



PIE Tech

POLLACHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

(Approved by AICTE and Affiliated to Anna University)

sky is the limit

Department of Mechanical Engineering

Regulation 2021

II Year – IV Semester

ME3493 MANUFACTURING TECHNOLOGY

COURSE OBJECTIVES:

- 1 To study the concepts and basic mechanics of metal cutting and the factors affecting machinability
- 2 To learn working of basic and advanced turning machines.
- 3 To teach the basics of machine tools with reciprocating and rotating motions and abrasive finishing processes.
- 4 To study the basic concepts of CNC of machine tools and constructional features of CNC.
- 5 To learn the basics of CNC programming concepts to develop the part programme for Machine centre and turning centre

UNIT – I MECHANICS OF METAL CUTTING

9

Mechanics of chip formation, forces in machining, Types of chip, cutting tools – single point cutting tool nomenclature, orthogonal and oblique metal cutting, thermal aspects, cutting tool materials, tool wear, tool life, surface finish, cutting fluids and Machinability.

UNIT – II TURNING MACHINES

Centre lathe, constructional features, specification, operations – taper turning methods, thread cutting methods, special attachments, surface roughness in turning, machining time and power estimation. Special lathes - Capstan and turret lathes- tool layout – automatic lathes: semi-automatic – single spindle: Swiss type, automatic screw type – multi spindle

UNIT – III RECIPROCATING MACHINE TOOLS

9

Reciprocating machine tools: shaper, planer, slotter: Types and operations- Hole making: Drilling, reaming, boring, tapping, type of milling operations-attachments- types of milling cutters- machining time calculation - Gear cutting, gear hobbing and gear shaping – gear finishing methods Abrasive processes: grinding wheel – specifications and selection, types of grinding process – cylindrical grinding, surface grinding, centreless grinding, internal grinding - micro finishing methods

UNIT – IV CNC MACHINES

9

Computer Numerical Control (CNC) machine tools, constructional details, special features – Drives, Recirculating ball screws, tool changers; CNC Control systems – Open/closed, point-to-point/continuous - Turning and machining centres – Work holding methods in Turning and machining centres, Coolant systems, Safety features.

UNIT – V PROGRAMMING OF CNC MACHINE TOOLS

9

Coordinates, axis and motion, Absolute vs Incremental, Interpolators, Polar coordinates, Program planning, G and M codes, Manual part programming for CNC machining centers and Turning centers – Fixed cycles, Loops and subroutines, Setting up a CNC machine for machining.

THEORY OF METAL CUTTING.Introduction:

Metal cutting also called as machining, is the process of producing w/p, Component by removing unwanted material from metal block.

Various metal cutting process.

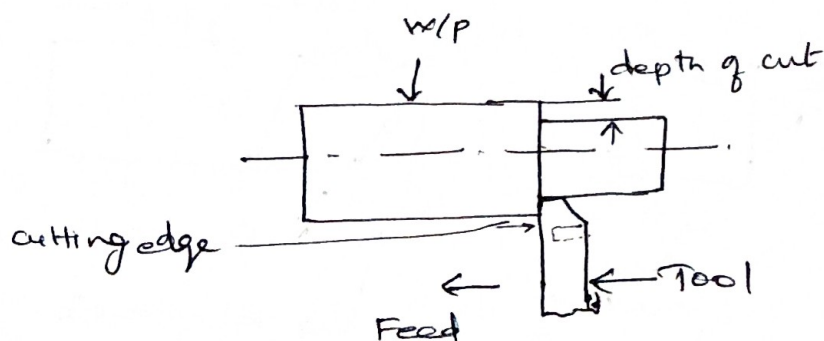
- | | |
|------------|---------------|
| 1. Turning | 5. Grinding |
| 2. Boring | 6. Drilling |
| 3. Planing | 7. Shaping |
| 4. Milling | 8. Honing etc |

Basic Elements of Machining:

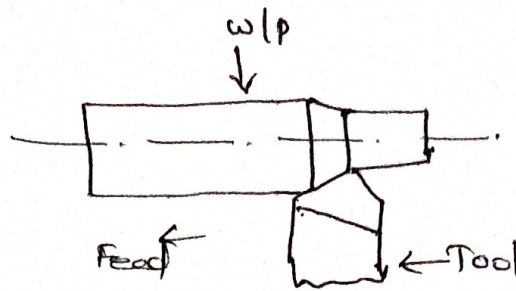
- Work piece
- Tool
- Chip

Methods of Machining:

(i) Orthogonal cutting.



(ii) Oblique cutting (Three dimensional)

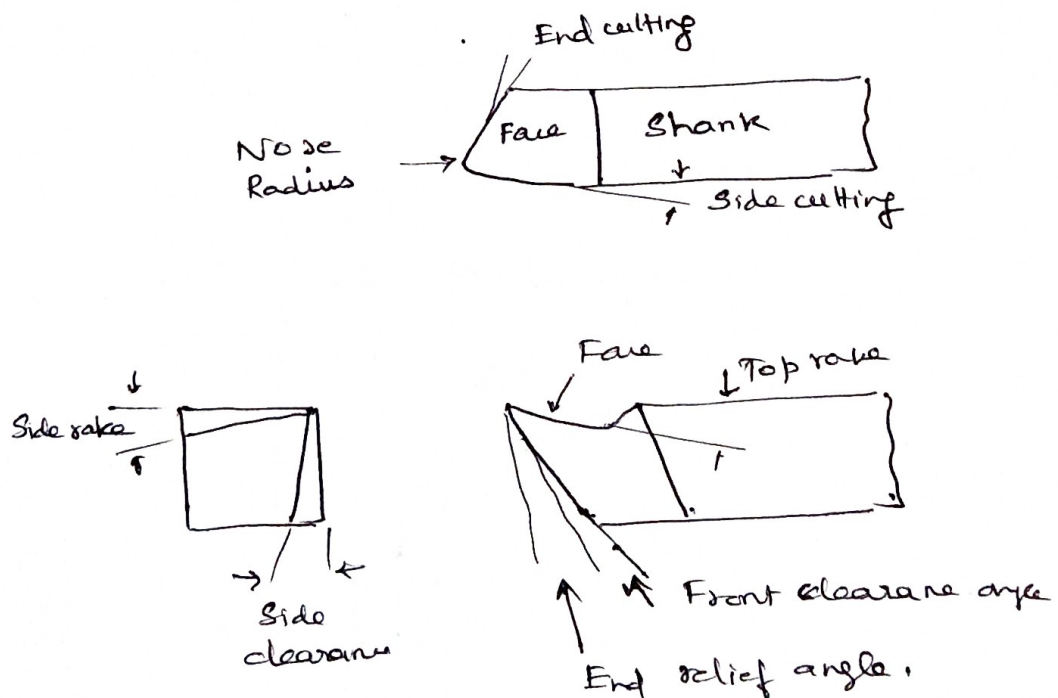


Classification of cutting tools

According to } 1. Single point cutting tool
No. of edges. } 2. Multi point cutting tool

According to } 1. Linear motion cutting tool
the Motion } 2. Rotary motion cutting tool
3. Linear and Rotary motion tools.

Important terms and Angles of Single point cutting tool



- Shank

- Face

- Point

- Flank

- Base

- Heel

- Nose Radius

- Rake angle

- Top rake angle.

- Side rake angle

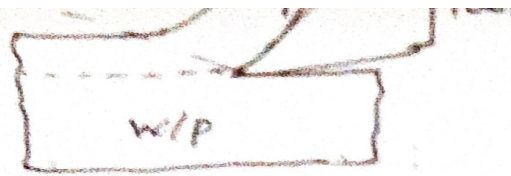
- clearance angle (or) Relief angle

- End relief angle

- Side relief angle

- Hip angle

- Cutting edge angle.



Types of chips:

Dis continuous corr. segmented chip



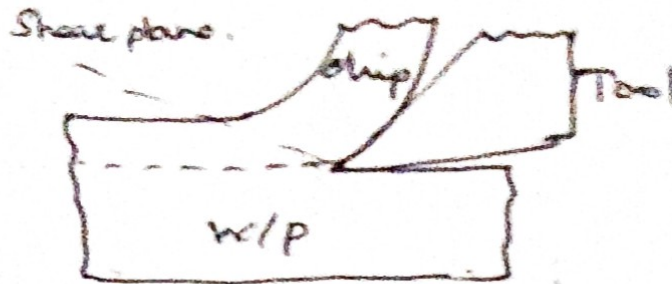
Continuous chips



Continuous chips with built up edge:



chip formation:

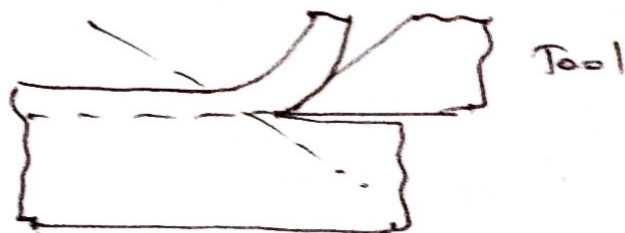


Types of chips:

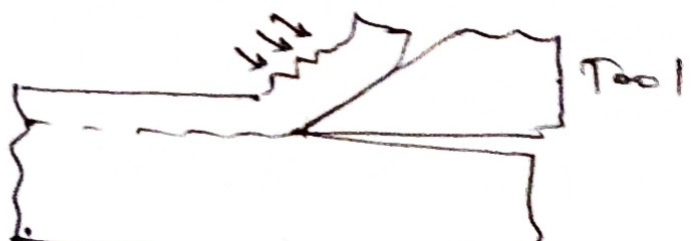
Dis continuous (or) segmented chip



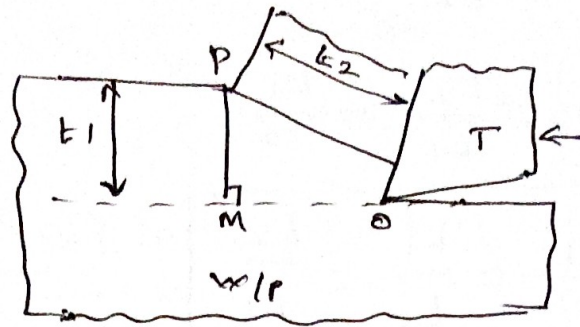
Continuous chips



Continuous chips with built up edge:



Chip Thickness Ratio.



