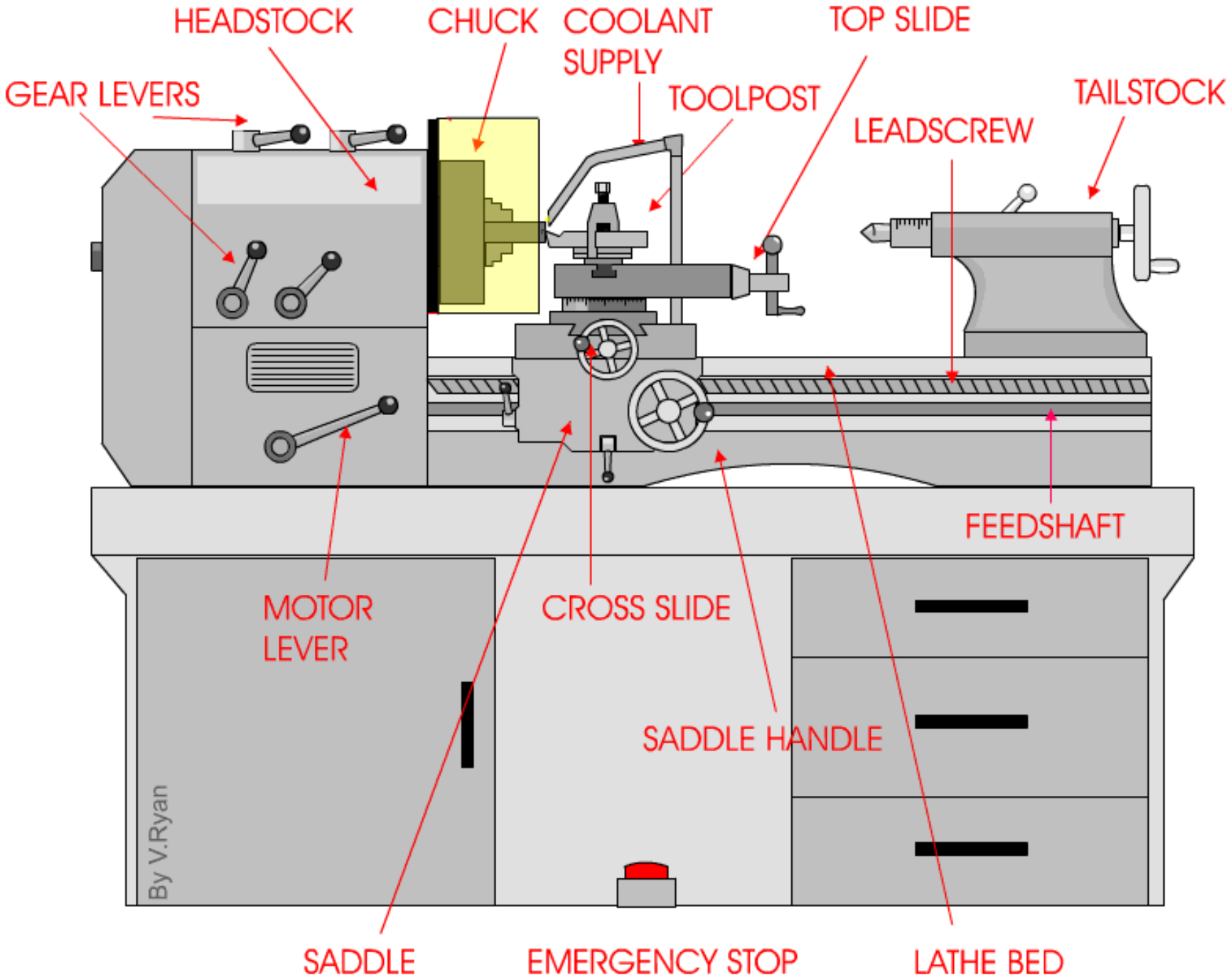
MODULE 2

LATHE

Lathe is a machine, which removes the metal from a piece of work to the required shape and size.

- Lathe is one of the most important machine tools in the metal working industry. A lathe operates on the principle of a rotating workpiece and a fixed cutting tool.

- The cutting tool is feed into the workpiece, which rotates about its own axis, causing the workpiece to be formed to the desired shape.


HEADSTOCK
CHUCK
COOLANT SUPPLY
TOP SLIDE
GEAR LEVERS
TOOLPOST
TAILSTOCK
LEADSCREW
FEEDSHAFT
MOTOR LEVER
CROSS SLIDE
SADDLE HANDLE
By V.Ryan
SADDLE
EMERGENCY STOP
LATHE BED

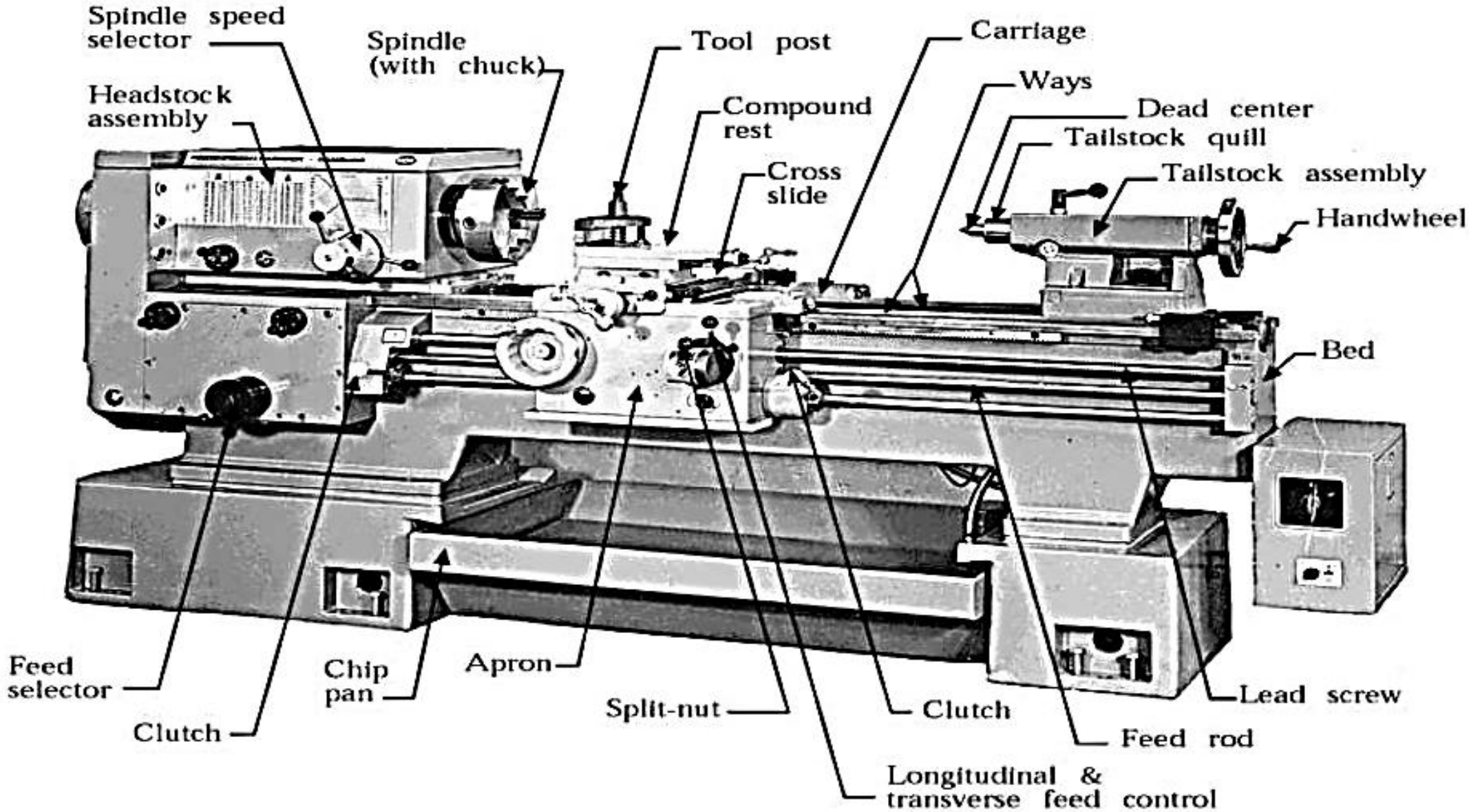
MAIN PARTS

Lathe Machine is also known as "**Centre Lathe**", because it has two centres between which the job can be held and rotated.

The main parts of centre lathe are:

- Bed,
- Head stock,
- Tail stock,
- Carriage,etc

Lathe


Spindle speed selector
Spindle (with chuck)
Tool post
Carriage
Headstock assembly
Ways
Compound rest
Dead center
Tailstock quill
Cross slide
Tailstock assembly
Handwheel
Bed
Feed selector
Clutch
Chip pan
Apron
Split-nut
Clutch
Lead screw
Feed rod
Longitudinal & transverse feed control

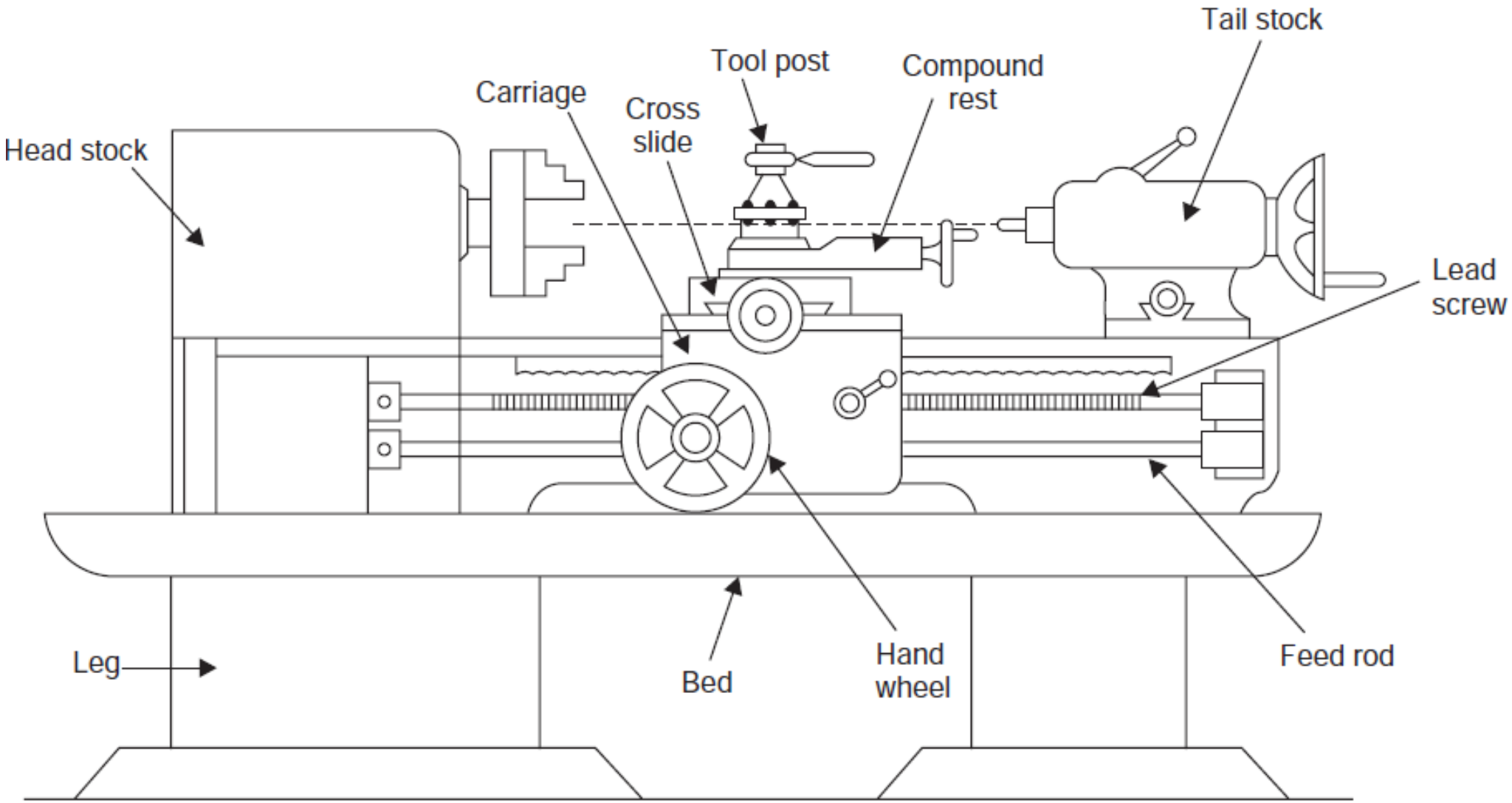


Fig. 1. Lathe Machine.

- Lathe Components
  - Bed: supports all major components
  - Carriage: slides along the *ways* and consists of the *cross-slide, tool post, apron*
  - Headstock – Holds the jaws for the work piece, supplies power to the jaws and has various drive speeds
- Tailstock – supports the other end of the workpiece
- Feed Rod and Lead Screw – Feed rod is powered by a set of gears from the headstock

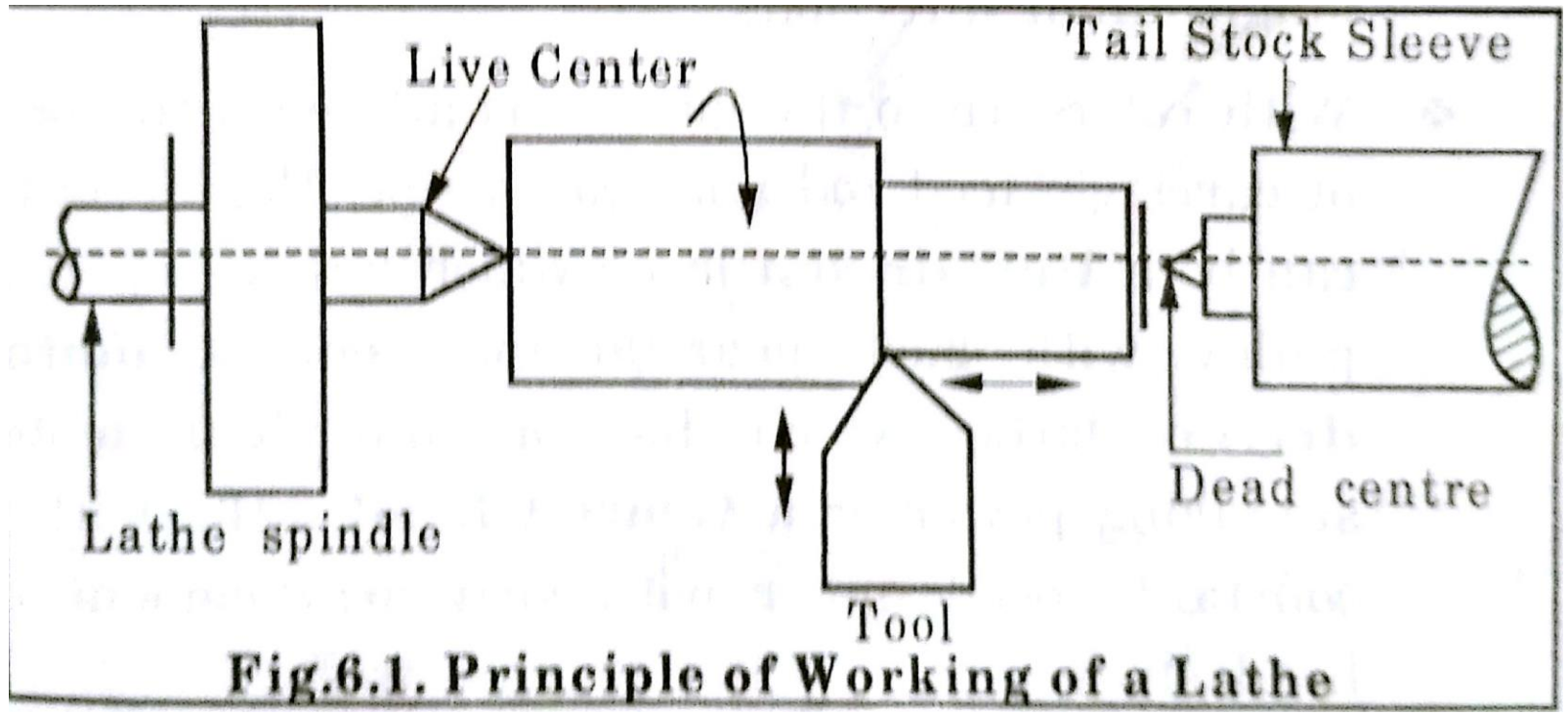


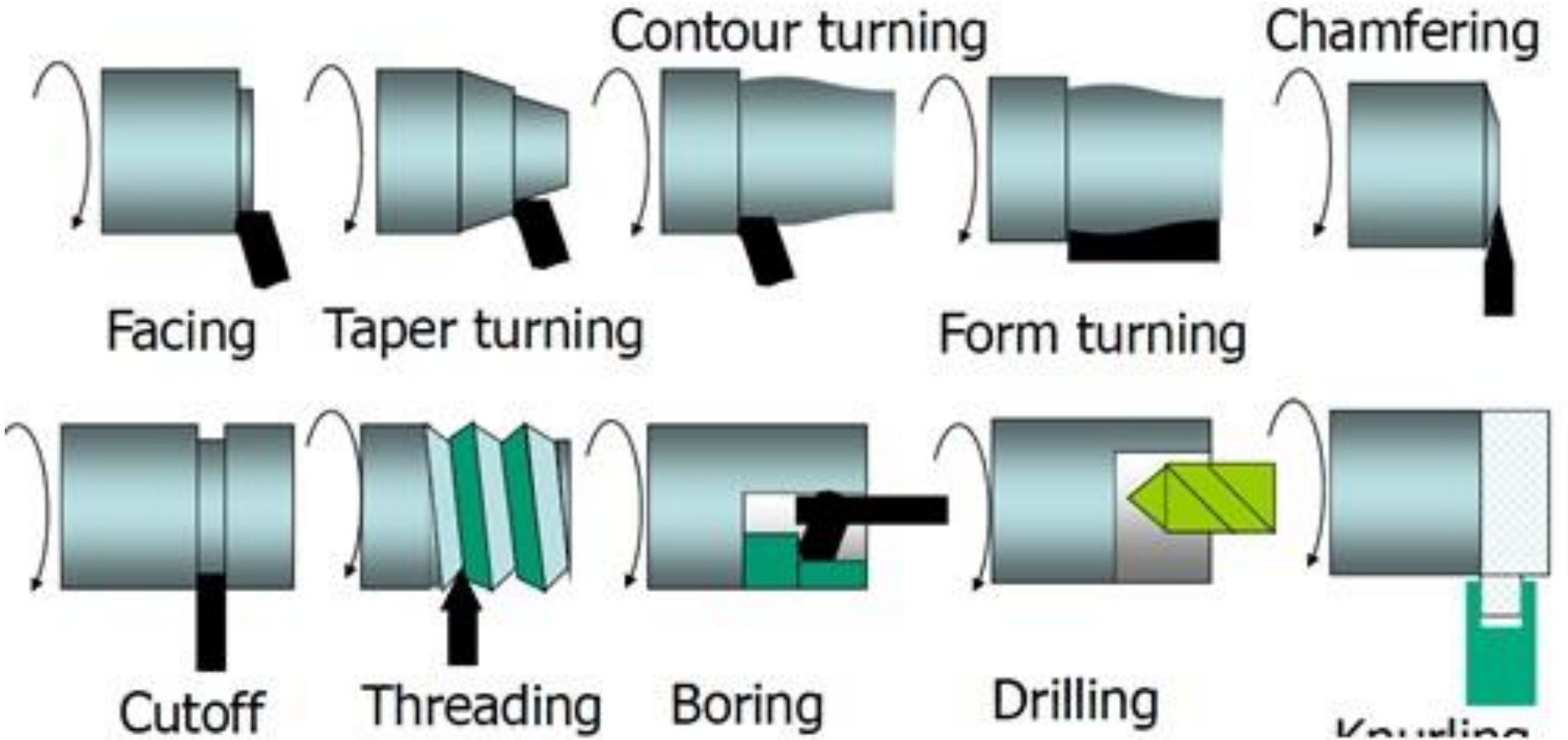
Fig.6.1. Principle of Working of a Lathe

WORKING PRINCIPLE OF LATHE

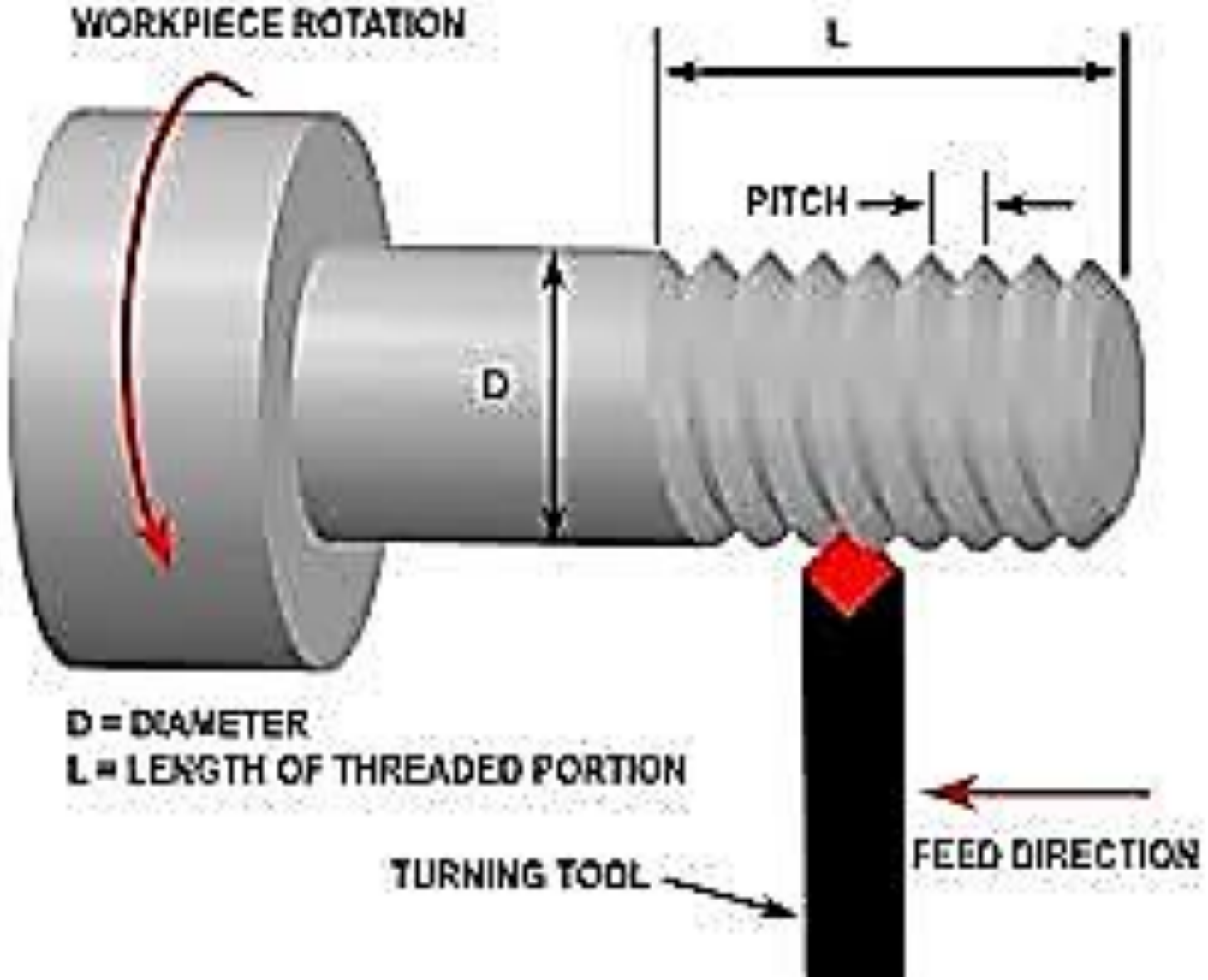
- It holds the work between two supports called centers.
- Chuck or Face plate is also used for holding the work.
- Chuck or face plate is mounted on machine spindle
- Cutting tool is held and supported on a tool post.
- Movement of the job is rotation about spindle axis
- Tool is fed against the revolving work
- Movement of the tool is either parallel to or at any inclination to the work axis

LATHE OPERATIONS

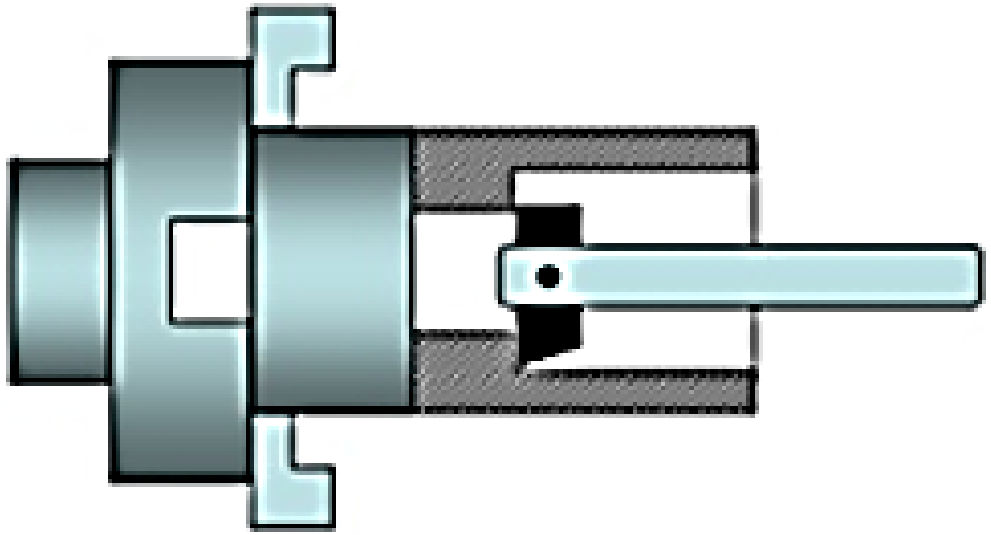
- **Turning:** to remove material from the outside diameter of a workpiece to obtain a finished surface.
- **Facing:** to produce a flat surface at the end of the workpiece or for making face grooves.
- **Boring:** to enlarge a hole or cylindrical cavity made by a previous process or to produce circular internal grooves.
- **Drilling:** to produce a hole on the work piece.
- **Reaming**: to finishing the drilled hole.
- **Threading:** to produce external or internal threads on the work piece.
- **Knurling:** to produce a regularly shaped roughness on the workpiece.


