ToppersNotes

IES/GATE

MECHANICAL ENGINEERING

PRODUCTION ENGINEERING (MATERIAL SCIENCE)

VOLUME-IV

Sierra Innovations Pvt. Ltd.

Contents

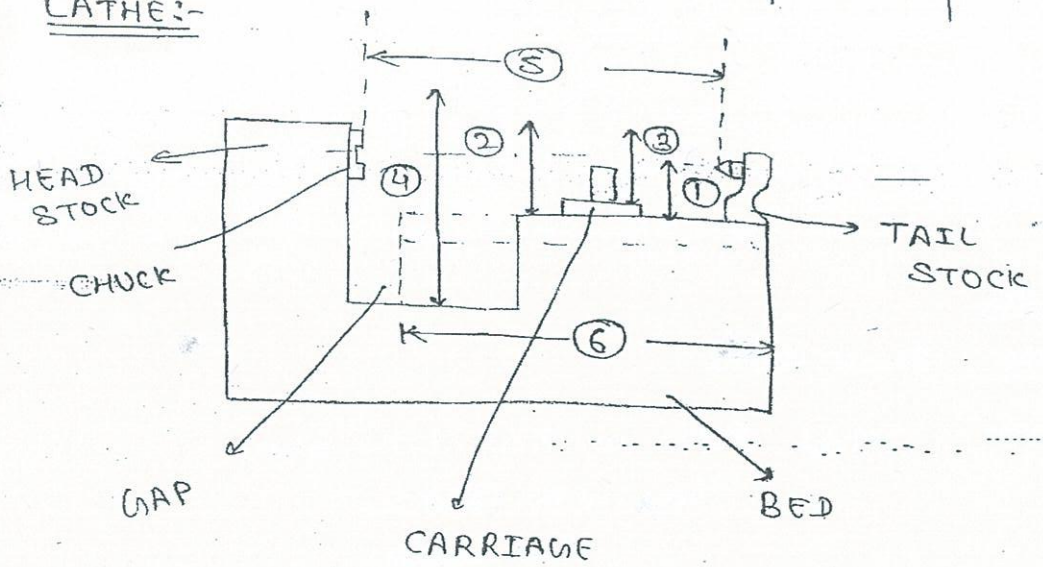
The process of metal cutting in which the chip is formed affected by a relative movement between workpiece & hard edge of the cutting tool.

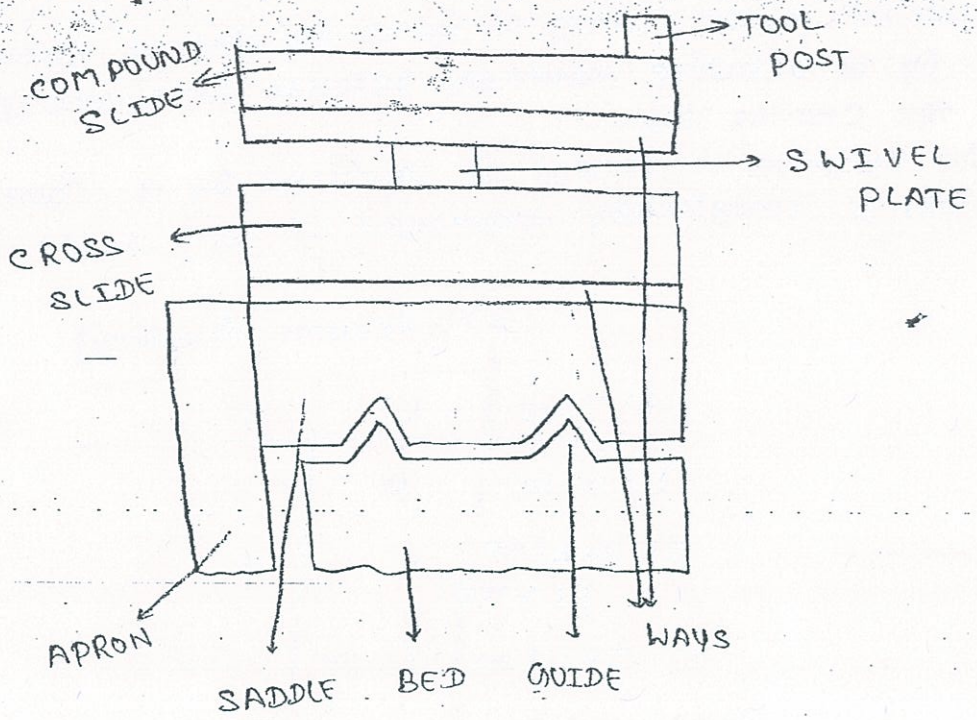
the relative movement is produced by a combination of Rotary & translatory movement of either the workpiece or tool.

