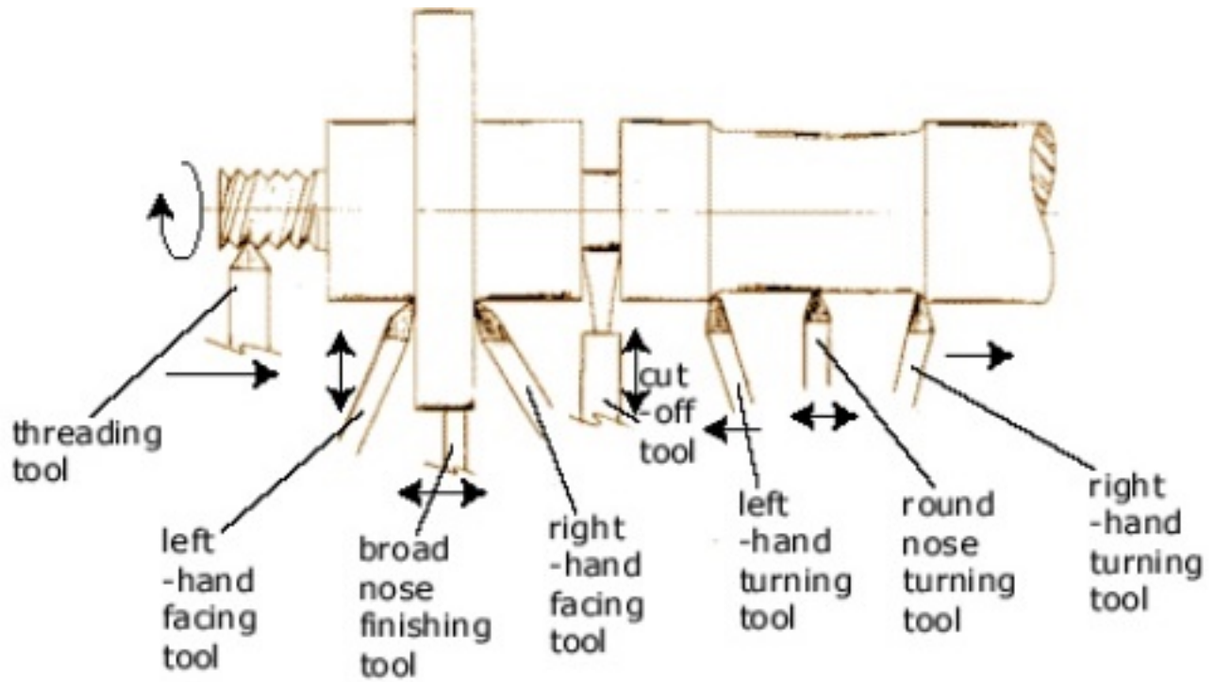
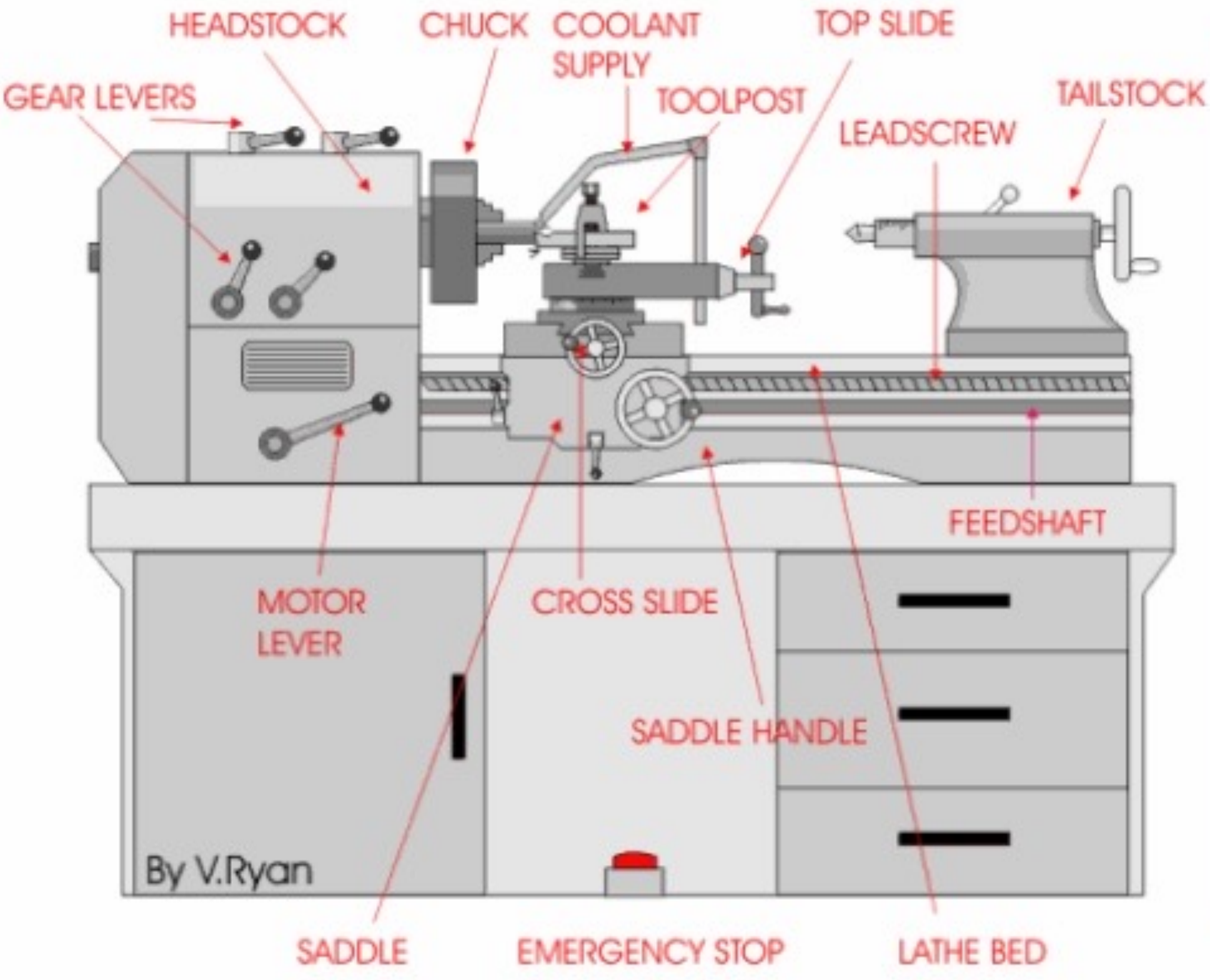

threading tool
left -hand facing tool
broad nose finishing tool
right -hand facing tool
cut -off tool
left -hand turning tool
round nose turning tool
right -hand turning tool

Machine Tools



A machine tool is a power driven device where energy is utilized to deform material to attain required shape size or to process a product to desired accuracy by removing excess material.

