TITLE:- BENCH DRILLING MACHINES

LECTURER:- GERRY HEYNIS

DATE:- 13-3-81

EQUIPMENT:-

Introduction - a drilling machine is a device used in a workshop for the purpose of drilling holes in various materials, of all shapes and sizes. Use in the correct manner and with the appropriate accessories, a high degree of accuracy and finish can be obtained on drilling work, thus saving time and manual effort, with less need for excessive filing and hacksawing.

Parts

(1) Head - this is made up of several parts -

(a) the motor and belt housing - in some cases a gearbox is provided in place of belts and pulleys to give various speeds.

(b) motor controls - usually a push button stop and start control. In the case of a gearbox type machine, a selector switch is also provided to select the different speeds.

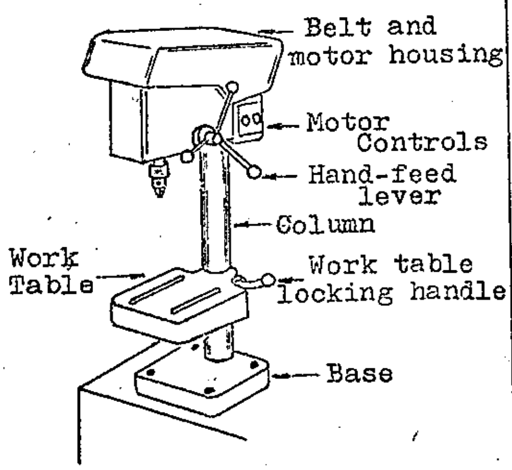
(c) spindle and chuck - the part which does the actual "work". The spindle is driven either by belted pulley or a gearbox and the chuck is fitted onto the spindle, allowing a twist drill to be placed in the chuck and rotate when switched on.

(d) Hand feed lever - moves the spindle and chuck vertically which in turn feeds the twist drill into the material. The lever has a spring return, allowing the spindle to resume its normal position when not in use.

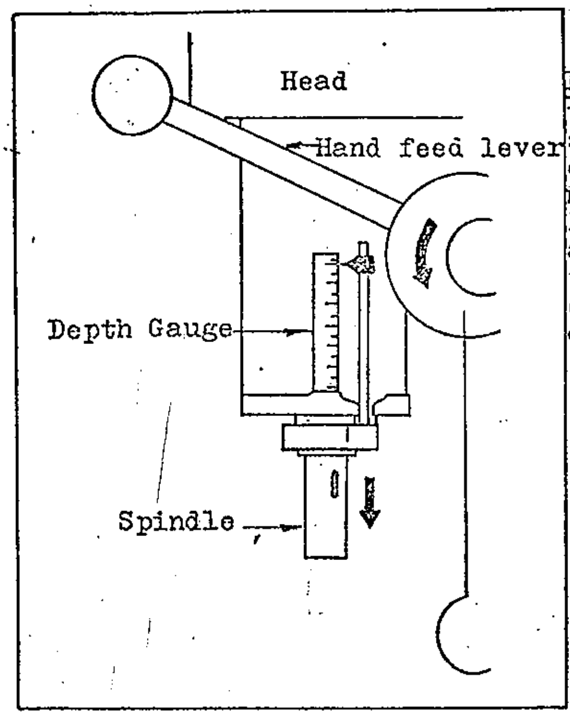
(2) Column - a large diameter shaft which supports the head to the base.

(3) Base - large, strong plate which is bolted to a bench or onto the floor to stabilise the machine.

(4) Work Table - a machined-surface plate on which the work is placed. It is clamped to the column by a locking handle and can be moved vertically along the column to any desired position. Slots are provided in the table to allow the clamping of work onto it (heavier drilling). When adjusting the height of the work table, ensure that the drill is not the chuck nor is there any workpieces on the table - the weight of the table makes it difficult to support it and a vice with a workpiece in it. A locking ring on the column will assist in adjusting the table height.



BENCH DRILLING MACHINE



Depth Gauge - where it is required to drill a "blind hole" to a specified depth, the depth gauge can be used. A graduated scale is mounted on the main body of the Head. A pointer, which is attached to an arm, which is in turn connected to the spindle, enables the operator to see the distance travelled.

Changing Speeds - on the belt driven machines, there is a certain procedure to be followed when changing speeds.

(1) Switch off power supply - accidental switching on while changing belts could result in loss of fingers etc.
(2) Release the belt tension locking screws.
(3) Select the desired pulley and place the belt in position.
(4) Adjust the tension of the belt and lock the screws.
(5) Replace cover.
(6) Switch on and check the speed.

TITLE:- LATHES
LECTURER:- CRAIG, JEFFY, SMUS, TREV, ME, SMITHY, STEVE
DATE:-
EQUIPMENT:-

Introduction -

The lathe, while being the most important machine shop tool, is also one of the simplest in construction. The function of the lathe is the removal of material by means of a suitably formed cutting tool. The general lathe operations are straight turning, facing, taper turning, drilling, boring, reaming and thread cutting.

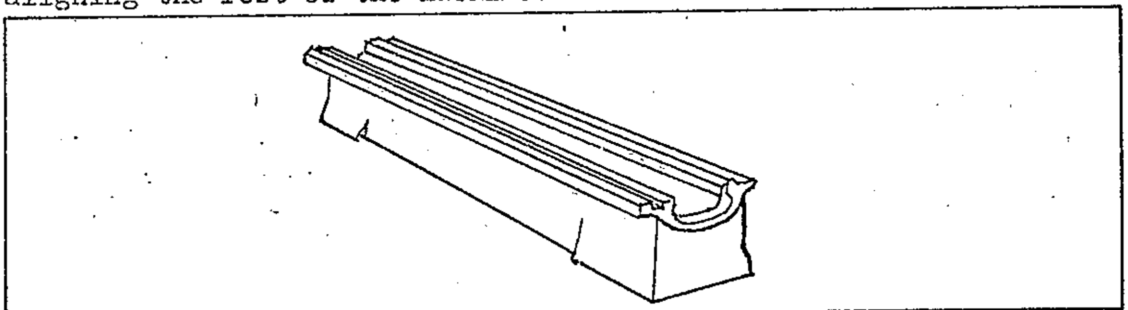
Special lathes of a variety of patterns and sizes are made for different kinds of work, the most notable example being the turret lathe, which is used for quantity production.

Parts of the lathe -

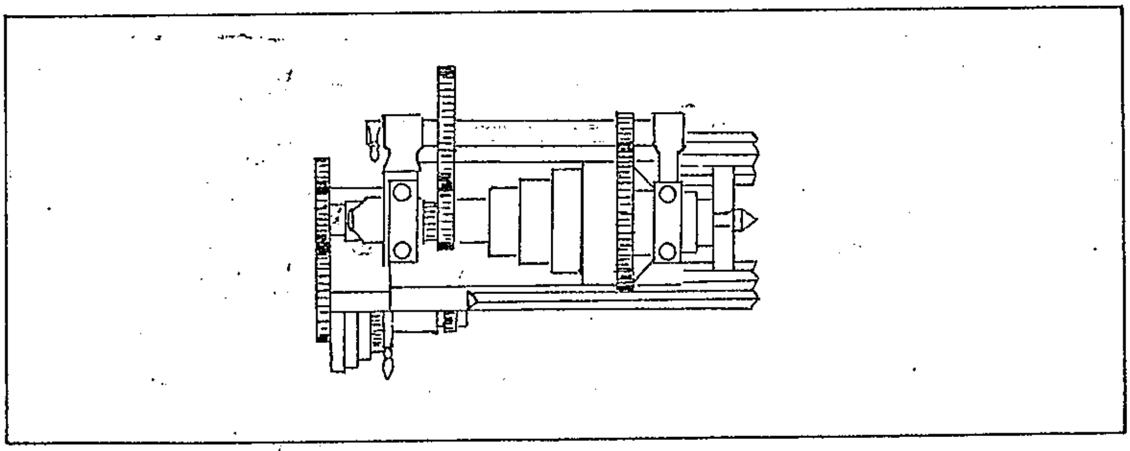
The lathe is comprised of six essential features -

(1) The Bed
(2) The Headstock
(3) The Tailstock
(4) The Carriage
(5) The Feeding mechanism
(6) The Thread cutting mechanism.