RM (Relative movement)

M/C Tool	W	T
1) LATHE	R	T
2) SHAPER PLANER	T	T
3) DRILLING	fixed	R & T
4) MILLING	T	R
5) S. Grinding Surface	T	R
6) C. Grinding cylindrical	R & T	R

LATHE:-





LATHE SPECIFICATIONS

1) HEIGHT OF CENTRES
2) SWING OVER BED
3) SWING OVER CARRIGE
4) SWING OVER GAP
5) DISTANCE B/W CENTRES
6) LENGTH OF BED
7) NO OF SPEEDS, FEEDS etc.

TYPES OF LATHE

i) **Bench lathe:-** Small lathe

ii) **Speed lathe:-** Speed lathe is that lathe where
there is no carriage
no gearbox
no tool post.

iii) engine lathe:-

iv) tool room lathe:- Used for tool room Used to make Dies and frames Used in production.

~~Prodn production lathe~~

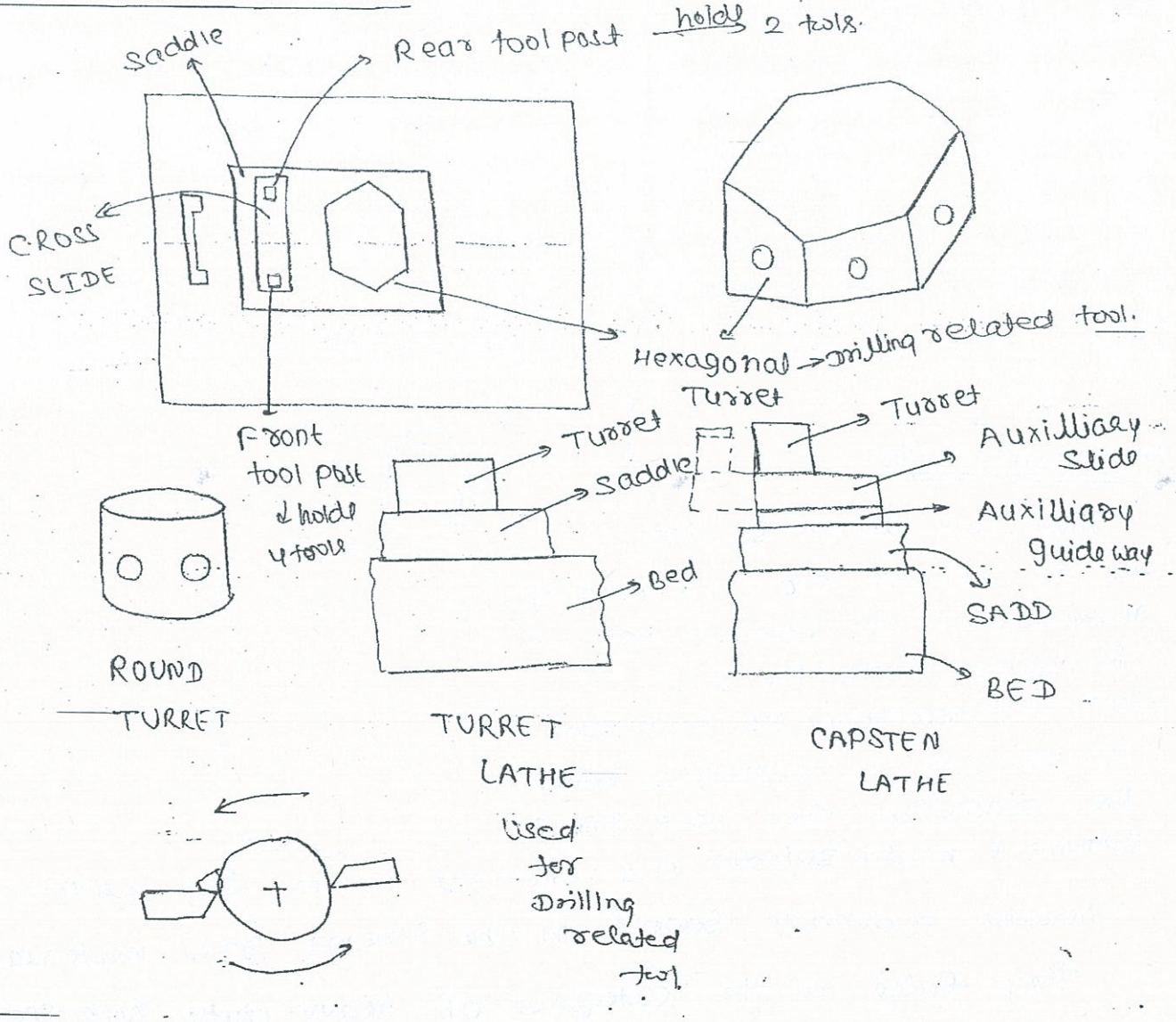
Bench lathe:-
It is very small lathe and it is mounted on a separately bench or cabinate and used for small worked.

Speed lathe:- they do not have provision for ~~power~~ power feed and have no gear box, or carriage or lead screw. these are used for good turning polishing, wood turning, metal screening etc.

engine lathe:- in olden days lathe is drawn by steam engine. hence the name is still in existence even after modern lath are provided with motor drive.

tool room lathe:- it is ~~nothing but~~ enaine lathe provided with some extra attachement for accurate and precission work like paper turning attachement, collets, follower rest etc.