Lathe

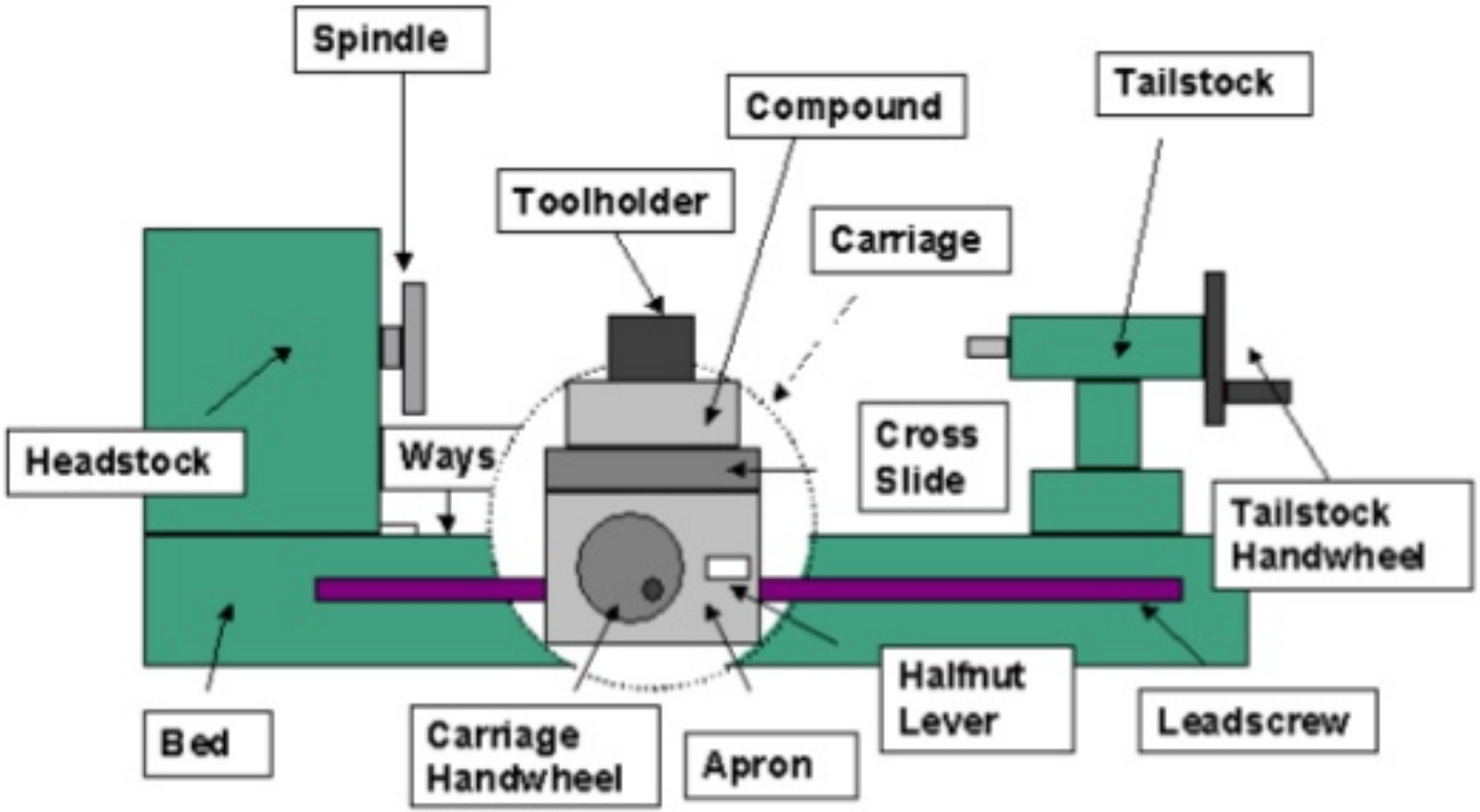
- Oldest known machine tool.
- Henry Mauldsley developed sliding carriage and screw cutting lathe in 1800 AD
- It is a general purpose machine tool used in production an repair work since it permits large variety of operations on it.

Working Principle of Lathe:

- Lathe removes undesired material from a rotating w/p in from of chips with the help of a tool of harder material than the w/p, traversed either across or deep in the w/p.
- W/p should be held securely & rigidly on the machine tool.
- It is principally used to produce cylindrical surfaces and plan surfaces, at right angle to axis of rotation.

Specification of a Lathe: Lathe is generally designated by:

- Swing: Largest work dia that can be swung over the bed.
- Distance b/w head and tail stock centre.
- Sometimes by the swing and length of the bed. Sometimes by the maximum dia of bar which can be accommodated for Bar automatic Lathe..

