Phase 1 Fabrication

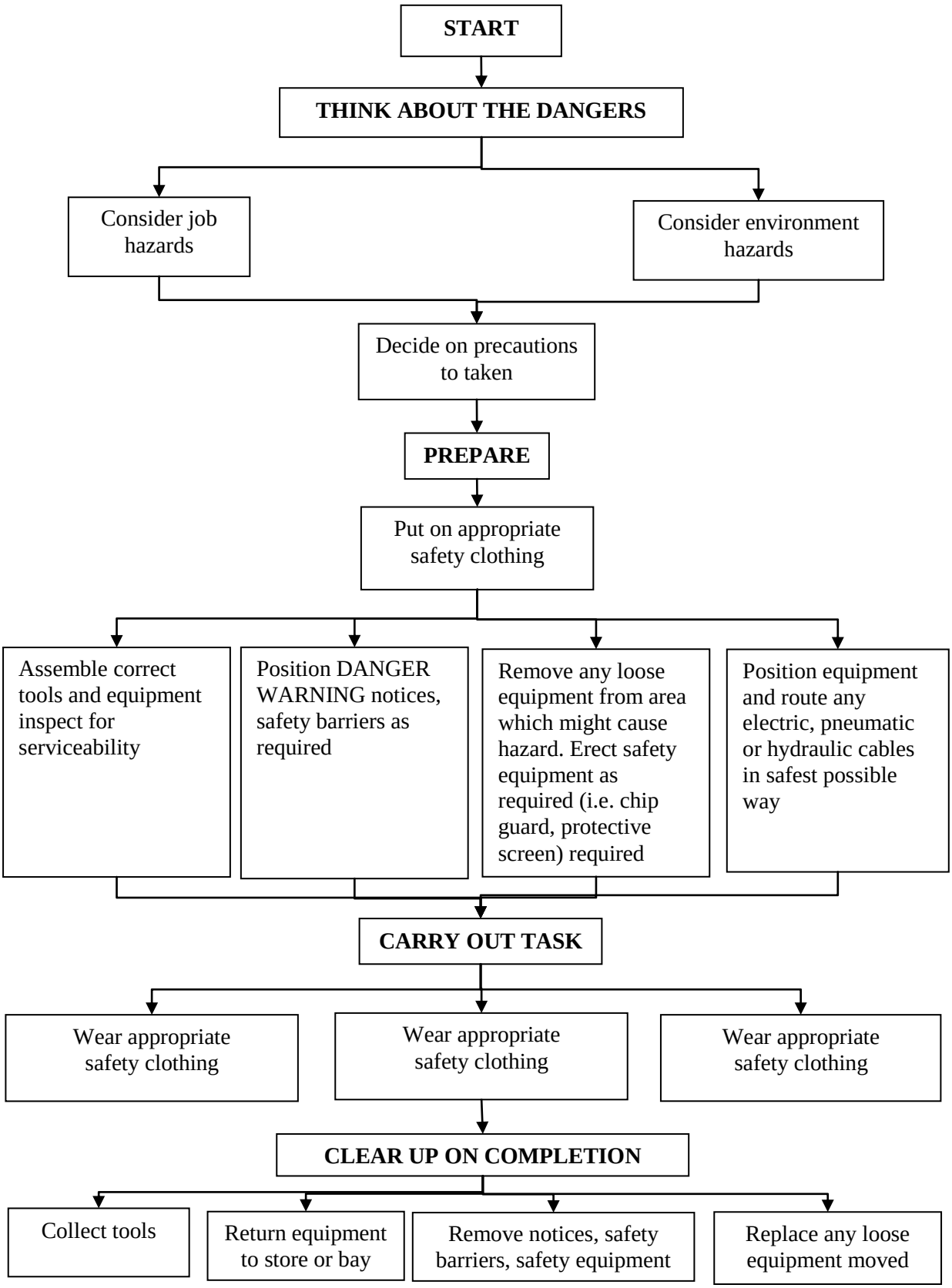
Carousel 2

Fabrication Development

Practice and Standards

FABRICATION AND DEVELOPMENT

SAFE WAY TO WORK


START
THINK ABOUT THE DANGERS
Consider job hazards
Consider environment hazards
Decide on precautions to taken
PREPARE
Put on appropriate safety clothing
Assemble correct tools and equipment inspect for serviceability
Position DANGER WARNING notices, safety barriers as required
Remove any loose equipment from area which might cause hazard. Erect safety equipment as required (i.e. chip guard, protective screen) required
Position equipment and route any electric, pneumatic or hydraulic cables in safest possible way
CARRY OUT TASK
Wear appropriate safety clothing
Wear appropriate safety clothing
Wear appropriate safety clothing
CLEAR UP ON COMPLETION
Collect tools
Return equipment to store or bay
Remove notices, safety barriers, safety equipment
Replace any loose equipment moved

MACHINE SAFETY

DO:

1. Ensure that you know how to stop a machine before starting it.
2. Ensure that all machine guards are in position.
3. Keep the machine clean and in good condition.
4. Switch off the machine immediately, if anything goes wrong.
5. Isolate a machine before making any adjustments.

1. Do not attempt to operate a machine until you know how to use it.
2. Do not touch moving parts.
3. Do not move cuttings or drillings with your fingers.

SAFETY – POWER

DO:

1. Report all electrical faults, e.g. Damaged cables.
2. Keep loose cables off the floor.
3. Keep all electrical equipment dry and clean.
4. Use compressed air carefully.
5. Ensure that the lifting tackle is correctly fitted before lifting.
6. Protect slings when lifting objects having burrs or sharp edges.
7. Stand clear when lifting equipment by crane.

1. Do not use defective electrical equipment: cables, plugs, etc.
2. Do not connect power tools to lamp sockets.
3. Do not attempt to repair electrical equipment.
4. Do not direct compressed air at yourself or your mates – **IT CAN KILL**

SAFETY – LIFTING

DO:

1. Use the right tools and tackle for the job.
2. Lift correctly, using leg muscles and keeping the back straight.
3. Check the safe working load marked on the lifting tackle.
4. Examine lifting tackle to ensure that it is in good condition, i.e. not worn or damaged.

1. Do not attempt to lift heavy loads manually.
2. Do not leave lifting tackle lying about the working area.

CUTTING

Safe and correct use of guillotines

When cutting polished or coated sheets, cover bed of guillotine and brackets with felt brown paper or other covering to avoid marking surface. Place strip of protective material under hold down. On many guillotines, provision is made for single or continuous cutting action. If doubt exists as to position of control, check as follows:

1. Switch on guillotine.

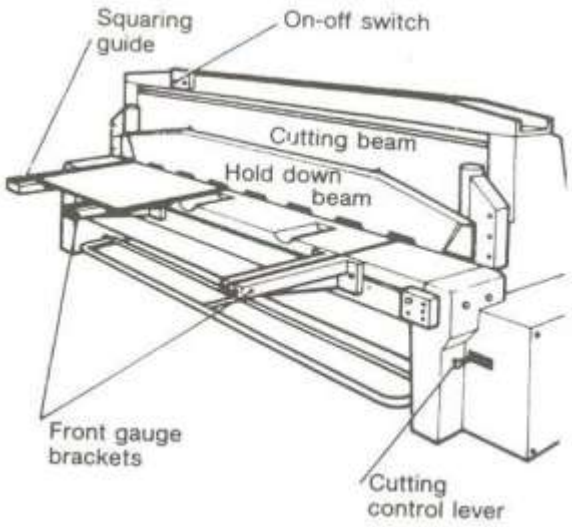
2. Depress pedal to check setting of cutting control.