Capstan & Turret lathe:- (mass production lathe)



in turret lathe forced directing Given to the foundation.

heavy workpieced mass production

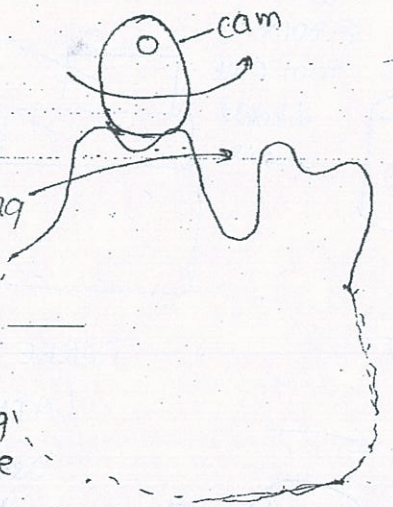
they ~~Carried~~

These are Semi-Automatic type machines very useful for mass production. they Carried special mechanisms for indexing the turret.

angular rotation

Turret lathe	Capsten lathe (easy to manufacture)
i) the turret head (square or hexagonal) is mounted on the saddle.	i) the turret head (round or square or hexagonal) is mounted on a auxillary slide. the moved on the auxillary slide ways provided on the saddle.
ii) the above arrangement gives the rigidity as forced are transfered to the bed. hence this is capable handling heavy jobs and severe cutting condition	ii) Less rigidity, vibration occurs and hence Suitable for lighter & Smaller jobs.
iii) tool travel is along entire bed length	iii) tool travel is limited because of auxillary slide travel limitation.
iv) tool feeding is slow & Causes more fatigue to the operator hands.	iv) tool feeding is fast & caused less fatigue to the operater hands.
v) No tail stock.	v) No tail stock.

Automatic lathe:-



these are design so that all the working and job handling movements of the complete manufacturing process for a job are done automatically. no participation of operator is required during the operation. they have Single Spindle & multi-spindle and clamied in to. Bar automatic Chucking automatic based on the size of raw material.

They falls in the categories of heavy duty, high speed

lathe used in mass production. Geneva mechanism is used for indexing the turrets

Special purpose lathe:- these are design to perform certain Specify only ex:- facing lathe, crankshaft lath etc.

Work holding Devices:-

(1) CHUCKS: ⟷ 3 JAW (round) — self centering chuck

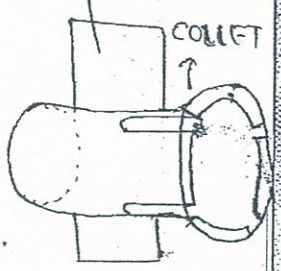
4 JAW

COLLET

Chucking automatics ← Used for PNEUMATIC

MAGNETIC

VACCUM } ⟶ Used for S. Grinding mic

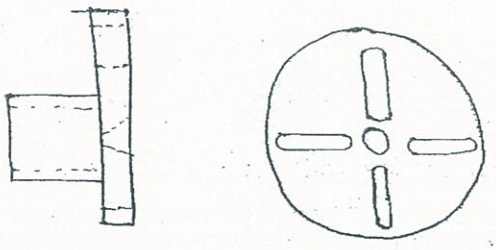


only for Bar Stocks. ⇓ Small rods.

Very fast clamping and non-clamping operation.

in TOOLROOM LATHES, BAR AUTOMATICS, VERTICAL MILLING MC TO HOLD ENDMILLS ← Used for

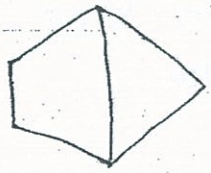
2) FACE PLATE

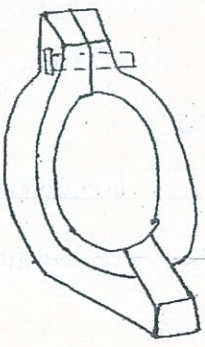


every sliding element have a screw & nut.

