplicated, the original key is used as base for the path reader which guides the movement of tool to make its duplicate key.

PURPOSE AND ADVANTAGES OF JIGS AND FIXTURES

- 1) It reduces or sometimes eliminates the efforts of marking, measuring and setting of workpiece on a machine and maintains the accuracy of performance.
- 2) The workpiece and tool are relatively located at their exact positions before the operation automatically within negligible time. So it reduces product cycle time.
- 3) Variability of dimension in mass production is very low so manufacturing processes supported by use of jigs and fixtures maintain a consistent quality.

PURPOSE AND ADVANTAGES OF JIGS AND FIXTURES

(4) Due to low variability in dimension assembly operation becomes easy, low rejection due to less defective production is observed.

(5) It reduces the production cycle time so increases production capacity. Simultaneously working by more than one tool on the same workpiece is possible.

(6) The operating conditions like speed, feed rate and depth of cut can be set to higher values due to rigidity of clamping of workpiece by jigs and fixtures.

PURPOSE AND ADVANTAGES OF JIGS AND FIXTURES

(7) Operators working becomes comfortable as his efforts in setting the workpiece can be eliminated.

(8) Semi-skilled operators can be assigned the work so it saves the cost of manpower also.

(9) There is no need to examine the quality of product provided that quality of employed jigs and fixtures is ensured.

IMPORTANT CONSIDERATIONS WHILE DESIGNING JIGS AND FIXTURES

- (a) Study of workpiece and finished component size and geometry.
- (b) Type and capacity of the machine, its extent of automation.
- (c) Provision of locating devices in the machine.
- (d) Available clamping arrangements in the machine.
- (e) Available indexing devices, their accuracy.
- (f) Evaluation of variability in the performance results of the machine.
- (g) Rigidity and of the machine tool under consideration.
- (h) Study of ejecting devices, safety devices, etc.
- (i) Required level of the accuracy in the work and quality to be produced.

LOCATION???

Location refers to the establishment of a desired relationship between the workpiece and the jigs or fixture correctness of location directly influences the accuracy of the finished product.

The jigs and fixtures are desired so that all undesirable movements of the workpiece can be restricted.

Determination of the locating points and clamping of the workpiece serve to restrict movements of the component in any direction, while setting it in a particular pre-decided position relative to the jig.

Before deciding the locating points it is advisable to find out the all possible degrees of freedom of the workpiece.

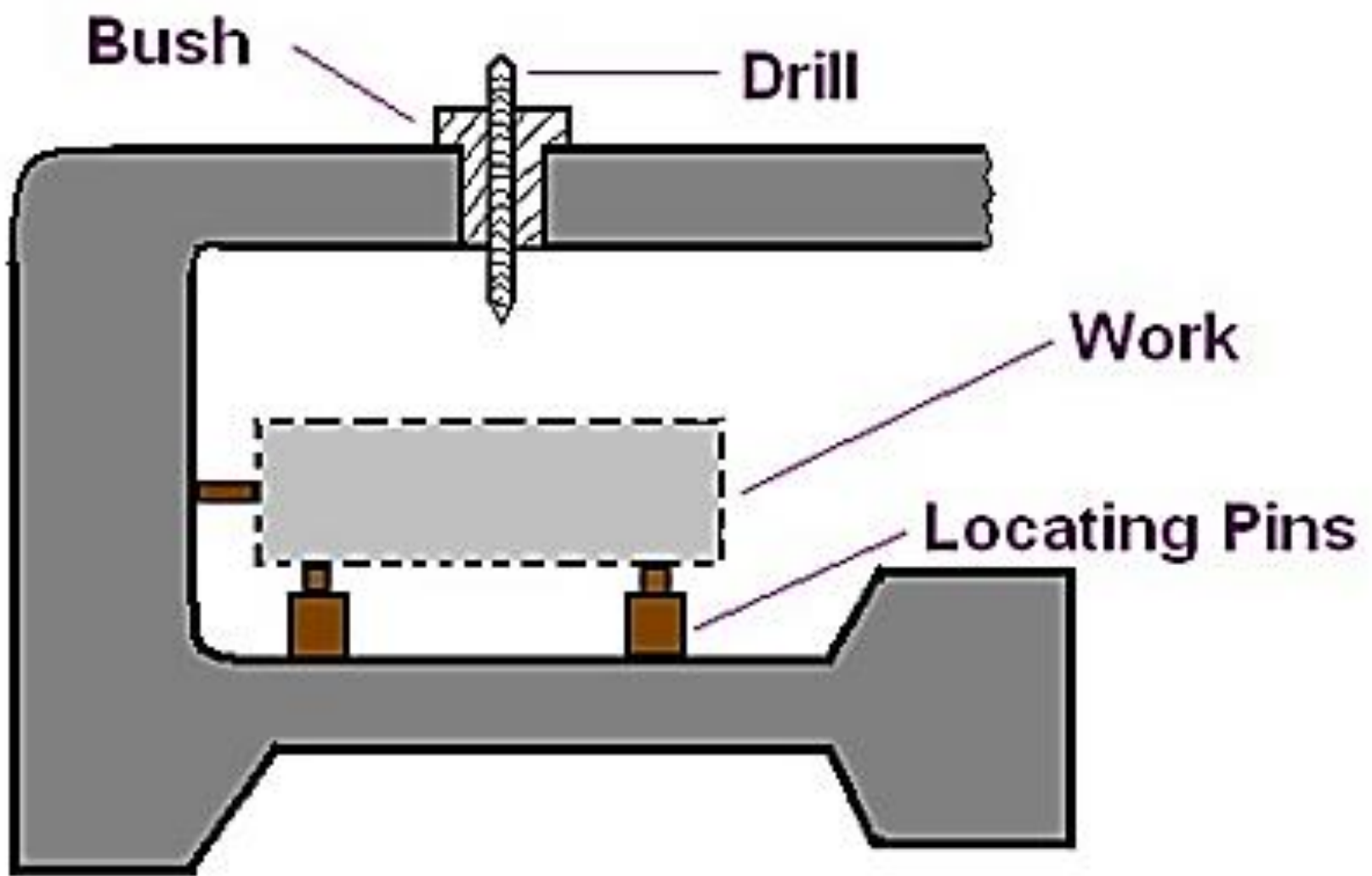
Then some of the degrees of freedom or all of them are restrained by making suitable arrangements. These arrangements are called locators.

LOCATING METHODS

JIGS & FIXTURES

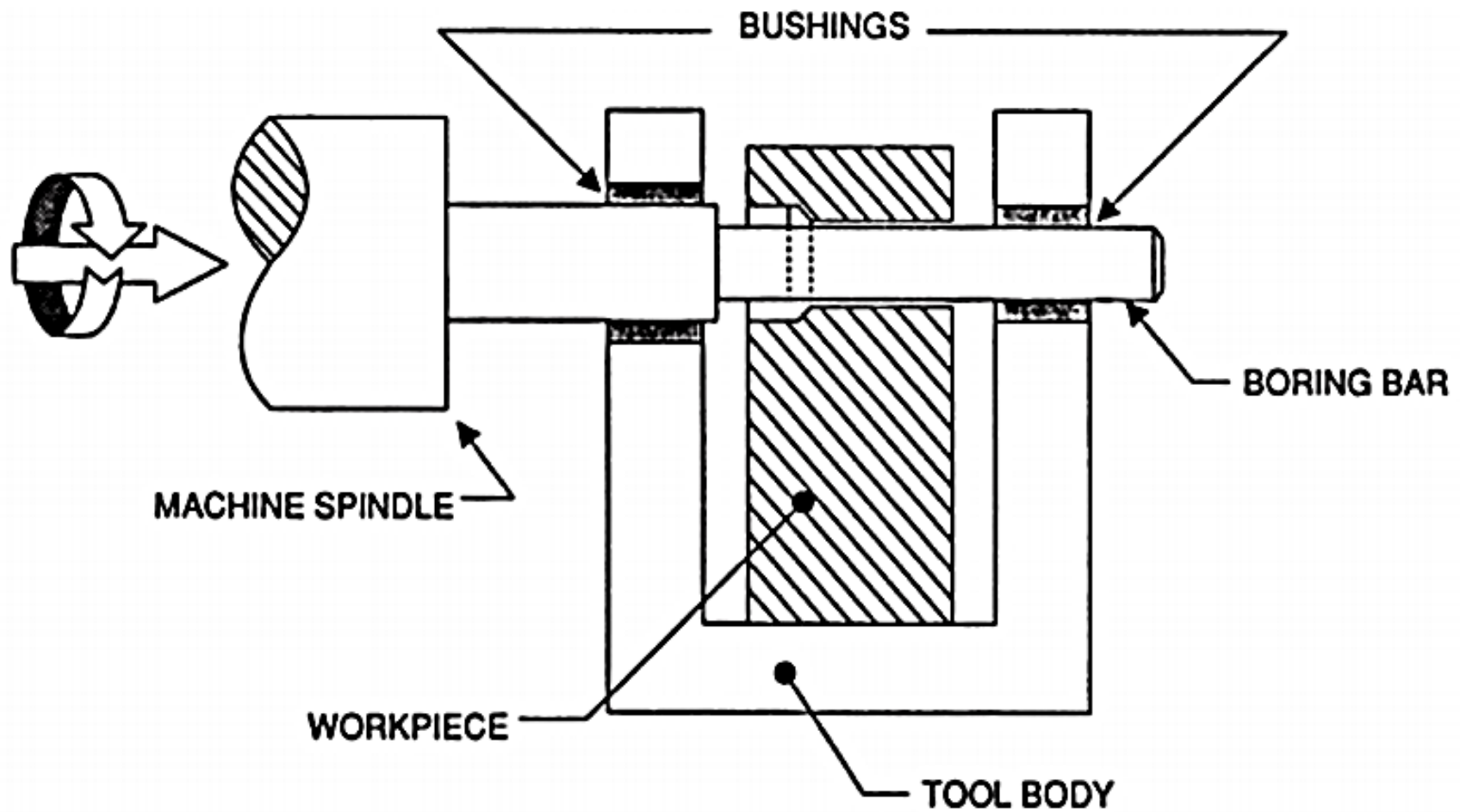
JIGS

It is a work holding device that holds, supports and locates the workpiece and guides the cutting tool for a specific operation.



-: Jig :-

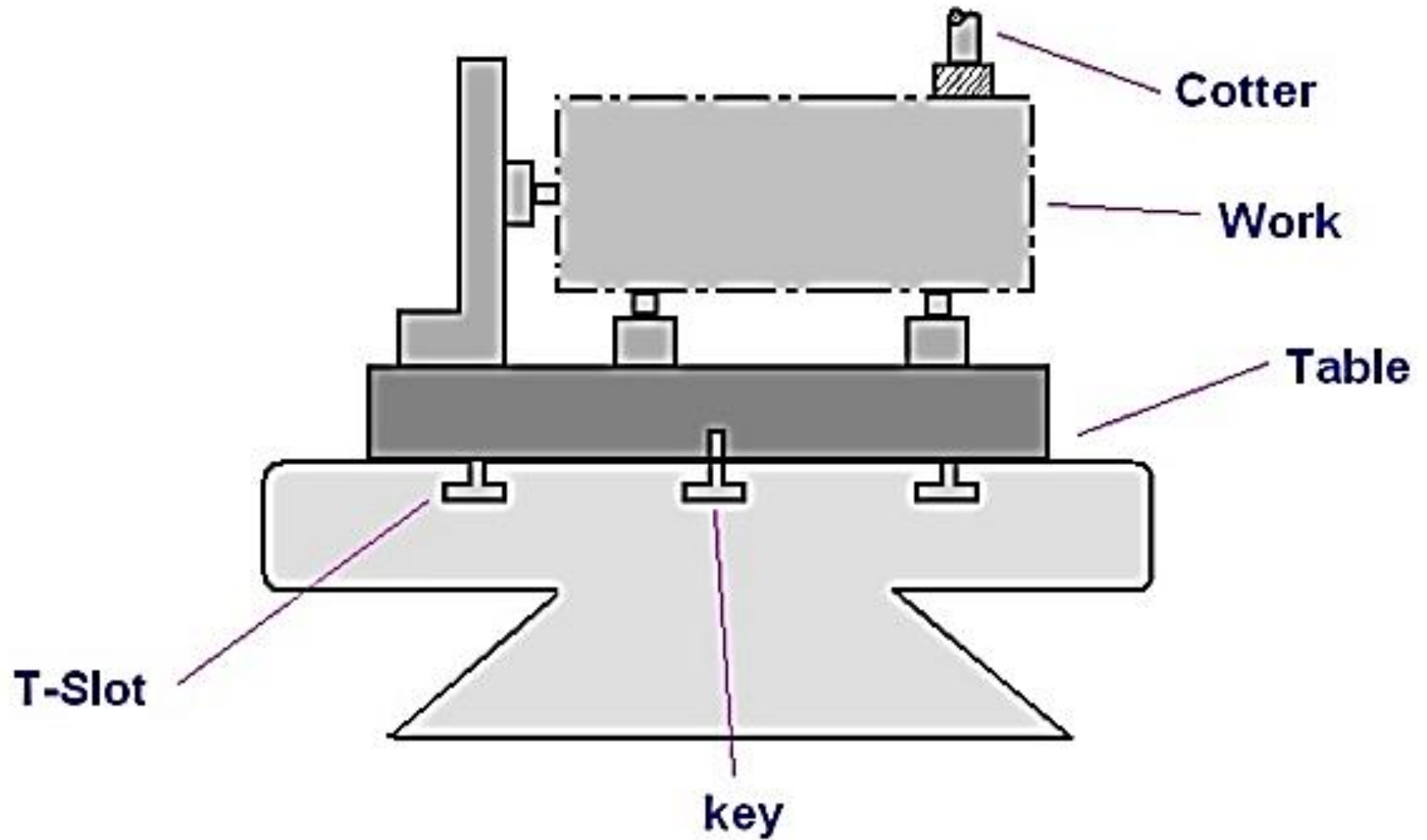
BORING JIG



FIXTURES

It is a work holding device that holds, supports and locates the workpiece for a specific operation but does not guide the cutting tool.

-: Fixture :-



How do jigs and fixtures differ

JIGS

1. It is a work holding device that holds, supports and locates the workpiece and guides the cutting tool for a specific operation
2. Jigs are not clamped to the drill press table unless large diameters to be drilled and there is a necessity to move the jig to bring one each bush directly under the drill.

FIXTURES

1. It is a work holding device that holds, supports and locates the workpiece for a specific operation but does not guide the cutting tool
2. Fixtures should be securely clamped to the table of the machine upon which the work is done.

JIGS

3. The jigs are special tools particularly in drilling, reaming, tapping and boring operation.

4. Gauge blocks are not necessary.

5. Lighter in construction.

FIXTURES

3. Fixtures are specific tools used particularly in milling machine, shapers and slotting machine.

4. Gauge blocks may be provided for effective handling.

5. Heavier in construction.

Advantages of Jigs and Fixtures

PRODUCTIVITY:

INTERCHANGEABILITY AND QUALITY:

SKILL REDUCTION

COST REDUCTION:

Design Considerations For Jigs And Fixtures

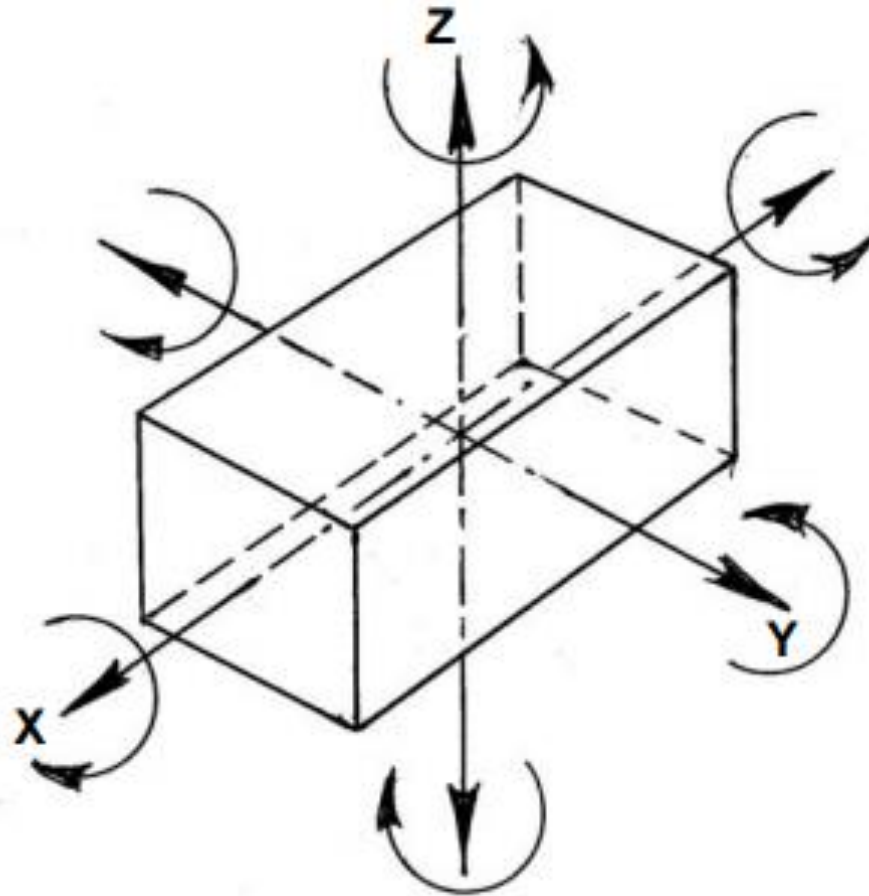
- base and body or frame with clamping features
- locating elements for proper positioning and orientation of the blank
- supporting surfaces and base
- clamping elements
- tool guiding frame and bushes (for jig)
- indexing plates or systems, if necessary
- auxiliary elements
- fastening parts

FACTORS CONSIDERED FOR DESIGN, FABRICATION AND ASSEMBLY OF JIGS AND FIXTURES

- easy, quick and consistently accurate locating of the blank in the jig or fixture in reference to the cutting tool
- providing strong, rigid and stable support to the blank
- quick, strong and rigid clamping of the blank in the jig or fixture without interrupting any other operations
- tool guidance for slender cutting tools like drills and reamers
- easy and quick loading and unloading the job to and from the jig or fixture

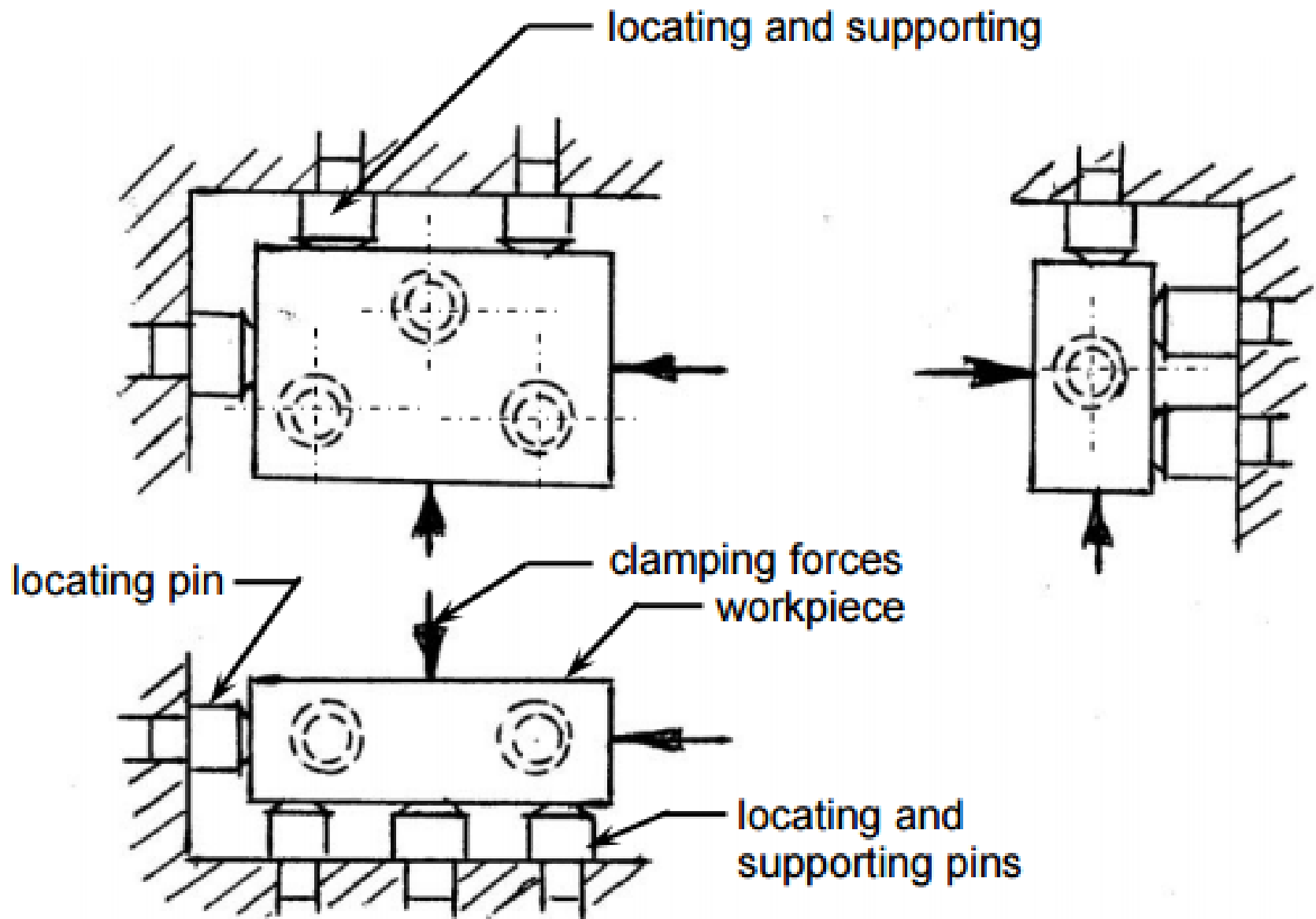
- use of minimum number of parts for making the jig or fixture
- use of standard parts as much as possible
- reasonable amount of flexibility or adjustability, if feasible, to accommodate slight variation in the job - dimensions.
- prevention of jamming of chips, i.e. wide chips-space and easy chip disposal
- easy, quick and accurate indexing system if required.
- easy and safe handling and moving the jig or fixture on the machine table, i.e., their shape, size, weight and sharp edges and corners
- easy and quick removal and replacement of small parts
- manufacturability i.e. ease of manufacture
- durability and maintainability
- service life and overall expenses

□ **Locating – principles and methods**



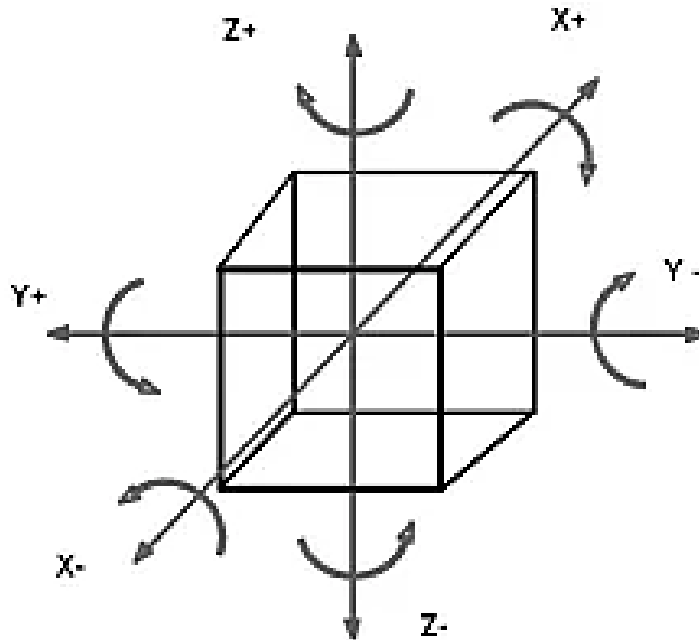
Possible degrees of freedom of a solid body.

Arresting all degrees of freedom of a blank in a fixture.



Degree of Freedom

Degree of Freedom is defined as
number of independent motion a body
has



3-2-1 Principle of Clamping Workpiece

It is principle of clamping widely used.

1) **3 Pin** are used at **Bottom**

It will restrict 4 Rotational motion (X,Y Axis) and 1 Translation motion (-Z Direction)

2) **2 Pin**

It will Restrict 2 Rotational Motion (Z Axis) and 1 Translation motion in (+X Direction)

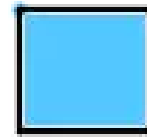
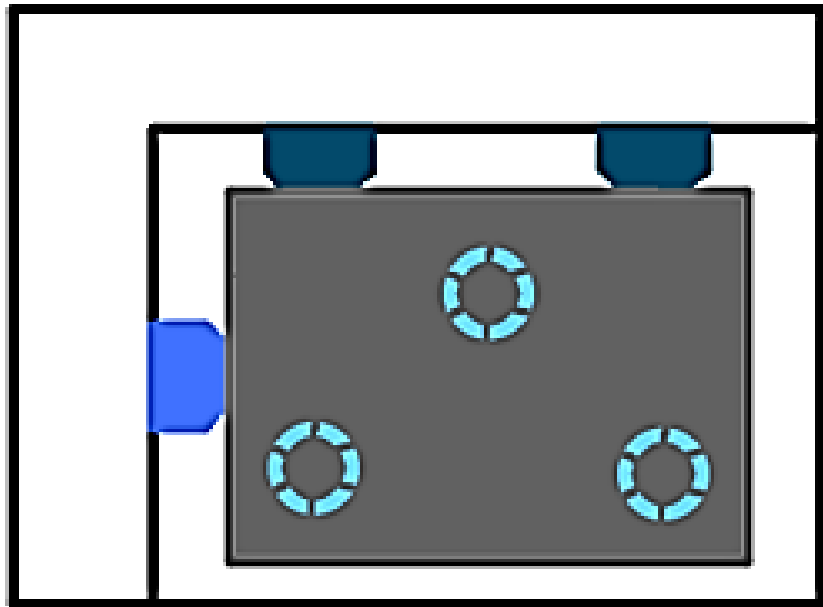
3) **1 Pin**

It will restrict 1 Translation Motion (+Y)

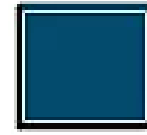
And Pin 3-2-1 combined will restrict 9 Motion

And Remaining 3 Motion is used to set work-piece at desired location and can be restricted by Clamp.