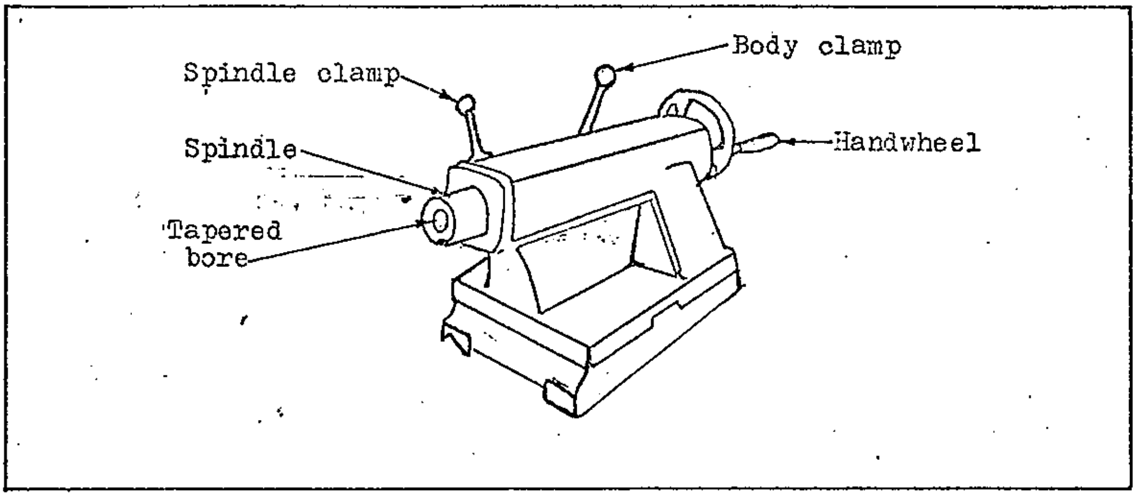
The Bed:- A strong casting which is a base for supporting and aligning the rest of the machine.



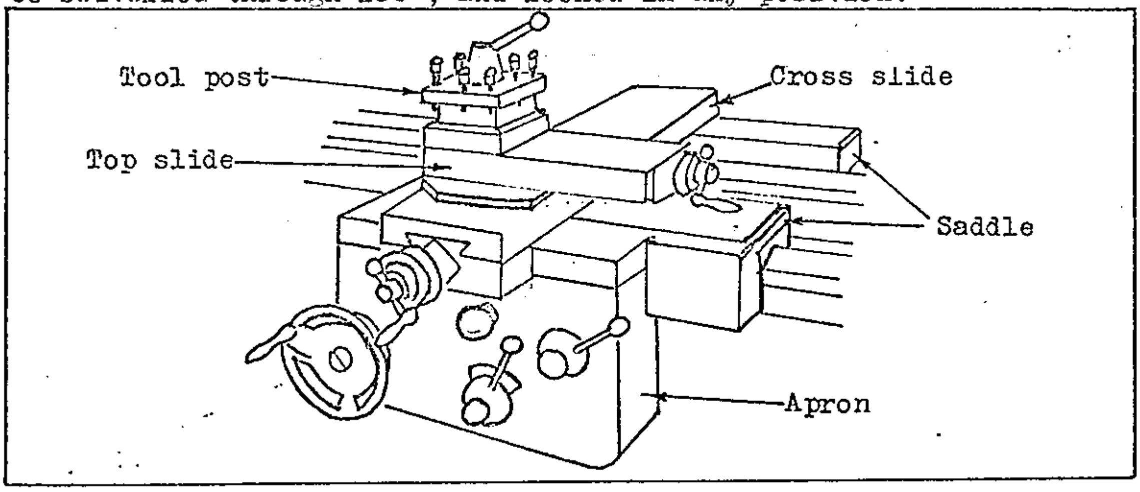
The Headstock:- This is the driving end of the lathe and consists of a strong casting which forms the support for a pair of accurately bored bearings whose axes are exactly parallel to the ways of the lathe. These bearings mount a true running hollow spindle, which enables long work to be held short in the lathe.



The Tailstock:- This is situated on the right hand when facing the lathe. Its function is to support the bearing for one end of work, turned between centres, and to mount tools for certain operations such as drilling, reaming and tapping. The tailstock may be clamped in position anywhere along the bed, by a clamping arrangement. There is no vertical adjustment of the tailstock, but it may be adjusted transversely by means of adjusting screws.



The Carriage:- This is the unit which carries the cutting tool. It includes the saddle, apron, compound rest & tool post, and is moved at uniform speed along the lathe bed. The saddle is in the form of the letter H, and is bridged across the lathe bed to carry the cross slide and tool post. Attached to the front wing of the saddle is the Apron, which carries the mechanism which engages the feed mechanism to drive the carriage.
On top of the saddle, is the compound rest, upon which the tool post is mounted. The compound rest slide is built so that it may be swivelled through 180°, and locked in any position.



Necessity for cleaning the lathe:-

The lathe is a precision machine and the successful continued operation of it depends largely upon the care it receives. There are three reasons why it is important to learn how to clean machines properly.

(1) It forms the habit of cleanliness, which is essential for good work.
(2) You learn the safe ways of cleaning the machine thus avoiding personal injury.
(3) While cleaning the machine it is necessary to manipulate the controls, this leads to better knowledge of the construction and operation of the machine.

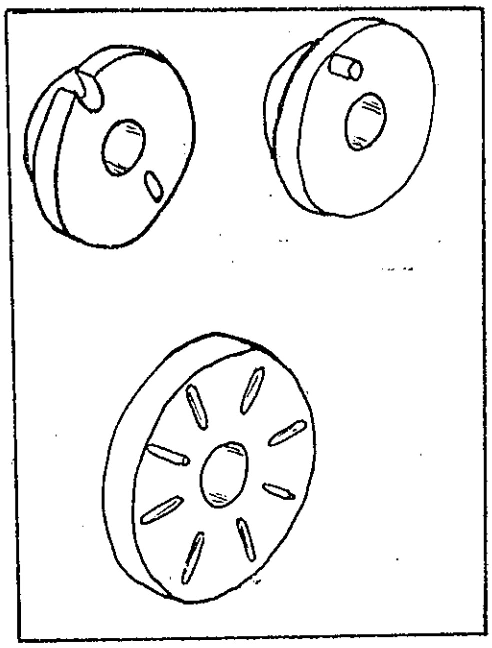
Types of accessories:-

The accessories fitted to the headstock spindle, are used for holding or driving the work.

The accessories are:-
1. The drive plate
2. The face plate
3. Chucks
4. The headstock centre

1. The drive plate:-

The plate is used to drive work that has been set up between centres. The plate rotates the work. It does not support it in any way. A lathe carrier is used to connect the work with the plate.



2. The face plate:-

The face plate is used to hold and drive work that cannot be held between centres or in a chuck. Slots in the face plate allow the work to be bolted in position. Counter balances must be used, when large work is mounted out of centre on the face plate.