3) CENTRES → LIVE, DEAD

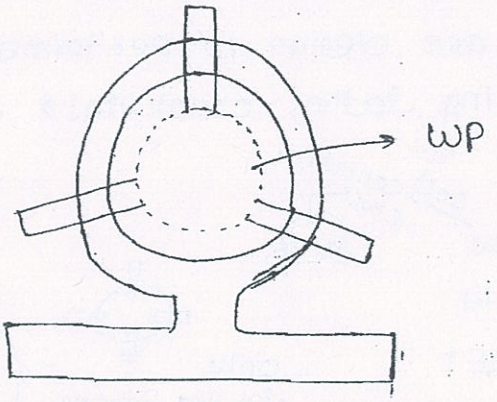
5) CARRIER DOGS



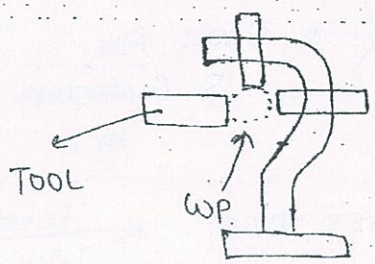


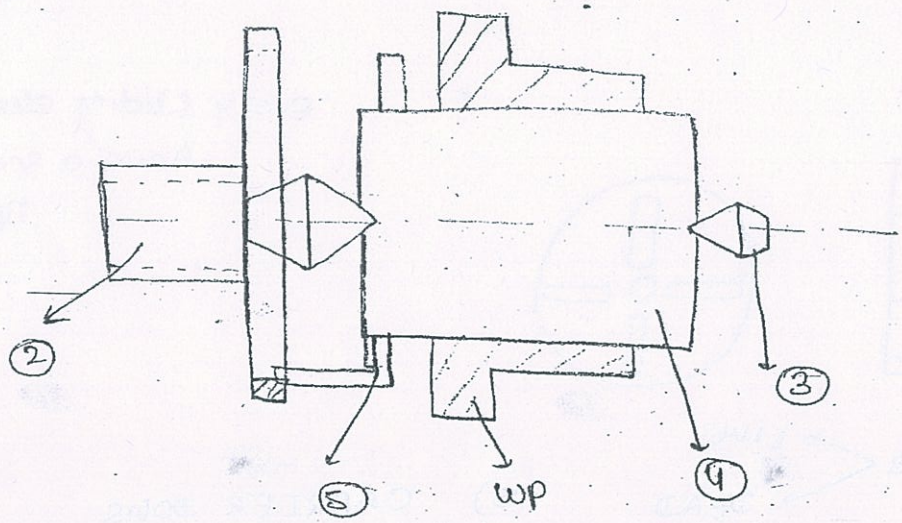
4) MANDRELS

6) STEADM REST



7) FOLLOWER REST





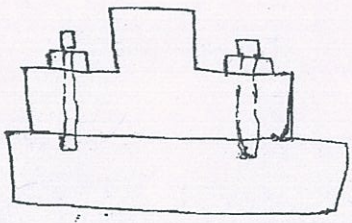
→ max Size of Collet is 40mm. fixed size Collet is always in open Condition.

in Pneumatic

→ Face plate is holding the workpiece. there is no jaws.

hold → Round, Square, Rectange

* Mandrel is like Small shaft which supported hollow w/ps. it is a specific device.



a) SWIVELING THE COMPOUND REST

→ ANY ANGLE ; ANY LENGTH

b) TAIL STOCK SET OVER

→ SMALL ANGLE , LONG JOB

→ tail stroked width is limited

c) FORM TOOL

→ ANY ANGLE , SHORT JOB

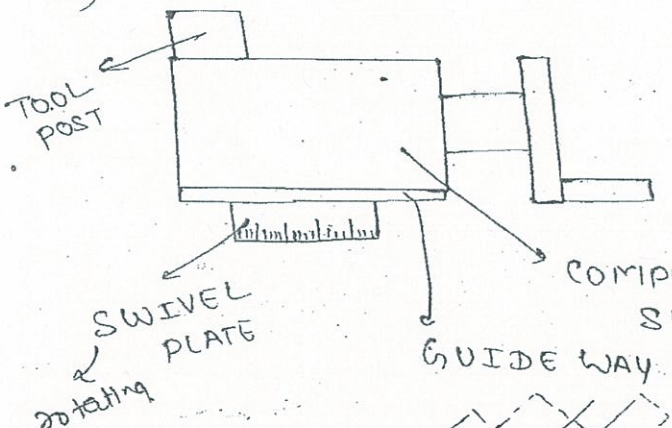
d) COMBINED FEEDS

→ 45° CHAMFERS

e) TAPER TURNING ATTACHMENT

→ SMALL ANGLE , LONG JOB

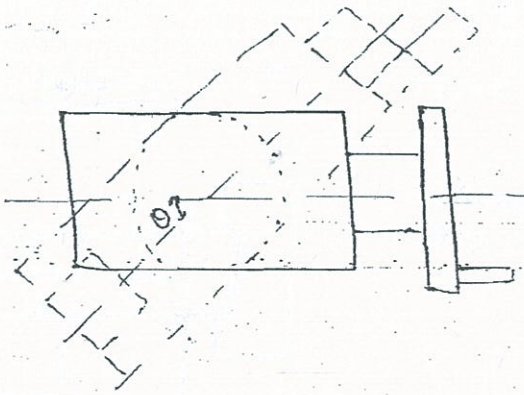
a)



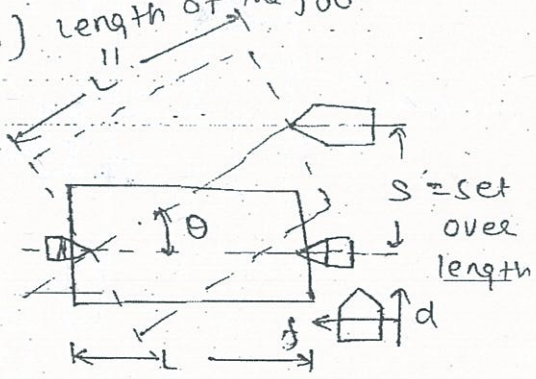
when marked angle 0° compound slid is ll to saddle.