3. Control set for single cutting will allow cutting beam to descend only one each time pedal is depressed.

4. Pedal must be allowed to lift between each cut.

Note: Continuous cutting is normally used for batch quantity cutting of narrow strips.

Cutting beam will rise and descend while pedal is depressed.



Safety

Before using any guillotine, its safe operation must be fully understood. Particular note should be taken of the position and operation of any emergency switches, or methods of immobilisation. Before switching on ensure all guards are in place and back of guillotine is clear of personnel. Gauges, if not to be used should be clear of material being cut.

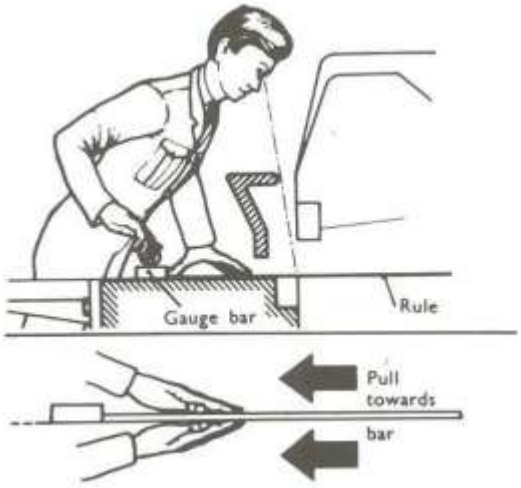
Cutting to previously marked line

1. Switch on guillotine.

2. Place sheet on bed of guillotine and slide between blades.

3. Align cutting mark against edge of bottom blade.

4. Depress pedal, ensuring other foot is clear of pedal bar.

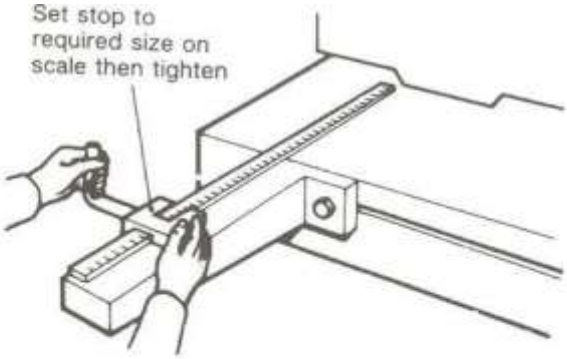


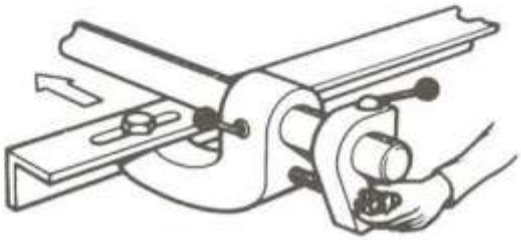
Bench shears

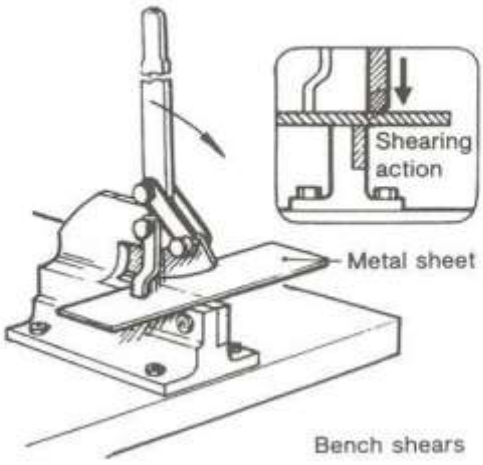
Bench shears provide a quick and safe way of cutting thicker metal. They must not be used beyond their specified capacity.

Safety

If the bench shears are aligned along the bench, when not in use, the handle should be left down so that the jaws are closed. If the shears are aligned across the bench, when not in use, the handle should be left upright out of the way. Some method of locking the handle in this position is essential.







FORMING

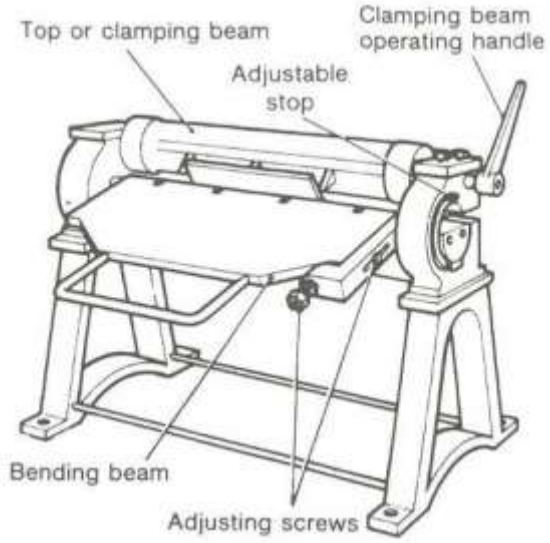
Safe and correct use of the cramp folding machine

Safety

Take care when using hand-operated cramp folding machines to prevent accidental injury to hands or fingers.

Where clamping beams are operated by an eccentric shaft, ensure that beam is fully opened or closed.

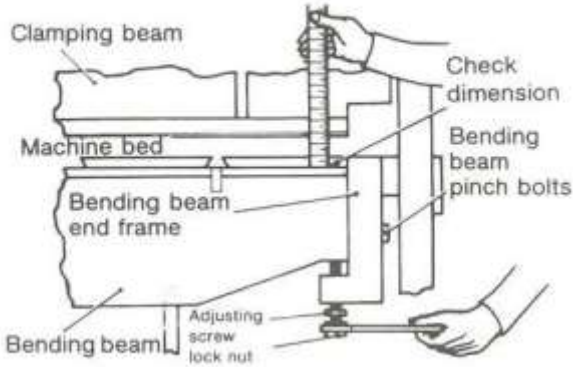
Ensure that working area of any balance weights and arms are clear of personnel and unobstructed.



Adjusting bending beam

Provision is made on most folding and bending machines, to raise or lower the bending beam. This enables bends to be made with either sharp or round radii.

The common means of adjustment is by use of adjusting screws at each end of the bending beam.



1. Loosen the bending beam pinch bolts situated in slots in beam end frame.
2. Loosen lock nut on adjusting screw. Unscrew nut well clear of end frame.
3. Turn adjusting screw to give required clearance of bending beam.