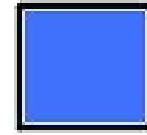
(* Notation given i.e +X, -X . Changes according to views)



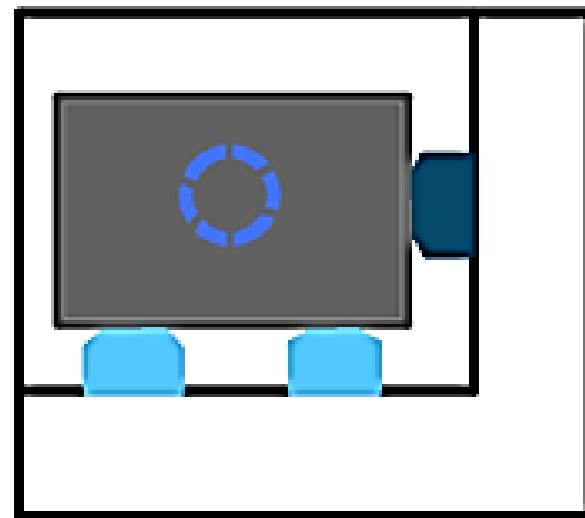
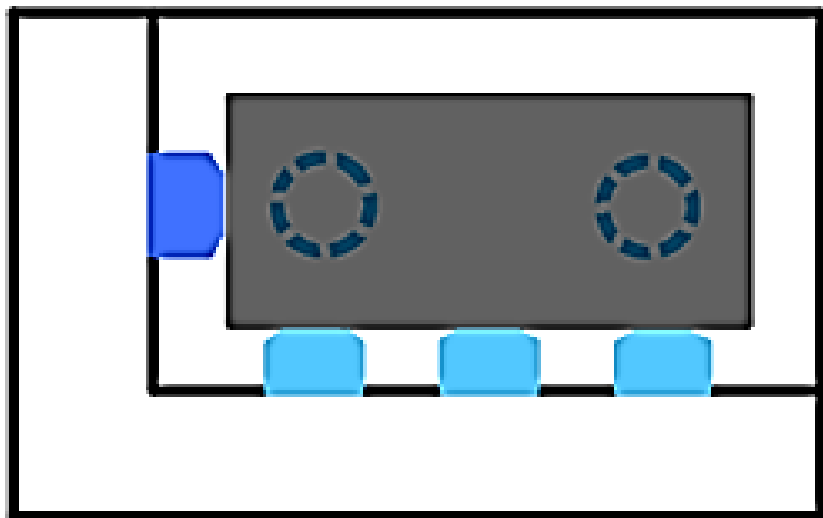
3 Pin



2 Pin



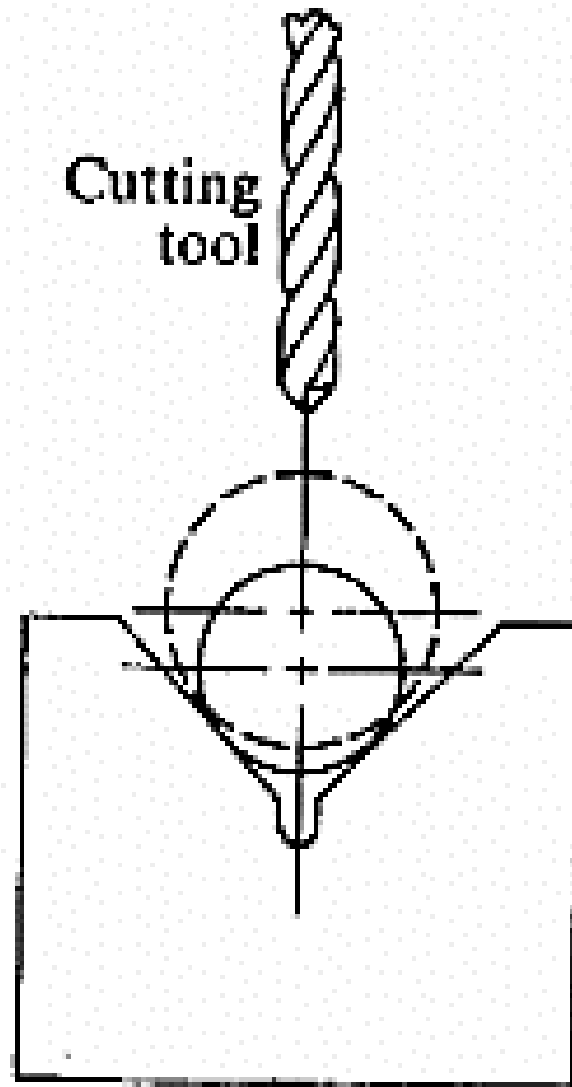
1 Pin



Some basic principles or rules need to be followed while planning for locating blanks in fixtures, such as

- One or more surfaces (preferably machined) and / or drilled / bored hole(s) are to be taken for reference
- The reference surfaces should be significant and important feature(s) based on which most of the dimensions are laid down
- Locating should be easy, quick and accurate
- In case of locating by pin, the pins and their mounting and contact points should be strong, rigid and hard
- A minimum of three point must be used to locate a horizontal flat surface
- The locating pins should be as far apart as feasible

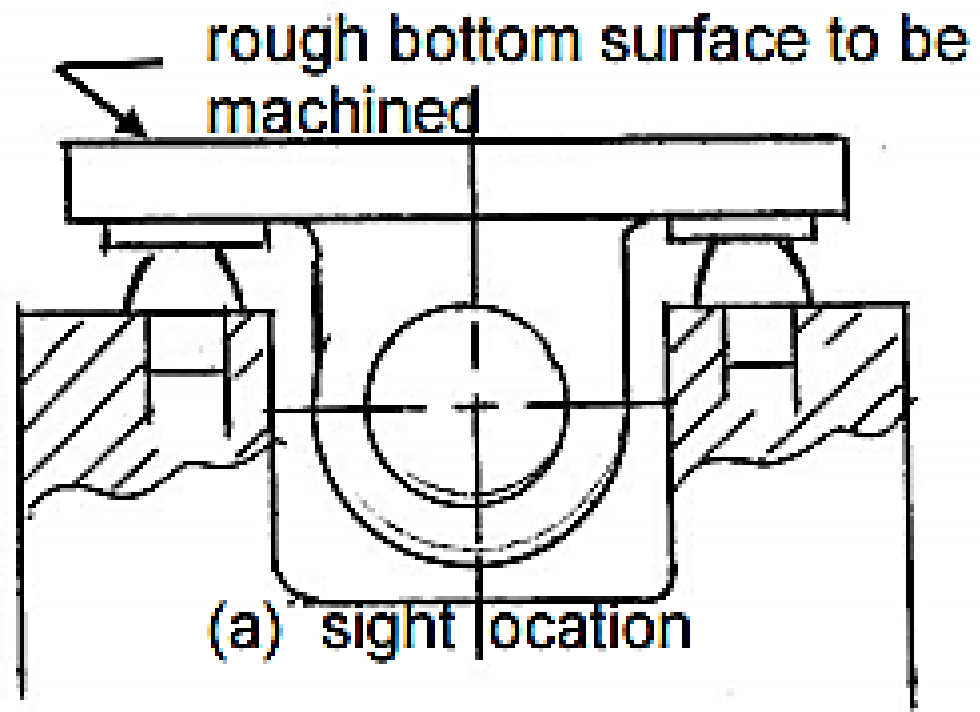
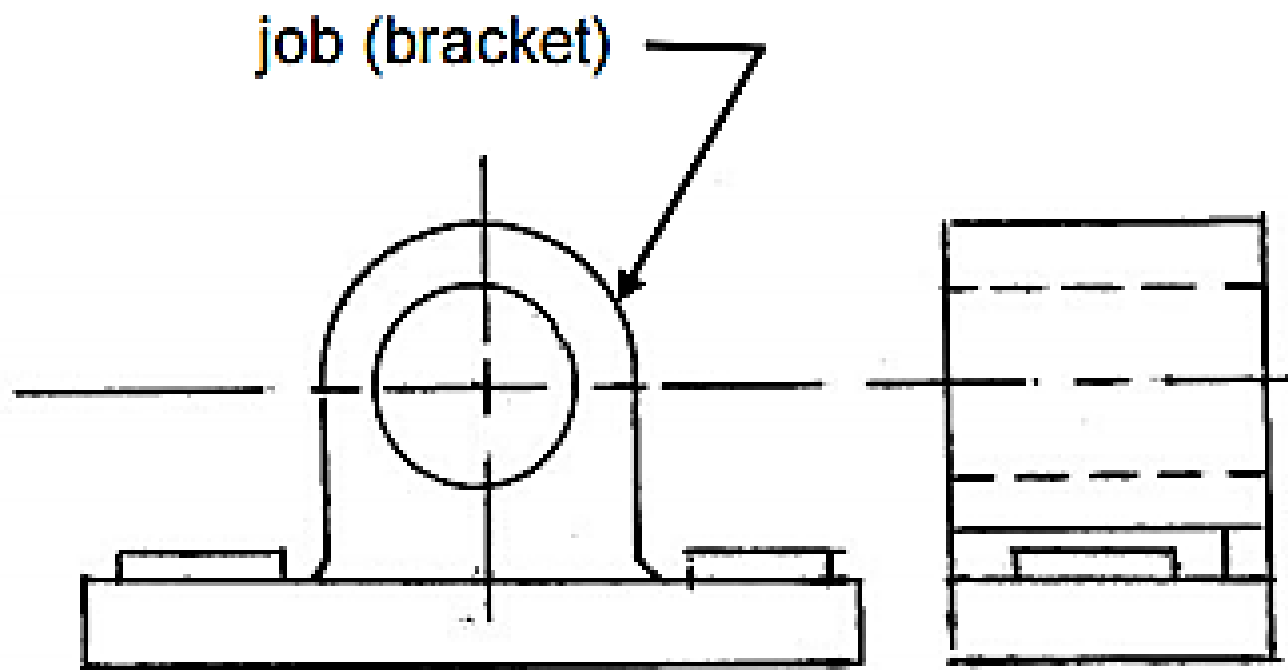
- Vee block and cones should be used for self-locating solid and hollow cylindrical jobs
- Sight location is applicable to first - operation location of blank with irregular surfaces produced by casting, forging etc. when the bracket is first located on two edges to machine the bottom surface which will be used for subsequent locating.
- Adjustable locating pin(s) is to be used to accommodate limited part size variation



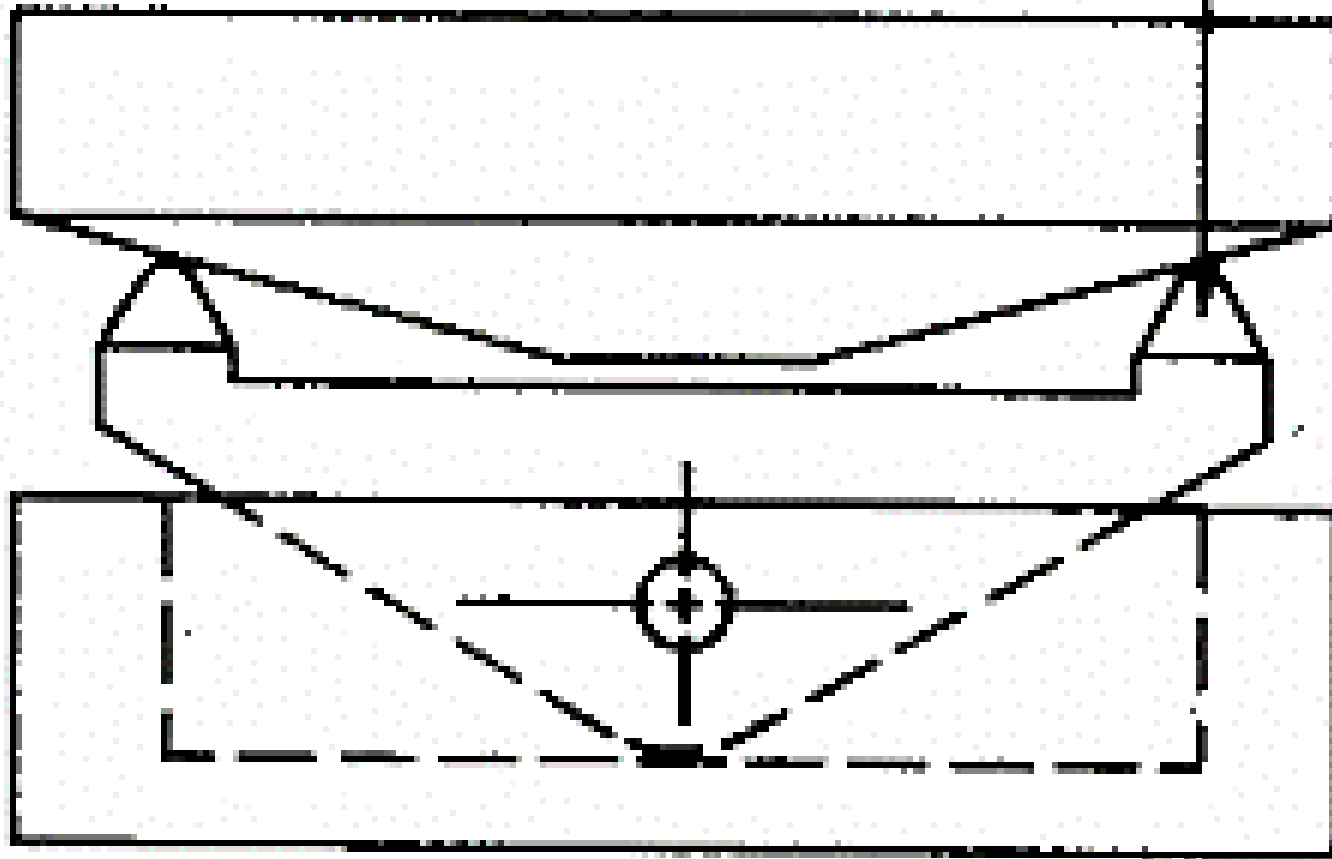
Locating by Vee block

For locating large jobs by rough bottom surface one of the three pins may be replaced by a pivoted arm.

The pivoted arm provides two contact points.



Rocker



pivoted arm with two points

General methods of locating

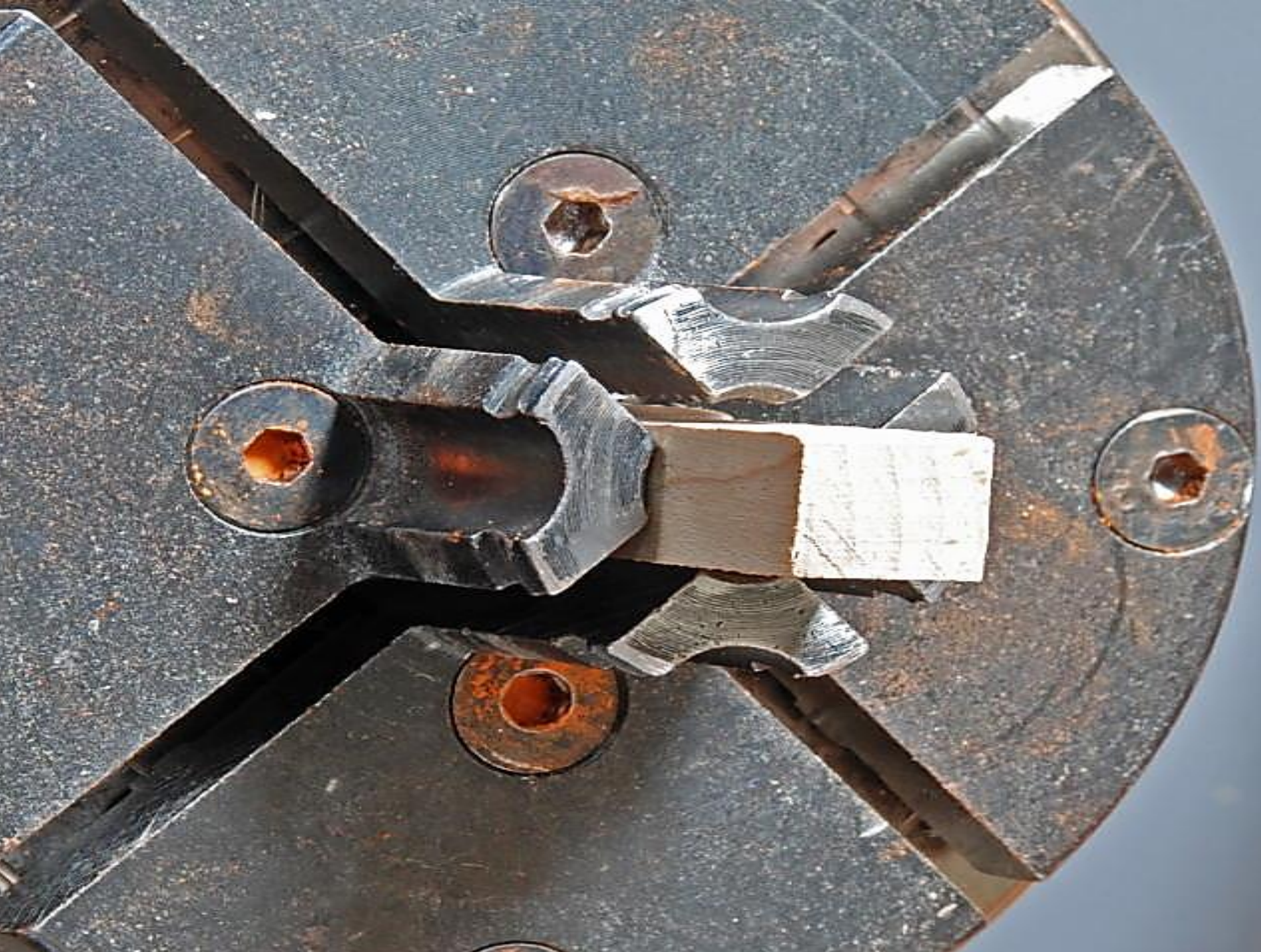
Locating blanks for machining in lathes

In lathes, where the job rotates, the blanks are located by

- ✓ fitting into self centering chuck
- ✓ fitting into 4 - independent jaw chuck and dead centre
- ✓ in self - centering collets
- ✓ in between live and dead centres
- ✓ by using mandrel fitted into the head stock - spindle
- ✓ fitting in a separate fixture which is properly clamped on a driving plate which is coaxially fitted into the lathe spindle.

True the blank and form a tenon at each end.



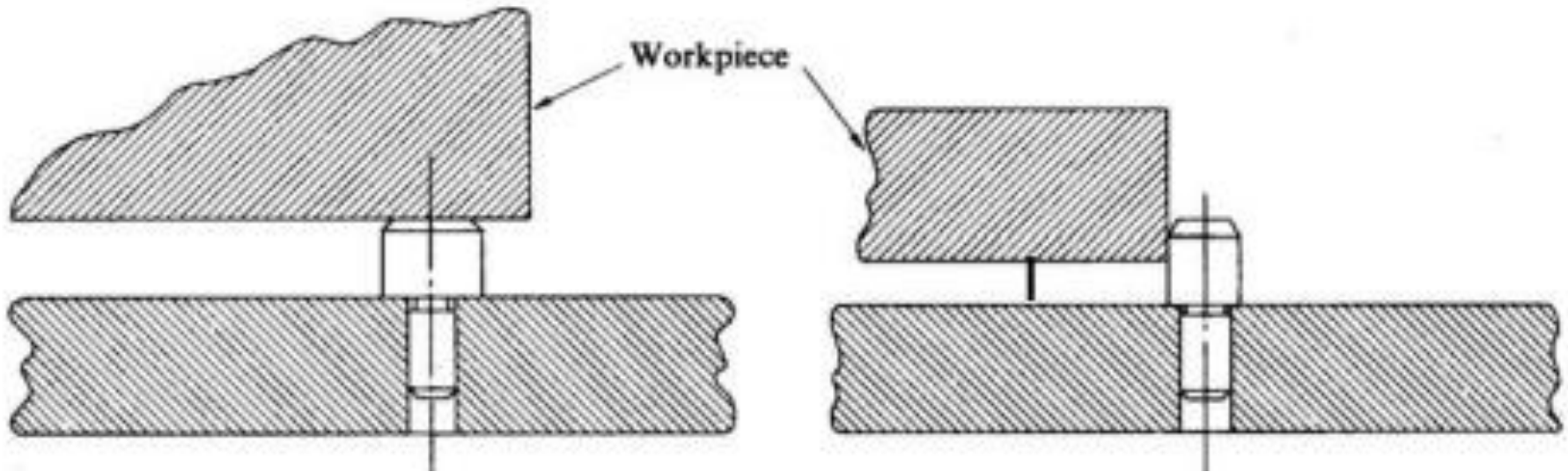


Locating for machining in other than lathes

- In machine tools like drilling machine, boring machine, milling machine, planing machine, broaching machine and surface grinding machine the job remains fixed on the bed or work table of those machine tools.

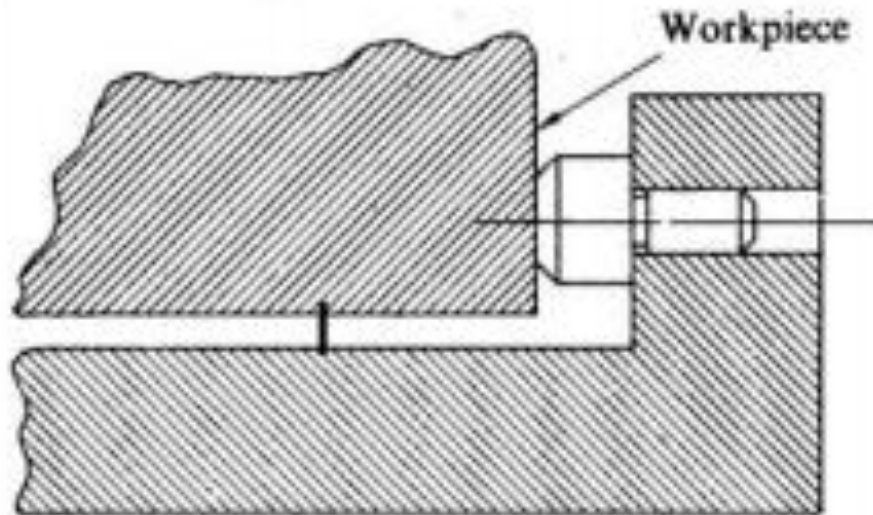
Fixtures are mostly used in the aforesaid machine tools and jig specially for drilling, reaming etc. for batch production.

Locating by flat surfaces

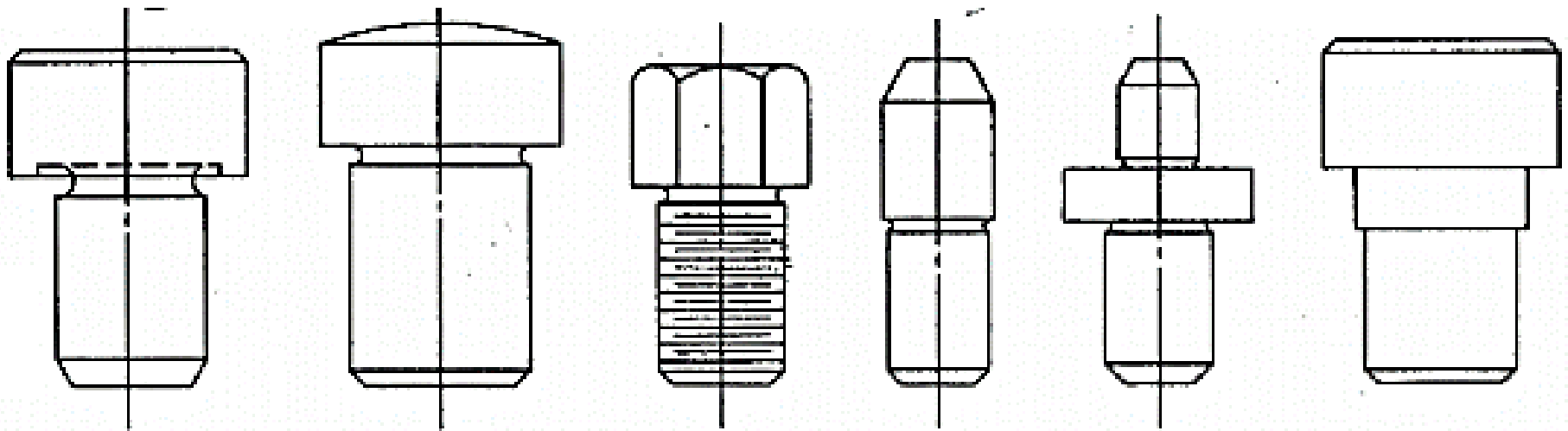


a)

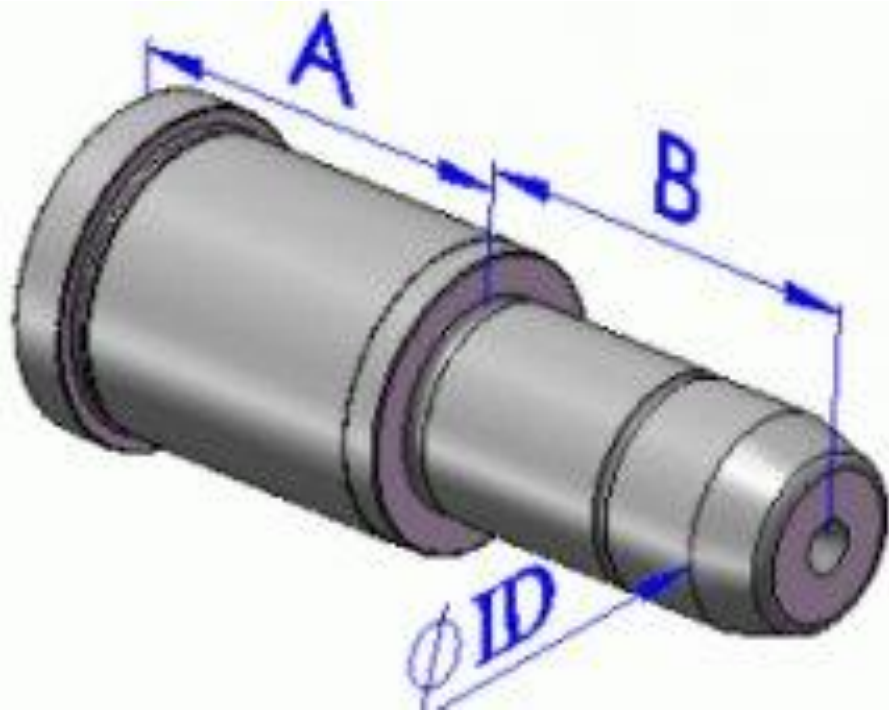
b)



c)



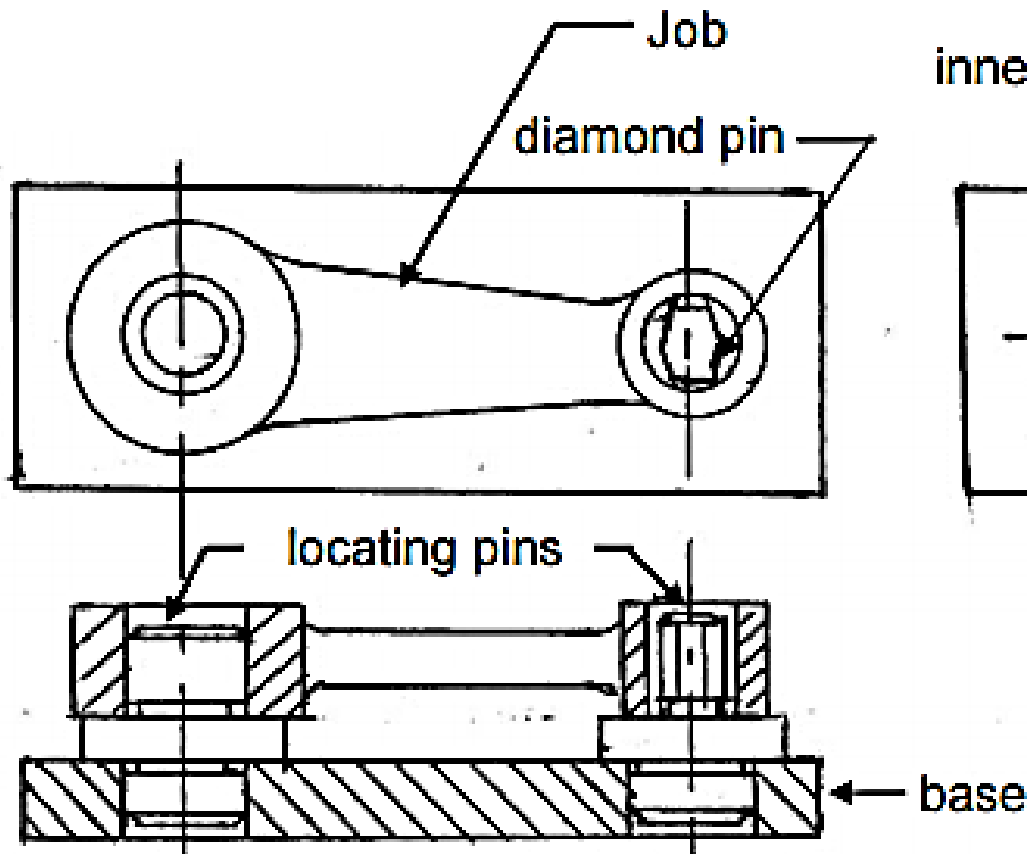
types of pins



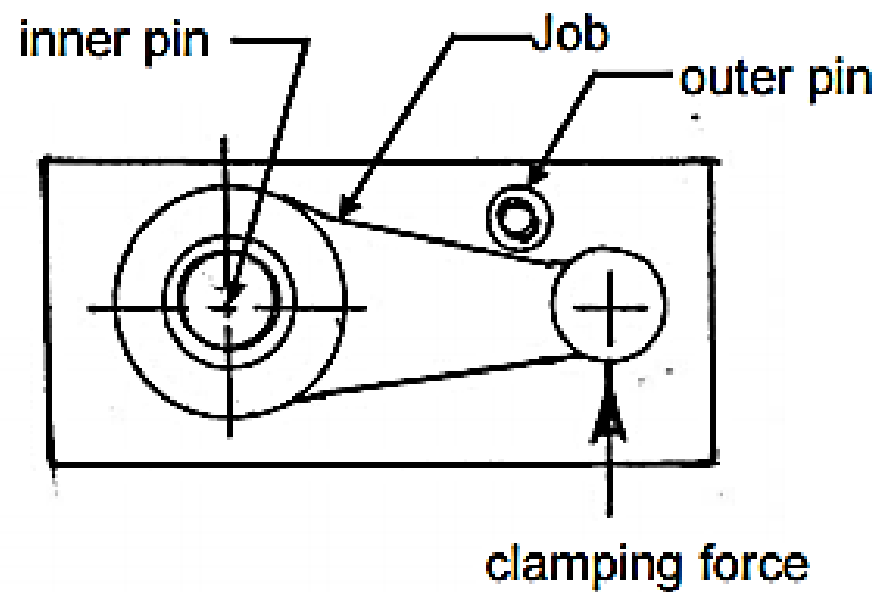
In several cases, workpieces are located by premachined (drilled, bored or pierced) holes, such as;

- * Locating by two holes where one of the pins has to be diamond shaped to accommodate tolerance on the distance between the holes and their diameters
- * Locating by one hole and an external pin which prevents rotation of the blank around the inner pin
- * Locating by one hole and one Vee-block

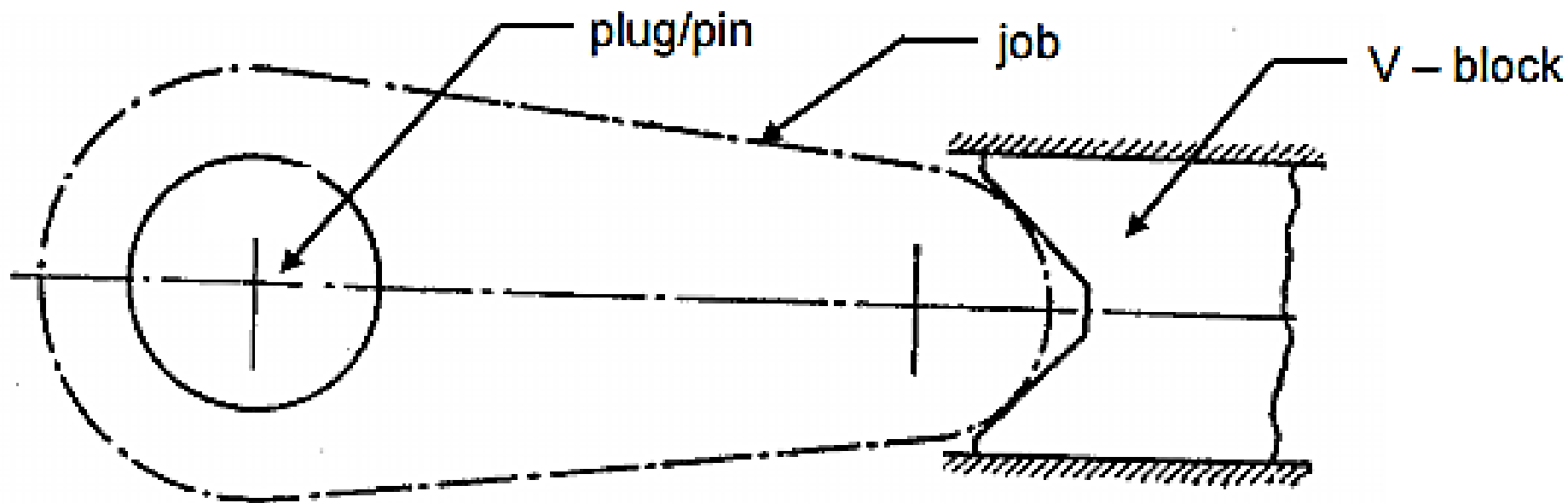
o Locating by holes



locating by two holes



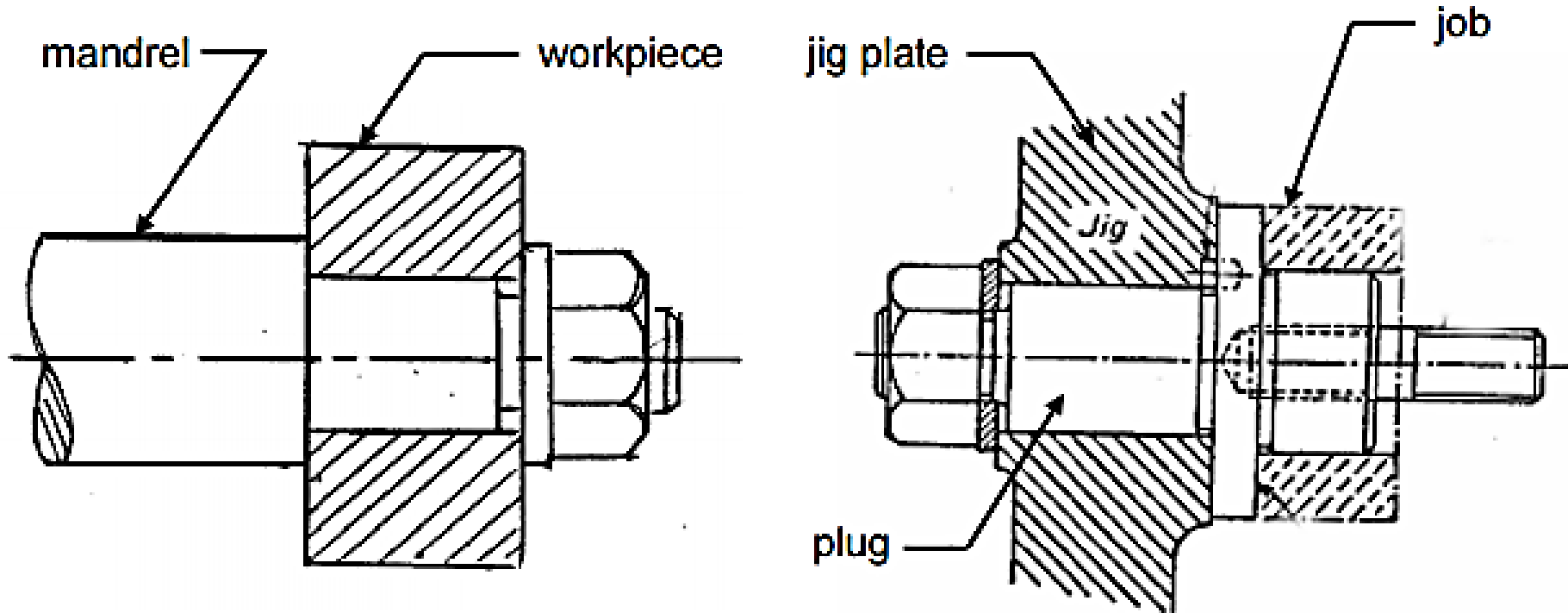
locating by one hole



Locating by a pin and Vee block.