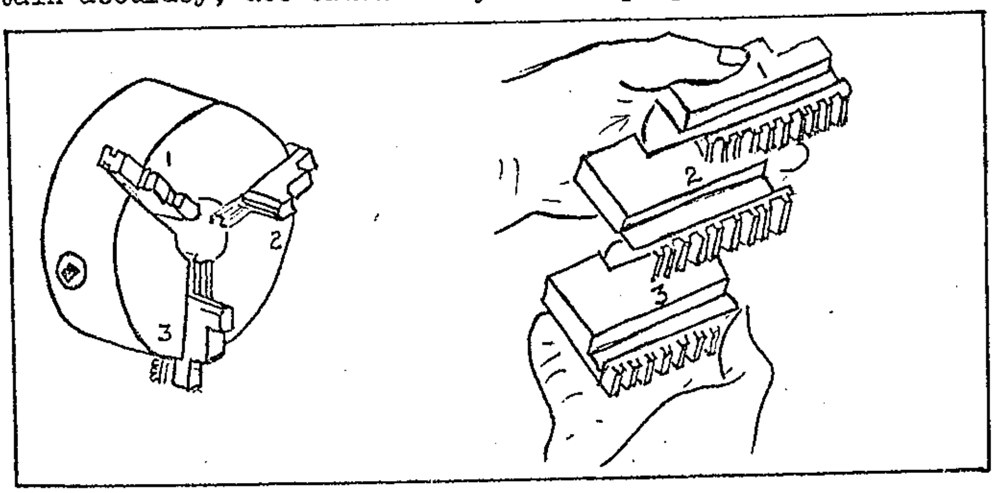
3. Chucks:-

Chucks are work holding devices, which grip work of various size & shape - by means of adjustable jaws. There are many types of chucks used. The most commonly used are:-

(a) The 3 jaw self-centring chuck
(b) The 4 jaw independent chuck

(a) The 3 jaw self-centring chuck:

This chuck is used to hold round, or hexagonal work. A chuck key is used to rotate a scroll, that moves the three jaws simultaneously. Generally, two sets of jaws are provided, one set is used for holding work externally, the other set is for holding work internally. The jaws are marked, and must be fitted in the correct order, in order to maintain the self-centring features of the chuck. The chuck is easily distorted when gripping irregular work such as castings, black and hot rolled steel, or when taking heavy cuts. To maintain accuracy, use chucks only in the proper manner.

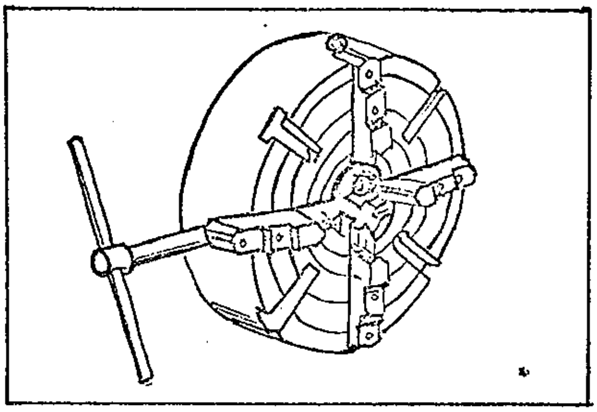


(b) The 4 jaw independent chuck:

This chuck has 4 jaws that can be moved independently of each other. The chuck is used to hold regular or irregular and odd shaped work.

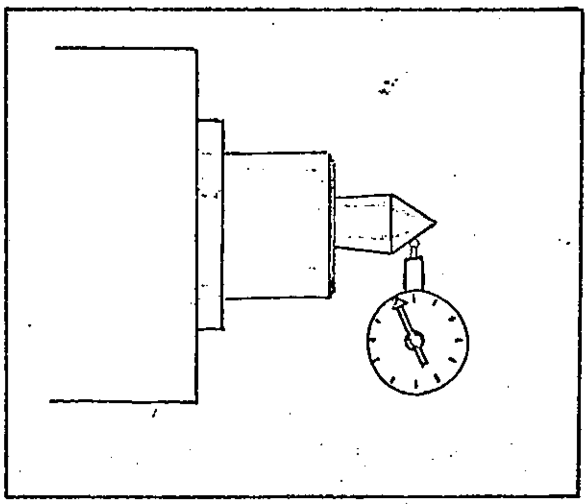
Advantages -

1. Each jaw can be moved independently, by turning a screw with a chuck key.
2. Work can be held very firmly, because each jaw opposes the others.
3. Work can be set up to run very true by adjusting the jaws & checking with a dial indicator.
4. Each jaw can be reversed independently, to enable odd shaped work to be held.
5. Concentric circles marked on the face, assist in locating work centrally.



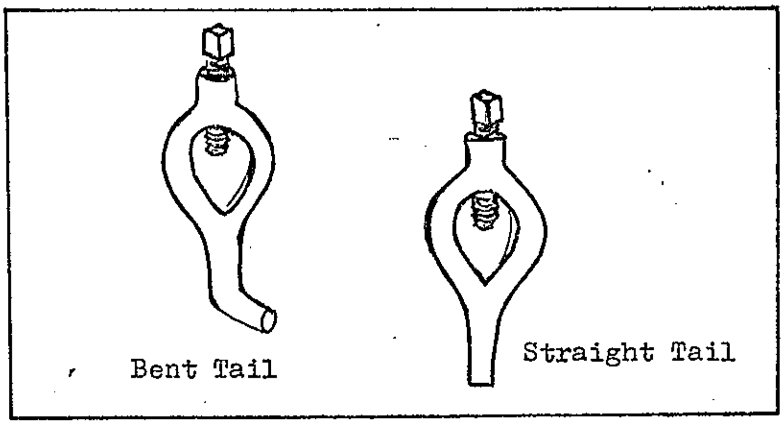
4. The headstock centre:-

The headstock spindle is bored out to a standard taper, to receive the headstock centre. On a lathe that has a large spindle bore, a sleeve is required, to reduce the size of the taper. The headstock centre is machined, to a 60° included angle point. This locates in a mating centre hole, drilled into the end of the work. The centre supports and rotates with the work. Because it rotates with the work, the centre must run perfectly true. A hardened headstock centre must be checked with a dial indicator, to test if it is running true.



Lathe carriers:

Work to be turned between centres, is driven by a clamp, attached to the work, this clamp (or carrier), has a "leg" or "tail", which locates against the pin of the driving plate.



Tailstock centres:

The tailstock centre is held in the tapered bore of the tailstock spindle. It supports the right hand end, of work to be turned between centres.

Plain centres:

The work rotates on this centre, therefore, the mating surfaces between the centre and the work must be lubricated.

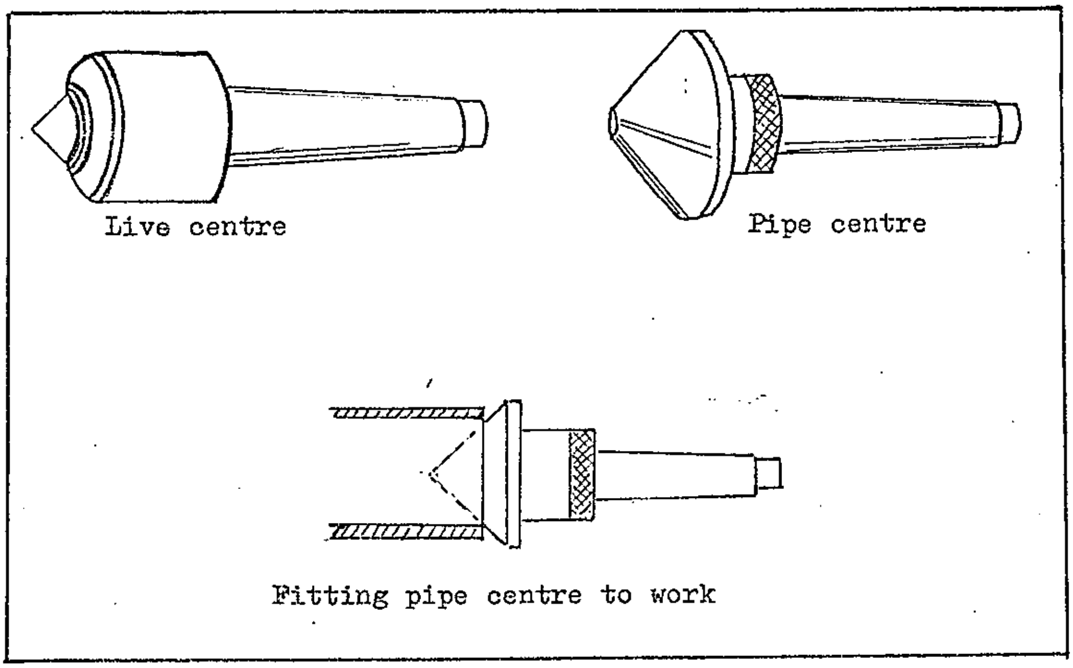
Live centres:

These are tailstock centres, that run on roller or ball bearings. This enables the point of the centre to rotate with the work. Excessive pressure on the centre would cause the bearings to overheat and become damaged. Live centres have the following advantages:-

1. The work can be rotated at higher speeds.
2. Lubrication is not needed, between the centre and the work.
3. Heavy cutting loads can be carried by the centre.