Contour turning
Chamfering
Facing
Taper turning
Form turning
Cutoff
Threading
Boring
Drilling

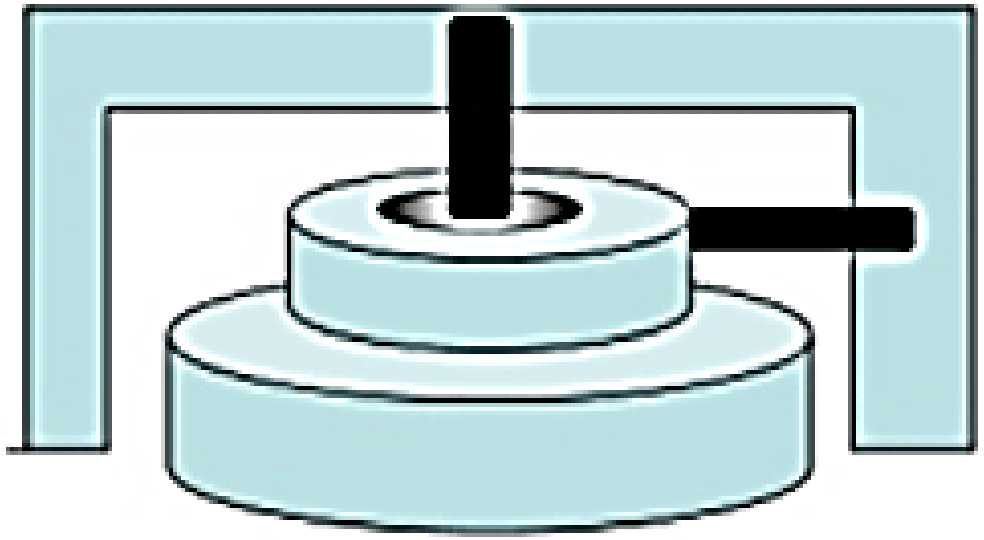
THREADING


WORKPIECE ROTATION
L
PITCH
D
D = DIAMETER
L = LENGTH OF THREADED PORTION
TURNING TOOL
FEED DIRECTION

- Boring – Cutting is done inside diameter of the work material



Horizontal Boring Machining



Vertical Boring Machining

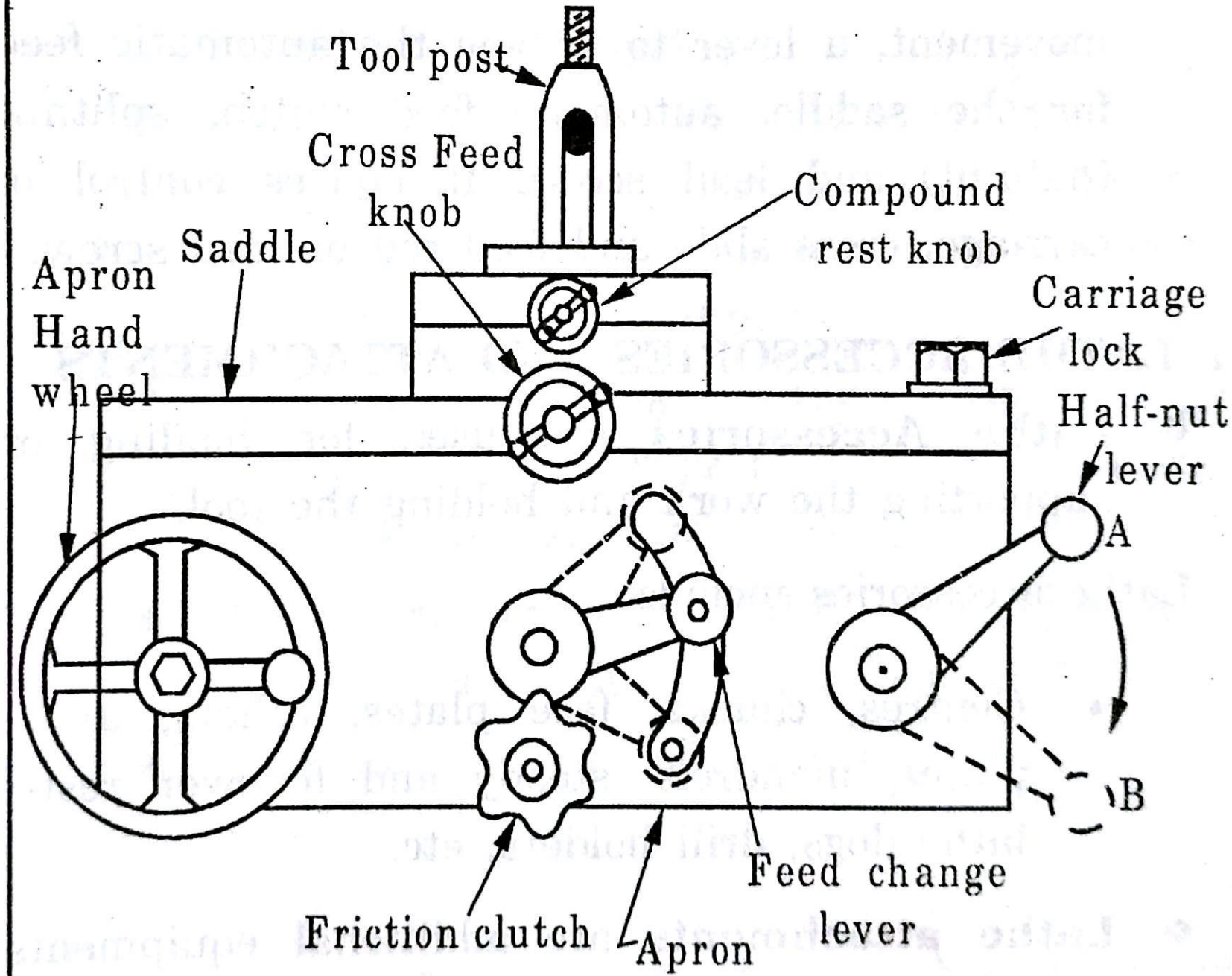


Fig 6.11. Controls on Carriage and Apron Assembly.