LOCATING ON MANDREL OR PLUG

Locating on mandrel or plug Ring or disc type work pieces are conveniently located on mandrel or single plug.





Supporting - principles and methods

Workpiece has to be properly placed in the jig or fixture not only for desired positioning and orientation but also on strong and rigid support such that the blank does not elastically deflect or deform under the actions of the clamping forces, cutting forces and even its own weight

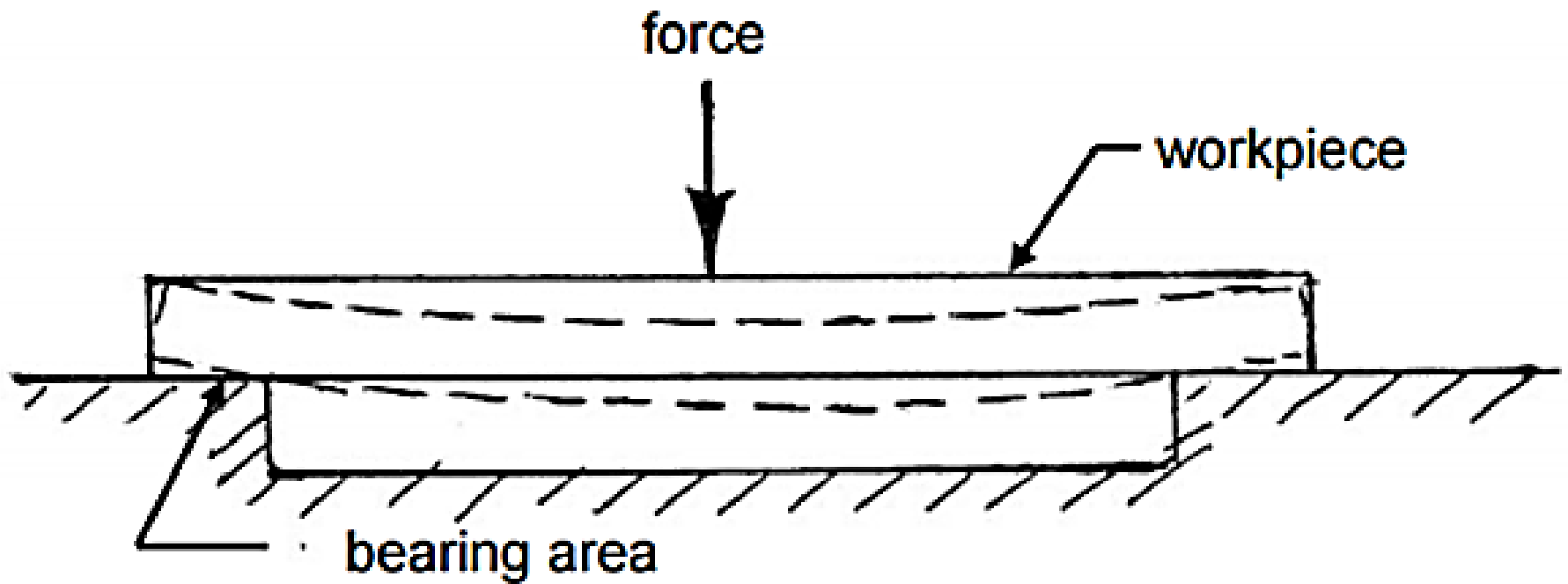
Basic principles or rules to be followed while designing or planning for supporting

- ✓ supporting should be provided at least at three points
- ✓ supporting elements and system have to be enough strong and rigid to prevent deformation due to clamping and cutting forces
- ✓ unsupported span should not be large to cause sagging
- ✓ supporting should keep the blank in stable condition under the forces

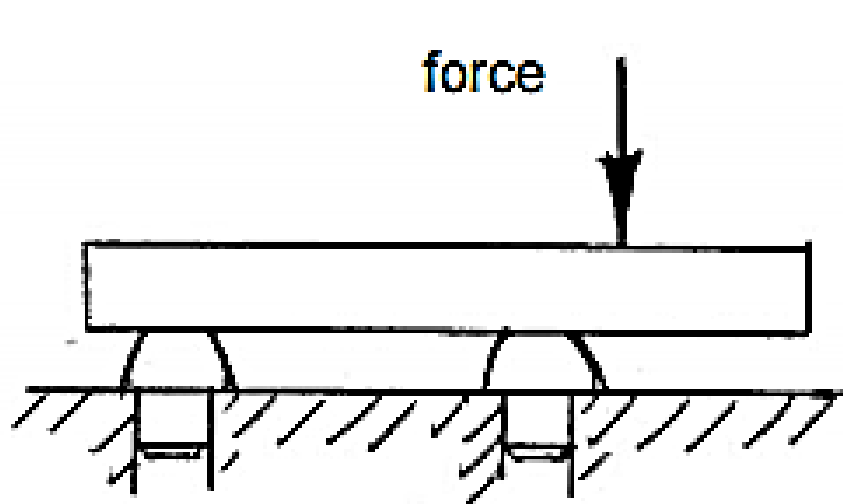
- ✓ for supporting large flat area proper recess is to be provided, for better and stable support.
- ✓ round or cylindrical workpieces should be supported (along with locating) on strong vee block of suitable size
- ✓ heavy workpieces with pre-machined bottom surface should be supported on wide flat areas, otherwise on flat ended strong pins or plugs.
- ✓ if more than three pins are required for supporting large workpieces then the additional supporting pins are to be spring loaded or adjustable

additional adjustable supporting pins need to be provided

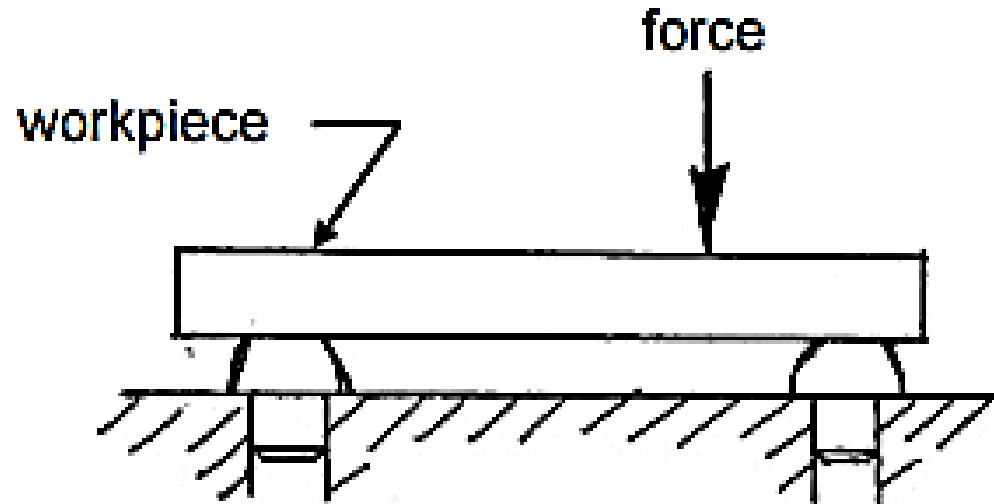
- * to compensate part size variation
 - * when the supporting surface is large and irregular
 - * when clamping and cutting forces are large
-
- ring or disc type jobs, specially requiring indexing should be supported (and located) in mandrel



Deflection due to force(s) for wide gap in between supports.

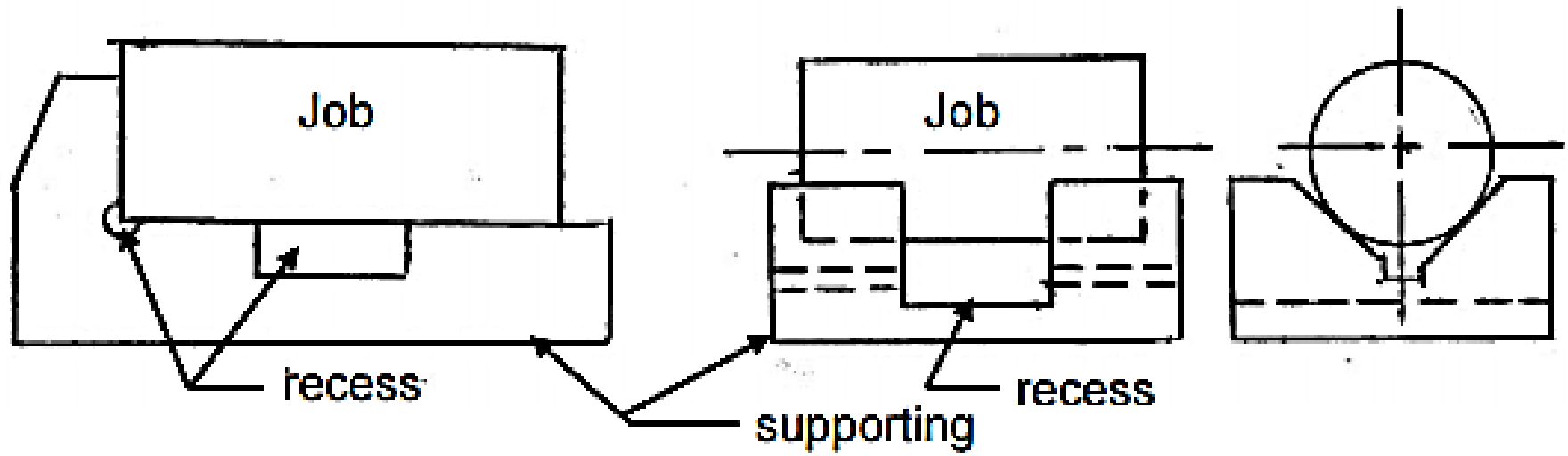


(a) not correct (unstable)

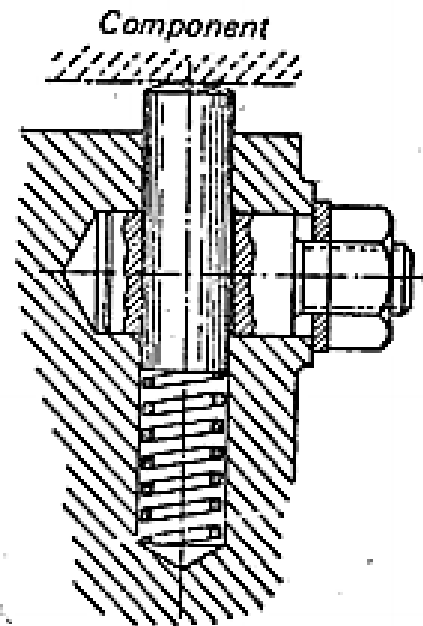
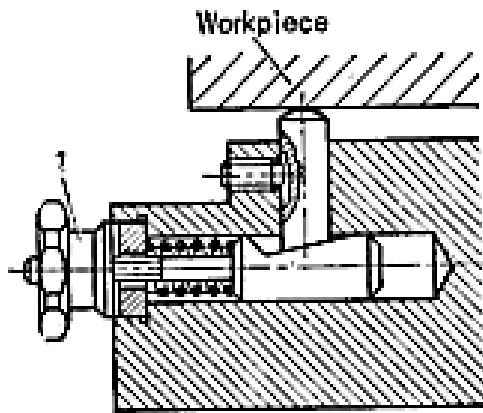
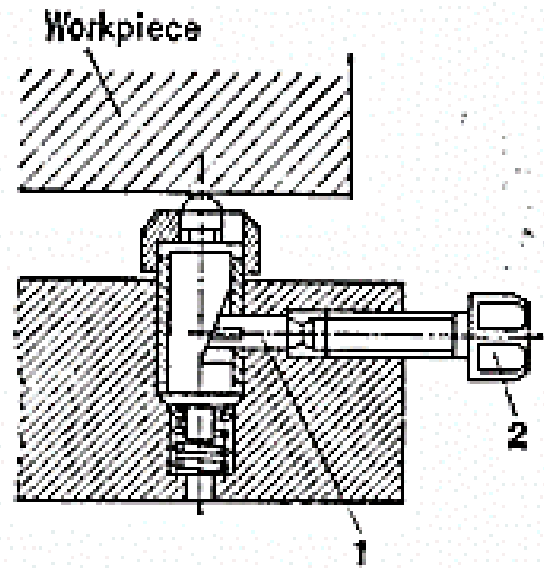
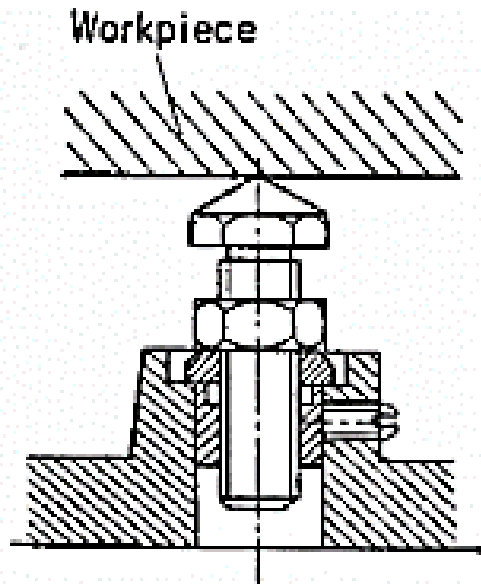


(b) correct (stable)

Stability in supporting.



Recess in long span supporting.



Adjustable supporting pins.

What is Clamping?

Once workpiece is located, it is necessary to press it against locating surfaces and hold it there against the force acting upon it.

The tool designer refers to this action as clamping and the mechanisms used for this action are known as clamps.

Clamping Principles

- Clamp should firmly hold the workpiece without distorting it.
- Should overcome the maximum possible force exerted on workpiece by using minimum clamping force
- Easy to operate
- Vibrations should tighten the cams and wedges in the clamp design(if any) and not loosen them

Types Of Clamping

- Mechanical Actuation Clamps
- Pneumatic and Hydraulic Clamps
- Vacuum Clamping
- Magnetic Clamping
- Electrostatic Clamping
- Non Mechanical Clamping
- Special Clamping Operations

Clamping of workpiece in fixtures

In jigs and fixtures the workpiece or blank has to be strongly and rigidly clamped against the supporting surfaces and also the locating features so that the blank does not get displaced at all under the cutting forces during machining.

While designing for clamping the following factors essentially need to be considered :

- ✓ Clamping need to be strong and rigid enough to hold the blank firmly during machining
- ✓ Clamping should be easy, quick and consistently adequate
- ✓ Clamping should be such that it is not affected by vibration, chatter or heavy pressure
- ✓ Way of clamping and unclamping should not hinder loading and unloading the blank in the jig or fixture

- ✓ the clamp and clamping force must not damage or deform the workpiece
- ✓ clamping operation should be very simple and quick acting when the jig or fixture is to be used more frequently and for large volume of work o clamps, which move by slide or slip or tend to do so during applying clamping forces, should be avoided
- ✓ clamping system should comprise of less number of parts for ease of design, operation and maintenance

- ✓ the wearing parts should be hard or hardened and also be easily replaceable
- ✓ clamping force should act on heavy part(s) and against supporting and locating surfaces
- ✓ clamping force should be away from the machining thrust forces
- ✓ clamping method should be fool proof and safe
- ✓ clamping must be reliable but also inexpensive

Various methods of clamping

Clamping method and system are basically of two categories :

- (a) general type without much consideration on speed of clamping operations
- (b) quick acting type

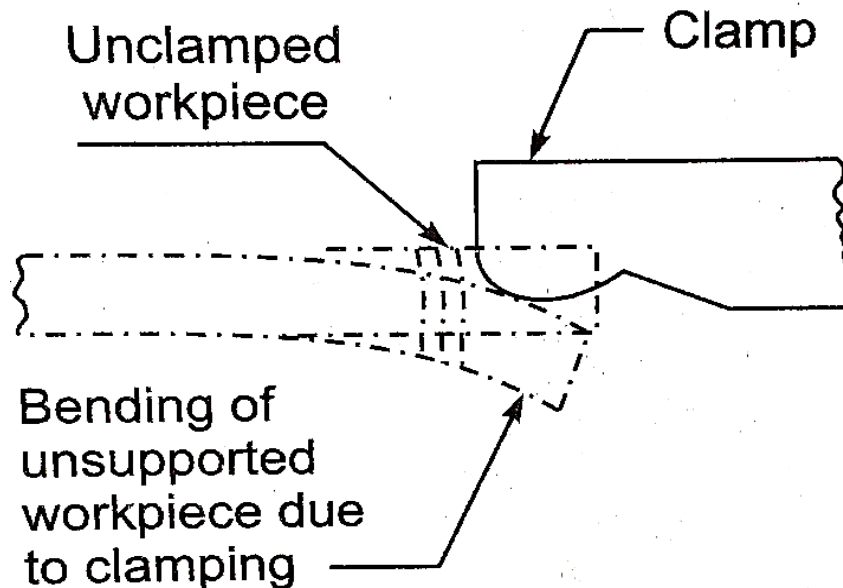
Principles of Clamping

- Position
- Strength
- Productivity
- Operator fatigue

Principles of Clamping

Position:

- Clamping system should be positioned at thick sections of the workpiece.
- Clamping should be positioned to direct the clamping force on a strong, supported part of the workpiece.
- Clamping on unsupported part bends slender workpieces, affects accuracy of operation.

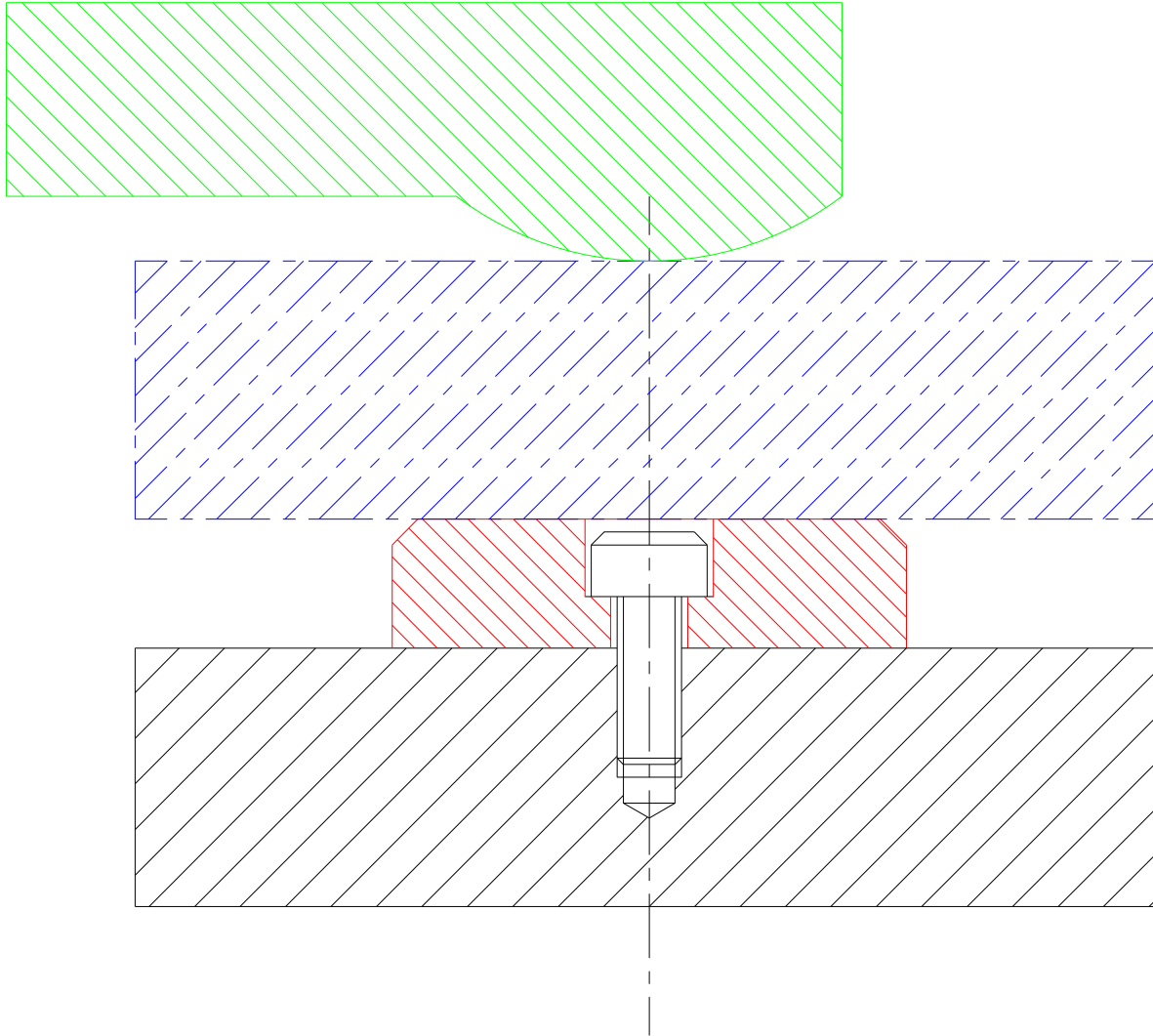


Distortion of unsupported workpiece

- Clamping system should not obstruct **loading and unloading of the workpiece.**
- Clamping system should not obstruct the **paths of cutting tool.**
- Operator should be able to operate clamps easily and safely
- A vertical hole drilled in the bent workpiece would become **angular** when the unclamped workpiece springs back to its original shape.

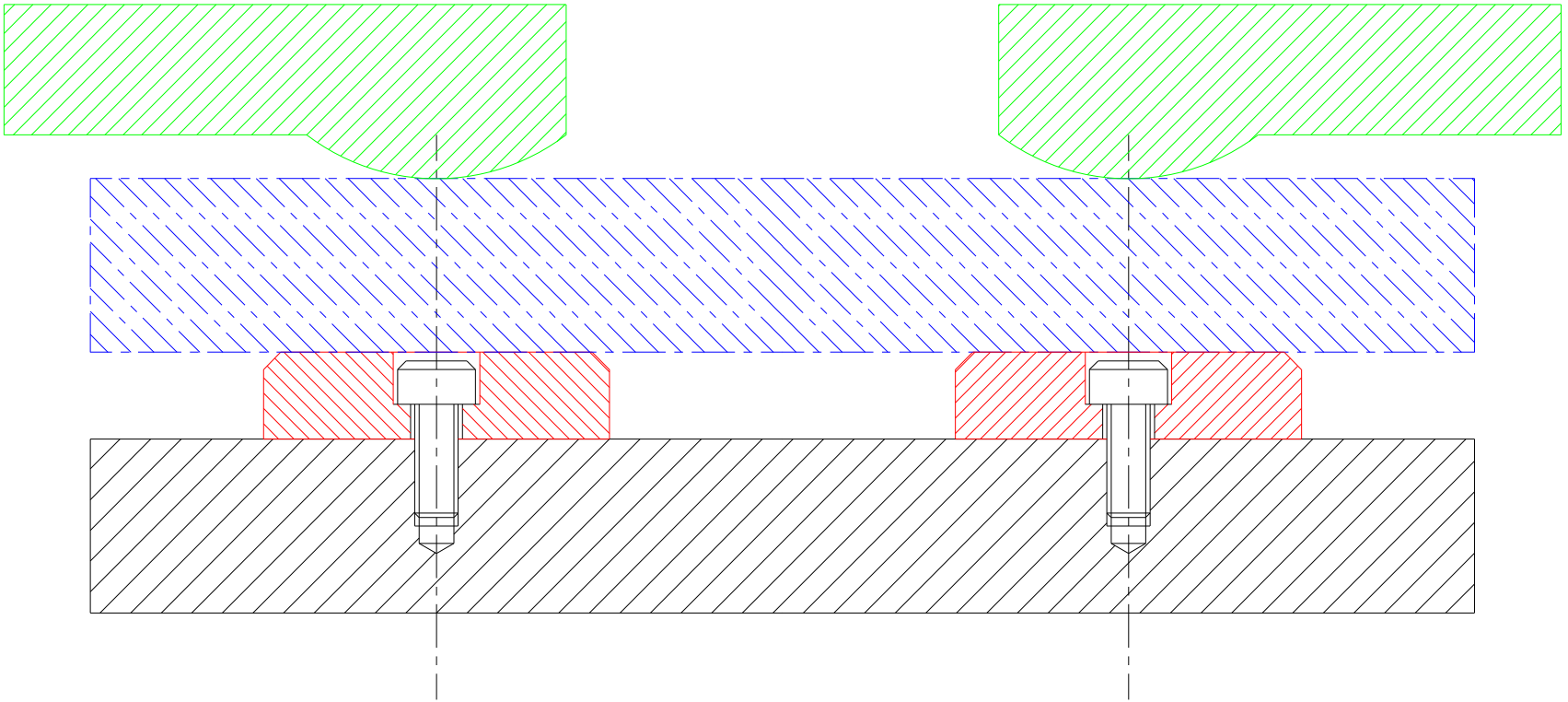
Principles of Clamping

- Clamping force shall be directed towards support / locators.