Pipe centres:-

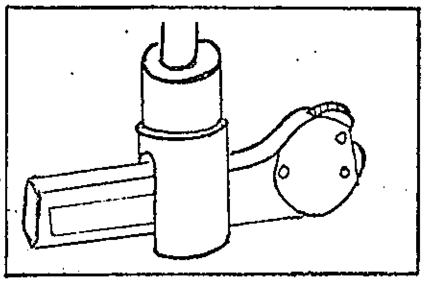
These are similar to live centres. Cones can be attached, to enable the centre to support work which has a large bore. Pipe centres would not normally be run at as high a speed as live centres.



Fitting pipe centre to work

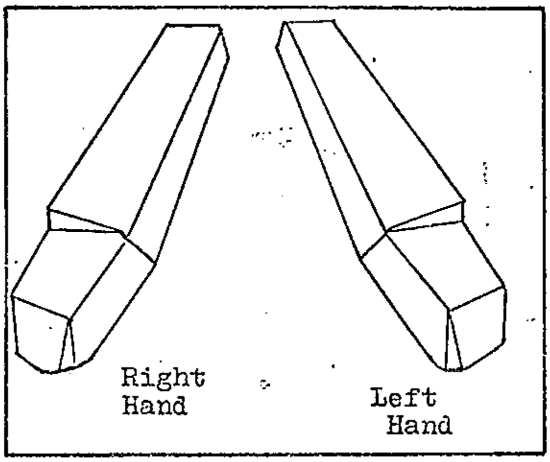
Knurling tools:

Knurling is a displacement process, not a cutting process. The knurling tool produces a raised diamond shape, or straight lined figure, on the circumference of cylindrical work. The tool consists of a body, on which knurl rolls are mounted on hardened steel pins. The knurling rollers are cylindrical discs of high grade tool steel, which have formed teeth cut in their circumference. The rollers produce a fine, medium or coarse knurl.



Tool terms:

Cutting tools used on a lathe, are usually of the single point type. The same common terms are used to describe the parts of all lathe cutting tools.



Right hand tool:

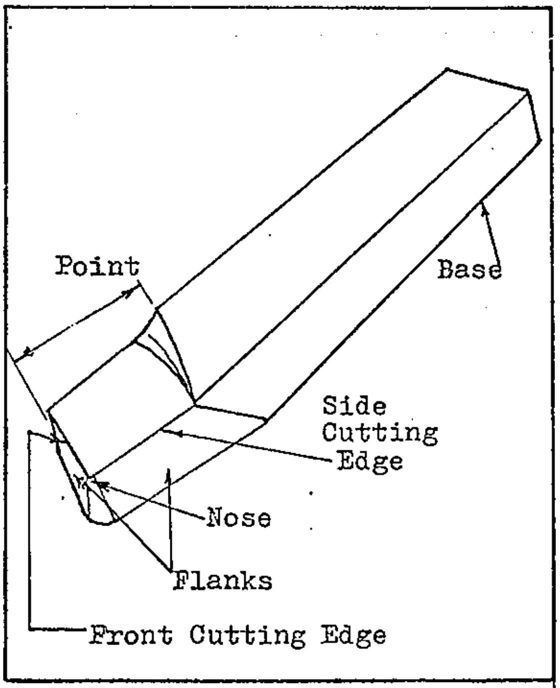
A tool which cuts on the right hand side when viewed from the point end, with the face up and the shank pointing away.

Left hand tool:

Cuts on the left hand side when viewed from the point end, with the face up and the shank pointing away.

Shank:

The part of the tool on which the tool point is formed, or a tip fixed. It provides the means for securing the tool in a tool post or tool holder.



Point:

The end section of the tool, on which the cutting edges, faces & flanks have been ground.

Cutting edge:
The leading edge of the tool, which does the cutting. It consists of the side cutting edge, front cutting edge, and nose of the tool.

Face:
The upper surface of the tool point, on which the chips bear, as they leave the workpiece.

Base:
The bottom surface of the tool.

Flanks:
The sides of the tool point, below the cutting edges.

Nose:
The curve of the tool, formed by, the junction of the front and side cutting edges.

Tool angles:

Shape is an important factor in determining the cutting properties of a tool bit. The tool should be ground, so that it is sharp enough to force its way into the work. It must also retain sufficient material behind the cutting edge, to make the tool bit strong enough to withstand the pressure imposed on it when cutting. The operation the tool is to perform, also determines its shape.

Angles of rake:- Rake, is the angle at which the tool slopes away from the cutting edge.

Top rake:- The slope of the tool face, from the nose, to the back of the tool point.

Side rake:- The angle at which the face of the tool slopes sideways from the cutting edge.

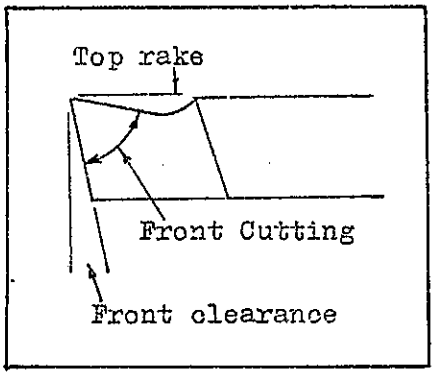
Clearance angles: Clearance is the angle necessary to clear the work as the tool is fed into it. It is necessary because, the cutting edge is the only part of the tool to touch the work when cutting commences.

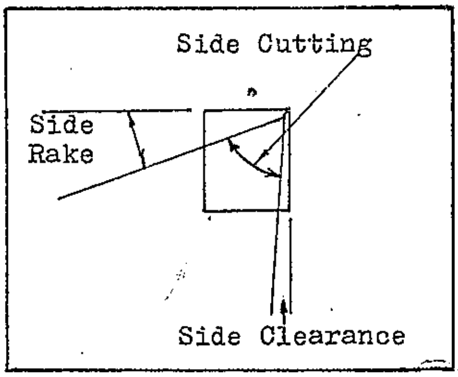
Front clearancé: The angle on the front flank of the tool point below the front cutting edge.

Side clearance: The angle on the side flank of the tool point below the side cutting edge.

Front cutting angle: Is the included angle of the tóol.

Side cutting angle: Is the sectional angle of the tool point.





The speed & efficiency with which the metal is removed, and the finish produced on the work, depend upon the lathe cutting tool. It is the responsibility of the operator to keep the tools sharp. Since the tool is held by hand whilst being ground, the accuracy to which it is ground, is totally dependent on the operator. The following chart gives the recommended tool angles for various metals, and serves as a guide for sharpening high speed steel tools.

Material	Front Clearance	Side Clearance	Top Rake	Side Rake	Front Cutting Angle	Side Cutting Angle
Low Carbon Steel	8°	12°	15°	17°	67°	61°
Medium Carbon Steel	8	10	12	15	70	65
High Carbon Steel	8	10	8	12	74	68
Cast Iron	8	8	5	12	77	70
Brass	8	10	0	0	92	80
Bronze	8	10	0	0	92	80
Aluminium	8	12	35	15	47	63

Safety

Most accidents are avoidable. A good tradesman has the knowledge and skill to avoid accidents, to himself, his workmates, his work, and to the equipment he is using. Do not attempt to use any machine until you are familiar with its operation.
Carelessness, negligence, thoughtlessness and over-confidence on the part of the operator, may result in serious personal injury, or damage to a costly machine.