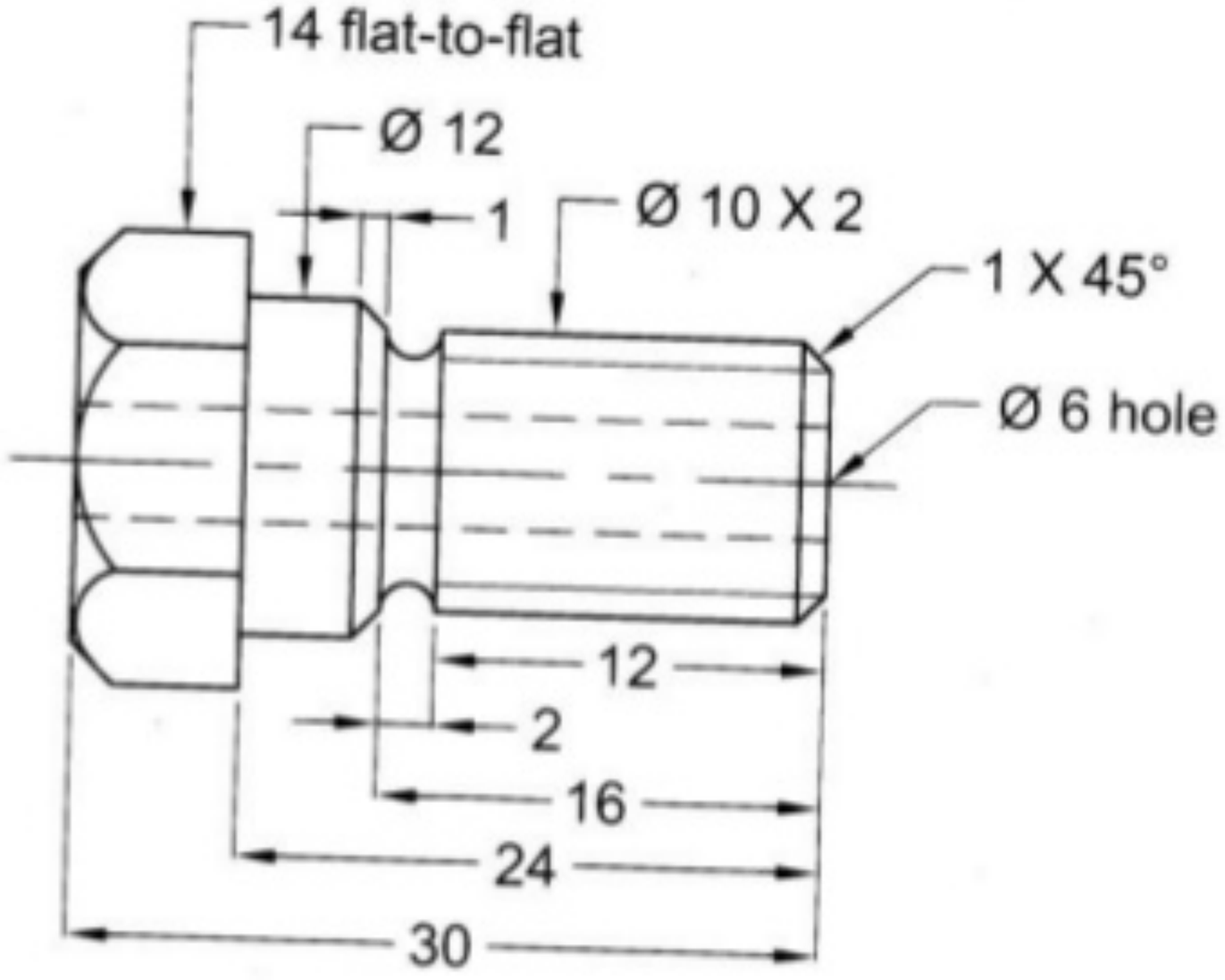

Spindle
Compound
Tailstock
Toolholder
Carriage
Cross
Slide
Headstock
Ways
Tailstock
Handwheel
Halfnut
Lever
Leadscrew
Bed
Carriage
Handwheel
Apron

Operations on Lathe:

- Cylindrical and Conical Jobs.
- Flat Surfaces.
- Grooving
- Drilling and Reaming.
- Counter sinking and counter boring.
- Knurling, parting, chamfering.
- Thread cutting.
- Milling, slotting, grinding Etc.

Tool layout:

- Schematically showing the type and configuration of cutting tools and their location and mounting.
- To draw tool layout for hexagonal headed mild steel bolt (below drawing).



- Hot rolled hexagonal mild steel bar of standard size is selected.

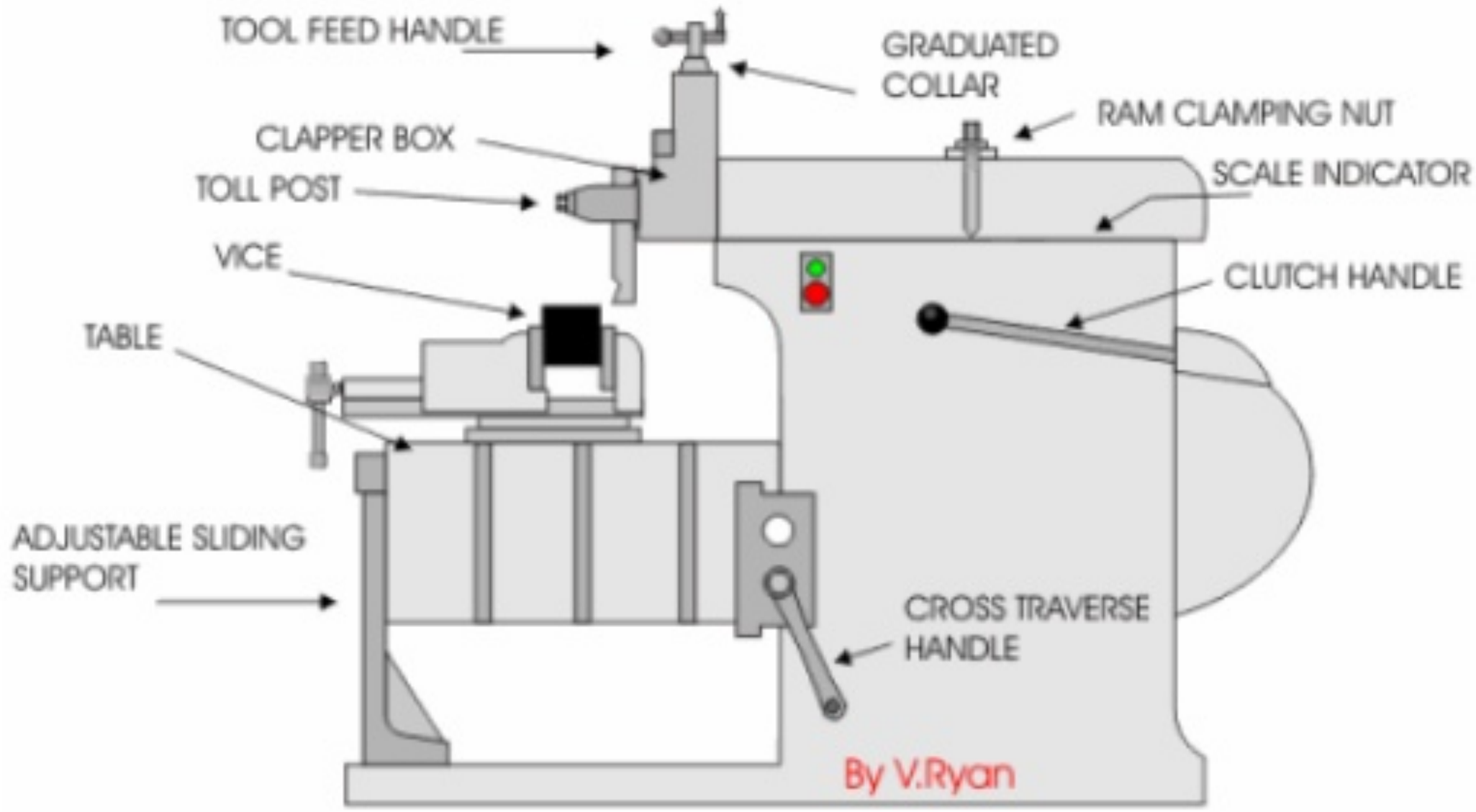
Elementary machining operations identified as follows:

Facing | Centering | Front Chamfering (1)
Chamfering bolt head (3) | Drilling | Grooving (forming)
Rough turning (1) – to make the bar circular from hexagon
Rough turning (2) – to reduce diameter to 12 mm
Finish turning – to φ10 mm
Thread cutting | Initial parting | Parting

Listed elementary operations can be combined and sequenced as follows:

1. Rough turning (1), Initial parting, Chamfering (3).
2. Rough turning (2), drilling and centering for the next job.
3. Finish turning.
4. Spot facing and front chamfering.
5. Grooving and centre chamfering.
6. Thread cutting.
7. Parting.