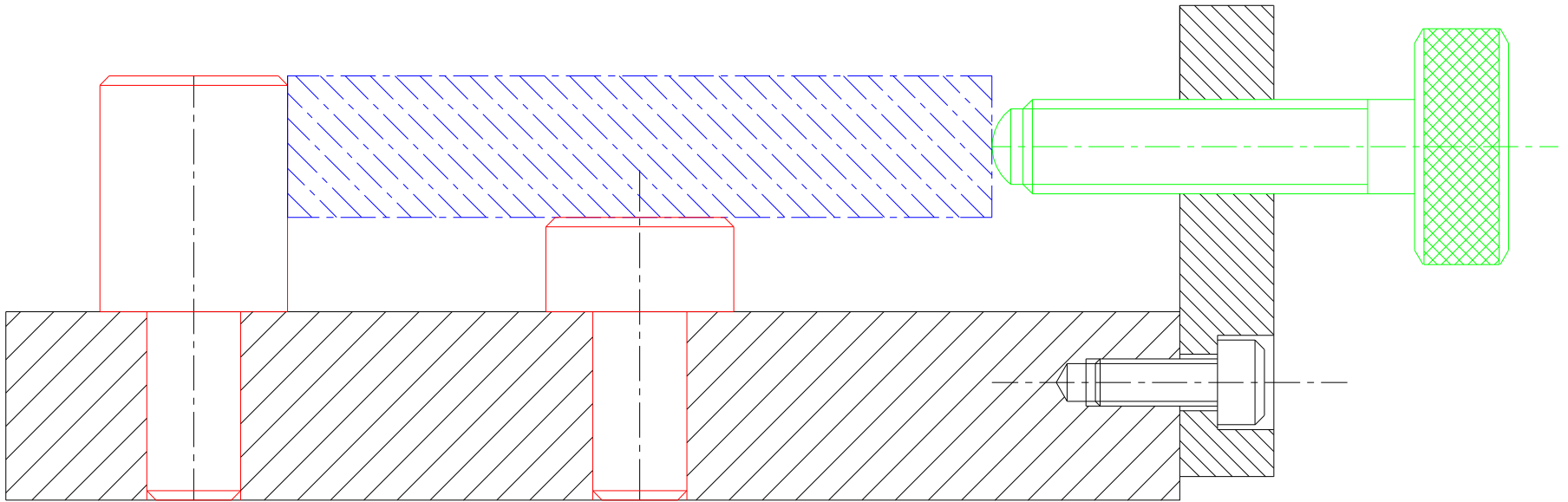
Principles of Clamping

- Clamp shall be directly in line with the support



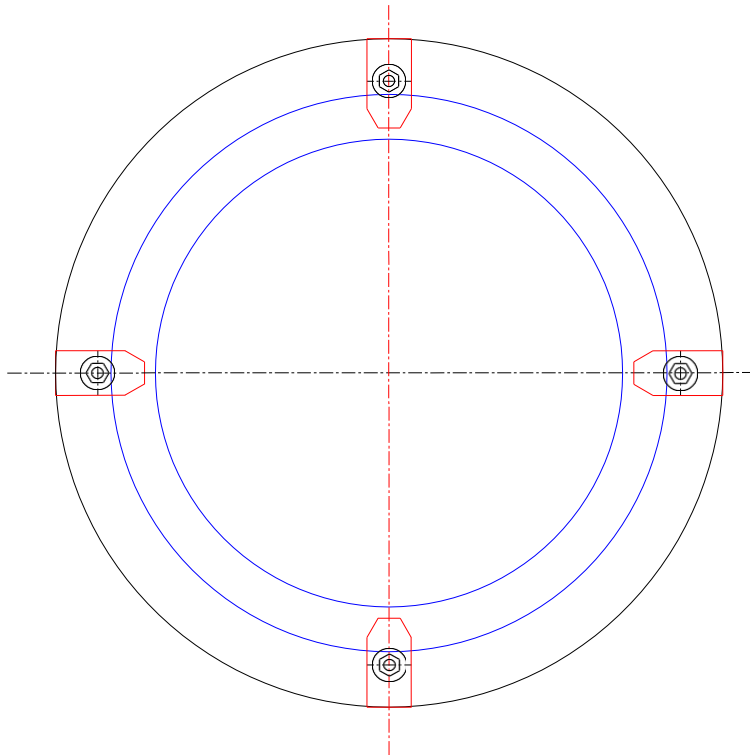
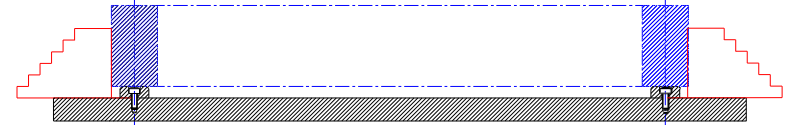
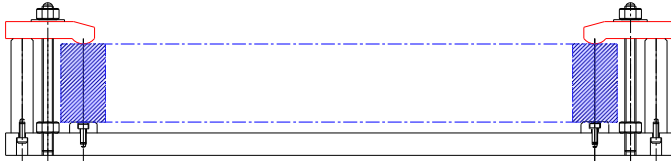
Principles of Clamping

- Clamping force shall be directed towards support / locators.

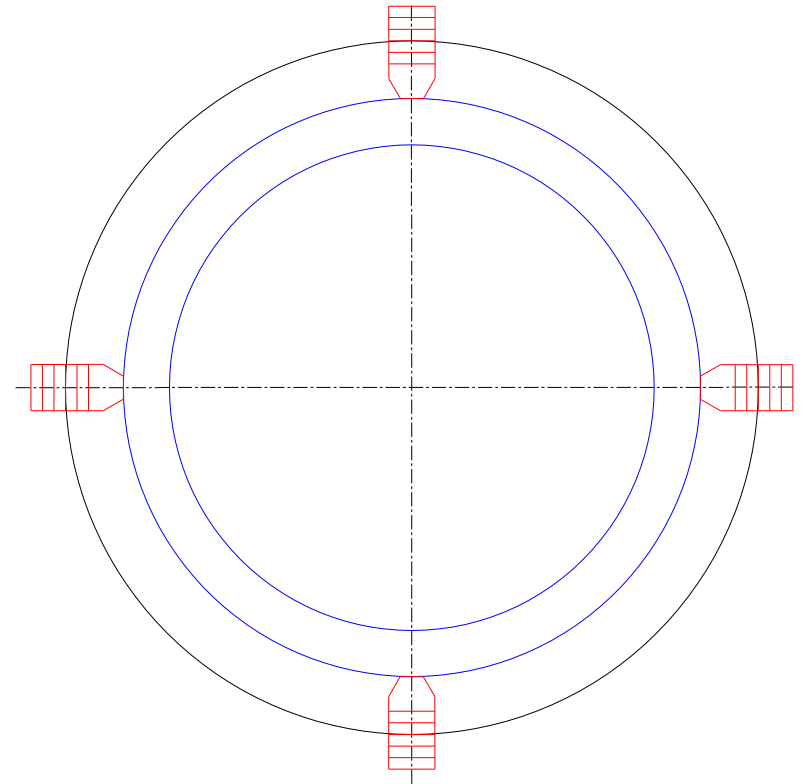


Principles of Clamping

- Clamps shall apply force against supported area of work piece



Good



Bad

Principles of Clamping

Strength:

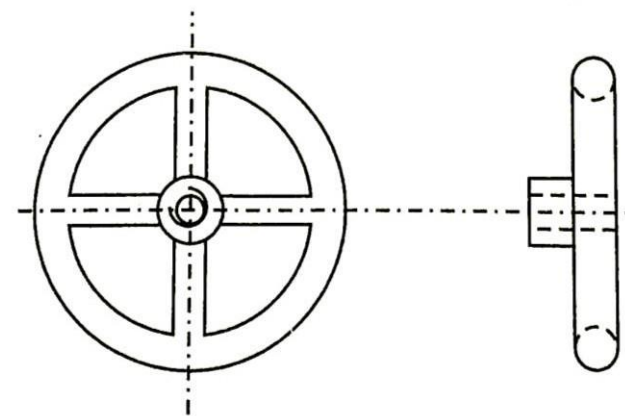
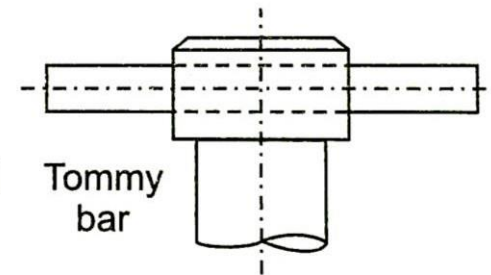
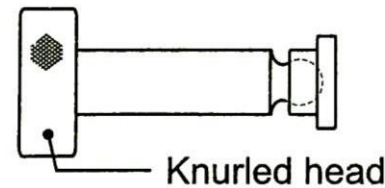
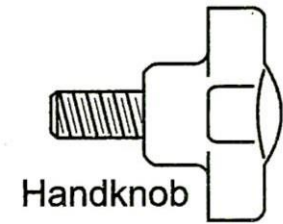
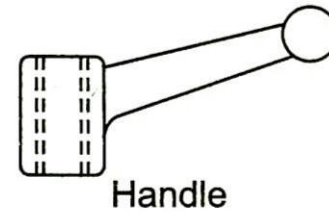
- The clamping system should be capable to hold the workpiece securely against the forces developed during operation.
- Clamping device should be capable to be unaffected by the vibrations generated during an operation.
- The clamping force should not dent or damage the workpiece with excessive pressure.

- For clamping weak and fragile workpiece, clamping force should be equally distributed over a wider area of the workpiece.
- While clamping soft workpiece, clamps should be fitted with pads or softer materials such as Nylon or Fibre to prevent damage and denting of the workpiece.
- Clamping faces should be hardened by proper treatments to minimize their wearing out.

Principles of Clamping

Productivity:

- Clamping time should be minimised by using hand knobs, tommy bars, knurled screws, handwheels and handles, so that clamp can be tightened or loosened manually without using spanners.
- Most of the clamps use hexagonal nut or hand nut



Hand operated clamping devices

Principles of Clamping



**Hand operated
clamping devices**

Principles of Clamping

Operator Fatigue:

- Operator fatigue should be taken into account.
- Clamping should be operator friendly.
- Clamping and releasing should be easy and less time consuming.
- Maintenance should be easy.
- If considerable number of clamps are to be tightened or loosened repeatedly, it is better to use pneumatic or hydraulic clamping which reduces operator fatigue and saves clamping time.
- Hand nuts are more convenient for the operator than hexagonal nuts because a spanner is not required to tighten them.

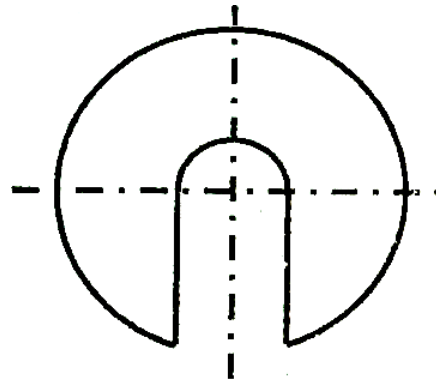
Methods of Clamping

Clamping method and system are basically of two categories:

1. General type without much consideration of the speed of clamping operations.
2. Quick acting clamping method / quick action clamps.

Types of Clamps

- Screw clamps
- Strap clamps
- Pivoted clamps
- Hinged clamps
- Swinging clamps
- Quick action clamps
- Power clamps
- Non-conventional clamps



C Washer

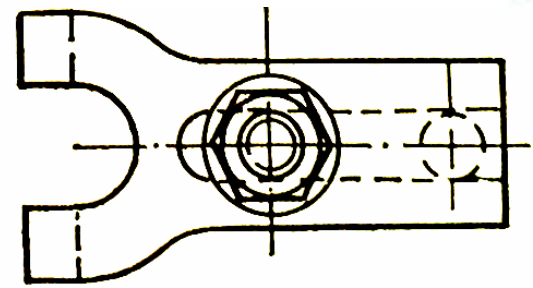
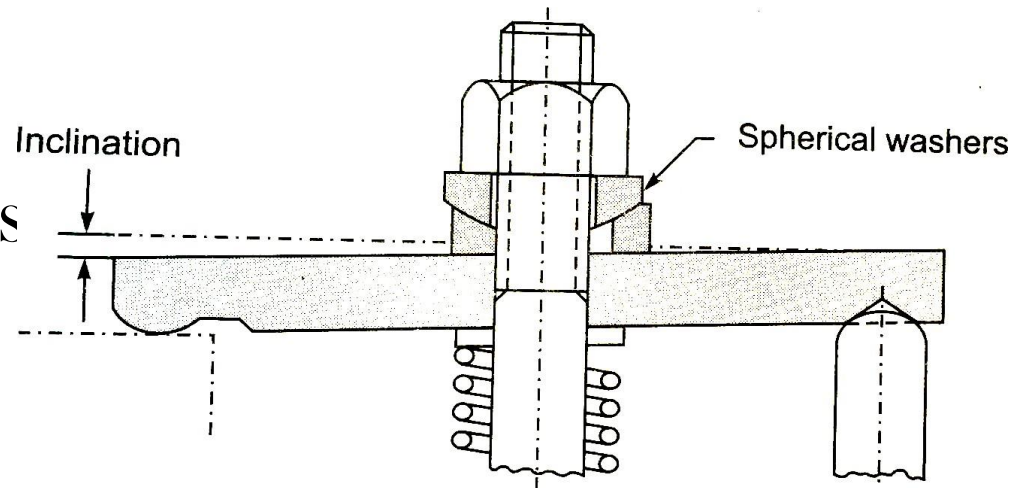


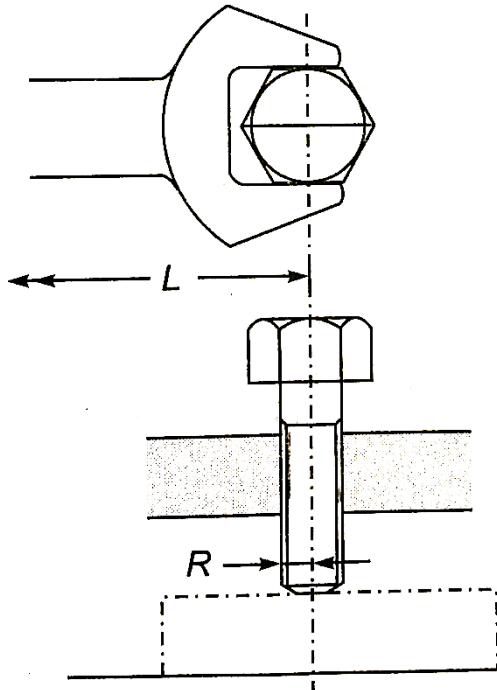
FIG 4.6

TWO POINT CLAMP



Screw Clamps

- They are threaded devices with knurled collar, hand knob, Allen keys, tommy bar or spanner flats for rotating and tightening the screw.
- They are used for light clamping.



Screw Clamp



Screw Clamps

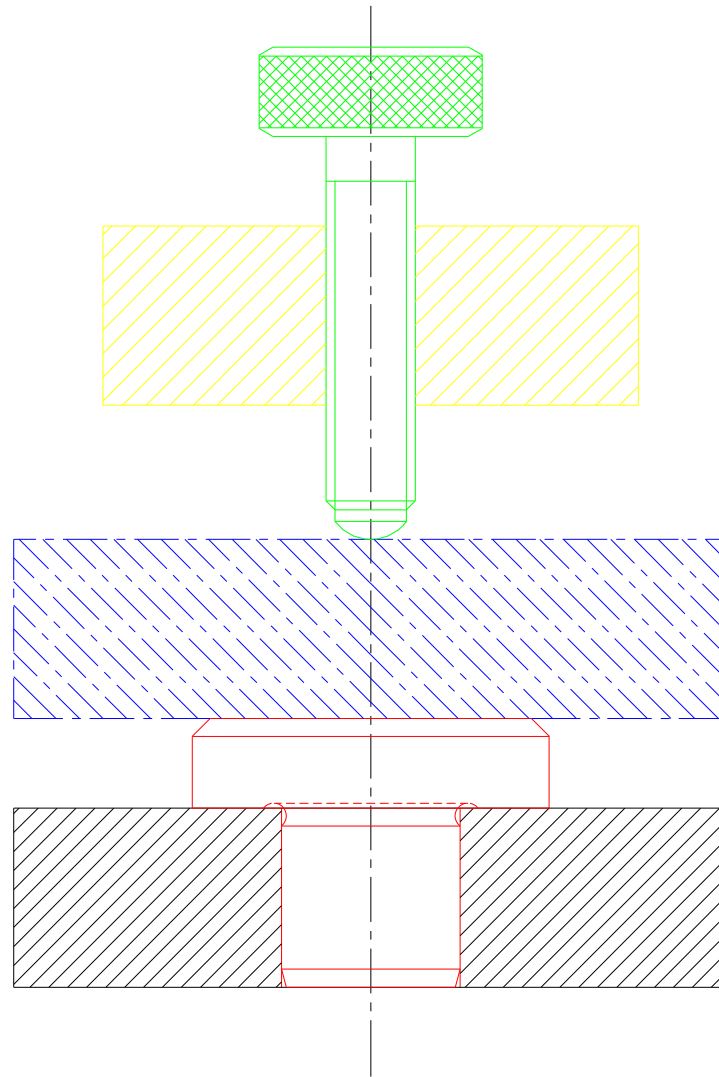
- The clamping area of screw is increased by providing **a pad**.
- **The clamping pad remains stationary** on the workpiece while the screw rotates and rubs on the conical seat of the pad.

Screw Clamps

- **The disadvantage** of screw clamp is, the clamping pressure largely depends on the workpiece, it varies from one workpiece to other.
- It is more **time consuming** and **more efforts** are required.

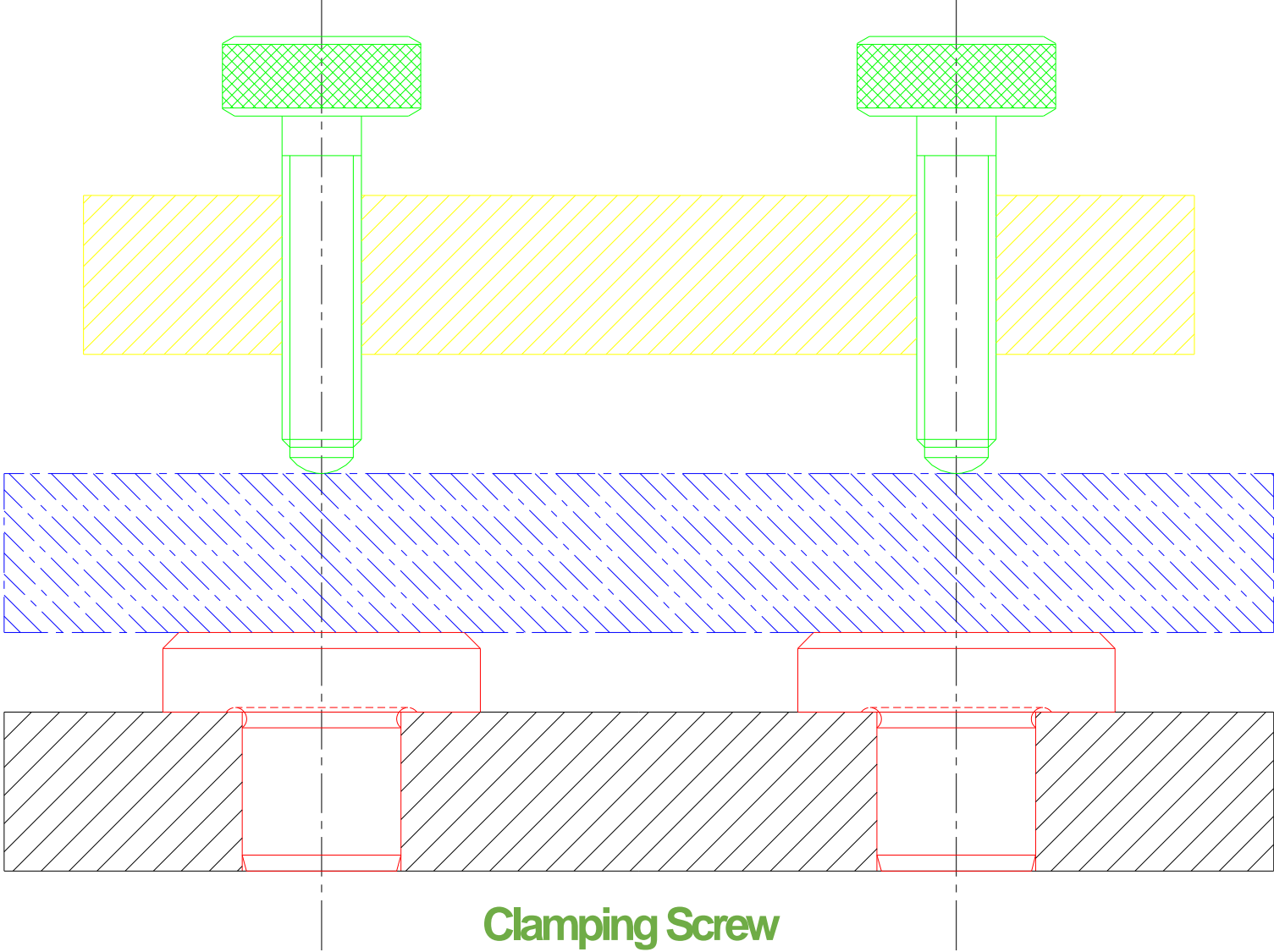


Screw Clamps

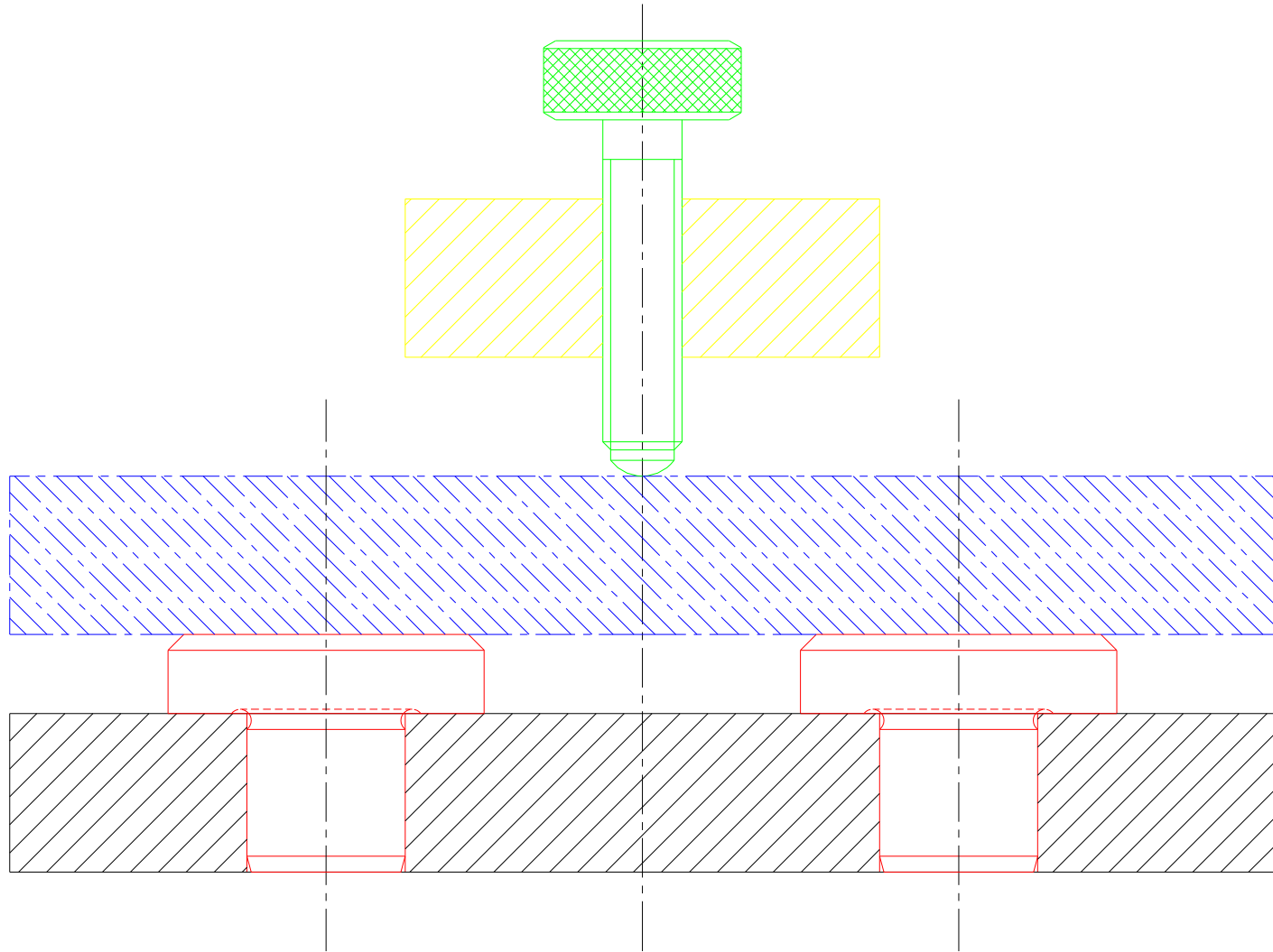


Clamping Screw

Screw Clamps

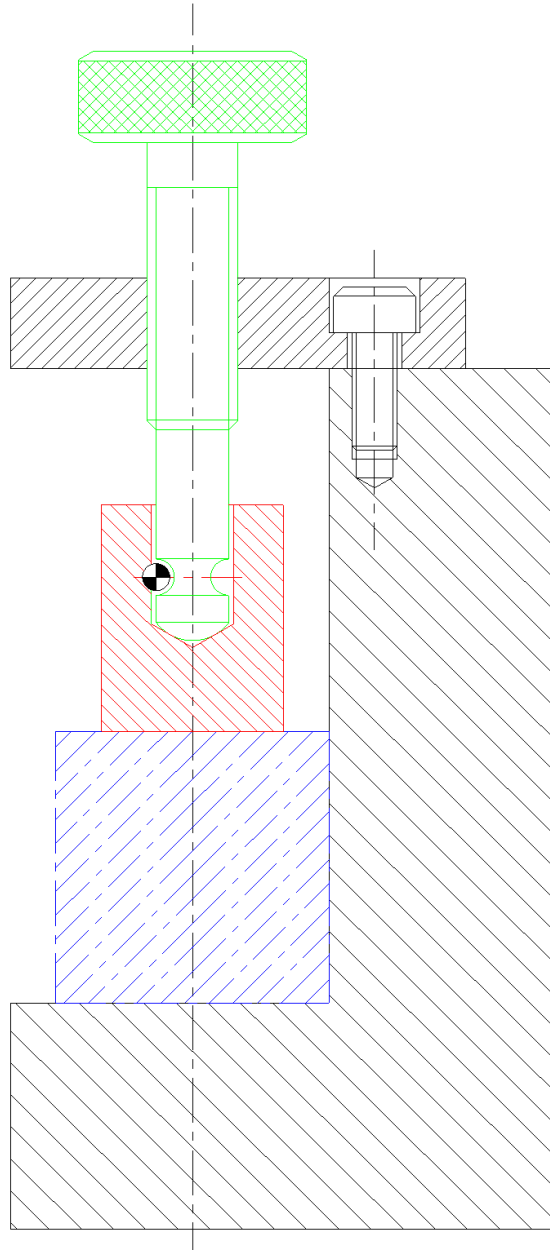


Screw Clamps



Clamping Screw

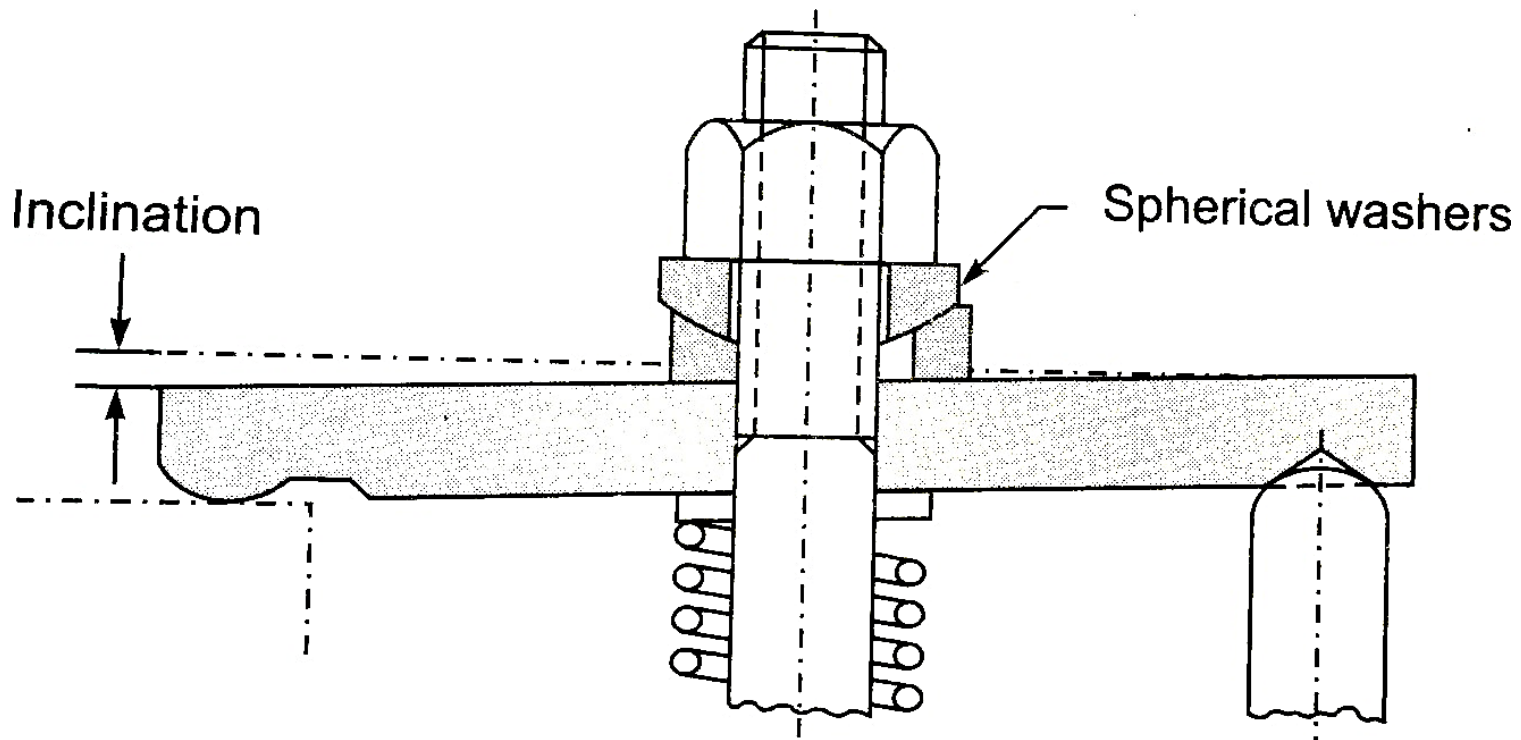
Screw Clamps



Strap or Plate Clamps

Strap / Plate / Bridge Clamps

- It is very **simple and reliable** clamping device.
- The clamping force is applied by spring loaded nut.



Strap Clamp

Strap / Plate / Bridge Clamps

- These are made of rectangular plates and act like levers.
- The clamps are tightened by rotating a hexagonal nut on a clamping screw.
- One end of the clamp presses against **the workpiece** and the other end on **the heel pin**.
- **The toe** i.e. clamping face of the clamp is **curved** and the pressure face of the heel pin is made **spherical** to take care of **any variations in the workpiece**.
- **Spherical washers** permits the clamp to **tilt** with respect to the screw and the nut.

Strap / Plate / Bridge Clamps

- Strap clamps are provided with a washer and spring below the clamp.
- The spring lifts the clamp as the nut is loosened and workpiece becomes free.
- The Spring holds the clamp in a raised position during loading and unloading of the workpiece.
- Washer prevents the entry of the spring in the hole of the clamp.
- Clamp is rotated about the stud to release the workpiece.

Strap Clamp: Workpiece Variation

- The clamp is prevented from rotating during clamping by providing **pin at the heel-end**.
- The clamp stud is usually **at least 10mm in diameter** and nearer to the toe-end than heel-end of the clamp.