Let t_1 - chip thickness before deformation

t_2 - chip thickness after deformation

r - chip thickness ratio = $\frac{t_1}{t_2}$

$$r = \frac{t_1}{t_2}$$

As we have seen $t_2 > t_1$ $\therefore r < 1$

$k \rightarrow$ chip reduction coefficient

$$\rightarrow \frac{1}{r} = \frac{t_2}{t_1}$$

$$\therefore k > 1$$

ϕ - Shear plane angle

α - Rake angle

L_1 - length of metal cut

L_2 - length of chip

In orthogonal cutting

$$t_1 \cdot L_1 = t_2 \cdot L_2$$

$$\frac{t_1}{t_2} = \frac{L_2}{L_1}$$

but $r = \frac{t_1}{t_2}$

$$r = \frac{L_2}{L_1} = \frac{t_1}{t_2} \quad \text{--- (1)}$$

$$k = \frac{1}{r} = \frac{L_1}{L_2} = \frac{t_2}{t_1} \quad \text{--- (2)}$$

There are two right angle triangles

$\triangle OMP$ and $\triangle ONP$

$$\sin \phi = \frac{MP}{OP} \quad \therefore OP = \frac{MP}{\sin \phi} = \frac{t_1}{\sin \phi} \quad \text{--- (3)}$$

Consider $\triangle ONP$

$$\sin(NOP) = \sin(90 - \phi + \alpha) = \frac{NP}{OP}$$

$$\cos(\phi - \alpha) = \frac{NP}{OP}$$

$$OP = \frac{NP}{\cos(\phi - \alpha)} = \frac{t_2}{\cos(\phi - \alpha)} \quad \text{--- (4)}$$

Equating equations (3) (4)

$$\frac{t_1}{\sin \phi} = \frac{t_2}{\cos(\phi - \alpha)}$$

$$\frac{t_1}{t_2} = \frac{\sin \phi}{\cos(\phi - \alpha)} = r \quad \text{--- (5)}$$

we can write

$$r = \frac{\sin \phi}{\cos \phi \cos \alpha + \sin \phi \sin \alpha}$$

$$r(\cos \phi \cos \alpha) + r(\sin \phi \sin \alpha) = \sin \phi$$

$$\frac{r(\cos \phi \cos \alpha)}{\sin \phi} + \frac{r \sin \phi \sin \alpha}{\sin \phi} = 1$$

$$\frac{r \cos \alpha}{\tan \phi} + r \sin \alpha = 1$$

$$\frac{r \cos \alpha}{\tan \phi} = 1 - r \sin \alpha$$

$$\tan \phi = \frac{r \cos \alpha}{1 - r \sin \alpha}$$

Shear angle $\tan \phi = \frac{r \cos \alpha}{1 - r \sin \alpha}$

Chip Control and Chip Breakers:

- Groove type
- Step type
- Secondary rake type
- Clamp type

Surface finish:

- Cutting speed
- Feed
- depth of cut
- Metal Removal rate

$$MRR = f \times t \times V_c$$

Tool Failure:

- Thermal cracking and Softening
- Mechanical chipping
- Gradual wear
 - Crater wear
 - Flank wear
 - Chemical wear.

Tool wear Mechanisms:

- Abrasion
- Adhesion
- Attrition
- Diffusion
- Fatigue
- Corrosion.

Surface finish:

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- Corrosion.

Tool life:

Interval of time for which tool works satisfactorily between the two successive sharpening.

$$\text{Volume of metal removed} = \pi D t f N T \text{ mm}^3$$

$$\text{Cutting Speed } V = \frac{\pi D N}{1000} \text{ m/min}$$

$$\left. \begin{array}{l} \text{Total Volume of metal removed} \\ \text{for tool failure} \end{array} \right\} = V \times 1000 \times t \times f \times T \text{ mm}^3$$

Factors affecting tool life:

- Cutting speed

$$VT^n = C$$

V - Cutting Speed

T - Tool life

n - Tool life index

C - machining constant

- Feed, depth of cut

$$V = \frac{257}{T^{0.19} \times f^{0.36} \times t^{0.8}} \text{ m/min}$$

- Tool geometry

- Rake angles

- Relief angles

- Cutting edge angles

- Nose radius

Tool

- Tool materials
- work materials
- Nature of cutting
- Rigidity of machine tool and work
- cutting fluids.

Cutting tool materials:

- High carbon Steel.
- High Speed Steel
- Cemented carbides
- Stellite
- Cemented oxides
- Diamonds
- Cubic Boron Nitride

Characteristics of cutting tool materials:

- hardness
- Hot hardness
- Toughness
- Wear resistance
- Surface finish
- Cost

Machinability:

Common machine variables:

- Cutting Speed, feed, depth of cut
- Tool materials
- Tool form
- Cutting fluid
- Nature of tool

Common workpiece material variables:

- Hardness
- Chemical Composition
- Tensile properties
- Strain hardenability
- Shape
- Rigidity of w/p

General criteria:

- Tool life
- Surface finish
- Power Consumption
- Cutting force
- Shear angle.

Cutting Fluid
Function

Cutting Fluids:

Functions:

- It cools tool and work piece
- Reduce friction.
- Prevents adhesion of chips
- Provides lubrication
- Permits higher cutting speeds
- Cleaning of machining zone.

Basic Requirements of cutting Fluids:

- Removes heat
- Not dis colour finished w/p
- fairly mild smell
- Avoid fog and smoke
- Flash point high
- Non poisonous
- Easily cover entire cutting area
- good lubricating property
- low shear strength.

Types of cutting fluids:

- Greaseous type
- Liquid type
 - water
 - Fatty oil
 - Straight mineral oil
 - cutting oils
 - Soluble oils
- Synthetic coolants

Selection of cutting fluids:

- Cutting tool materials
- Work piece materials
- Types of machining process
- viscosity of oils
- Machine condition
- human interaction and cost
- colour, smell and high oiliness

Methods of Application of cutting fluids:

- Mist Cooling
- Flood Cooling
- Manual application.

In orthogonal turning of mild steel bar of 65mm diameter on a lathe a feed of 0.8mm was used. A continuous chip of 1.4mm thickness was removed at a rotational speed of 85 rpm of work. calculate the chip thickness ratio, chip reduction ratio and total length of the chip removed in one minute.

Sol/

Given data

$$D = 65 \text{ mm}$$

$$t_1 = 0.8 \text{ mm}$$

$$t_2 = 1.4 \text{ mm}$$

$$N = 85 \text{ rpm}$$

To find

Chip thickness ratio - r

chip reduction ratio - k

length of chip removal - L_2

i) Chip thickness ratio (r)

$$r = \frac{t_1}{t_2} = \frac{0.8}{1.4} = 0.5714$$

ii) Chip Reduction ratio (k)

$$k = \frac{1}{r} = \frac{1}{0.5714} = 1.75$$

Length of chip removed (L_2)

$$r = \frac{L_2}{L_1}$$

$$L_2 = L_1 \times r$$

$$= r \times \pi D N$$

$$= 0.5714 \times \pi \times 65 \times 85$$

$$= 9917.96 \text{ mm/min}$$

UNIT-II

CENTRE LATHE AND SPECIAL PURPOSE LATHES

Syllabus:

Centre lathe, constructional features, cutting tool geometry, various operations, Taper turning methods, Thread cutting methods, Special attachments, Machining time and power estimation, Capstan and turret lathes - Automats - Single Spindle, Swiss type, automatic screw type, Multi Spindle - Turret indexing mechanism, Bar feed Mechanisms.

Types of lathes

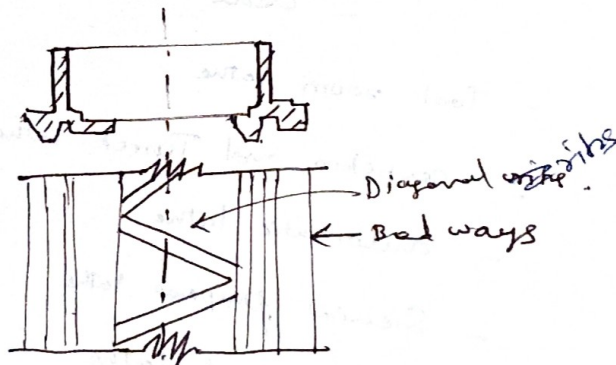
- Bench lathe
- Speed lathe
- Engine lathe
 - Belt drive lathe
 - Individual motor drive lathe
 - Cope head lathe
- Tool room lathe
- Capstan and Turret lathe
- automatic lathe
- Special purpose lathe
 - wheel lathe
 - Crap bed lathe
 - Duplicating lathe
 - T - lathe

Size of The lathe:

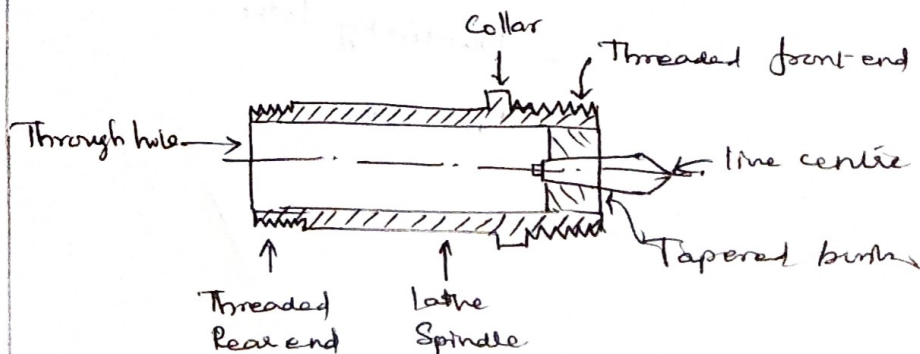
- Height of The centres
- The length between the centres
- The length of bed
- The bed diameter
- Maximum bar diameter
- Spindle speed
- Spindle nose diameter
- Lead screw pitch
- Motor horse power and RPM.

Various parts of The lathe:

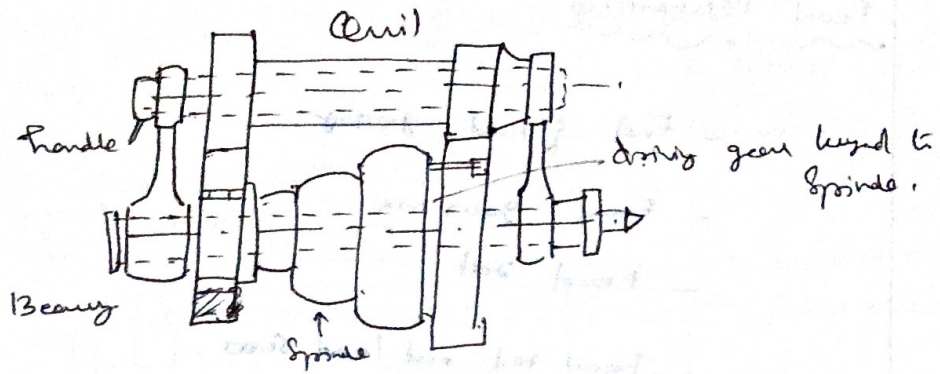
Bed



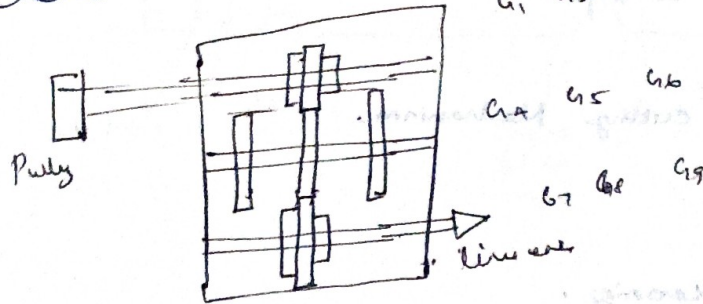
Head Stock



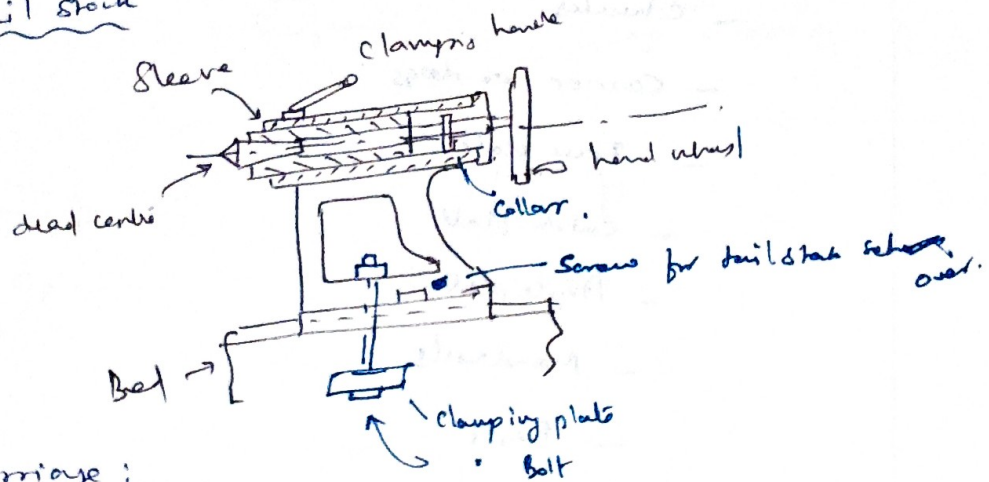
Back gear cone pulley type head stock



All geared feed stock



Tail stock



Carriage:

- Saddle
- Cross slide
- Compound rest
- Tool post
- Apron
-

Feed Mechanism

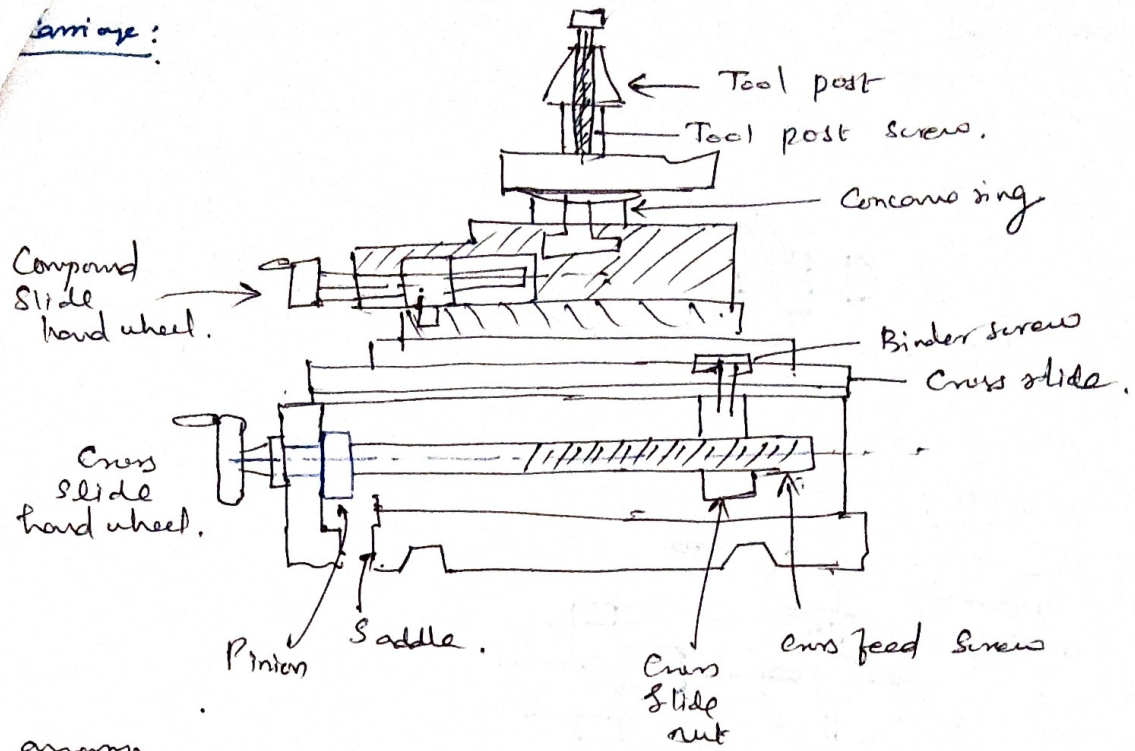
- End of head gears
- Feed gear box
- Feed rod
- Feed rod and lead screw
- Apion Mechanism.

Thread cutting Mechanism.

Lathe accessories.

- Centres
- Chucks
- Carrier or dogs
- Face plate
- Catch plate
- Angle plate
- Mandrels
- Rests

Carriage:



Lathe accessories

Centres



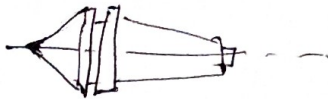
Standard



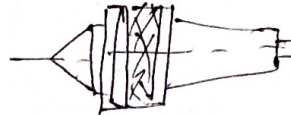
Half center



Cup or Reverse



Carbide tip



Revolving centers

Chucks

Three jaws chucks

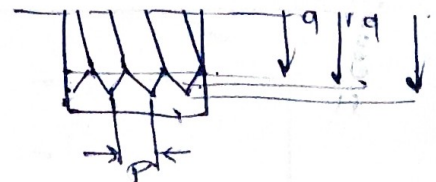
Four jaws independent chuck

Combination chuck

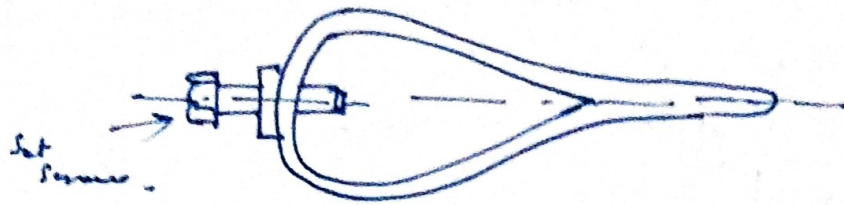
Magnetic chuck

Drill or collet chuck

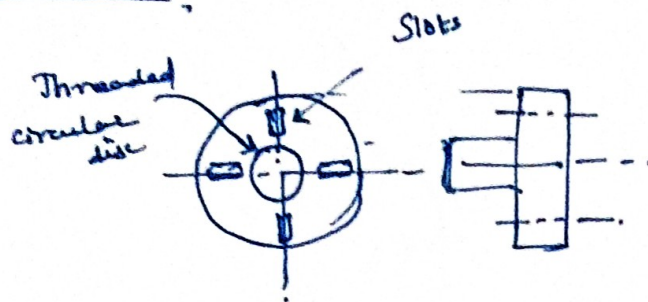
Air or hydraulic chuck



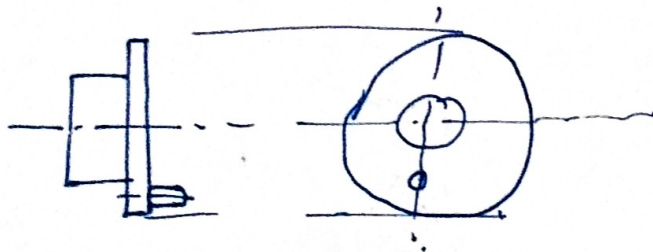
Chamber Cross Reg.



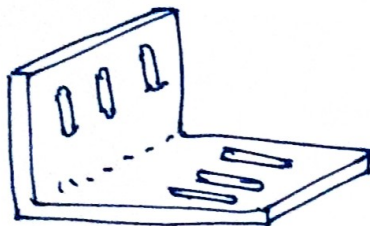
Power plate:



Catch plates:

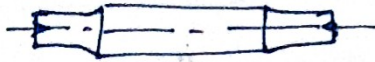


Angle plate:

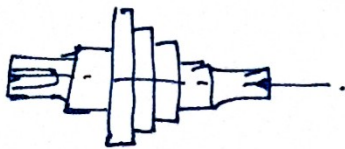


Mandrels:

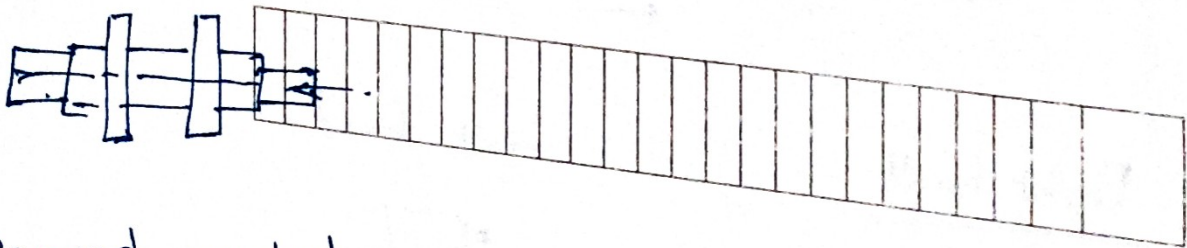
(a) Simple Mandrels.



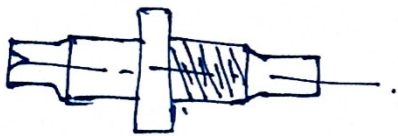
(b) Step mandrel



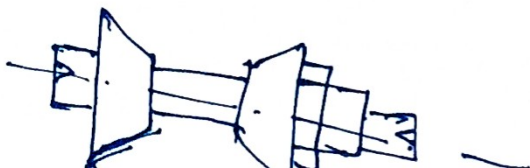
(c) Collar mandrel.



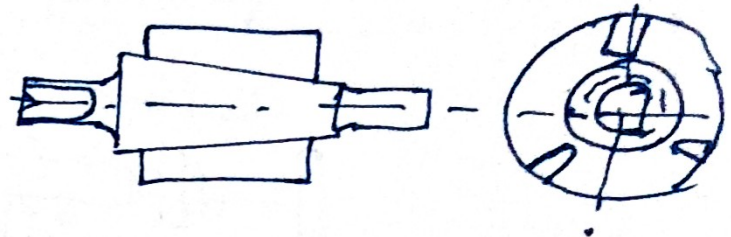
(d) Screwed mandrel.



(e) Cone mandrel.



(f) expansion mandrel.



Rest

1. Steady rest
2. Follower rest

Lathe Operations:

- Straight turning
- Step turning
- Eccentric turning
- Facing

Drilling

Boring

Reaming

Knurling

Parting off

Chamfering

Grooving

Forming

Taper turning

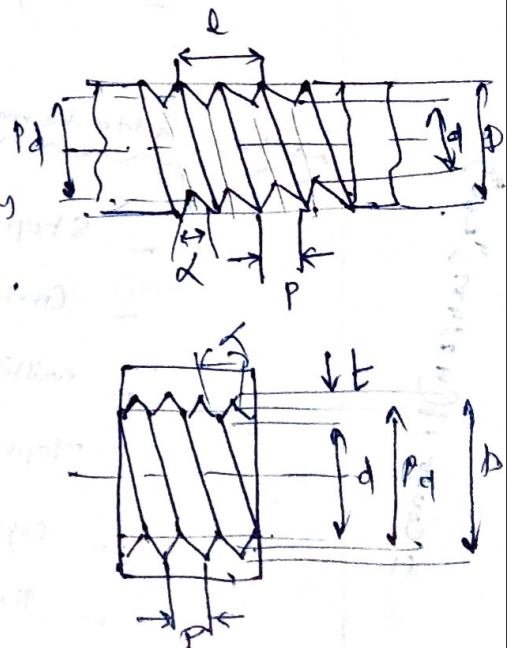
methods

- using tail stock set over method
- By swivelling compound rest

Thread cutting:

Elements of threads

- External threads
- Internal threads



- Claudio - A cura

Change ~ 6

Change of

-
- The image contains two sets of hand-drawn diagrams illustrating gear trains.
- Simple Gear Train:** This diagram shows three gears arranged in a vertical line. The top gear is labeled "driver" and has an arrow pointing to it from the left. The middle gear is labeled "Intermediate gear" and has an arrow pointing to it from the left. The bottom gear is labeled "driven" and "(gear on last shaft)" and has an arrow pointing to it from the left. To the left of these gears is a vertical shaft with four gears mounted on it, representing a parallel shaft gear train.
- Compound Gear Train:** This diagram shows two gears of different sizes meshing together. The top gear is labeled "driver" and has an arrow pointing to it from the left. The bottom gear is labeled "driven" and has an arrow pointing to it from the left. To the left of these gears is a vertical shaft with two gears of different sizes mounted on it, representing a parallel shaft gear train.

a t t a h e m e n t s

-
- Compound.