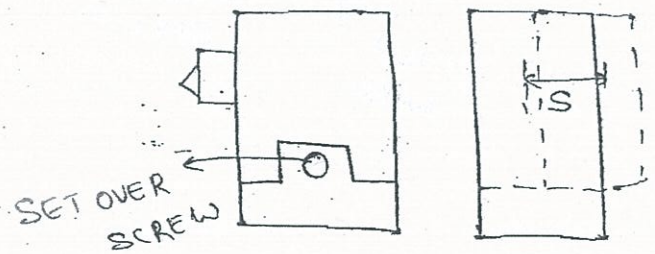
When make angle 90° perallel to ~~Compound~~ Cross Slide.

helps you in taper turning

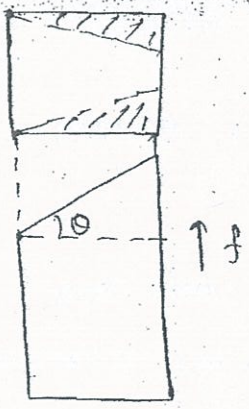


b) length of the job





$\sin\theta = \frac{S}{L}$

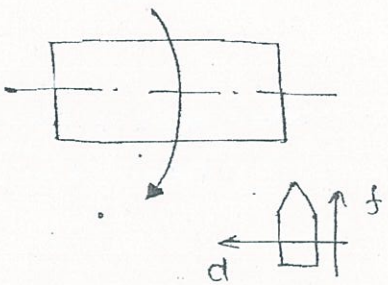


Combined feeds based of engineering mechanics.

it magnitude is same.

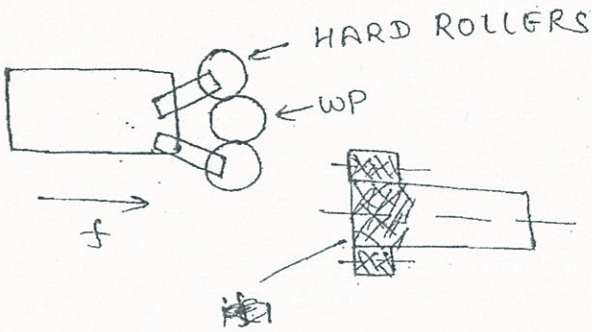
Taper turning attachement holding the job in centre. rotate the cross slide.

4) FACING

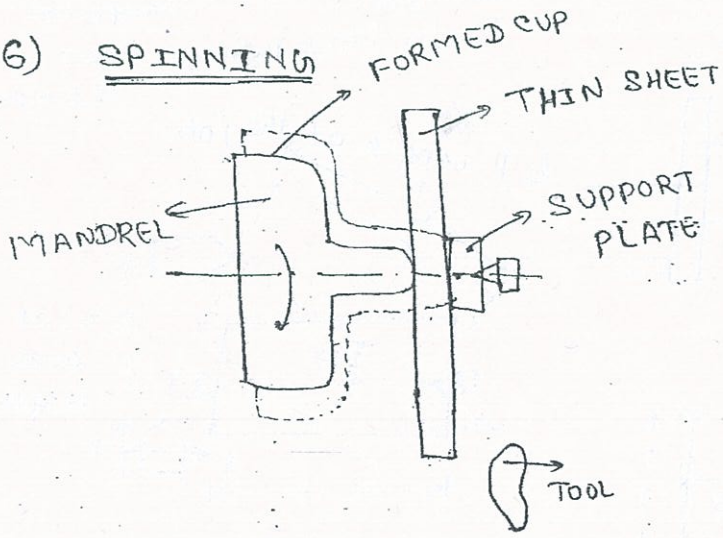


DIA is not effected
length/ thickness is ↓

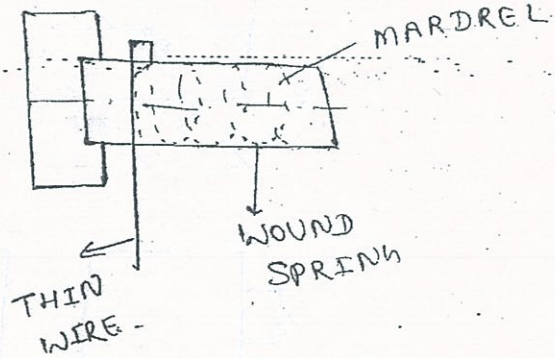
5) KNURLING



6) SPINNING



7) SPRING WINDING



Time estimation

i) **Time for machining:-** $T = \frac{L}{f \times N} = \frac{L}{f_m} \simeq min$