Check dimension between top of bending beam and bed of machine.

(As a general rule, this dimension may be taken as radius of bend plus thickness of metal)

4. Repeat operations (2) and (3) at other end of machine.

5. Screw up and tighten lock nuts. Tighten pinch bolts.

Adjusting angle stop

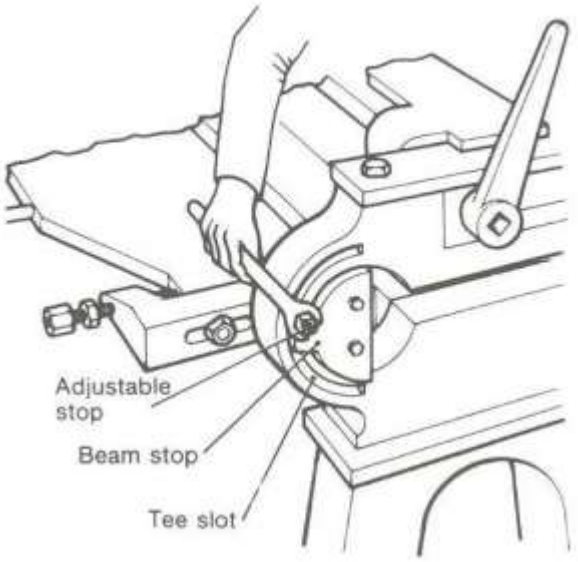
Use is made of the angle stop when repetition bends are to be formed

1. Loosen nut on adjustable stop until stop slides freely in tee slot.

2. Raise bending beam to required angle. Beam stop will push adjustable stop round in tee slot.

3. Tighten nut on adjustable slot.

4. Bend test piece and check angle formed, using a template or bevel stock set to required angle.

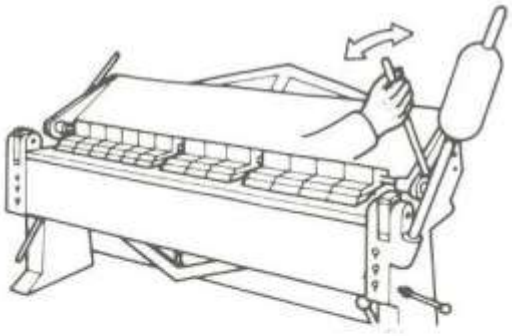


Clamping

Clamping beam is operated by two hand levers, each operating independently.

One lever only need be operated when working at end of machine.

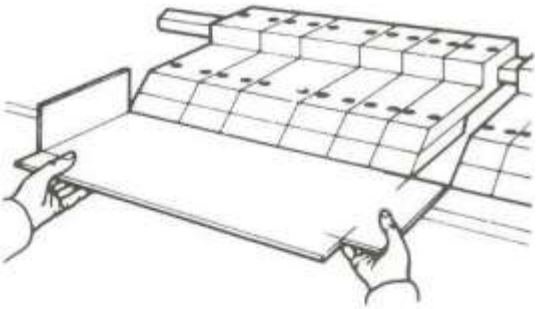
Use both levers when clamping full length plates.



Forming

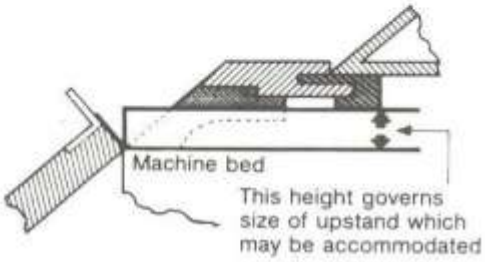
Where small upstand edges are to be formed, position plate as shown.

Clearance between machine bed and clamping beam governs height of upstand which may be formed by this method of clamping plate.



1. Set folding marks against edge of forming blades. Use appropriate combination of blades.

2. Clamp in position using hand levers.

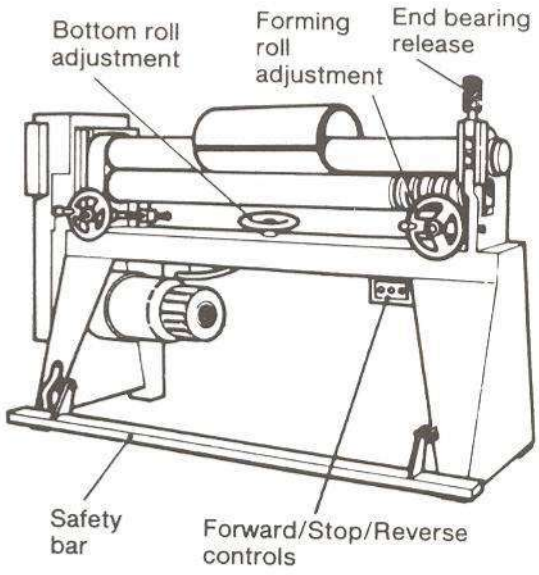


3. Raise bending beam to form upstand edge.

4. Lower bending beam and release clamping beam.

5. Repeat operations (1) to (4) for each side of tray.

Safe and correct use of power-operated pinch bending rolls.

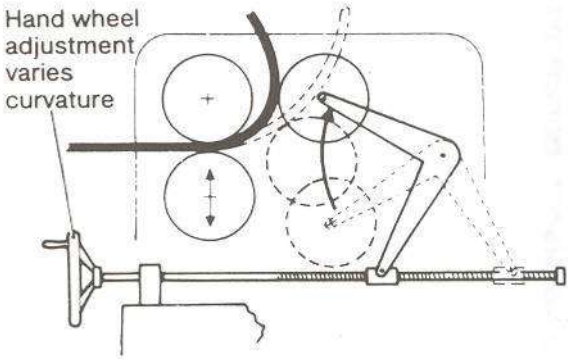


Safety

Before using any power operated bending rolls, a trainee must thoroughly understand the functions and safe operation of the various controls.

Particular note must be taken of the position and use of any emergency methods of stopping the machine.

Before using any machine fitting with a foot operated safety bar, ensure that these are no obstructions under the bar which would prevent it from operating properly. Ensure that the work is properly held or supported, when the rolling operation is near the plate edge. Never work behind the machine unless assistance is available to depress the safety pedal if an emergency occurs. If gloves are worn, ensure that the plate edges are free from rags, burrs or sharp projections which may catch a glove and drag the hand into the machine.

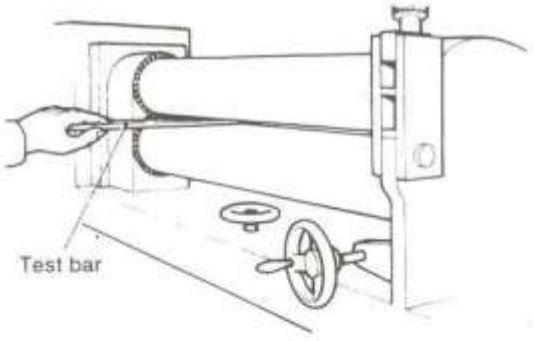


Arrangement of pinch bending rolls

Pinch bending rolls have two front rolls fitted vertically and one back roll, adjustable to vary diameters being formed.