Classification of lathe tools

- According to the hand
 - Right hand tool
 - Left hand tool
- According to the form of the point
 - Straight Shank tools
 - Round Shank tools
- According to the purpose
- According to the method of manufacturing
 - Forged tools
 - Tipped tools

Capstan and Turret lathe

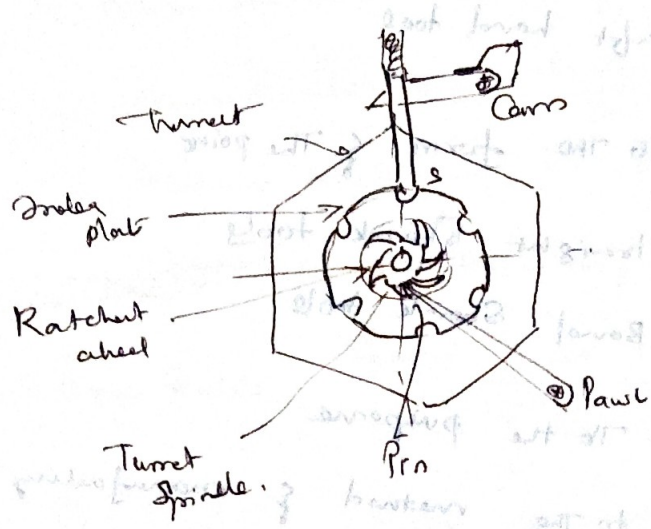
Parts:

- head stock
- Carriage or Chaser Saddle
- Turret Saddle
- Bed
- Legs

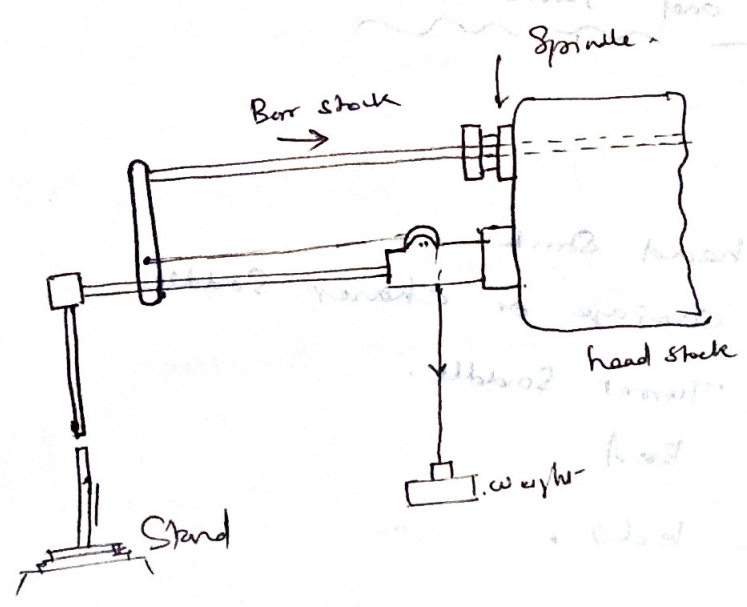
head Stock

- Cone pulley drive head stock
- Direct motor driven
- All geared

Turret Indexing Mechanism:

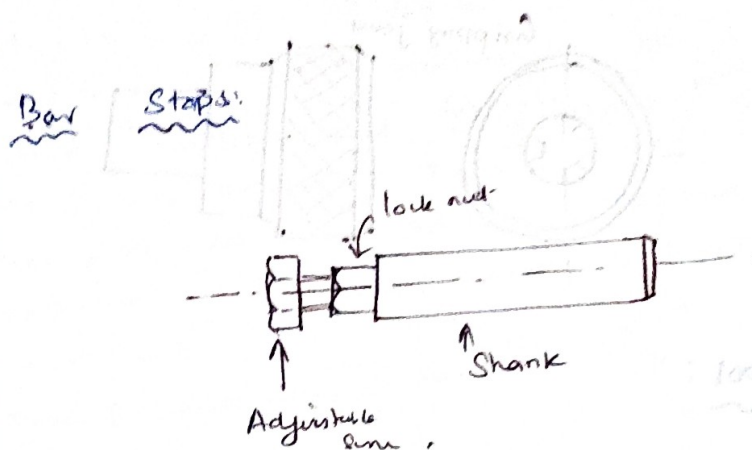


Bar Feeding Mechanism:

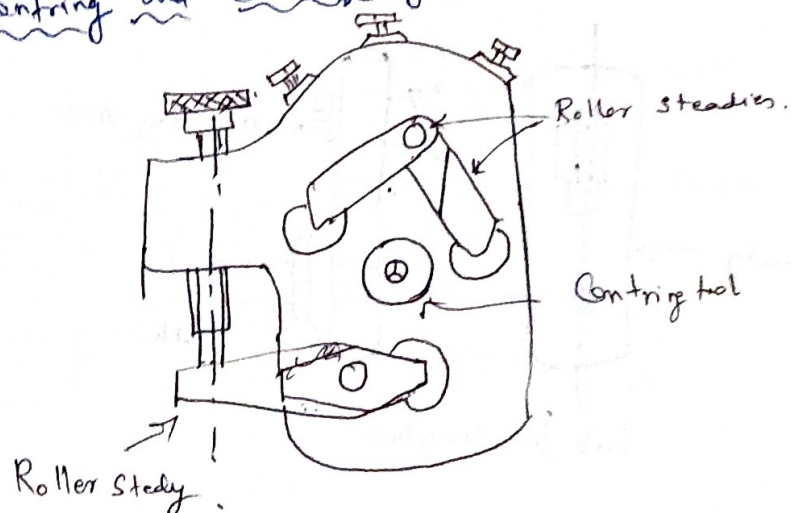


Tools used on Capstan and Turret lathes:

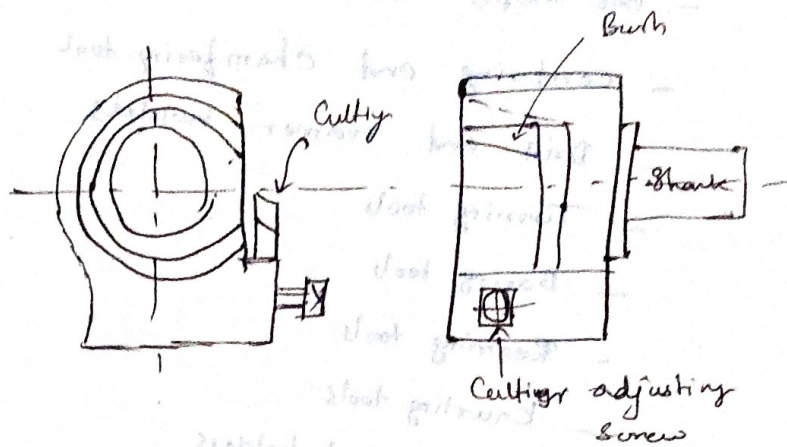
- Bar stock, work stops
- Centring and chamfering tool
- Drill and reamer holders
- Turning tools
- Boring tools
- Reaming tools
- Knurling tools
- Tap and die holders
- Centres and supports
- Box tools.



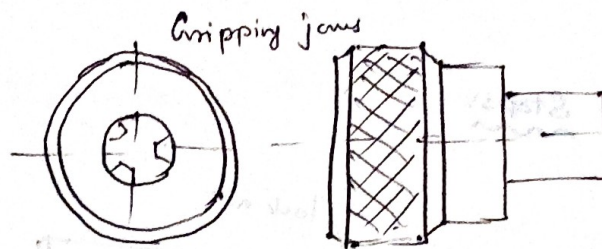
Centring and Chamfering tools.



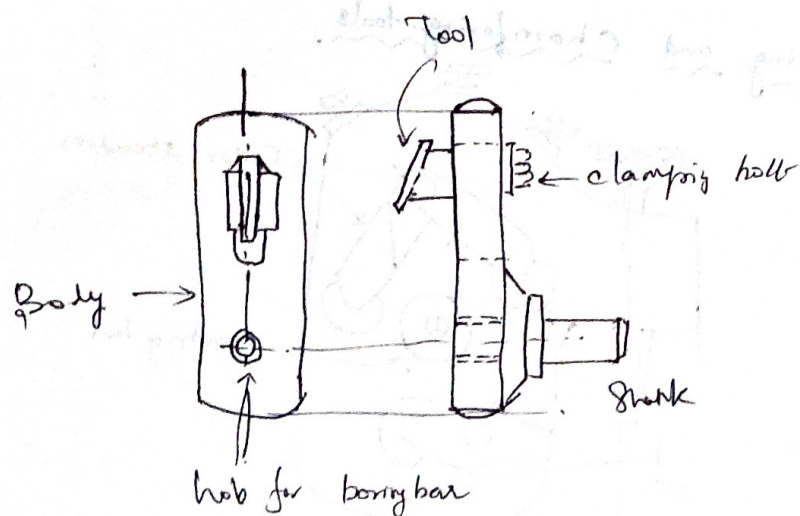
Chamfering tool:



Drill and Reamer Holder:

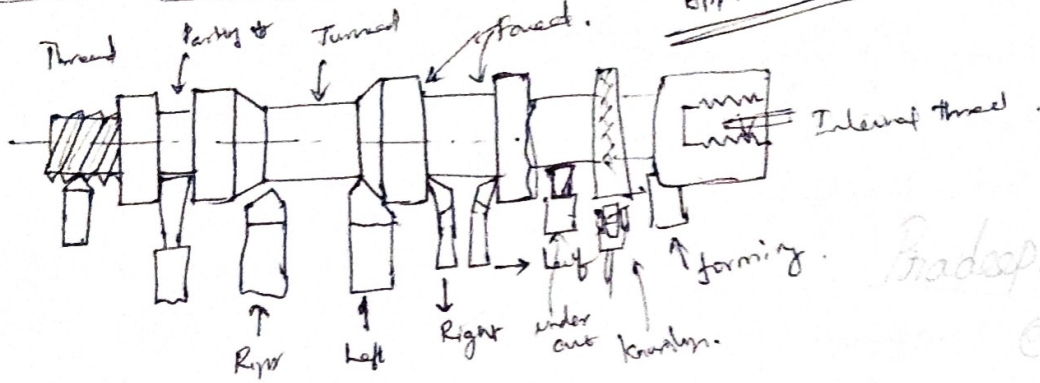


Turning tool:



Capstan and Turret lathes

Classification of Lathe tools:



Capstan and Turret lathes:

Parameters:

1. Head Stock - Speed

2. Tail Stock -

3. Tool post

4. Lead screws

5. Method of mounting the head

6. No. of tools mounted

7. Tool setting time

8. Applications

9. Operator Skill

10. Degree of automation

11. Production rate

12. Initial cost

Centre lathe
Smaller range

Single tool

Adjustable

does not carry capstan head

Single

every time

tool room work

↑

manual

↓

↓

Capstan

wide range

capstan head

more than 2

NC

mm

Four

one time

production

↓

↓

Semi

↑

↑

Turret
same

turret head

same

NC

Saddle

same

"

"

↓

Semi

↑

↑

Main Parts:

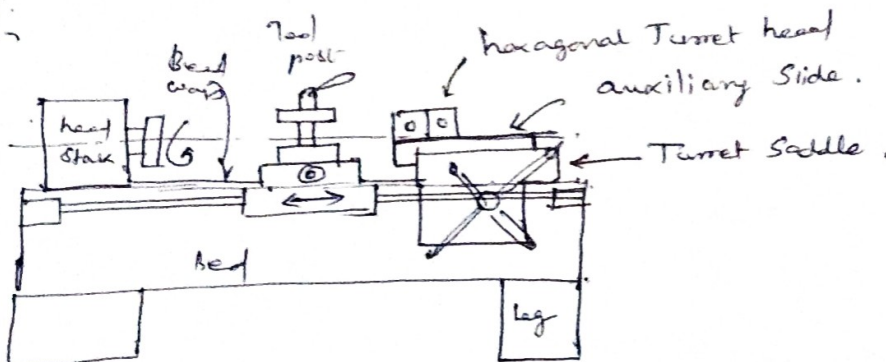


Chart. 1.1

Spindle
Turret

Capstan and Turret lathes operations:

- Straight turning
- Form turning
- Taper turning
- Boring
- Chamfering
- Parting off
- Facing
- Knurling
- Threading
- Drilling
- Bore grinding
- Tapping

Size and Specifications of Capstan and Turret lathes:

- Maximum diameter of w/p
- Max dia of bar
- Swing diameter
- Spindle speeds
- Size of chuck
- Power of driving motor
- Total wt
- over all dimensions
- Special features like chucking pneumatic or hydraulic.