Where L = length of cut → mm
f = feed → mm/rev
f_m = feed per min
mm/min

(2) $V = \frac{\pi D N}{1000}$ = m/min

V = cutting speed
D = starting dia of the workpiece.
ϕ 4cm − ϕ 3cm

$= \frac{4+3}{2} = 3.5$

(3) $d = \frac{D_i - D_f}{2}$ d = depth of cut

(4) P (or) $W \cdot D = F_c \cdot V = Nm/min$

F_c = cutting force
V = cutting speed

$\boxed{F_c = K \cdot d \cdot f}$

K = material constant
d = depth of cut
f = feed

(5) Time for threading

= Time per cut x No. of cuts

$\boxed{\text{Time per cut (Time/cut)} = \frac{L}{PXN}}$

Where $L = L_1 + AL + OT$
P = Lead
Extra distance travelled by the tool to engages the W.P

extra distance travelled by the tool to disengages the W.P

$$P = \frac{1}{\text{No. of Threads/Unit length}}$$

(6) Time for drilling

$$T = \frac{\pi D L}{1000 f V}$$

V, V, assume, C, C

Where D = dia of the drill

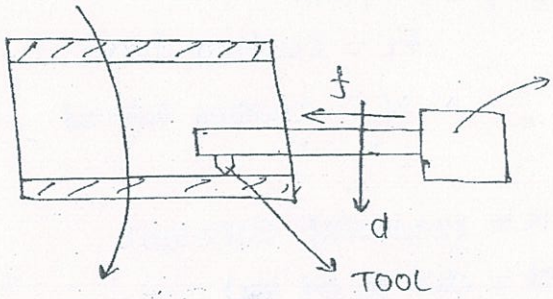
L = depth of hole

(7) Time for Boring

$$T = \frac{\pi D L}{1000 f V}$$

Where D = Starting dia of the hole

L = depth to be bore.



Boring Bar → tool holder in front Slog.

→ Boring is next operation after drilling.

→ We can't apply heavy cuts in Boring. Boring is always time taking. Smaller the depth of cut higher the surface finish.

→ In Drilling Surface finish is less Compare to Boring.

→ if Surface finish is co Boring is Used.

→ Boring is like internal turning

(8) Time for facing

$$T = \frac{L}{f \times N}$$

Where $L = \frac{D}{2}$

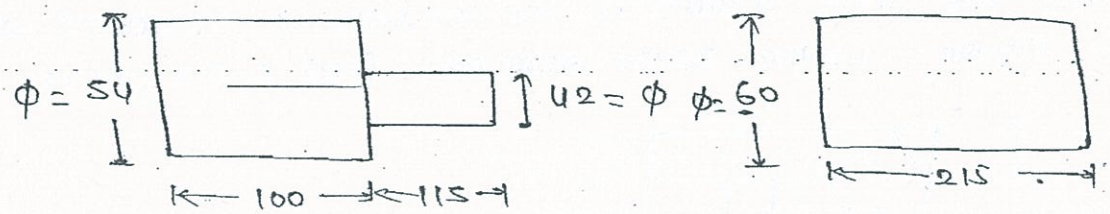
Q. estimate the maching time to turn an m.s rod from 4cm dia to 3.5cm dia up to length of 15cm in a single cut assume cutting speed 30 m/min, feed 0.4 mm/rev

Soln:- $\phi 4 - \phi 3.5$

$D = 4, \quad L = 15$

$T = 1.58 \text{ min}$

Q. for the time required to turn a 60mm dia rod into dimension shown taking cutting speed 20 m/min. feed 1.2 mm/rev all cuts are 3mm D.



depth of cut control the upper lower limit decides the availability of material.

Soln:-

	D	L
1)	$\phi 60 - 54$	215
2)	$\phi 54 - \phi 48$	115
3)	$\phi 48 - \phi 42$	115

$$T_1 = \frac{\pi DL}{1000 f v} = \frac{\pi \times 60 \times 215}{1000 \times 1.2 \times 20} = 1.6886$$

$$T_2 = \frac{\pi DL}{1000 f v} = \frac{\pi \times 54 \times 215}{1000 \times 1.2 \times 20} = 0.81288$$

$$T_3 = \frac{\pi DL}{1000 f v} = \frac{\pi \times 48 \times 215}{1000 \times 1.2 \times 20} = 0.7225$$

$$T = T_1 + T_2 + T_3$$

$$= 3.2239 \text{ min}$$

Q. find the time required for threading on a 3cm spindle of m.s of a length of 15cm. no of threads to be cut are 3/cm the lathe run at 88 rpm. assume approach & overtravel. 0.5 cm each. no of cuts for