Causes of accidents -

(a) Carelessness:- Every second accident in the workshop is caused by carelessness. Concentration on the work being carried out, eliminates the possibility of most accidents. Skylarking often causes accidents.
(b) Ignorance:- An operator must understand the uses and functions of his machine. If you don't know, ASK.
(c) Unsuitable clothing:- Loose sleeves, unbuttoned or torn sweaters, long hair, incorrect footwear, finger rings, have all been the cause of serious accidents.
(d) Untidiness:- Keep cotton waste, rags etc. away from any moving parts. Off-cut materials, especially round stock is very dangerous under foot. Do not use old cotton waste to wipe the hands with; it may contain metal cuttings.
(e) Machinery:- See that all guards are in position.
Remove the tool post, when filing work.
Switch machine off before making adjustments, cleaning or lubricating etc.
Do not attempt to clear away shavings while the machine is in operation.
Never re-set the tool post while the machine is running.
Always allow the chuck to stop of its own accord.
Remove chips with a brush, pliers or a stick - never use your hands.
Stop the machine before attempting to measure a job.
Never allow someone else to operate the start switch.
Do not distract a person who is operating a machine.
(f) Lathe-machine safety:- (1) When operating a machine for the first time, check controls for direction of operation with free movement in all directions.
(2) Do not throw tools on machines or finished surfaces.
(3) Never engage or dis-engage the back gears while the lathe is running, nor connect or disconnect gears.
(4) Make sure the tail-stock is locked before starting.
(5) Always put the lead screw in neutral, when filing, polishing, drilling, reaming or whenever the feeds are not being used.
(6) Never use the lathe bed, for hammering etc.
(7) Never leave any machine running unattended.
(8) When filing, use the file left-handed and lean towards the tail-stock - this places the body away from the machine.
(9) Do not leave the key in the chuck.
(10) Keep the ways free from grit and shavings, and clean the machine after use.
(11) Report any faults or unsatisfactory operation.
(12) Never tighten the automatic feed too tight.

TITLE:- BUFFING MACHINES

LECTURER:-

DATE:-

EQUIPMENT:-

Buffing is the name given to the process of polishing with rotating fabric buffs, sewn or clamped together in the form of a wheel, and loaded with an abrasive compound.

These buffs are placed on a high speed machine, much the same as a bench grinder. Usually there is a wire wheel attached to the other end of the machine - this wheel is used for initial preparation of material before the buffing process.

The buff is charged with abrasive by pressing a bar of polishing compound (abrasive set in grease or other base) against the buff while it is rotated at high speed.

The workpiece is then held against the rotating buff and moved systematically at right angles to the buff to give a scratch-free, polished surface. It may be necessary to charge the buff with polishing compound at intervals, particularly on larger workpieces - never use a buff without compound because it will tear the fabric.

When buffing sheet material, do not use the thin edge as the leading edge, or the job will be wrenched from the operator's grip, thus causing damage to the job and the operator.

Small jobs should be held with pliers, to prevent the risk of hand injury and being burnt with the material, which, due to friction, reaches high temperatures very quickly.
Gloves should never be worn when using a buffing machine, the reason being that the operator's hands could be "dragged" into the wheel, causing serious injury.

TITLE:- GRINDING MACHINES
LECTURER:- Gerry Heynis
DATE:- 25-5-81
EQUIPMENT:-

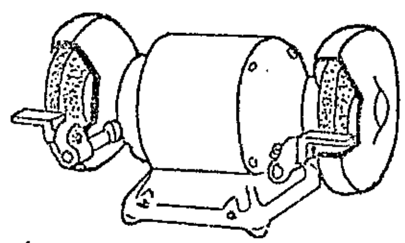
Introduction - "Off hand" grinding is the term used to describe the process where workpieces are held in the hand and material is removed by a rotating abrasive wheel, which is called a grinder.

A grinder has a variety of uses in the workshop, including rough shaping, removing excess material, preparation of surfaces for welding etc., smoothing surfaces and sharpening tools such as drills, punches, chisels and lathe cutting tools.

There are 3 main types of off-hand grinding machines.

1. Pedestal -,consists of a heavy base, which is mounted on the floor, supporting the motor. The spindle, upon which there are 2 abrasive wheels, is driven by belts. This type of machine is commonly used for heavy work and rough shaping.

2. Bench - may be mounted directly to bench or to a stand fixed on the floor. Abrasive wheels are fixed directly to the ends of the motor shaft. Bench grinders are used mainly for tool sharpening.



BENCH GRINDER

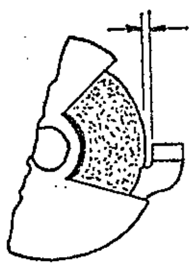
Both pedestal and bench type grinders are usually fitted with a coarse grit wheel for roughing and a fine grit wheel for finishing.

3. Portable - used where it is impracticable to use either a pedestal or bench grinder. The portable grinder is held in the hand and passed over the work. It is difficult to keep this type of grinder steady, and consequently a poor finish results.

Note - portable grinders should never be placed with the abrasive wheel down on the bench when not in operation. The wheel could crack, causing it to disintegrate when next used. There is also the possibility of accidental starting, which would cause the machine to "snake" wildly, thus causing damage to persons or equipment.

Machine Features

Work Rests - adjustable work rests are provided to steady and guide the work.
They are positioned as close to the working face as possible - the distance between the rest and the wheel must never be greater than 2 millimetres, because the work could get jammed between the rest and the wheel. Abrasive wheels are reduced in diameter due to wear, and work rest adjustments are required constantly.



WORK REST ADJUSTMENT

Wheel Guards - All grinding machines should have protective guards mounted around the abrasive wheel and machines should not be operated unless these guards are in place and secure. The guards serve 3 main purposes -

1. To retain the fragments of the wheel should it break.
2. To protect the operator from coming in contact with the rotating wheel.
3. To prevent the fitting of a wheel that is too large for the machine.

As an added precaution and safety measure, most machines are fitted with a glass eye shield, which is attached to the wheel guard. This shield prevents sparks from the abrasive wheel being "thrown" into the face of the operator. Whilst the eye shield is a sensible precaution, safety glasses should also be worn to give the operator double protection from eye injury.

Wheel Speed - The recommended maximum safe speed of abrasive wheels is specified on the wheel by the manufacturer - DO NOT EXCEED THIS SPEED. Increased spindle speed will cause the wheel to run at a high surface speed, thus presenting a very dangerous situation because the wheel may fly apart.

Wheel Rotation - The rotation of the abrasive wheel should be downwards against the work rest. The nuts holding the wheels on the spindle should tend to tighten against the direction of rotation.

Wheel Conditions - During normal operations, certain conditions may develop in regard to the abrasive wheel. These are -

(1) Loading - small particles of material become embedded in the grain of the wheel. The surface of the wheel becomes "clogged" or "loaded", and reduces the efficiency of the wheel. Loading is a result of using the wrong type of wheel for the material being ground.

(2) Glazing - caused by grinding hard materials on a wheel that has too hard a grade of bond. The abrasive particles become dull due to cutting the hard material and the bond will not allow them to break out. The surface of the wheel takes on a smooth glassy appearance. Glazing may be prevented by selecting a wheel with a softer grade of bond.

(3) Grooving - grooves are worn in the surface of the wheel by pressure being applied in the one position. It can be prevented by moving the work across the full face of the wheel - avoid grinding on the outside edges of the wheel.

(4) Out-of-Round - uneven application, bumping or vibration of the work against the wheel, will cause an out-of-round condition. Apply even pressure to the work on the wheel and make sure the work is solidly supported by the work rest.

Maintenance - Abrasive wheels become worn, grooved and sometimes cracked because of constant use, mis-use and, in some cases, abuse and lack of care.

Grooved and out-of-round wheels are "trued" by means of a "dresser"- this is a job for a grinding specialist.