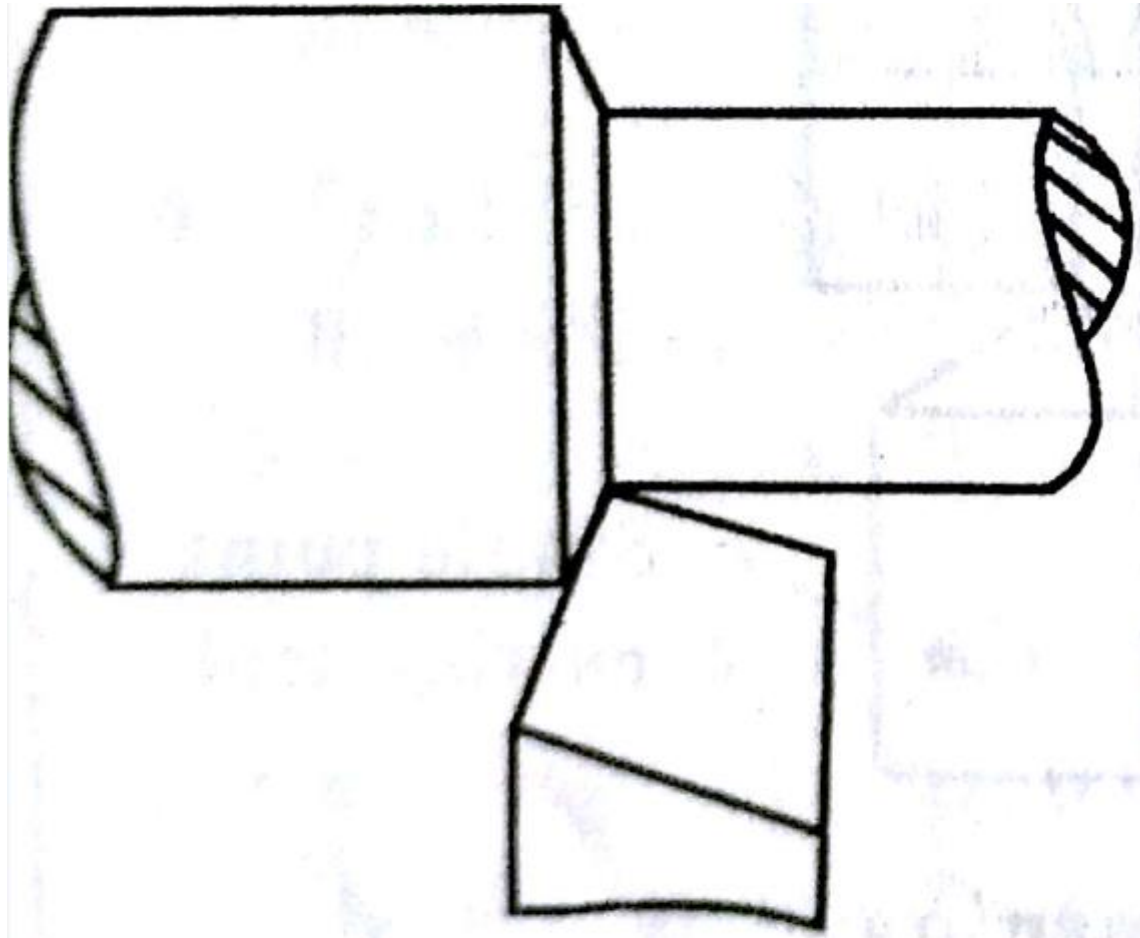


Fig. 6.27 Rough turning operation

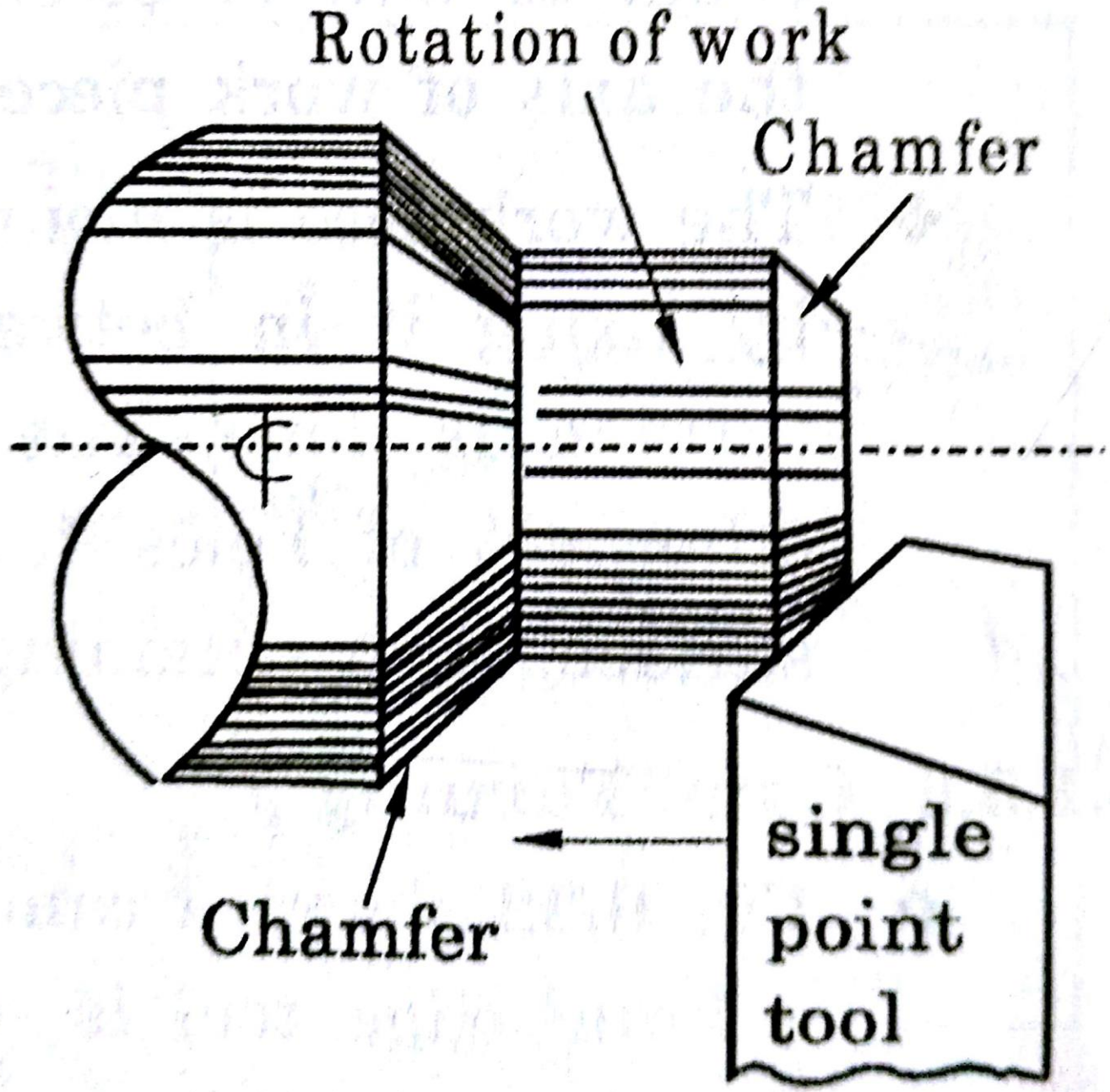


Fig 6.33 Chamfering operation

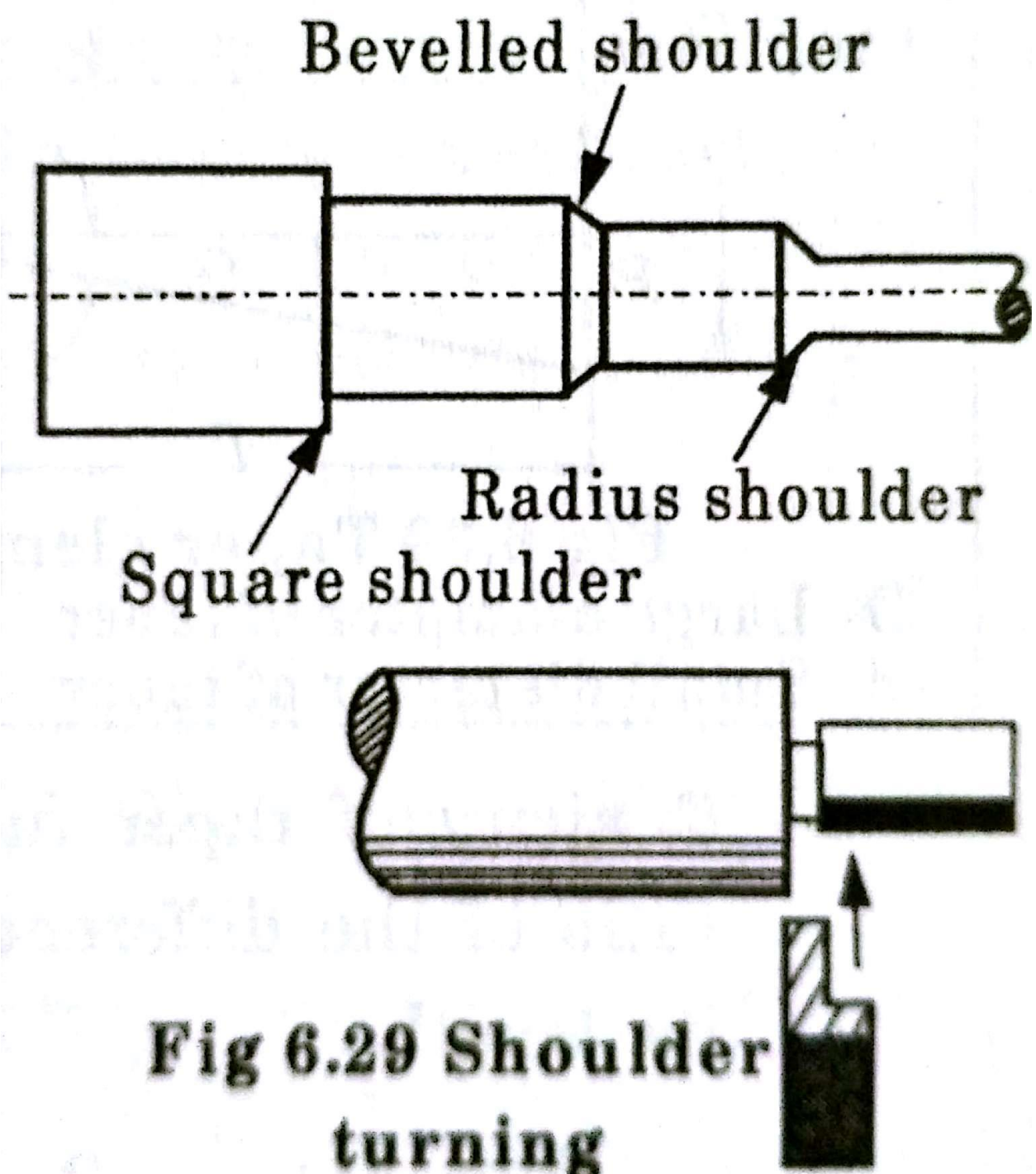


Fig 6.29 Shoulder turning

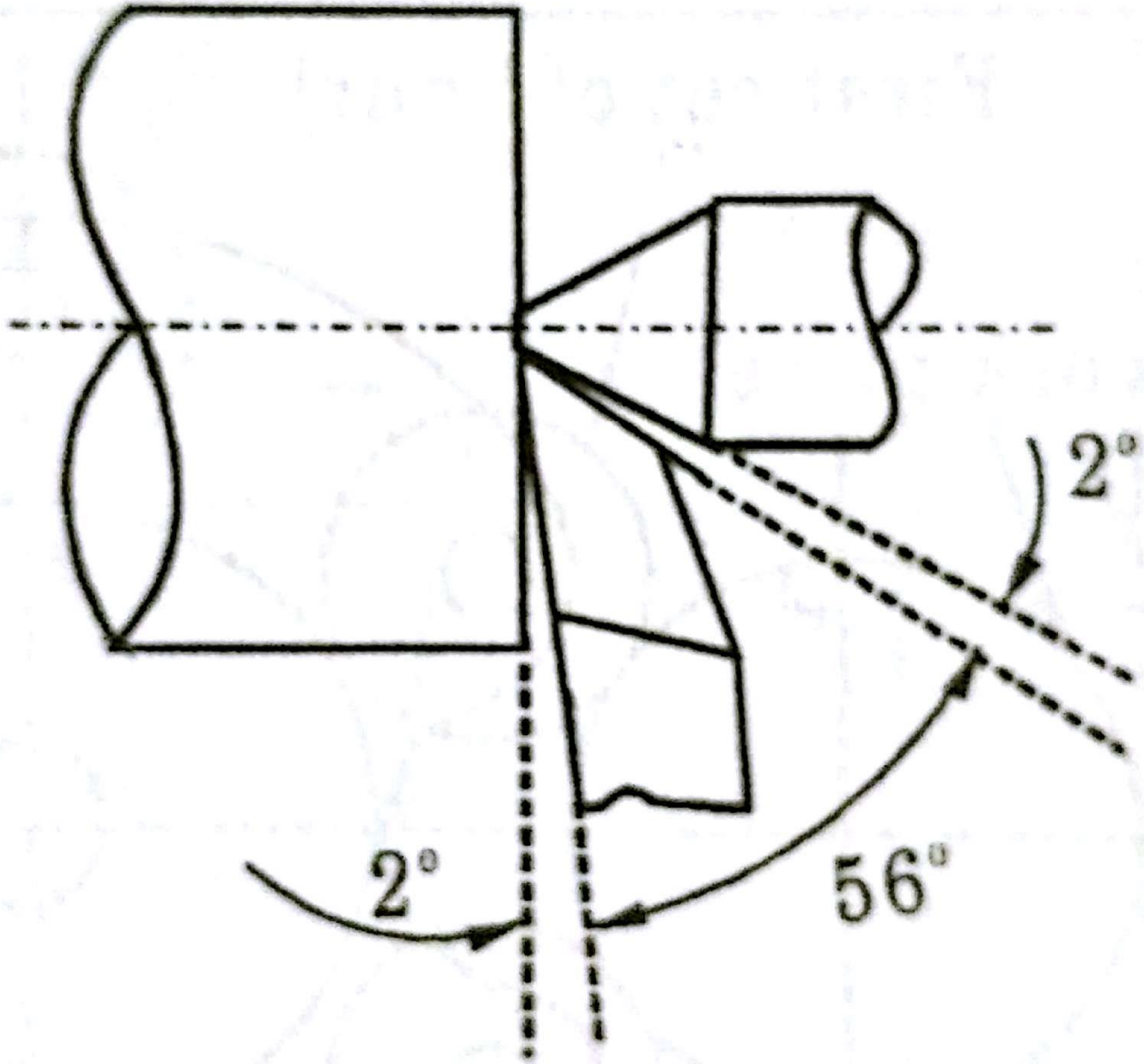


Fig 6.34 Facing operation

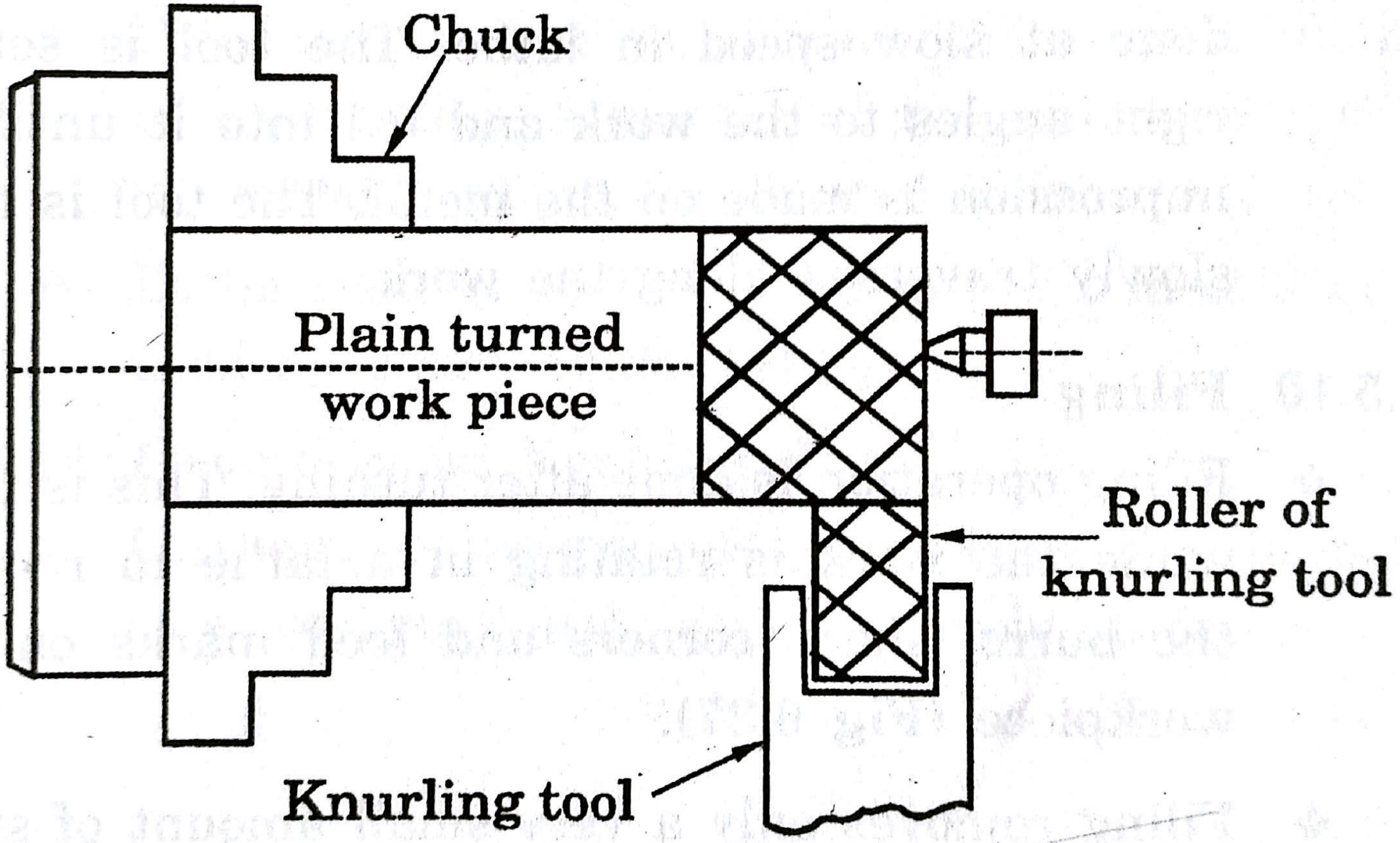
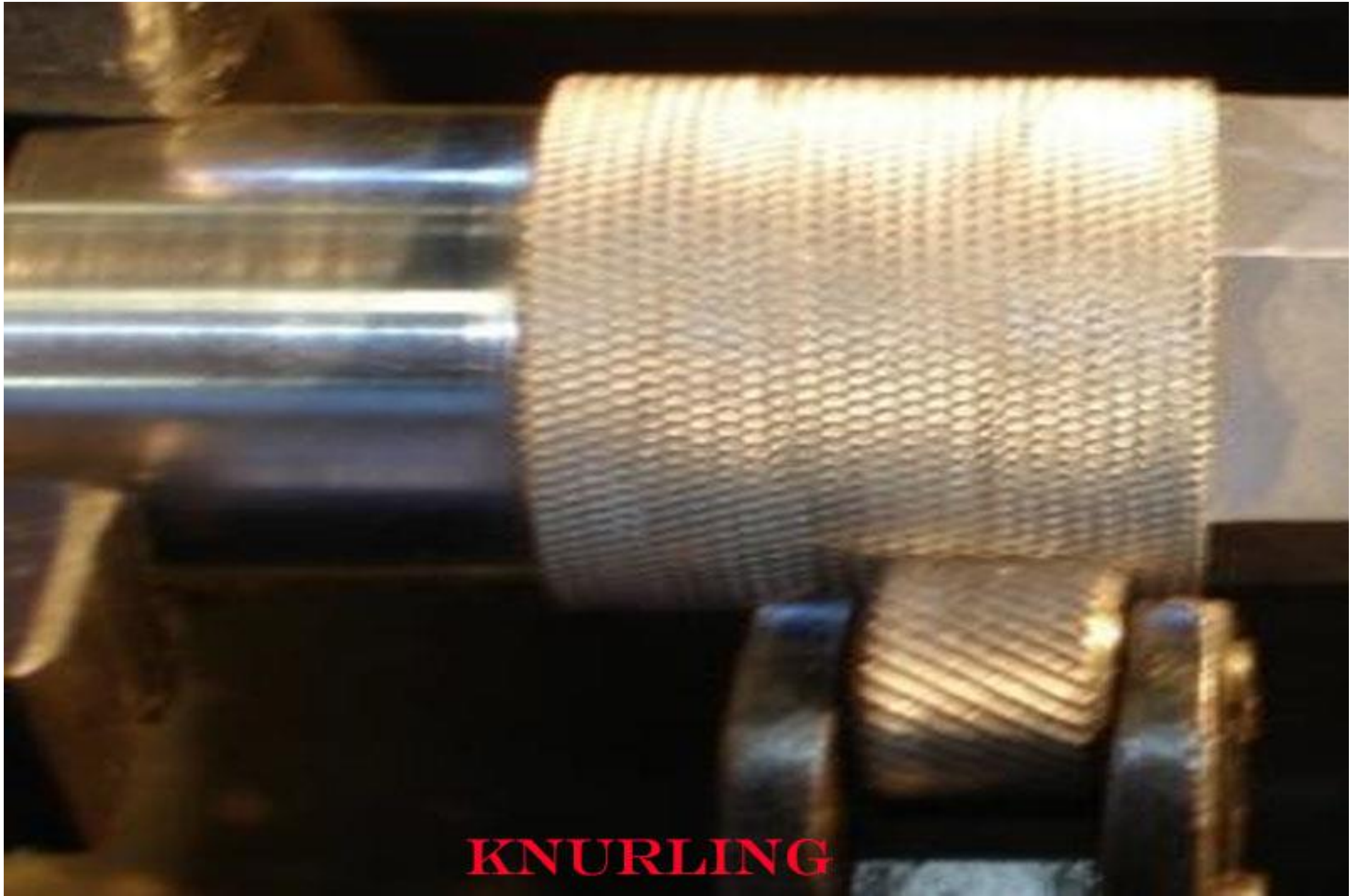


Fig 6.35 Knurling operation


KNURLING

DRILLING MACHINE

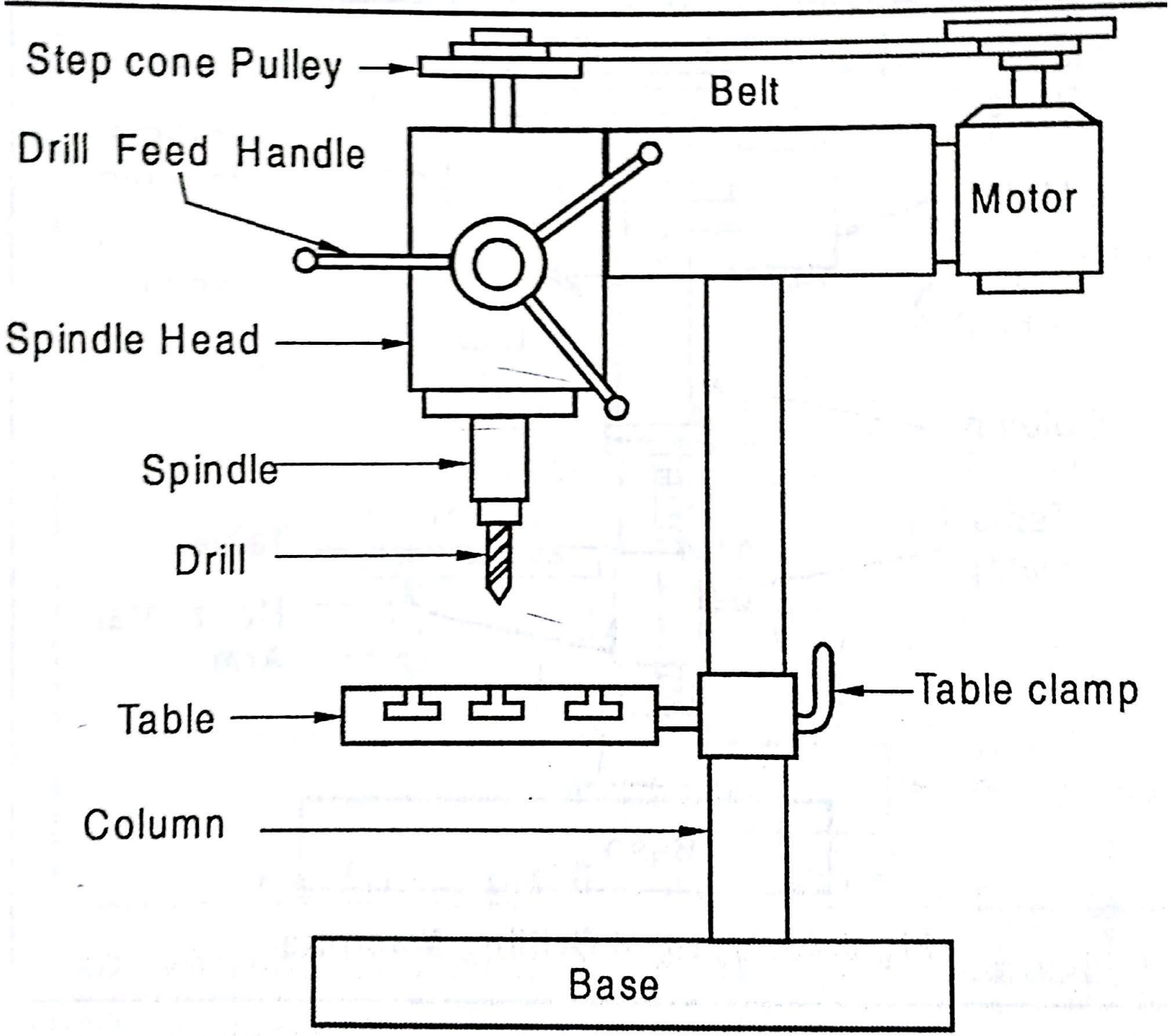


Fig.6.47. Pillar Drilling Machine.