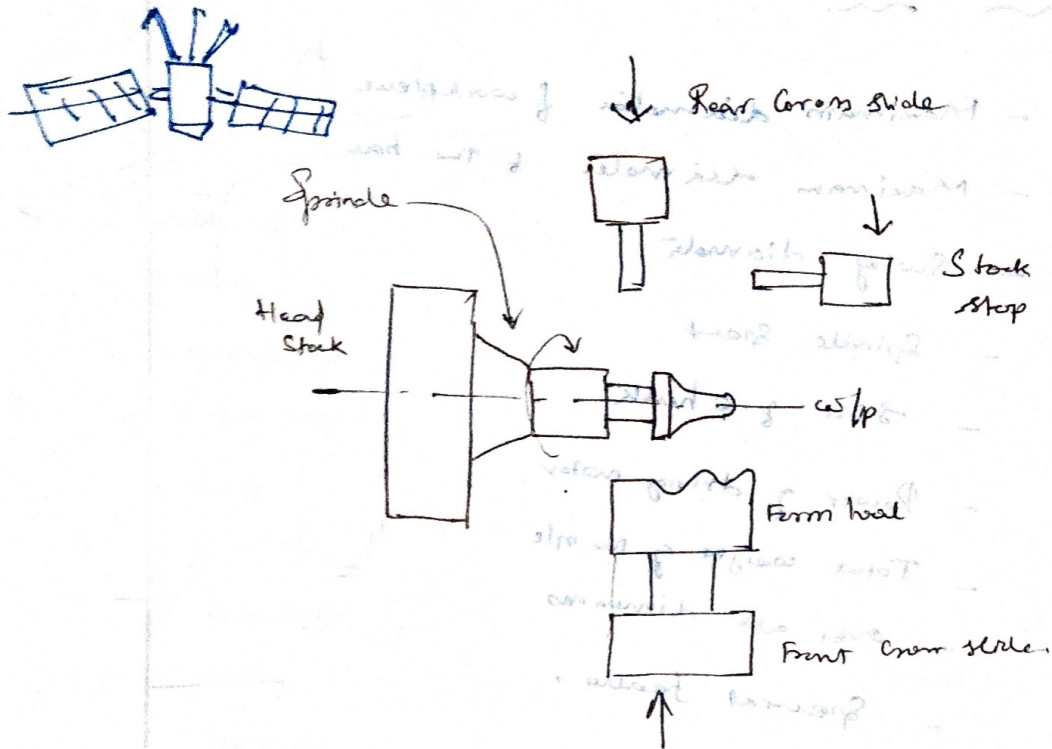
Size and Specification of Capstan and Turret lathe.

- maximum diameter of workpiece
- Maximum diameter of the bar
- Swing diameter
- Spindle speed
- size of chuck
- Power of driving motor
- Total weight of machine
- over all dimensions
- Special features.

Classification of Automatic Machines:

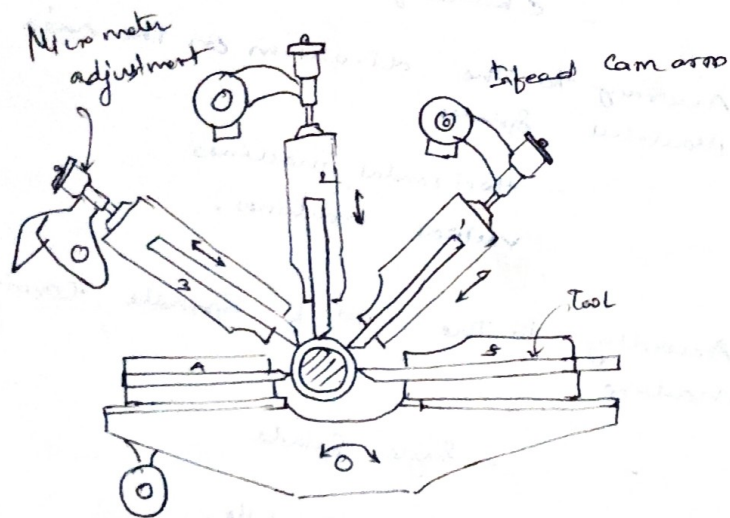
- * According to the type of stock material used
 - Bar automatic
 - chucking machines
- * According to the direction on the axis of the Machine Spindle
 - Horizontal machines
 - vertical machines.
- * According to the no of Spindle carried by the machine
 - Single Spindle
 - multi spindle.

Automatic Cutting off Machine



Swiss type (Sliding head) automatic screw machine:

- movable head stock



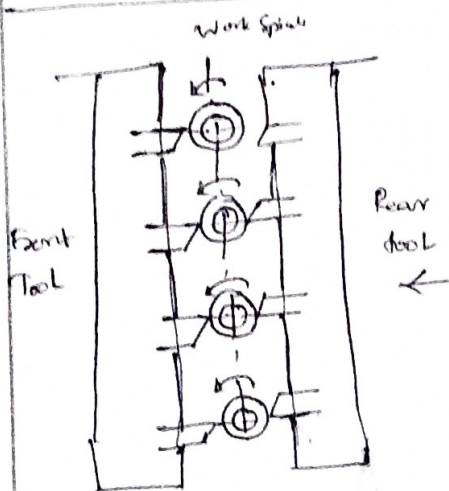
Multi Spindle Automatic Lathes:

- Bar type automatic m/c
- Chucking type car magazine loading
- Parallel action multi spindle automatic
- Progressive action multi spindle automatic etc.

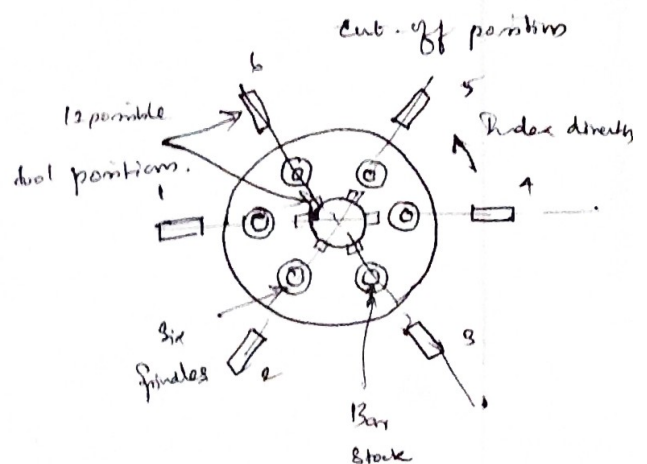
Advantages and Applications:

- Mass production
- accuracy
- less production time
- Floor Space - less
- More than one machine two operators
- bar stock are automatic
- reduction in cost.

Parallel action multi spindle m/c



Progressive action:



UNIT-III

OTHER MACHINE TOOLS.

Reciprocating machine tools, Shaper, planer, Slotter - milling type, milling cutter, operations, hole making, drilling - Drill mechanism, Reaming, Boring, Tapping, Super finishing, polishing and buffing, abrasive belt machining, Gear cutting, forming, generation, Shaving, hobbing.

Shaping machine:

Principle parts of Shaper.

- Base
- Column
- Cross rail
- Saddle
- Table
- Ram
- Shaper head

- 1) Feeding mechanism
- 2) 3rd angle of cutting
- 3) Direction of work
- 4) Direction of feed

Classification of Shaper:

- Crank type
 - Creased type
 - Hydraulic type
- } type & mechanism

- Horizontal
 - Vertical type
 - Travelling head type
- } position and travel of ram.

- Standard Shaper
 - Universal Shaper
- } according to design of table

- Push type
 - Draw type
- } Cutting Stroke.

- Crank Shaper
- Cleared Shaper
- Hydraulic Shaper
- Horizontal Shaper
- Vertical Shaper
- Travelling Head Type
- Universal Shaper
- Push Type Shaper
- Draw Type

Shaper Mechanisms.

- Quick Return Mechanisms
 - Crank and Slotted Link Mechanisms
 - Hydraulic Mechanisms
 - Whitworth Quick Return Mechanism.

Shaper Operations:

- Machining Horizontal Surfaces
- Machining Vertical Surfaces
- Machining angular Surfaces
- Machining V or key ways
- Cutting splines (or) gears.

Types & Shapes tools:

- According to Shape
- to cutting direction
- operation
- degree of finish
- cutting edge, tool

Work holding devices

- Vices
- clamps
- Parallel strips
- Angle plates
- Jaws
- Centres
- V Block
- Stop pins.

Planners:

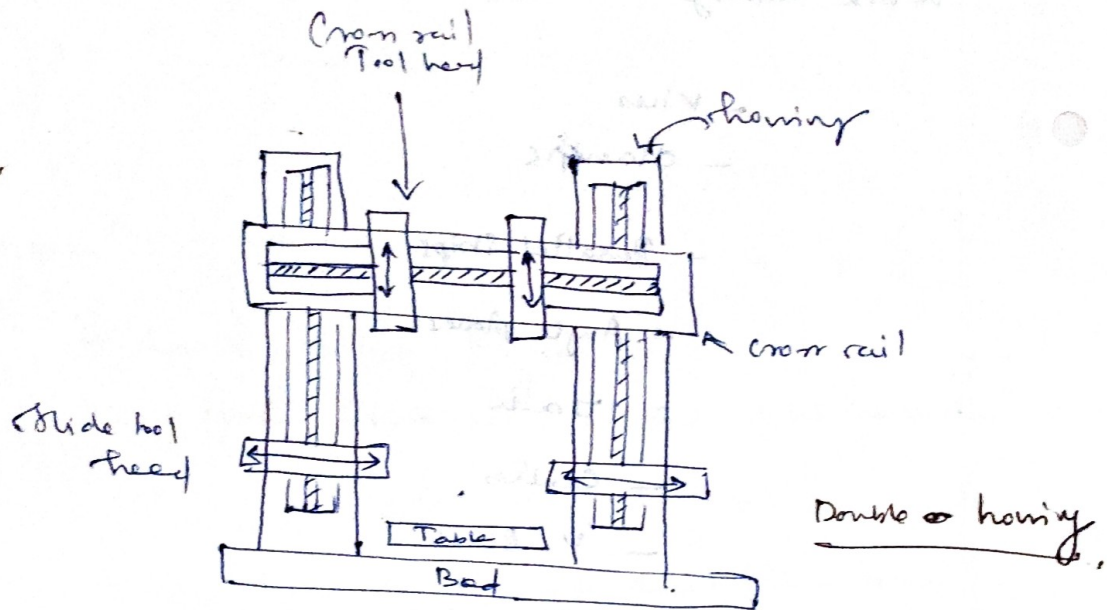
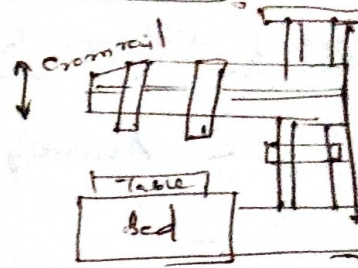
Types & planner.