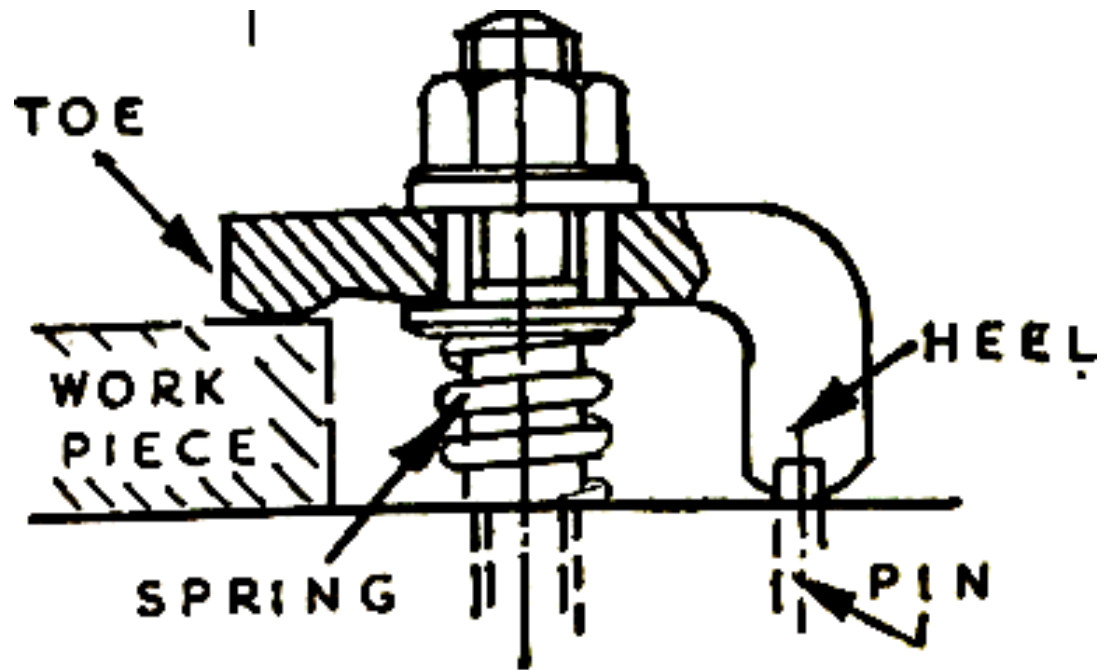


FIG 4.1

SOLID CLAMP

Strap Clamp: Workpiece Variation

- **The heel pin** engages the clamp plate to prevent it from rotating during clamping.

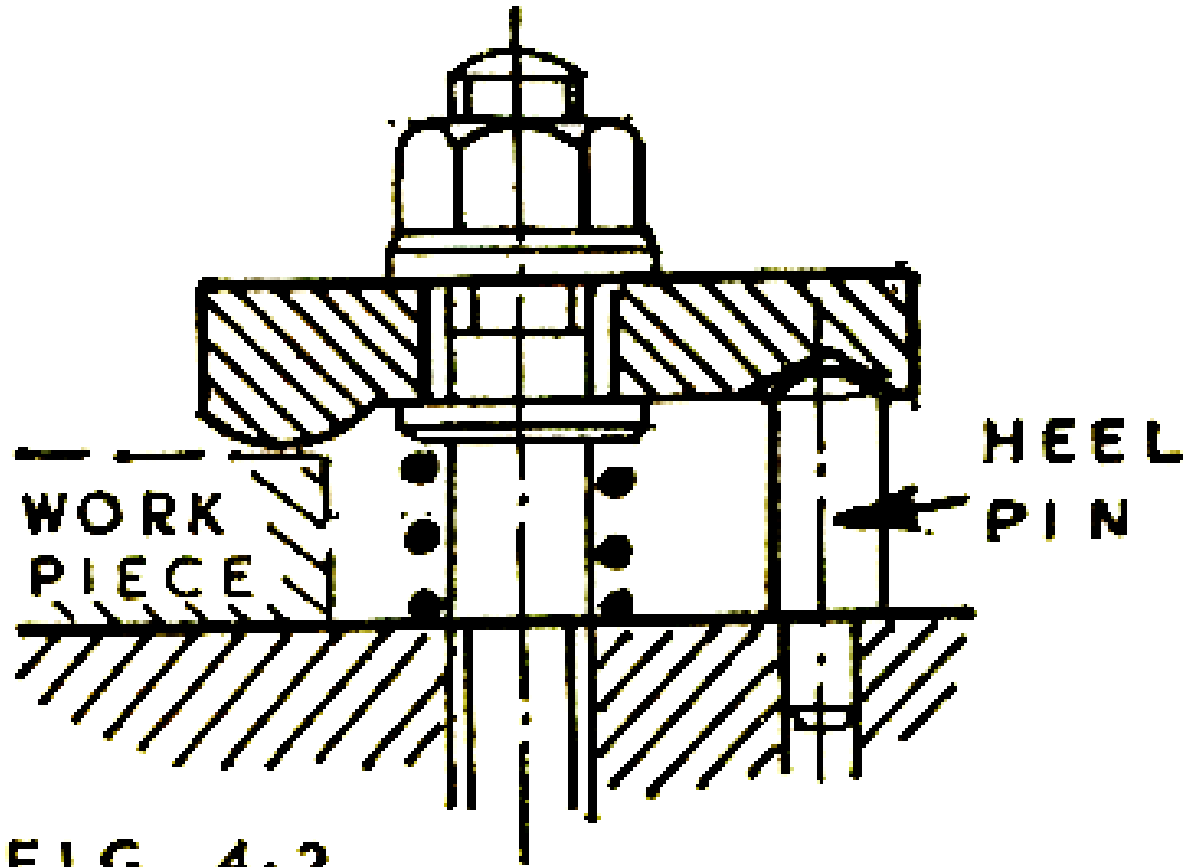
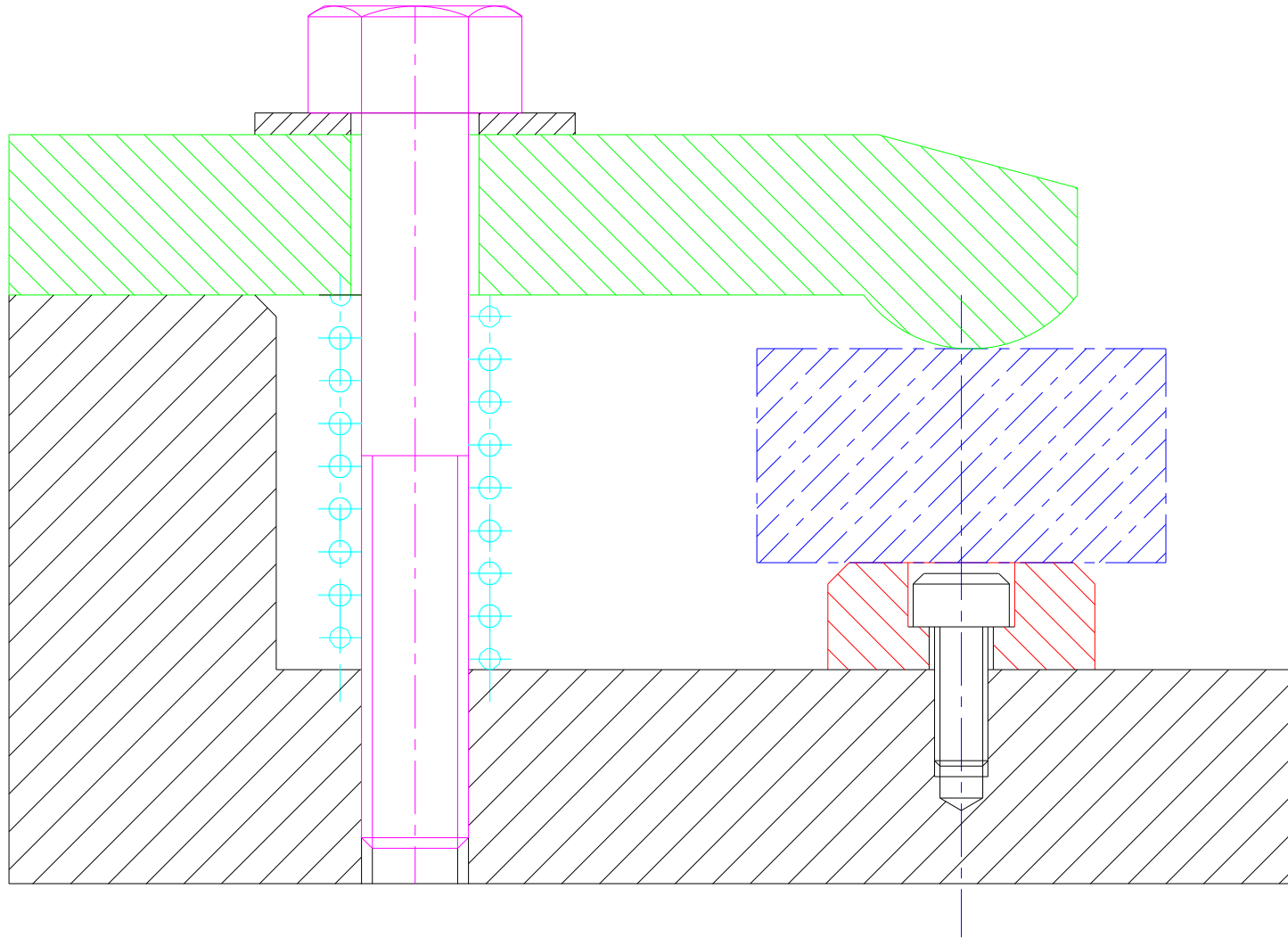


FIG 4.2

CLAMP WITH HEEL PIN

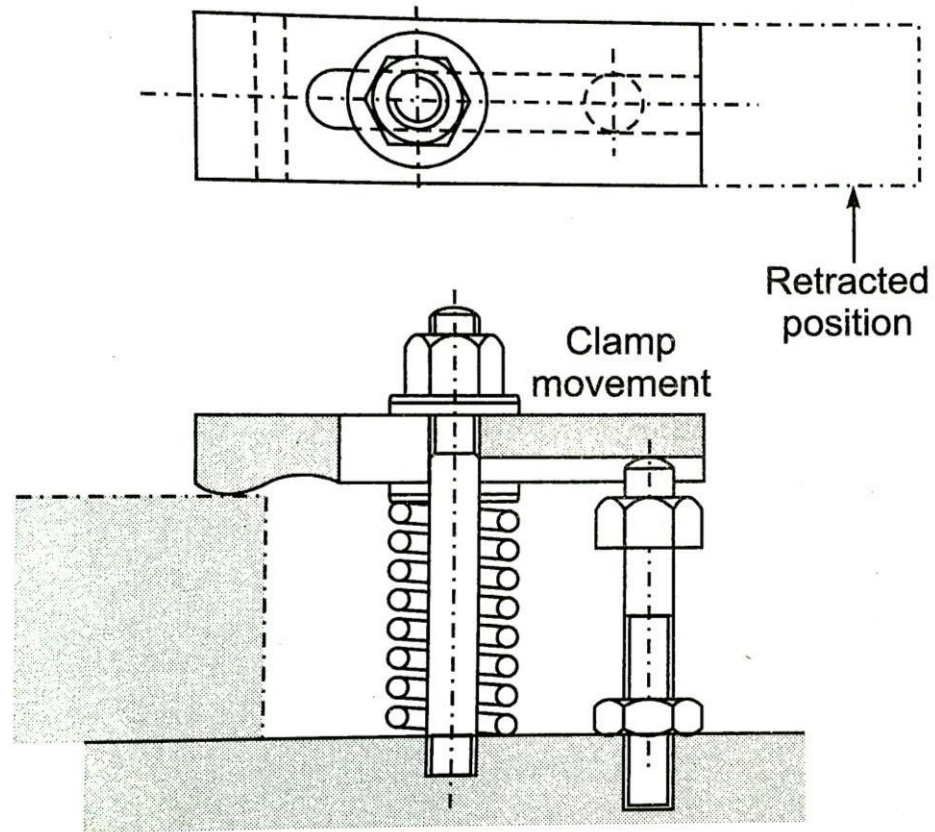
Strap / Plate / Bridge Clamp



Bridge Clamp

Retractable Strap Clamp

- When clamps fall in the path of **loading and unloading**, they are made **slotted** to permit **linear withdrawal**.
- The clamp is retraced to the position shown by chain dotted line during loading and unloading of the workpiece.
- Slotted clamp plate so that the workpiece can be released **without clamp rotation**.
- **Adjustable heel pin** is used where workpiece height is likely to vary more considerably.



Slotted Strap Clamp with adjustable heel pin

Retractable Strap Clamp

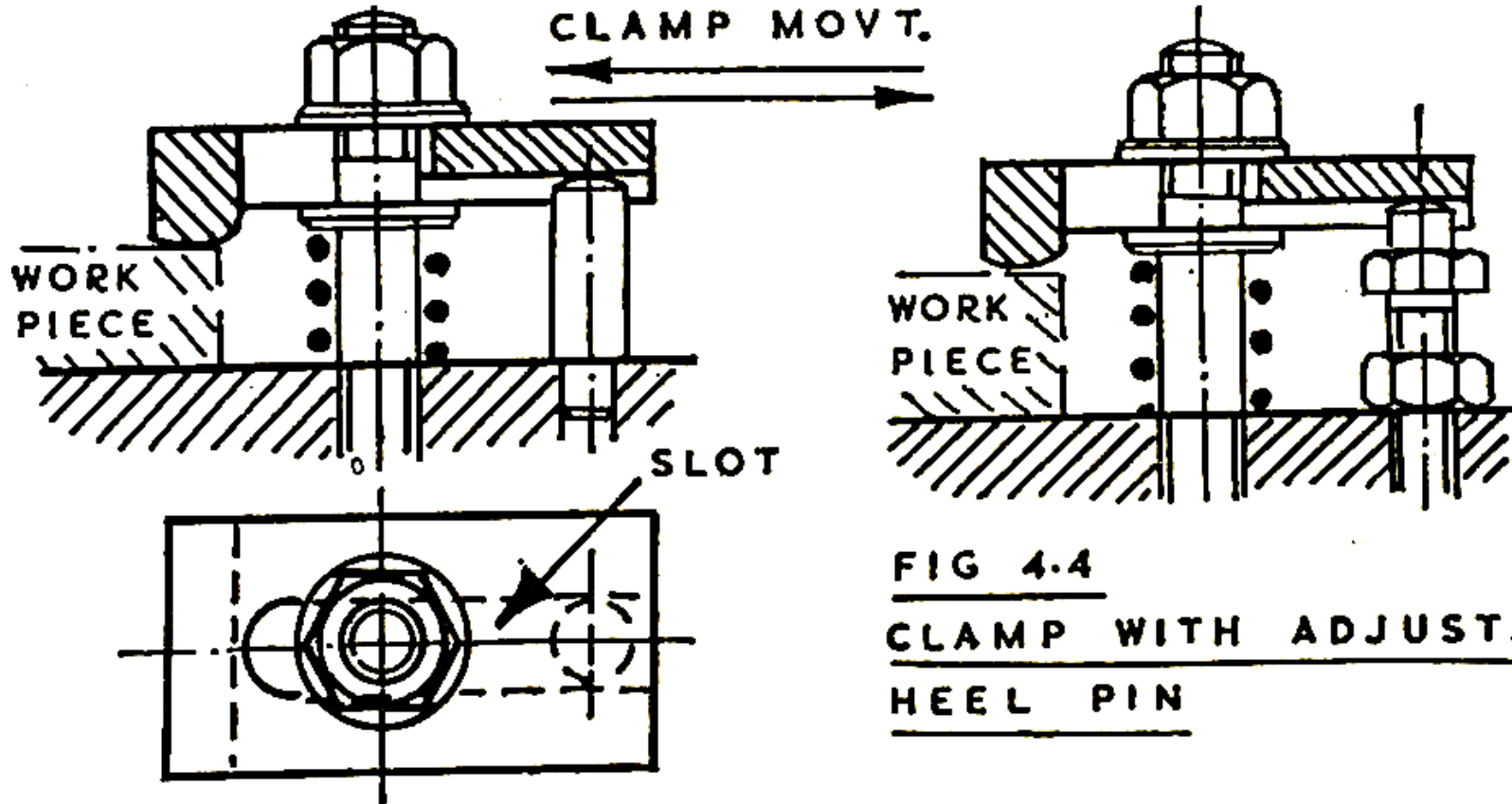
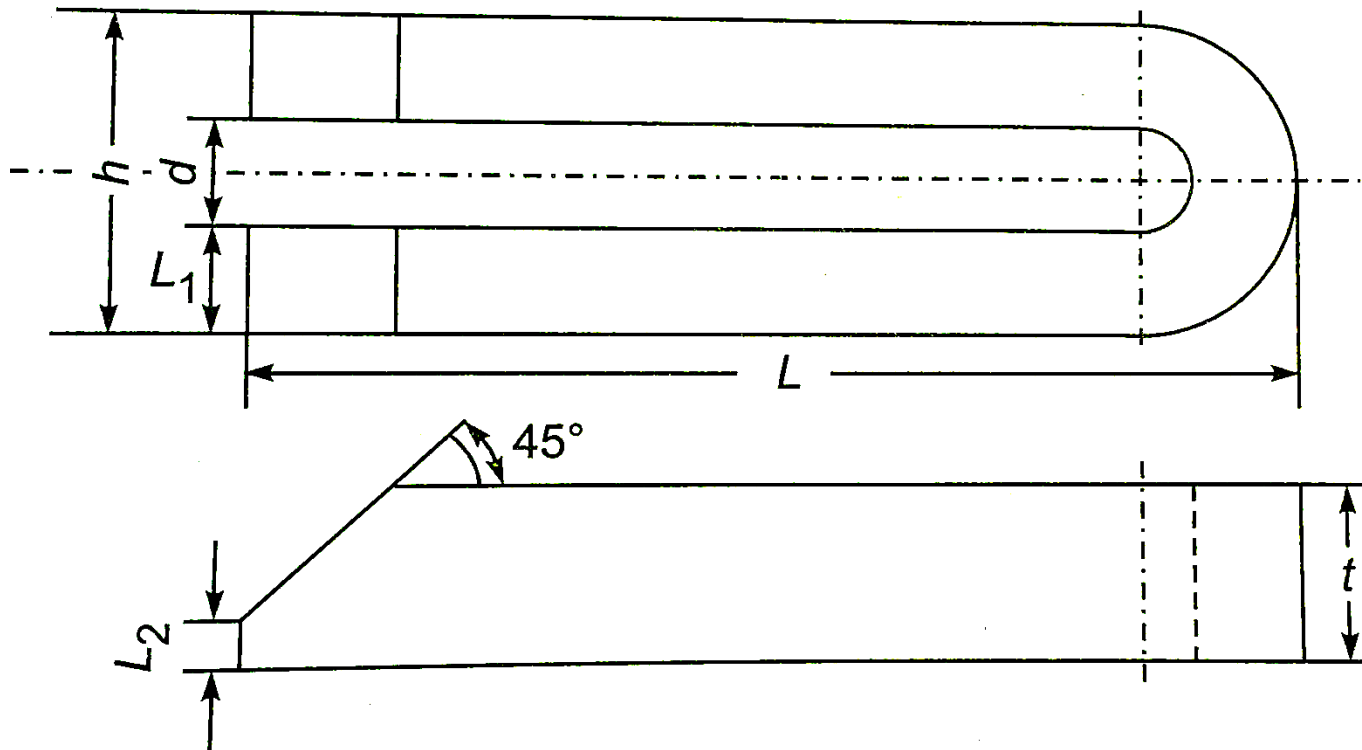


FIG 4.4
CLAMP WITH ADJUSTABLE
HEEL PIN

“U” Clamp

- U Clamp can **be removed altogether** to facilitate loading and unloading of the workpiece.



U Clamp with open slot

Two Point Clamp

- It is used to clamp two workpieces or to clamp a single workpiece at two locations.

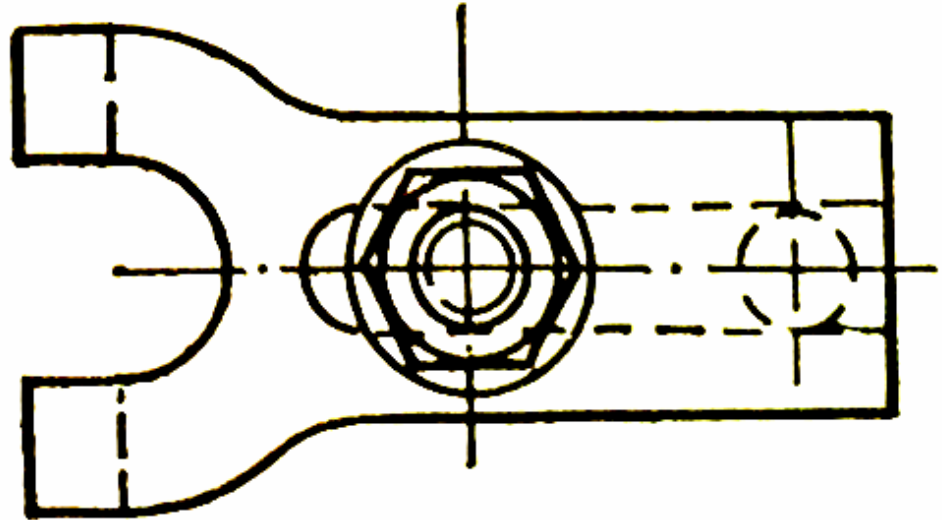
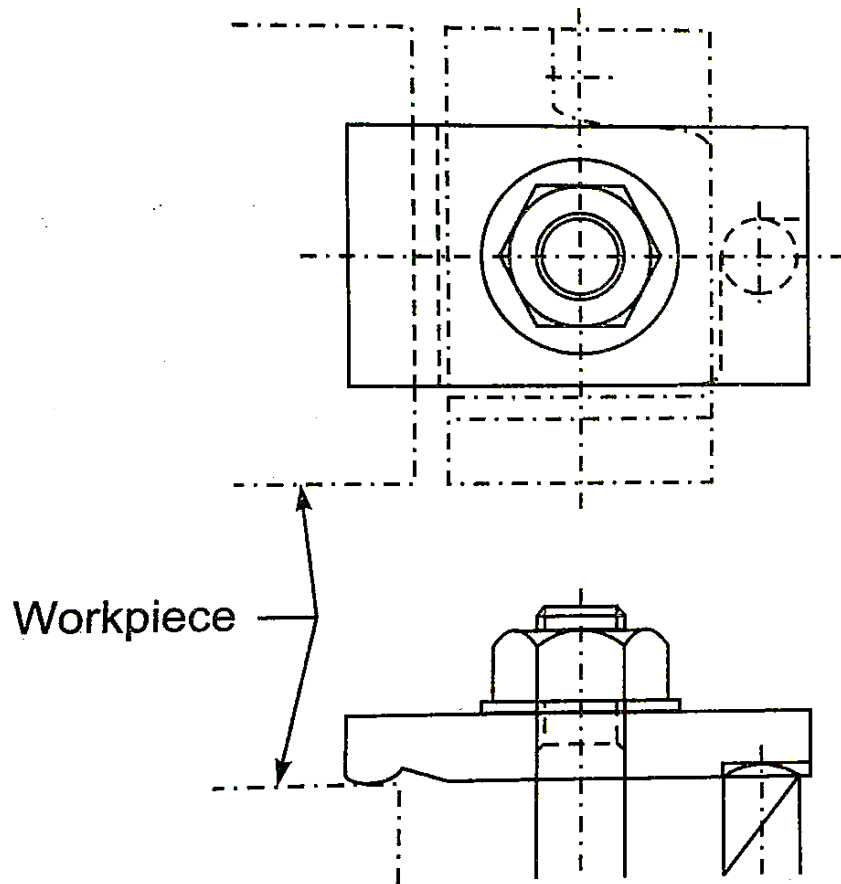


FIG 4.6

TWO POINT CLAMP

Swinging Strap Clamp

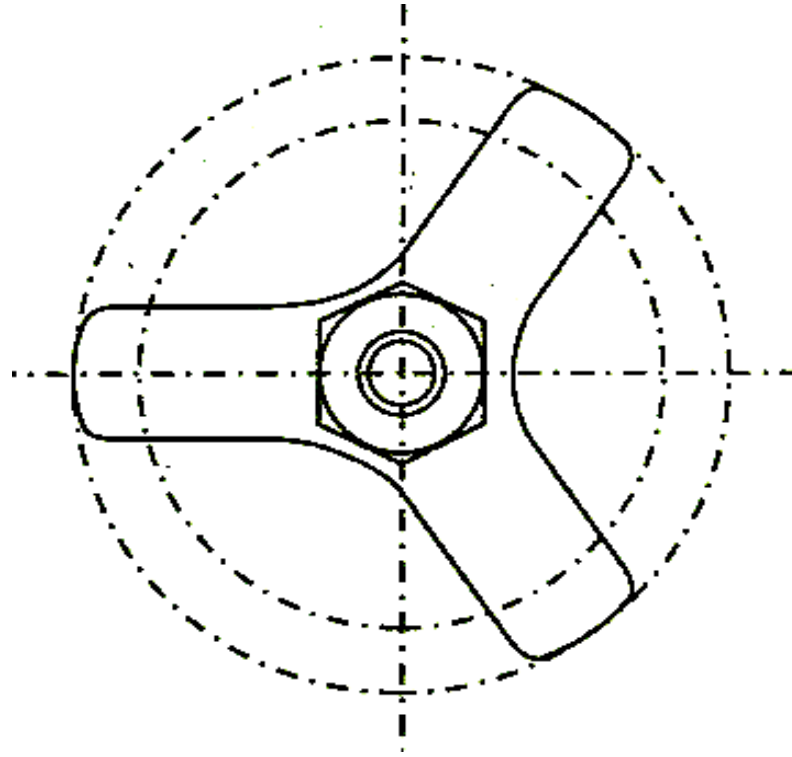
- This type of clamp can **be rotated by 90°** to clear the passage for loading and unloading the workpiece.
- The clamp is swung to the position shown by the chain dotted line during loading and unloading of the workpieces.



Swinging Strap Clamp

Special Strap Clamp

- The clamp shape can be changed **to suit the workpiece and the operation.**

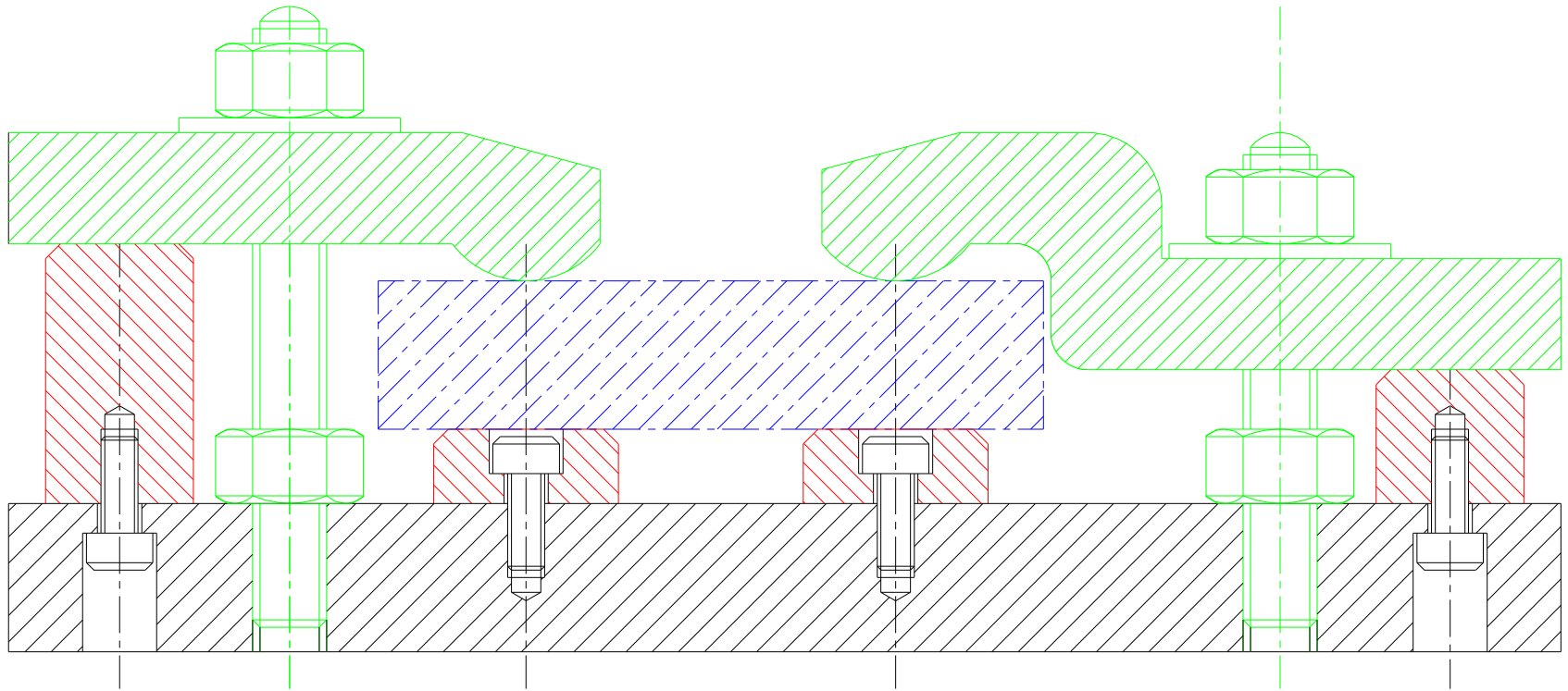


Spider Clamp or Three-point Clamp

- **Circular and symmetrical workpieces** can be clamped well with **a spider clamp** having three clamping points, no heel pin is necessary.