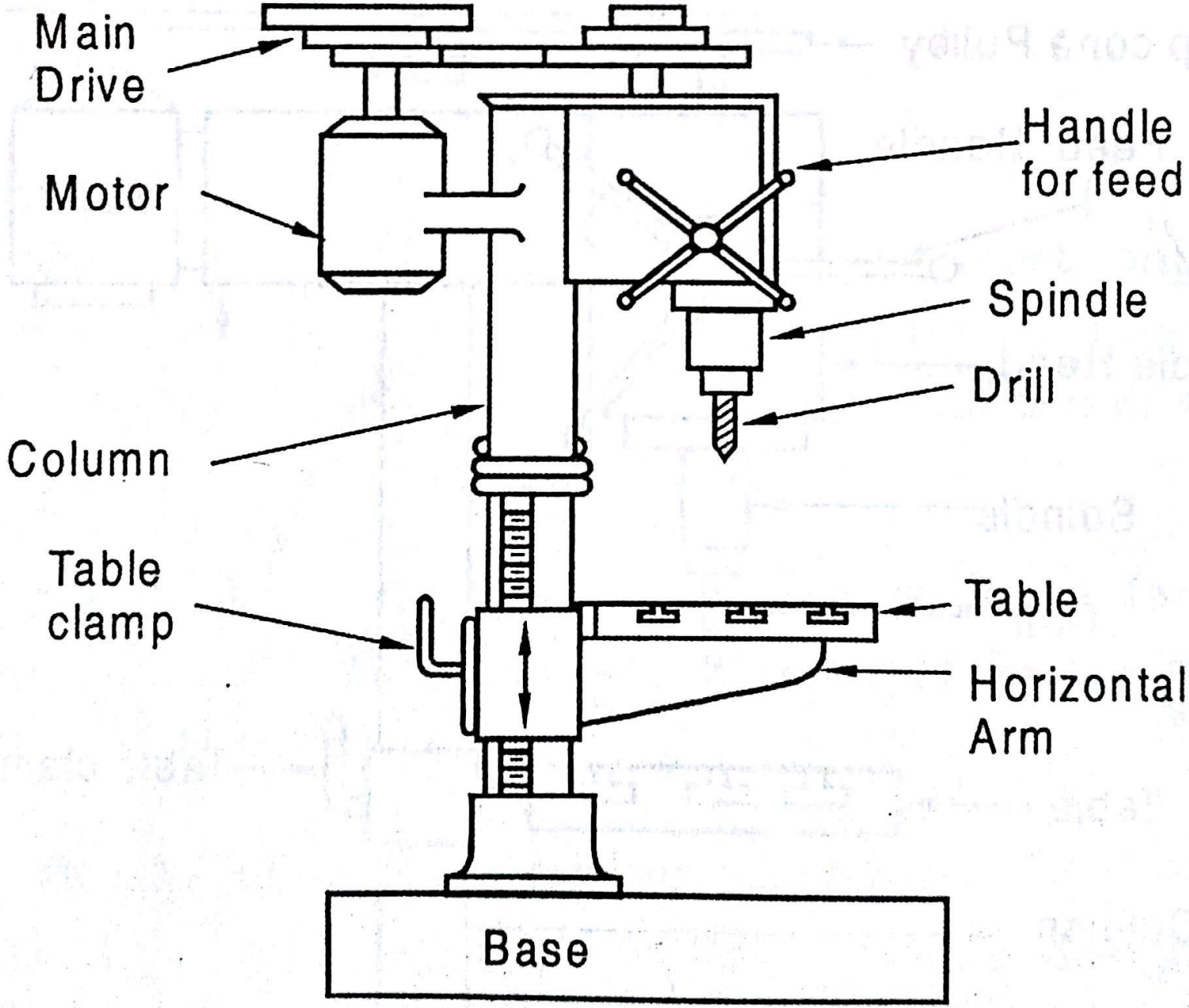


Fig.6.48. Upright Drilling Machine

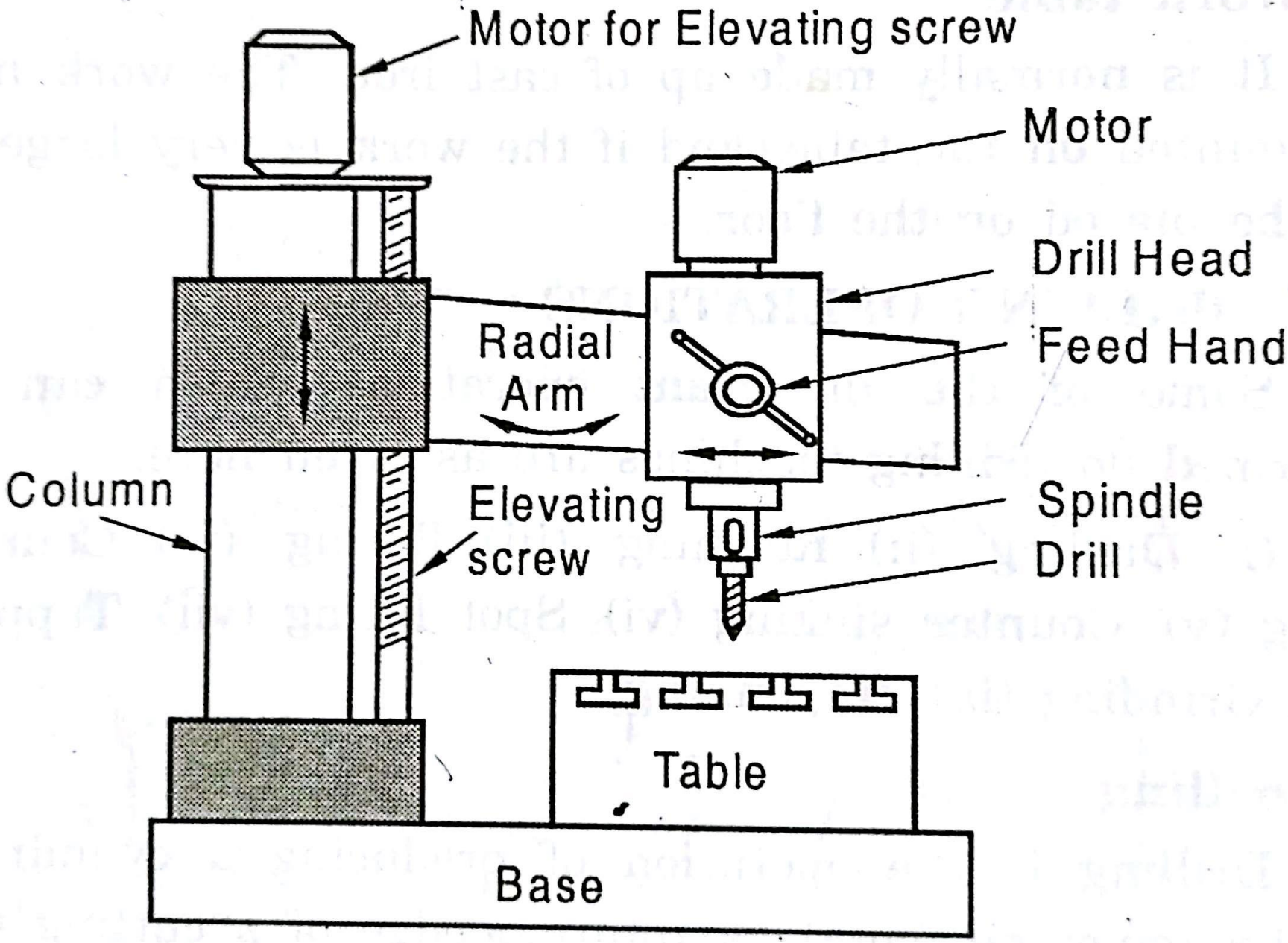


Fig. 6.49 Radial Drilling Machine

MILLING MACHINE

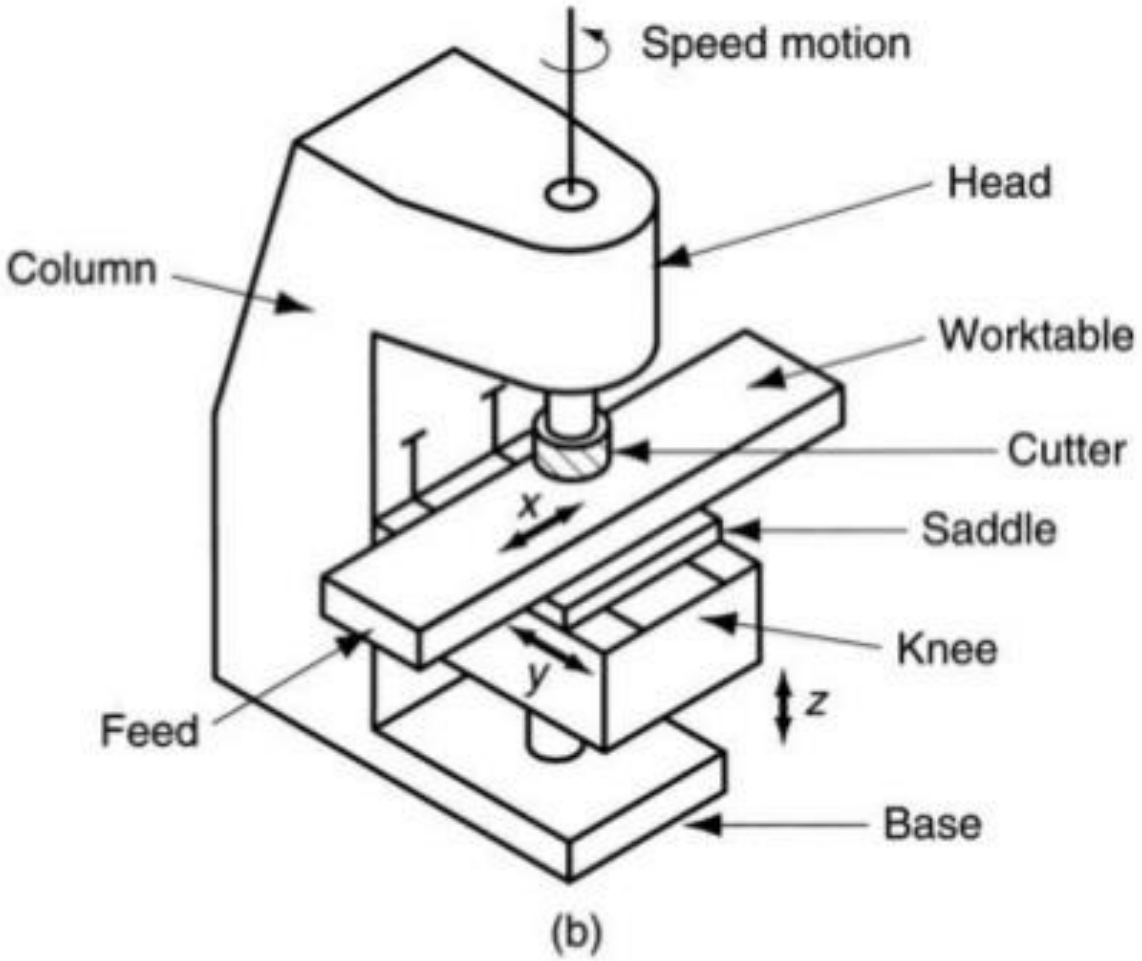


Fig. (b) vertical knee-and-column milling machine

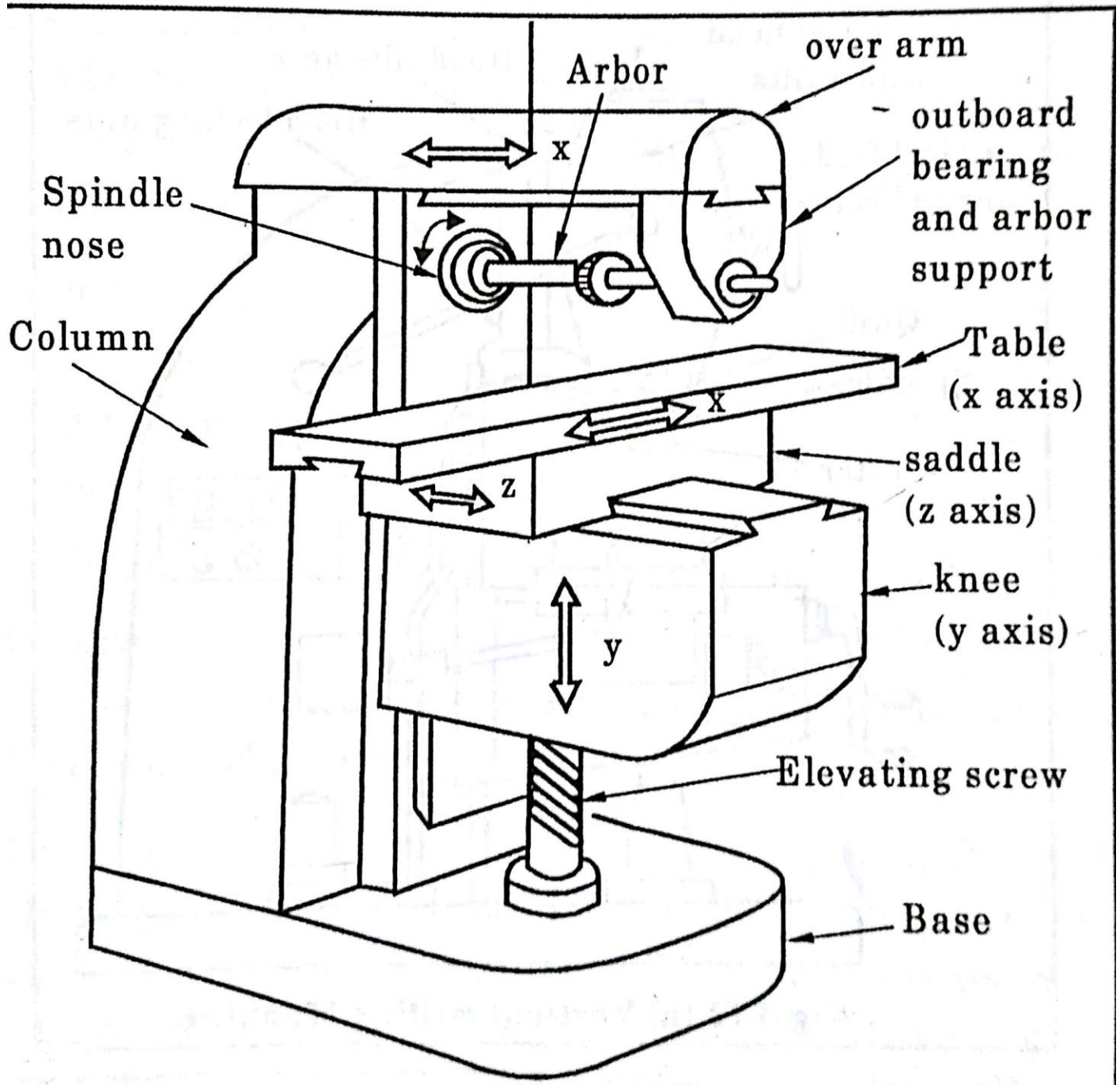


Fig 6.71 Horizontal Milling Machine

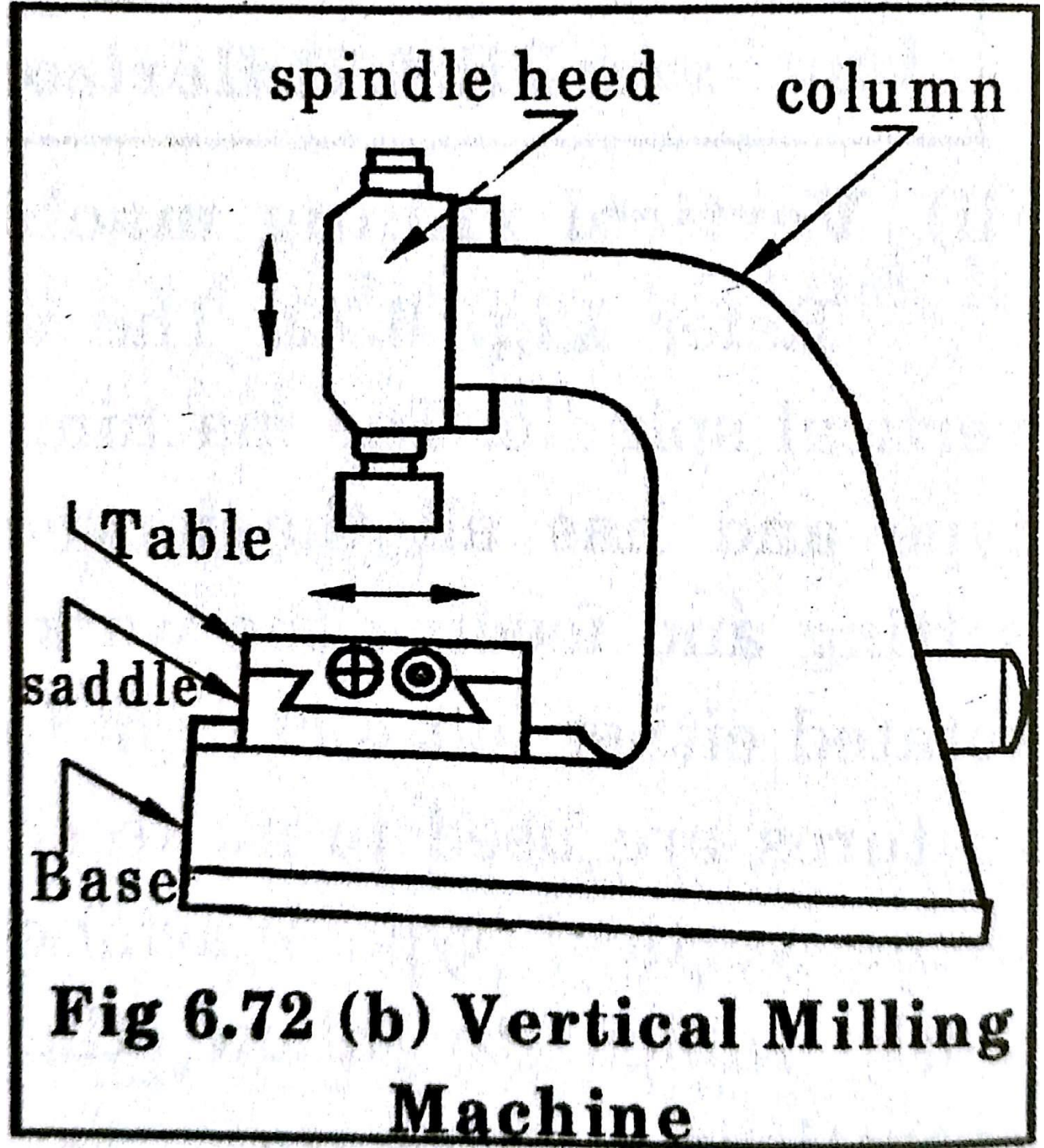
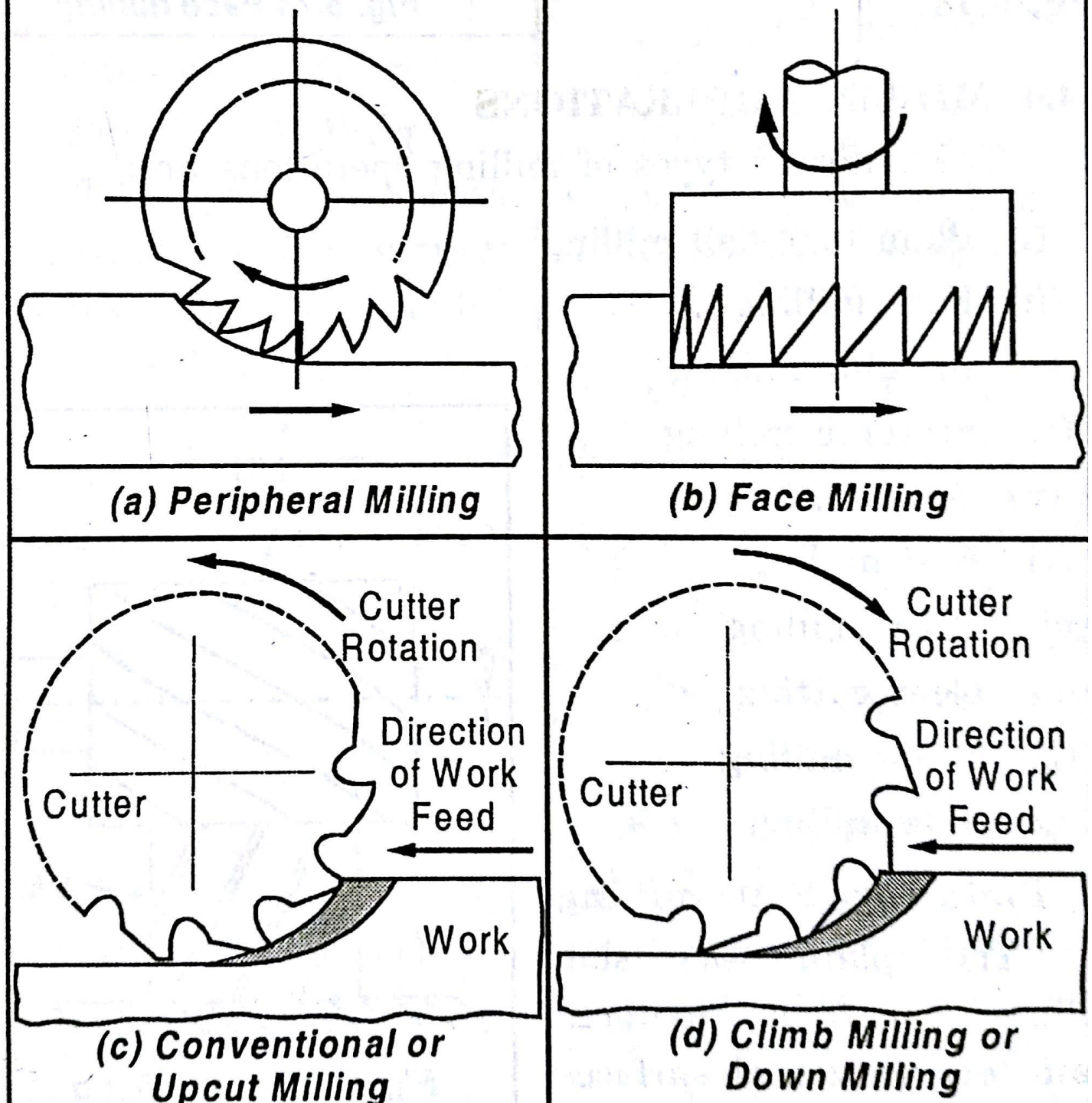


Fig 6.72 (b) Vertical Milling Machine


(a) Peripheral Milling
(b) Face Milling
Cutter Rotation
Direction of Work Feed
Cutter
Work
(c) Conventional or Upcut Milling
Cutter Rotation
Direction of Work Feed
Cutter
Work
(d) Climb Milling or Down Milling

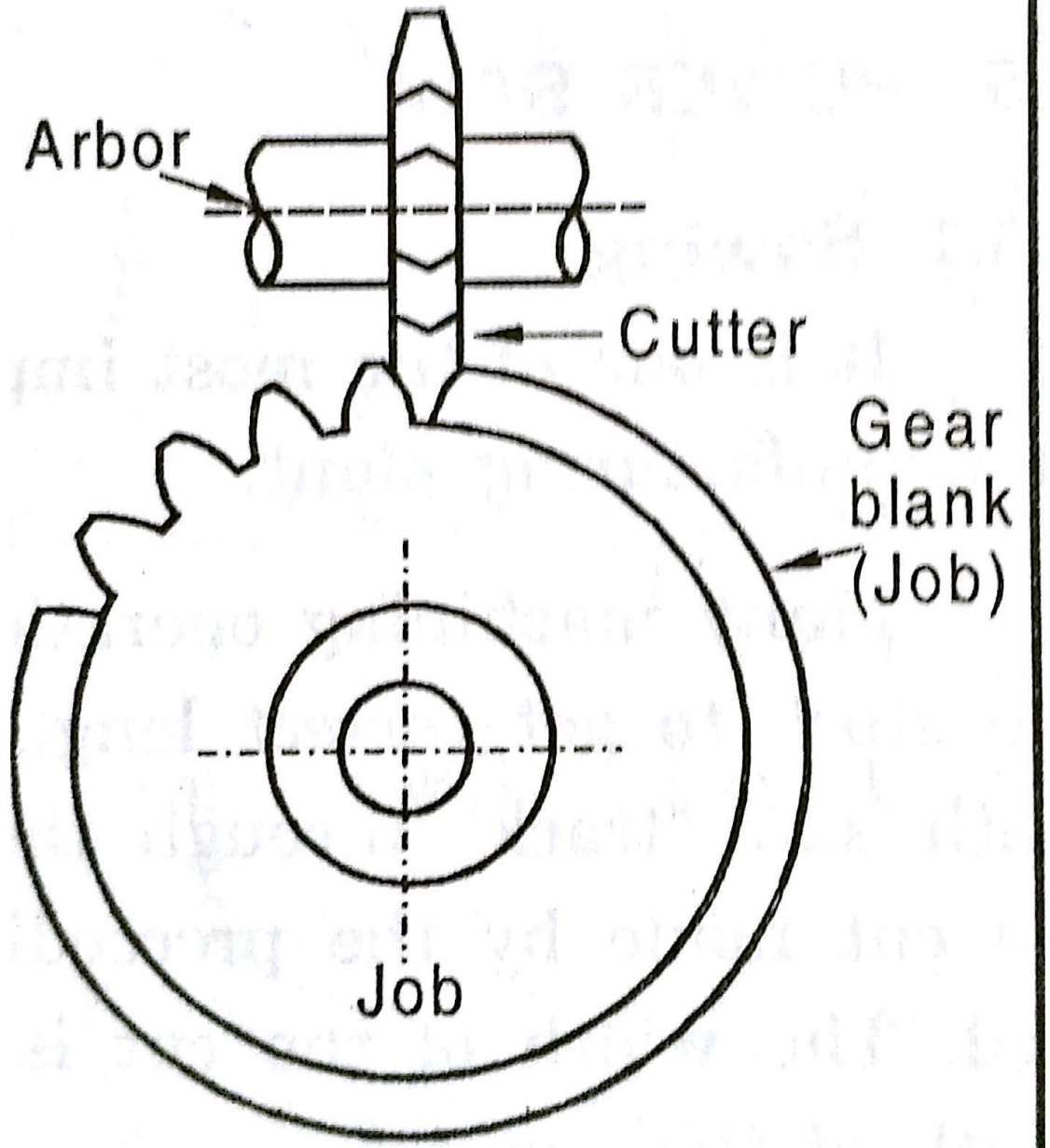
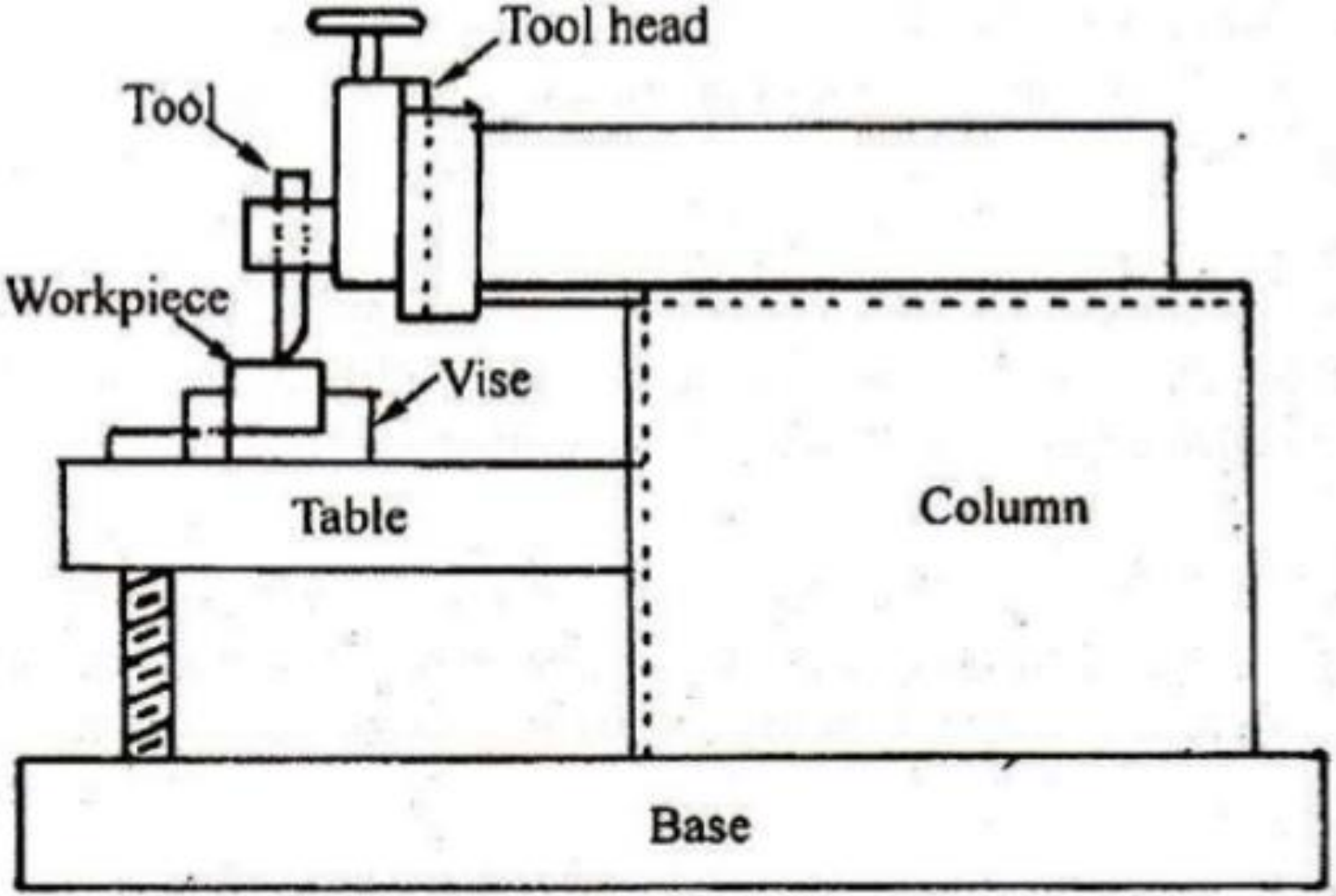
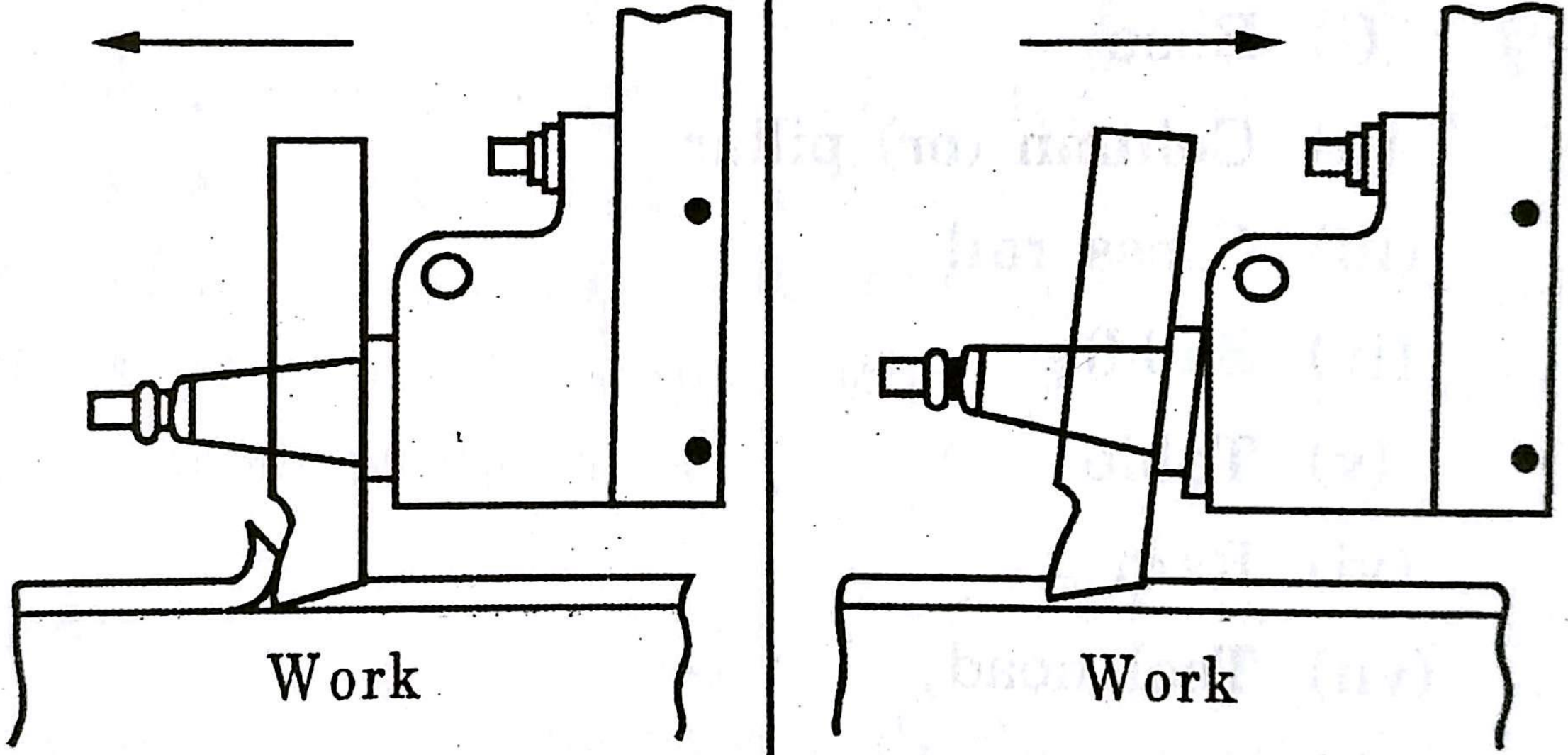


Fig.6.81. Gear cutting

SHAPING MACHINE/SHAPER



Block diagram of shaper



Cutting Stroke **Return Stroke**

Fig. 6.53. Working Principle of a Shaper.

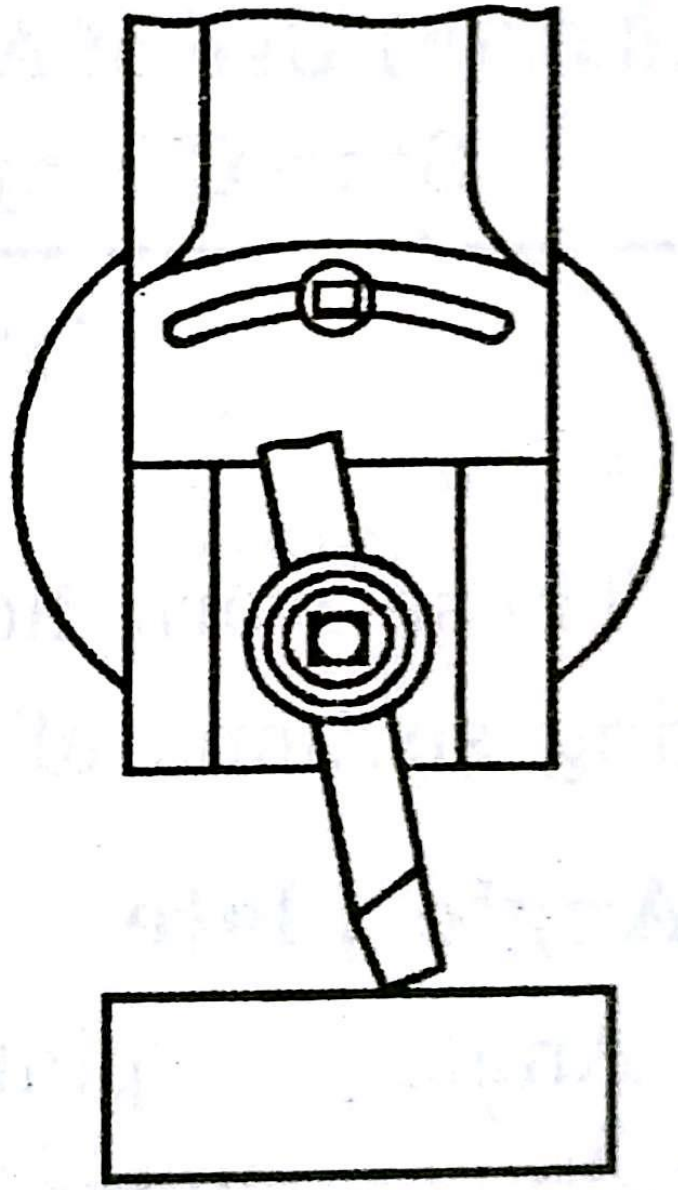
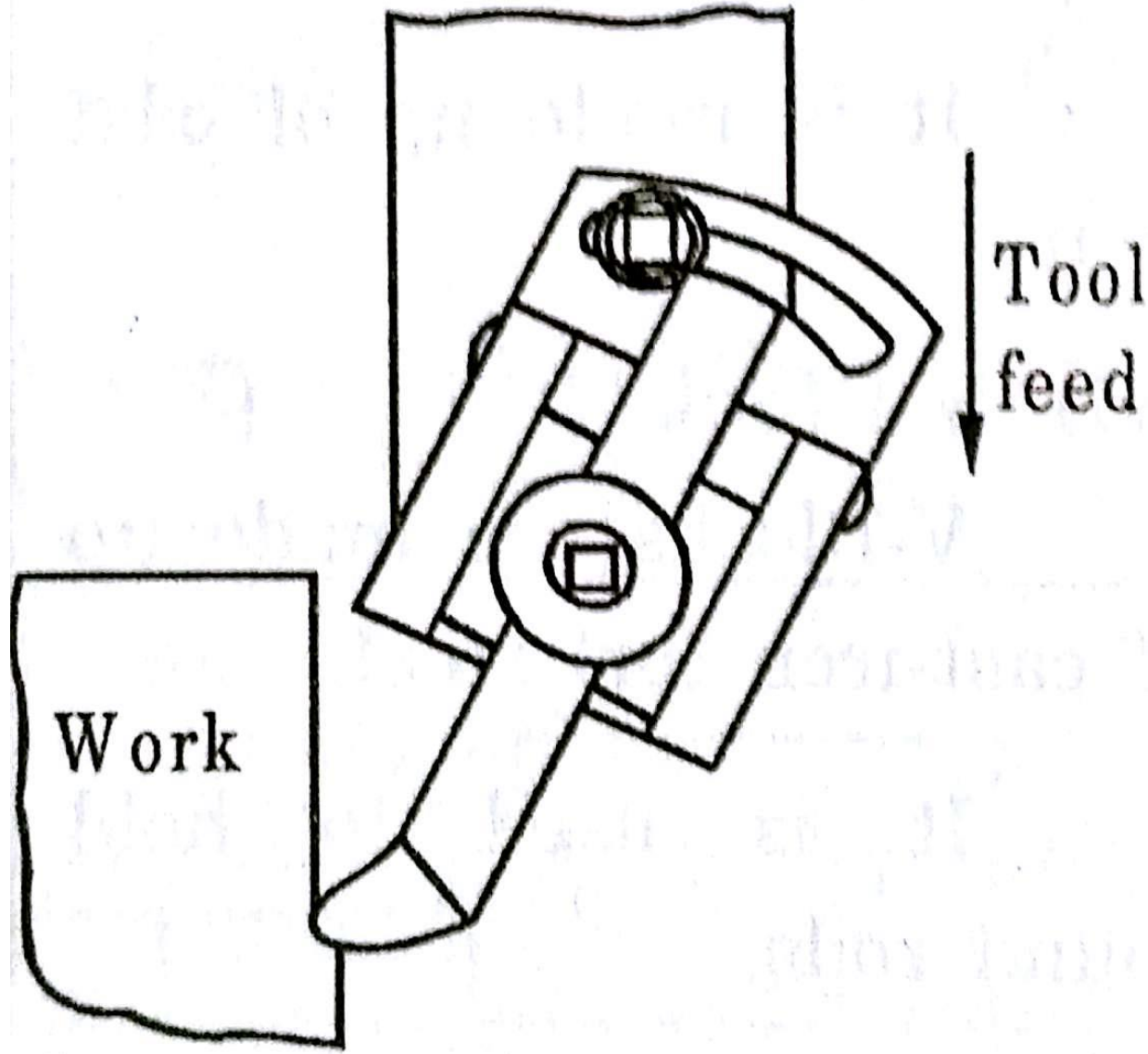


Fig.6.58. Machining Horizontal surface.