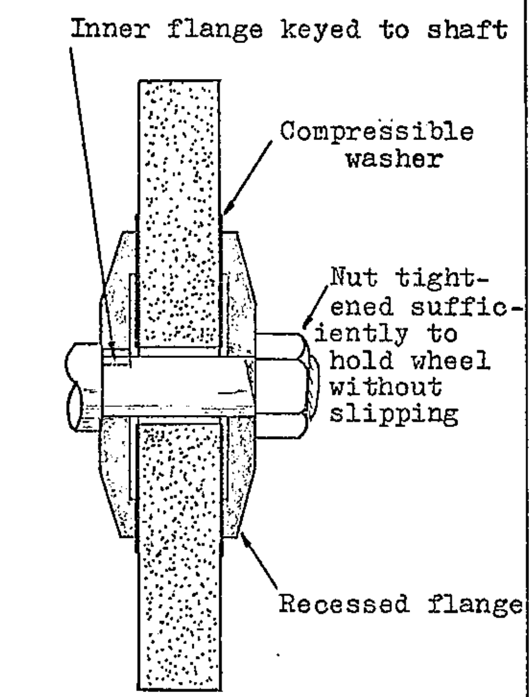
Cracked wheels are usually also changed by the specialist, but there may be occasions when wheels will have to be changed by electrical tradesmen or apprentices. In this case there are a few points which have to be considered. -

1. Ensure that the replacement wheel is the same as the wheel that is being replaced.
2. Check that the lead bush on the new wheel is free from burrs.
3. Never force a wheel on to the spindle - the bush can be cleaned out to enable a "push-on" fit onto the spindle. A loose-fitting wheel will cause a dangerous out-of-balance condition.
4. Abrasive wheels must be mounted on the spindle between steel flanges of equal sizes. ($\frac{1}{2}$ the diameter of the wheel, never less than 1/3). These flanges locate the wheel centrally on the spindle and give positive drive.

5. Compressible washers of blotting paper or hard rubber must be used between the flanges and the wheel to even up the clamping pressures.

6. Tighten the nut sufficiently to hold the wheel firmly without slipping. Excessive tightening will cause damage to the wheel.

7. When the new wheel has been fitted and all guards have been replaced securely, the machine must be given a test run. Check that the speed of the motor does not exceed the maximum safe speed of the wheel. Stand to one side of the new wheel and switch on for approximately ½ minute. (Do not stand directly in front of the wheel, in case it should shatter). If the wheel is not out-of-balance, the machine is now ready for operation.



CORRECTLY MOUNTED WHEEL

TITLE:- BELT SANDER

LECTURER:-

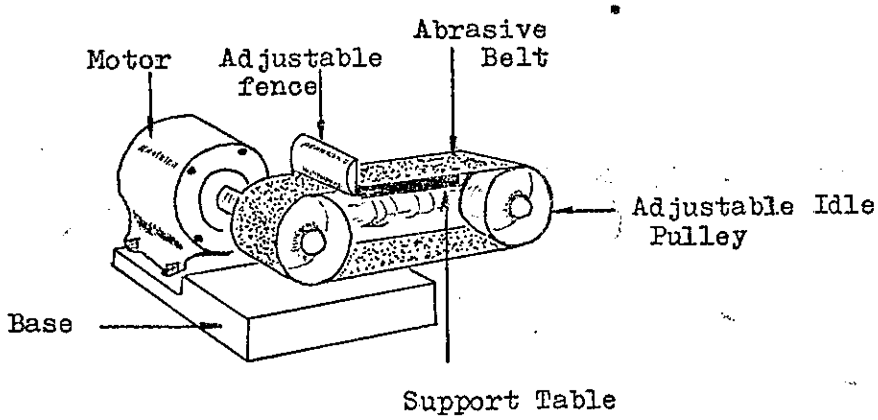
DATE:-

EQUIPMENT:

A belt sander is basically another form of grinding machine and is used mainly for shaping and surfacing insulating materials and metals, such as copper, brass and mild steel. It is ideal for rough shaping, because it eliminates the time-consuming filing process.

Construction:- an endless, cloth backed, abrasive belt is stretched between a pair of pulleys, one of which is power driven. The idle pulley is adjustable, so that tension can be placed on the belt. An adjustable fence acts as a stop for the material being ground and can be set at any angle to the belt table. A flat support table lies below the upper portion of the belt. This support enables flat surfaces to be ground fairly accurately.

Safety:- because there are no guards on the sander, there is a high risk of injury, especially to the hands. Ensure that the workpiece is gripped firmly, otherwise, due to the rotation of the belt, it could be wrenched from the hands and "thrown" from the machine.



TITLE:- BANDSAW

LECTURER:-

DATE:-

EQUIPMENT:- Bandsaw blades, Push stick, Blade guides.

Preparation:-

Select the correct blade for the job (as for hacksaw).
Cut blade to the correct length (approx. 10'6").
Adjust the settings for welding, then weld the ends and anneal the weld.
Select the appropriate speed, adjust guard and guide, ensure that all clearances are adequate, and there are no materials underfoot.

Operation:-

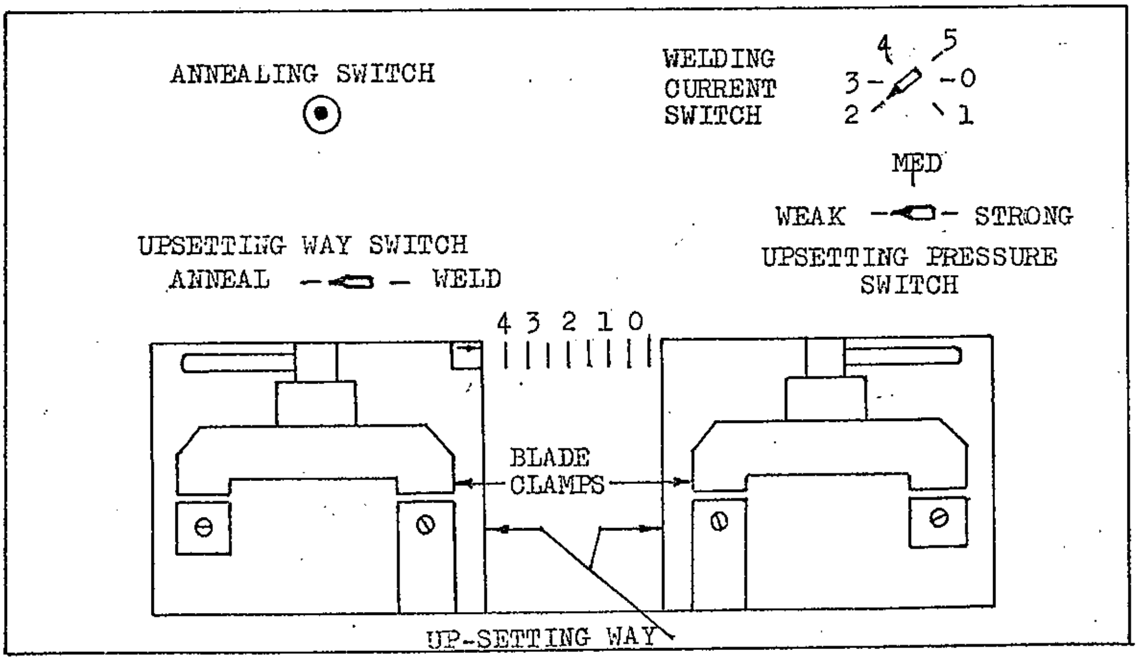
Adjust goggles, position material to the line of cut, then switch "ON". Commence cutting using a steady pressure. Towards the end of the cut, use a piece of scrap material to feed the workpiece onto the blade. Similar to hacksawing, the pressure is eased off before the end of the cut.

Finishing:-

Switch "OFF", place off-cut material in the appropriate bin.

Safety:-

(1) Isolate supply at the main switch, before making any adjustments.
(2) Wear goggles.
(3) Keep fingers clear of the cutting line.
(4) Don't attempt to cut sharp bends.
(5) Use a stick to clear off-cut material.
(6) Check for clearances before commencing.
(7) Get assistance with awkward sized material.
(8) Ignore any distraction while cutting.
(9) Dispose of worn blades as shown.
(10) Always switch "OFF" before attempting to clear jammed off-cuts.



