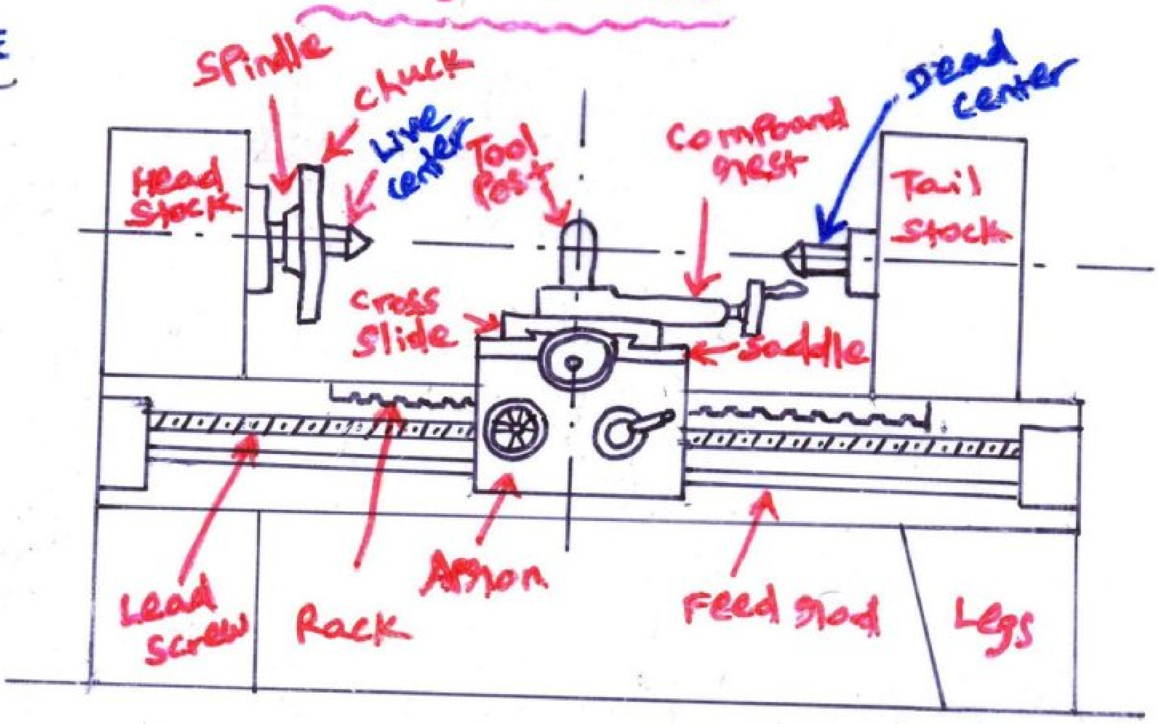
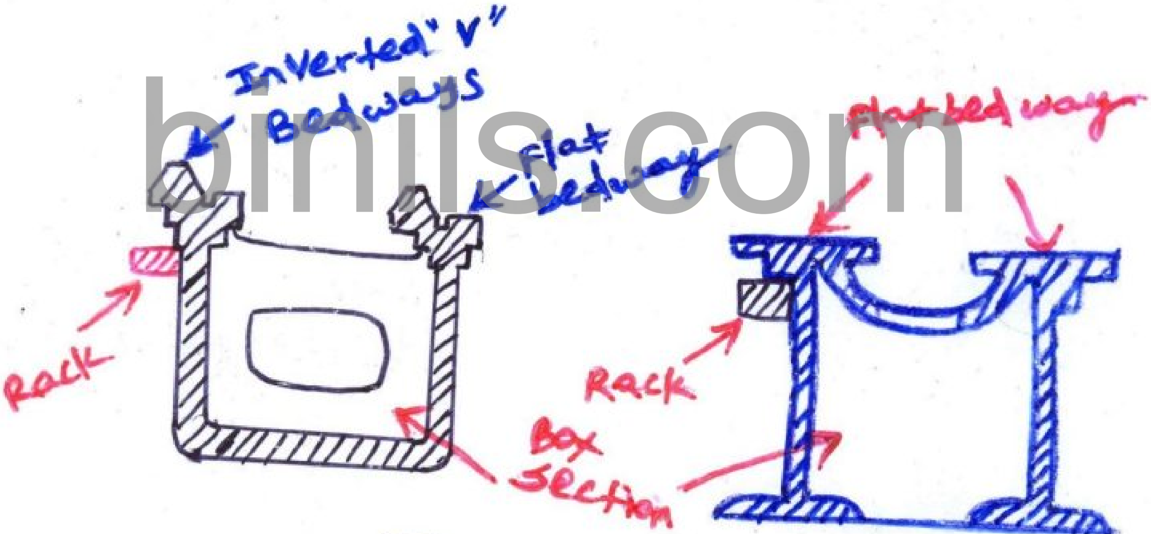
Turning Machines

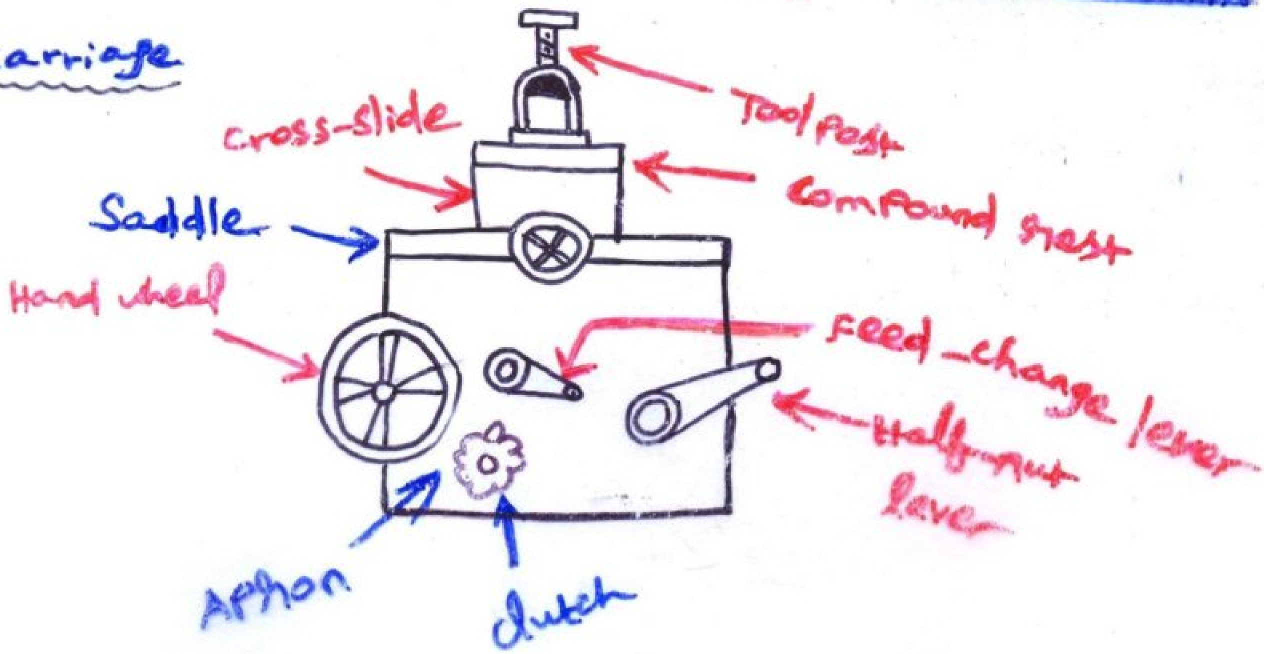
LATHE



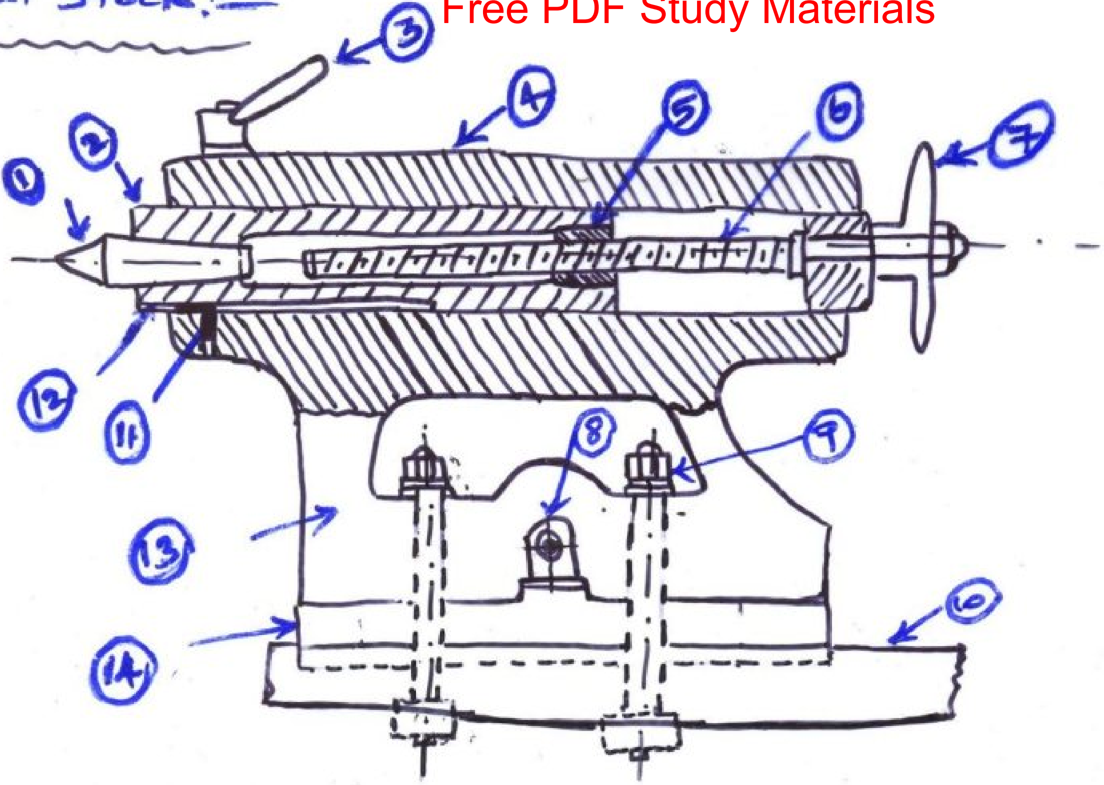
Bed



Carriage

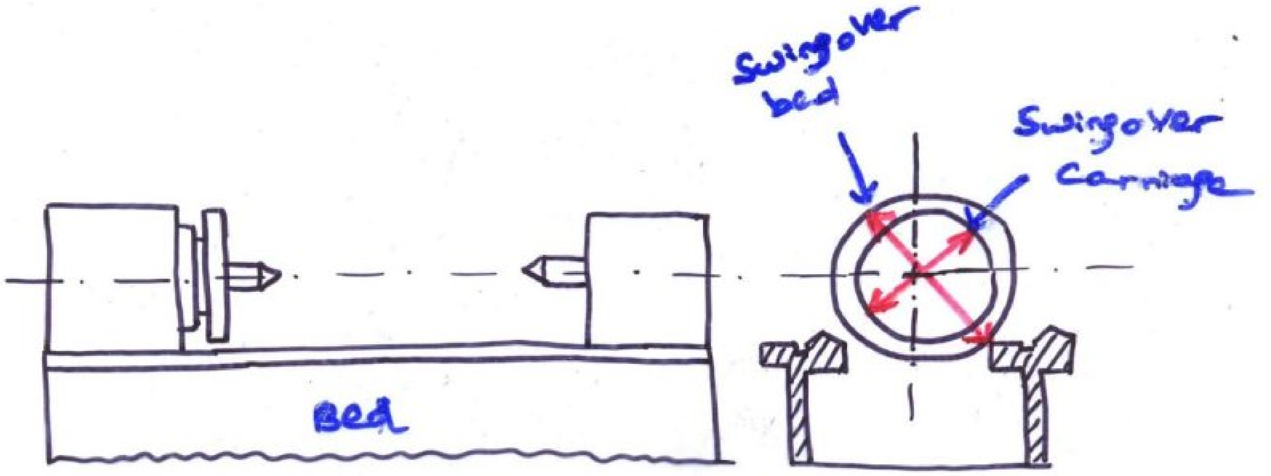


Tail Stock:



1. Dead center 2. Spindle 3. Spindle clamp 4. Barrel
5. Bush 6. Screw 7. Hand wheel. 8. Set over screw
9. Tail stock clamping bolt 10. Lathe bed ways.
11. Key 12. Keyway 13. Top body 14. Lower body

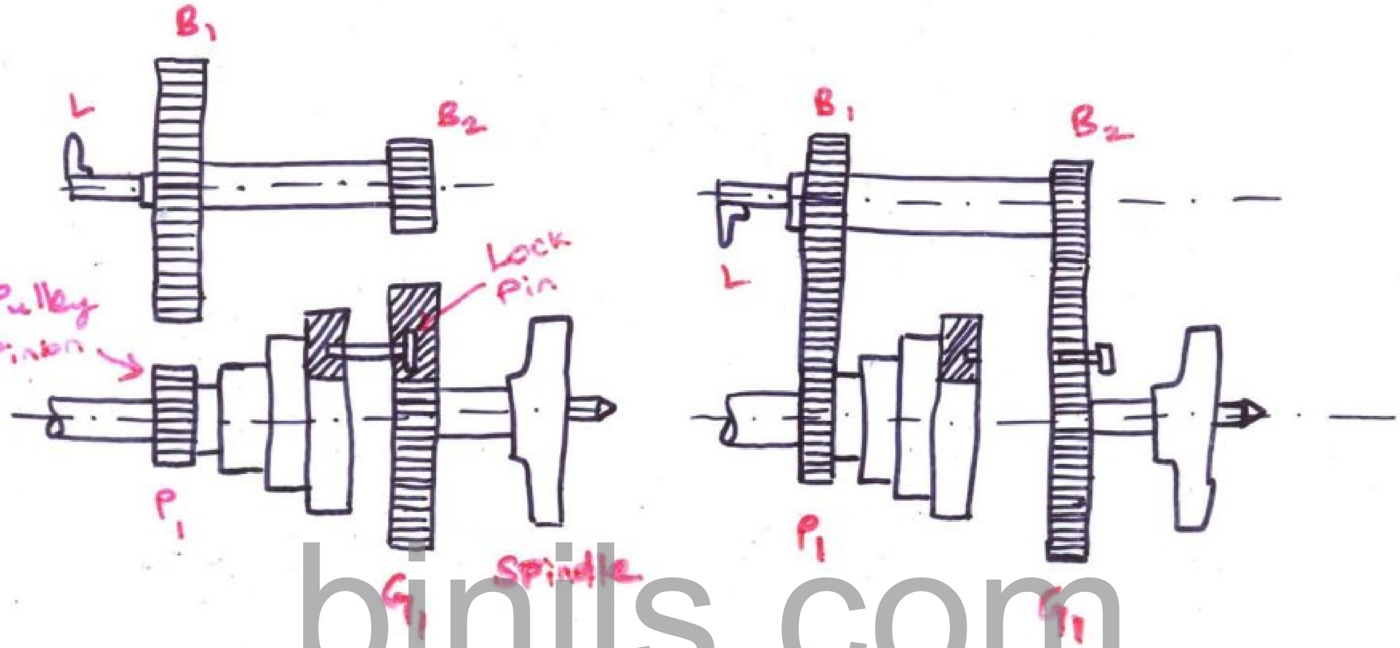
Specification of Lathe:



Head Stock Mechanism:-

1. Back Geared Head Stock
2. All Geared Head Stock.

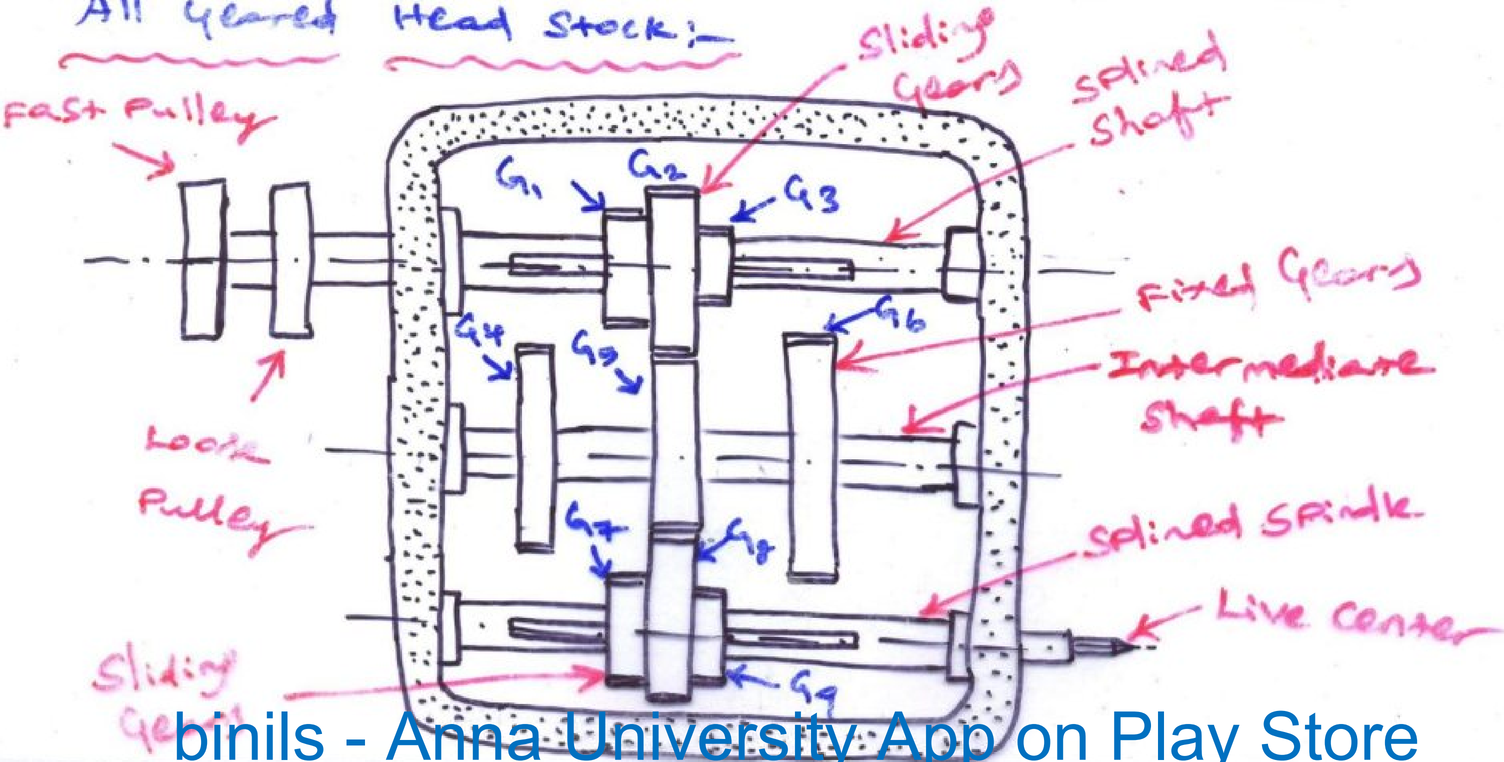
Back Geared Head Stock:-



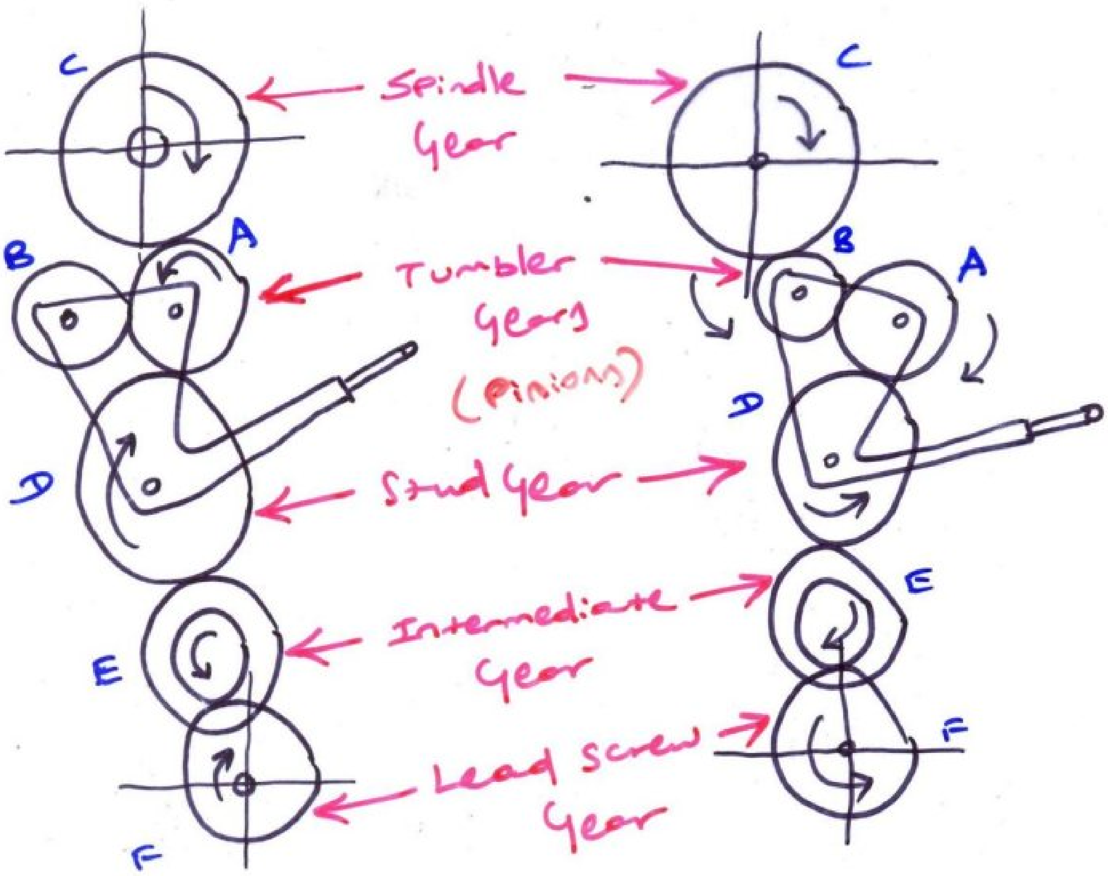
(a) Direct Speed [Lock Pin Engaged]

(b) Indirect Speed [Lock Pin Disengaged]