Shaping a vertical Surface

Fig.6.59. Vertical Shaping

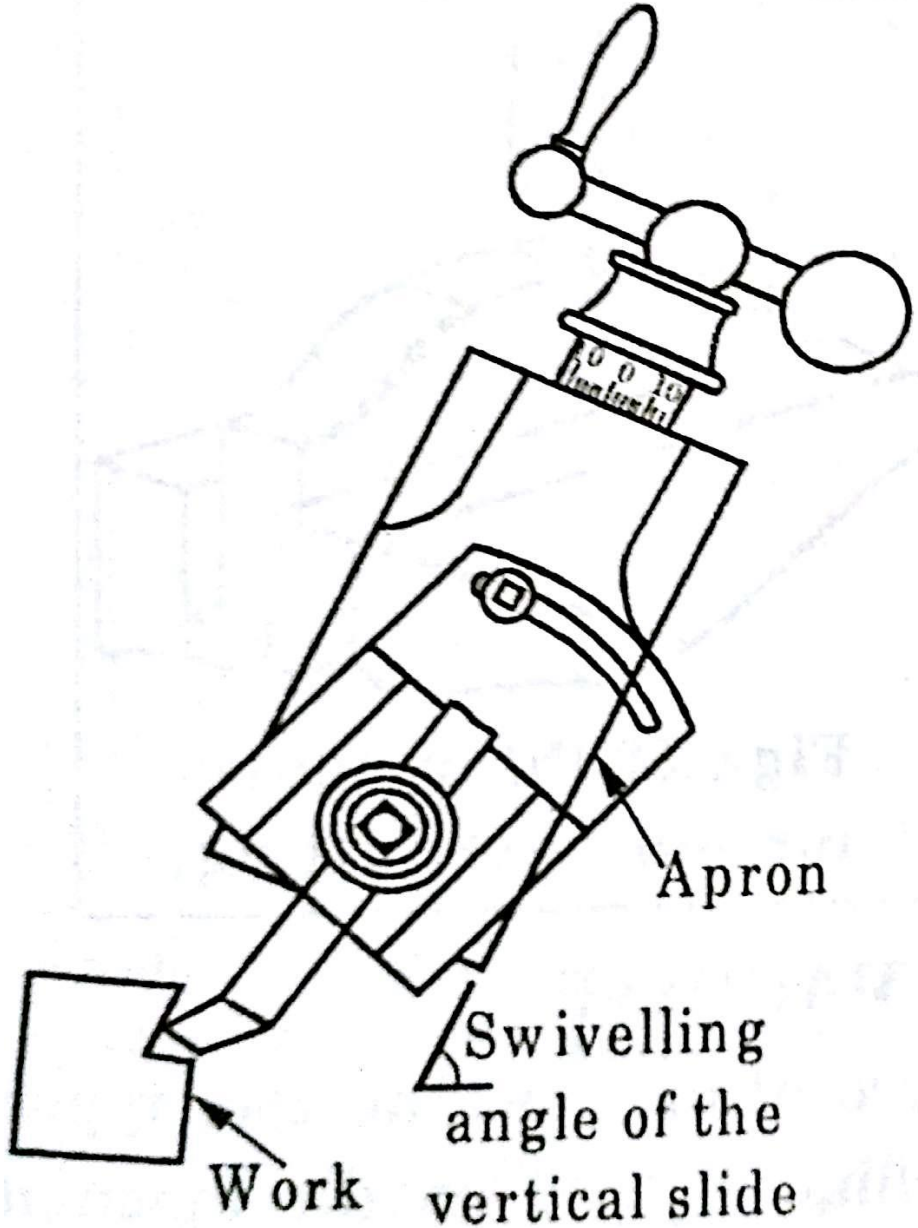
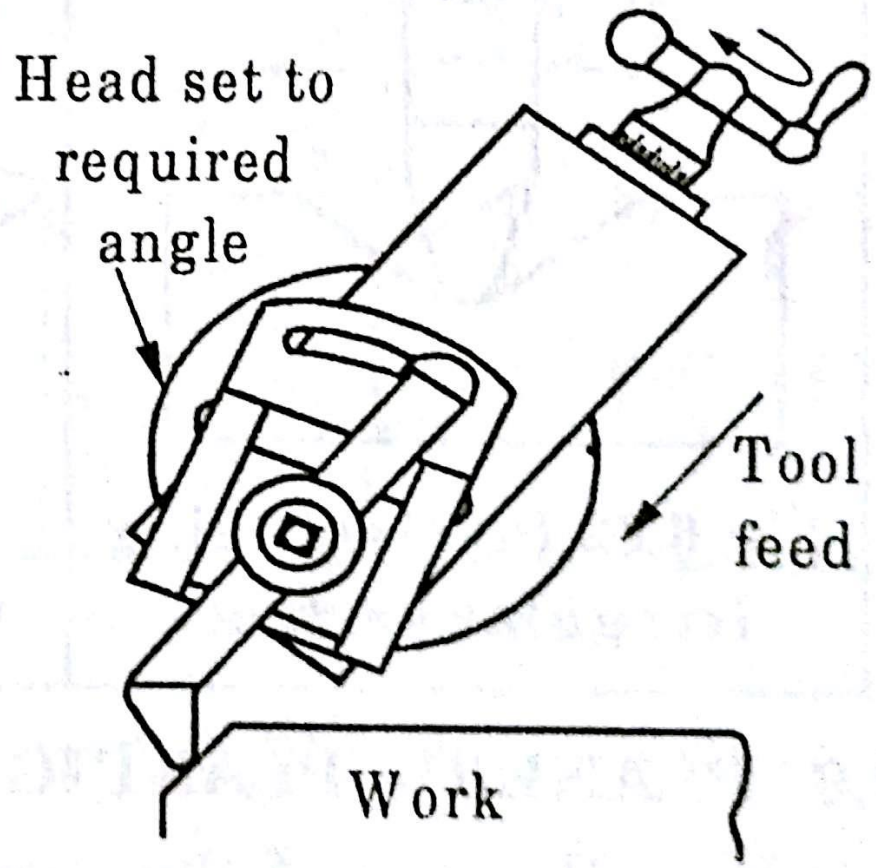


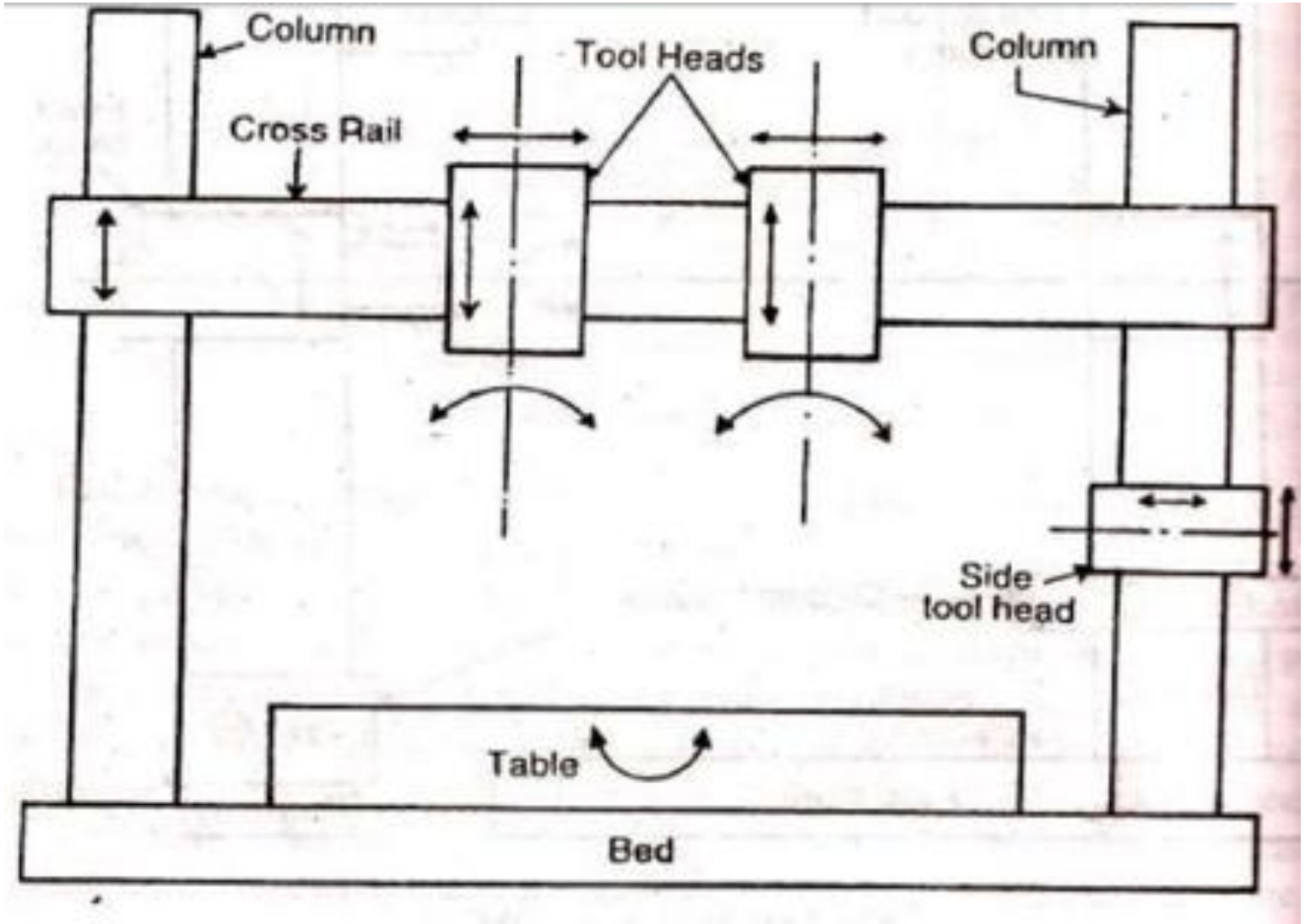
Fig.6.61.(a) Machining Angular surface.

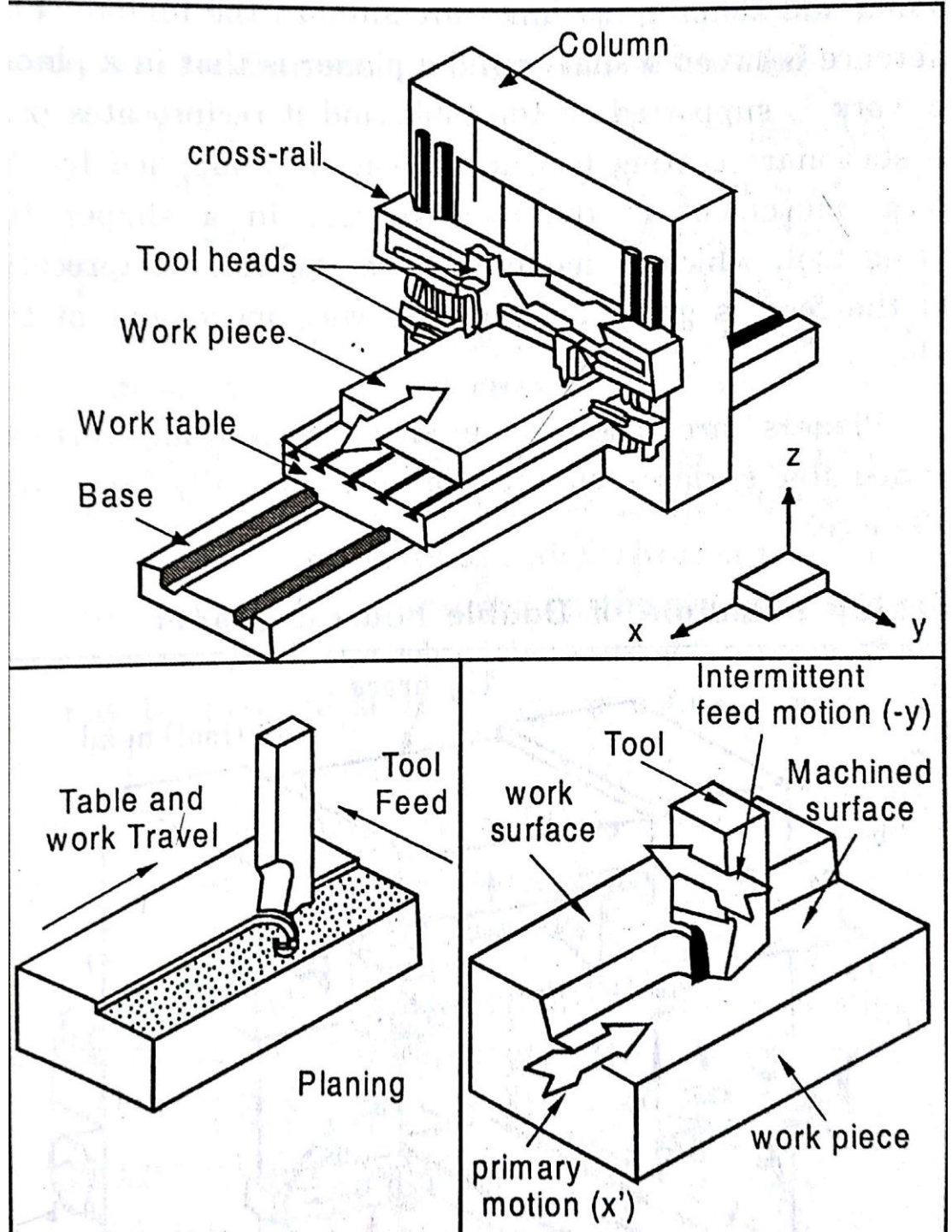


Shaping Angular Faces

Fig.6.61.(b) Angular Shaping.

PLANER MACHINE



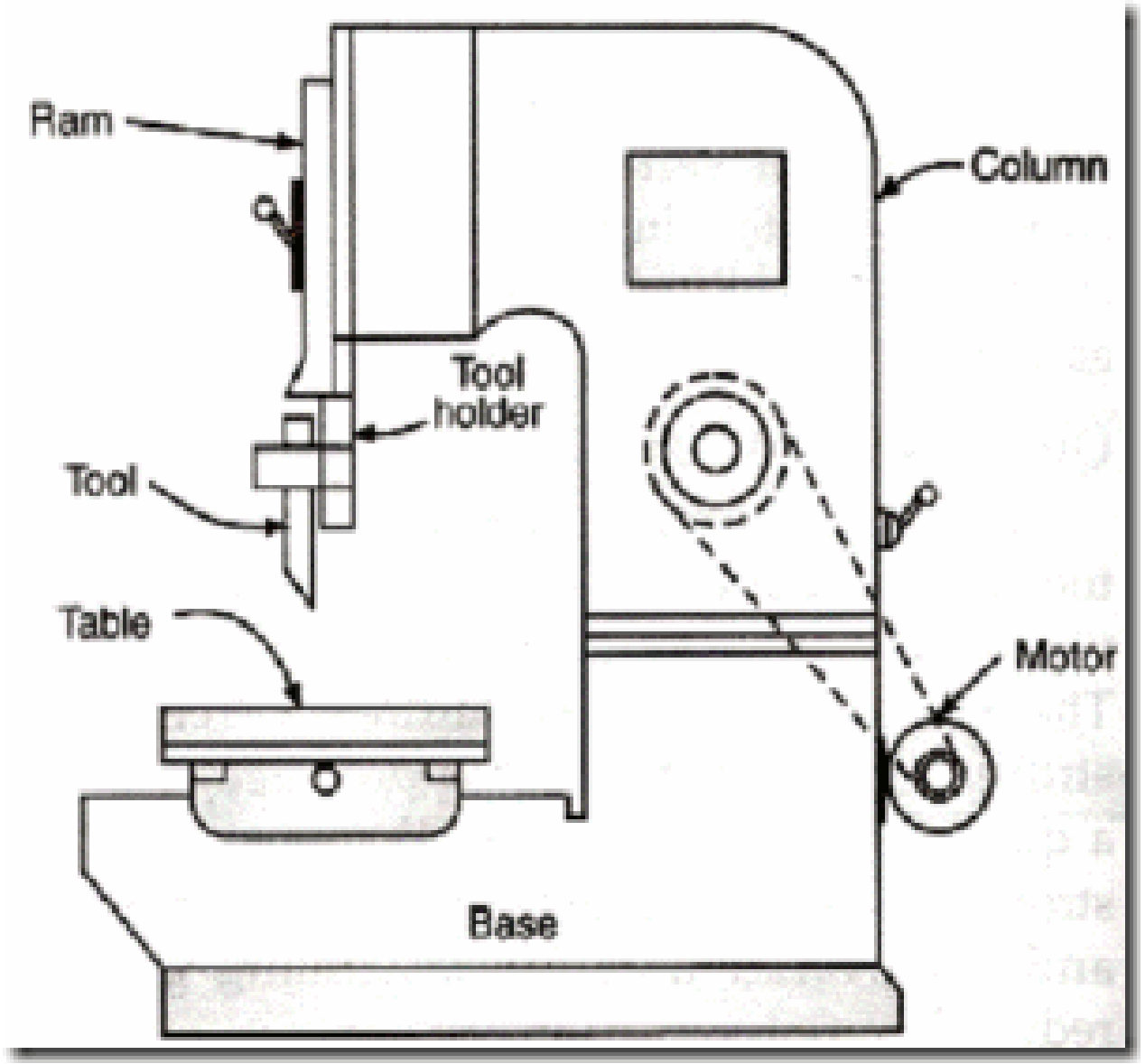

Column
cross-rail
Tool heads
Work piece
Work table
Base
z
x
y
Table and
work Travel
Tool
Feed
Planing
Intermittent
feed motion (-y)
Tool
Machined
surface
work
surface
work piece
primary
motion (x')

Difference between shaper and planer

Sl.No.	Shaper	Planer
1.	The cutting tool reciprocates and the work is stationary.	The workpiece reciprocates and the tool is stationary.
2.	It is used only for machining medium and small workpieces.	It is used for machining large and heavy workpieces

Sl.No.	Shaper	Planer
3.	Less Accuracy	More accuracy
4.	Production time is less.	Production time is more
5.	Workpiece setting is very easy.	Workpiece setting is very difficult

SLOTTING MACHINE/SLOTTER



Slotting machine is a reciprocating machine tool in which, the ram holding the tool reciprocates in a vertical axis and the cutting action of the tool is only during the downward stroke.

Construction: The slotter can be considered as a vertical shaper and its main parts are**:**

1. Base, column and table
2. Ram and tool head assembly
3. Saddle and cross slide
4. Ram drive mechanism and feed mechanism.

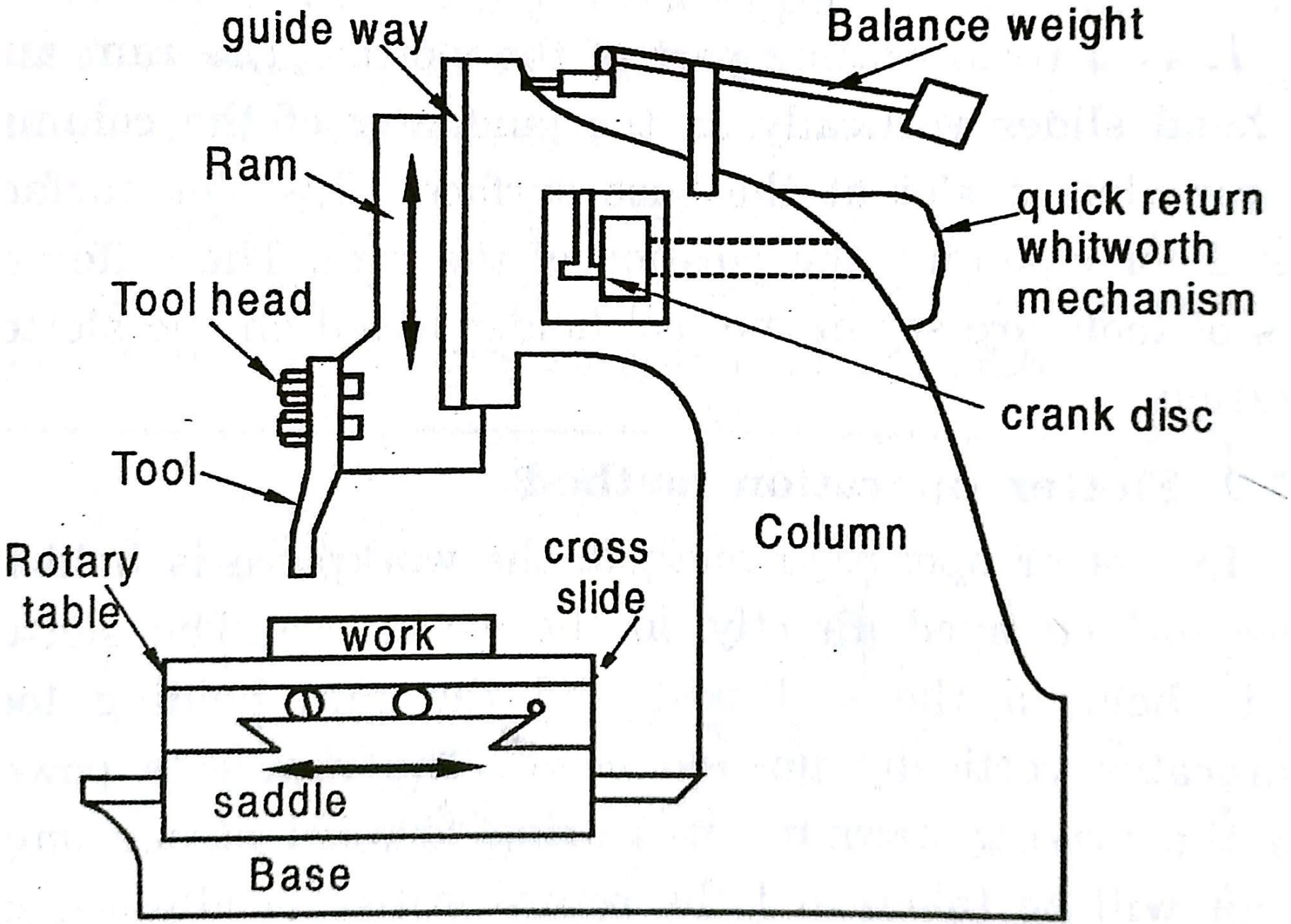
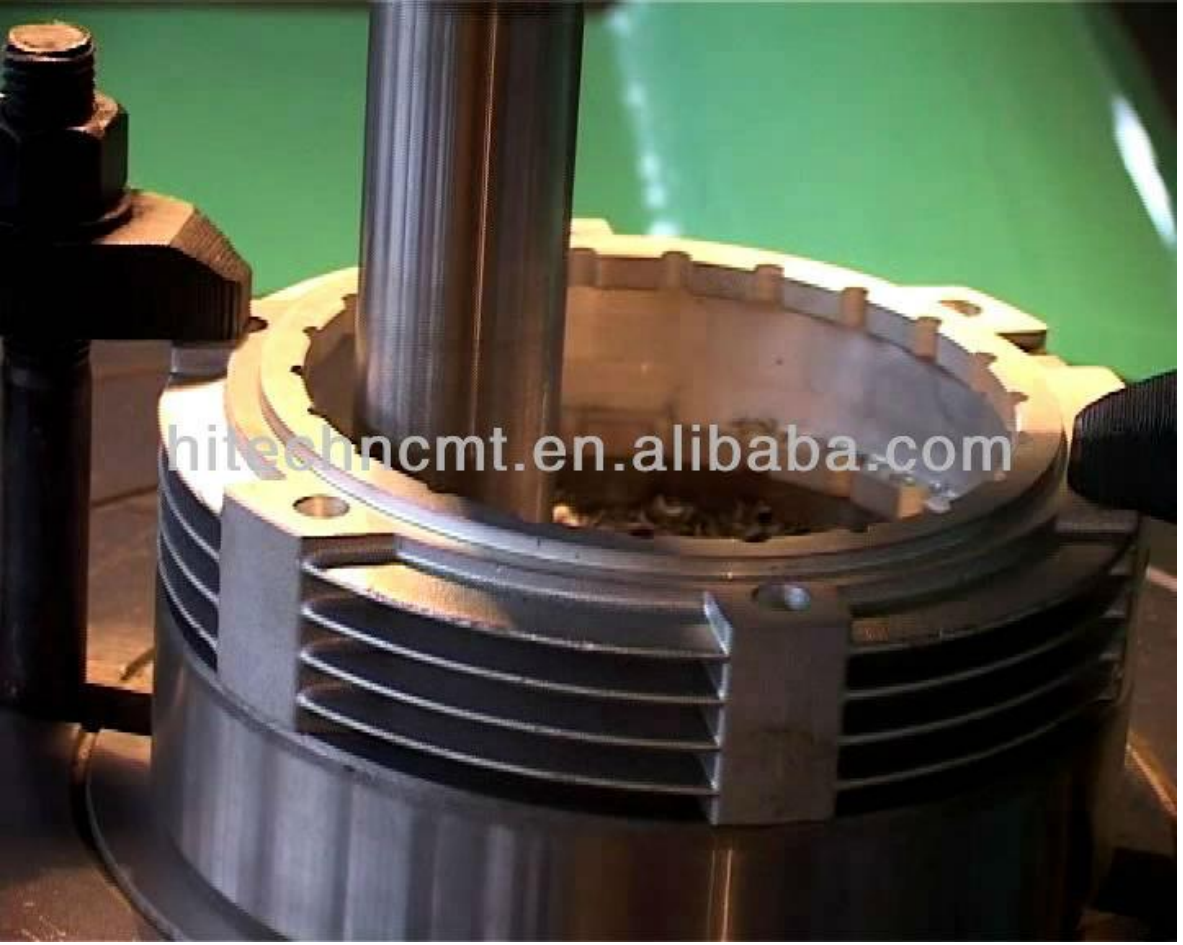


Fig 6.66 Slotter


hitechncmt.en.alibaba.com

- Base of the slotting machine is rigidly built to take up all the cutting forces.
- Front face of the vertical column has guide ways for Tool the reciprocating ram.
- Ram supports the tool head to which the tool is attached.
- Workpiece is mounted on the table which can be given longitudinal, cross and rotary feed motion.

Slotting machine is used for cutting grooves, keys and slotes of various shapes making regular and irregular surfaces both internal and external cutting internal and external gears and profiles.

Slotter machine can be used on any type of work where vertical tool movement is considered essential and advantageous.

Different types of slotting machines are:

1. **Punch slotter**: a heavy duty rigid machine designed for removing large amount of metal from large forgings or castings

2. **Tool room slotter**: a heavy machine which is designed to operate at high speeds. This machine takes light cuts and gives accurate finishing.

3. **Production slotter**: a heavy duty slotter consisting of heavy cast base and heavy frame, and is generally made in two parts.