Shaper:



- *A shaper is a type of machine tool that uses linear relative motion between the work piece and a single-point cutting tool to machine a linear tool path*
- *Uses SPCT to machine flat or plane surfaces in hz, vertical and angular plane.*
- *Ram imparts reciprocating motion to the tool with the help of the ram on the shaper head, while w/p is fixed on the table vice.*

BROACHING

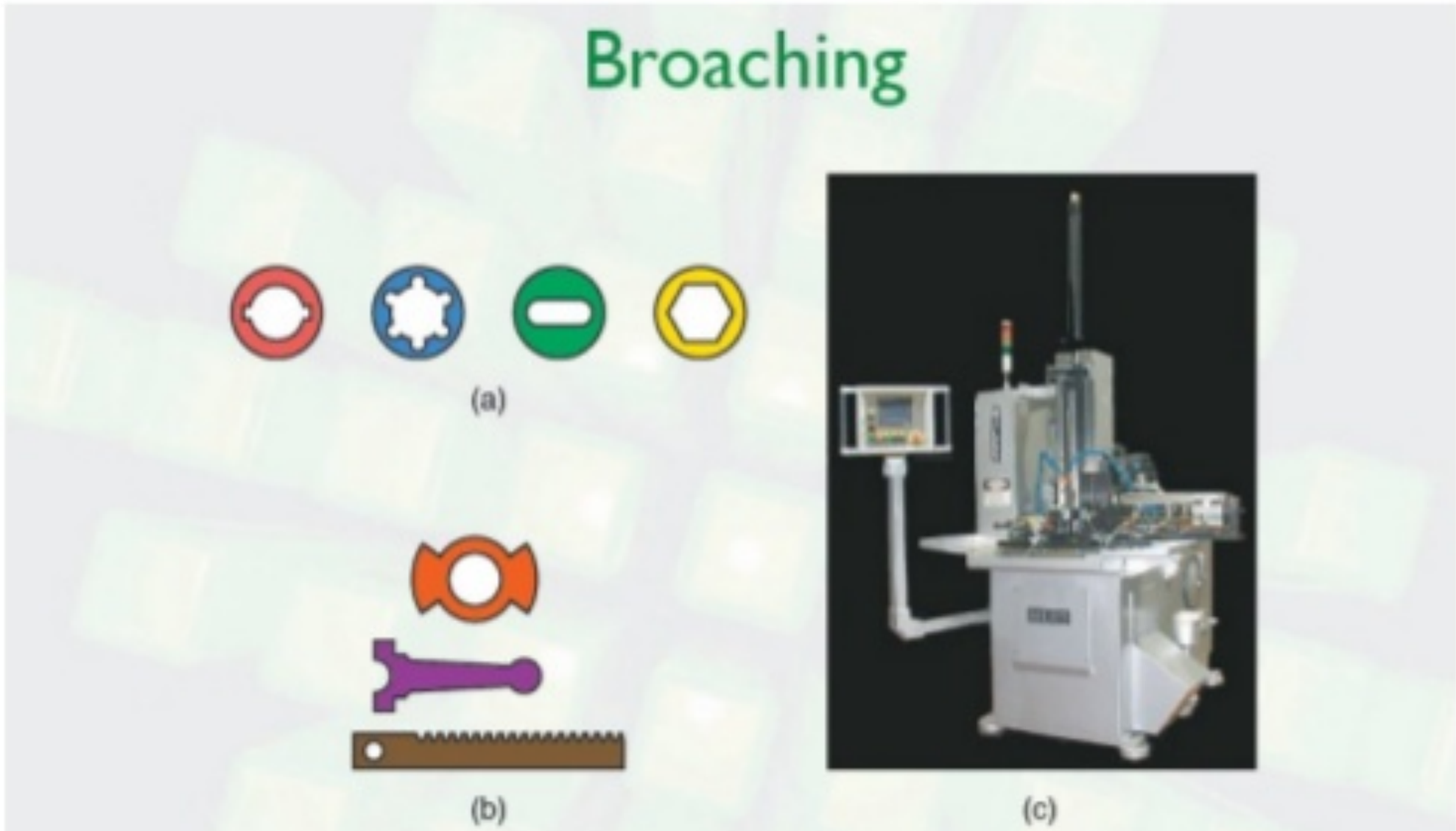
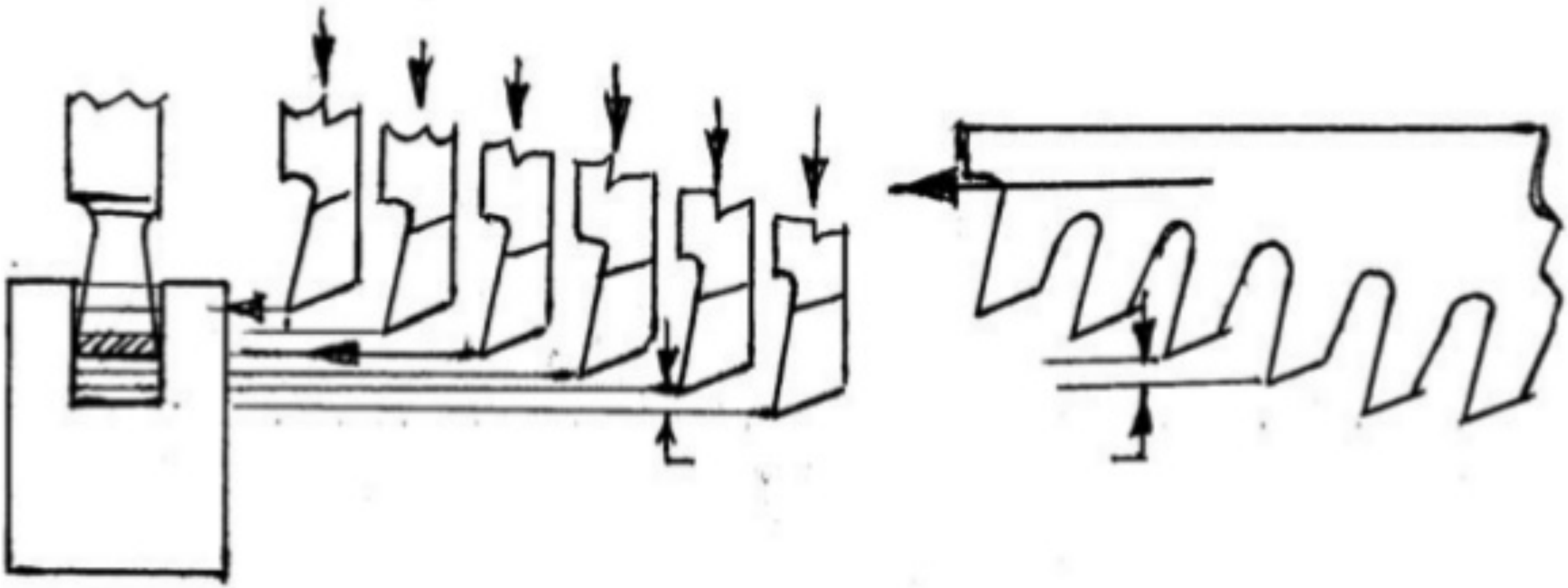