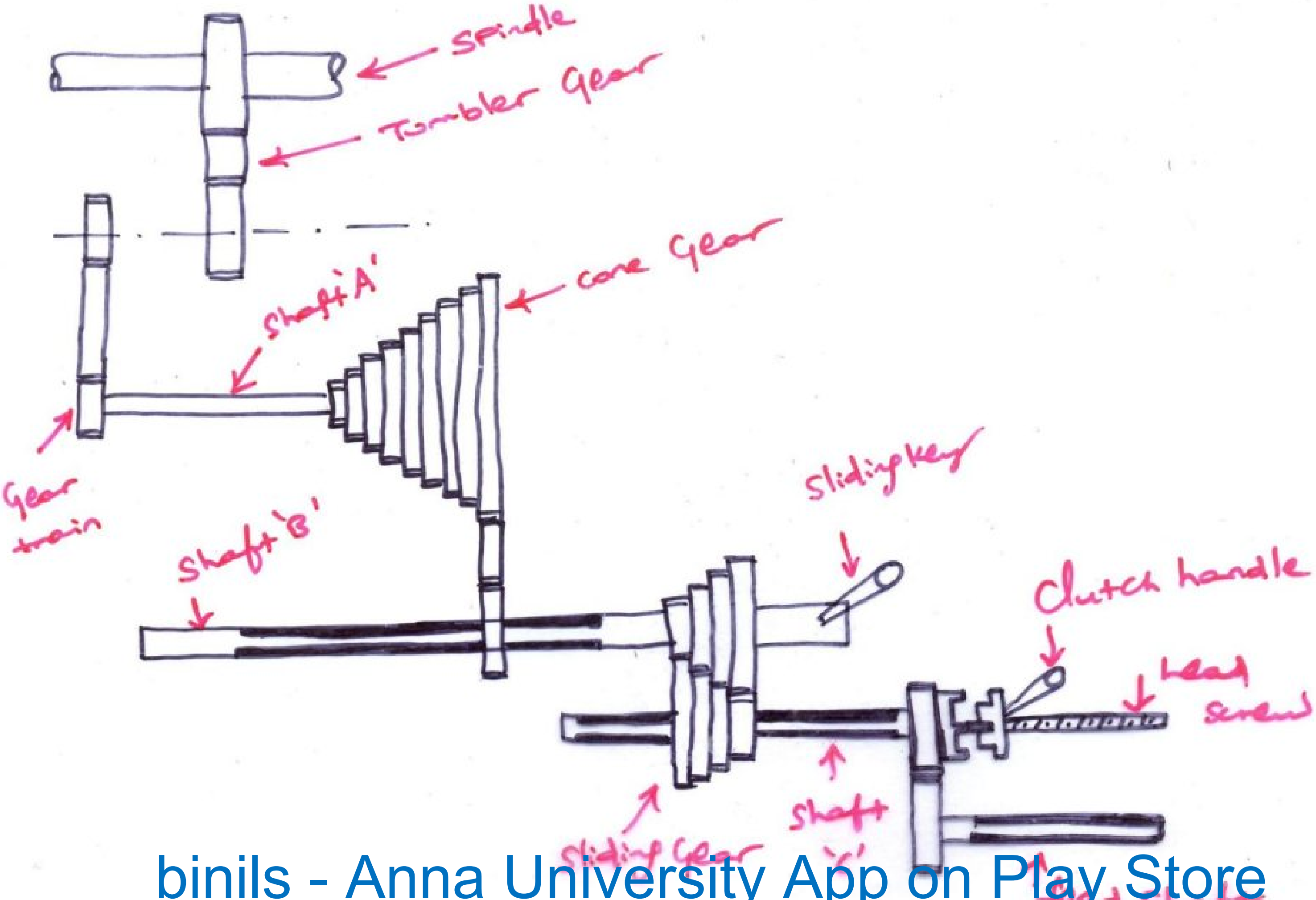
All Geared Head Stock:-



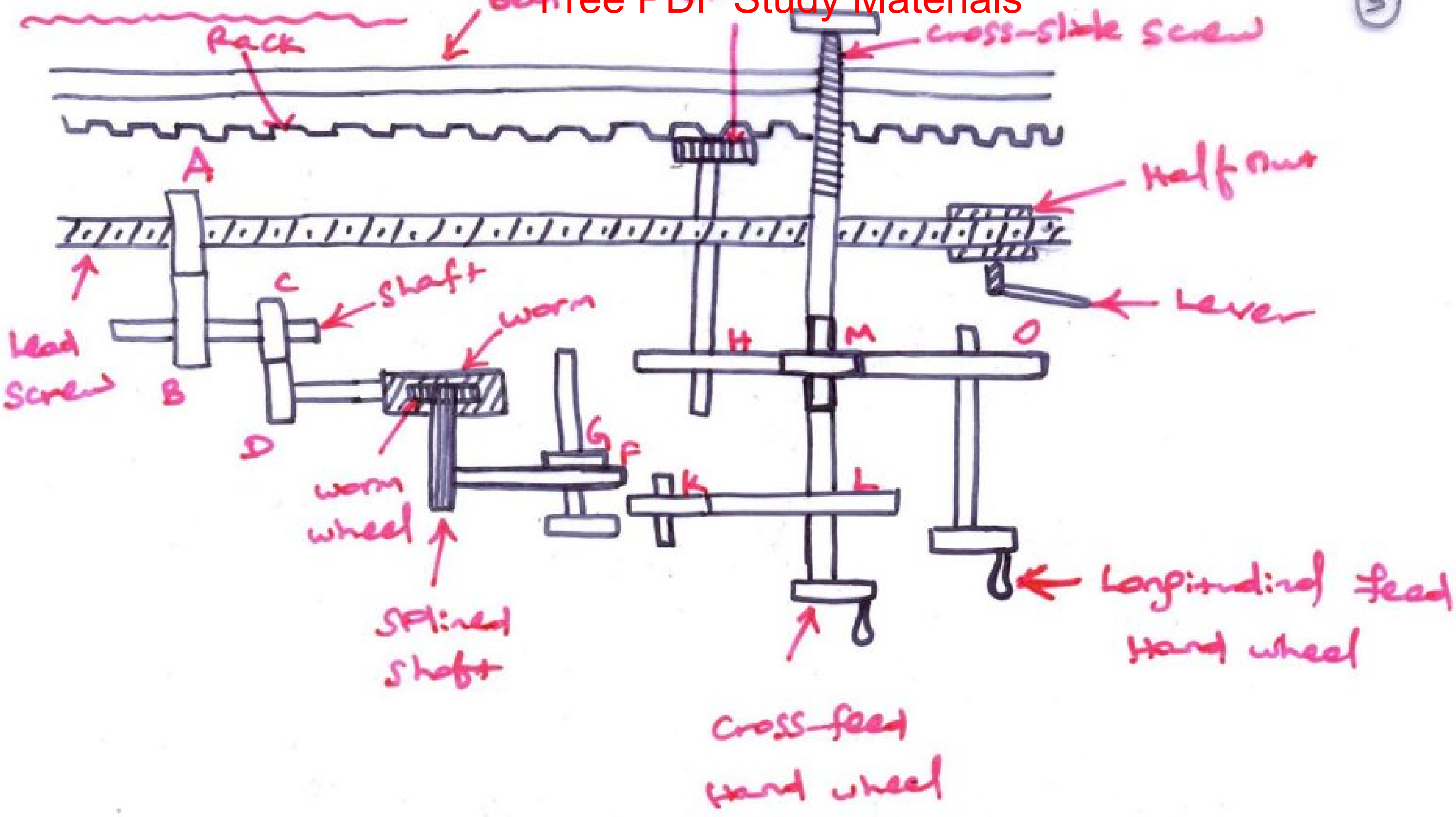
Tumbler Gear Reversing Mechanism



Quick change Gear box:-



Apron Mechanism

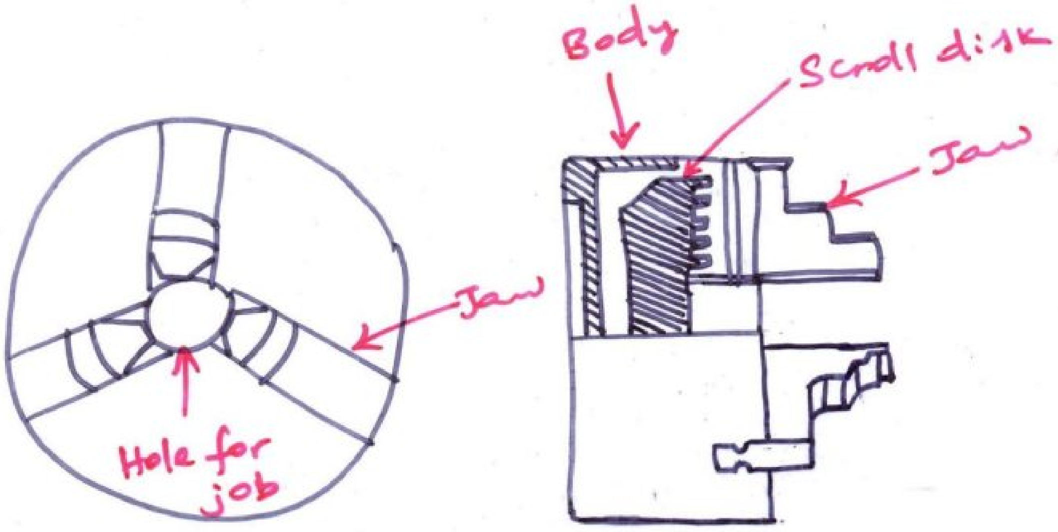


Work Holding Devices:—

① Chucks ② Centers ③ Faceplate ④ Angle plate
⑤ Mandrels ⑥ Steady & follower rest

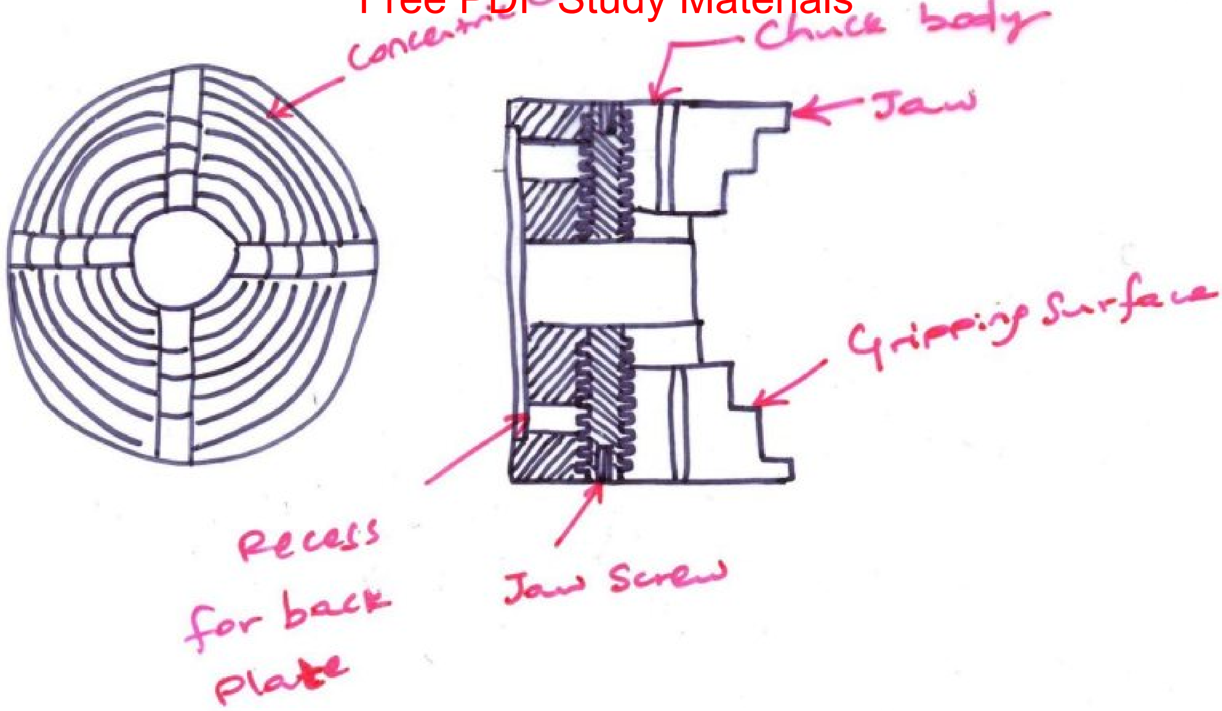
① Chucks

= ⓐ Three jaw (or) self Centering
ⓑ Four jaw Chuck. ⓒ Magnetic chuck



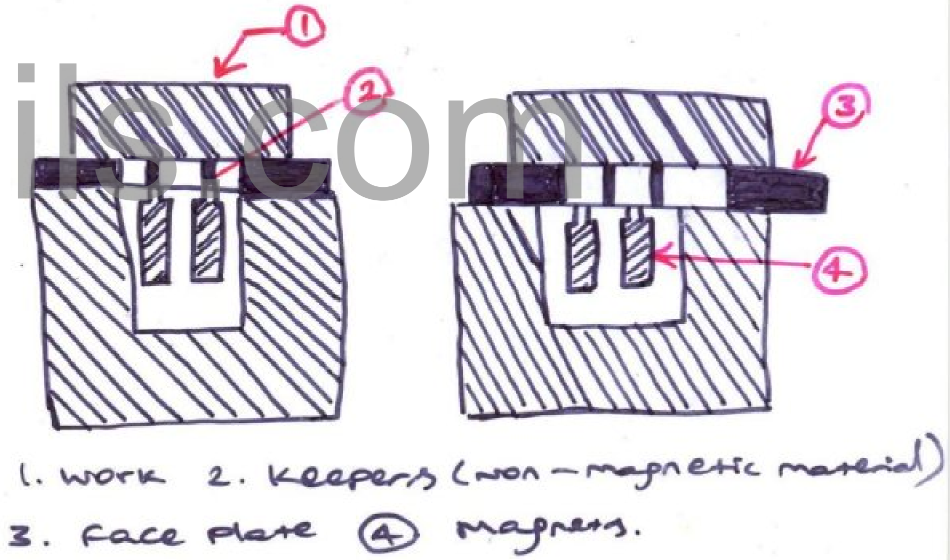
L < 40

Three jaw (or) Self-Centering Chuck



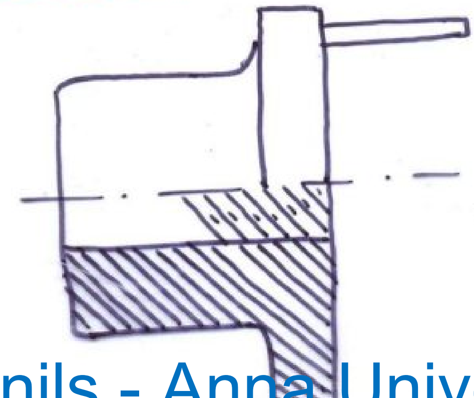
Four Jaw Independent Chuck

Magnetic Chuck

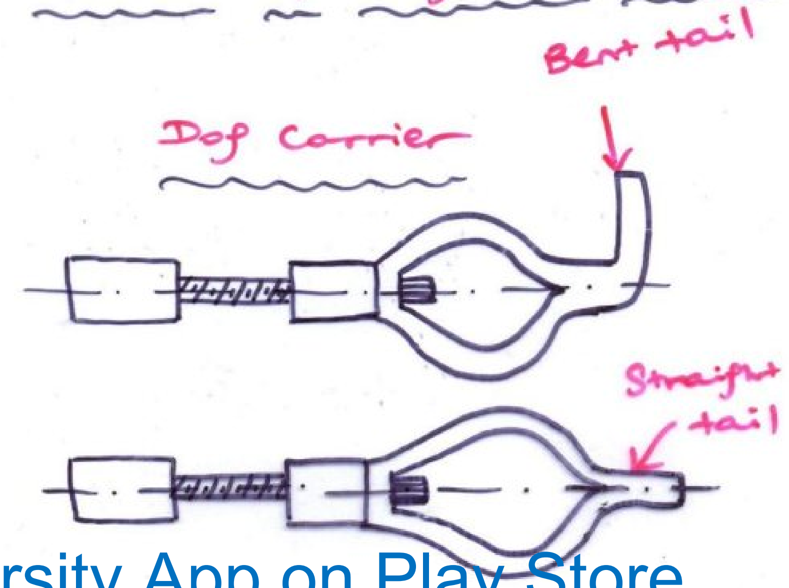


Principle of magnetic chuck

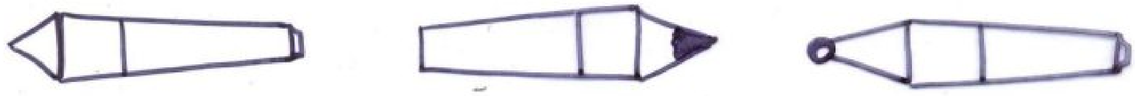
② Centers :-



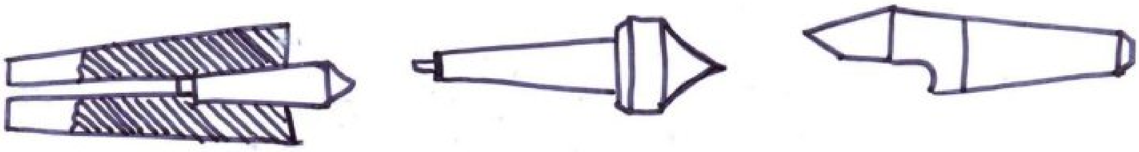
Catch Plate



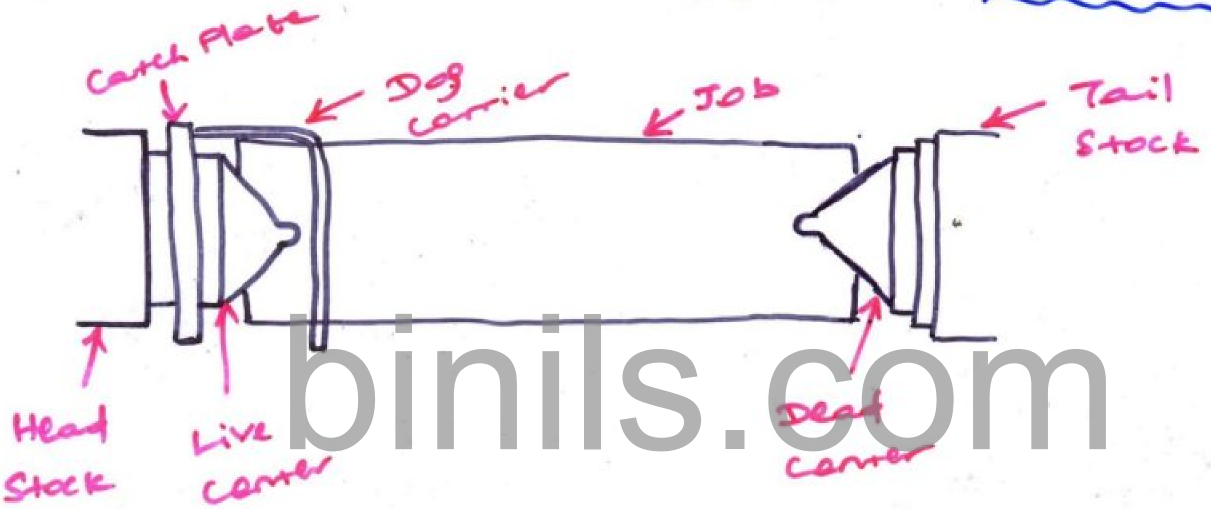
Dog carrier



Ordinary center   Tipped center   Ball center

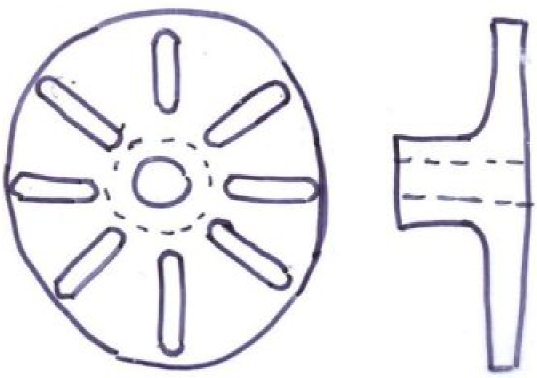


Insert type center   Pipe center   Half center

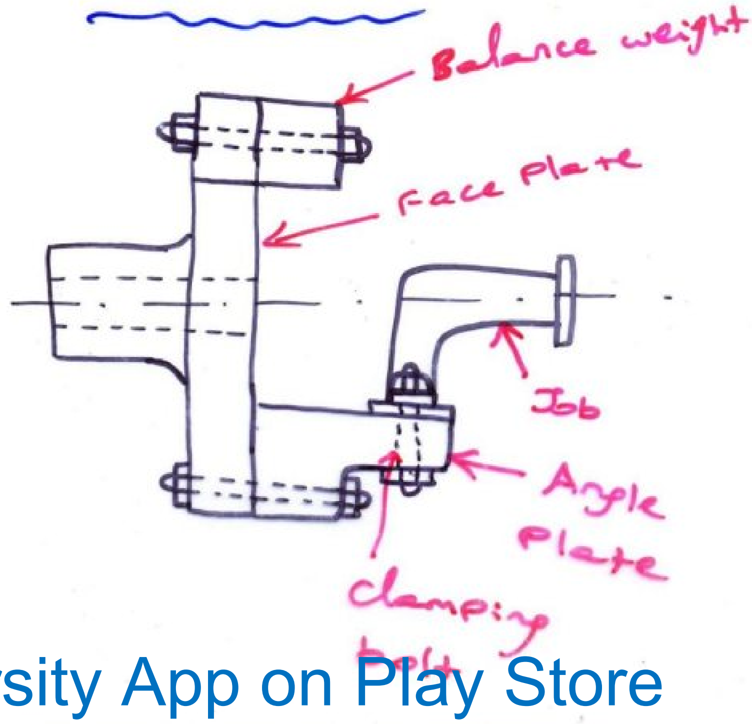


Work held b/w centers

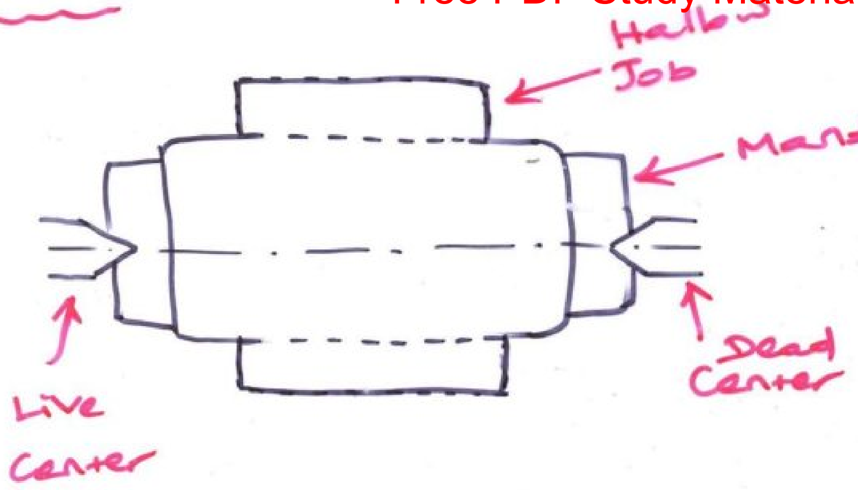
Face plate:-



Angle plate



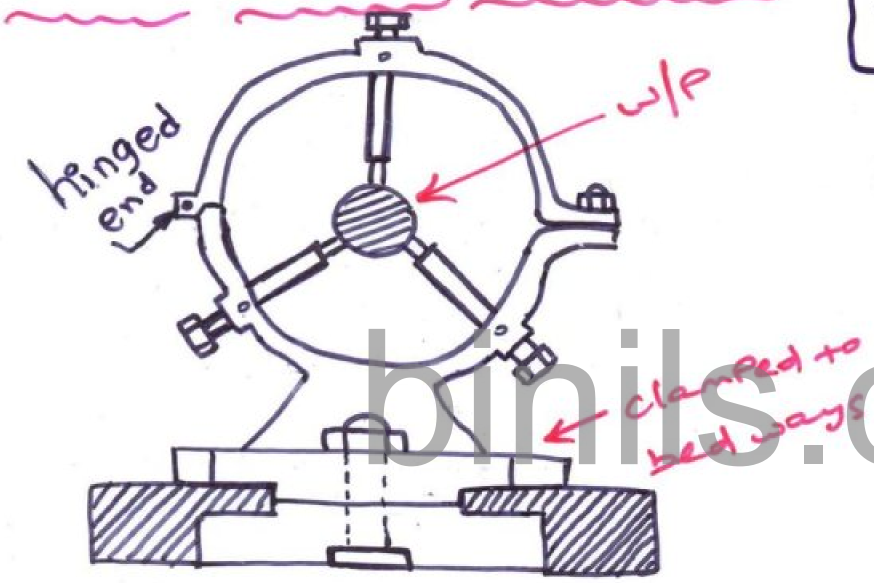
Mandrels:-



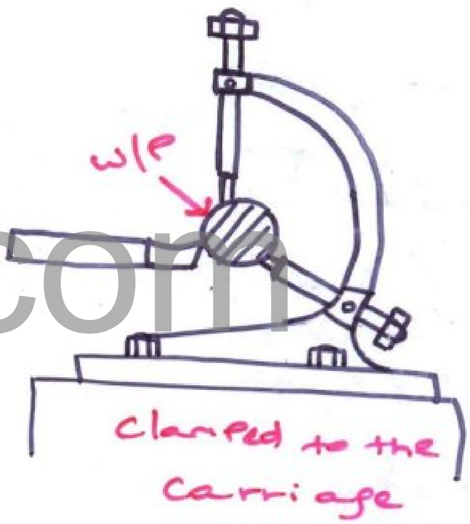
Plain Mandrel

Steady and Follower Rest:-

$$\left[\frac{L}{D} > 10 \text{ (or) } 12\right]$$



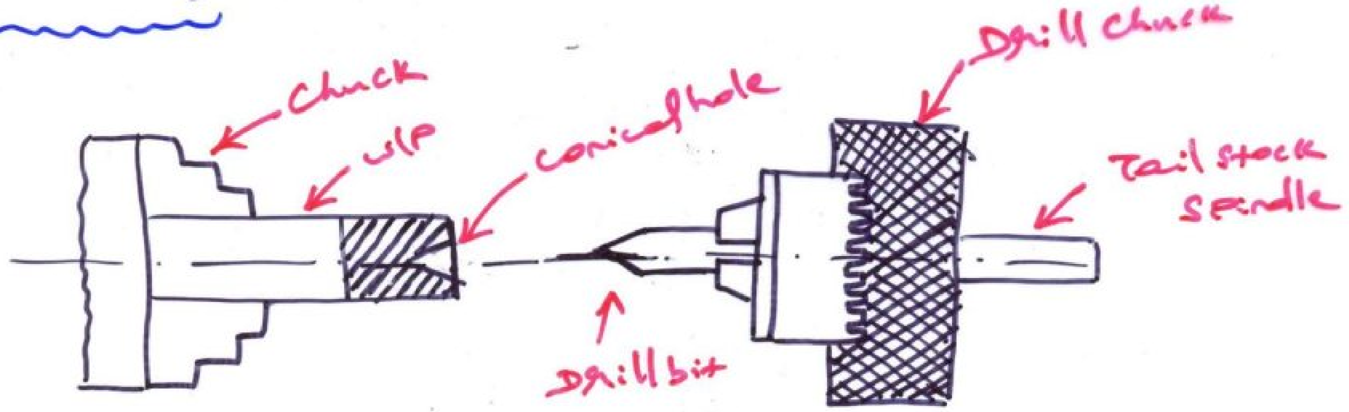
Steady Rest



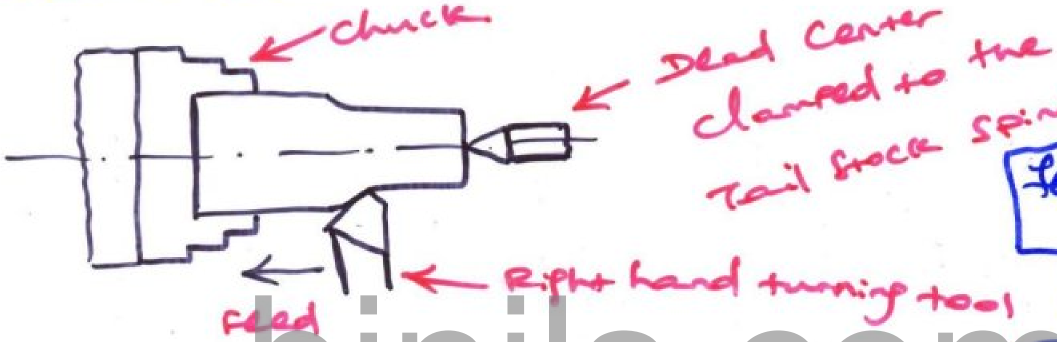
Follower Rest

Various operations performed on lathe

① Centering:—



② Straight (or) Plain turning:—



Rough turning

F ↑ d ↑ S ↓

feed, f = 0.3–1.5 mm/rev

d = 2m–5mm