GRINDING MACHINE

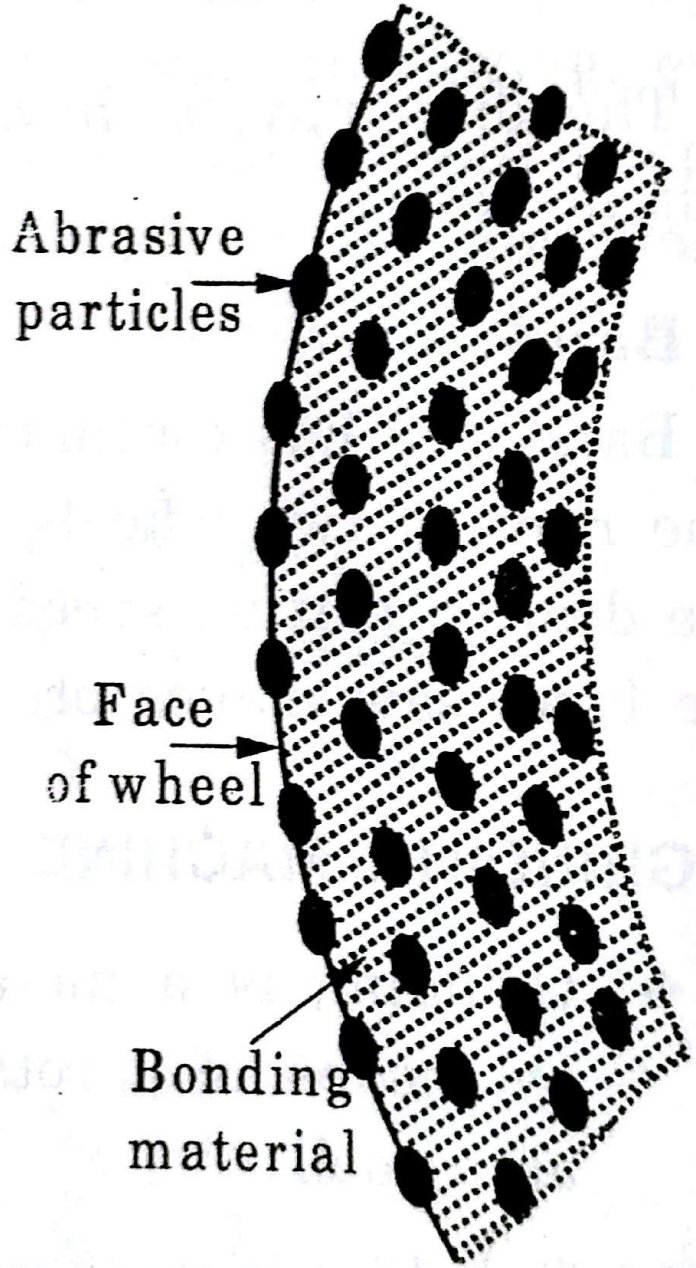
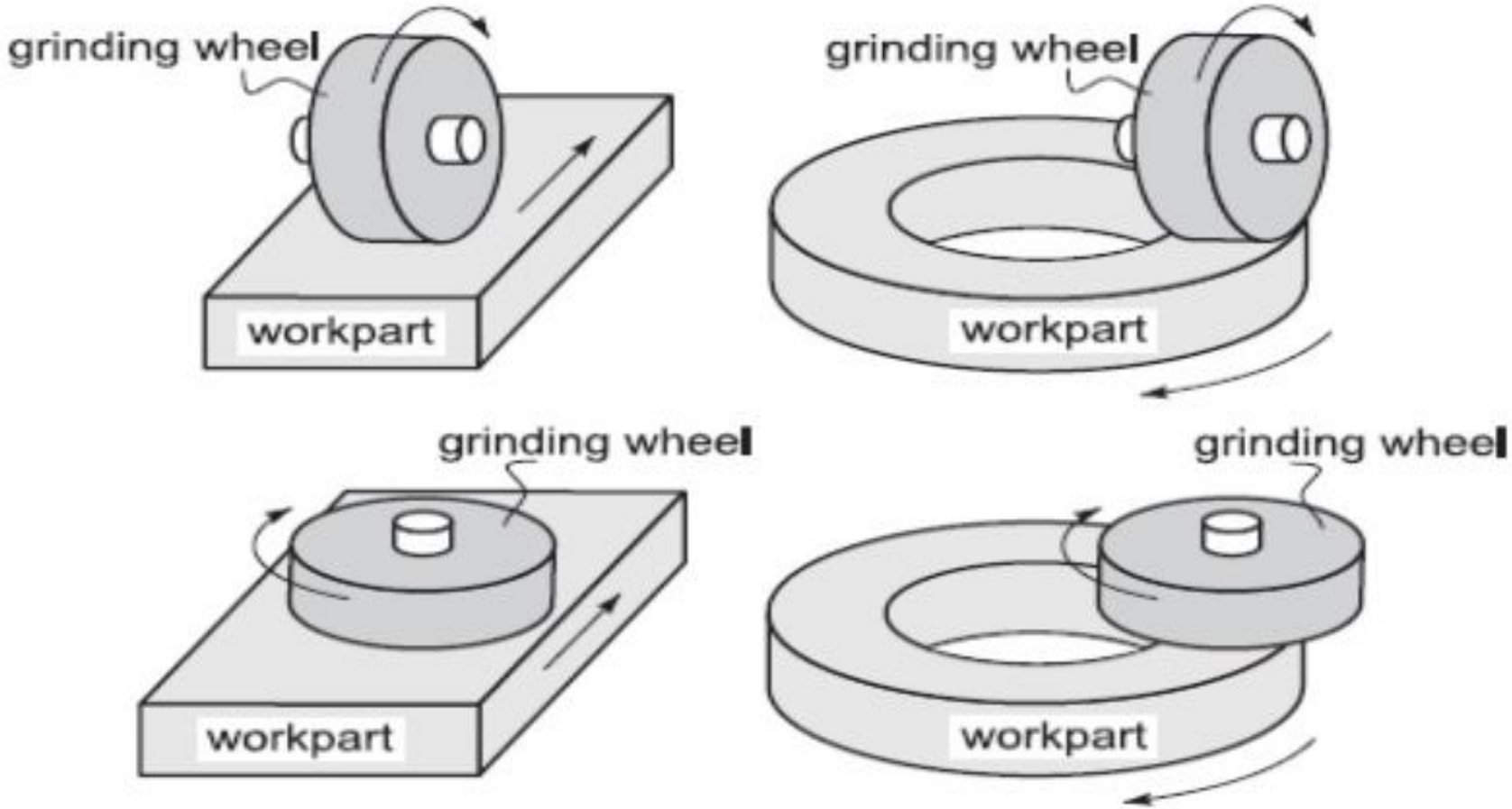
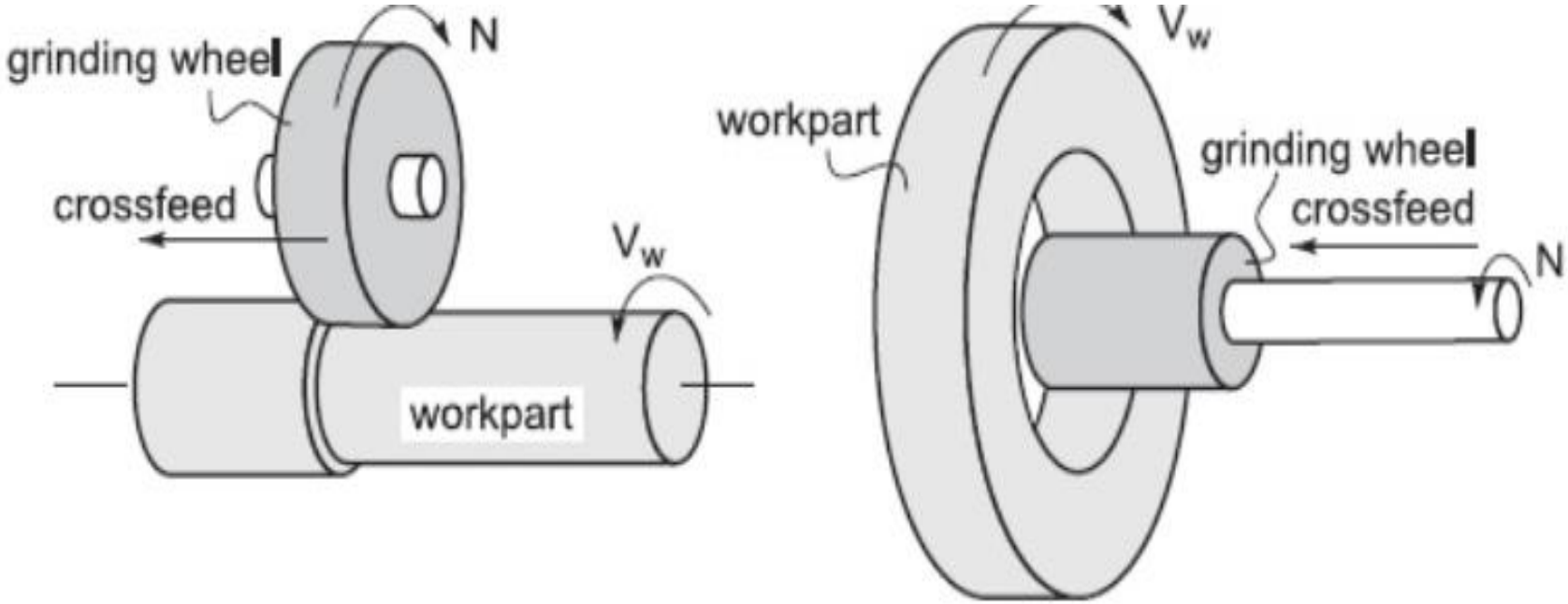


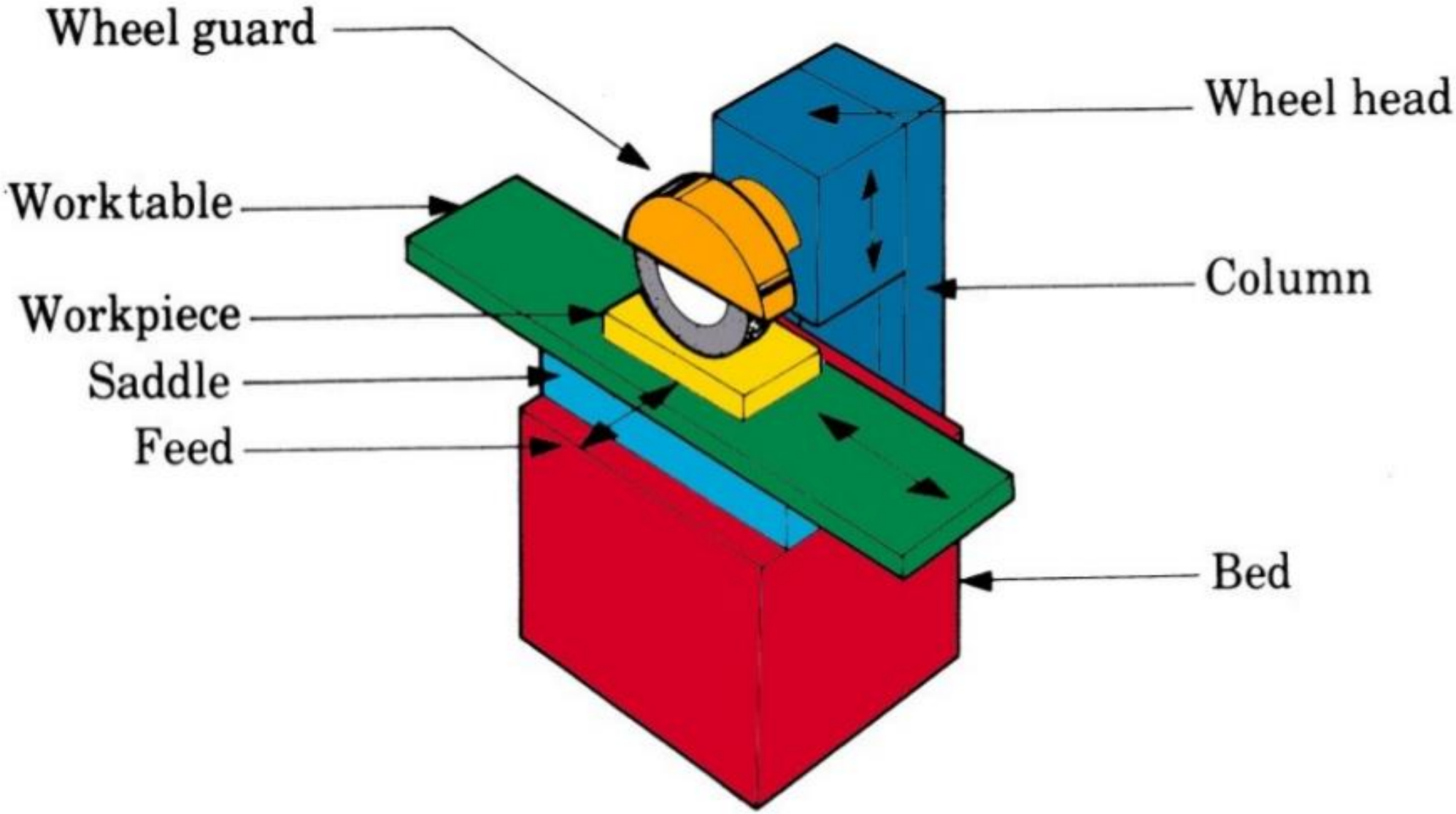
Fig. 6.83. Showing edge of abrasive grains.


grinding wheel
workpart
grinding wheel
workpart
grinding wheel
workpart
grinding wheel
workpart



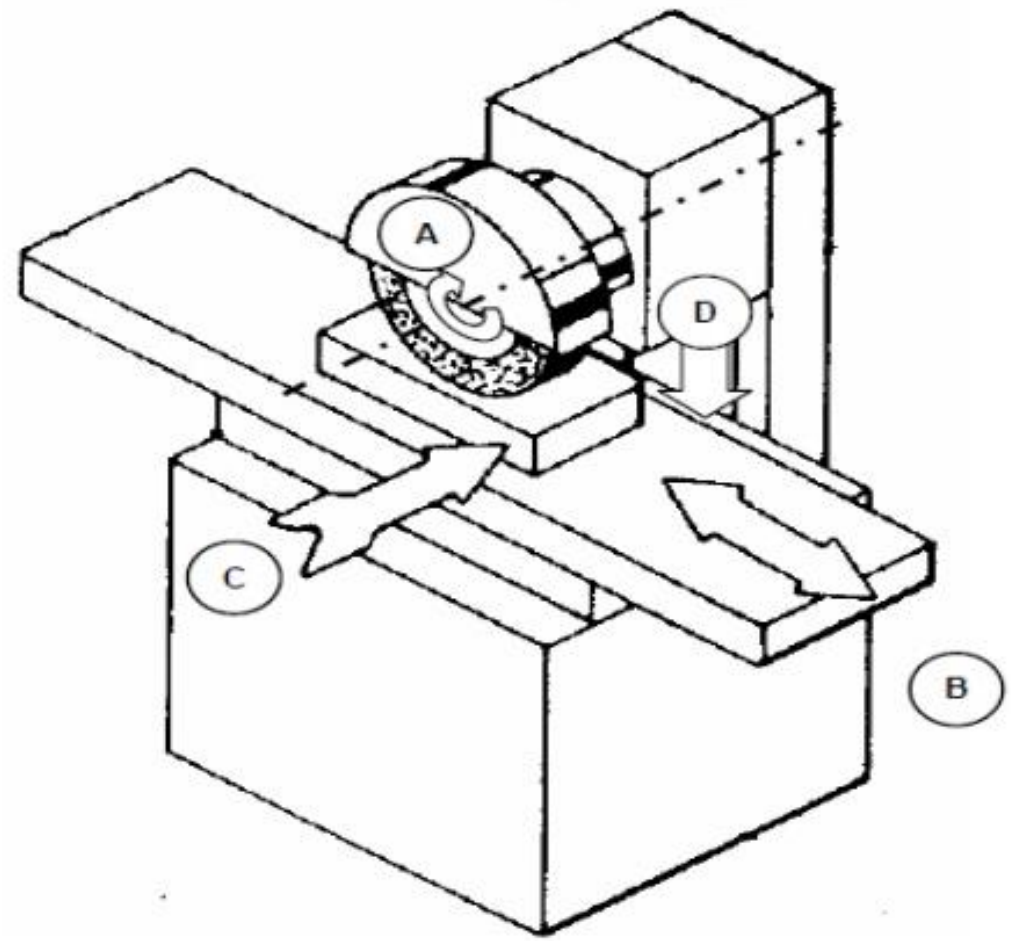
Two types of surface grinding, (*Left*) external, and (*Right*) internal.

Surface grinding machine

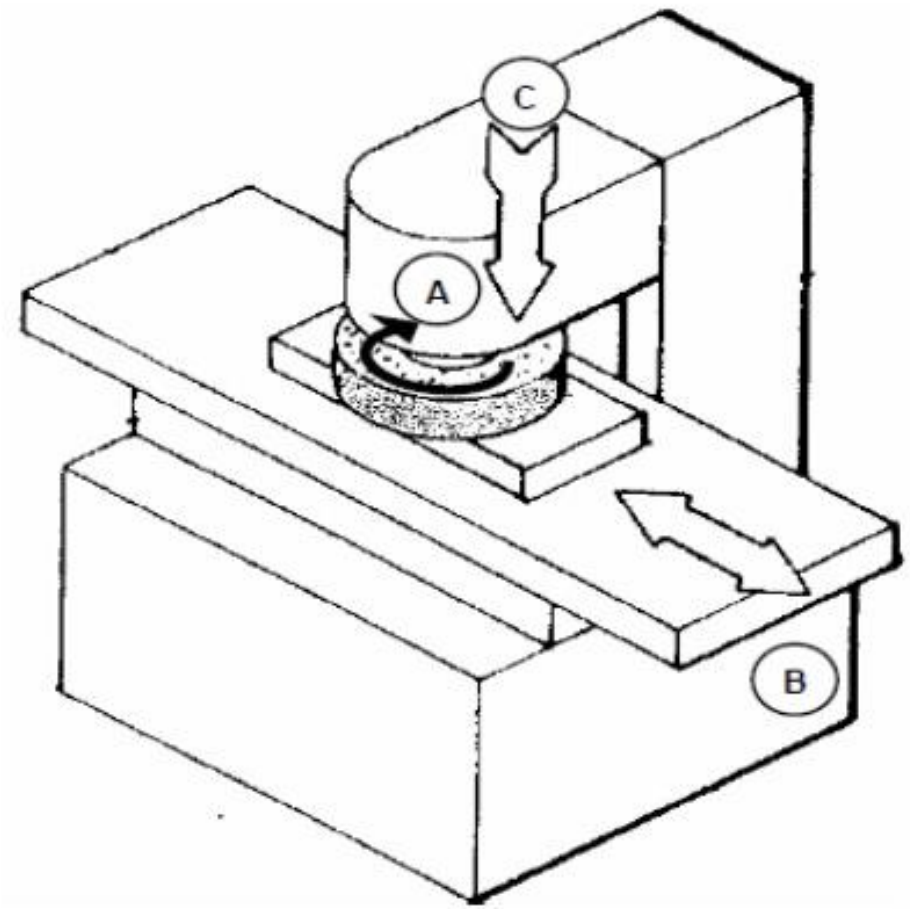


Surface grinding machine

- This machine may be similar to a milling machine used mainly to grind flat surface. However, some types of surface grinders are also capable of producing contour surface with formed grinding wheel.



Horizontal Grinding Machine



Vertical Grinding Machine

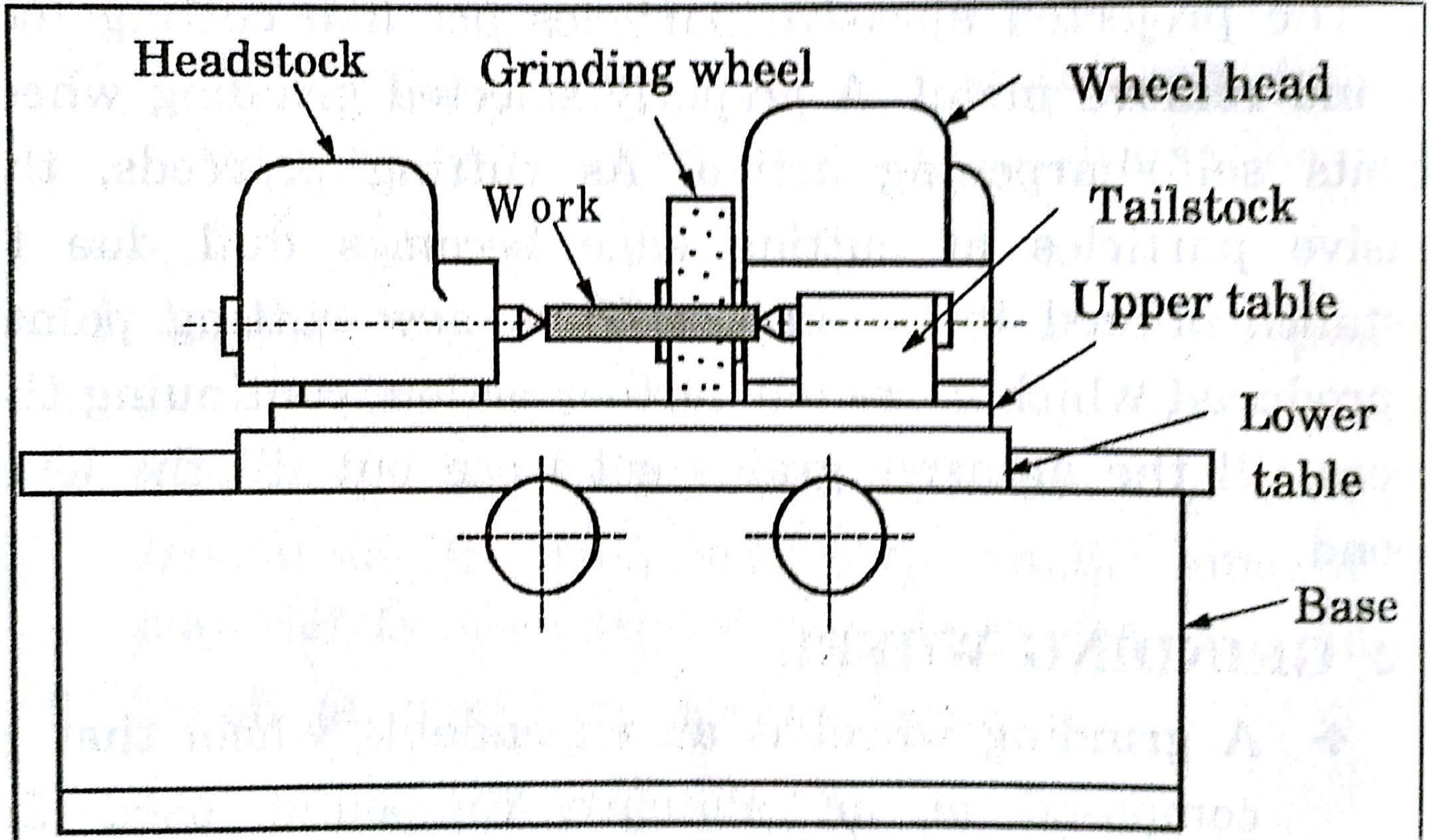


Fig. 6.84. Block Diagram of a plain centre type grinder

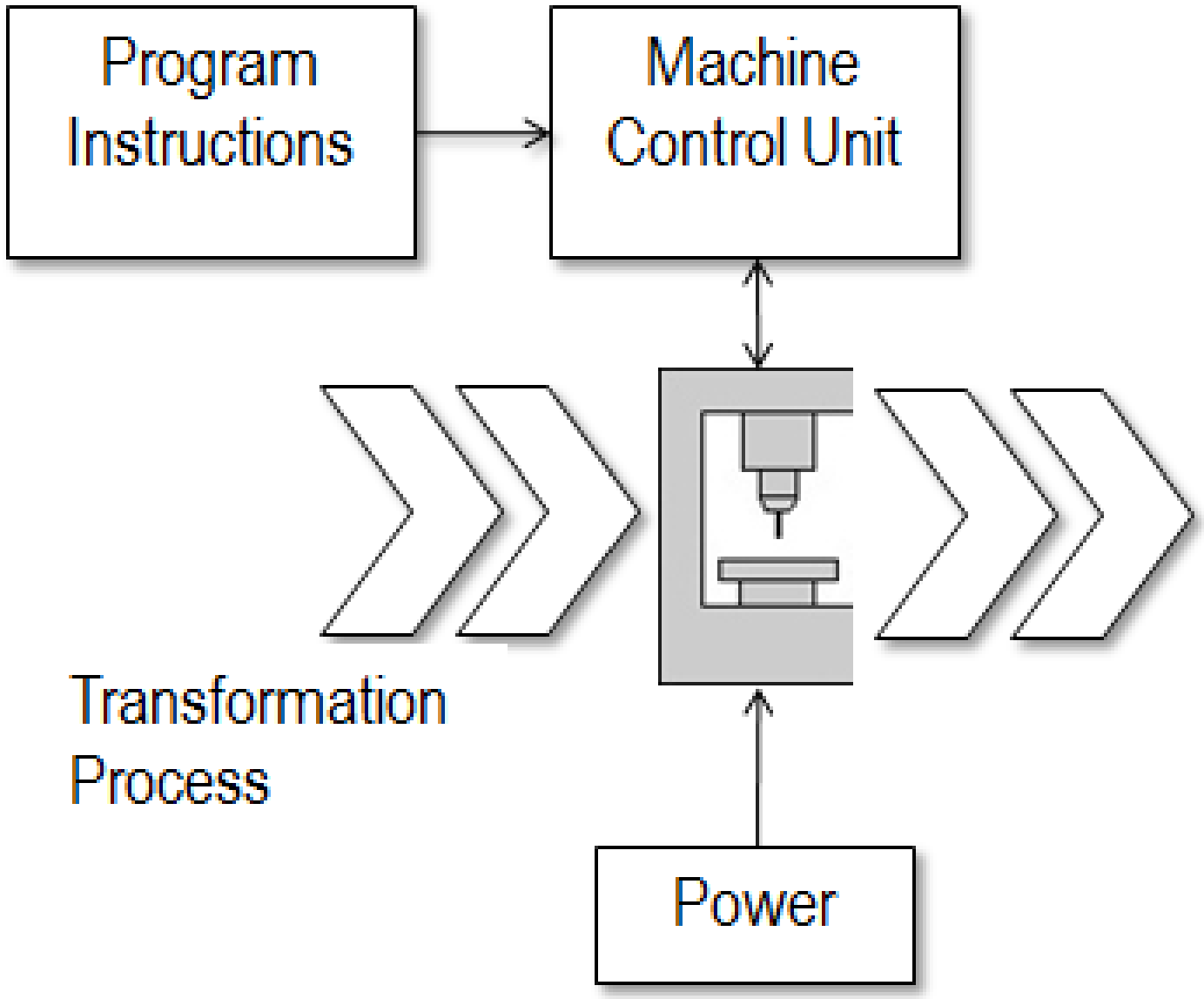
NUMERICAL CONTROL

DEFINITION

Programmable automation in which the mechanical actions of a ‘machine tool’ are controlled by a program containing coded alphanumeric data that represents relative positions between a work head (e.g., cutting tool) and a work part