FIGURE 8.60 (a) Typical parts finished by internal broaching. (b) Parts finished by surface broaching. The heavy lines indicate broached surfaces; (c) a vertical broaching machine. *Source:* (a) and (b) Courtesy of General Broach and Engineering Company. (c) Courtesy of Ty Miles, Inc.

BASIC PRINCIPLES OF BROACHINING…….

Broaching is a machining process for removal of a layer of material of desired width and depth usually in one stroke by a slender rod or bar type cutter having a series of cutting edges with gradually increased protrusion as indicated in Fig.

In shaping, attaining full depth requires a number of strokes to remove the material in thin layers step – by – step by gradually in feeding the single point tool Whereas, broaching enables remove the whole material in one stroke only by the gradually rising teeth of the cutter called broach. The amount of tooth rise between the successive teeth of the broach is equivalent to the in feed given in shaping.



SHAPING

BROACHING

Material of broach

- Being a cutting tool, broaches are also made of materials having the usual cutting tool material properties, i.e., high strength, hardness, toughness and good heat and wear resistance.
- For ease of manufacture and re-sharpening the complex shape and cutting edges, broaches are mostly made of HSS (high speed steel). To enhance cutting speed, productivity and product quality, now-a-days cemented carbide segments (assembled) or replaceable inserts are also used specially.

Broaching Machines

- **Horizontal broaching machine**
- Horizontal broaching machines, typically shown in Fig., are the most versatile in application and performance and hence are most widely employed for various types of production. These are used for internal broaching but external broaching work are also possible. The horizontal broaching machines are usually hydraulically driven and occupies large floor space.