Metal is formed round fixed top roll. Bottom roll adjustable vertically by operation of centre hand wheel. Operation of hand wheel raises or lowers bottom roll parallel to top roll. Bottom roll must be adjusted to grip or “pinch” plate being rolled. Plate must be gripped lightly as too much pressure will result in stretching and buckling of plate.

Forming is adjustable vertically to produce deflection of plate. Individual adjustment at end of roll allows for non-parallel setting of forming roll.



Parallel adjustment of forming roll

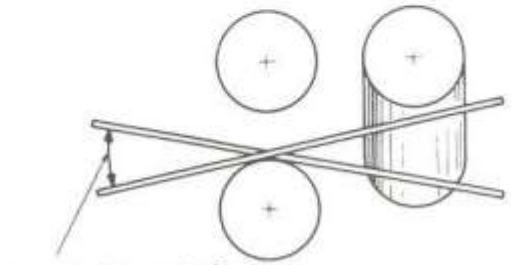
Ensure machine is switched off before setting.

1. Obtain two test bars equal thickness. Bars must be thick enough to remain rigid when overhung on rolls.

2. Adjust pinch roll handwheel until test bars slide freely between front rolls.

3. Raise forming roll to full extent using hand wheels alternatively.

4. Slide test bars between front rolls allowing them to rest on underside of forming roll.

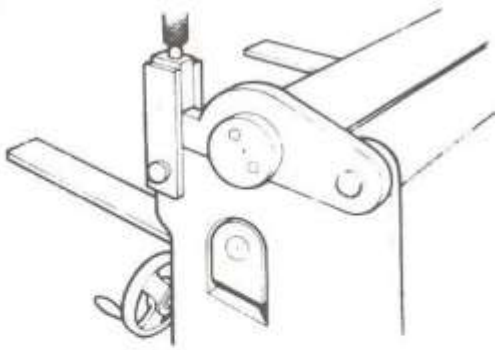


Place one bar at each end of machine.

5. Observe alignment of bars visually.

6. Turn one forming roll hand wheel until bars are parallel. Observe bars at eye level for accurate alignment.

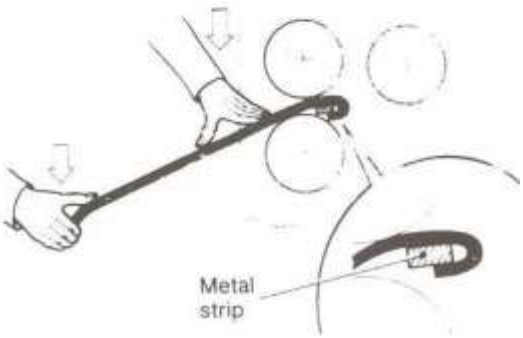
7. Chalk an alignment mark on hand wheels to assist parallel adjustment.



Edge Positioning
Plate edges must be positioned before rolling to prevent formation of flats at joint.

Edges must be positioned sufficiently far back to allow forming roll to continue the curve without formation of a flat area.

Using rolls to position edges
Use this method for thin plate, particularly when a grooved joint is to be made on the cylinder.



a) Open pinch roll by use of hand wheel sufficiently to allow folded edge of grooving allowance to enter.
b) Position plate between front rolls and adjust pinch roll slightly.
c) Check visually to ensure edge is parallel to rolls.
d) Apply downward pressure to plate using pinch roll to form curvature.
e) Open pinch roll to allow plate to be removed.
f) Repeat operations (b-e) for other side.

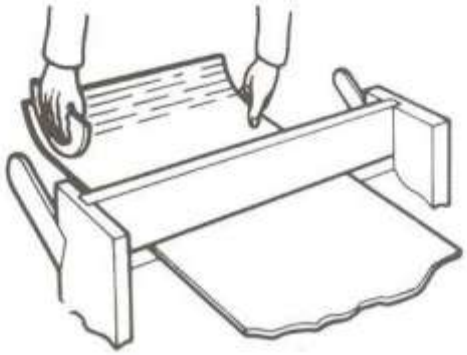
Note: Accuracy of set is not essential. Cylinder will be finally trued after joint is formed.

Forming edges, using a bar or mandrel
Use this method for thicker plates or small diameter cylinders.

1. Place plate on a suitable bar or mandrel, edge overlapping slightly.
2. Strike edge of plate with a mallet. (Ensure that mallet is free from splits and marks, and head is secure on shaft).
3. Form edge by striking slightly off the bar.
4. Repeat operations (1) to (3) for other edge.

Note: Accuracy of set may be checked by use of a pattern cut to required radius.

Forming edges, using a folding machine
Use this method as an alternative, for plates too thick to be easily set by use of a mallet or hammer.



1. Mark edges for folding. Close spacing of marks is essential to allow curve to be formed using minimum angle of fold, thus avoiding formation of prominent flats.
2. Position work in folder and clamp on first mark.
3. Break edge slightly.
4. Repeat operations (2) and (3) for each mark in turn.
5. Check curve frequently using a pattern or template.

Forming cylinders, using pinch-bending rolls

1. Lower forming roll until level with pinch roll.
   Count number of turns on each hand wheel to
   Ensure roll is kept parallel.

2. Open pinch roll by use of hand wheel.

3. Insert plate between rolls. Position pre-set edge above centre of forming roll.

4. Close pinch roll by adjusting hand wheel?? plate is lightly held. Do not grip plate too tight
   otherwise plate may be stretched. Plate should be able to move under heavy hand pressure.

5. Raise forming roll to engage plate edge. Turn hand wheels and equal amount.

Press forward start button and keeping end of plate supported, allow machine to form plate.

6. Support formed end of sheet as it comes over top roll.

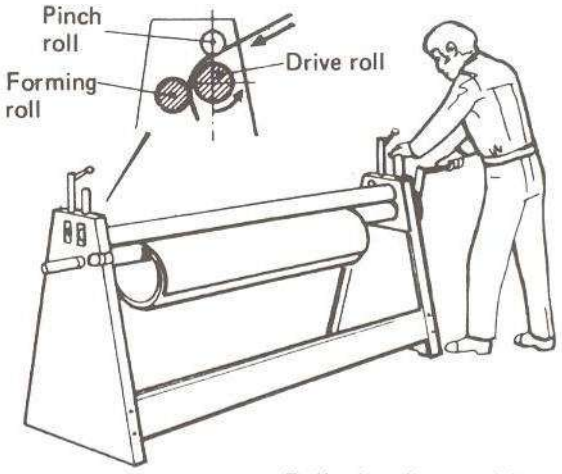
7. Press stop button before plate leaves front rolls.