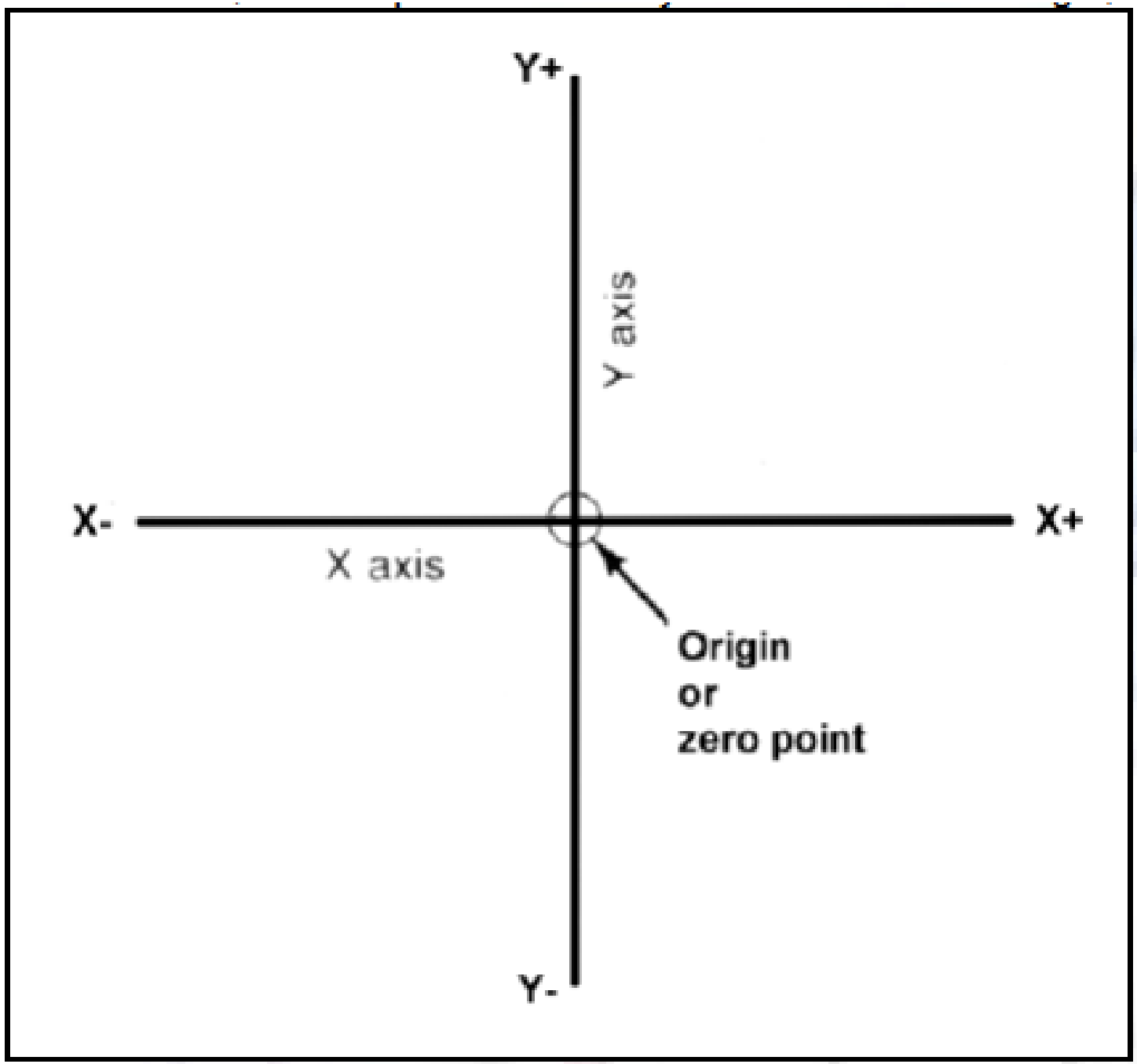
THREE BASIC COMPONENTS OF NC

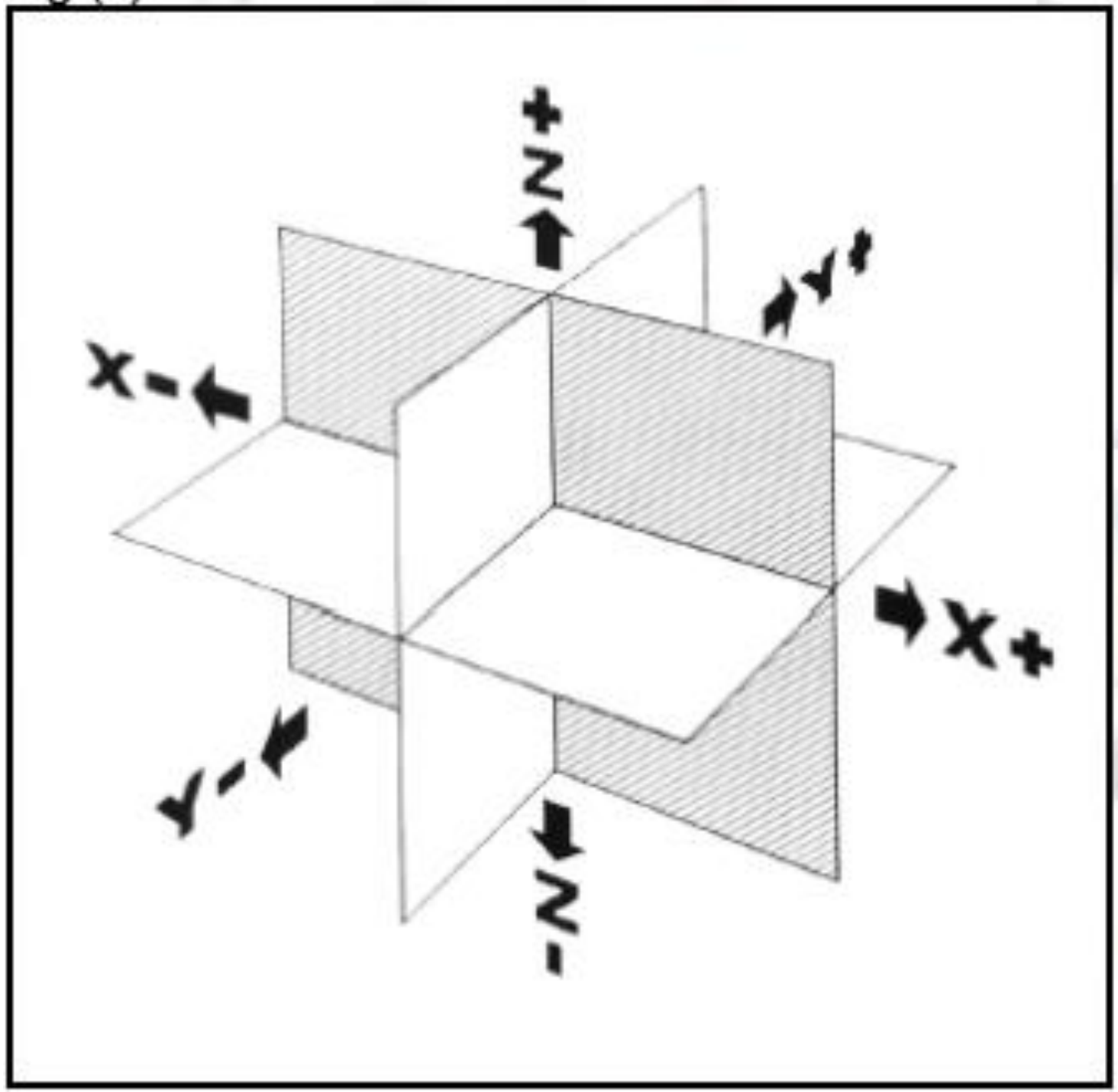
1. INPUT MEDIUM
2. MACHINE CONTROL UNIT
3. MACHINE TOOL

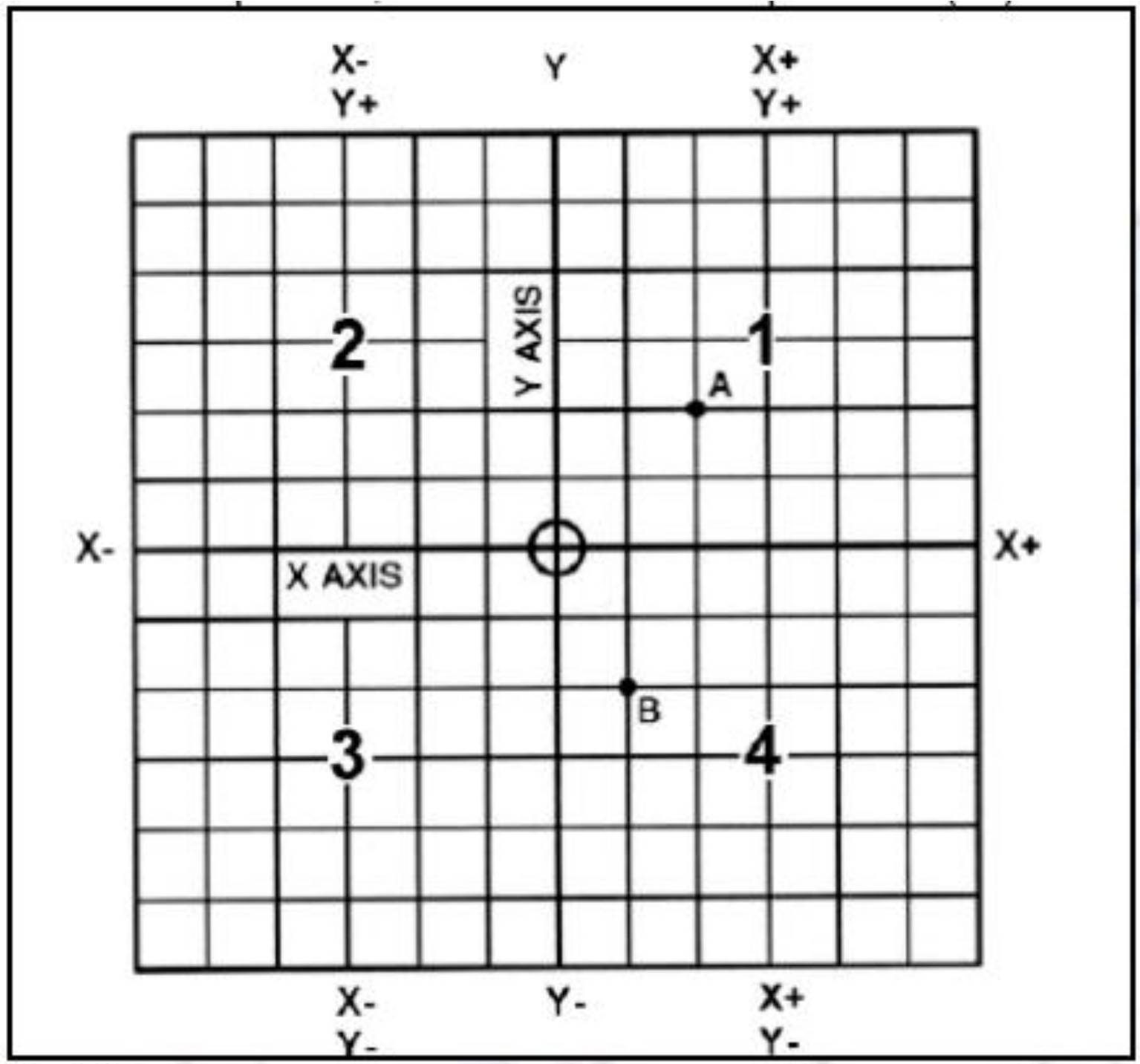

Program Instructions
Machine Control Unit
Transformation Process
Power

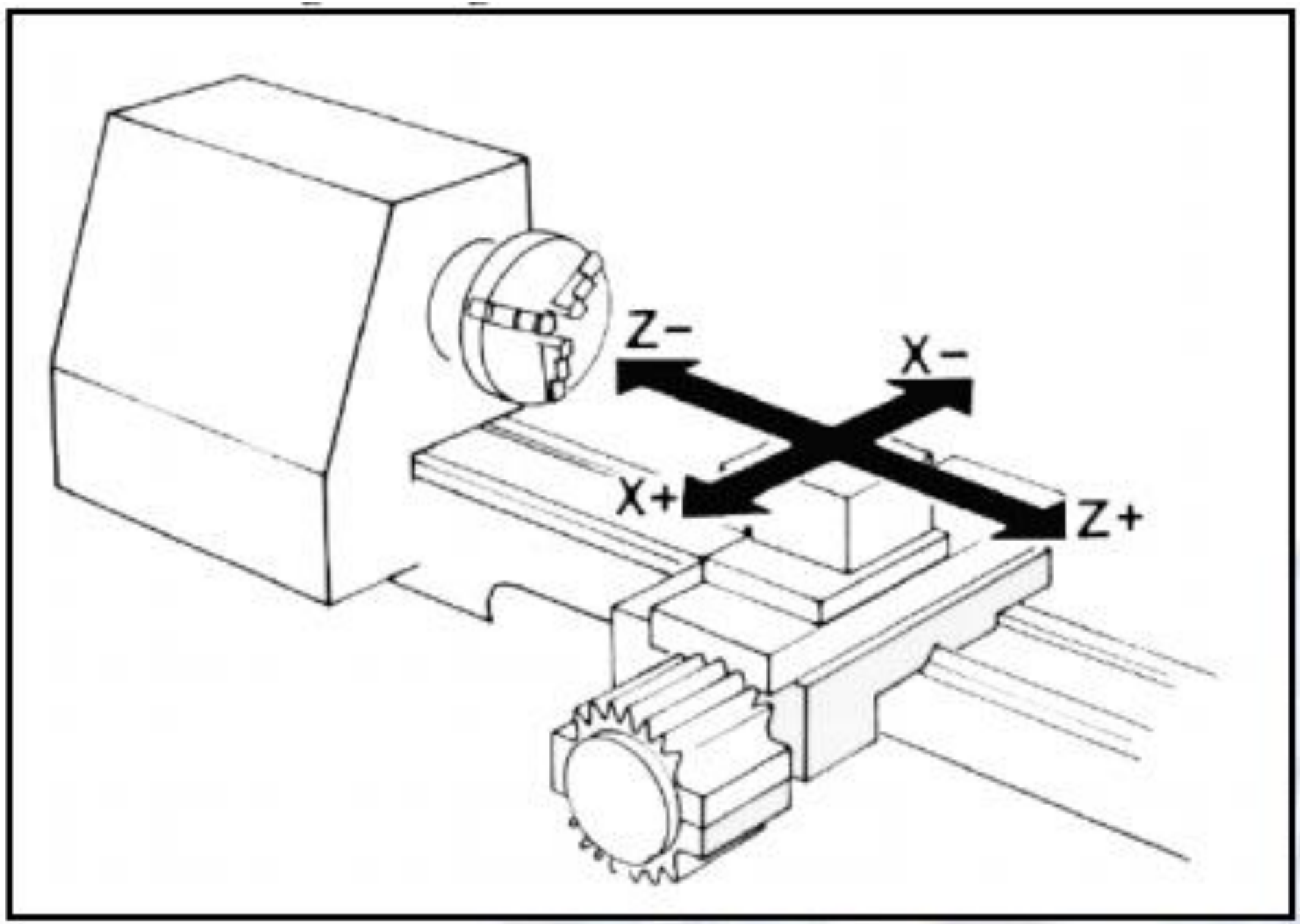
Principle

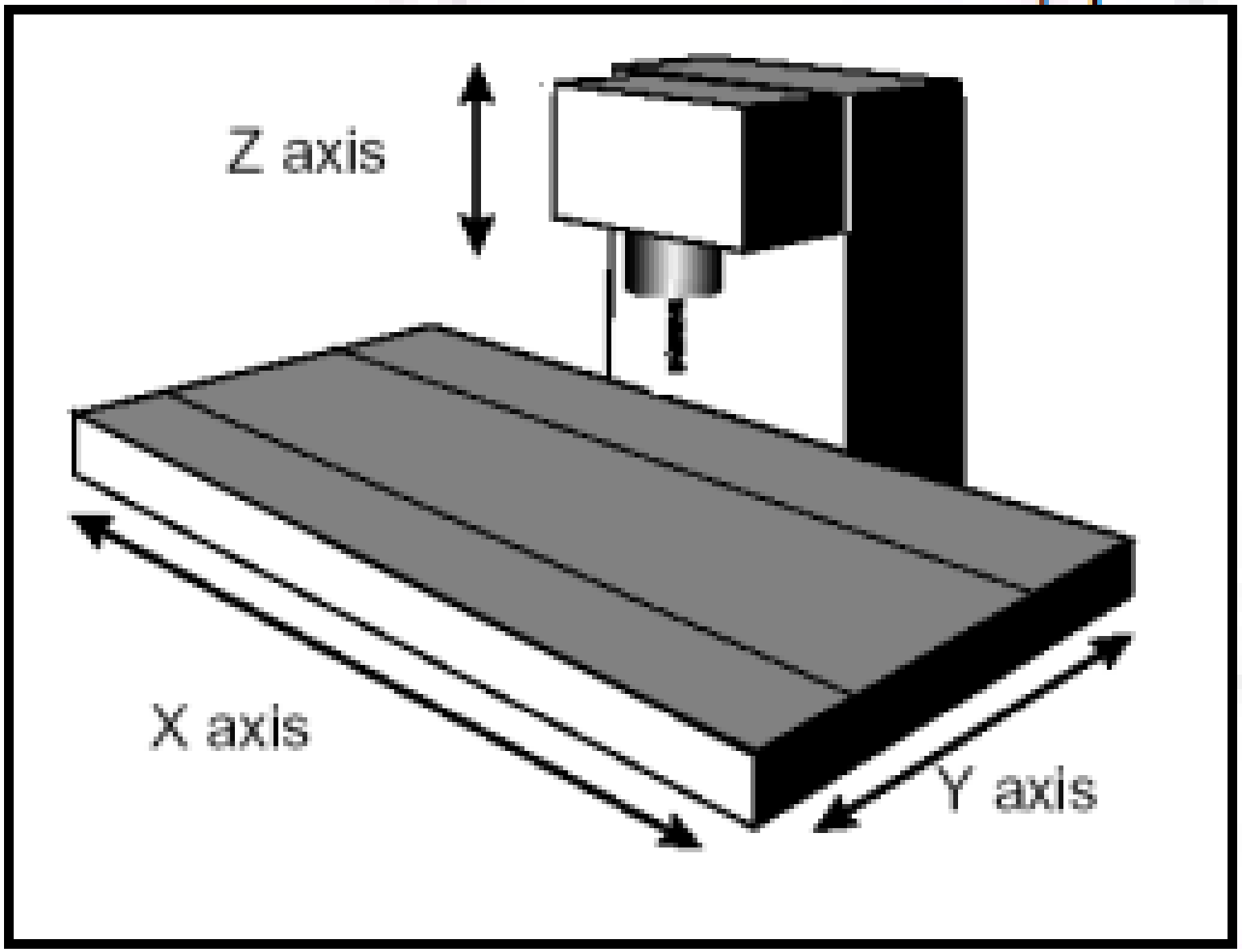
A system in which actions are controlled by direct insertion of numerical data.

