Safety precautions in handling gas cutting plant

Objectives: At the end of this lesson you shall be able to
- **State the general safety precautions in oxy-acetylene plants.**
- **State the safety rules for handling gas cylindedrs**
- **State the safety practices for handling gas regulators and hose-pipes.**
- **State the safety precautions related to blow pipe operations.**
- **State the safety required during gas cutting operation.**

To be accident-free, one must know the safety rules first and then practise them as well. As we know can accident starts when safety ends.

Ignorance of rules is no excuse!

In gas welding, the welder must follow the safety precautions in handling gas welding plants and flame-setting to keep himself and others safe.

Safety precautions are always based on good common sense.

The following precautions are to be observed, to keep a gas welder accident-free.

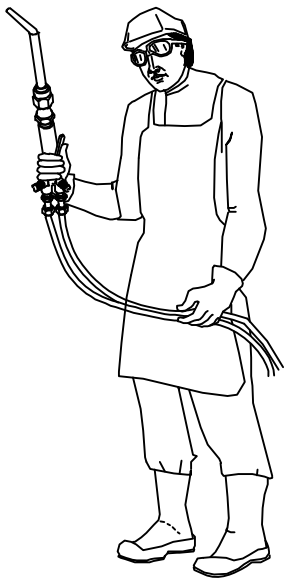
General safety

Do not use lubricants (oil or grease) in any part or assembly of a gas welding plant. It may cause explosion.

Keep all flammable material away from the welding area. Always wear goggles with filter lens during gas welding. (Fig 1)

Always wear fire resistant clothes, asbestos gloves and apron.

Fig 1



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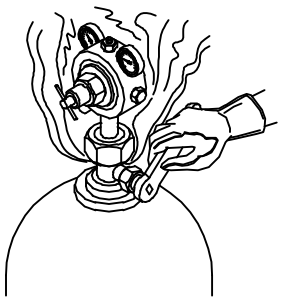
Never wear nylon, greasy and torn clothes while welding.

Whenever a leakage is noticed rectify it immediately to avoid fire hazards (Fig 2)

Fig 2



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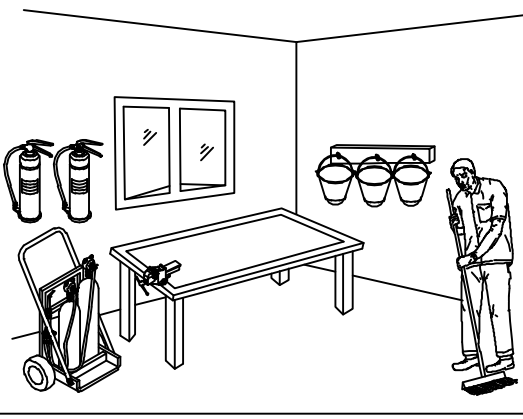
Even a small leakage can cause serious accidents

Always keep fire-fighting equipment handy and in working order to put out fires. (Fig 3)

Fig 3



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Keep the work area free from any form of fire.

Safety gas Cylinders

Do not roll gas cylinders or use them as rollers.

Use a troiley to carry the cyclinders.

Close the cylinder valves when not in use or empty.

Keep full and empty cylinders separately.

Always open the cylinder valves slowly, not more than one and a half turn.

Use the correct cylinder keys to open the cylinders.

Do not remove the cylinder keys from the cylinders while welding. It will help to close the cylinders QUICKLY in the case of a back-fire or flash-back

Always use the cylinders in an upright position for easy handling and safety.

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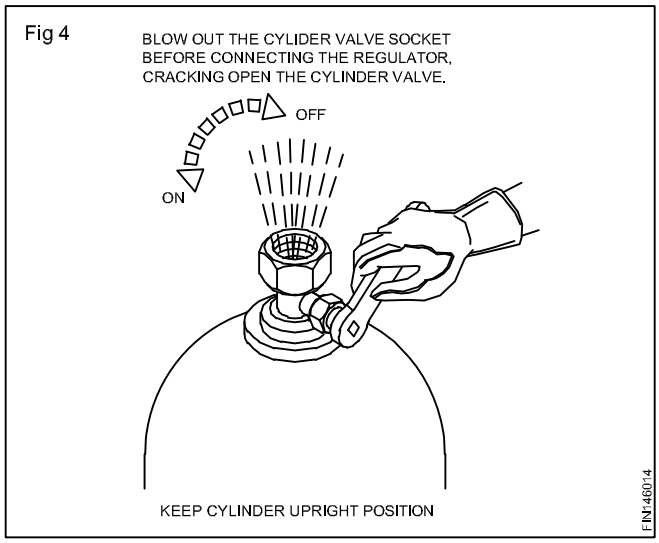
Always crack the cylinder valves to clean the valve sockets before attaching regulators (Fig 4)