Strap Clamp

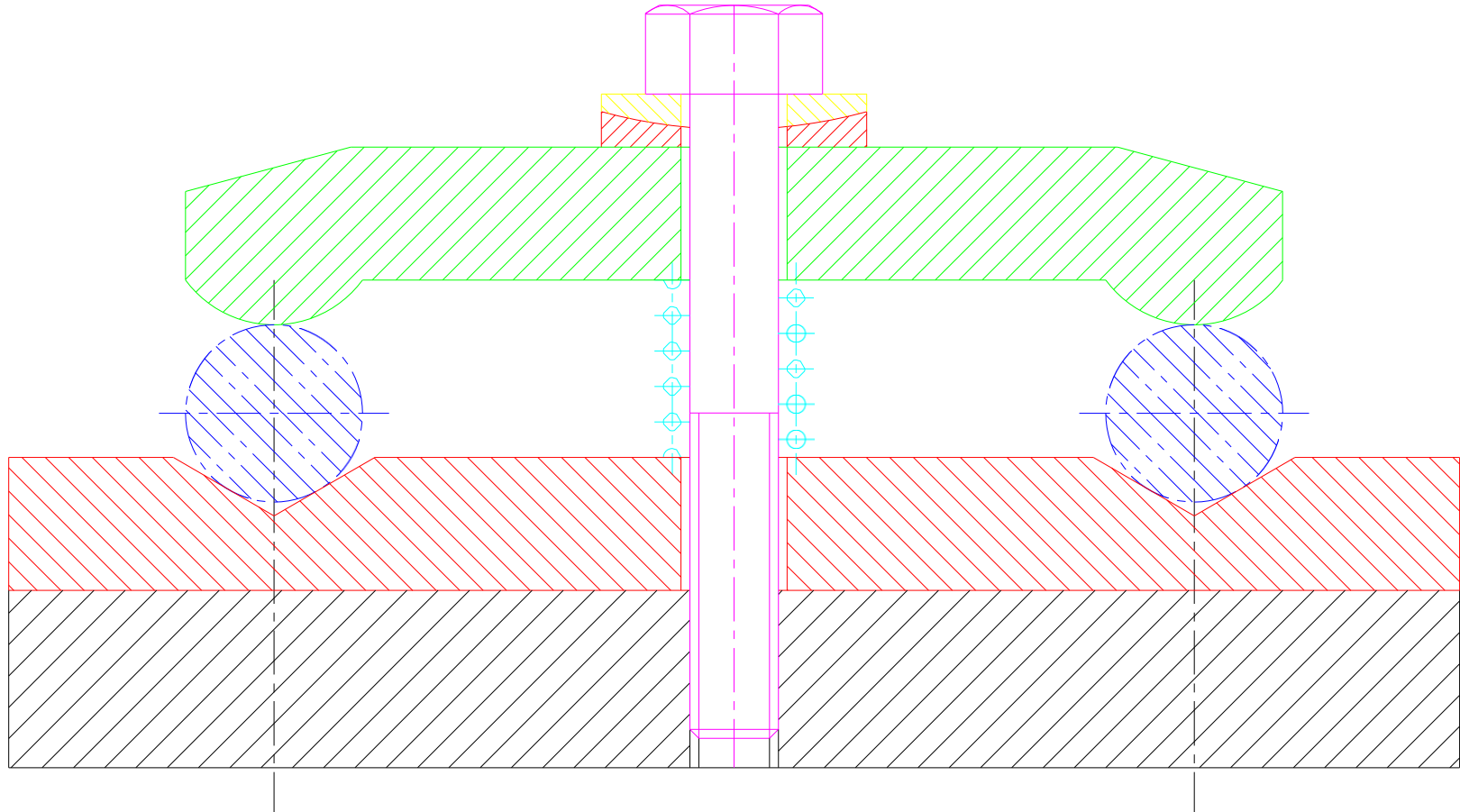
- **Gooseneck Clamp** can reduce the clamp height with respect to the work piece height.



Gooseneck Clamp

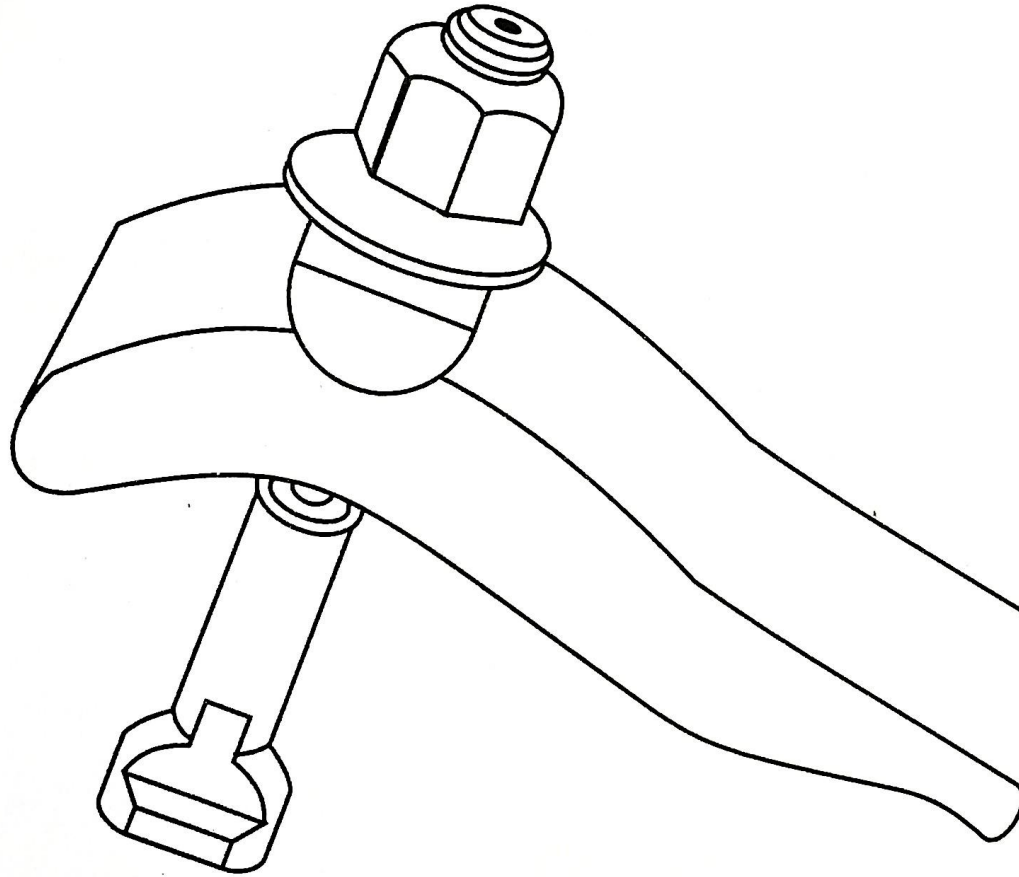
Strap Clamp

- Strap Clamp clamping two work pieces



Strap Clamp

Strap Clamp: Workpiece Variation



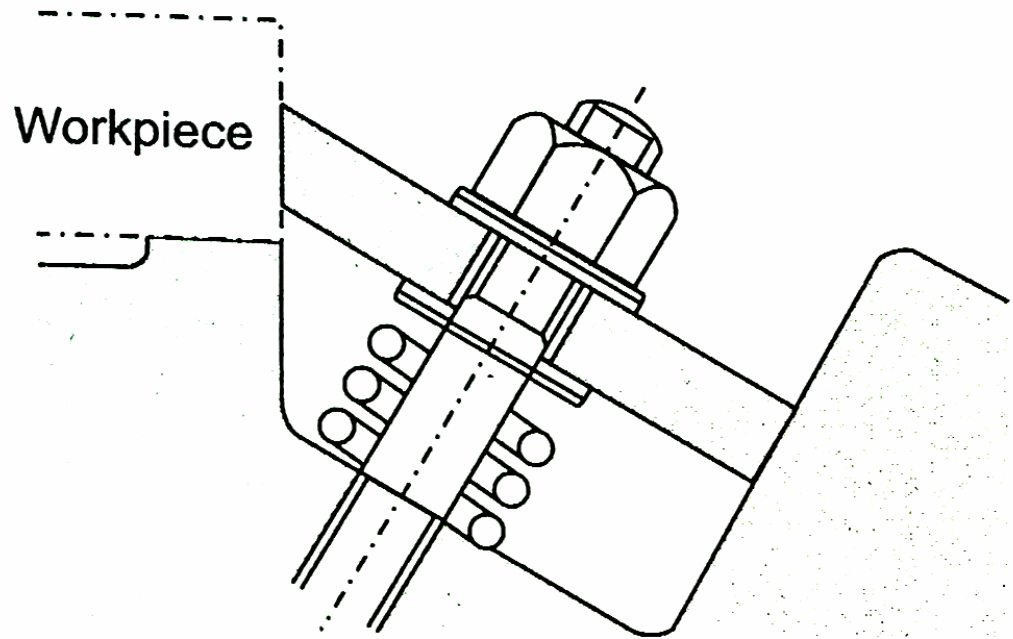
Universal Clamp with cylindrical washer

Edge Clamps

Edge Strap Clamp

- Edge Clamps are used for clamping workpieces on the edges during facing operations or when only horizontal surface is to be machined.
- Tightening of the hexagonal nut wedges the clamp between the workpiece and the angular heel surface.

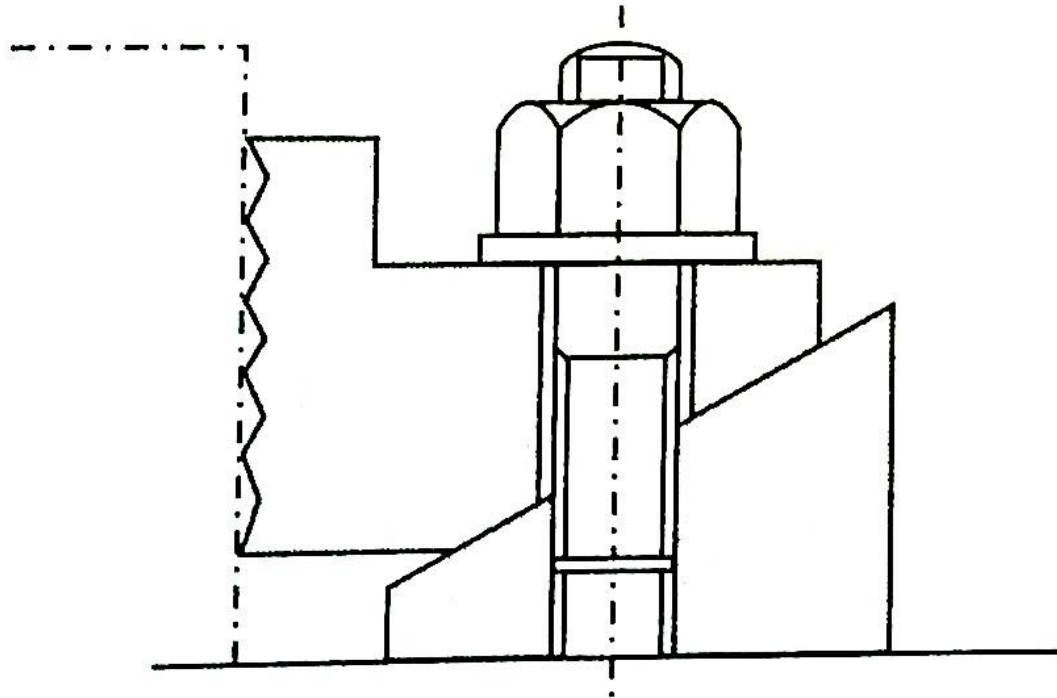
Edge Strap Clamp



Edge Jaw Clamp

- Edge jaw clamp slides down **the inclined heel** as the hexagonal nut is tightened.
- Tightening of the hexagonal nut pushes **the jaw** against the workpiece **to clamp its edge**.

Edge Jaw Clamp

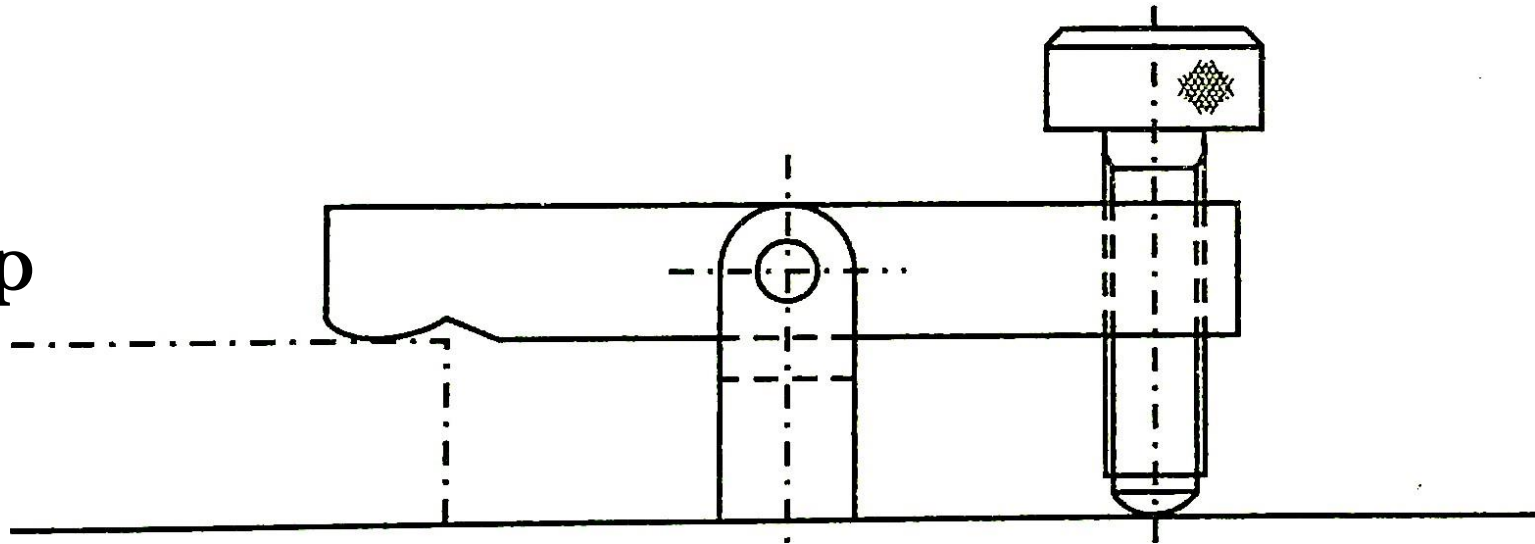


Pivoted Clamps

Pivoted Strap Clamp

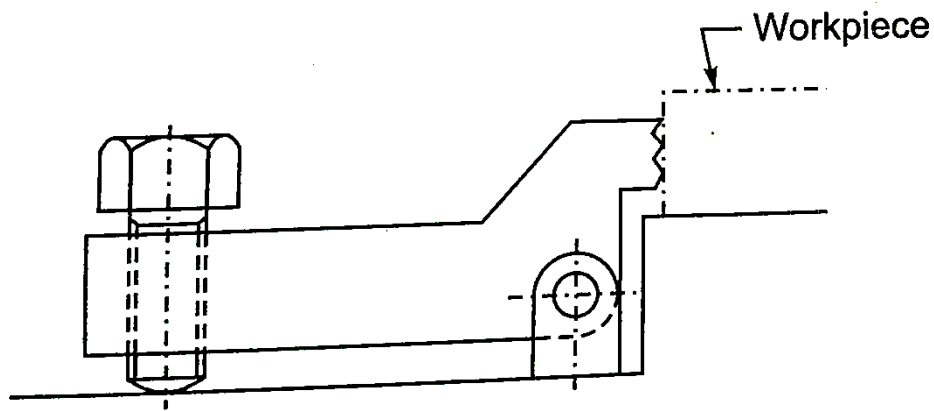
- Clamps are often pivoted at the centre to simplify their operation.
- Knurled headed screw is used to loosen and tighten the clamp.

Pivoted
Strap Clamp

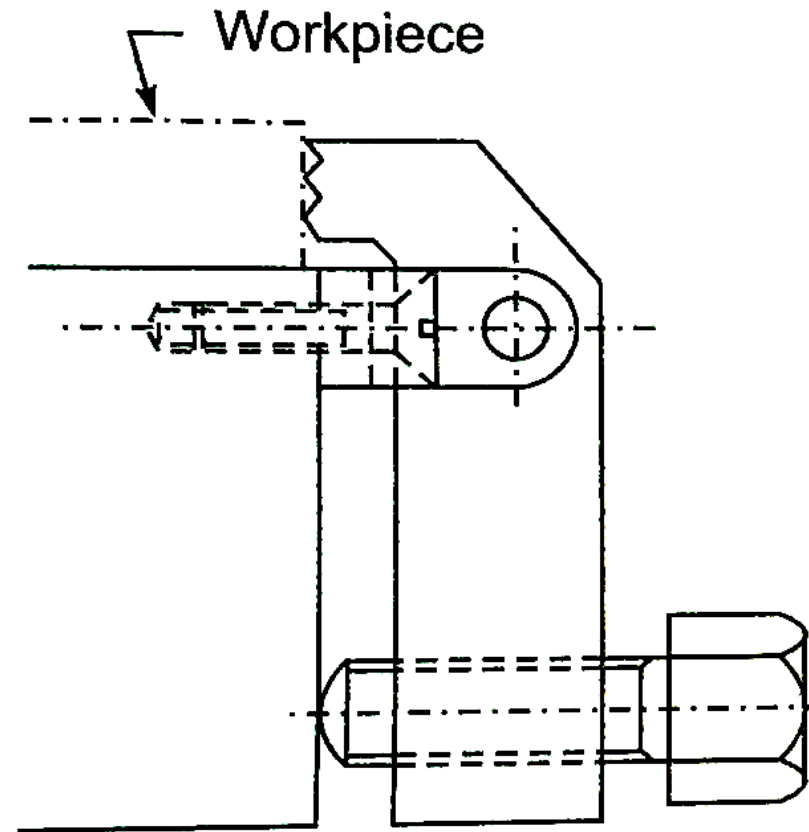


Pivoted Edge Clamp

- **Pivot pin** is nearer to the clamping point.
- Screw is shifted to the end opposite the clamping point.
- Clamping screw becomes more accessible to the operator.



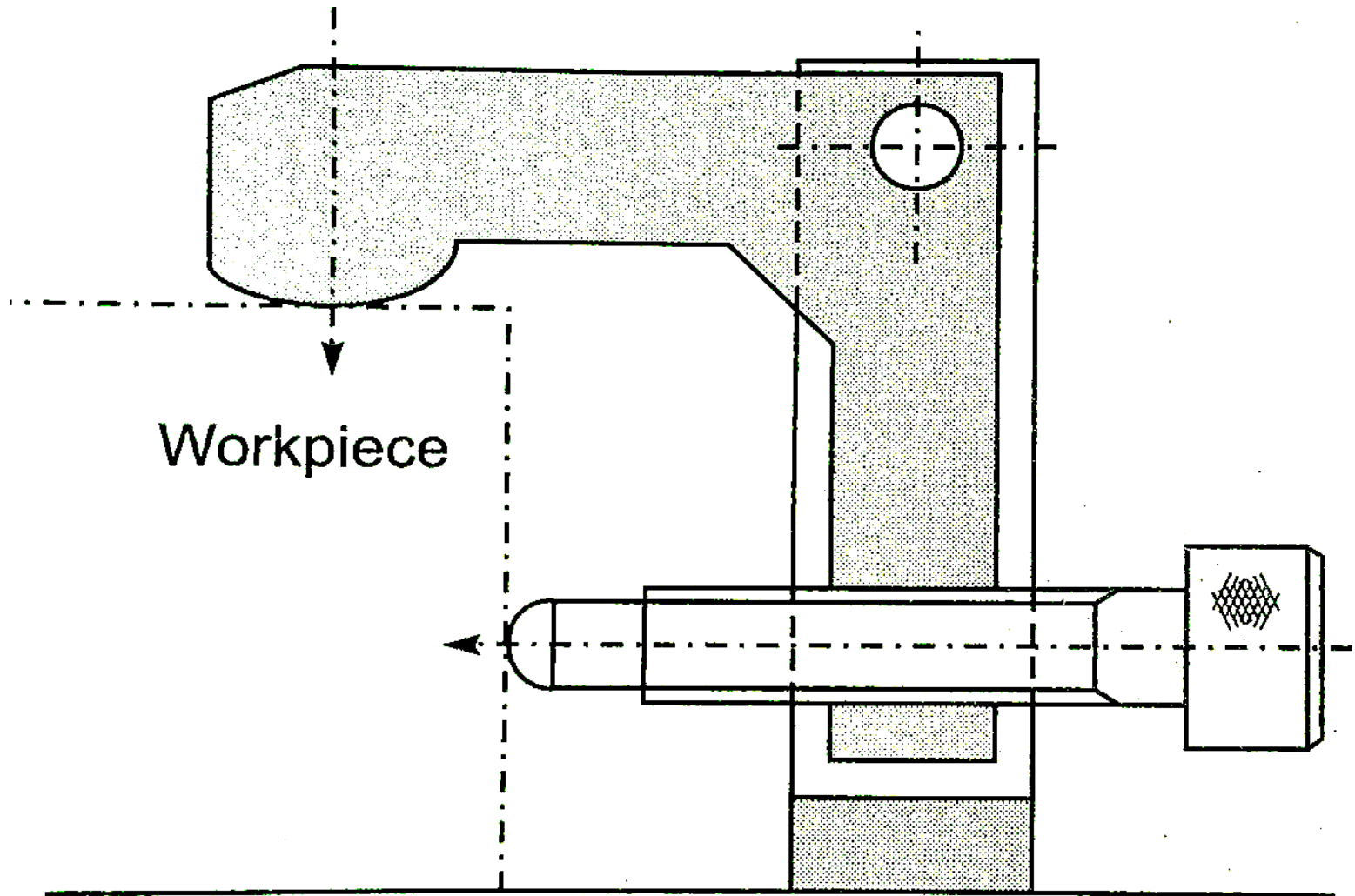
**Pivoted Edge
Clamps**



Pivoted Two-way Clamp

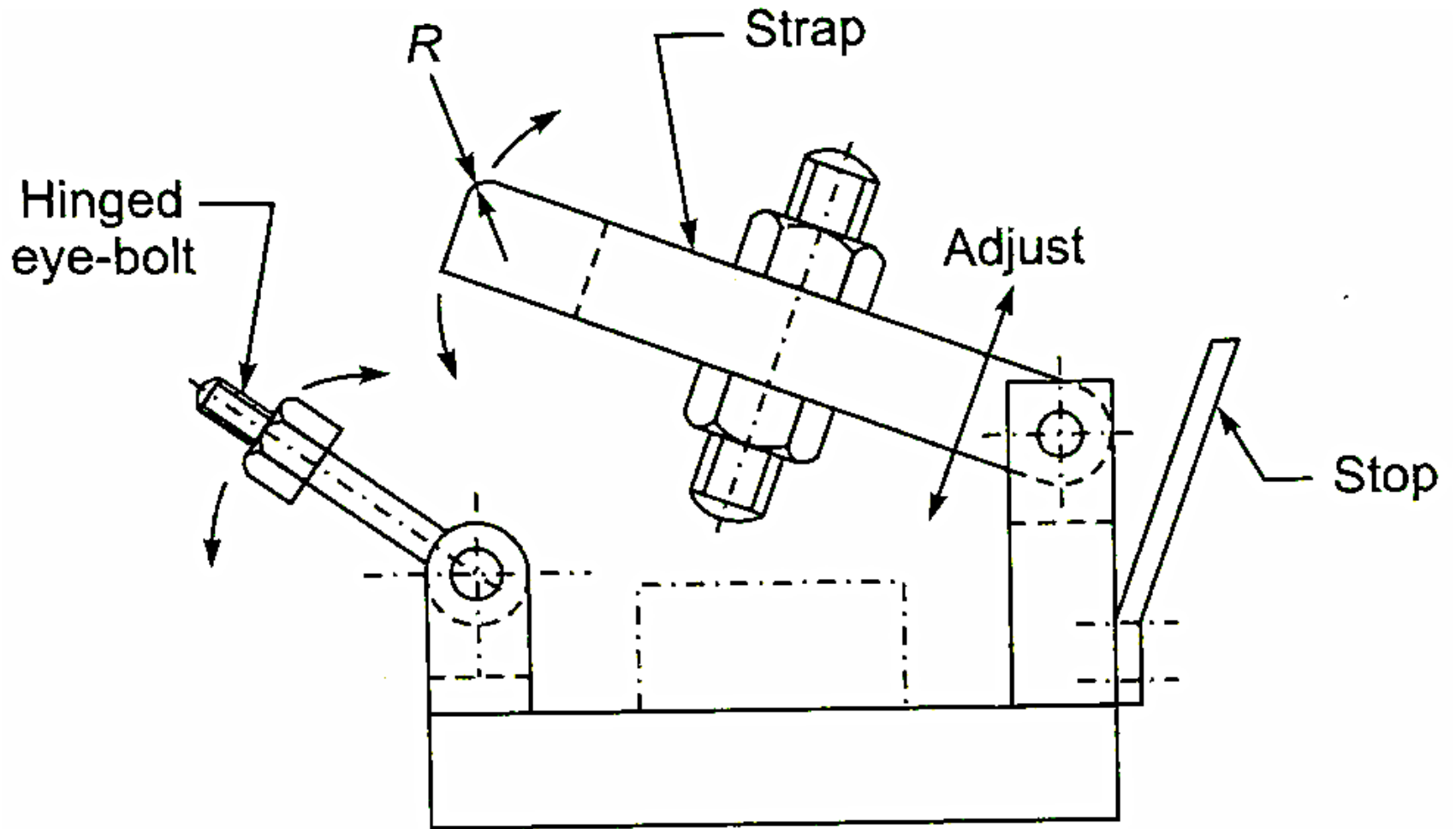
- Pivot action can be used for two-way clamping of the workpiece.
- Tightening of the screw makes the curved surface of the clamp touch the workpiece and further tightening of the screw clamps the workpiece vertically and horizontally.
- Two-way clamp also pushes the workpiece against two locators.

Pivoted Two-way Clamp



Hinged / Latch Clamps

Hinged Clamp



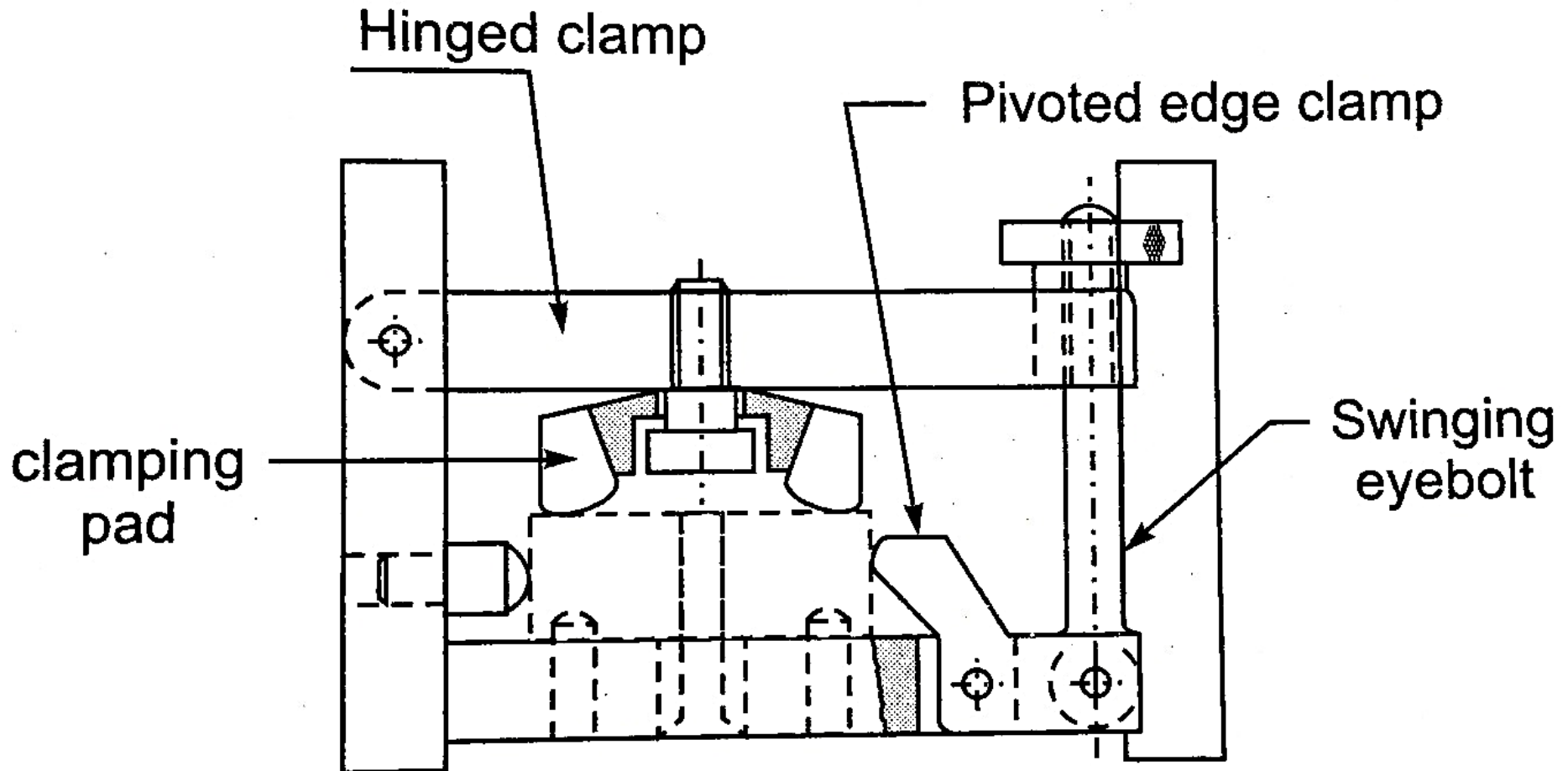
Hinged Clamp

- Hinged clamp provides rapid clearance of the passage for loading and unloading.
- It is clamped with swinging eyebolt. The clamp has open slot through which the eyebolt can be swung into position.
- Tightening of the hexagonal nut clamps the workpiece.
- For loading and unloading the workpiece, the hexagonal nut is loosened half-a-turn and the eyebolt is swung out of the open slot to free the hinged plate.