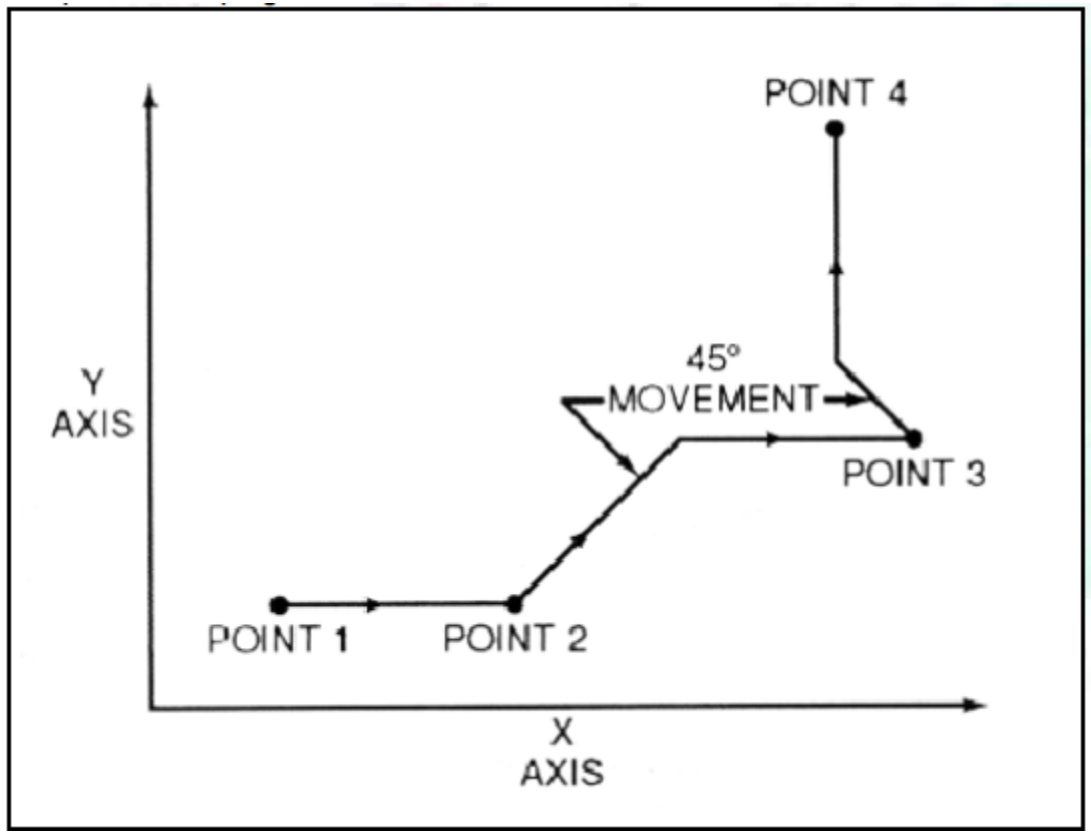

Y+
Y axis
X-
X+
X axis
Origin
or
zero point
Y-


+Z
Y+
X-
X+
Y-
-Z


X-
Y+
Y
X+
Y+
2
1
Y AXIS
A
X-
X+
X AXIS
B
3
4
X-
Y-
Y-
X+
Y-


Z–
X–
X+
Z+

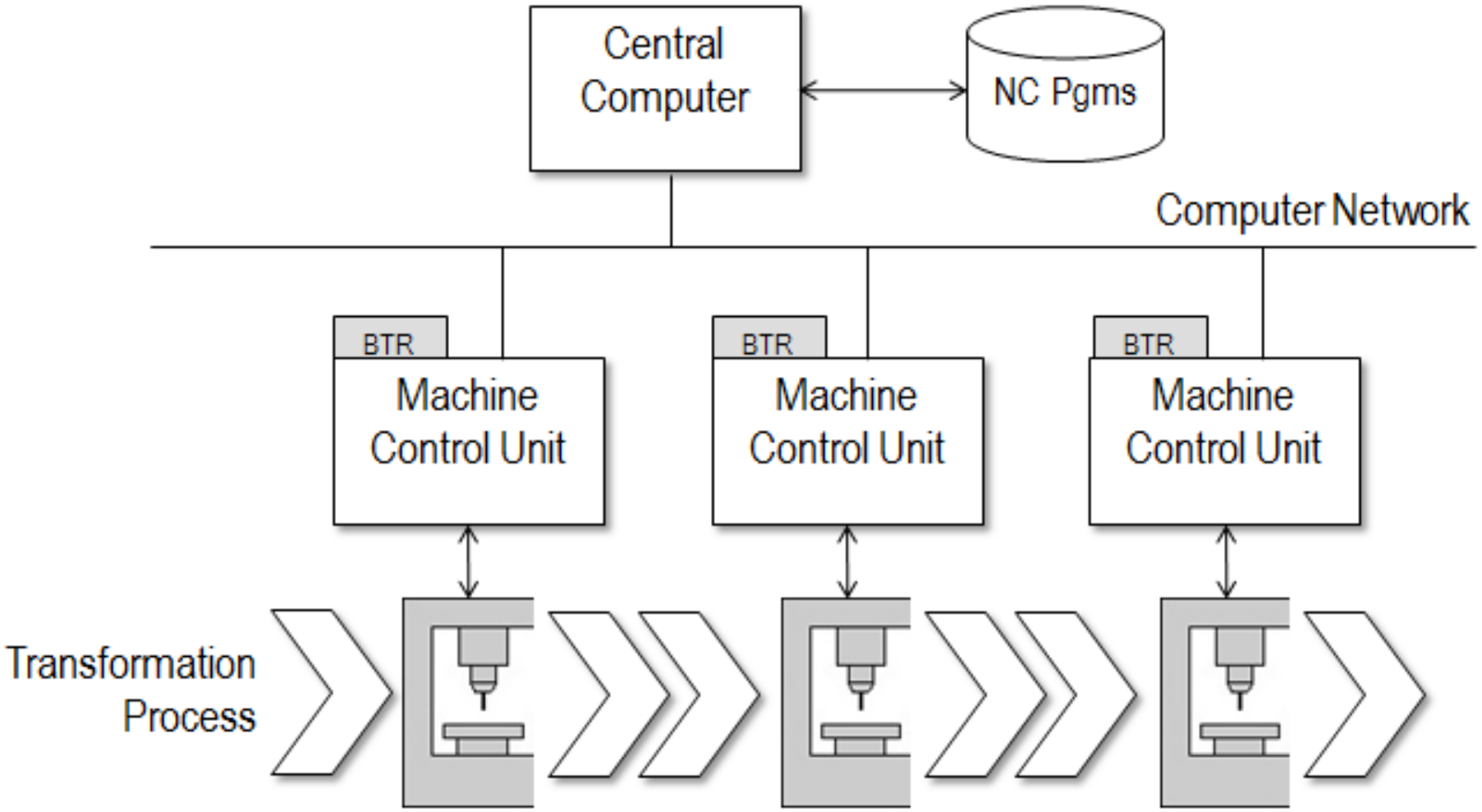

Z axis
X axis
Y axis


POINT 4
45°
MOVEMENT
Y
AXIS
POINT 3
POINT 1
POINT 2
X
AXIS

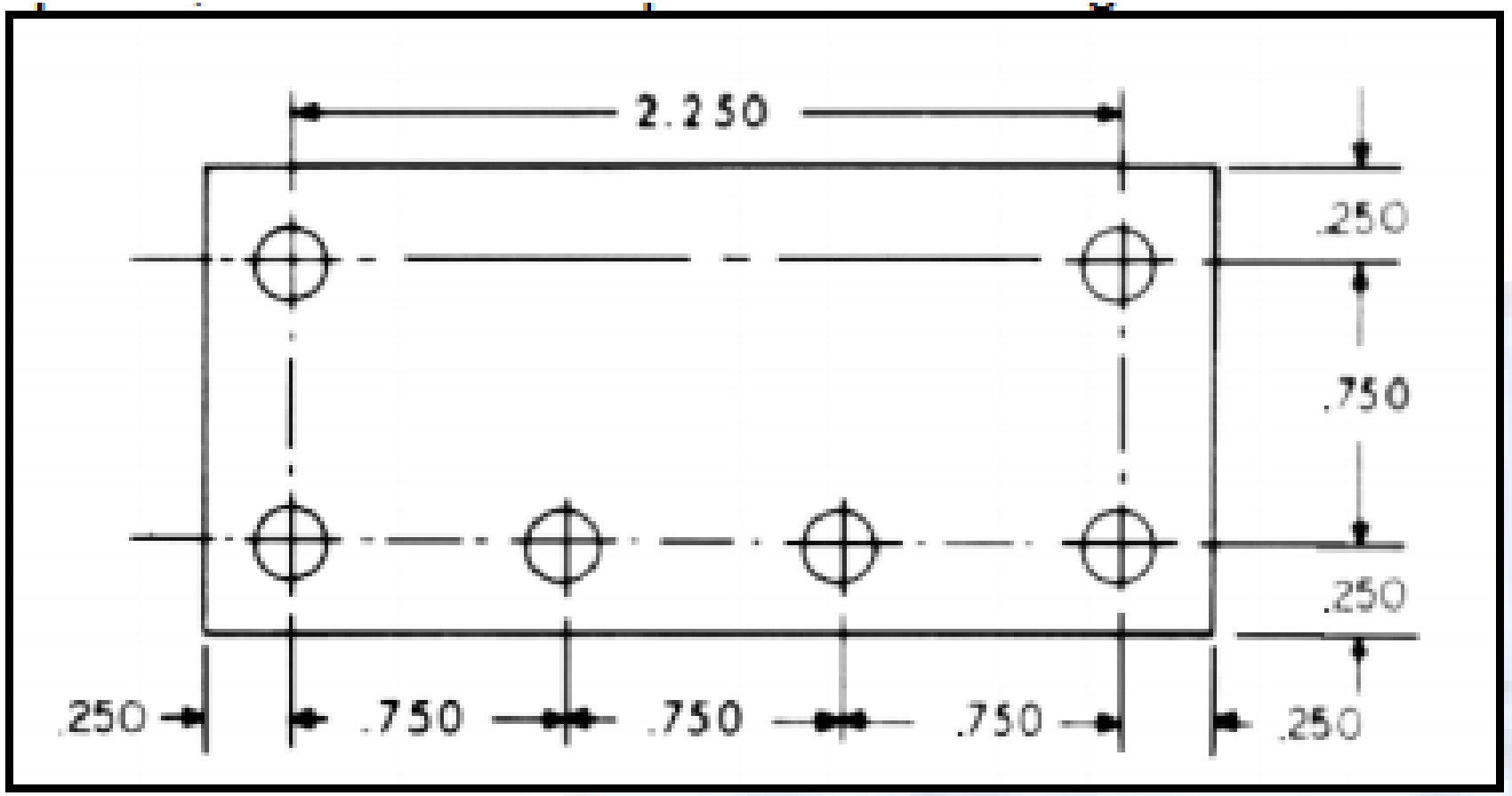
COMPUTER NUMERICAL CONTROL (CNC)

- Storage of more than one part program
- Various forms of program input
- Program editing at the machine tool
- Fixed cycles and programming subroutines
- Interpolation
- Acceleration and deceleration computations
- Communications interface
- Diagnostics

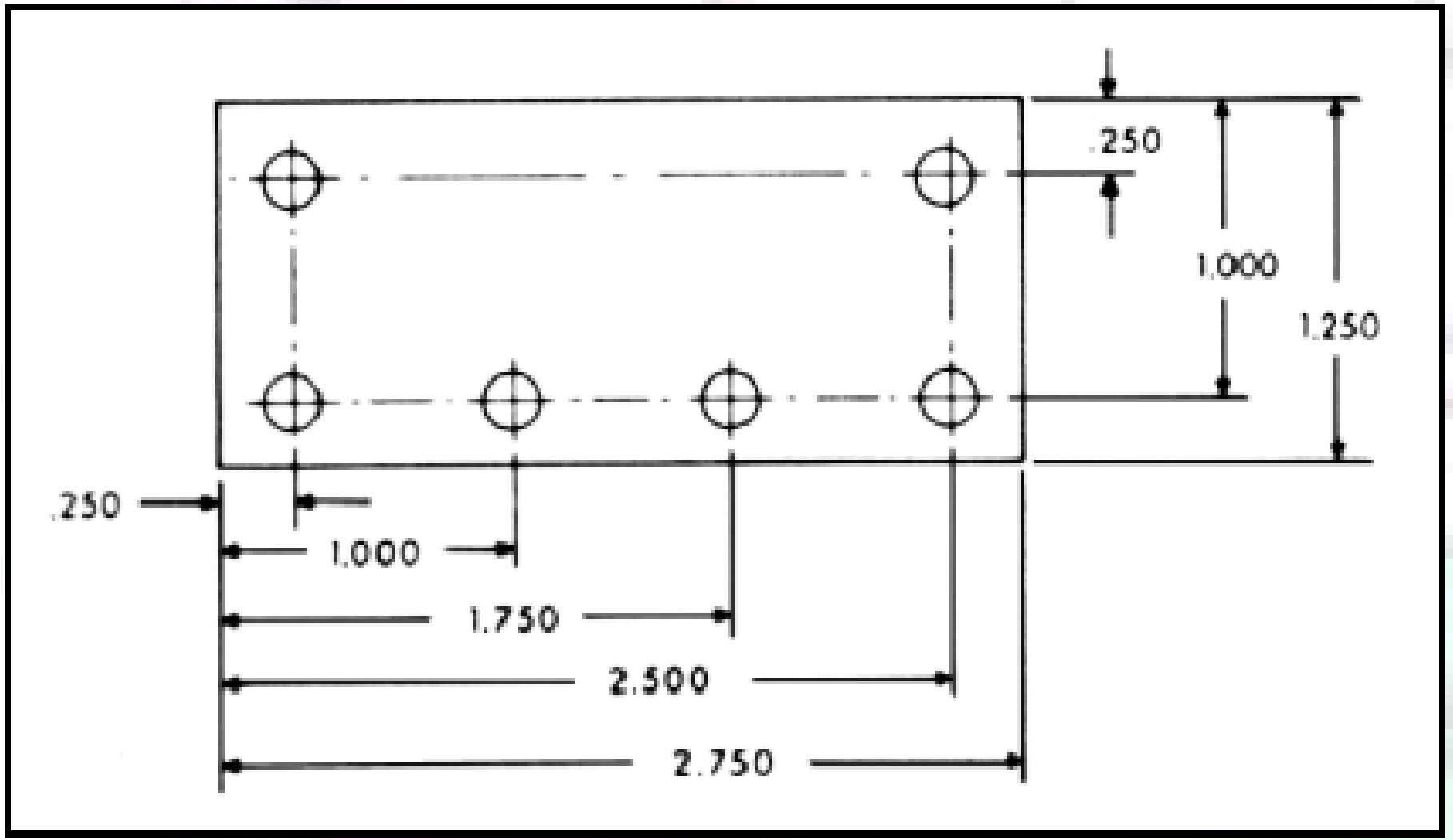
DIRECT NUMERICAL CONTROL (DNC)



REFERENCE POSTIONING SYSTEMS



INCREMENTAL



ABSOLUTE

Degree of Motion Control

Point-to-Point (PTP)

> Good for holes & slots

> Position tool over point.

Contouring

> Complex curved surfaces

> Computers needed for complex calculations

> Motion control to motors: varying voltages to DC servo motors.

Motion Control Systems

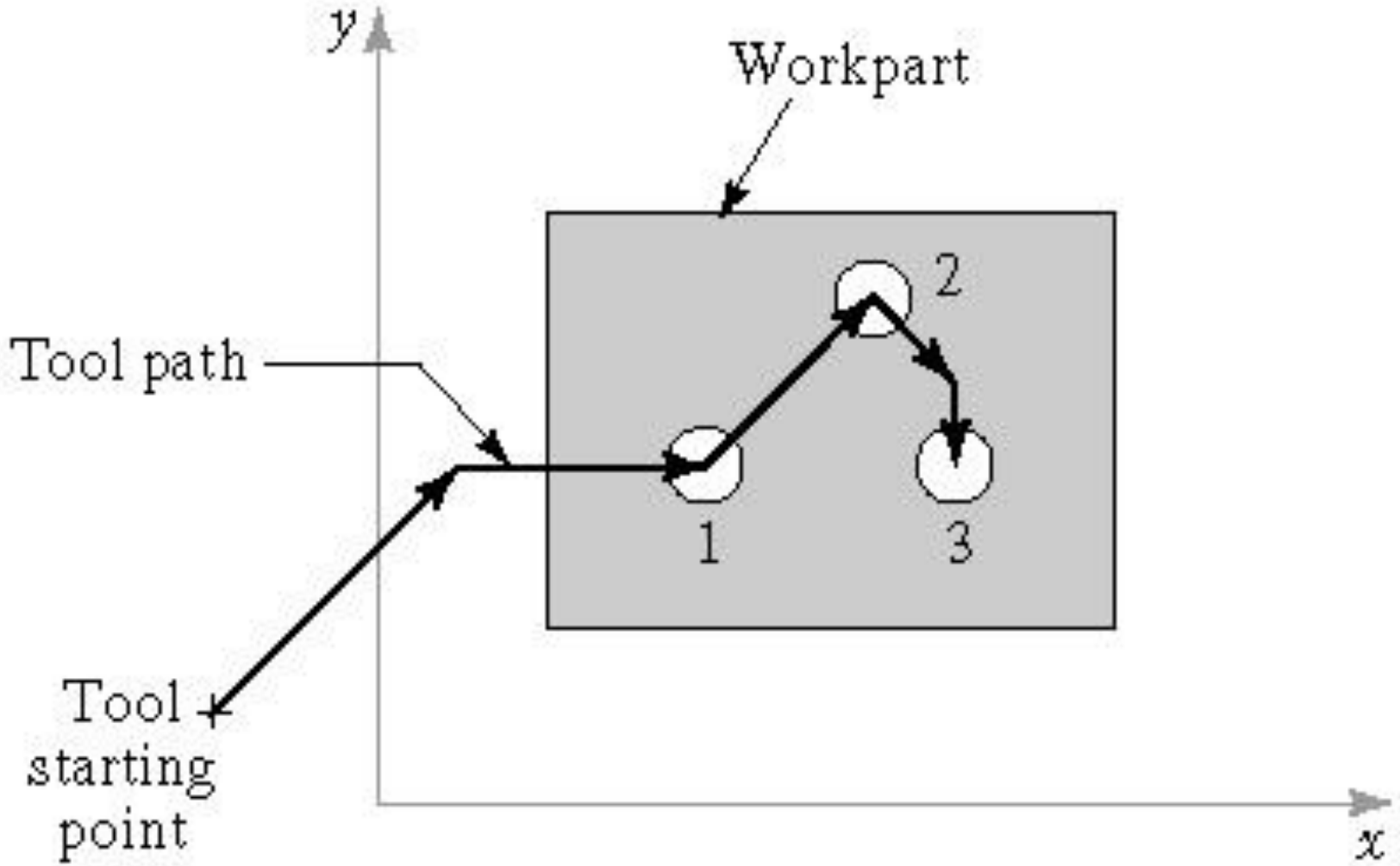
Point-to-Point systems

- Also called position systems
- System moves to a location and performs an operation at that location (e.g., drilling)
- Also applicable in robotics

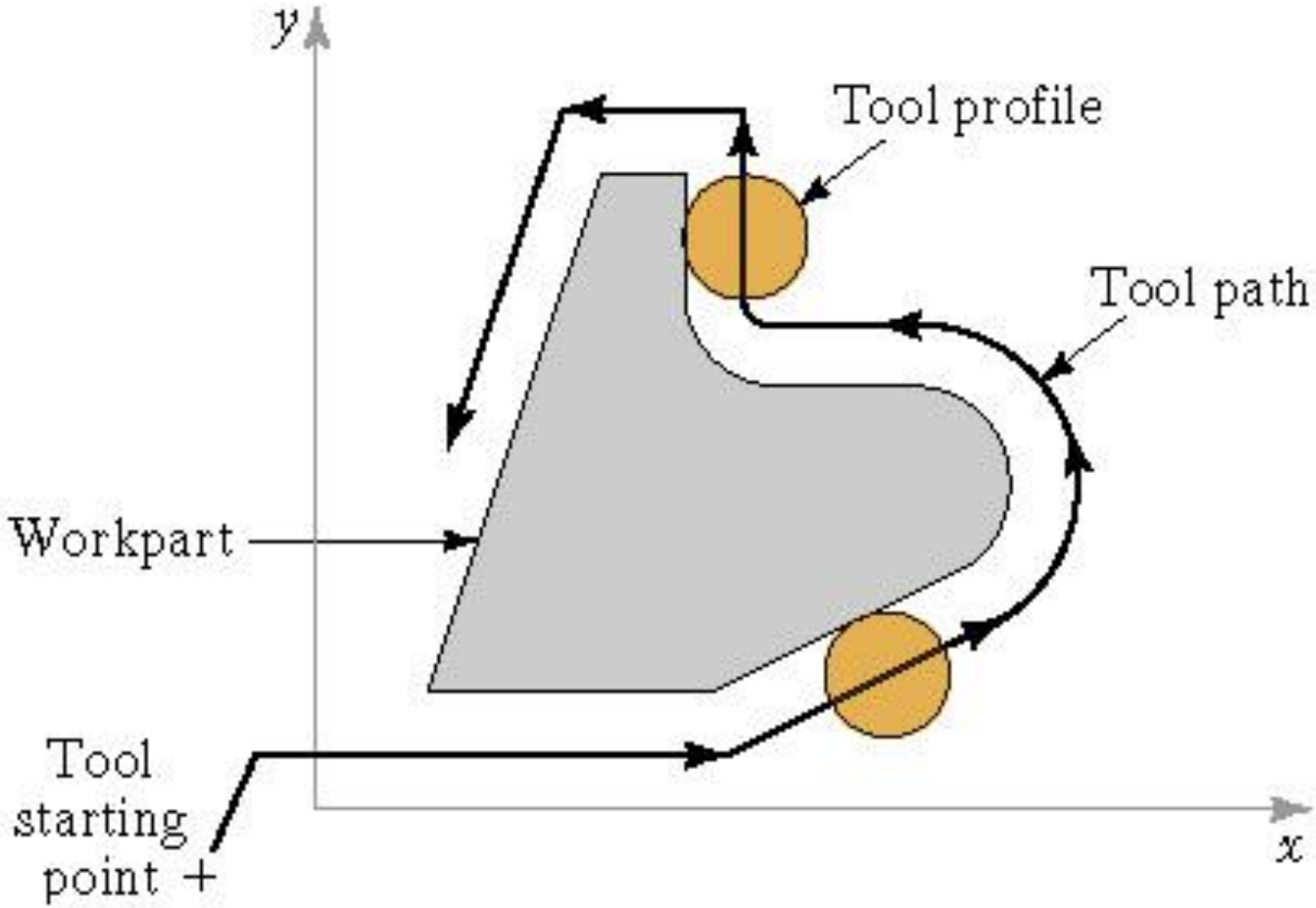
Continuous path systems

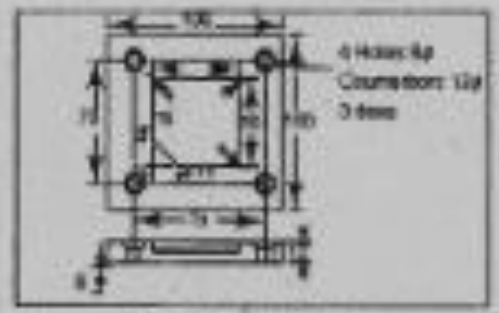
- Also called contouring systems in machining
- System performs an operation during movement (e.g., milling and turning)

PTP



CONTOURING

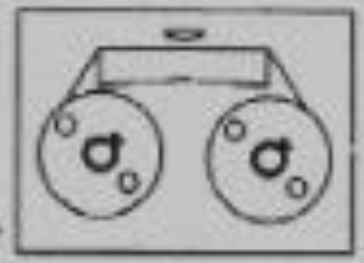




Part Drawing

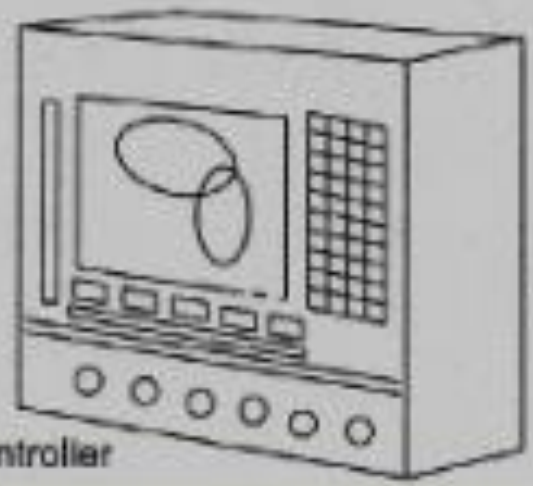
```
N030 G00 X34.43 Y12.5
N035 Z2.0
N040 G01 X105.0 Y35.5
N045 X55.0 Y65.0
N050 G00 Z50
```

Part Program

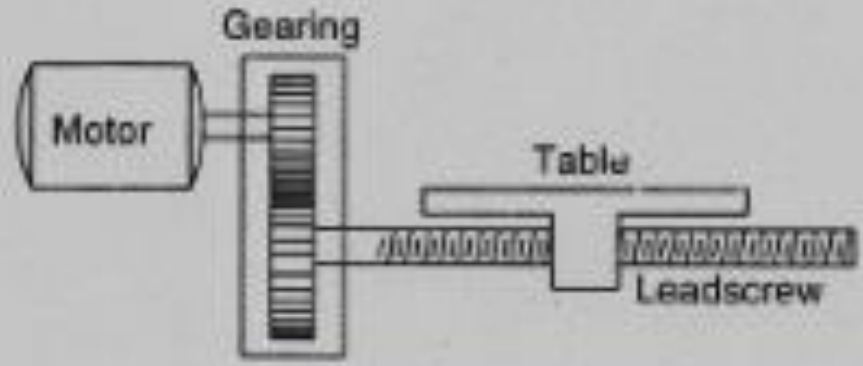


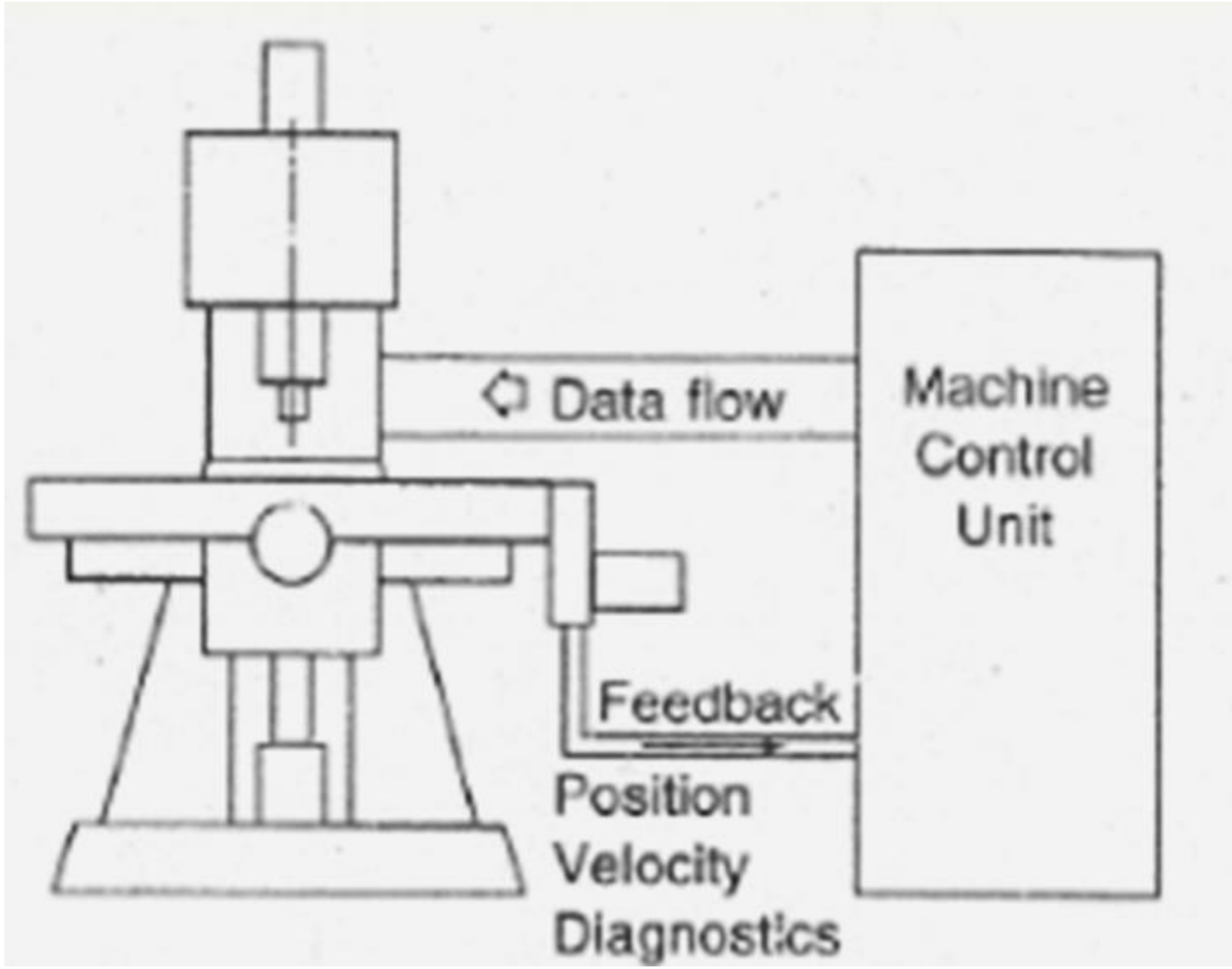
Paper
Tape Reader

Program
Tape



Controller




Data flow
Machine
Control
Unit
Feedback
Position
Velocity
Diagnostics

Advantages of NC

Flexibility

Capability for Complex

Work-pieces

Manage Large Work-pieces

Reduced Jig & Fixture Cost

Higher Quality

Direct Numerical Control

Advantages:

> Library of programs

> Instant modifications

> Links with CAD

> Increase Information

Response

> Instant Reports

Computer Numerical Control (CNC)

Advantages:

> CRT allows review/editing

> Pre-check/simulation

> Interface allows more capability

> Accurate positioning

> More functions