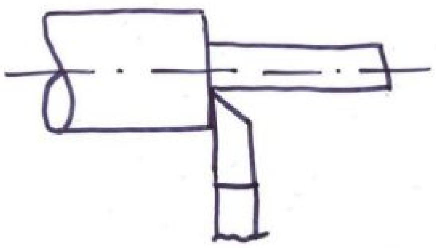
Finish turning

F ↓ d ↓ S ↑

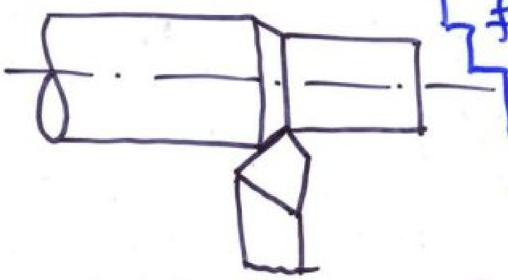
f = 0.1–0.3

d = 0.5–1

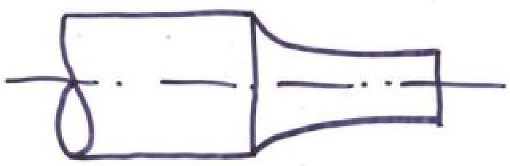
③ Shoulder turning:—



Square Shoulder



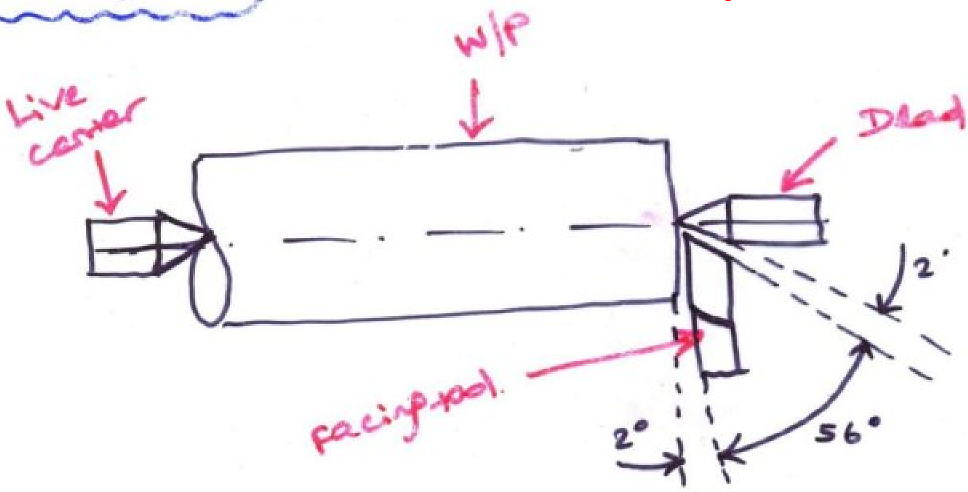
Angular (or) Bevelled Shoulder



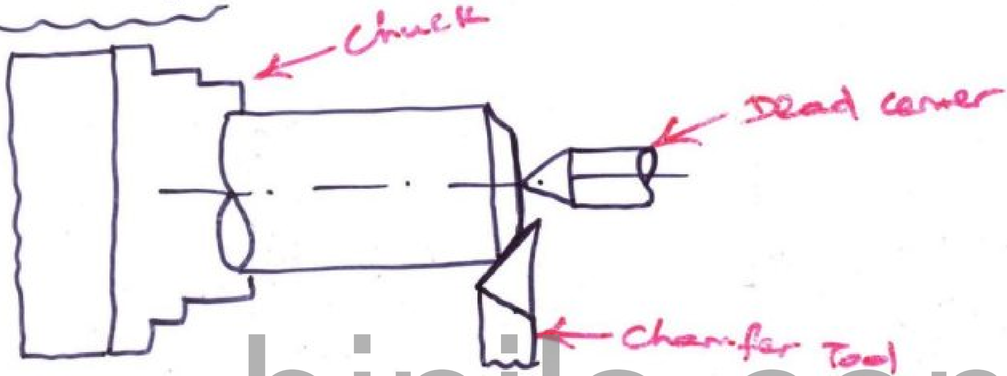
Radious (or) filleted Shoulder

undercut Shoulder

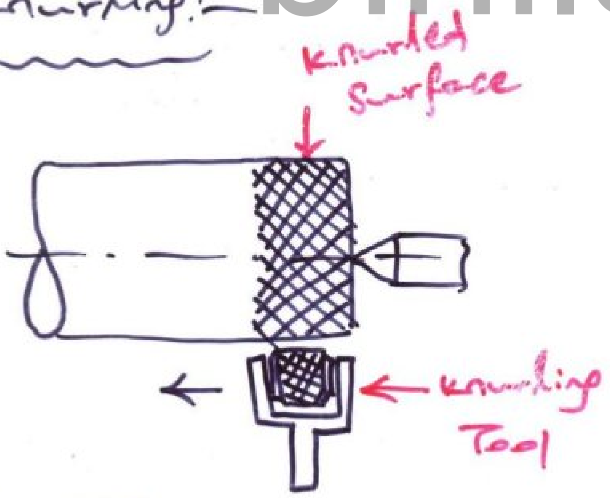
④ Facing :-



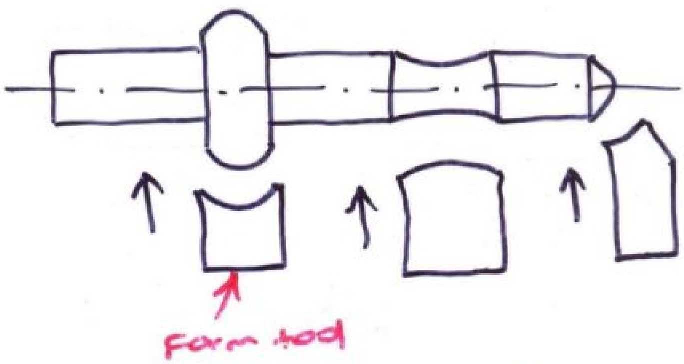
⑤ Chamfering :-



⑥ Knurling :-

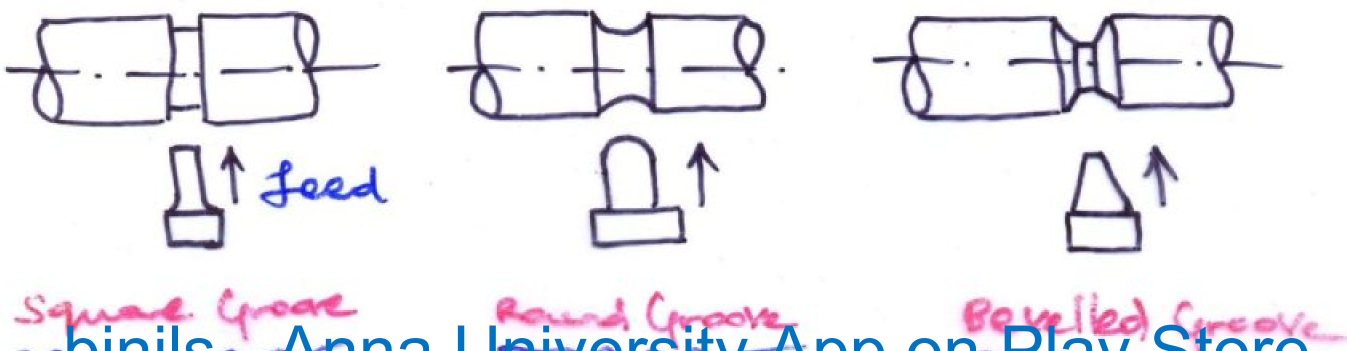


⑦ Forming :-

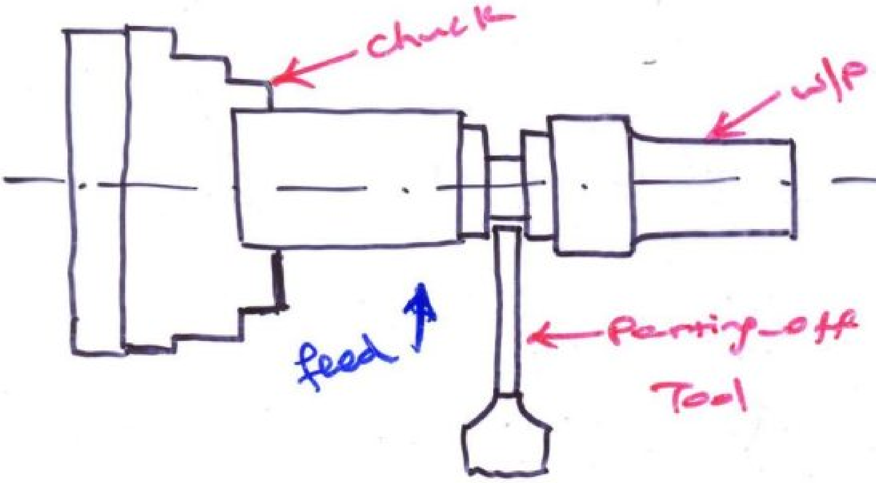


⑧ Grooving :-

(Recessing, undercutting, necking)



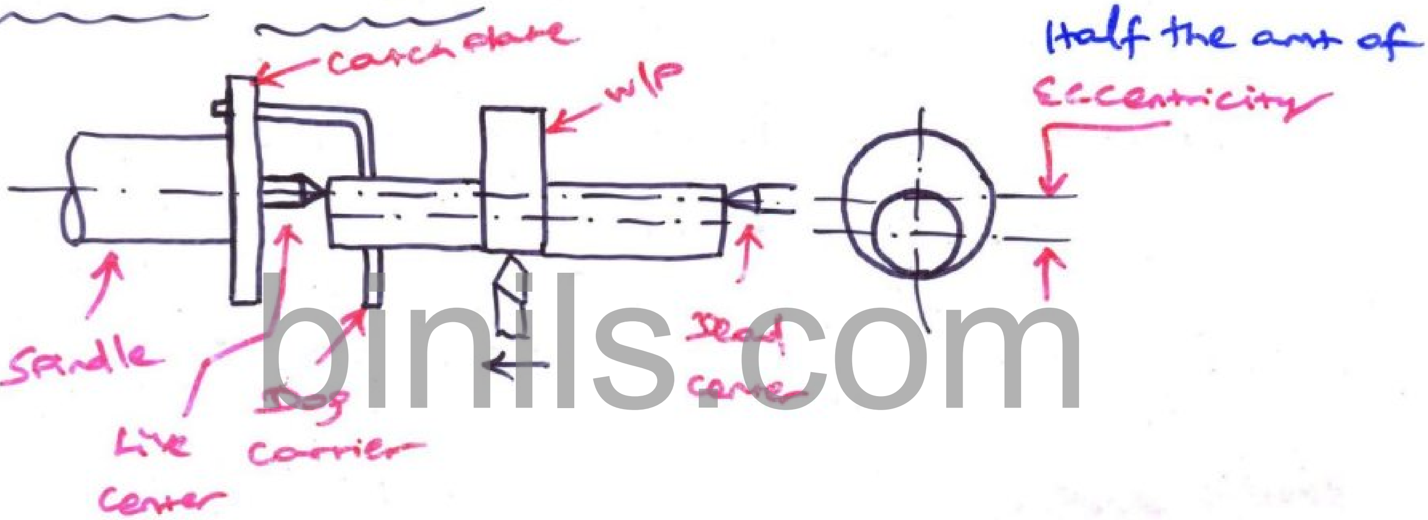
(10) Parting-off:-



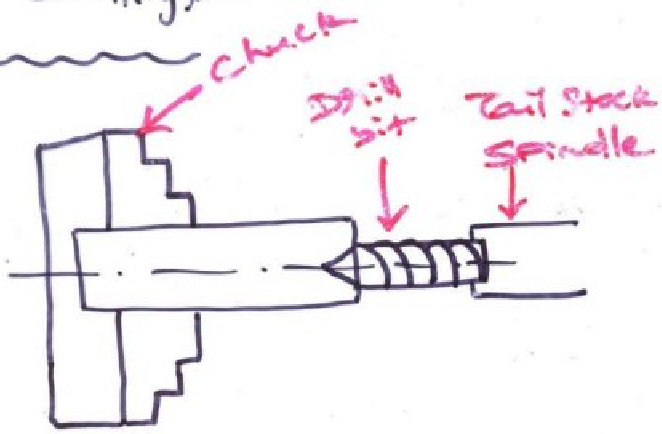
① Spindle speed $= \frac{1}{2}$ (speed of turning)

② Slow cross-feed.

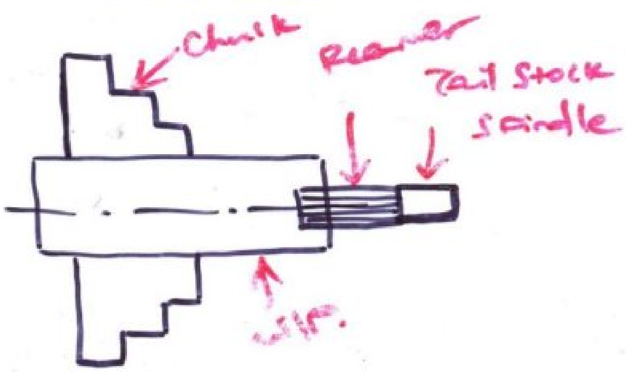
(11) Eccentric turning:-



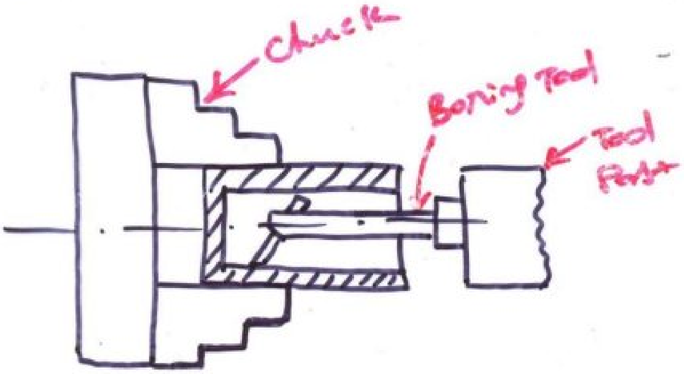
(12) Drilling:-



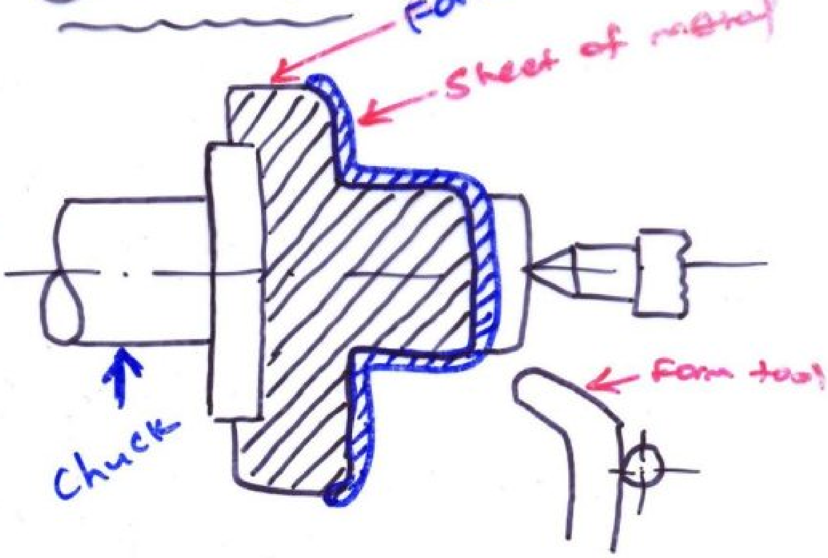
(13) Reaming:-



(14) Boring:–



(15) Spinning:–

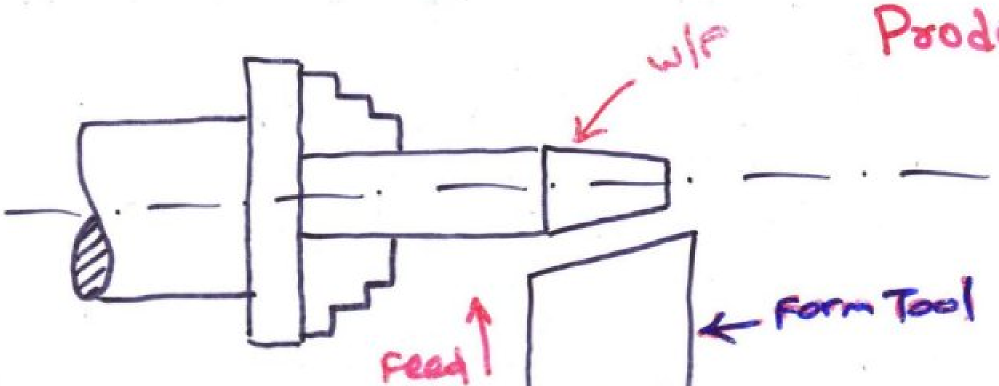


Taper turning Methods:–

(a) Form Tool method (b) Tailstock set over method

(c) Compound Rest method (d) Taper turning Attachment method (e) by Combining feeds.

(a) Form Tool Method:–



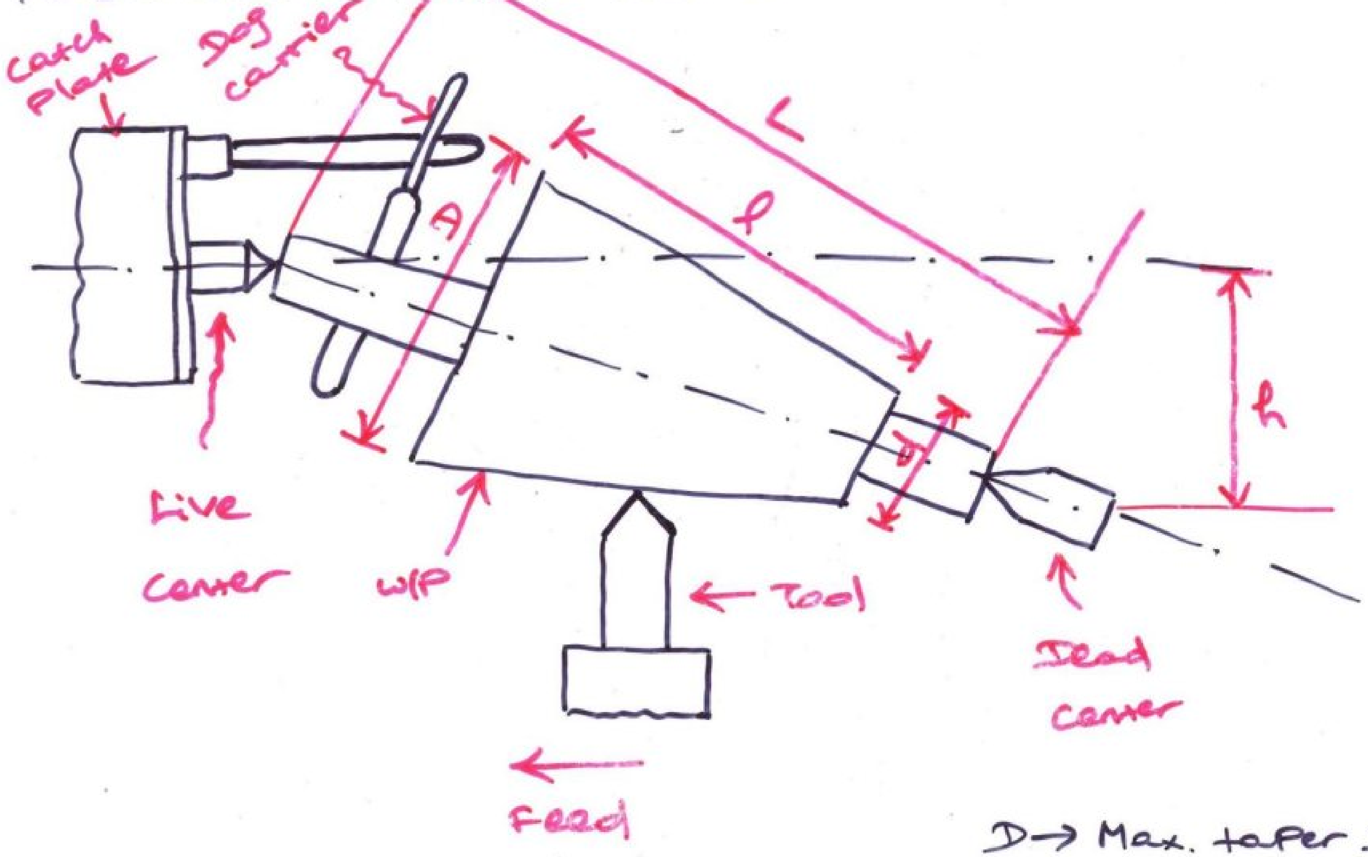
Produce Short taper

(b) Compound Rest method:–

α – Half of the taper angle

$\tan\alpha = \frac{D-d}{2l}$

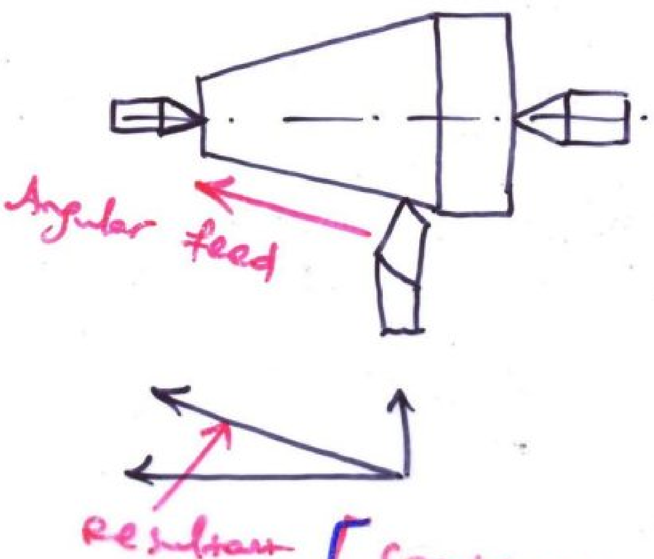
(c) Tail Stock Set over method:-



D → Max. taper Dia
d → Min taper Dia
l → Taper length
L → Length of w/P
α → Half taper angle