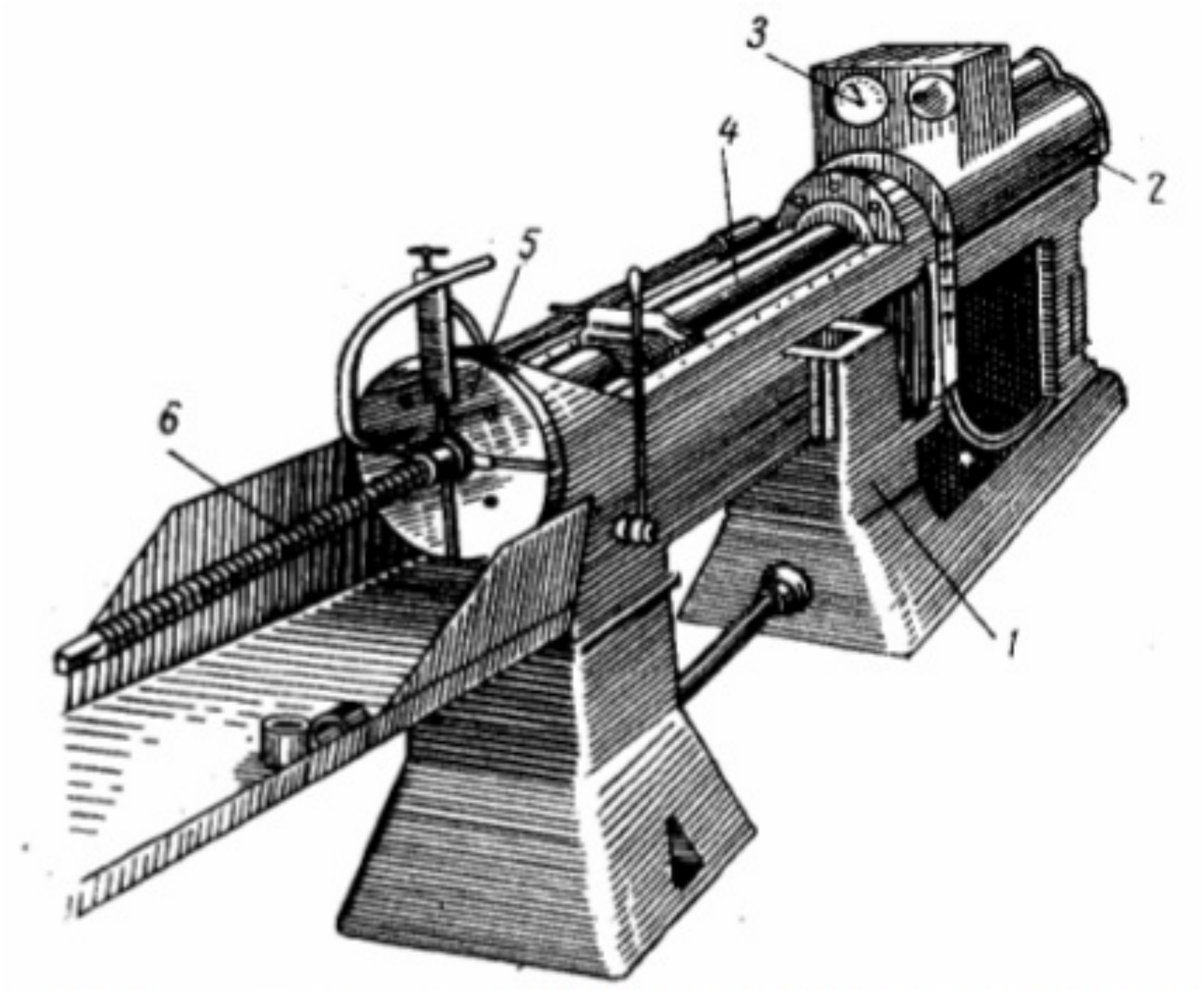
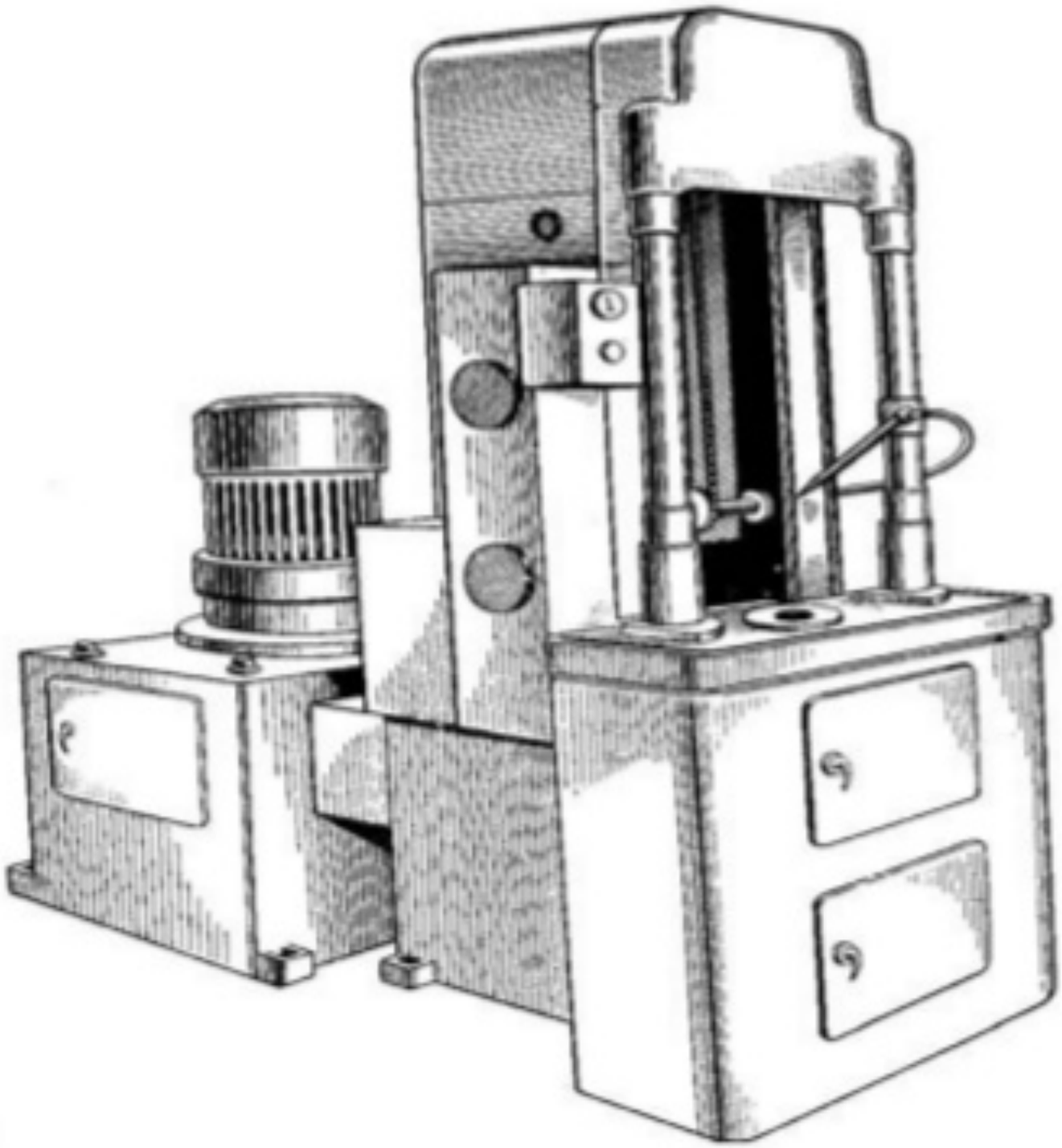


Fig. *Horizontal broaching machine.*



- Vertical broaching machine

GRINDING

Grinding is the most common form of abrasive machining. It is a material cutting process which engages an abrasive tool whose cutting elements are grains of abrasive material known as grit. These grits are characterized by sharp cutting points, high hot hardness, chemical stability and wear resistance. The grits are held together by a suitable bonding material to give shape of an abrasive tool.

Major advantages and applications of grinding

- ✓ dimensional accuracy
- ✓ good surface finish
- ✓ good form and locational accuracy
- ✓ applicable to both hardened and unhardened material

Applications

- surface finishing
- slitting and parting
- stock removal (abrasive milling) finishing of flat as well as cylindrical surface
- grinding of tools and cutters and resharpening of the same.

Grinding Machines

- Conventional grinding machines can be broadly classified as:

(a) Surface grinding machine

(b) Cylindrical grinding machine

(c) Internal grinding machine

(d) Tool and cutter grinding machine

Surface grinding machine:

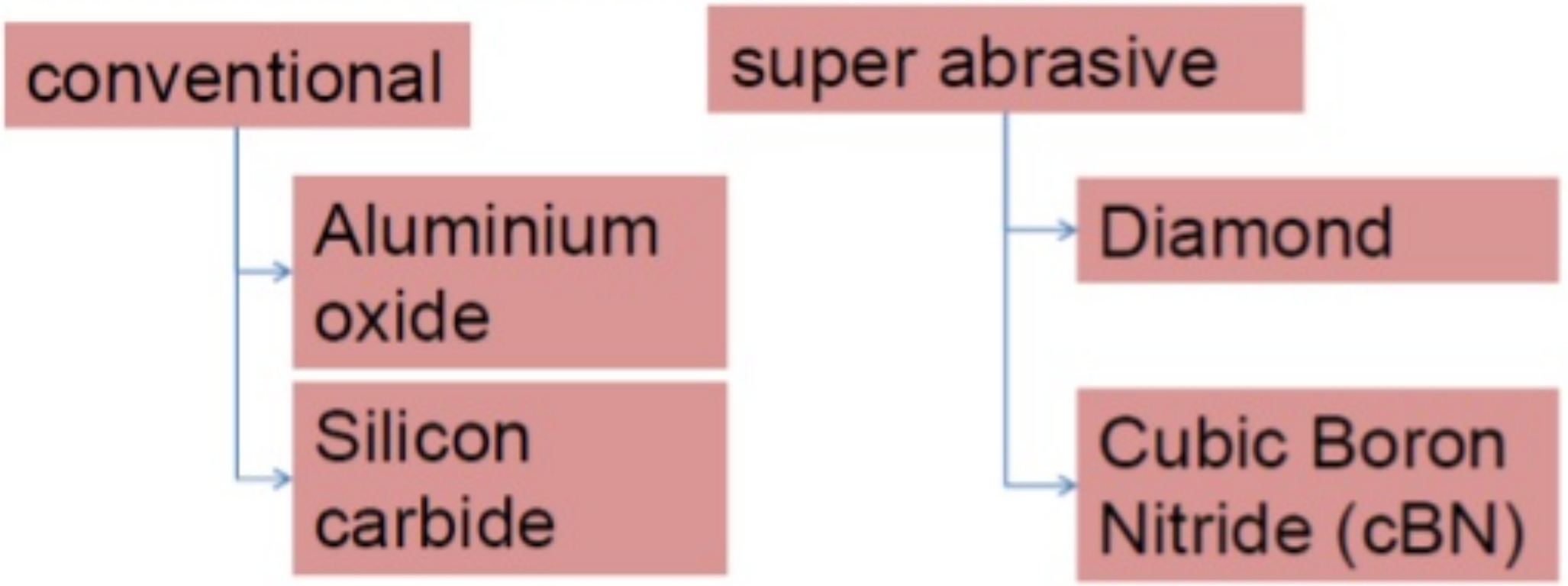
- Horizontal spindle and reciprocating table
- Vertical spindle and reciprocating table
- Horizontal spindle and rotary table
- Vertical spindle and rotary table

Grinding wheels

- Grinding wheel consists of hard abrasive grains called grits, which perform the cutting or material removal, held in the weak bonding matrix. A grinding wheel commonly identified by the type of the abrasive material used. The conventional wheels include aluminium oxide and silicon carbide wheels while diamond and cBN (cubic boron nitride) wheels fall in the category of superabrasive wheel.

Grinding Wheels

- The classification based on type of material



- **Conventional** – in aviation, gas turbine nozzles, IC engine pumps, finishing of gears
- **Super abrasives** – to machine ultra-hard materials like ceramics, glass, powder-coated steels
  - Cost-effective In tool manufacturing

Selection of grinding wheels

1. Type of abrasives

- Aluminium oxide
- Silicon carbide
- Diamond
  - ✓ Natural diamond
  - ✓ Mono crystalline diamond
  - ✓ Polycrystalline diamond
- cBN (cubic boron nitride)

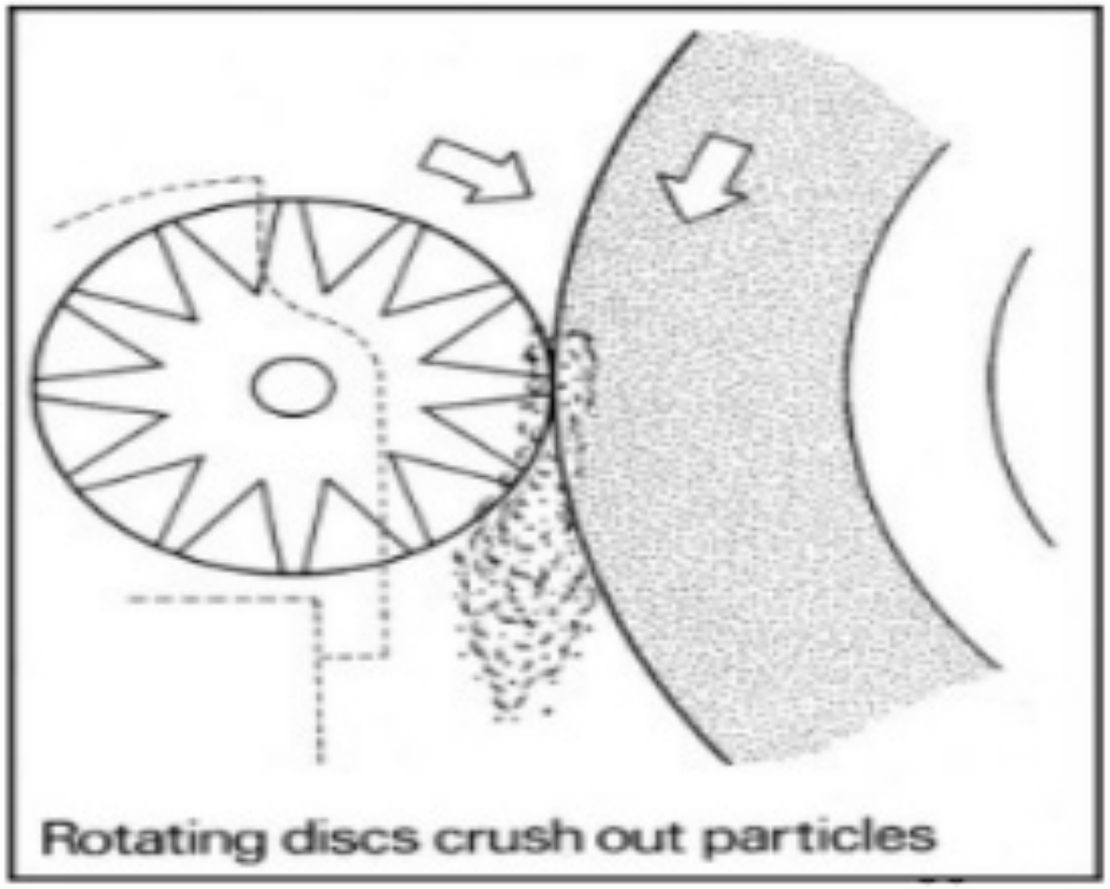
Truing and dressing of grinding wheel

- **Truing**
- Truing is the act of regenerating the required geometry on the grinding wheel, whether the geometry is a special form or flat profile. Therefore, truing produces the macro-geometry of the grinding wheel.
- Truing is also required on a new conventional wheel to ensure concentricity with specific mounting system. In practice the effective macro-geometry of a grinding wheel is of vital importance and accuracy of the finished workpiece is directly related to effective wheel geometry.

Dressing

- When the sharpness of grinding wheel becomes dull because of glazing and loading, dulled grains and chips are removed (crushed or fallen) with a proper dressing tool to make sharp cutting edges and simultaneously, make recesses for chips by properly extruding to grain cutting edges. Thus, these operations are for the dressing
- Dressing is the conditioning

of the wheel surface which ensures that grit cutting edges are exposed from the bond and thus able to penetrate into the work piece material.