Sol?:-

$$T = \frac{L}{P \times N}$$

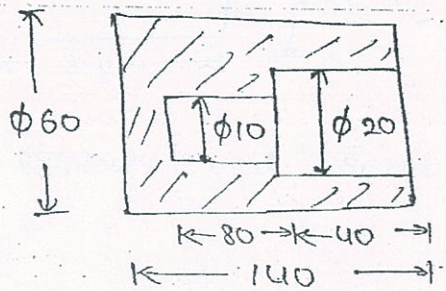
$$L = L_1 + AL + OT$$

$$= 15 + 0.5 + 0.5$$

$$= 16 \text{ cm}.$$

$$T = \frac{16}{\frac{1}{3} \times 88} \times 7 = 3.82 \text{ min}.$$

Q. find the time required for drilling a component shown in the figure: cutting speed 20m/min, feed 0.02 cm/rev.



Sol?:-

	D	L	
T_1 =	ϕ10	120	$T_1 = \frac{\pi \times 10 \times 120}{1000 \times 0.02 \times 10 \times 20} = 0.9424$
T_2 =	ϕ20	40	$T_2 = \frac{\pi \times 20 \times 40}{1000 \times 0.02 \times 10 \times 20} = 0.6283$

$$T = 1.58 \text{ min}$$

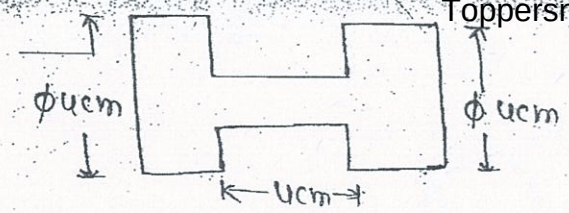
Q. A hollow spindle is to be bored to enlarge its hole dia from 2.5 cm to 3 cm up to 12 cm depth in a single cut. estimate the boring time if cutting speed 30 m/min feed 0.02 cm/rev

Sol?:- D → 2.5 – ϕ3.

$$T = \frac{\pi D L}{1000 f V} = \frac{\pi \times 2.5 \times 12}{1000 \times 0.02 \times 10 \times 30} = 1.58 \text{ min}$$

Q. find the time required to face both end of a component shown in one cut. assume rpm 100, coose feed = 0.03 cm/rev.

In cylinder only two faces



$$\text{Time / face} = \frac{L}{fXN} = \frac{D/2}{fXN}$$

$$\therefore \text{total time} = \frac{D/2}{fXN} \times 2 = 1.33 \text{ min}$$

Q. The roughing speed & finishing speed for turning a job 30 m/min & 60 m/min the respective feeds are 0.24 mm/rev 0.1 mm/rev the max depth of cut is 2mm, min depth of cut is 0.75 mm take material constant 1600 N/mm^2. Calculate power required for roughing & finishing in watts.