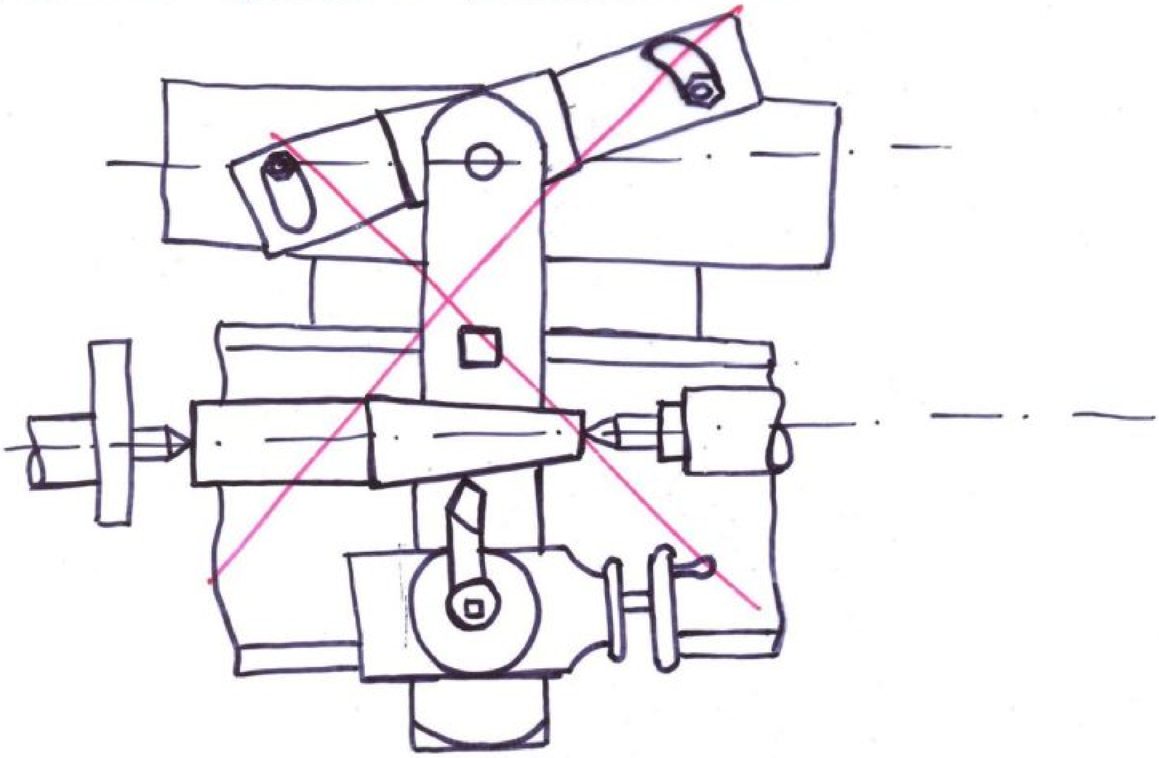
$$\text{Set over } h = \frac{D-d}{2l} \times L = L \tan\alpha$$

(d) Taper turning by giving Combined feed:-

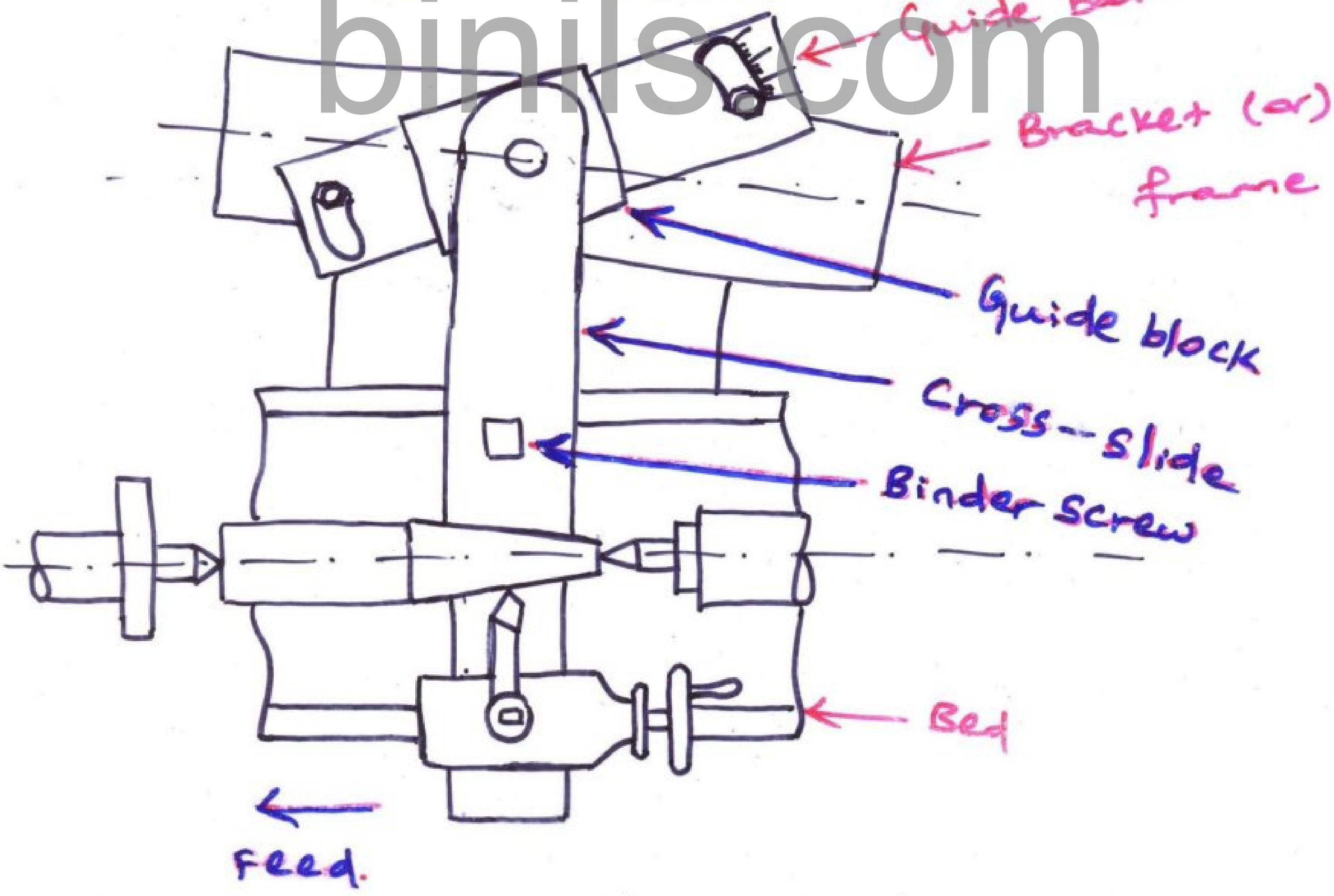


[Combination of Cross & Longitudinal feed]

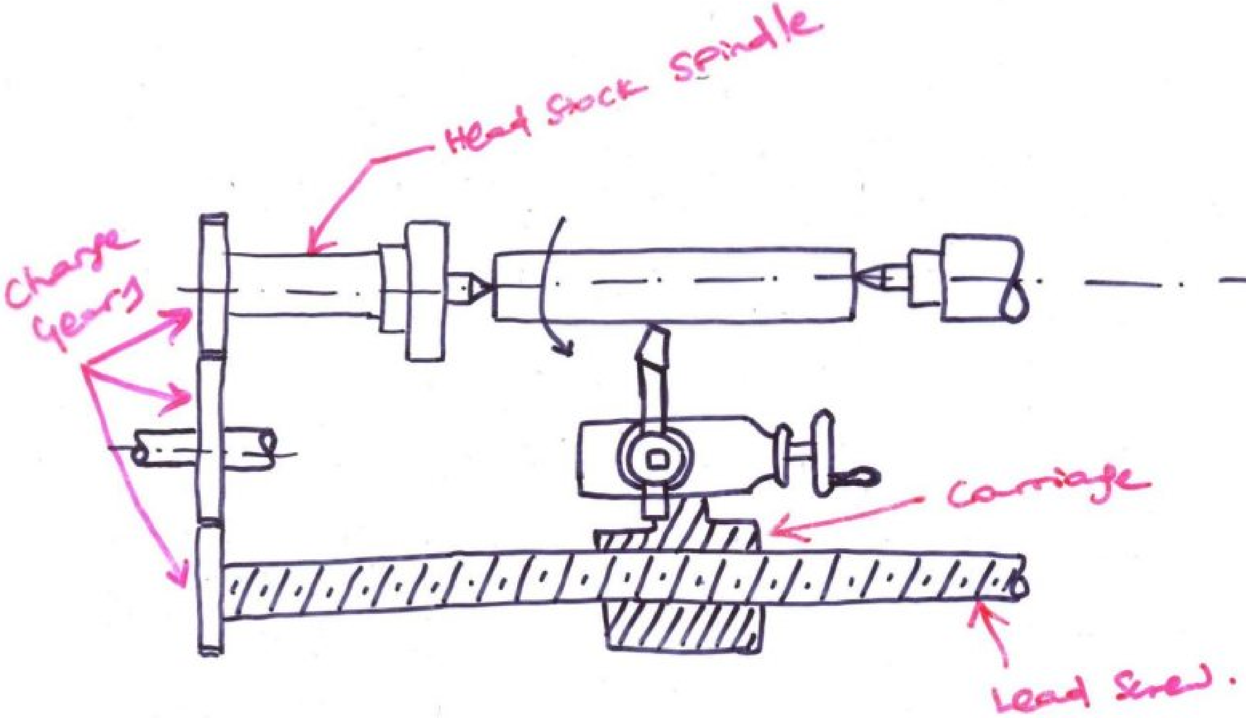
(e) Taper turning Attachment:-



(e) Taper turning Attachment:-



Thread cutting:—



Formula for calculating the change wheels (gears):—

(1) $$\frac{\text{Driver teeth}}{\text{Driven teeth}} = \frac{\text{lead screw speed}}{\text{spindle speed}} = \frac{\text{Pitch of screw to be cut}}{\text{Pitch of the lead screw}}$$

In English measurements

(2) $$\frac{\text{Driver teeth}}{\text{Driven teeth}} = \frac{\text{thread per inch [t.p.i] of w/p}}{\text{thread per inch [t.p.i] of leadscrew}}$$

Here,

$$\text{pitch} = \frac{1}{\text{No of thread / inch}}$$

Metric thread on English lead screw:

$$\frac{\text{Driver teeth}}{\text{Driven teeth}} = \frac{\text{Pitch on the work}}{\text{Pitch on the lead screw}}$$

$$= \frac{P}{\left[\frac{1}{n} \times \frac{127}{5}\right]}$$

$$\frac{127}{5} = 25.4\,mm$$

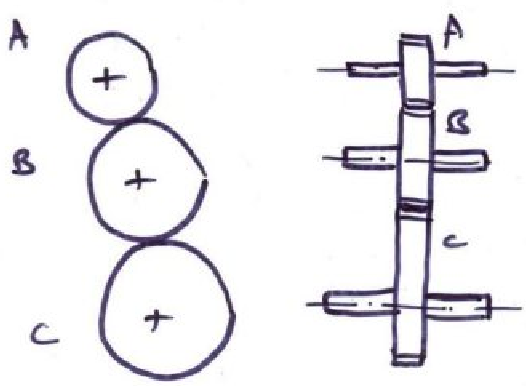
(3)
$$\frac{\text{Driver teeth}}{\text{Driven teeth}} = \frac{5Pn}{127}$$

1 inch = 25.4 mm

$$= \frac{25.4 \times 5}{5} = \frac{127}{5}$$

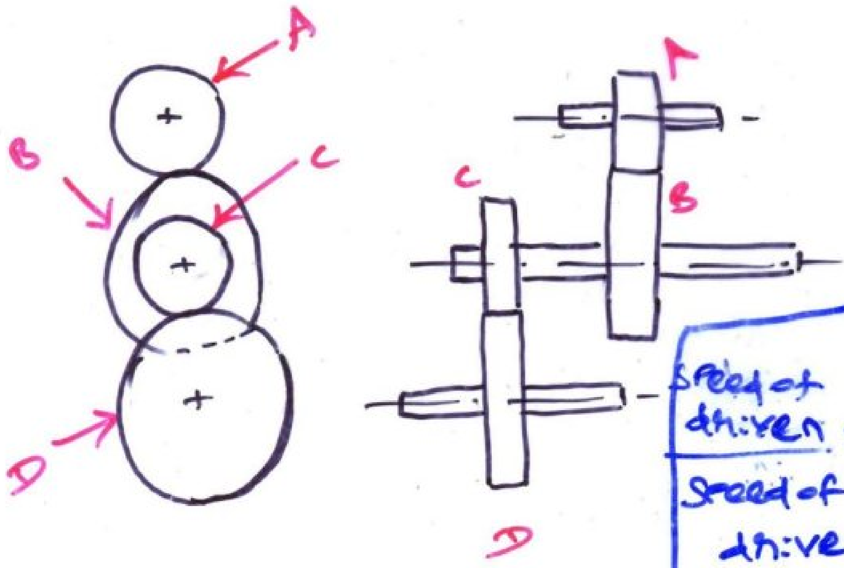
* So, the cutting of metric thread on a lathe with a English lead screw may be carried out by introducing a traslating gear of 127 teeth.

Simple and compound Gear train:—



B → Intermediate Gear

Simple Gear train



A, C ⇒ Driver

B, D ⇒ Driven

$$\frac{\text{Speed of driven}}{\text{Speed of driver}} \Rightarrow \frac{A}{B} \times \frac{C}{D}$$

driven – lead screw

driver – Spindle

Compound Gear train

Often engine lathe are equipped with a set of gears ranging from 20 to 120 teeth in a steps of 5 teeth and one gear with 127 teeth.

Problems:–

① The pitch of a lead screw is 6mm & the pitch of the thread to be cut 1 mm. Find change gears

$$= \frac{\text{Driver teeth}}{\text{Driven teeth}} = \frac{\text{pitch of work}}{\text{Pitch of lead screw}}$$

$$= \frac{1}{6} = \frac{1 \times 20}{6 \times 20} = \frac{20}{120}$$ [Simple Gear train]

So, Driver gear should have 20T & Driven gear should have 120 teeth.

(2) Pitch of lead screw is 6mm. Pitch of thread to be cut is 1.25mm. Find the change wheels

Soln:-

$$\frac{\text{Driver teeth}}{\text{Driven teeth}} = \frac{\text{Pitch of work}}{\text{Pitch of lead screw}} = \frac{1.25}{6}$$

$$= \frac{1.25 \times 4}{6 \times 4} = \frac{5}{24}$$

$$= \frac{5 \times 5}{24 \times 5} = \frac{25}{120}$$ [Simple Gear train]

(or)

$$= \frac{5 \times 1}{6 \times 4} = \frac{5 \times 10}{4 \times 10} \times \frac{1 \times 20}{6 \times 20}$$

$$= \frac{50}{40} \times \frac{20}{120}$$ $\left[\frac{A}{B} \times \frac{C}{D}\right]$

[Compound Gear train]

∴ Driver A & C = 50T & 20T

Driven B & D = 40T & 120T

(3) It is required to cut a screw having 7mm pitch on a lathe having a leadscrew of 4 threads per inch. Calculate gears.

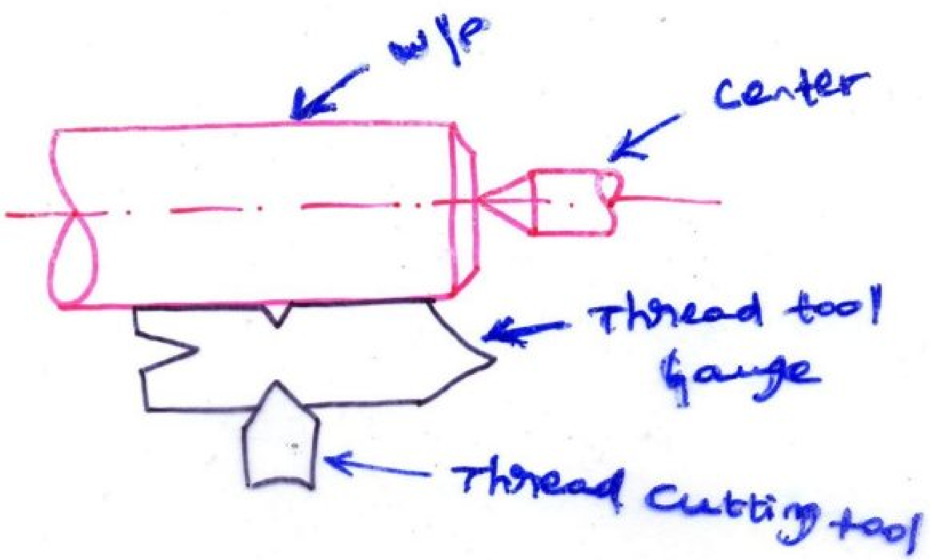
$$\frac{\text{Driver teeth}}{\text{Driven teeth}} = \frac{5P_n}{127} = \frac{140}{127}$$

$$= \frac{70 \times 2}{127} = \frac{70 \times 2 \times 20}{127 \times 20} = \frac{70}{127} \times \frac{40}{20}$$

Steps involved in Thread Cutting Operation:—

1. Remove the excess material from the w/p to make its diameter equal to the major diameter of the thread.
2. Change gears of correct size are then fitted b/w the Spindle and the Lead Screw.
3. Choose the cutting tool based on the shape (or) form of the thread.
4. For a metric thread, the included angle b/w the cutting edge of the tool is 60°.
5. The nose of the tool should be set at the same height as the center of the w/p.

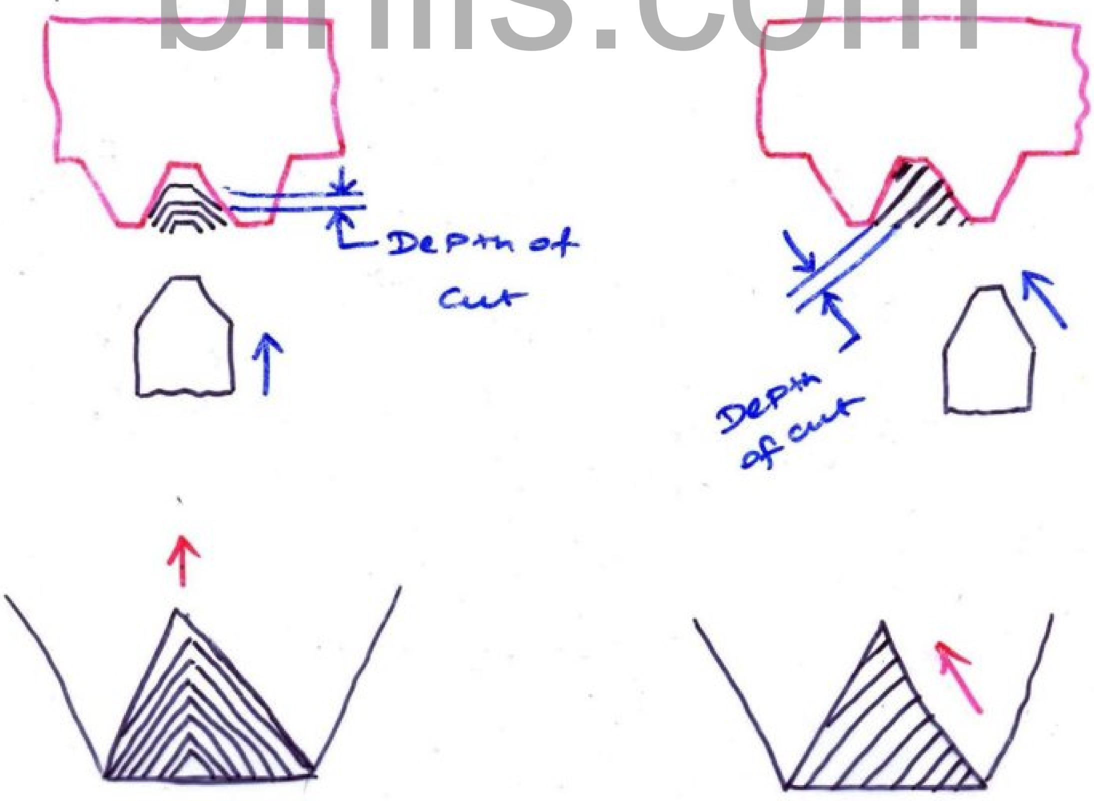
6. A thread tool gauge is usually used against the turned surface to check the cutting tool so that each face of the tool is equally inclined to the centerline of the workpiece



(7) The speed of the spindle is reduced by one-half to one-fourth of the speed required for turning according to the type of material being machined.