- Double handing or Standard planner.
- Open side planner
- pit planner
- Edge or plate planner
- Divided table planner

Parts of Planner.

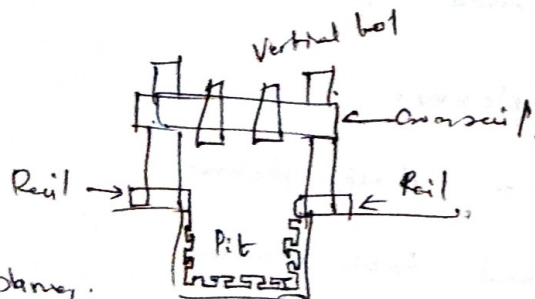
- Bed
- Table
- Hoisting
- Cross rail
- Tool head
- Driving or Feed Mechanism.

operate planner.



Planner Mechanism

- Open and Cross belt drive
- D-C reversible motor drive
- Hydraulic drive.

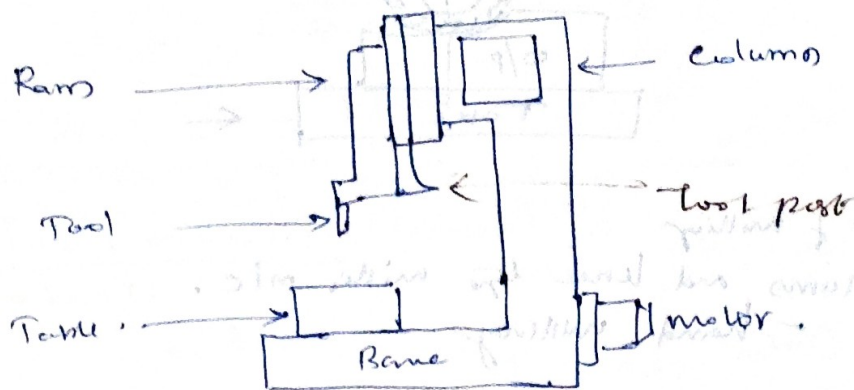


pit planner:

operation on Planner.

- Planning of horizontal flat surface
- vertical flat surface
- Angle
- curved surface
- slots and grooves.
- Relief

Slotted:



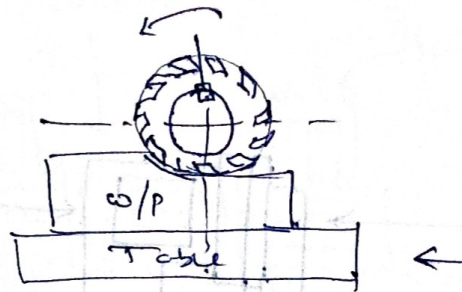
Types of drives.

- Slotted disk Mechanism
- Variable speed reversible motor drive.
- Hydraulic drive
- Slotted disk Mechanism

Platter operations.

- Flat Surfaces.
- Cylindrical Surfaces
- Cam Machining
- Slots, keyways.

Milling Machines.



Types of milling

① Columns and knee type mill's m/c.

- hand milling

- Plain or horizontal milling

- Vertical milling

- Universal milling

- Universal milling

② Fixed Bed or Manufacturing type

- Plain type

- Duplex type

- Triplex type

- Rise and fall

② Plavne lize mlti mla

(2) Productions of the day, week

Dear Sir,

Test plan rolled

2) Special purpose miller etc

Thoreau willing

People will be

can mills

head milky

Planetary

Parts 1 milling m/c.

- Base

column D

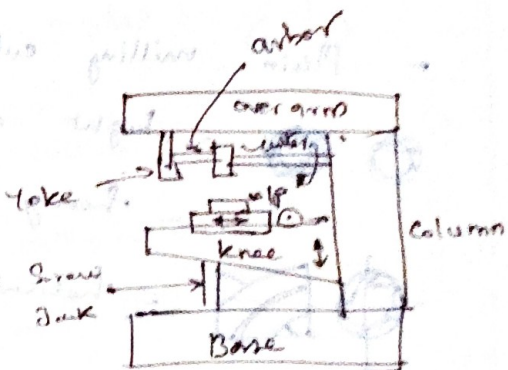
W naa

7. united

Saddle

(c) Not at all

Arbeit



Plain milky etc.

fixed base

Qinla

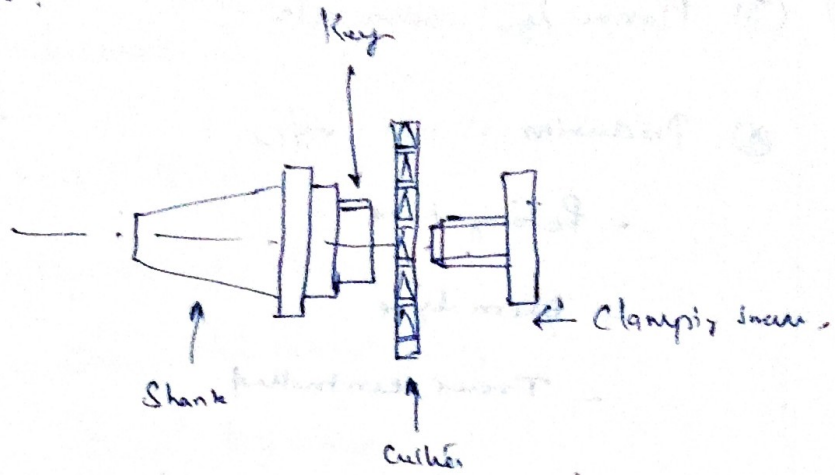
5. water

P 5140

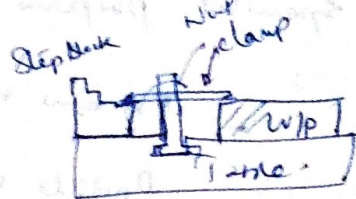
14

Teuku

Milling Arbors:



work holding devices.



- T-bolts

- Angle plates

- V-Blocks

- Vices

- Plain mtc vice

- Swivel vice

- Universal vice

- Vertical vice

- Precision angle vice

- Compound vice

Milling Cutters:

- Plain milling cutters



- Light duty cutters up to 20 mm width

- Heavy duty cutters



- Helical cutters, teeth angle $45^\circ - 60^\circ$

- Side milling cutters



- plain cutters

- Staggered teeth cutters

- Side flange cutters - Straddle milling

- Interlocking cutters

- Metal cutting cutters (drilling saws)
- Plain cutters
- Staggered tooth cutters

- End mill cutters

- Taper Shank cutters

- Slotted Shank cutters

- Shell cutters



- T slot milling cutters

- Straight fluted cutters



- Woodruff key slot milling cutters

- Fly cutters



- Angle milling cutters



- Single angle

- Double angle



- Formed milling cutters

- Corner milling cutters



- Concave



- Corner rounding milling cutters

- gear

- T and miller

- Tap and reamer cutters

Feeding

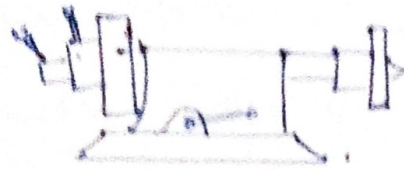
- upmilling
- down milling

Milling operations

- Plain or Slab milling
- Face milling
- Angular milling
- Form milling
- Shroud milling
- Chain milling
- Slot and groove milling
- Key way milling
- Slitting or Saw milling
- Slide milling
- End milling
- Profile milling
- Gear milling
- Thread milling
- Helical milling
- Cam milling

Dividing heads

Plain dividing heads,



Universal dividing heads.

Indexing methods:

- Direct Indexing
- Simple or plain Indexing
- Compound Indexing
- Differential Indexing
- Angular Indexing

Hole making machines:

Classification of Drilling:

According to Shank

- Parallel Shank
- Tapered Shank

According to the type of drills

- Flat drills.
- Twist drills.

According to length of drill

- Short Series drills
- Stub Series drill
- Long Series.

to applications.

- Core drills
- Centre drills
- Masonary drills.

material of tool

- HSS tool
- Carbide tipped tool

330846

Twist drill Terminology

12/3/15

10, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 50, 52, 54, 56, 58, 60, 62, 64, 66, 68, 70, 72, 74, 76, 78, 80, 82, 84, 86, 88, 90, 92, 94, 96, 98, 100

- Body

- axis

- Chisel edge (on dead centre)

- Shank

- Point

- Lip or cutting edge

- Body clearance

- Land

- Flute

- Flute

- Neck

- Tang

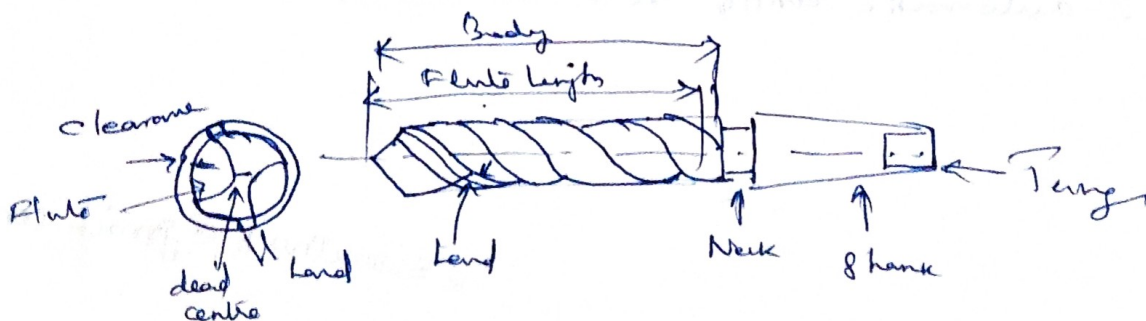
- ~~Back~~ Heel

- Length of body

- Flute length

- Overall length

- Lead & helix



Reamer Terminology:

- Flute

- Flare

- Land

- Heel

- Taper

- Body

- Shank

- Axis

Types of Reamers:

- Hand reamers

- Machine reamers

- Adjustable reamers

- Expansion reamers

- Taper reamers

- Taper pin reamers

- Shell reamer

- Carbide tip reamers

Taps

- Hand Tap

- Machine tap

Tap Nomenclature

- Axis

- Body

- Chamfer lead

- Cutting edge

- Flare

- Flute

- Heel

- Land

- Shank

- Overall length

Boring machine:

Types :

Horizontal

- Floor type
- Planer type
- Multiple head type

Vertical

- Standard vertical boring m/c
- Vertical turret lathes
- Vertical pneumatic boring m/c

Big boring

- Planer
- Vertical milling m/c

Sawing m/c.

Classification.

- Reciprocating Saw
 - Manual
 - Power
- Band Saw
 - Vertical cut-off
 - Horizontal cut off
 - Combination cut off
 - Friction
- Circular type
 - cold
 - Slit friction
 - abrasive disc

14. 1992

head, face
at a distance.

Booby house

24

Behind
hand

head
2-14

and supporting columns

12/1/20

Cont'd

2004



VB.10

Standard
with.

Column

— ~~long~~ well

Spindle heads.

Used

Abrasive process

Types of grinding machines.

Rough (or) Non Precision grinders.

- Bench, pedestal
- Swing frame
- Portable
- Belt

Precision grinders.