Fig 4



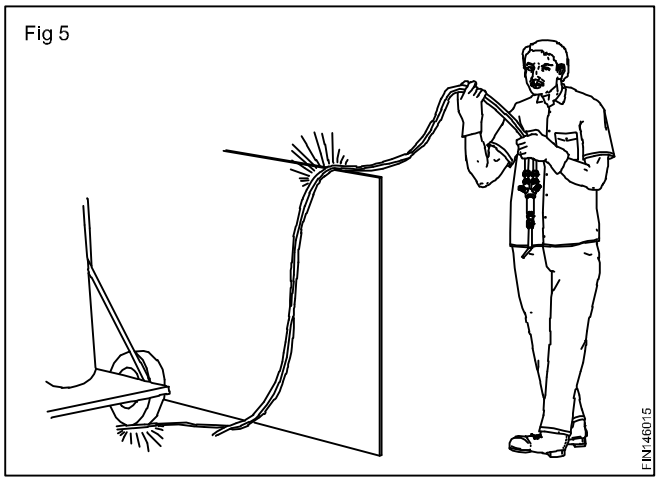
Safety for rubber hose pipes (Fig 5)

Inspect the rubber hose pipes periodically and replace the damaged ones.

Do not use odd bits of hose pipes / tubes.

Do not replace the hose pipes for acetylene with the ones used for oxygen.

Fig 5



Always use a black hose pipes for oxygen and maroon hosepipes for acetylene.

Safety for regulators

Prevent hammer blows to the gas cyclinders and ensure that water, dust and oil do not settle on the cylinders.

One right hand threaded connection for oxygen and left hand threaded connection for acetylene.

Safety for blowpipes

When a blowpipe is not in use put out the flame and place the blowpipe in a safe place.

When flame snaps out and backfires, quickly shut both the blowpipe valves (oxygen first) and dip in water.

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Method of handling cutting torch-description, parts, function and uses

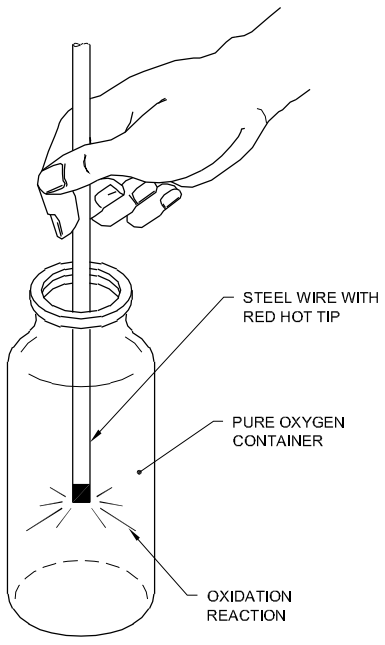
Objectives: At the end of this lesson you shall be able to
- **explain the principle of gas cutting**
- **describe the cutting operation and its application.**

Introduction to gas cutting : The most common method of cutting mild steel is by an oxy-acetylene cutting process. With an oxy-acetylene cutting torch, the cutting (oxidation) can be confined to a narrow strip and with little effect of heat on the adjoining metal. The cut appears like a saw-cut on a wooden plank. The method can be successfully used to cut ferrous metals i.e. mild steel.

Non-ferrous metals and their alloys cannot be cut by this process.

Principle of gas cutting: When a ferrous metal is heated to red hot condition and then exposed to pure oxygen, a chemical reaction takes place between the heated metal and oxygen. Due to this oxidation reaction, a large amount of heat is produced and cutting action takes place.

Fig 1



OXIDATION

When a piece of wire with a red hot tip is placed in a container of pure oxygen, it bursts into flame immediately and is completely consumed. Fig 1 illustrates this reaction. Similarly in oxy-acetylene cutting the combination of red hot metal and pure oxygen causes rapid burning and iron is changed into iron oxide (oxidation).