(8) The depth of cut which usually varies from 0.05 – 0.2 mm is applied by advancing the tool $\perp^r$ to the axis of the work (or) at an angle equal to one-half of the angle of the thread and 30° in case of metric thread by swivelling the compound rest.

Different Methods of Applying Depth of cut



Applying Depth of cut $\perp^r$ to the lathe axis

Applying Depth of cut inclined to the axis by

(9) After the tool has produced "helical groove" upto the end of the work, this is quickly withdrawn from the cross-slide and the tool is brought back to the starting position to give a fresh cut.

(10) Before giving a fresh cut, it is necessary to ensure that the tool is at the starting point of the thread. Otherwise the job will be spoiled. Several cuts are necessary before the full depth of thread is reached.

(11) Making the tool being at the start point of the thread when the fresh cut is given is called "pick-up of thread".

(12) Based on the "pick-up of thread", thread cutting methods can be classified as

1. Thread cutting by reversing the m/c
2. Thread cutting by marking the lathe parts
3. Thread cutting using chasing dial (or) thread indicator
4. Thread cutting by thread chaser

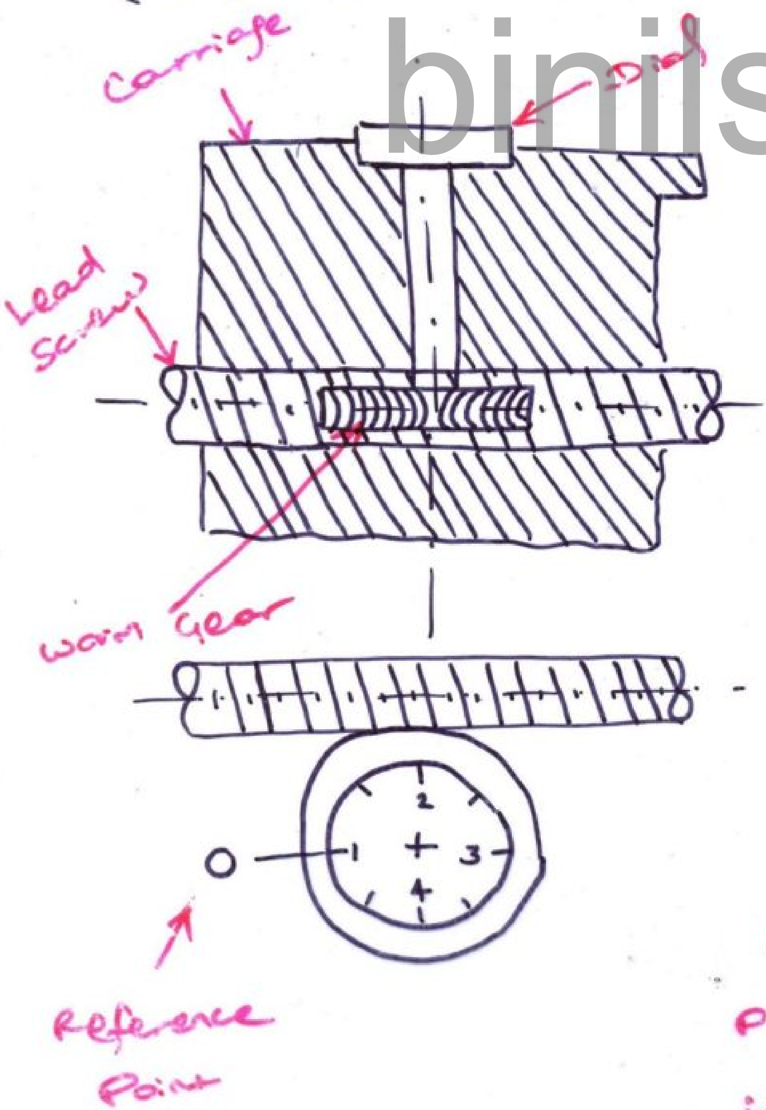
① Reversing the m/c:-

After the end of one cut, the tool is brought back to the starting position by reversing the machine keeping half-nut permanently engaged. This method requires considerable time.

② Marking the lathe parts:-

Marking lead screw, gear wheels, starting position of the carriage on the bed.

③ Using chasing dial (or) thread Indicator:-



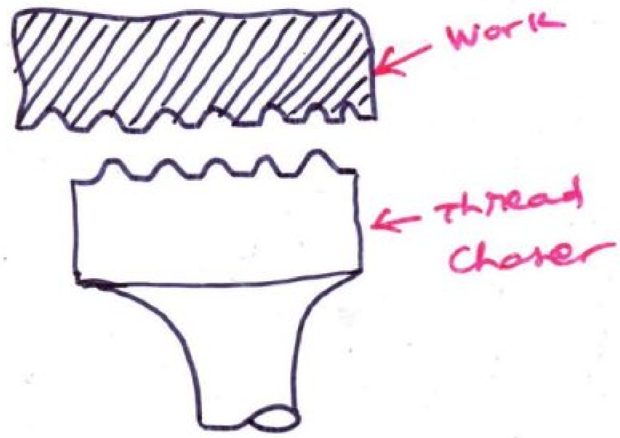
① Chasing dial (or) thread Indicator consists of a worm gear which is in mesh with a lead screw.

② With a worm gear attached, a vertical shaft connecting the dial gauge.

③ When the lead screw rotates, the dial gauge will also rotate.

④ By using this, the start point of the tool can be easily identified.

(4) Thread Cutting by using Thread Chaser:-



(1) A chaser is a multi point threading tool having the same form and pitch of the thread to be chased.

(2) It is used to finish a partly cut thread to the size & shape required

(3) Thread chasing is done $\frac{1}{3}$ to $\frac{1}{2}$ of the speed of the turning.

Classification of threads:-

(1) Based on the standards

(1) Whitworth [British Standard]

Depth = 0.6403 x P

Angle = 55° to the Lathe axis

(2) British Association [BA]

Depth = 0.6 x P

Angle = 47.5°

(3) Metric thread [ISO]

Max Depth = 0.7035 x P

Min Depth = 0.6855 x P

Angle = 60°

(4) ACME [American Standards]

Height of thread = 0.5P + 0.254 mm

Angle = 29°

(2) Based on the pitch of the lead screw & work

(1) Even thread

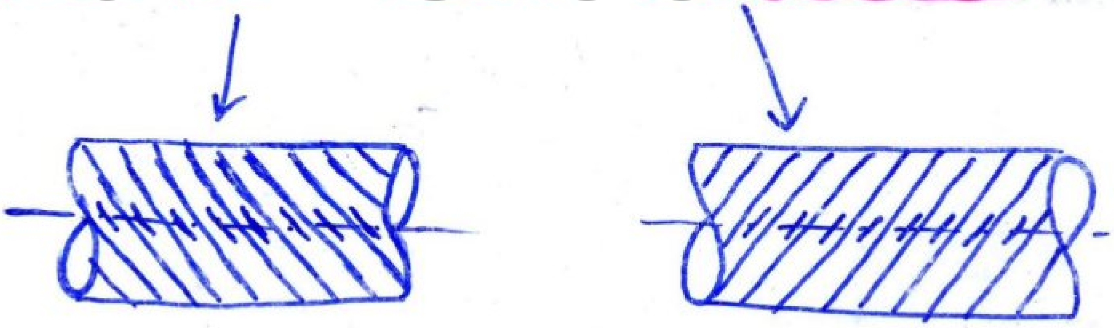
- Pitch of work is an multiple of the pitch of lead screw.

(2) Odd thread

- Pitch of work is not an multiple of pitch of lead screw.

(3) Based on the thread position

Right hand & Left hand thread



(4) Single Start & Multi-Start threaded Screw

Single Start threaded Screw :-

For one complete turn round the screw, if there is a movement of one thread, the screw is called single start thread.

* "Lead" is the distance thread advances along its axis in one turn.

* So, In single start thread, Lead = Pitch

| Lead = No. of Start × Pitch |

Multi-Start thread:-

* For one complete turns when there is a movement of more than one thread it is called multi start thread.

* In case of, say, a three-start thread, for one complete turn, the thread advances three time as if it was a single thread.

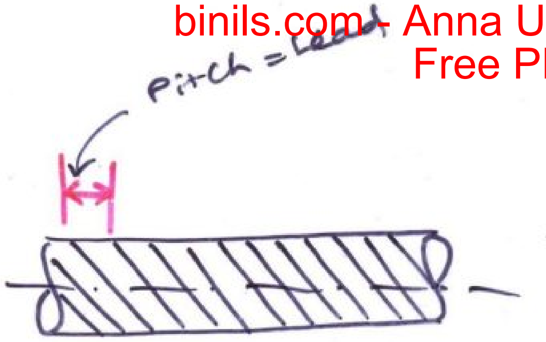
Here Lead ≠ pitch

Lead = 3P [for three start thread]

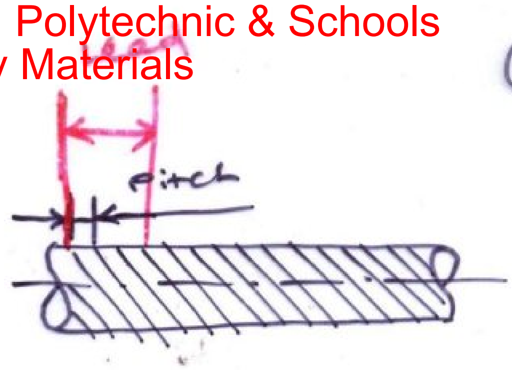
Application:-

1. House hold faucet's & taps
2. Milk bottles & water bottles
3. Medicines. etc.

$$\frac{\text{Driver Gear}}{\text{Driven Gear}} = \frac{\text{Lead of the work}}{\text{Pitch of the lead Screw}}$$

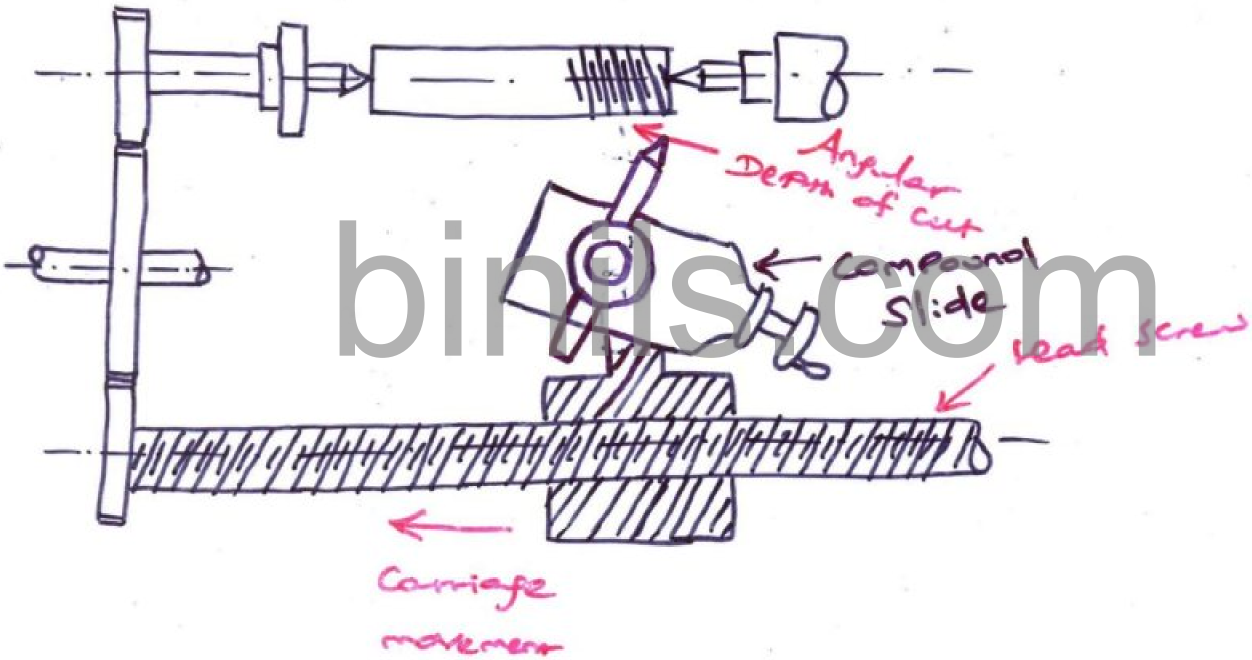


Single Start thread



Three Start thread

Thread cutting using compound slide

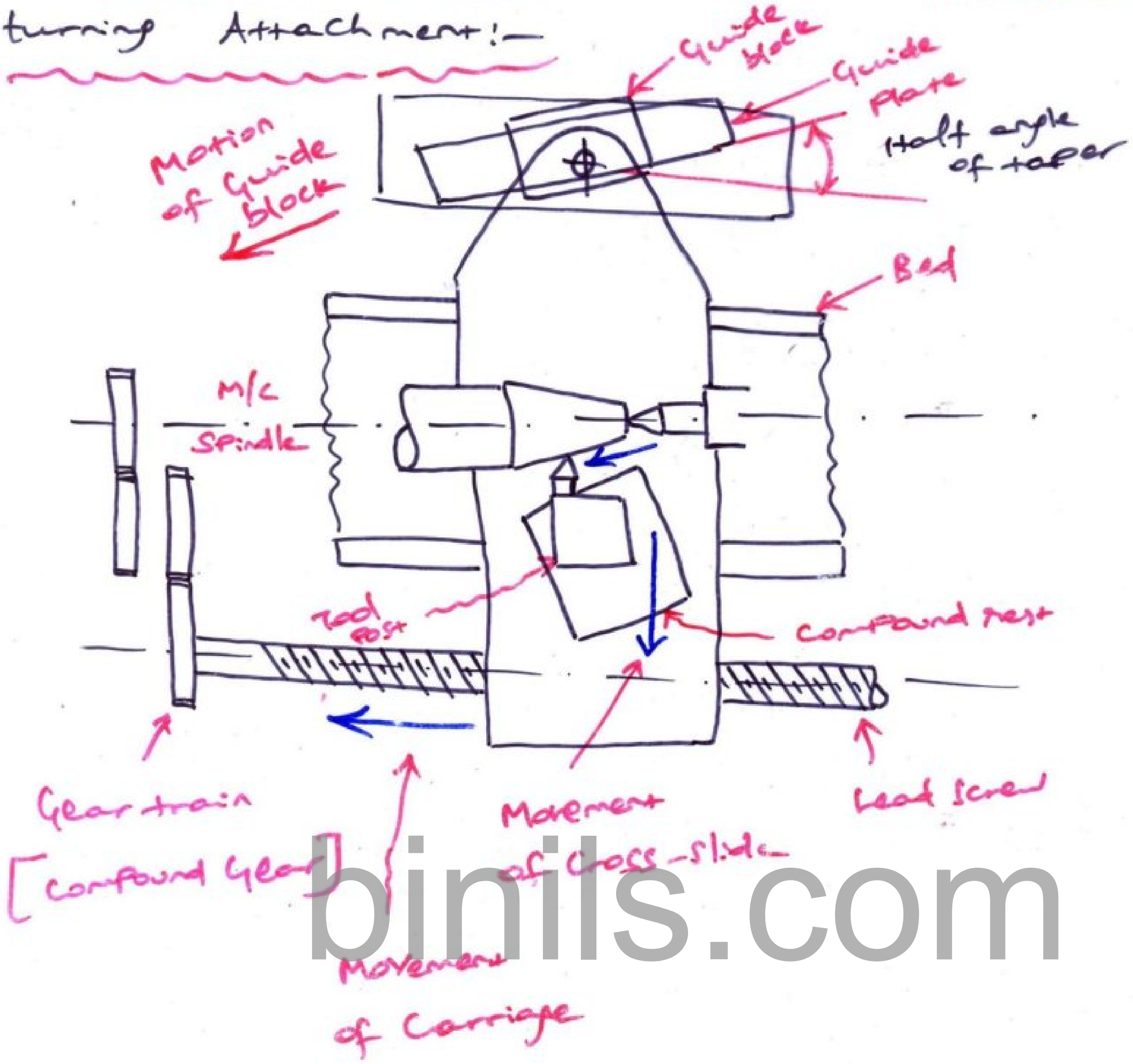


* when cutting Right hand thread, the carriage must move towards the tail stock.

* For left hand thread, the carriage must move away from the Head Stock and towards the tail Stock.

* The job moves as always in anticlockwise direction when viewed from the tail Stock.

Thread cutting on lathe using taper turning Attachment:-



Checking a Screw Cutting Set-up:-

1. The Gear train must be correct.
2. Tumbler gears must give the carriage the movement in the right direction
3. The spindle should be arranged to give required low cutting speed.
4. The feed shaft must be disengaged
5. The apron feed mechanism must be at neutral
6. Finally Half-nut must be engaged to the lead screw

Special Attachments:-

1 Milling Attachment:-

a For cutting grooves & keyways

w/p – cross slide; Milling cutter – chuck

Depth of cut – Provided by vertical slide in the Attachment.

b For cutting multiple grooves & gear wheels:-

w/p – held b/w centers;

Attachment – cross-slide; [driven by separate motor]

No of grooves – by rotating the work

Gear – universal Dividing head attached to rear end of the spindle.

2 Grinding Attachment:-

* Abrasive wheel called as "Grinding wheel".
* work – b/w centers for external grinding.
* work – chuck (or) face plate
* Depth of cut – by moving cross-slide

Calculation of Machining time & Power for cutting:-

Formulae:-

Turning operations

① Cutting speed, $V = \frac{\pi D N}{1000}$ m/min

V - Cutting speed in m/min
D - Diameter of w/p in mm
N - Rotational speed of w/p in rpm.

② Diameter of w/p, $D = \frac{D_1 + D_2}{2}$ in mm

D_1 - Max (or) Blank Diameter
D_2 - Diameter after m/cing (or) Minimum Diameter of w/p

③ M/cing Time for single pass, $t = \frac{L + L_o + L_1}{fN}$ min

L = Length of job
L_o = Over travel beyond the length of the job to help in setting of the tool in mm
L_1 = Tool Approach Distance in mm
f = feed rate in mm/rev
N = Rotational speed in rpm.