Cylindrical grinders.

- Plain
- universal
- centerless

Surface grinders

- Reciprocating table
- Horizontal
- Vertical
- Rotary table
- Horizontal
- Vertical

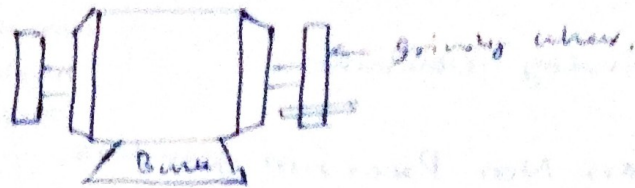
Internal grinders

- Plain
- universal
- Planetary
- Centerless
- Special grinding m/c.

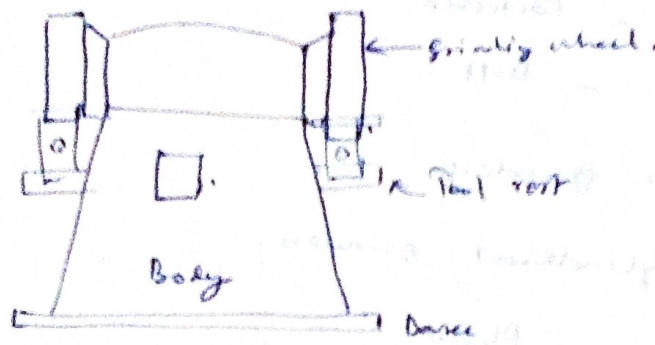
Grinding is a process of removing material by the abrasive action of a revolving wheel on the workpiece.

The wheel used for performing the grinding operation is called as grinding wheel.

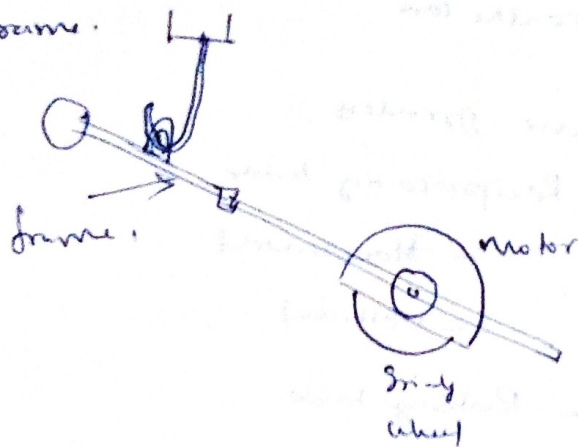
Bench grinder.



Pedestal grinder.



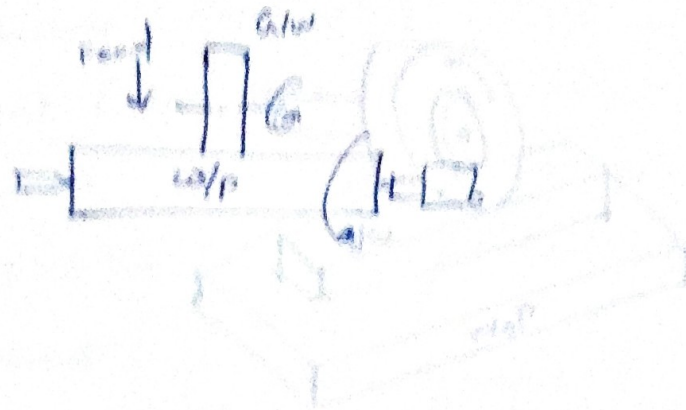
Swing frame.



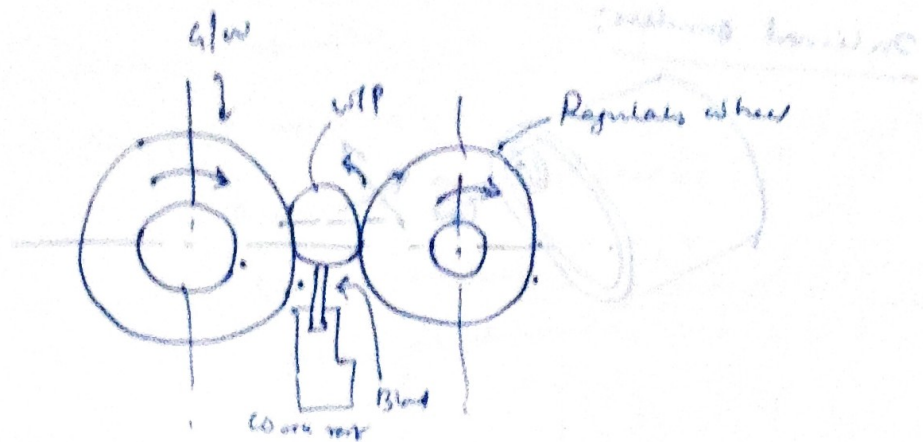
Portable grinder.



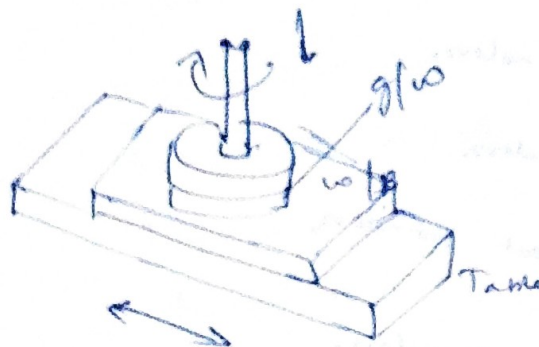
Cylindrical grinder:

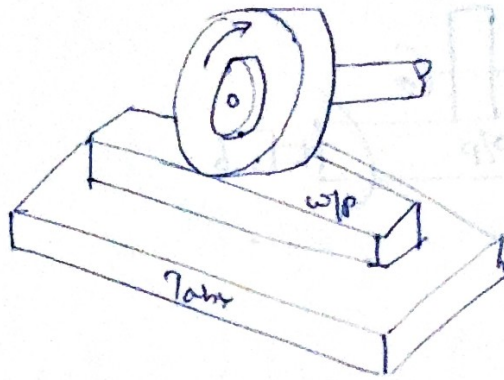


Carrie' low grinder:

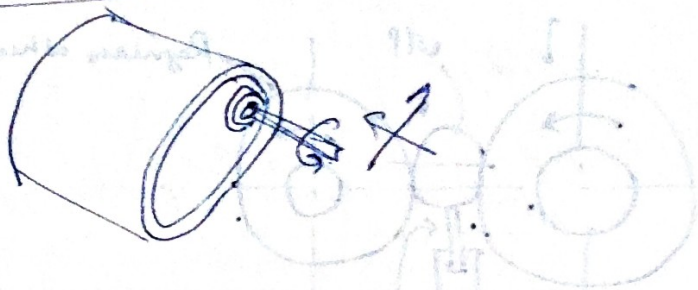


Reciprocating table:





Internal grinders:



Special grinders m/c.

- Tool and cutter grinders.
- Cam shaft grinders.
- Piston grinders.
- Disc grinders.
- Tool post grinders.
- Threaded grinders.

Method of specifying con Marking of grinding wheel;

- Abrasive
- grit (grain size)
- Grade
- Structure
- Bond

Grinding wheels / Materials;

= Natural abrasives.

Artificial abrasives.

- Aluminium oxide (Al₂O₃)
- Silicon carbide (SiC)
- Artificial diamonds.

Bonds;

- Vitrified bond 'V' - clay bond - 12000 psi
- Silicate bond 'S' - Silicate Soda - up to 15000 psi
- oxy chloride bond 'O' - for cutting
- Resinoid bond 'B' - cutting, fine grinding
- Shellac bond 'E' - high surface finish
- Rubber bond 'R' -

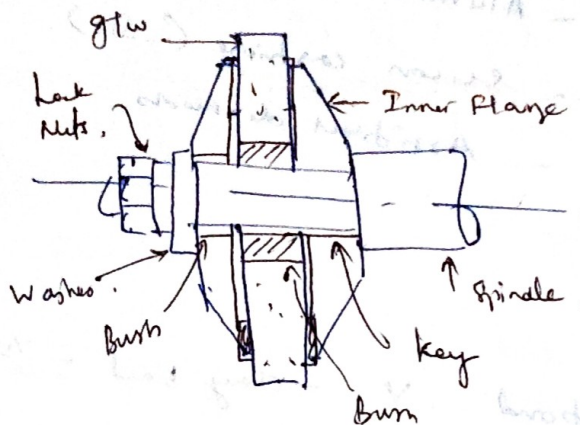
Grain, Grade

- Grain
- Grade
- Structure

Selection of grinding wheels.

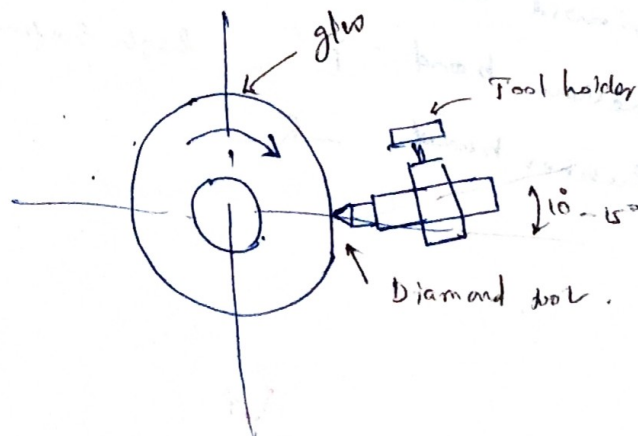
- Constant factors : *Work piece material*
- Variable factors.
 - Amount of material to be removed
 - Work piece area
 - M/C

Mounting of grinding wheel.



1. Speed of wheel
2. Speed of cut
3. M/C condition
4. Personal factors

Truing and Dressing of glw



1. Wheel dressers.
2. Abrasive sticks
3. Abrasive wheels
4. Diamond
5. Crush dressing machine

Gear - cutting

334346

Methods of gear manufacturing

- 1, 4, 6, 11, 18, 19 - Casting
- 4, 15, 7, 9, 11, 14, 15, 18, 19 - Plastic moulding
- 11, 14, 15, 18, 19 - Rolling
- Extrusion
- Stamping
- Powder metallurgy
- Machining

- Forging

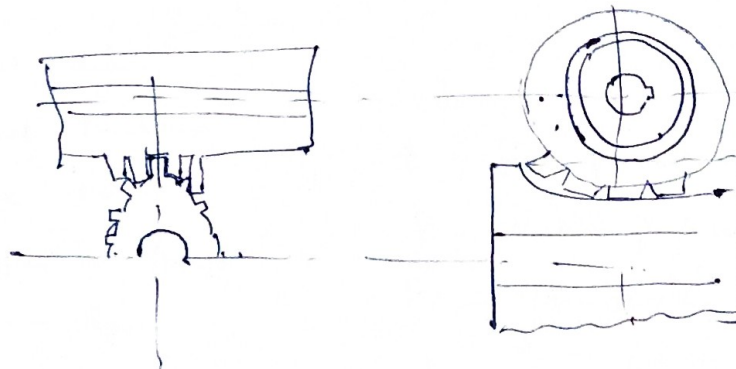
- Template

- ~~Generative~~
Generative

Gear Shape process:

- Rack type Shaper Cutter
- Continuous - cutting machine
- Planetary cutter m/c

Gear hobbing process



Throwing pairs - Coarse - 10-24

Medium - 30-60

Fine - 80-160

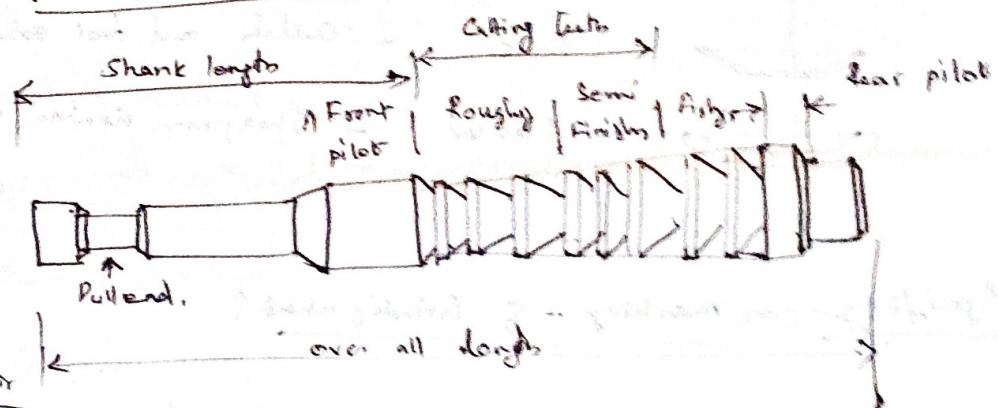
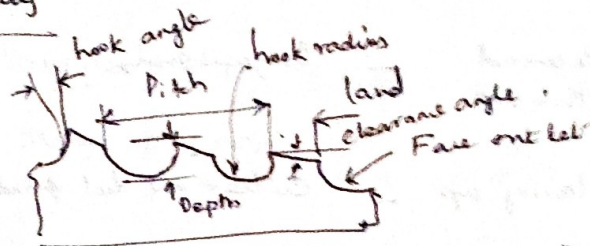
Very fine - 220-600

Grade Soft - A-H

Medium - I-J

Hard - Q-Z

Broach Geometry



Types of Broaching

- ① Push type
- Pull type

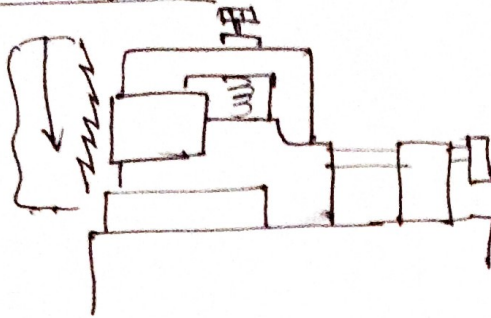
Types of Broaching rule:

1. Based on power
 - (a) Manually operated
 - (b) Power driven.
2. Based on direction of movement
 - horizontal
 - vertical - pull up and pull down.
3. Based on cutting,
 - Pull type
 - Push type
 - Continuous drive

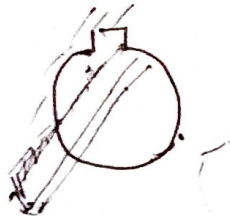
- 4) Based on type of drive.
- (a) Mechanical drive.
 - (b) Hydraulic drive.

- (5) Based on number of pull heads.
- Single pull head
 - Multiple pull head

Surface Boring M/c.



Keyway Borer:



CNC Machine tools / and Part Programming.

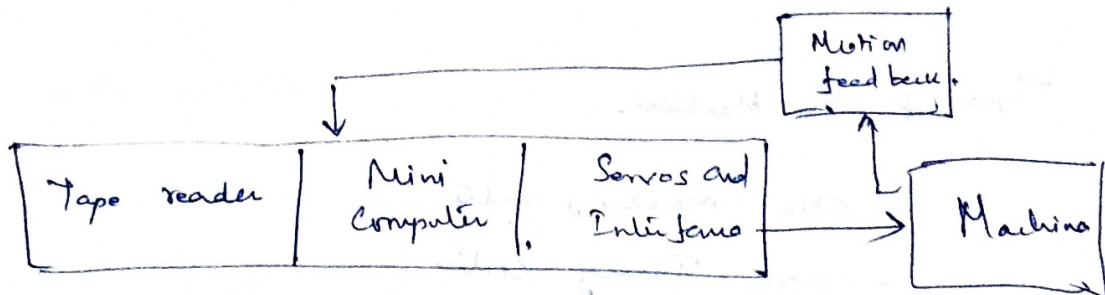
Numerical Control System

- Definition of NC system
- Types of NC systems
 - Point to point
 - Straight cut
 - Countering

Advantages.

- Greater accuracy
- Lesser production
- Improved product quality.
- Less scrap
- Less operator killed.

CNC control systems



Types

- hybrid CNC
- Straight CNC,

Elements of CNC system

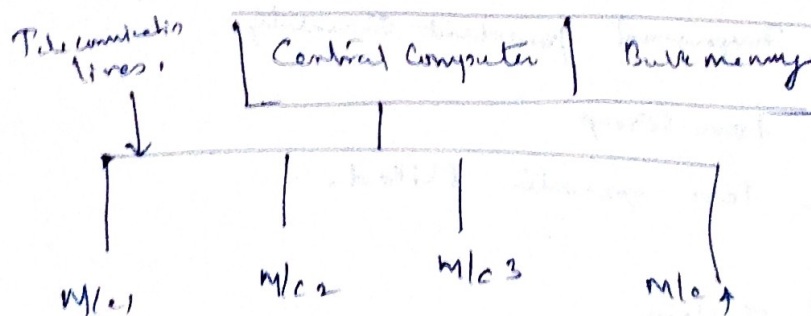
- Hardware
- Software
- Information

Application

DNC

- Central Computer
- Bulk memory
- Tele communication
- Machine tools.

Configuration



Types of CNC Machine.

- CNC milling centre
- CNC Turning centre
- CNC lathes.

Applications of CNC m/c.

- Metal cutting
- Milling, Drilling, Boring, Turning

Production jobs

- Part geometry
- Parts and processed frequently
- design change.
- close tolerances
- costly

Addition to metal cutting.

- Welding m/c
- Press working
- Forging
- Wire-wrap m/c.
- Laser beam process
- Flame and plasma.

Cutting Spindles.

Requirements of Spindles for CNC m/c.

- High stiffness
- Runout accuracy.
- Axial load
- Thermal stability
- Thermal expansion.

Spindle heads.

- Inclined head
- Robot like head
- Horizontal spindle head
- Vertical spindle head
- Universal head

Drive Systems

- Electromechanical drives.
- Digital circuits.

AC Drives.

- Principles of operation
- Advantages of AC motor over DC motor
- Disadvantages

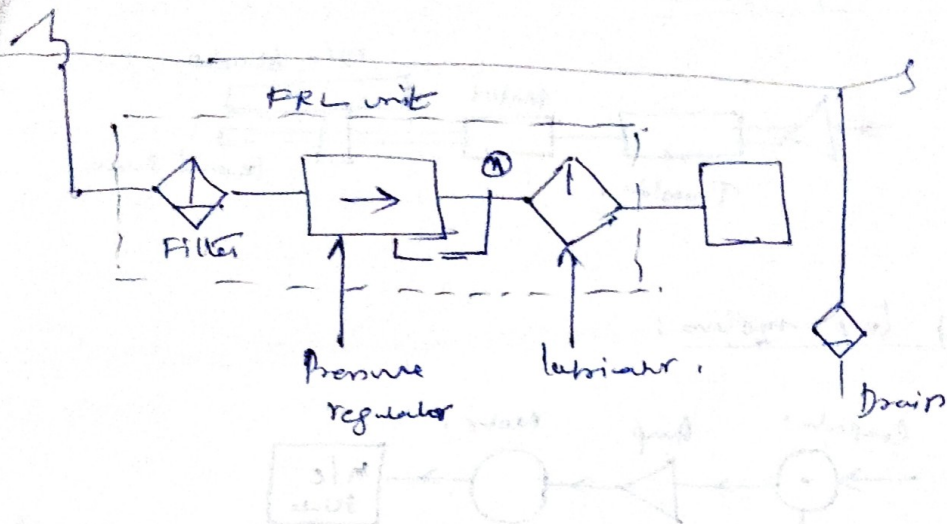
Stepping motor :

- Principles
- Advantages

Hydraulic system

- Hydraulic power supply
- Servo valve
- Pump
- Hydraulic motor.

Automatic Drives.



Classification of machines.

- Horizontal Spindle.
- Vertical Spindle.
- Universal machine.

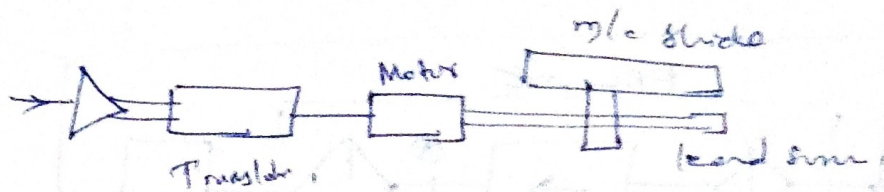
Classification of horizontal machines.

- Chucking machines.
- Shaft machines.
- Universal machines.

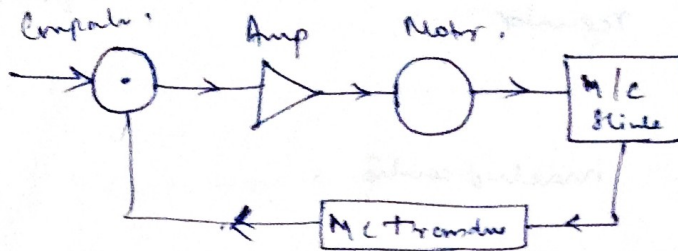
Work holding systems

- Fixtures
- Hydraulic chuck
- Coolant attachment
- Bar holding systems
- Shredders.

Open loop systems



Closed loop systems:



CMM

- Cantilever construction
- Bridge construction
- Column construction
- Carting construction

Post programming!

G-codes,

G00 - Point to point

G01 - Linear interpolation

G02 - Circular Interpolation

G03 - anti clockwise

G70 - Finish

G71 - Melt

Call macro function.

M00 program stop

M03 Spindle CW

M04 Spindle CCW

M05 stop

F - Feed

T - Tool

MACRO

DRILL

MACRO / Px

GOTO / Px

G0 DLT / 0,0, +1,0

G0 DLT / 0,0, +1,0

TERMAC

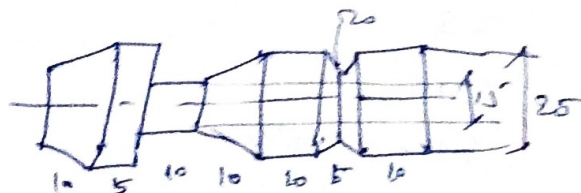
FROM / P0

CALL / DRILL, Px = P1

CALL / DRILL, Px = P2

GOTO / P0

Turning Program.



N01 G01 X-60 Y0 F8 Z1

G01 X-10 Y0

G01 X-2.5 Y2.5

G01 X-2.5 Y-2.5

G01 X-10 Y0

G01 X-10 Y5

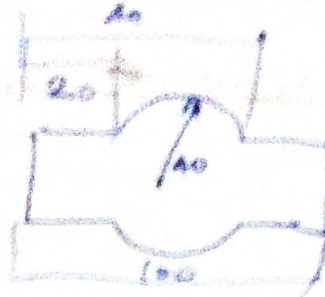
h01 x-10 y0

h01 y0 y-5

h01 x-5 y0

h01 x-10 y5

M05



N01 M03

N02 x0 y0 F1300 23 F1300

Q141

x0 y0

2-3 F1300

Y25 F1300

X20

h02 Y26.944 X050

h02 x80 y15

x100

y0

23

G140

G54 x100

h10

G112

h81

210

M05

G13

G10

x-50 y0

M02