8. Raise forming roll slightly, adjusting both ends equally.

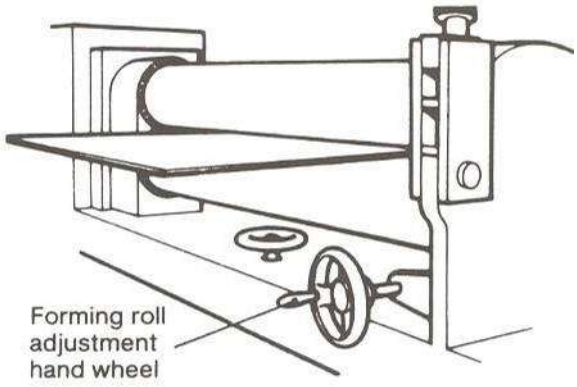
9. Press reverse start button.

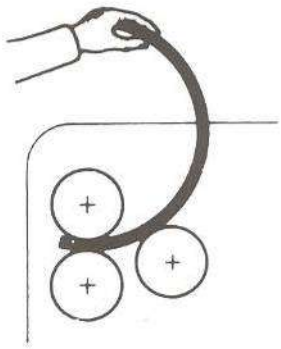
Repeat rolling alternately back and forward, adjusting forming roll slightly each time until complete cylinder is formed, with edges in close contact.

Note: When thin plate is being rolled, it is common practice to set forming roll to form a slightly smaller radius as plate will be finally rounded to true diameter after joint is made.



Roller bending machine





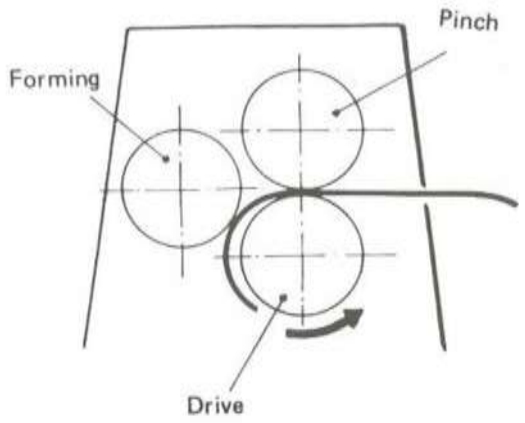
Pinch-bending rolls – cylinder removal

1. Switch off machine.

2. Lower forming roll by use of hand wheels. Lower roll by equal turns each equal to Maintain rolls parallel for batch quantity work.

3. Lower pinch roll slightly.

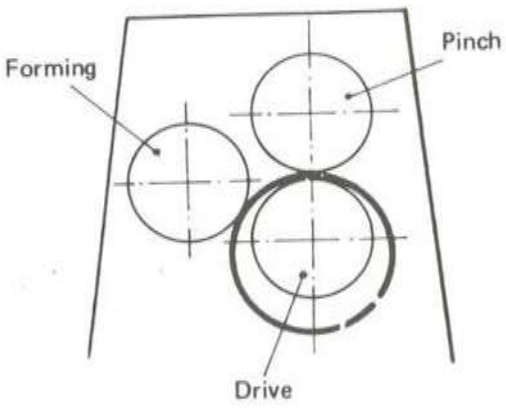
4. Loosed hinged clamp lock screw and swing bracket aside.



5. Swing end bearing top clamp aside.

6. Remove cylinder.

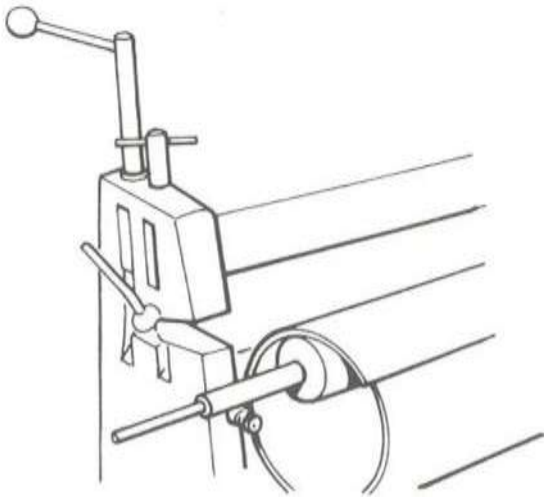
7. Replace end bearing top clamp and clamp lock. Tighten screw.



Note: When a drop end bearing is fitted the procedure is:

i) Operate bearing release handle and swing bearing housing down.

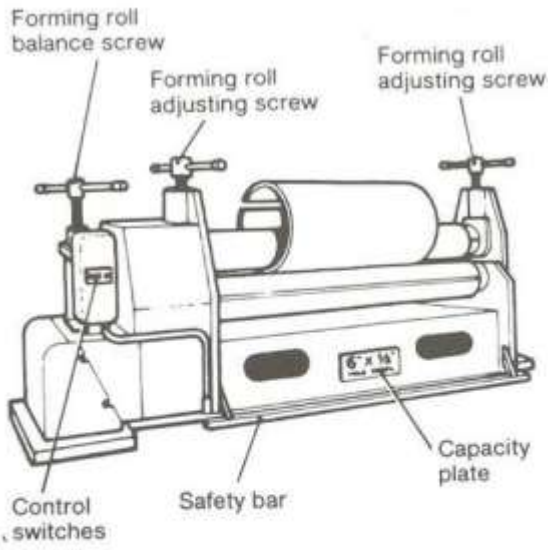
ii) Remove cylinder, swing bearing housing up to engage top roll and engage release handle.



Safe and correct use of power operated pyramid rolls

Safety

Before using any power operated bending rolls a trainee must thoroughly understand the functions and safe operation of the various controls. Particular note must be taken of the position and use of any emergency methods of stopping the machine. Before using any machine fitted with a foot operated safety bar, ensure that there are no obstructions under the bar which would prevent it from operating properly. Ensure that the work is properly held or supported when the rolling operation is near the plate edge. Never work behind the machine unless assistance is available to depress the safety pedal is an emergency occurs. If gloves are worn, ensure that the plate edges are free from rags, burrs or sharp projections which may catch a glove and drag the hand into the machine.



Pyramid bending rolls have two fixed centre bottom rolls and an adjustable top forming roll.

Parallel adjustment of forming roll

1. Ensure machine is switched off and isolated and forming roll balance screw is raised well clear of roll shaft extension.

2. Obtain flat strip thick enough to remain rigid.

3. Raise forming roll by use of adjusting screws until flat strip passes freely between rolls.

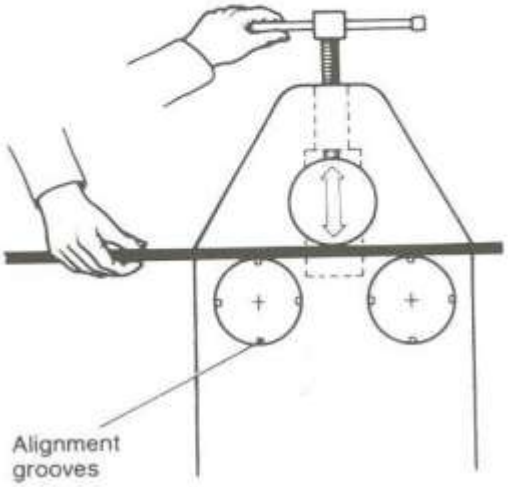
4. Place strip across bottom rolls at one end of machine.