Method of welding & annealing blade:-

BLADE WIDTH	WELDING CURRENT	UP-SETTING PRESSURE	UP-SETTING WAY
Up to 5 mm	1	WEAK	1
" " 10 mm	2	MEDIUM	2
" " 12 mm	3	MEDIUM	2
" " 16 mm	4	STRONG	3

(a) Adjust welding current switch, to the setting indicated by the table.
(b) Adjust up-setting pressure switch.
(c) Adjust up-setting way.
(d) Place the blade in the clamps, with the teeth forward and against the front stop of the clamps.
(e) Butt the two ends together in the centre of the up-setting way and clamp down.
(f) Turn up-setting way switch to WELD position and hold down, until the joint welds and returns to it!s normal colour.
(g) Release clamps then turn the up-setting way switch to the ANNEAL position.
(h) Position the welded joint in the centre of the up-setting way & clamp down.
(i) Press the annealing switch and hold in until the weld glows red, then release.
(j) Release clamps, remove blade, then grind off excess weld from the joint.

n.b. Upsetting pressure:- Is the pressure exerted between the blade ends during the weld.
Upsetting way switch:- This varies the distance over which the upsetting pressure is exerted.
Upsetting way:- Is the variable gap between the clamps.

M3/7/1

TITLE:- HAND DRILLS

LECTURER:- Gerry Hennis

DATE:- 25-5-81

EQUIPMENT:- Hammer Drill, 5/16 Portable Drill, S.C.R. control

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General operating rules:-

Usually, portable electric tools in use on the plant operate on either 32V or 110V, and are double insulated. It is the responsibility of the operator to check the condition of the machine cables and attachments before use. The following points should be checked: faulty plugs & extension sockets, damaged cables, faulty, loose, corroded or broken parts and attachments, listen for unusual noises, look for abnormal operation (sparking at the brushes, sluggish operation).

Switch off if you observe anything unusual, or smell burning insulation. Always plug in the machine, and any extension cables, before switching on the power, and switch off before disconnecting. Always disconnect before making any adjustments or alterations to the machine, or attachments. Do not allow extension cables to cross over walkways, or any place where they could create a hazard. Don't allow cables to be placed in a position where they could be subjected to any damage i.e., near moving parts, in an area where welding or cutting are taking place, near hot bodies or where they may be run over by vehicles. Where this is not possible, every effort should be made to provide adequate protection for the cables. The workpiece should be clamped securely in a vice, or to a bench, unless it is large enough to overcome the necessity for clamping. Drill bits, blades and other attachments, should be removed after use, to prevent breakage. Where a number of people are involved in using a portable machine, one person should be elected to operate, control and give instructions. This will avoid confusion, and possible injury.

Drilling machines are the most common of portable power tools. Holes up to ½" diameter may be drilled safely in most materials. Machines which are fitted with trigger locks, should be handled with caution, i.e. do not operate the lock if there is any possibility of the machine twisting. Some machines are multi-speed i.e., they have a 2 or 3 speed selection. Others may require a speed reduction. As a general rule for speeds,

Large drills require slow speeds
Small drills require fast speeds.

Hammer drill:-

This particular machine requires special care during use. It has a ½" chuck, but the hole saw attachments are capable of drilling up to 4" diameter holes in masonry etc. There is a collar adjustment on the machine for selecting the hammer, or ordinary drilling, also a two speed selector.

Due to the very high torque of this machine, it is essential to maintain a firm grip especially when drilling steel.

Note:- It is most important to remember that the hammer adjustment must NEVER be used for drilling steel or other metals.

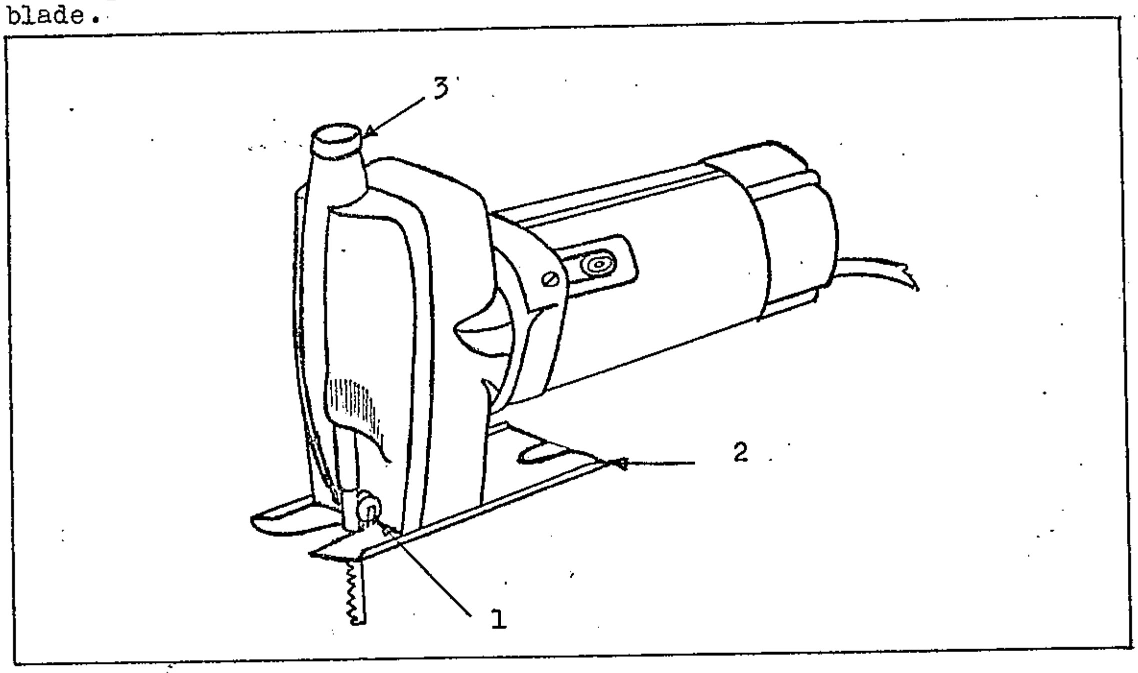
TITLE:- JIG SAW
LECTURER:- Terry Heyni's
DATE:- 25-5-81
EQUIPMENT:- Jig saw, blades

This is a machine which operates on the principle of a reciprocating blade, and is a simple means of making long cuts in sheet metal, where the use of a bandsaw or hand-saws is difficult or impossible. It is not to be used on small jobs which can be cut by hand.

It may be necessary to use a speed controller when cutting through thick material. A number of blades are available for use on varying thickness of material. A coarse blade would be used on thick material and a fine blade on thin material. To change the blade, insert a screwdriver into the hollow of the drive shaft, locate and turn the grub screw until the blade can be turned 90°. Withdraw the blade. Reverse this procedure for fitting a new blade. The machine must be disconnected for this operation.

Material must be clamped or otherwise held down onto a bench with the cutting line overhanging the bench edge by about ½"
Hold the machine with both hands behind the blade-line, press the foot-plate of the machine onto the material and switch on. Advance the blade slowly towards the edge of the material until it starts to cut, then apply steady forward pressure to cut, and heavy downward pressure to prevent lifting. Assistance will be required to support the off-cut. Under no circumstances should anyone place a hand or finger in front of the moving blade.

When stopping, switch off and retain downward pressure until the machine is completely stopped, otherwise blade breakage will occur. Cutting sharp corners or small circles will also tend to break the blade.



1. Roller Blade Guide, adjustable by the centre screw on the foot. Should be tight upto the blade or breakages will occur.
2. Foot reversible by 3 screws underneath.
3. Grub screw for locking the blade located inside a tube under this cover. Tighten grub screw before storing without the blade.

Due to the set of the teeth, the chips tend to travel upwards. It is essential to use adequate eye protection.