Hinged Two-way Clamp

- Workpiece is pushed against the location pins by the pivoted edge clamp which also houses the swinging eyebolt.
- Knurled nut is used to clamp the workpiece against the location pins.
- Workpiece is clamped in two direction by the edge clamp and the pad in the hinge.
- For loading and unloading the workpiece, the knurled nut is loosened half-a-turn and the eyebolt is swung out of the open slot to free the hinged plate.

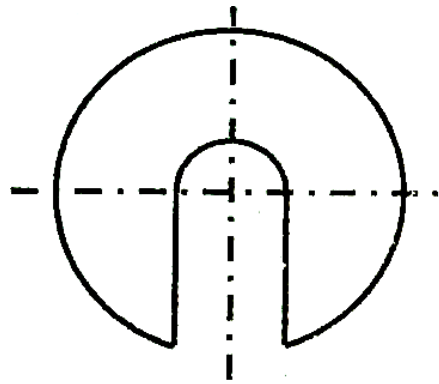
Hinged Two-way Clamp



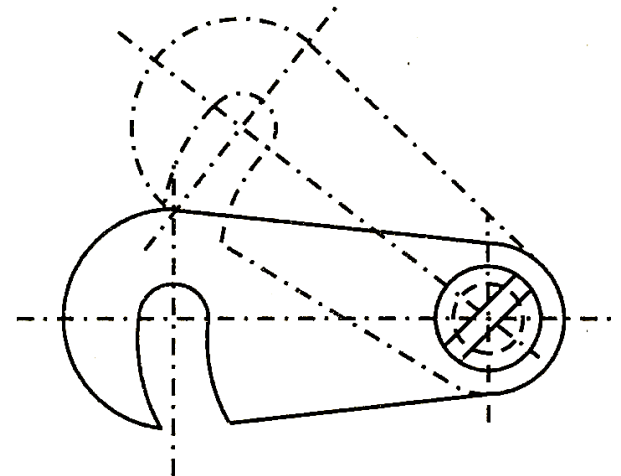
CWasher

CWasher

- **Strap clamp** with an open slot.
- **Simple and quick** in operation.
- **Slot** permits quick removal of C Washer after a slight loosening of the hexagonal nut.
- C washer is often **chained to the fixture** or **pivoted** around a shoulder screw to prevent its loss.
- **Pivot shoulder screw** makes the Cwasher captive.



C Washer



Captive C washer

Swinging Clamps

Swinging Clamps

- These clamps are swung to the position.
- They rotate in the plane of the plate.
- Figure depict the swinging clamp pivoted about the shoulder screw.
- Workpiece is clamped by knurled head screw.

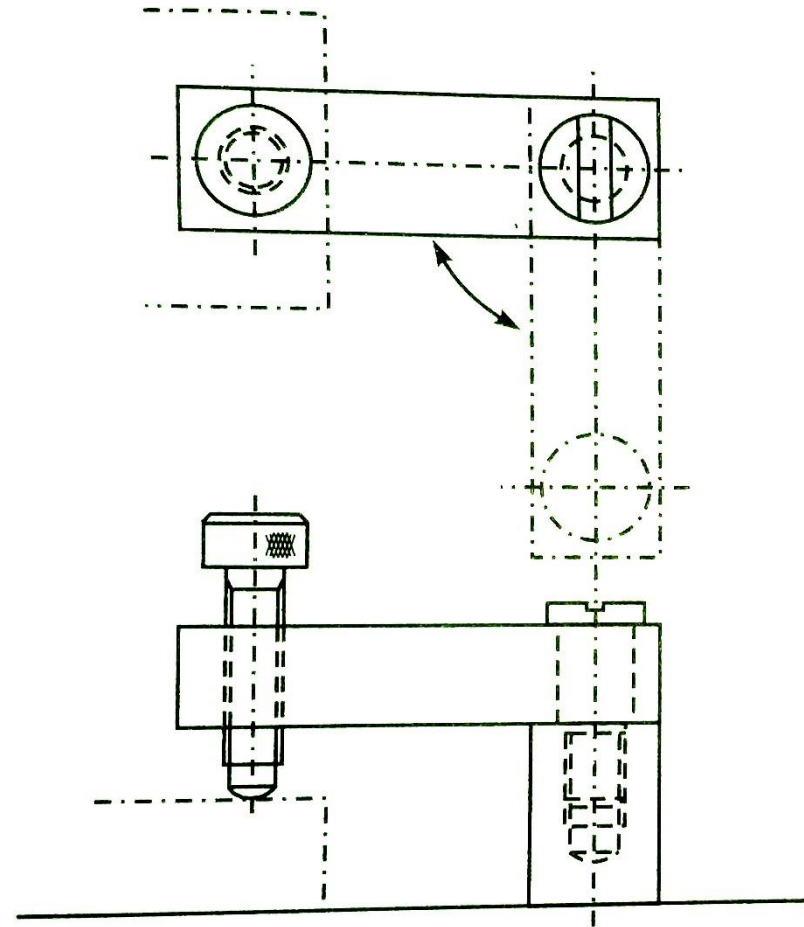


Fig. 3.19

Swinging strap clamp

Swinging Clamps

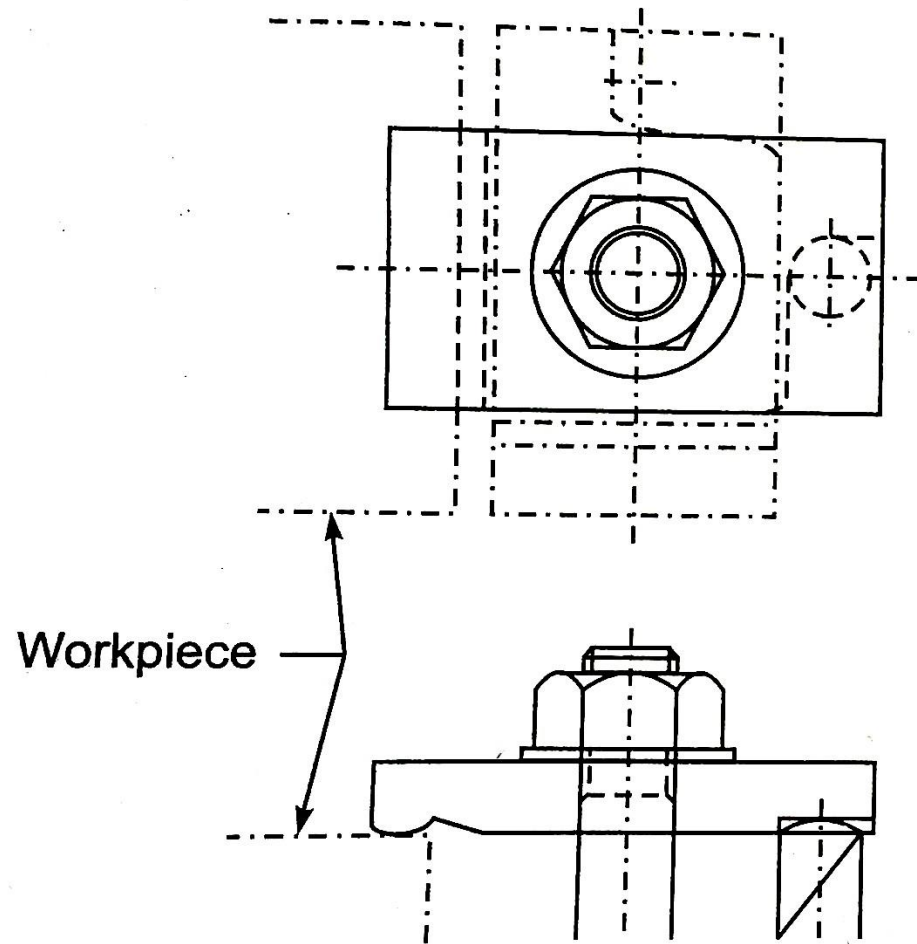


Fig. 3.10a

Swinging strap clamp

Swinging Clamps

- Swinging latch with an open slot at one end..
- The latch is swung around pivot P at the other end.
- Shoulder screw S centers the open slot during operation.
- The workpiece is clamped by knurled head screw.

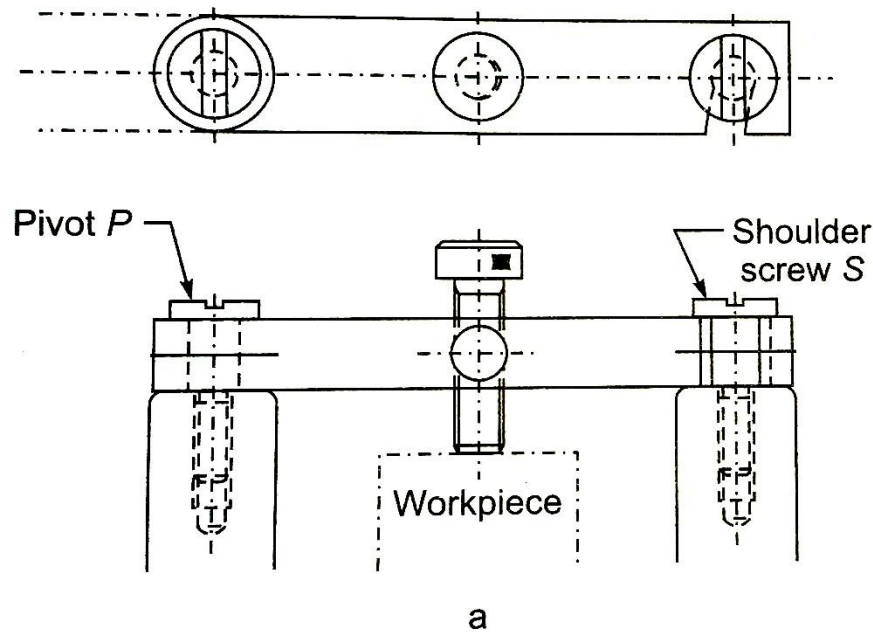
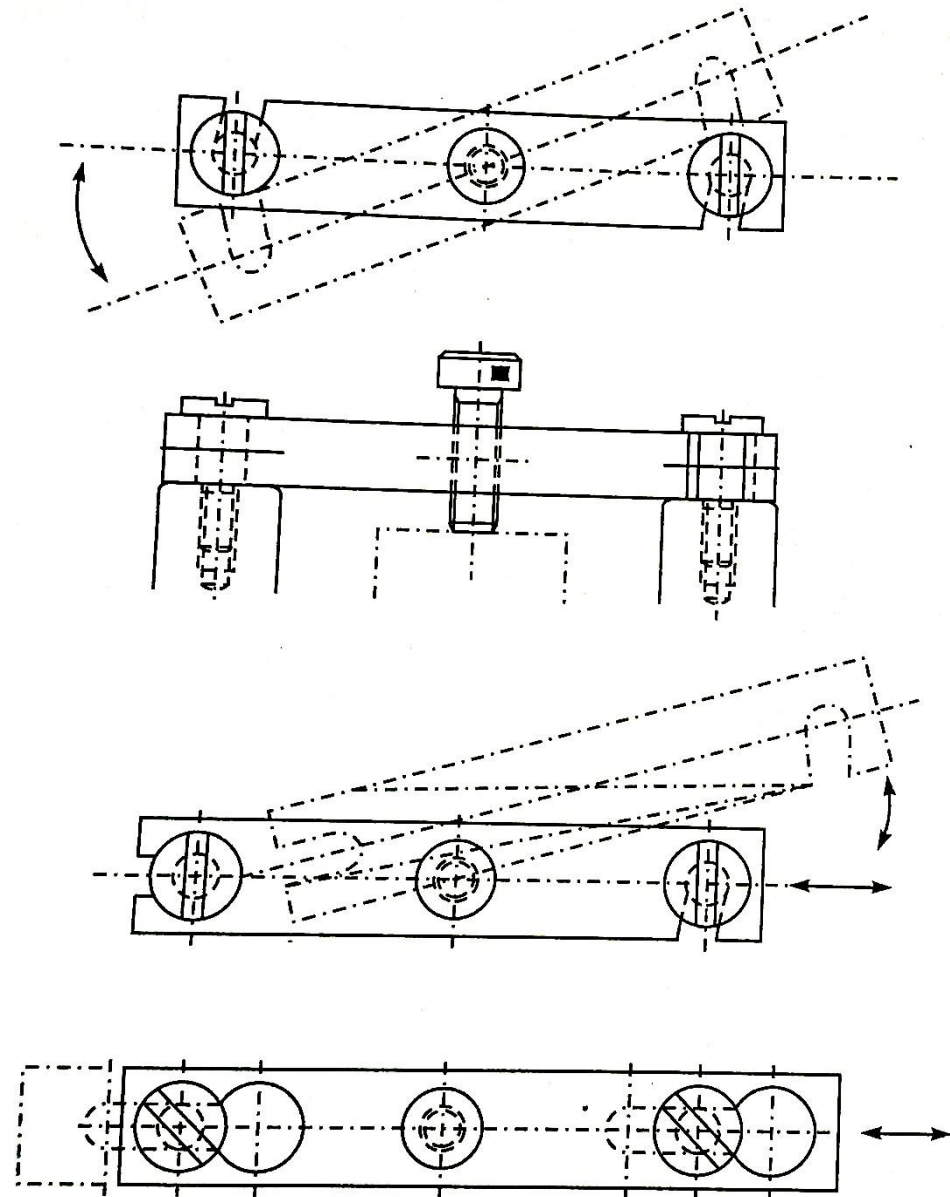


Fig. 3.21a

Swinging latch

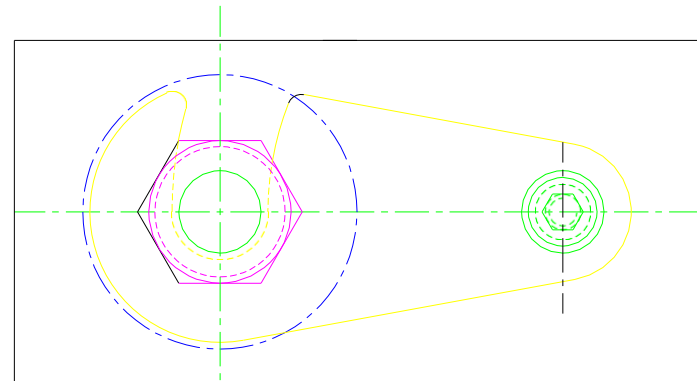
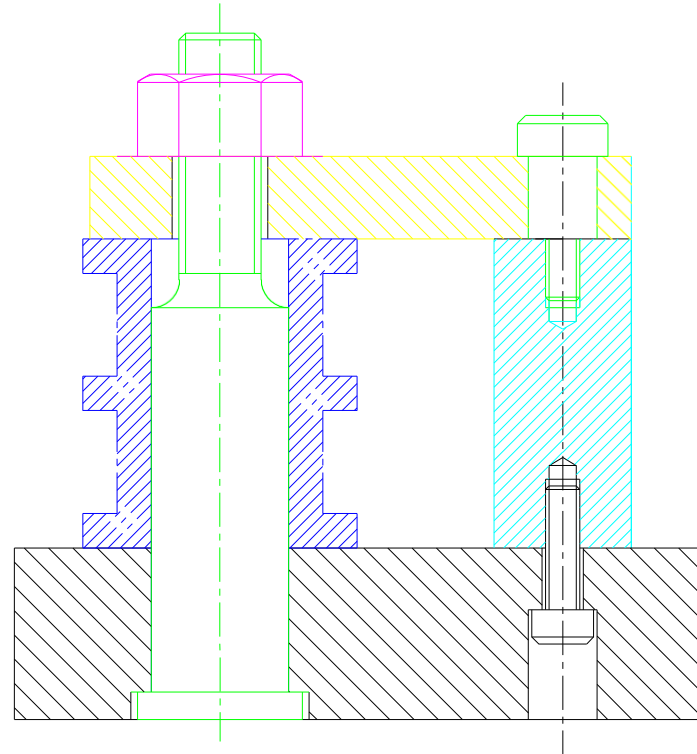
Swinging Clamps

- **Types of latches** and their methods of operation.
- Chain-dotted line shows the latches in their clear loading and unloading position.
- **Shoulder screws** are often used as pivots for thrust pads.
- The shoulder diameter must be bigger than the thrust diameter so that the shoulder face acts as a stop when the screw is tightened.



Swinging Clamps

- Swinging clamp with CWasher



Quick Action Clamps

Toggle Clamp

- They provide considerable **distance for loading and unloading** of the workpiece.
- **The Cframe clamp** can be swung to the chain dotted position during loading and unloading.

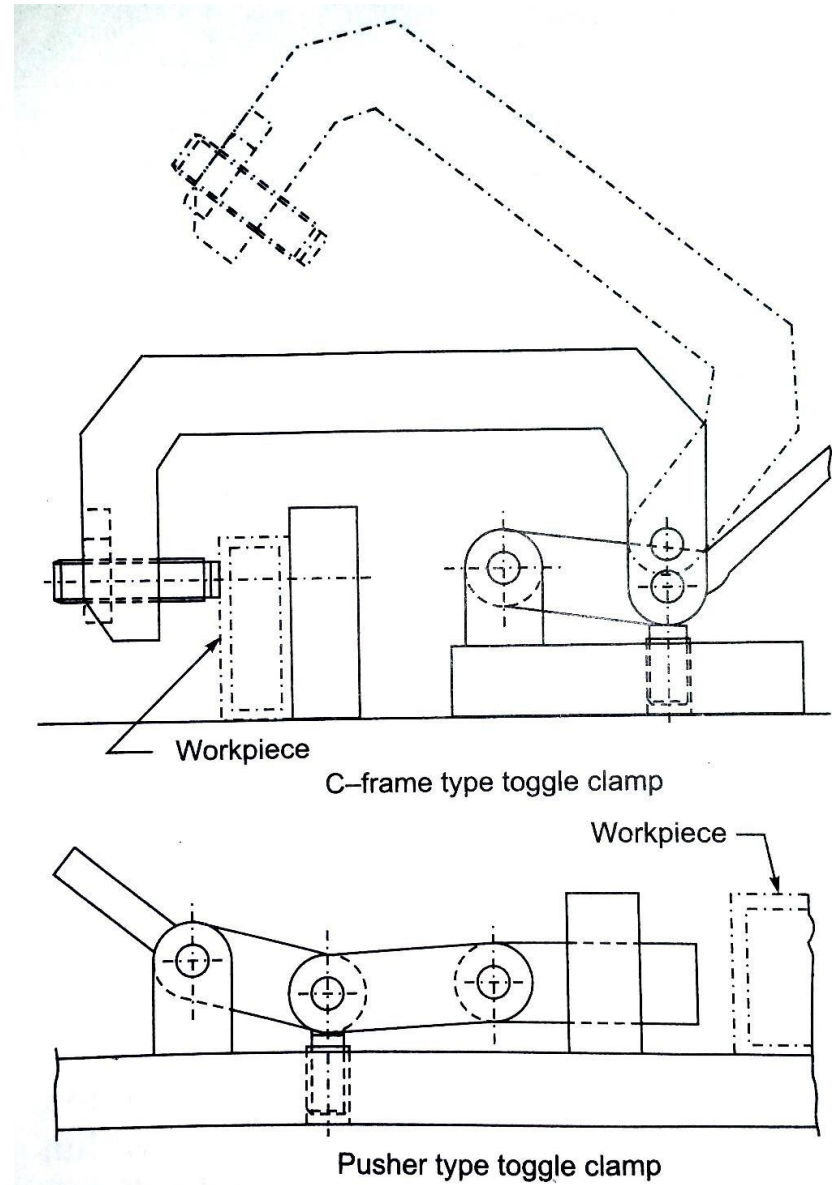
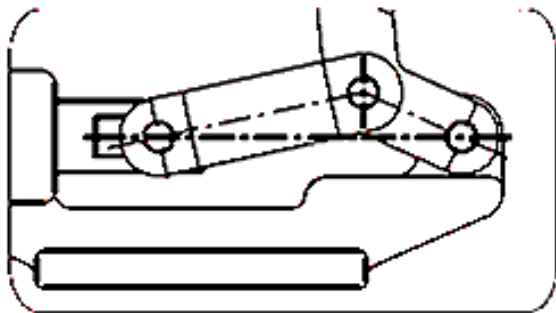


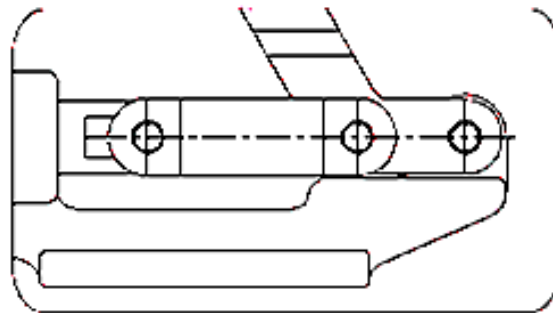
Fig. 3.29
Toggle clamps

Toggle Clamp

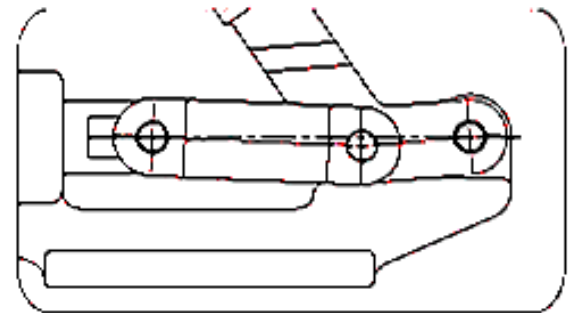
- The pusher-type toggle clamp **withdraws backwards** during unclamping.
- Toggle clamps are provided with clamping screws to accommodate workpiece variations.



Unclamped Position



Centre Position



Over-centre, Clamped Position

Toggle Clamp



Quick Turn Screw / ThumbScrew

- It is used to clamp **hinged jig plates and latches within a quarter turn.**
- **In unclamped position** head of the thumb screw can pass through the slot provided in the jig/latch plate.
- The plate can swung clear of the thumb screw head.
- **For clamping,** the thumb screw is **turned 90°** so its head is right angles to the slot in the plate.
- The mating surface of the thumb screw head must be **filed for proper clamping.**
- Quarter-turn screws are suitable for **light loads** only.
- For heavy loads, **swinging eyebolt and knob** combination is used.

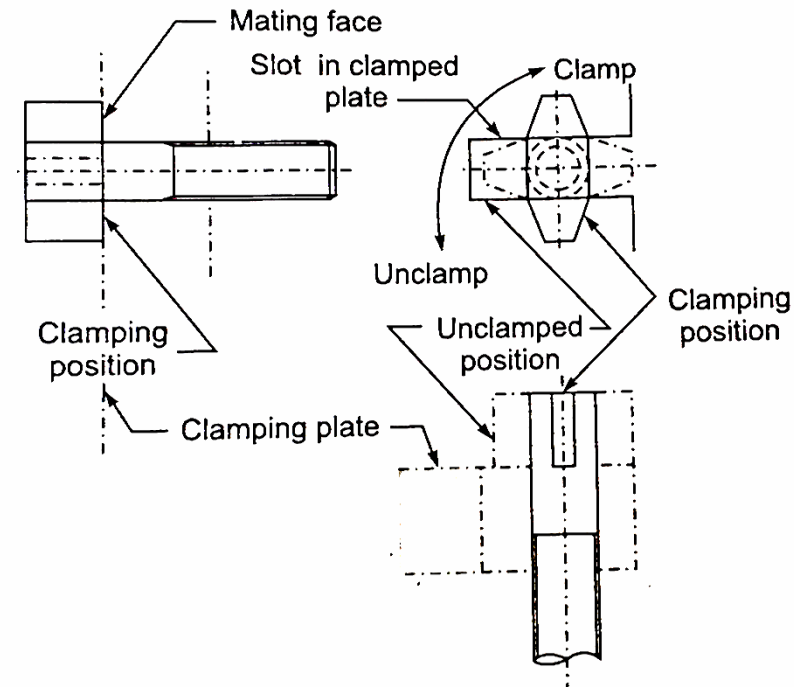
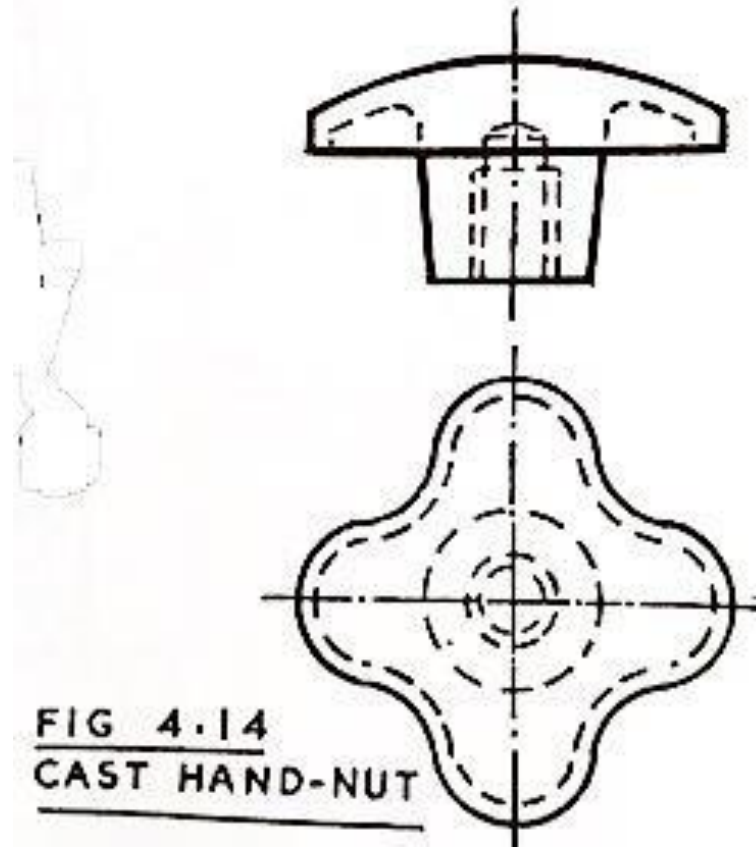


Fig. 3.30

Quarter-turn screw

Quick Action Hand Nut

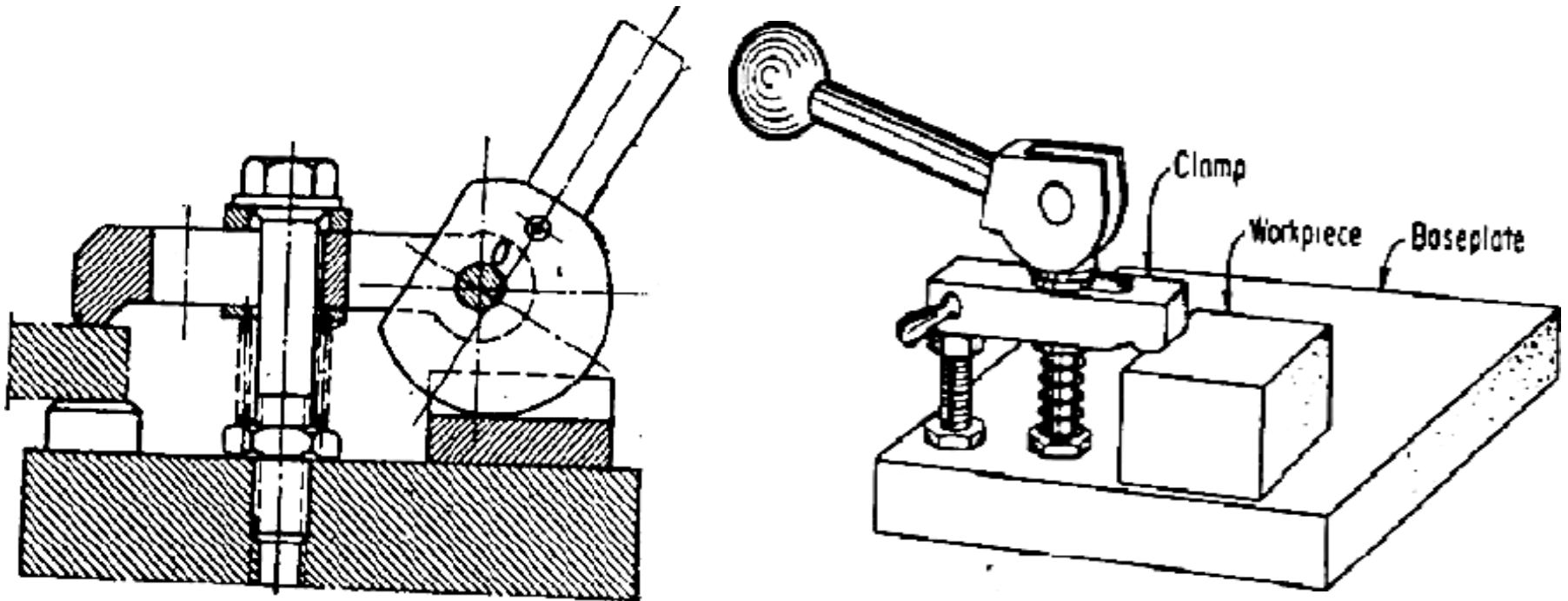
- They are available with the manufacturers of standard parts.
- Cast hand nuts are more convenient and less expensive than the turned nuts



Cast Hand Nut

Cam

- Quick clamping by cam is very effective and very simple in operation.
- The cam type clamping system is used for clamping through some interior parts where other simple system will not have access.



Cam

- Cam shifts its mating surfaces to clamp or unclamp the workpieces.