5. Lower forming roll at this end by use of adjusting screw. Slide strip back and forward during adjustment until forming rolls makes light contact with strip.

6. Repeat operations (3) and (4) at the other end of the machine.

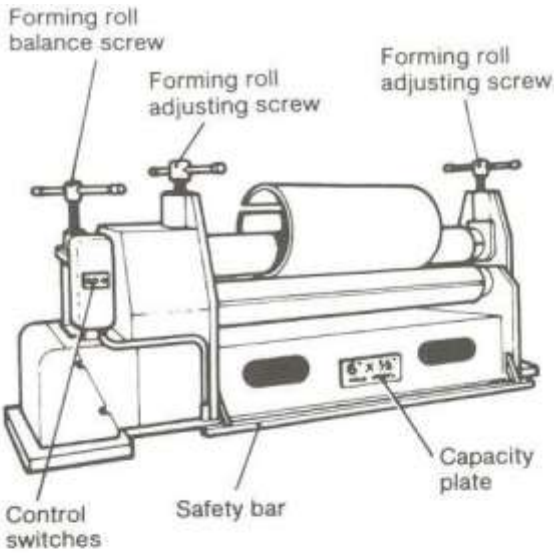
7. Re-check that strip slides easily between roll at each end which was set free.

8. Chalk alignment marks on end frames and screws.



Note: Alignment grooves nay be an added Feature of some machines.

Pyramid rolls: edge positioning
Plate edges must be positioned before rolling to prevent formation of flats at joint. Edges must be positioned sufficiently far back to allow forming roll to continue the curve without formation of a flat area.



Forming edges, using a bar or mandrel
Use this method for thin plate or small diameter cylinders.

1. Place plate on a suitable bar or mandrel edge overlapping slightly.

2. Strike edge of plate with a mallet. Ensure that mallet is free from splits and marks, and head is secure on shaft.

3. Form edge by striking slightly off the bar. Repeat operations (1) to (3) for other edge.

Note: Accuracy of set may be checked by use of a pattern cut to required radius.

Forming edges, using a folding machine
Use this method as an alternative, for plates too thick to be easily set by use of a mallet or hammer.

1. Mark edges for folding. Close spacing of marks is essential to allow curve to be formed using minimum angle or fold, thus avoiding formation of prominent flats.

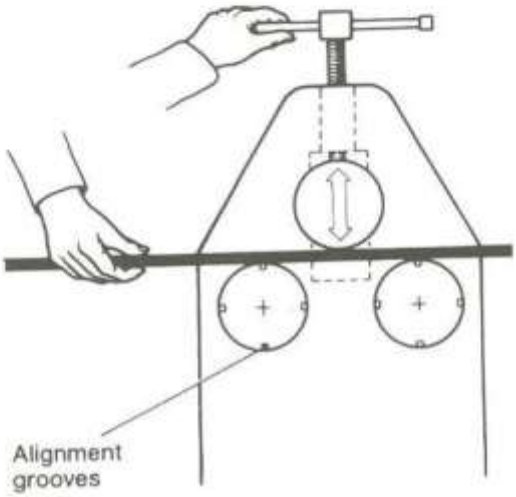
2. Position work in folder and clamp on first mark.

Use of pyramid rolls for forming cylinders
1. Raise forming roll until clear of bottom rolls. Keep roll parallel.

2. Position plate between rolls and position edge in line with centre line of lower back level.

3. Lower forming roll to contact plate surface, keeping roll parallel by adjusting screws equally.

4. Press forward start button and feed plate between rolls.

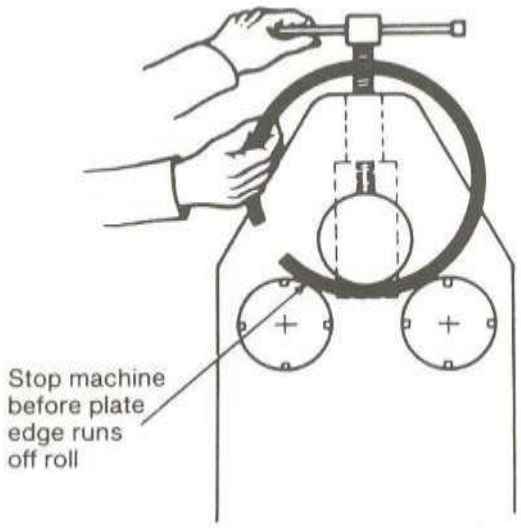


5. Press stop button before other edge of plate runs off front roll.

6. Lower forming roll slightly and press reverse button.

7. Press stop button before other edge of plate runs off back roll.

8. Repeat operations (4) to (7) lowering forming roll slightly at each operation until plate is fully formed.



Pyramid rolls – cylinder removal

1. Tighten forming roll balance screw to engage ball extension of roll shaft.

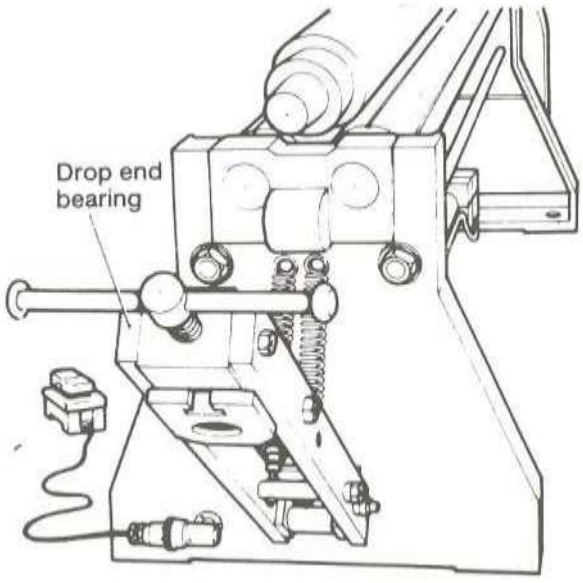
2. Withdraw end bearing securing pin.

3. Pull drop end bearing clear of roll.

4. Remove cylinder.

5. Replace drop end bearing. Replace bearing securing pin.

6. Unscrew balance screw clear of roll shaft extension.



PARALLEL LINE DEVELOPMENT

The parallel line method of pattern development depends on a process of locating the shape of the pattern on a series of parallel lines. All objects or articles which belong to the class or prism, which preserve a constant shape of cross-section throughout their length, may be developed by the parallel line method. The general method of procedure is to "unroll" the surface. For instance, a cylinder is a prism with a circular cross-section at right angles to its central axis. An ordinary round pencil is a cylinder, and may be easily rolled along the table or any flat surface. An ordinary cylindrical pipe may be rolled along in the same way. From these examples it will be readily seen that the development of the pattern is equivalent to "unrolling" the surface.