④ Power required for cutting, $P = K \times d \times f \times v$ watts

K = Constant depending on the work mat'l

Material being cut	K (N/mm²)
Steel, 100–150 BHN	1200
Steel, 150–200 BHN	1600
Steel, 200–300 BHN	2400
Steel, 300–400 BHN	3000
Cast Iron	900
Brass	1250
Bronze	1750
Aluminium	700

d = depth of cut in mm;

f = feed rate in mm/rev;

v = cutting speed in m/sec;

Problem :-

AU - May - 2012

① A Blank 180 mm long and 70 mm diameter is to be machined in a lathe to 175 mm long and 60 mm diameter. The workpiece rotates at 450 r.p.m, the feed is 0.3 mm/rev; and the maximum depth of cut is 2 mm. For turning operation, the approach plus over travel distance is 6 mm. Assuming that the facing operation is done after the turning, calculate the machining time.

Soln:-

Given:-

Length of w/p, $L = 180mm$;

Dia of blank, $D_1 = 70mm$;

Dia of w/p after machining, $D_2 = 60mm$;

feed rate, $f = 0.3$ mm/rev

Depth of cut, $d = 2mm$;

Approach + over travel $(L_o + L_1) = 6mm$;

} Turning.

Dia of w/p, $D = 70mm$;

Length of Tool travel, $L = D/2 + (L_o + L_1)$

$= 35 + 6$

$$L = 41 \text{ mm}$$

Cross feed rate for facing is not Given

So, Assume, $f = 0.3$ mm/rev;

Soln:-

M/cing time for turning opr:-

M/c'ing time, $t = \frac{L + L_o + L_1}{f N}$ minutes

$N = \frac{1000V}{\pi D}$ rpm = 450 r.p.m

$\therefore$ Machining time for turning $\Big\}$ $t = \frac{180+6}{0.3 \times 450}$

$\boxed{t = 1.37 \text{ minutes}}$ for one pass

$\boxed{\text{No of passes required} = 3}$ ⇒ $(D_1 - D_2)/2$ / Depth of cut

M/cing time for facing opern

$t = \frac{L}{fN}$ minutes

$L = \frac{60}{2} + (L_0 + L_1)$

$= \frac{60}{2} + 6 = 36$ mm

$\therefore t = \frac{36}{0.3 \times 450} = 0.26$ minutes $\simeq 0.3$ minutes

$\boxed{\text{No of passes required} = 3}$

$\therefore$ ~~Total~~ m/cing time for one pass $\Big\}$ $= 1.37 + 0.3 = \underline{\underline{1.67 \text{ minutes}}}$

Total M/cing time for complete m/cing $\Big\}$ $= (1.37 \times 3) + (0.3 \times 3)$ ← no of passes

$= 4.11 + 0.9$

Formulaes :-

(4) Number of passes required = $\dfrac{[D_1 - D_2]/2}{\text{Depth of cut } (d)}$

D_1 – Max (or) Blank dia (mm)

D_2 – Minimum Diameter (mm)

(5) Total Machining time = [M/cing time for Single pass] × [no of passes required]

(6) **For facing operation**

Diameter of w/p = Dia of blank diameter (or) Dia of finished w/p

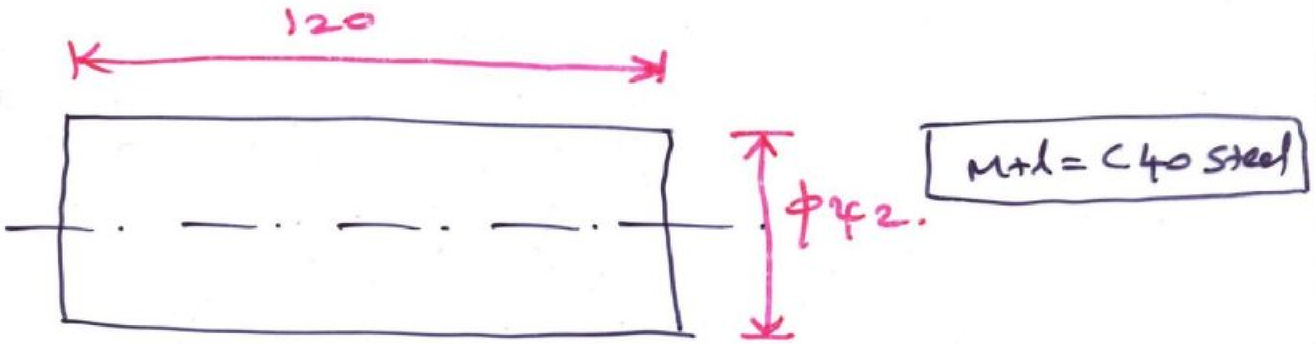
Length of Tool travel = $D/2 + (L_0 + L_1)$

$(L_0 + L_1)$ = Approach + over travel

Problem :- 2

Estimate the actual machining time required for a component shown in figure. The available spindle speeds are 70, 110, 176, 280, 440, 700, 1100, 1760, and 2800. Use a roughing speed of 30 m/min and finish speed of 60 m/min

The feed for roughing is 0.24 mm/rev. while that for finishing is 0.10 mm/rev. The maximum depth of cut for roughing is 2 mm. Finish allowance may be taken as 0.75 mm. Blank to be used for machining is 50 mm diameter.



Soln:-

Stock to be removed $= \frac{50-42}{2} = 4\,mm$

Finish allowance $= 0.75\,mm$

Roughing:-

Roughing stock $= 4 - 0.75 = 3.25\,mm$

$\therefore$ No of passes $= \frac{3.25}{2} = 2$ passes

Given cutting speed, $v = 30\,m/min$

Avg Diameter, $D = \frac{50+42}{2} = 46\,mm$

$\therefore$ Spindle speed $N = \frac{1000 \times 30}{\pi \times 46} = 207.59\,rpm$

Nearest rpm from the list, $N = 176$ r.p.m

M/c time for one pass $= \frac{120+2}{0.24 \times 176} = 2.898$ mts

Finishing:-

Given cutting speed, v = 60 m/min

$$\text{Spindle speed, } N = \frac{1000 \times 30}{\pi \times 42} = 439.05 \text{ rpm}$$

Nearest rpm from the list = 440 rpm

$$\text{M/cing time for one pass} = \frac{120+72}{0.10 \times 440} = 2.77 \text{ mts}$$

$$\therefore \text{Total m/cing time} = (2 \times 2.888) + (2.77 \times 1)$$

$$= 8.546 \text{ mts}$$

Power required for roughing cycle:-

Given feed rate, f = 0.24 mm/rev

Depth of cut, d = 2 mm

$$\text{Cutting speed, } v = \frac{\pi \times 176 \times 46}{1000} = 25.43 \text{ m/min}$$

The value of K from Table } K = 1600 N/mm²

$$\therefore P = \frac{1600 \times 25.43 \times 0.24 \times 2}{60} = 325.5 \text{ watts}$$

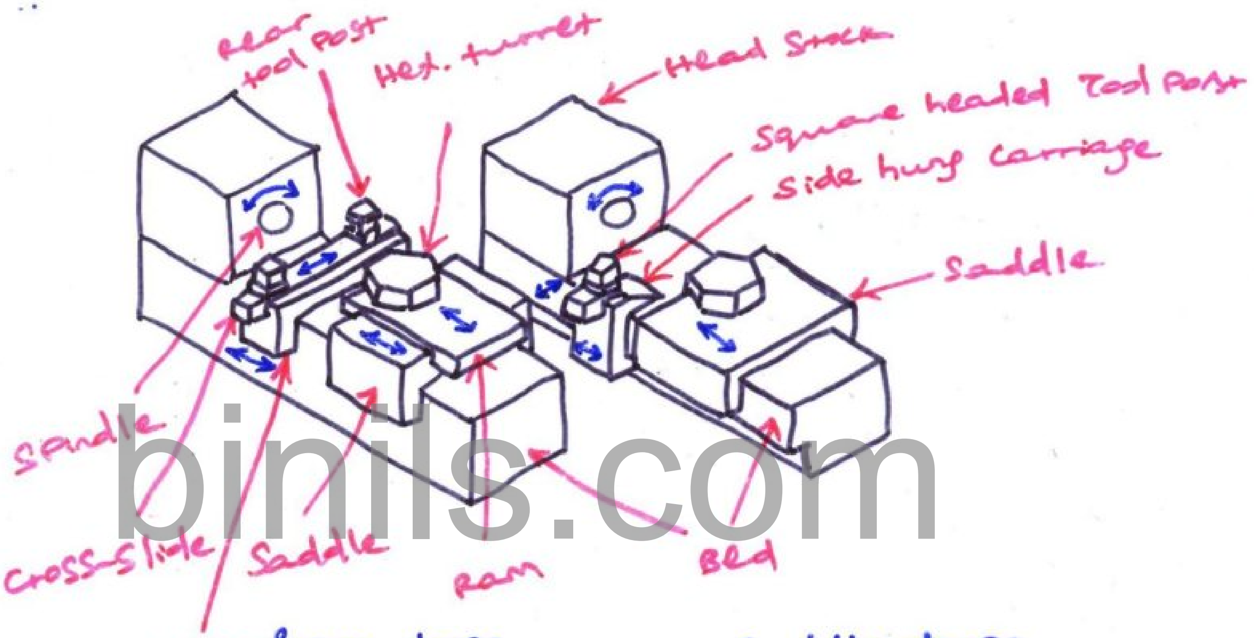
$$\boxed{P = 0.326 \text{ kW}}$$

$$\boxed{P = K \times d \times f \times v \quad \text{watts}}$$

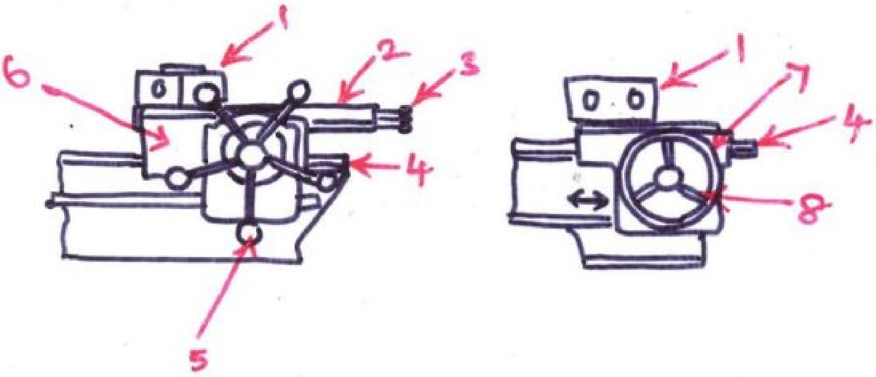
CAPSTAN & TURRET LATHE :-

* Development of Engine Lathe
* Semi - Automatic
* production Lathe
* Developed in U.S.A by Pratt & whitney in 1860

Parts:- Bed, All Geared Head Stock, Saddle, Carriage, Hexagonal turret, Adjustable stoppers.



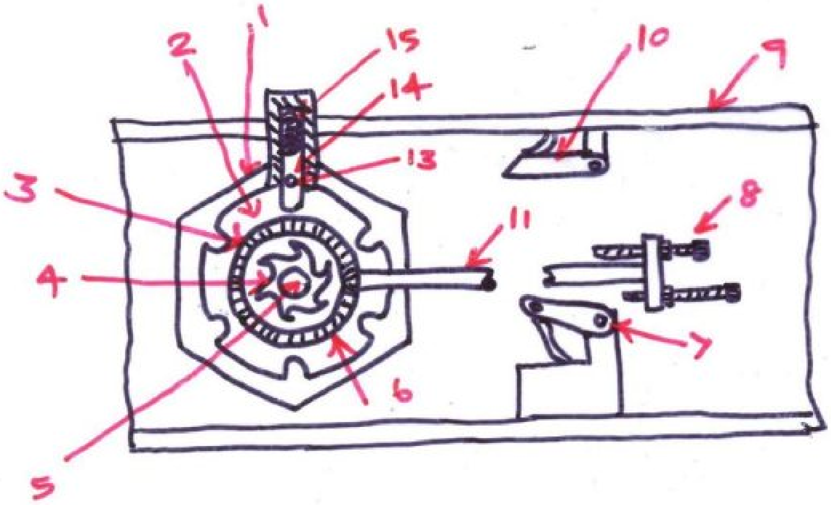
Ram type   Saddle type



Capstan & turret Lathe to show their difference

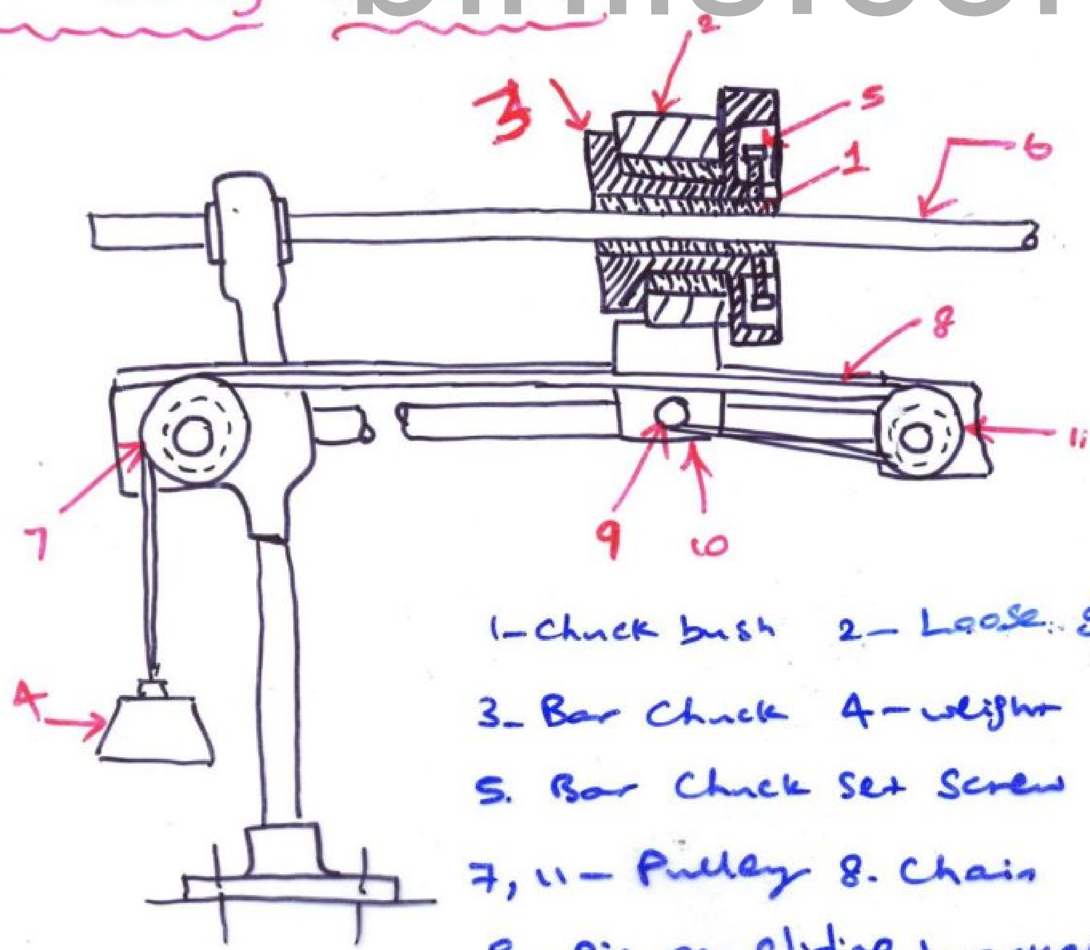
(1) Hexagonal turret (2) Ram (3) Adjustable stoppers
(4) Bed (5) Handwheel for Ram (6) Saddle (7) Turret Saddle (8) Handwheel for saddle

Turret Indexing Mechanism:-



1. Hexagonal turret 2. Index plate 3. Bevel gear 4. Indexing ratchet
5. Turret Spindle 6. Beveled pinion 7. Indexing Pawl
8. Screw type stop rod 9. Lathe bed 10. Cam 11. Pinion Shaft
13. Plunger pin 14. Plunger 15. Plunger Spring.