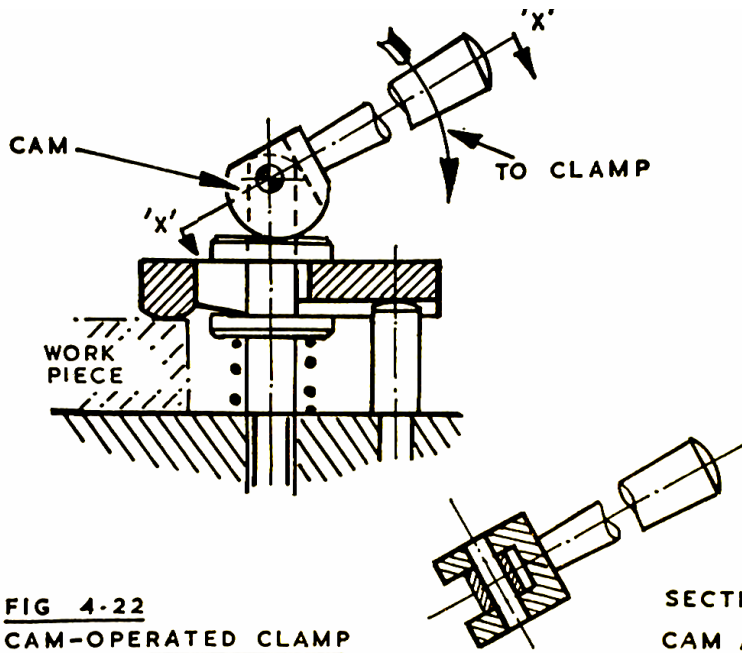
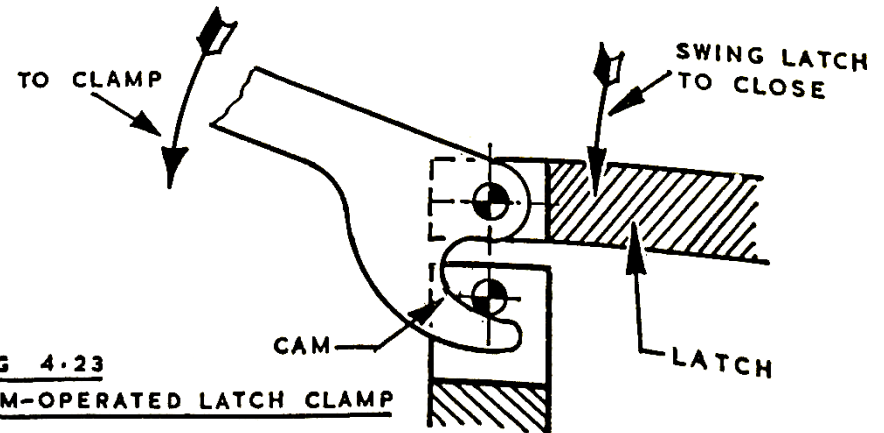


FIG 4-22
CAM-OPERATED CLAMP



Multiple Clamping

Double Clamping

- Two workpieces **with limited variation** can be clamped by a single strap clamp.
- **The spherical washers** are provided between the nut and the clamp which allow the clamp **to tilt slightly to suit the variation in the two workpieces.**

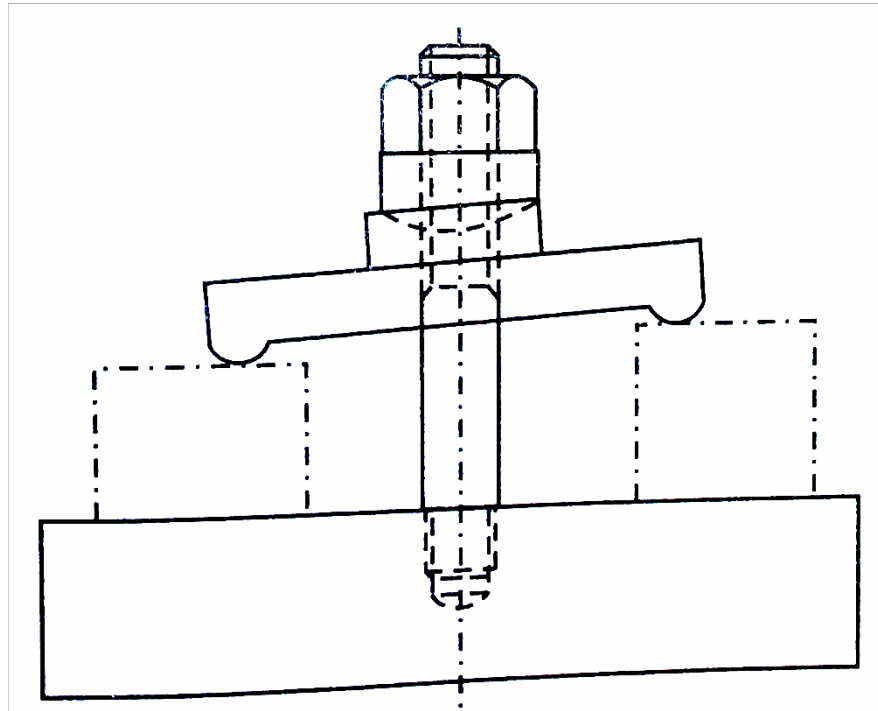


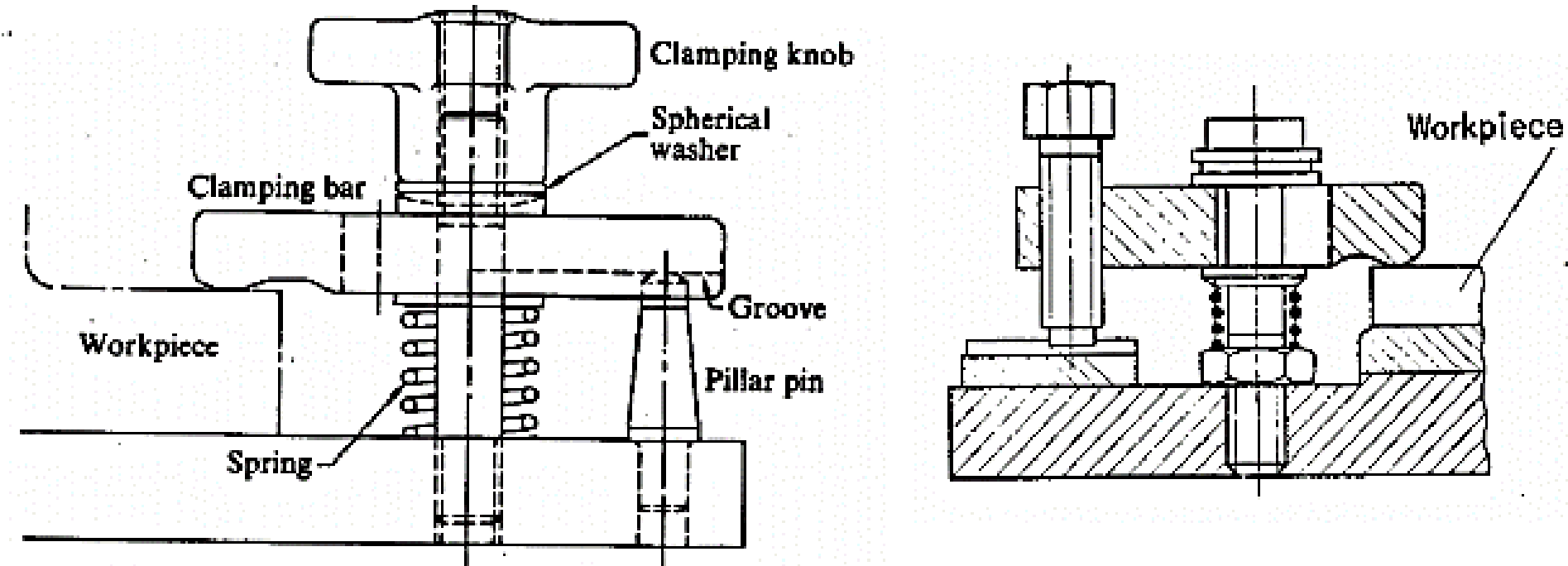
Fig. 3.31

Double clamping

General clamping methods of common use :

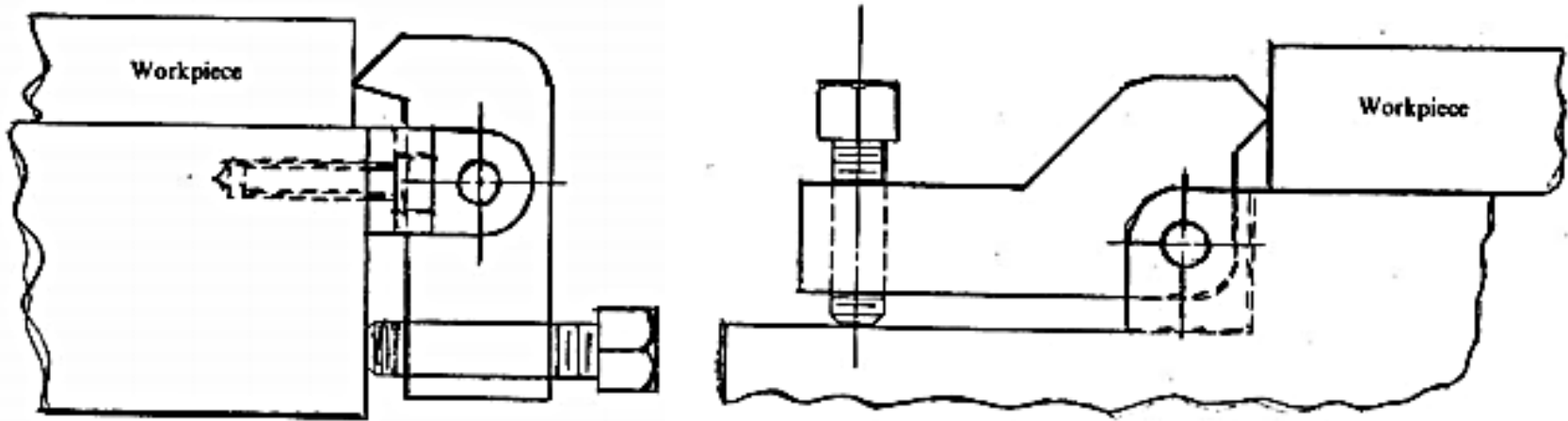
- Screw operated strap clamps

The clamping end of the strap is pressed against a spring which enables quick unclamping

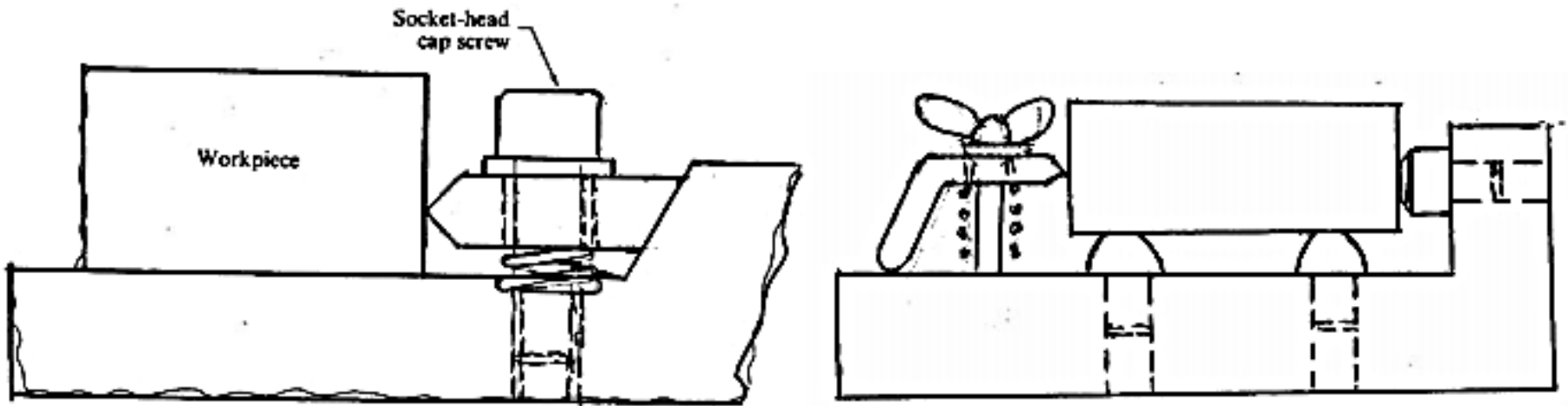


Common strap type clamping

Clamping from side for unobstructed through machining (like milling, planing and broaching) of the top surface.

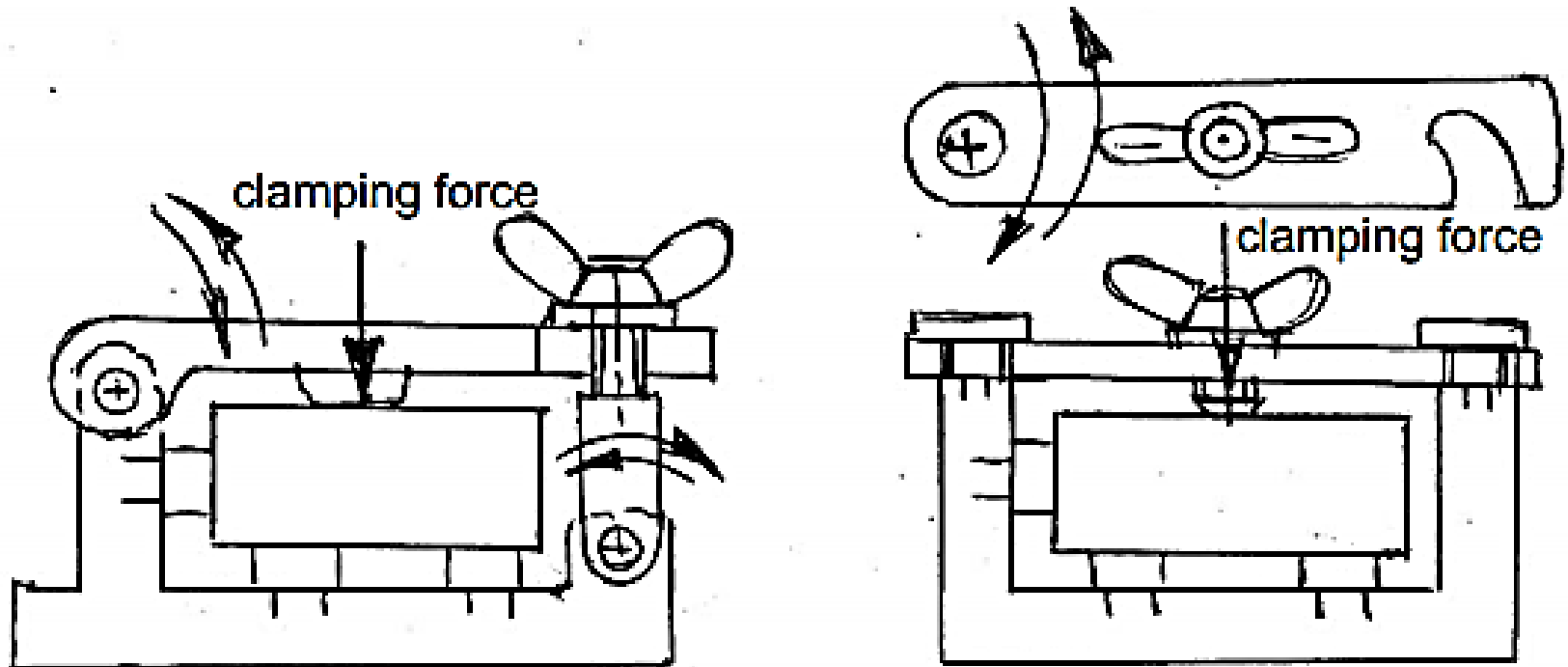


Clamping from side for free machining of the top surface



Clamping by swing plates

Such clamping, are simple and relatively quick in operation but is suitable for jobs of relatively smaller size, simpler shape and requiring lesser clamping forces.



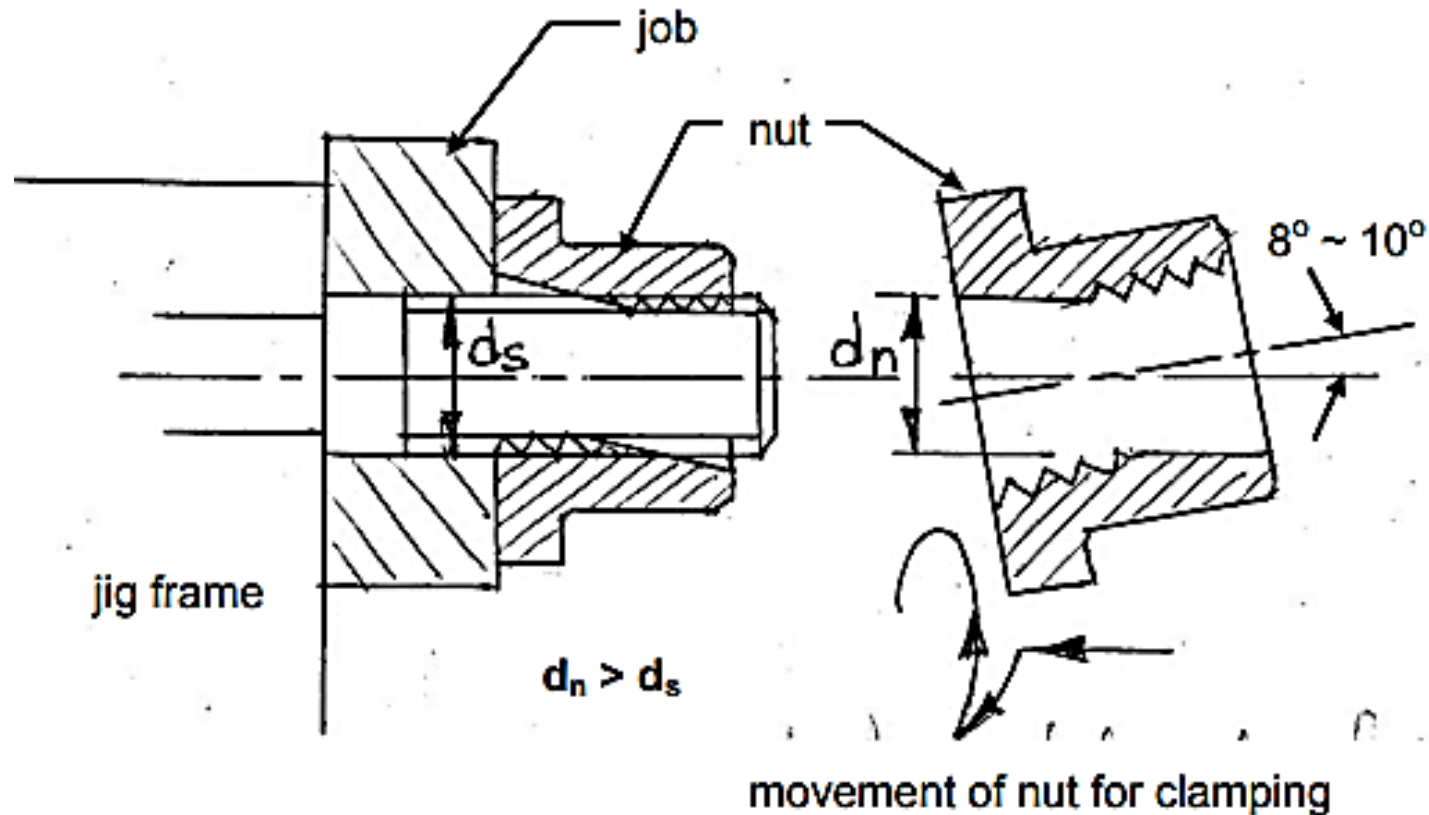
Clamping by swing plates

Other conventional clamping methods include :

- * Vices like drilling and milling vices
- * Magnetic chucks
- * Chucks and collets for lathe work

Quick clamping methods and systems

_o Use of quick acting nut - a typical of such nut and its application

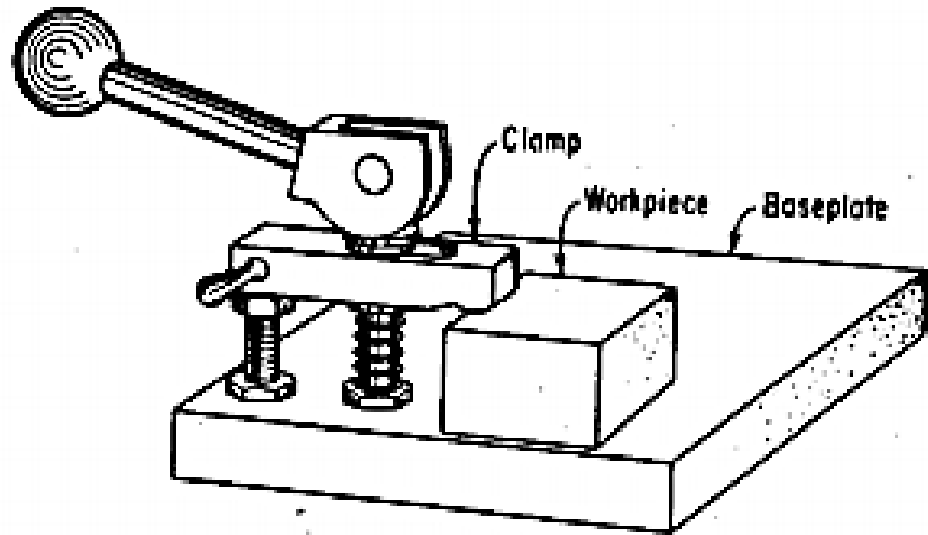
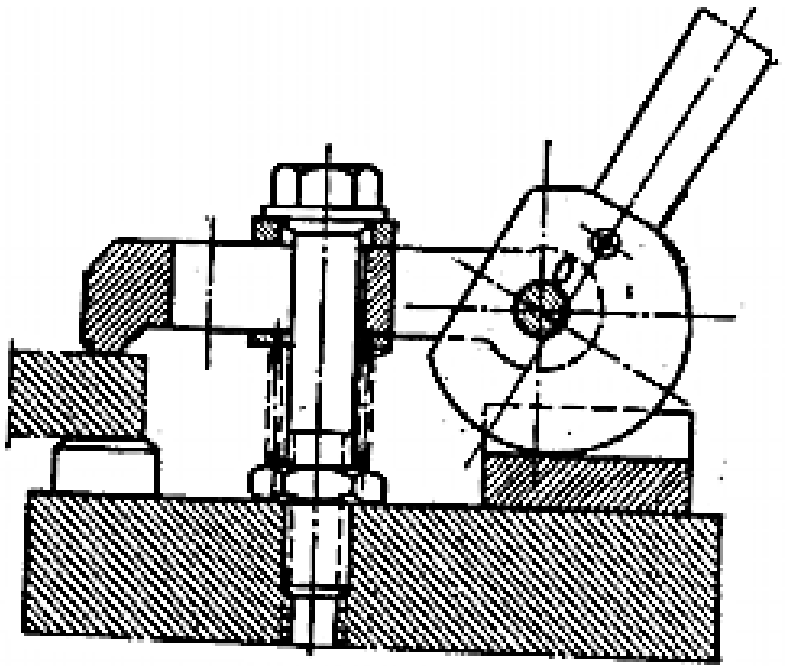


Quick acting nut for rapid clamping

Cam clamping

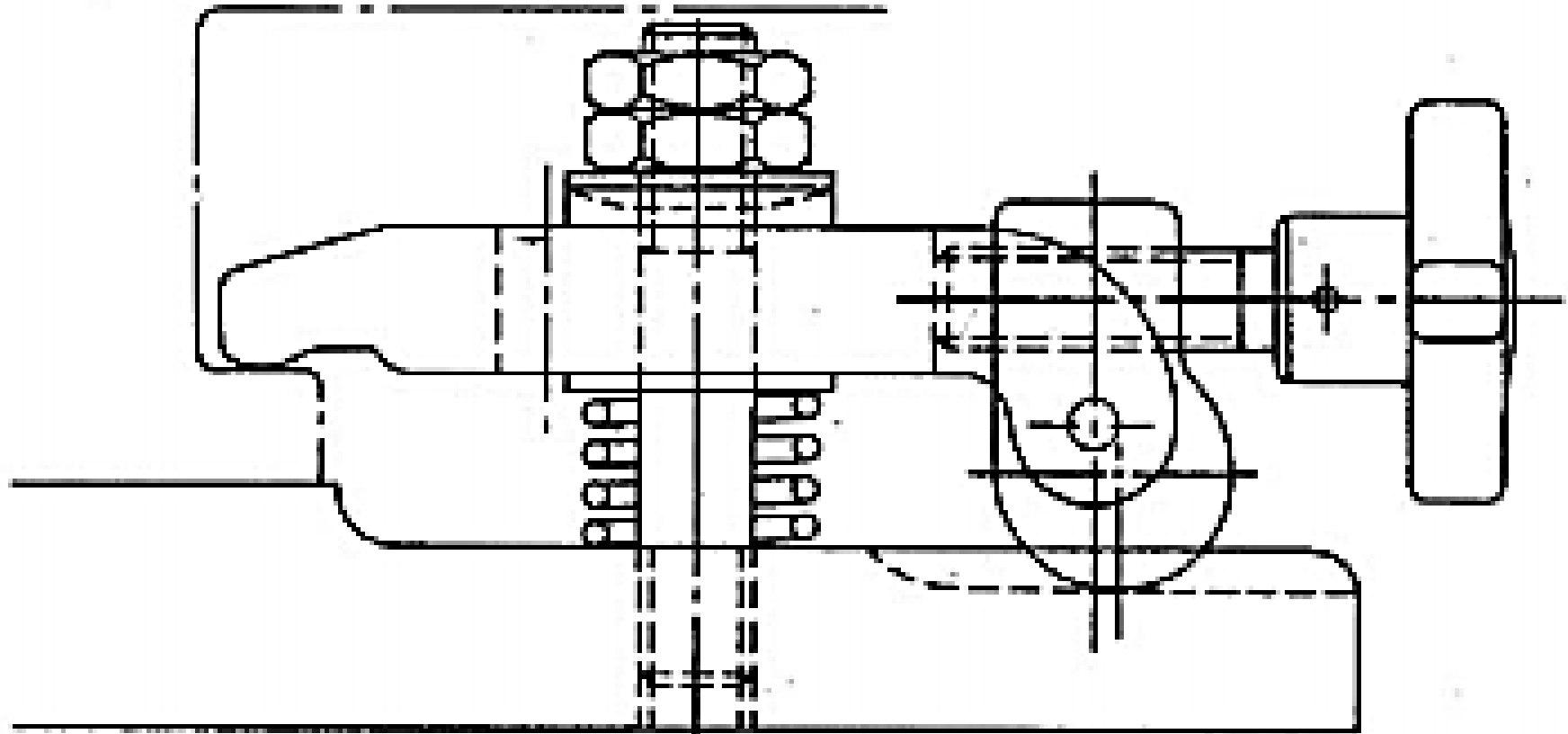
Quick clamping by cam is very effective and very simple in operation. Some popular methods and systems of clamping by cam.

The cam and screw type clamping system is used for clamping through some interior parts where other simple system will not have access.



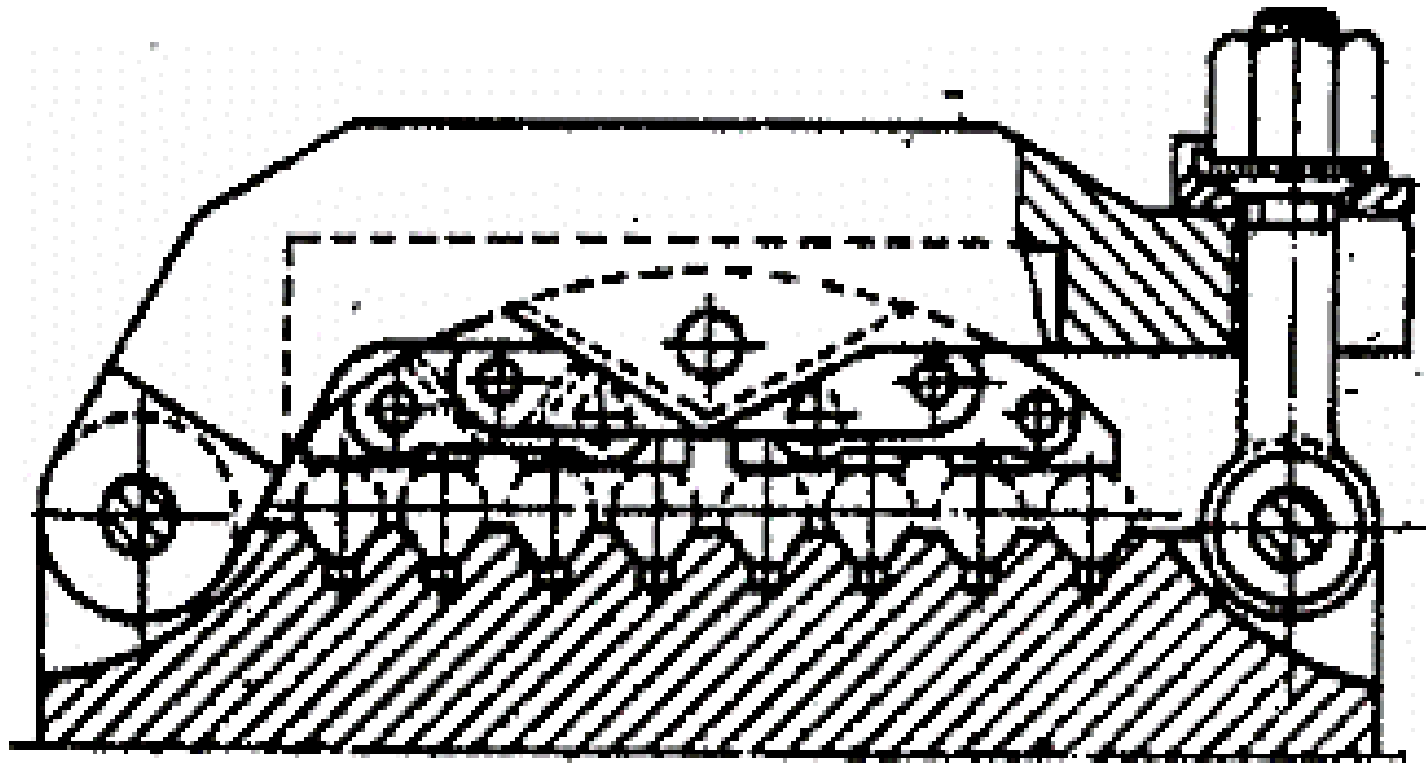
clamping by cam

workpiece



(b) screw and cam clamping from distance

Quick multiple clamping by pivoted clamps in series and parallel. This method is capable to simultaneously clamp number of rods even with slight diameter variation



Quick multiple locating and clamping of cylindrical jobs