Sol:-

$$F_c = K \cdot d \cdot f$$

$$(F_c)_r = 1600 \times 2 \times 0.24$$

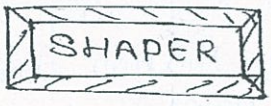
$$= 768$$

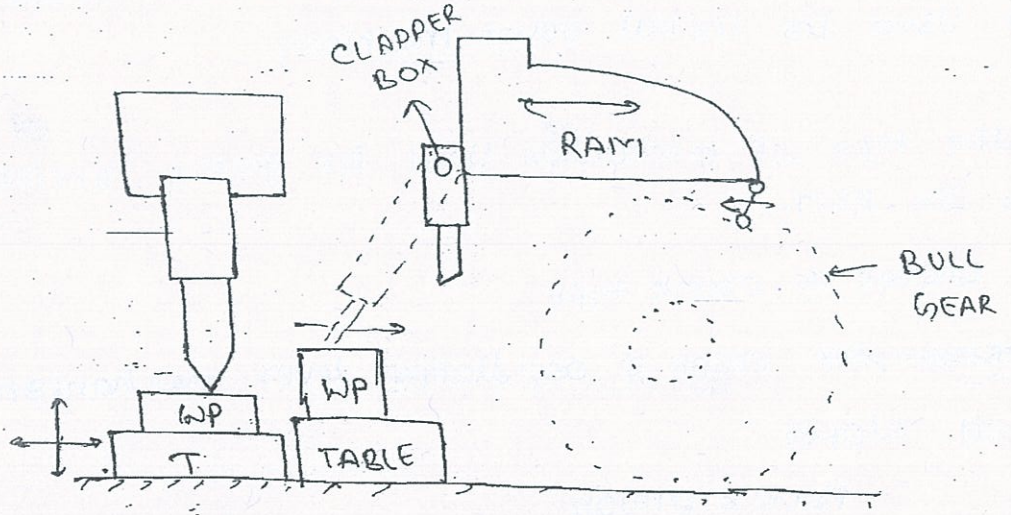
$$(P)_r = 768 \times 30$$

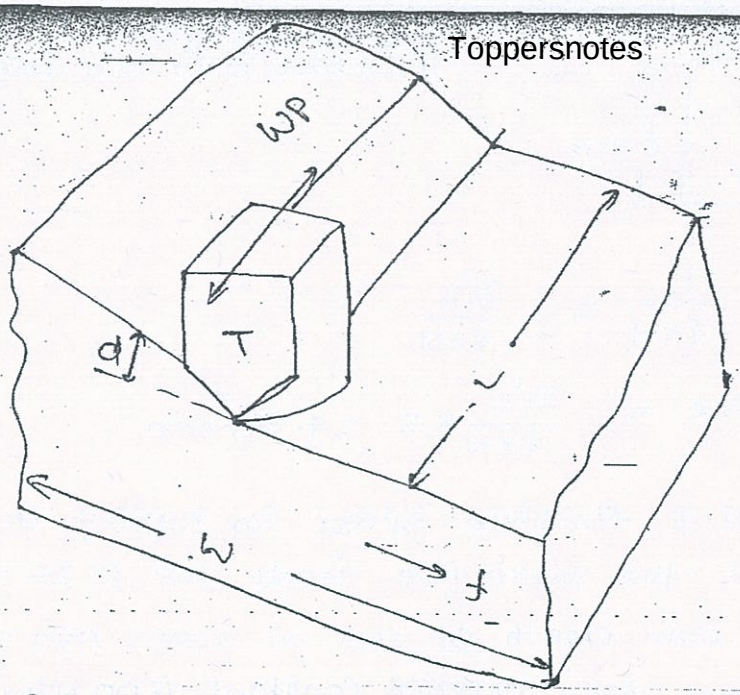
$$= 23040 = 384 \text{ watt}$$

$$(P)_f = \frac{1600 \times 0.75 \times 0.1 \times 60}{60}$$

$$= 120 \text{ watt.}$$







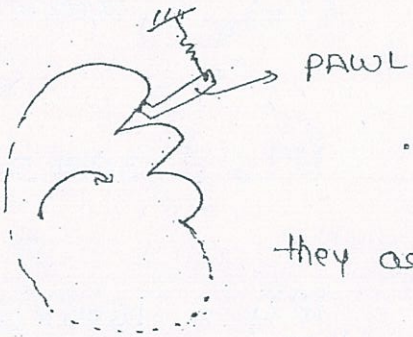
→ generating flat surface.

→ here converted Rotary to Reciprocating motion.

→ cutting is not continuous in this process.

BULL GEAR

→ it reducing the speed. we are using simple Gear train. reducing speed are used in Reciprocating motion.



they are using table feed.

RATCHET & PAWL

Shaper

Shaper is a reciprocating type of machine tool used for producing flat surfaces the tool is given reciprocating motion while the work is given feed. the tool is single point tool similar to lathe

→ This is used for initial rough machining.

Types

i) A/c to the type of mechanism used for giving reciprocating motion to the RAM.

A) crank shaper or crank type

~~Rack and pinion~~ crank & oscillating lever mechanism

Rotation to translation

B) Geared shaper

Rack & pinion

c) Hydraulic Shaper — Constant speed & Constant

By Hydraulic power oil is pumped into a piston with piston cylinder arrangement. any stroked length we will set.

2) A/c to the position and travel of the Ram

A) Horizontal Shaper / Ram reciprocates in horizontal axis.

B) Vertical shaper / Ram reciprocates in vertical axis.

C) travelling head type shaper / the Ram moves cross wise feed during reciprocation and it is used for heavy job where table feed is not possible.

3) A/c to the type of design of the table.

A) Standard Shaper / table has two movement.
(left & Right
Up & down)

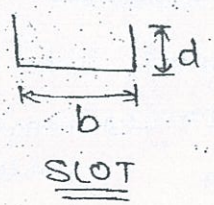
B) Universal shape / in addition to above two movements the table can be swivelled about a horizontal axis. Parallel to the Ram guide ways and upper portion of the table can be tilted about a second horizontal axis ⊥r to the first.

Specifications

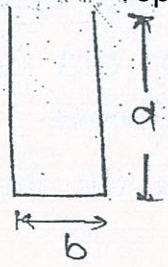
(i) max length of stroke or cut — width → table movement, length → Ram ,,
(ii) table size
(iii) return time to cutting time ratio.
(iv) no of speed & feeds
(v) floor space required.
(vi) weight of the machine etc.

Operations

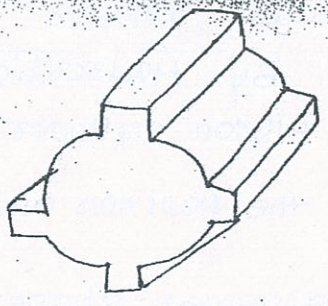
i) Machining of horizontal, vertical & angular surface
ii) cutting slots, groove, keyways, Grees, splines, ↙ External.



SLOT



GROOVE



Time estimation:-

1) Cutting Speed

$$V = \frac{NL\ell(1+m)}{1000}$$

where L = length of cutting stroke mm

m = ratio of return and to cutting time

N = No of double stroke / min (one cutting stroke + one Return stroke)

NOTE:- (i) in actual practice cutting speed changes during the cutting stroke in the crank type & Geared type Shapers. Hence sometime the avg. cutting speed can be expressed as

$$V_{avg} = \frac{NL\ell(1+m)}{2 \times 1000}$$

(ii) in hydraulic shaper constant speed is possible during the strokes & also any stroke length can be set.

2) total time for one complete cut:-

$$T = \frac{LW(1+m)}{1000 f V}$$

W = width of the workpiece

f = feed mm, mm/cutting stroke, mm/double stroke (SAME)

3) MRR :-

$$MRR = 1000 V f d \ mm^3/min$$