A SQUARE RIGHT PRISM

Perhaps the simplest example which might be taken to illustrate the principle is an ordinary square prism. Figure 1 shows a square right prism in plan and elevation. If this prism were rolled over from one side to another in the direction of the arrow, the pattern would be traced as shown at A', B', C', D', A" and would be an ordinary rectangle equal in length to the four sides of the square, AB, BC, CD and DA and equal in height to the height of the prism.

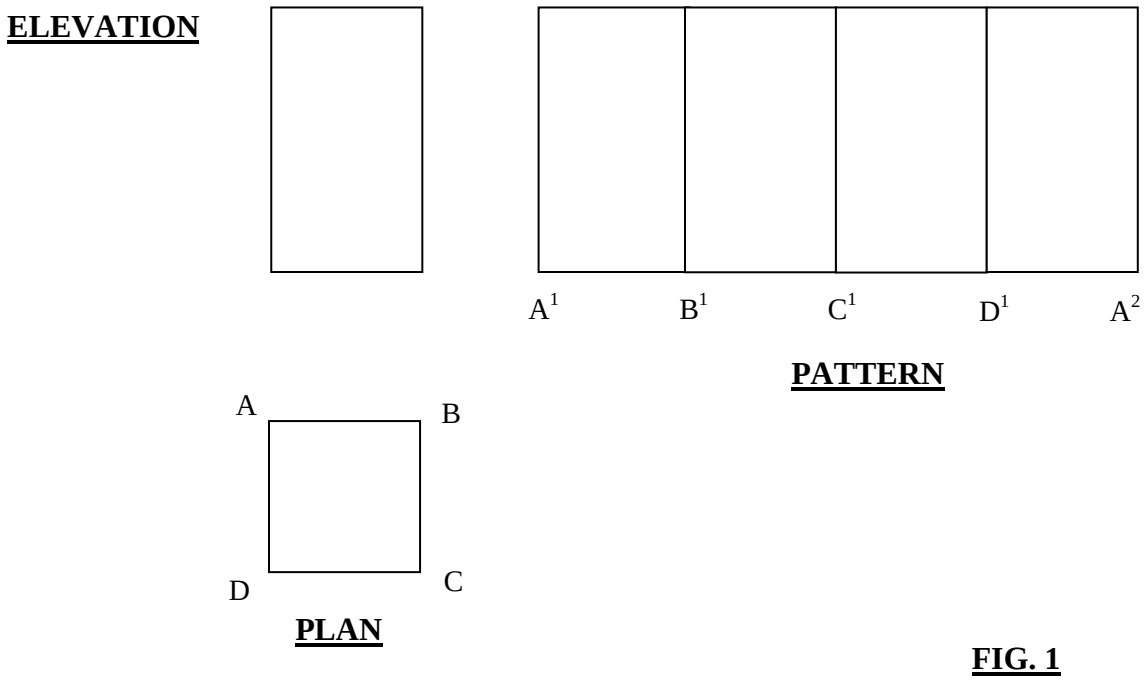


FIG. 1

THE SQUARE PIPE ELBOW

To develop the pattern for the square pipe elbow shown at Figure 2, imagine the pipe to be unfolded or unrolled at right angles to its central axis. Draw the base line S'S" and mark off S' 1' 2' 3' 4' S" equal to the corresponding distances round the perimeter, or girth line, in the plan. From the points thus marked on the base line erect perpendiculars parallel to each other. From the points A and B in the elevation draw lines parallel to the base line in the pattern, intersecting the perpendiculars S' B' A' A" B" S". The outline of the pattern should now be evident from the illustration given. The same contour S' B' A' A" B" S" should serve for the other side of the elbow.

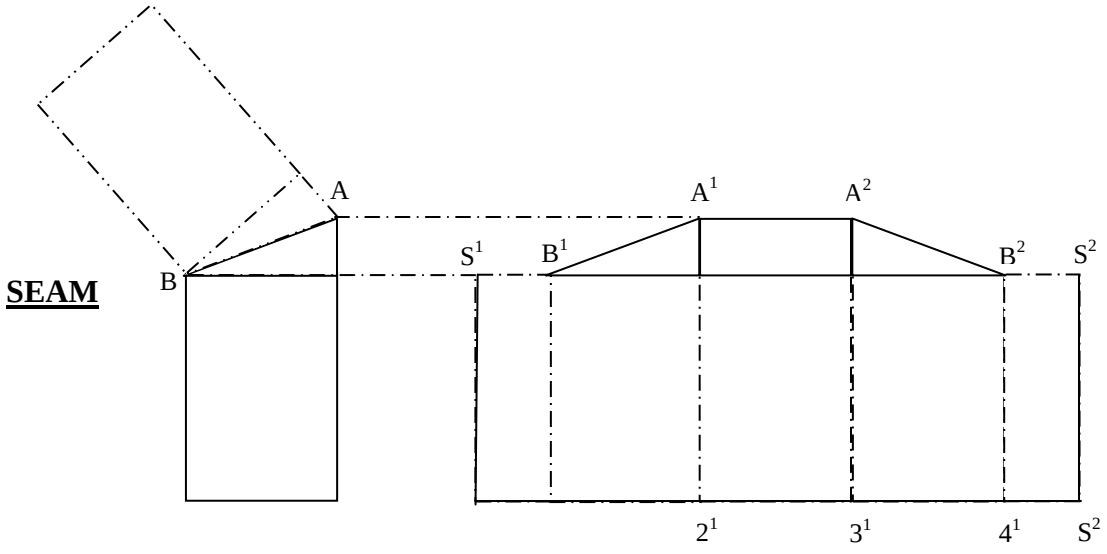


FIG. 2

The development of the cylinder follows the same trend as that of the two previous examples. Figure 3 represents a right cylinder in plan and elevation. There are no corners on this body which can offer a natural means of dividing the perimeter into a number of parts. However, it is usual to divide the circular cross-section into twelve equal sections with the divisions spaced along the girth of the pattern. In Figure 3, the circle on the plan is divided into twelve equal parts and these are spaced along the base line of the pattern from 1' to 1"