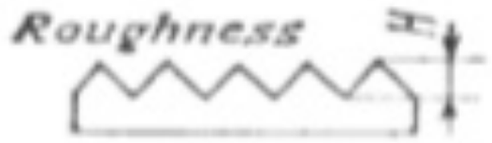
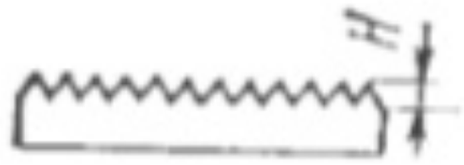
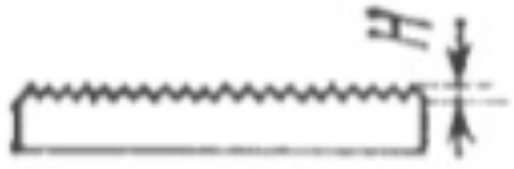
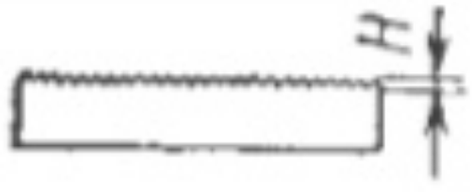


- Dressing therefore produces micro-geometry. The structure of micro-geometry of grinding wheel determine its cutting ability with a wheel of given composition. Dressing can substantially influence the condition of the grinding tool.
- Truing and dressing are commonly combined into one operation for conventional abrasive grinding wheels, but are usually two distinctly separate operation for super abrasive wheel.

- <u>Dressing of superabrasive wheel</u>

- Dressing of the super abrasive wheel is commonly done with soft conventional abrasive vitrified stick, which relieves the bond without affecting the super abrasive grits.

finishing operations

Process	Diagram of resulting surface	Height of micro irregularity (μm)
Precision Turning		1.25-12.50
Grinding		0.90-5.00
Honing		0.13-1.25
Lapping		0.08-0.25
Super Finishing		0.01-0.25

Polishing and buffing

- *Polishing*
- *Polishing* is a finishing operation to improve the surface finish by means of a *polishing wheel* made of fabrics or leather and rotating at high speed. The abrasive grains are glued to the outside periphery of the polishing wheel. Polishing operations are often accomplished manually

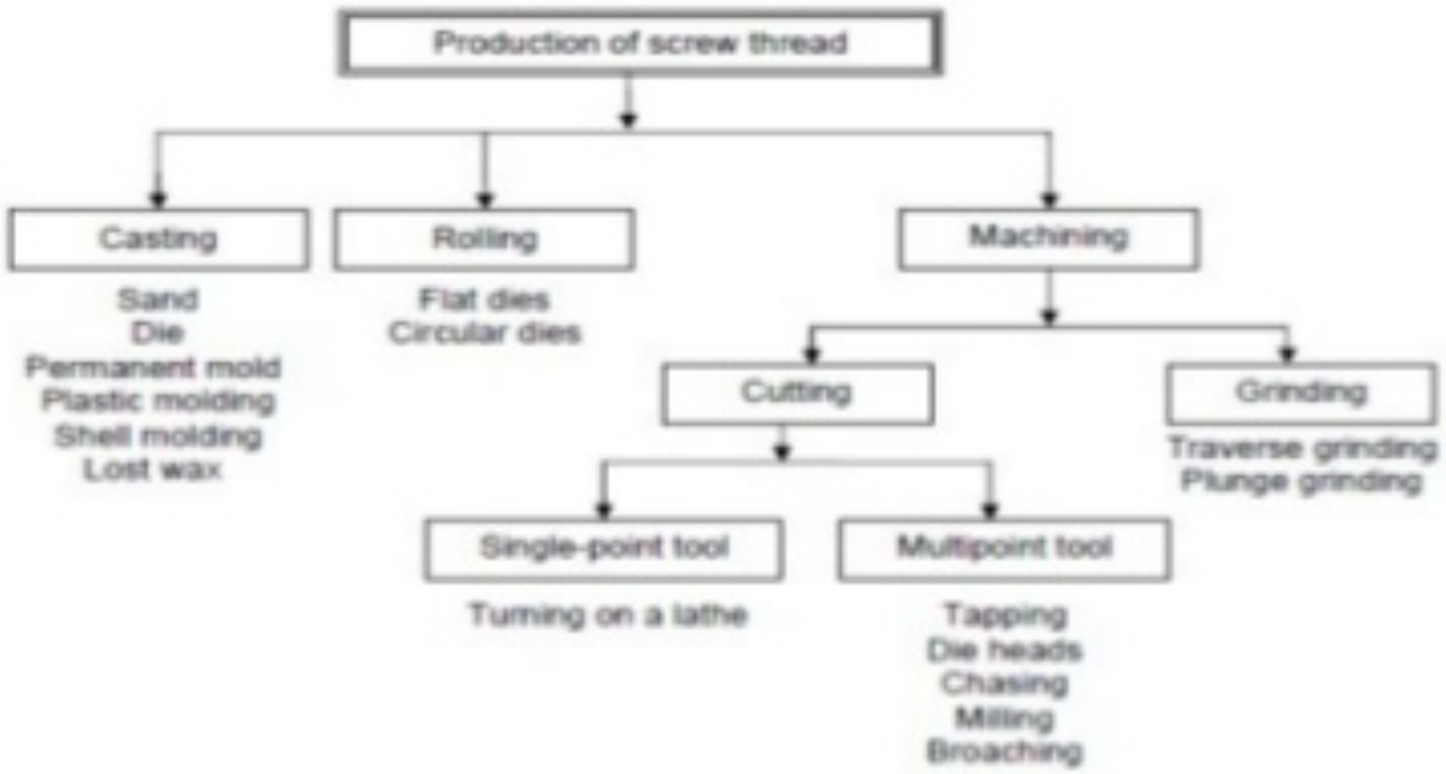
- **Buffing**

- *It* is a finishing operation similar to polishing, in which abrasive grains are not glued to the wheel but are contained in a buffing compound that is pressed into the outside surface of the *buffing wheel* while it rotates. As in polishing, the abrasive particles must be periodically replenished. As in polishing, buffing is usually done manually, although machines have been designed to perform the process automatically.

- Polishing is used to remove scratches and burrs and to smooth rough surfaces while butting is used to provide attractive surfaces with high luster.

Screw thread manufacturing

Methods of screw thread production



Thread milling:

Thread milling is a machining process used for cutting screw threads with a single-form or multiple form milling cutter. Thread milling makes smoother and more accurate threads than a tap or a die. It is more efficient than using a single-cutting-point tool in a lathe.