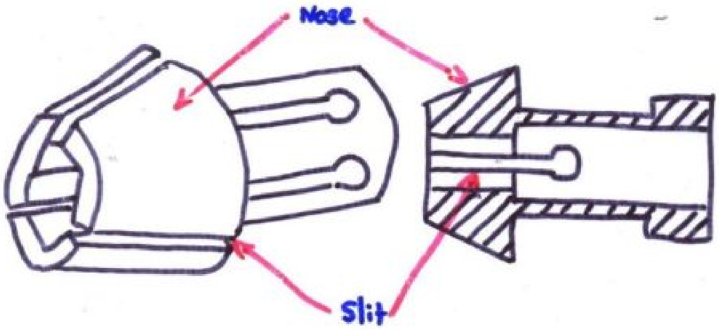
Bar feeding Mechanism:-

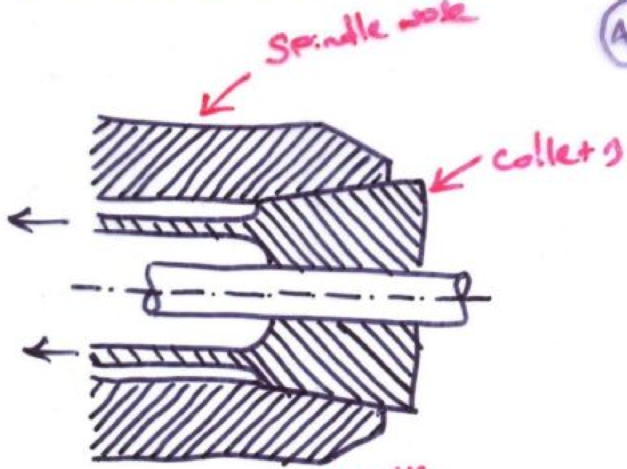


1– Chuck bush 2– Loose Sleeve
3– Bar Chuck 4– weight
5. Bar Chuck Set Screw 6. Bar
7, 11 – Pulley 8. Chain
9– Pin on sliding bracket
10– Sliding bracket

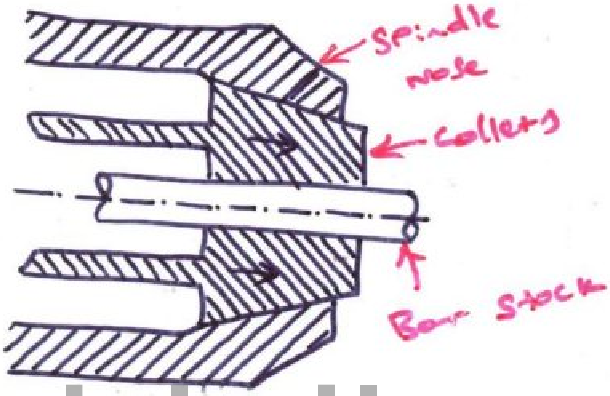
Work Holding Devices:

(1) Collets

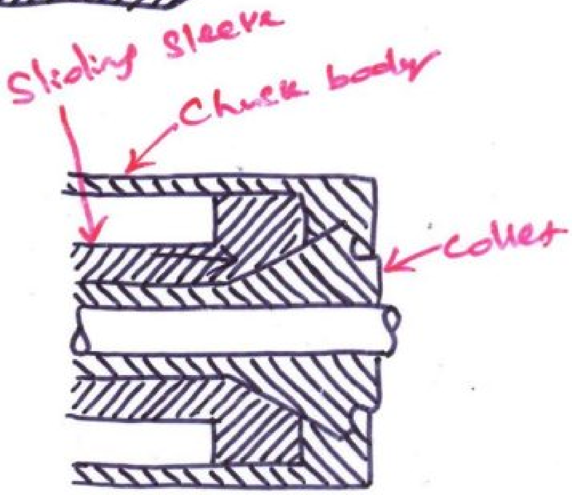




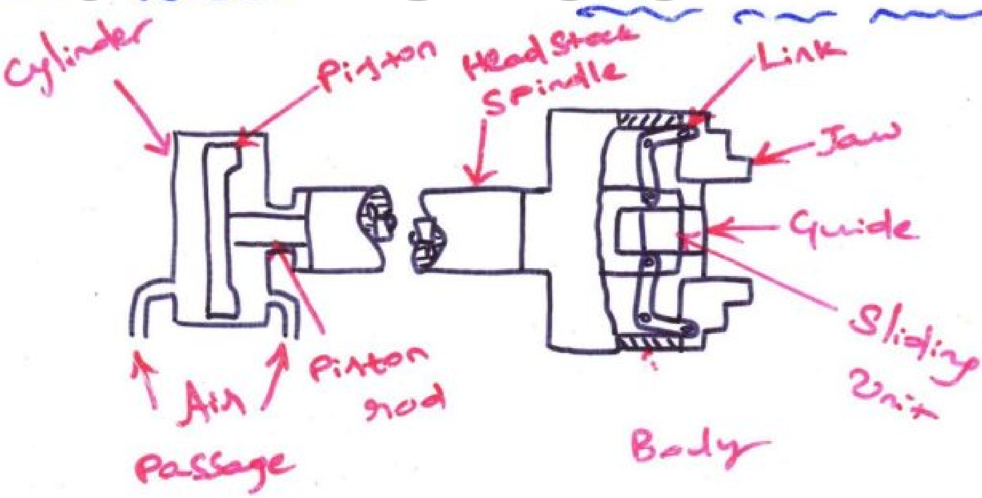
Draw back collet



Push out collet



Dead length collet



Power Chuck

Tool Layout:-

(A1)

Planning of Sequence of opreation & preparation of turret & capstan lathe as per the Sequence of oprn to be carried out on the work.

It includes three stages.

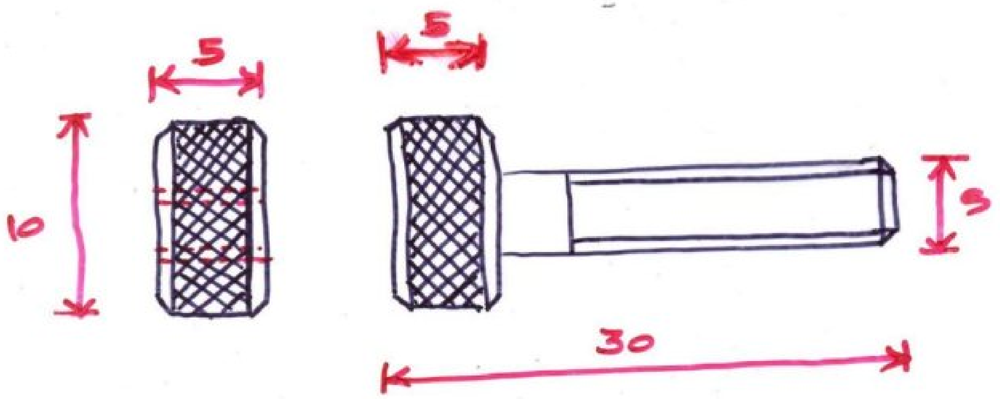
1. Preparation of opreation sheet (or) process planning sheet.
   * Component drawing
   * Sequence of oprn
   * Selection of Tool
   * Selection of V, f, d for each oprn
   * Tool travel length
2. Tool layout
3. Tool Sequence Chart

Feed, depth of cut, Cutting speed for Various oprn:-

S.no	Opreation	Mild steel			Aluminium		
		V	f	d	V	f	d
1.	Plain turning	50	0.10	2	200	0.10	2
2.	Form turning	40	0.05	–	200	0.05	–
3.	Thread cutting	7	0.05	2	7	0.05	2
4	Drilling	40	0.05	–	200	0.05	–

V – m/min
f – mm/rev
d – mm

Draw the tool layout for manufacturing knurled screw and nut as shown in figure on a turret lathe



Soln:-

Stage:-1 [Preparation of operation sheet]

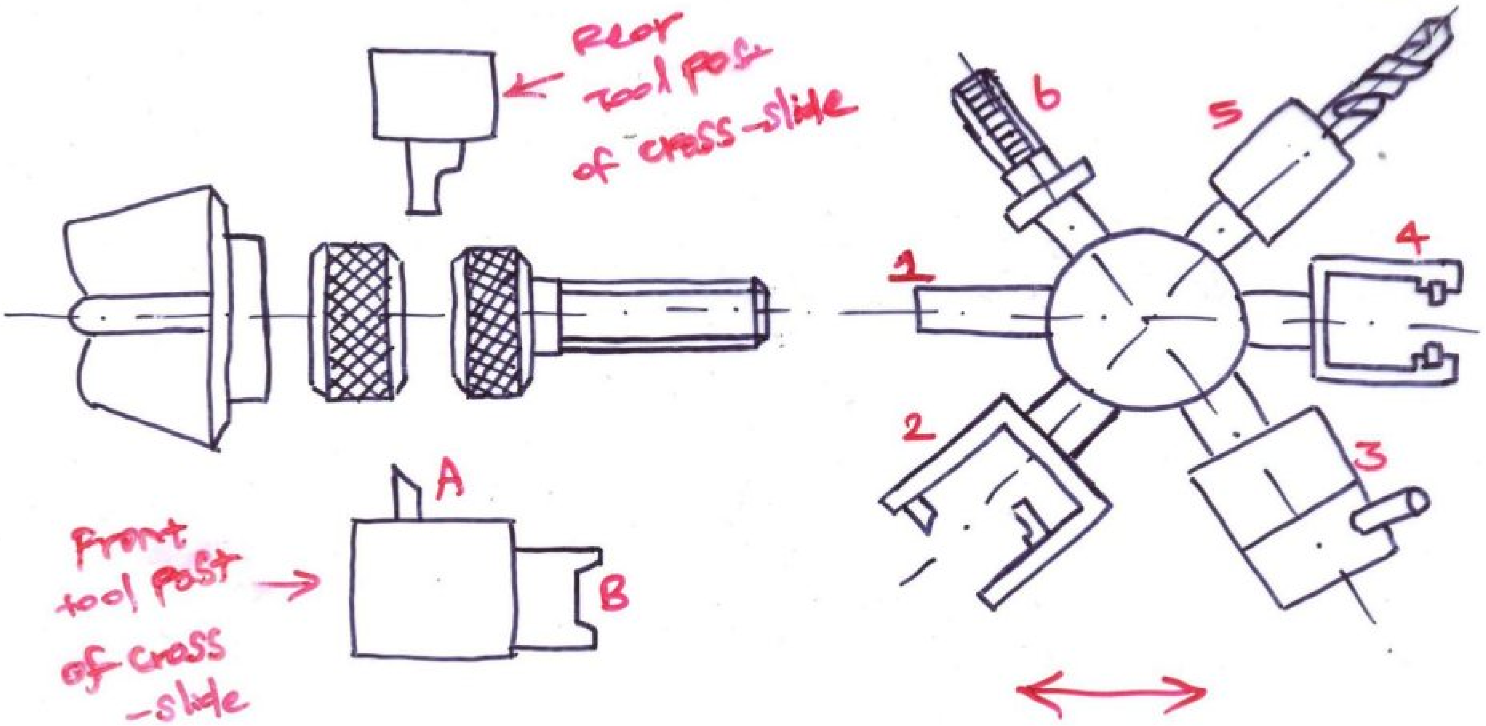
1. The component drawing is drawn
2. The total length of the work is calculated & 14mm is provided for clearance

   4+4 = Clearance for parting tool

   6 = clearance b/w chuck & parting tool.
3. Number of operation is listed.
4. Sequence of operation is listed.
5. Material - Mild steel.
6. Tool is selected & Tool length is adjusted by stopper

Stage:-2 [Tool - layout]

Tool layout is drawn as shown in figure



Stage:- 3 [Tool Scheduling Chart]

Machine:- turret lathe

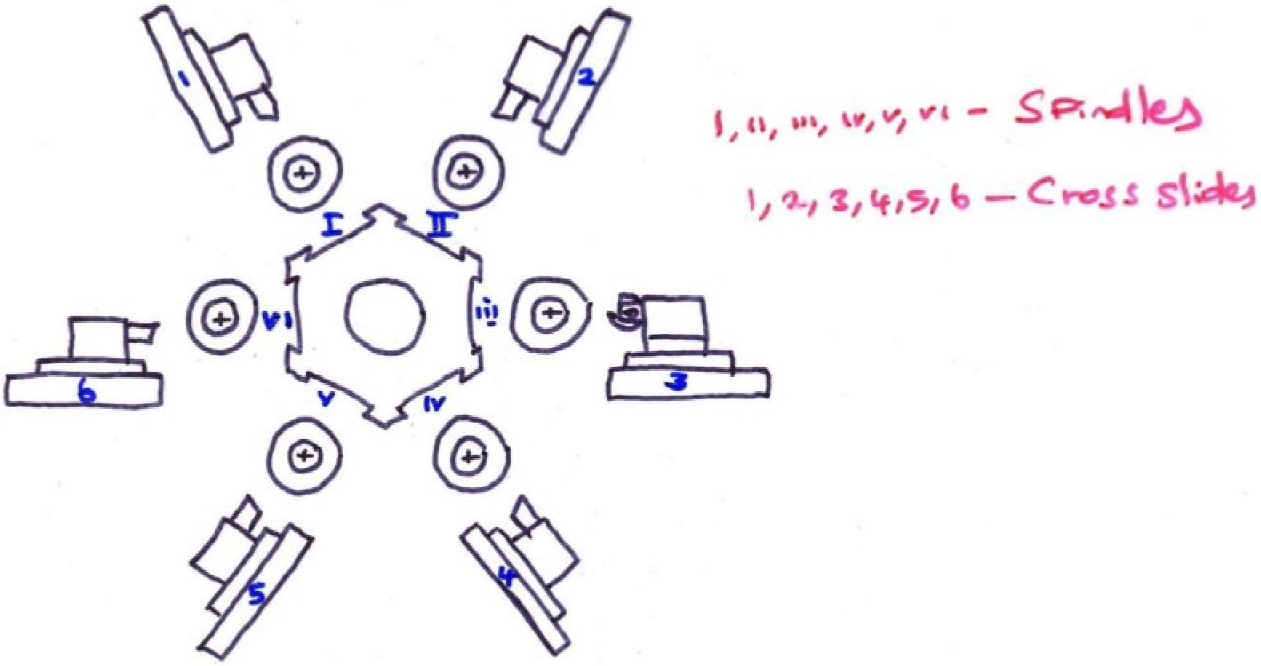
Material:- Mild steel

Operation sequence	Description of operation	Tool position	Tools	V (m/min)	f (mm/rev)	d (mm)
1.	Holding the required bar in the collet & setting the required length of 52 mm [35+14+3]	Turret position 1	Bar stop	-	-	-
2.	Turn to 10mm dia to a length of 46mm from right end	Front tool post [position A]	Turning tool	50	0.1	2

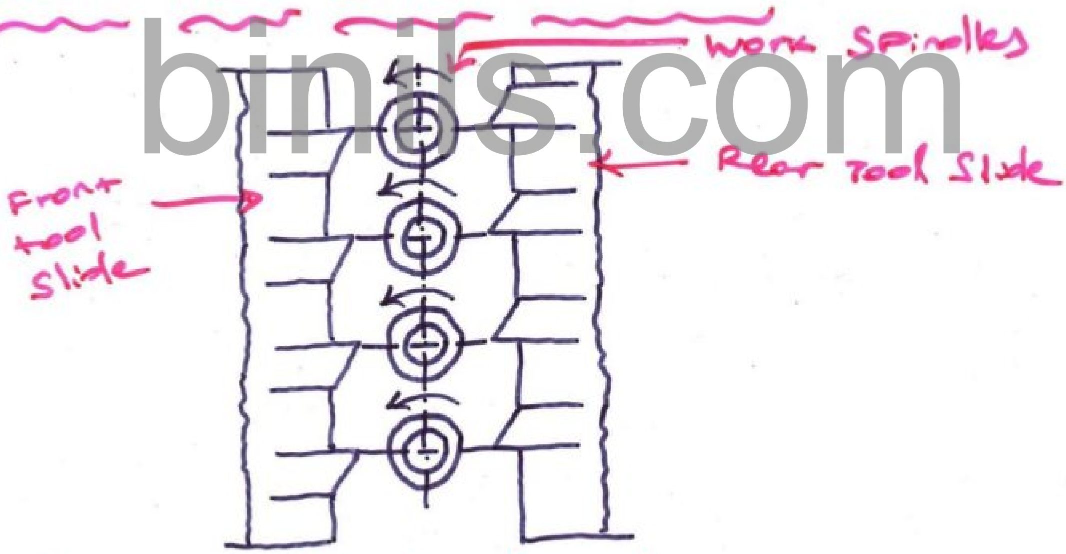
Operation Sequence	Description of operation	Tool Position	Tools	V (m/min)	f (mm/rev)	d (mm)
3.	Turn to 5mm dia & from the right end of the bolt for a length of 26.5mm	Turret Position 2	Roller Steady box Turning tool	50	0.1	2
4.	Facing the right end to a length of 1.5mm	Front Tool Post (Position A)	Turning tool	50	0.1	0.5
5.	External thread cutting of 5mm dia to a length 23mm from the right end	Turret Position 3	Self opening die head with thread chaser	7	0.05	2
6.	Knurling on the required length	Turret Position 4	Knurling tool	7	0.05	0.5
7.	Chamfering the bolt head	Front Tool Post B	Chamfering Tool (Form Tool)	40	0.05	–
8	Chamfering the end of bolt	A	Turning tool	50	0.1	2
9	Parting off the bolt	Rear Tool Post	Parting off Tool (In inverted Position)	40	0.05	–
10	Facing the right side of the nut to 1.5mm	Front Tool Post Position 'A'	Turning tool	50	0.1	0.5
11.	Drilling the nut	Turret Position 5	Drilling Tool	40	0.05	–

Operation Sequence	Description of operation	Tool Position	Tools	V	f	d
12	Threading by Tap	Turret Position '6'	Tapping Tool	40	0.05	–
13	Parting off the nut	Rear Tool Post	Parting off Tool	40	0.05	–

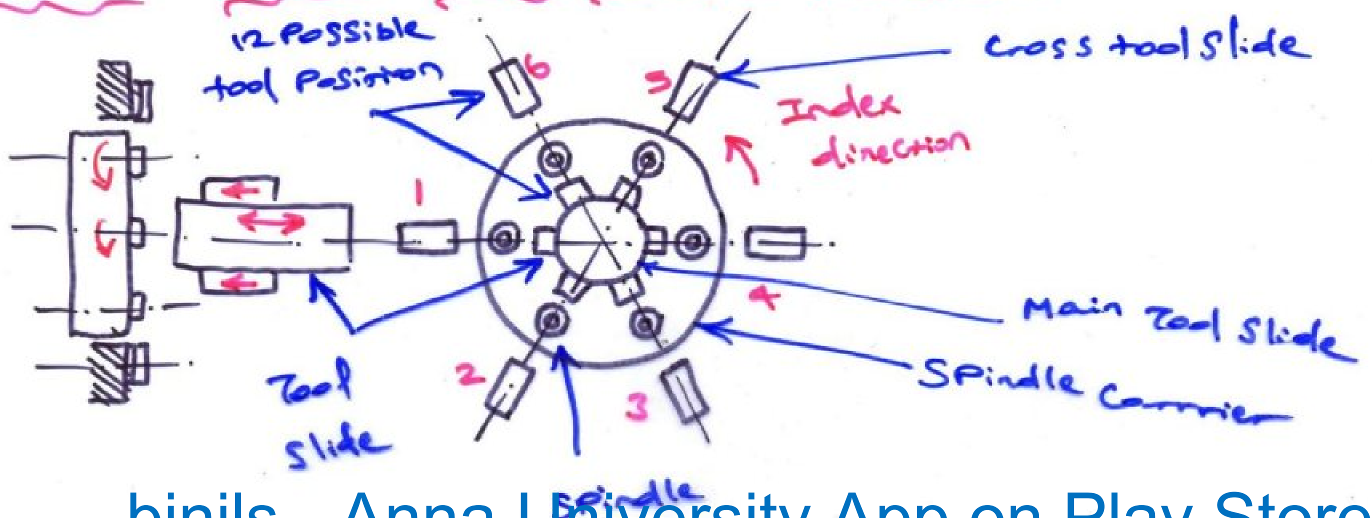
Multi-Spindle Automatic Lathes:-



Parallel Action Multi Spindle Automats



Progressive Action Multi Spindle Automats



Comparison of Single Spindle & Multi Spindle Auto Lathe:-

Sl no	Single Spindle	Multi-Spindle
1.	One Spindle	2, 4, 5, 6 (or) 8 Spindle
2.	Only 1 w/p machined at a time.	No of workpieces machined at a time.
3.	Production rate is low	High
4.	Accuracy is high	Lower.
5.	Tool setting time is less	More
6.	Tooling cost is less	more
7.	It is more economical for shorter as well as longer runs	It is more economical for longer runs only.
8.	The time required to produce one component is sum of the turret operation times.	Time of longest cut in any spindle
9.	Tools in turret are indexed.	w/p held in spindle are indexed. (progressive action type)

Comparison b/w Parallel Action & Progressive Multi spindle Lathe:—

Sl no	Parallel Action Machine	Progressive Action Machine
1.	Same operations in all spindles	Different oprns on jobs one after the another
2.	In one cycle, no of components produced simultaneously is equal to no of spindles	For every indexing of component, one component is produced.
3.	Rate of production is high	Moderate.
4.	If anything goes wrong in one station, the production in that particular station is only affected.	The production is completely affected in all station.
5.	Small parts of simple shapes are produced.	Parts of complicated shapes