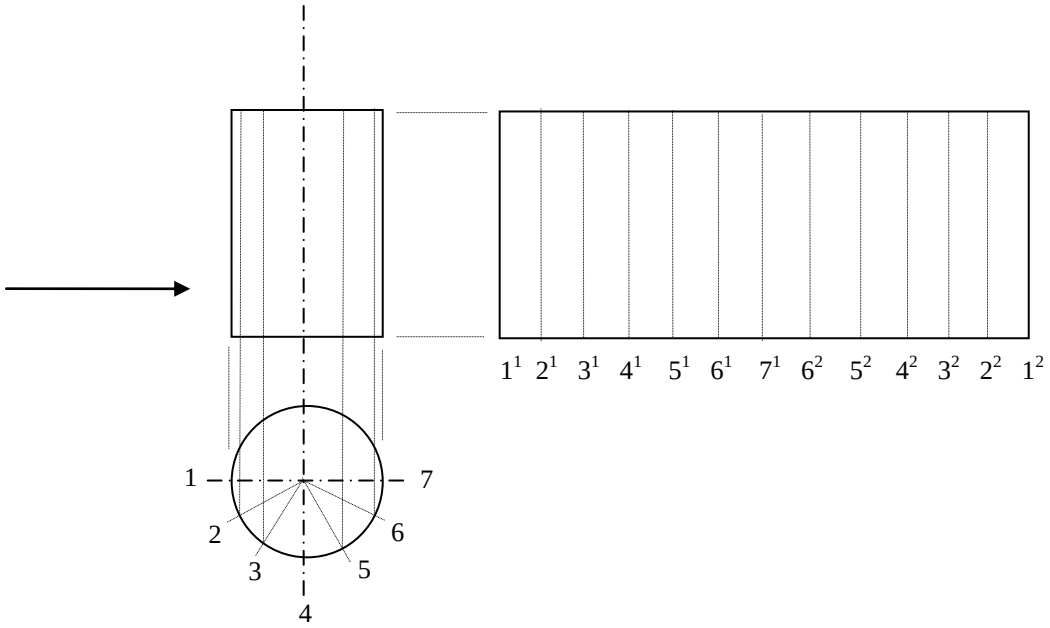


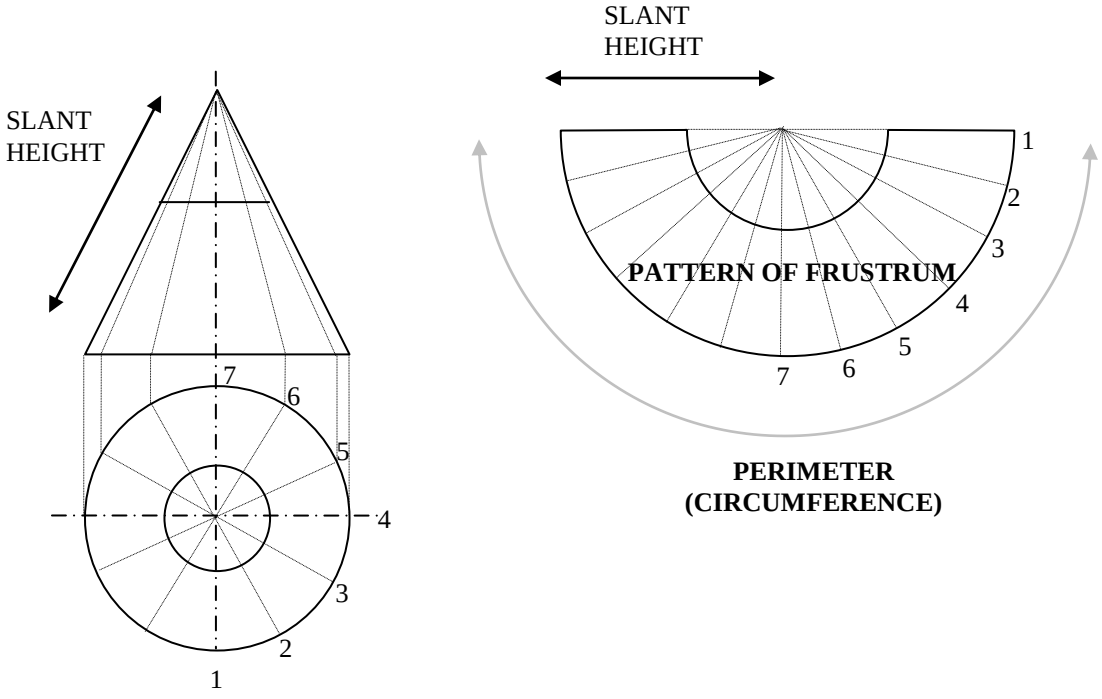
FIG. 3

RADIAL LINE DEVELOPMENT

The pattern for any article which tapers to an apex may be developed by the radial line method. This method also applies to fustrums which would taper to an apex if the sides were produced.

The radial line method is based on the location of a series of lines which radiate from the apex down the surface of the object to a base, or assumed base, from which a curve may be drawn on which the perimeter of the base may be marked off.

RIGHT CONIC FRUSTRUM



DEVELOPMENT BY TRIANGULATION

Triangulation is far by the most important method of pattern development, since the greater part of the geometry of sheet metal work is concerned with bodies of complex design. In a broad sense, triangulation depends on a method of dividing the surface of the object into triangles, finding the true size of each triangle separately, and placing them side by side in the proper order to obtain the full pattern. It is, therefore, a process of addition, or building up. To obtain the true size of each triangle, the true length of each side must be found and placed in its correct relation to the other sides.

THE GOLDEN RULE OF TRIANGULATION

The method of finding the true length of a line is very simple, yet sometimes very elusive in a complex problem. This method, sometimes called the “Golden Rule” of triangulation, is to place the plan length of a line at right angles to its vertical height, when the diagonal will represent its true length. The principle of this rule will be seen by reference to Fig. 45, which shows pictorially, a ladder leaning against a wall.

The PLAN LENGTH will be horizontal distance from the foot of the wall to the foot of the ladder; the VERTICAL HEIGHT will be the height of the wall to the point where the top of the ladder leans against it; and the TRUE LENGTH will be the actual length of the ladder itself. It will be observed and when the position of the ladder is altered the plan length and the vertical height vary accordingly, but when placed at right angles to each other always produce a true length diagonal.

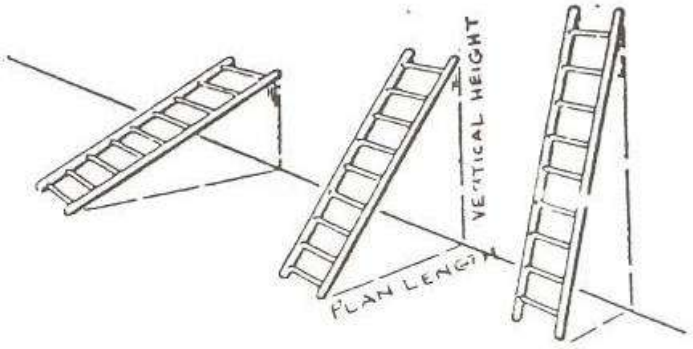
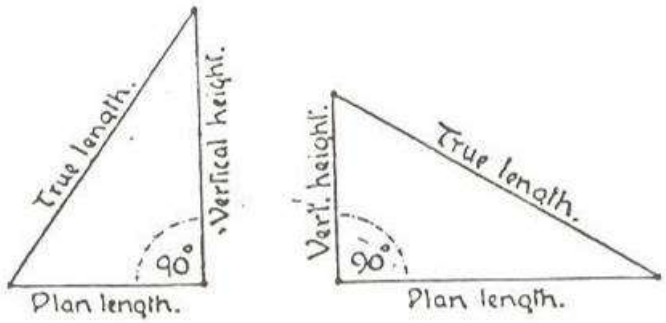


Fig. 45.



SQUARE TO CIRCLE TRANSFORMING PIECE