TITLE:- DISC GRINDERS

LECTURER:-

DATE:-

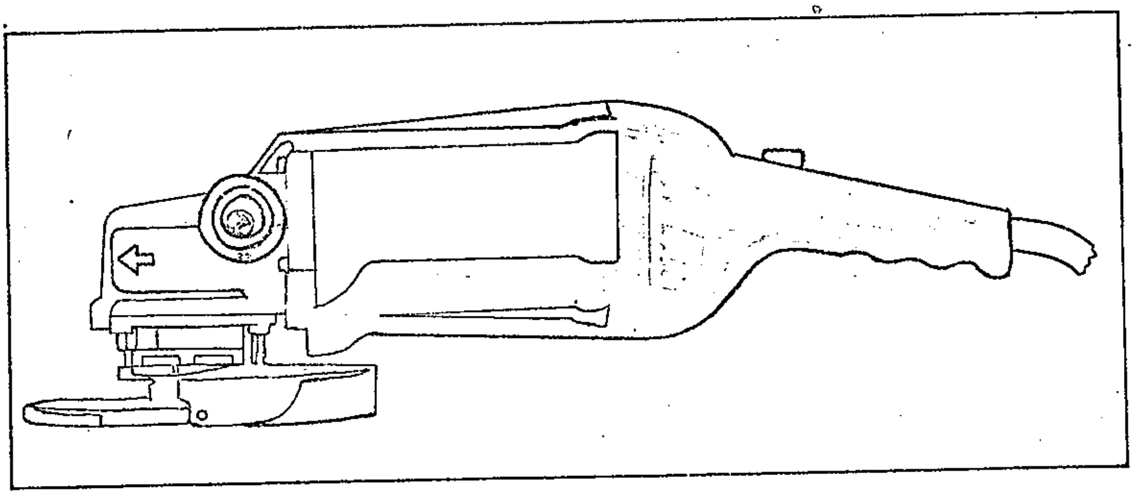
EQUIPMENT:- Large and small disc grinders

Disc Grinders run at very high speeds (8500 RPM and more) and are designed to remove metal more rapidly than grinders. Sparks travel greater distances (over 30 ft.) and are more hazardous in this respect than grinders. Guards and shields must be used to prevent accident or injury. Allow the machine to stop before placing it down on the bench or floor.

Ensure that the disc is used on the material for which it is designed, e.g. if a wheel designed for hard material is used on copper or other soft material, it will become clogged and unusable.

New types of disc grinders are available which are in effect abrasive circular saws. They may not look as dangerous as a circular saw because they don't have teeth, but these machines can cut through solid steel and would easily therefore remove a hand. Treat these machines with as much caution as you would a circular saw.

Ear muffs must be worn when using a disc grinder and anyone working within 2 metres of a disc grinder in use must wear ear muffs.



TITLE:- SPEED CONTROL, SPEEDS AND FEEDS

LECTURER:-

DATE:-

EQUIPMENT REQUIRED:-

The selection of proper cutting speeds and feeds is an important part of a machine operator's work, since it enables him to use his machine for the most rapid production possible without over-taxing it. No advantage is gained by running a machine below its correct speed. The high finish that can be obtained from a slow speed can also be obtained at the correct cutting speed.

Definition of cutting speed and cutting feed

Cutting speed and cutting feed are inseparable in practice since they are always dependant on one another.

(a) Cutting speed is the number of feet of metal that passes the tool in one minute, measured round the outside of the work. If, for example, a material is said to have a cutting speed of 100 f.p.m., then 100 ft. of the material will rotate past the cutting tool in one minute.

(b) Cutting feed is the distance which the tool advances along the face of the work for each revolution in the case of a lathe, and the distance the drill advances into the work in the case of a drill. It can be regarded as the thickness of chips. If for example, a feed of 1/64" is used, it will take 64 revolutions to advance the tool 1".

Factors determining cutting speeds

Cutting speed is dependant upon several factors:-

(a) The cutting tool material - a high speed steel cutting tool can be safely used at twice the cutting speed of a carbon steel cutting tool.

(b) Type of material being machined - In general, the harder the material, the slower the speed.

(c) Cutting lubricant - Cutting speeds for any material may be increased by the use of proper lubricant which keeps the tool from overheating at higher speeds.

(d) Rate of feed - The greater the feed, the slower the speed.

MATERIAL	SPEED FPM	LUBRICANTS
Aluminium	200 - 300	Kerosene
Bakelite	100 - 150	Dry
Brass or Bronze	150 - 250	Dry
Copper	80	Kerosene
Mild Steel	60 - 70	Soluble Oil
Stainless Steel	30 - 40	Soluble Oil
Wood	300 - 400	Dry

To calculate the speed of a Lathe/Drill for a particular job, the following information is necessary -

(a) Cutting speed, which is obtained from a table of speeds.

(b) Diameter of the (1) work, in the case of a lathe
(2) drill, when drilling.

$$\text{R.P.M.} = \text{Cutting Speed} \times \frac{12}{\text{Dia. in inches}} \times \frac{7}{22}$$

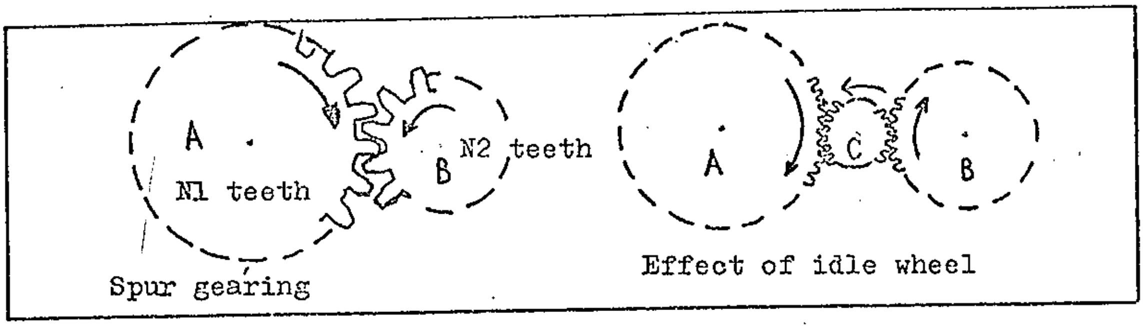
Speed control of machines

Gears - Many machines employ toothed wheels to transmit force and motion and to modify the speed in order to obtain a mechanical advantage or for some other reason.

Consider two gears, A & B. Suppose that A (called the "driver") has 24 teeth and B (called the "follower") has 12 teeth. For one revolution of A, the gear B will have turned through an angular amount corresponding to 24 teeth also. It will have turned $\frac{24}{12}$ turns or 2 turns.

In general, if A has N_1 teeth and B has N_2 teeth, then:-

$$\frac{\text{Speed of follower}}{\text{Speed of driver}} = \frac{N_1}{N_2} \quad \text{thus:- Speed of follower} = \text{Speed of driver} \times \frac{N1}{N2}$$



The effect of an "idle" wheel C between A & B is to cause B to rotate in the same direction as A instead of in the opposite direction, but it does not alter the speed of B.
Gearing is widely used to convert a small torque moving through many revolutions to a much larger torque moving through fewer revolutions.

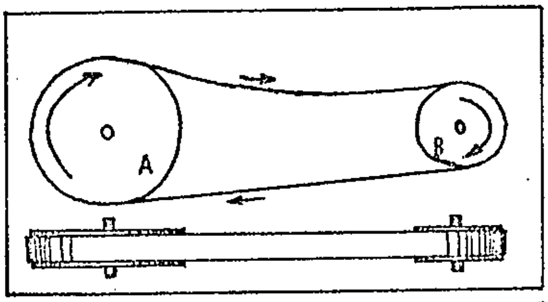
Belt driving

The greatest difference between gear driven and belt driven machines is that it is necessary to depend on friction for the transfer of motion between the pulley and the belt.
Neglecting all slip and creep, the velocity or movement ratio of "driver" to "driven" pulley is easily found from the fact that the belt and the outside surfaces of both pulleys will all be moving together through the same linear distances for any particular movement of the pulleys. If dA and dB be the diameters of the driver and the driven pulley respectively, and if B turns through Nb revolutions when A turns through Na revolutions, then since the linear distance travelled by the rims is the same for the two pulleys,

$$\pi, dB, Nb = \pi, dA, Na$$

$$\therefore \frac{Nb}{Na} = \frac{dA}{dB}$$

$$\frac{\text{Speed of driven}}{\text{Speed of driver}} = \frac{\text{Dia. of driver}}{\text{Dia. of driven}}$$



This is true whether the belt is open or crossed, but in the case of the open belt, the driven pulley rotates in the same direction as the driver, while in the case of the crossed belt it rotates in the opposite direction to the driver.

S.C.R. Speed control

Stepless speed control can be obtained from low speeds up to full speed with portable power tools by using an electronically controlled speed regulator. These are made for specific voltages, and must only be used on the voltage for which the particular controller is designed.