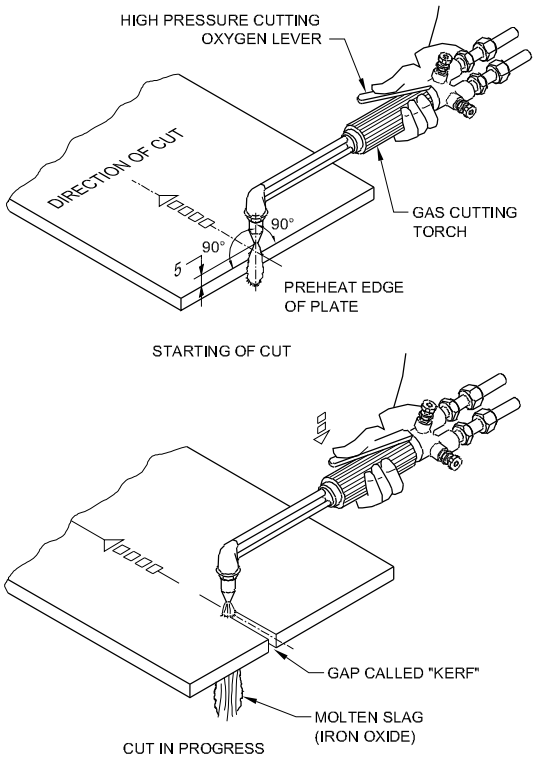
By this continuous process of oxidation the metal can be cut through very rapidly.

The iron oxide is less in weight than the base metal.

Also the iron oxide is in molten condition called slag. So the jet of oxygen coming from the cutting torch will blow the molten slag away from the metal making a gap called 'Kerf'. Fig.2

Cutting operation (Fig 2): There are two operations in oxy-acetylene gas cutting. A preheating flame is directed on the metal to be cut and raises it to bright red hot or ignition point (900°C app.). Then a stream of high pressure pure oxygen is directed on to the hot metal which oxidises and cuts the metal.

Fig 2



CUTTING OPERATION

The two operations are done simultaneously with a single torch.

The torch is moved at a proper travel speed to produce a smooth cut. The removal of oxide particles from the line of cut is automatic by means of the force of oxygen jet during the progress of cut.

300 litres of oxygen are required to oxidize one kilogram of iron completely. The ignition temperature of steel for gas cutting is 875°C to 900°C.

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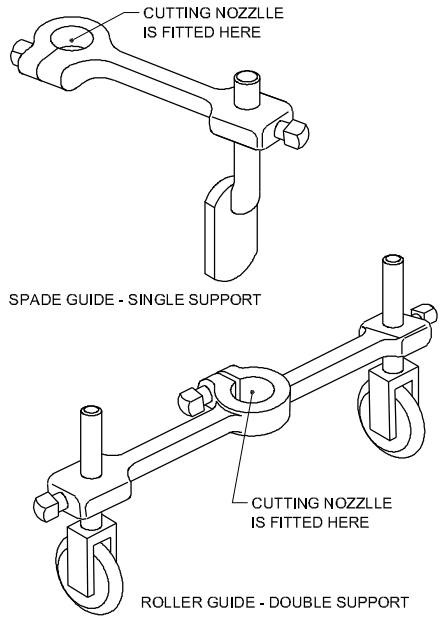
Application of cutting torch: Oxy-acetylene cutting torch is used to cut mild steel plates above 4mm thickness. The M.S plate can be cut to its full length in straight line either parallel to the edge or at any angle to the edge of the plate. Bevelling the edges of a plate to any required angle can also be done by tilting the torch. Circles and any other curved profile can also be cut using the cutting torch by using a suitable guide or template.

Fig.3 to Fig.7 shows the guides used to cut straight lines, bevel and small circles.

Fig 3



GUIDES

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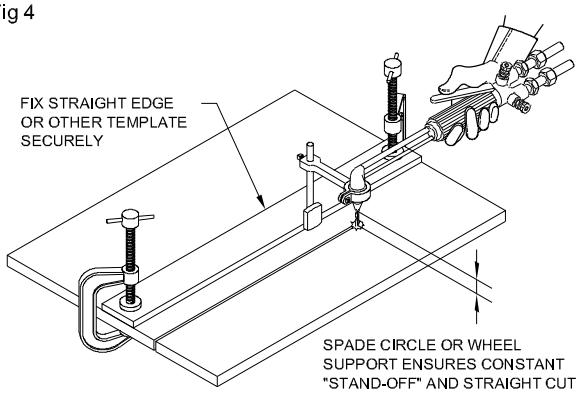
Fig 4



CUTTING WITH STRAIGHT EDGE AND SINGLE SUPPORT

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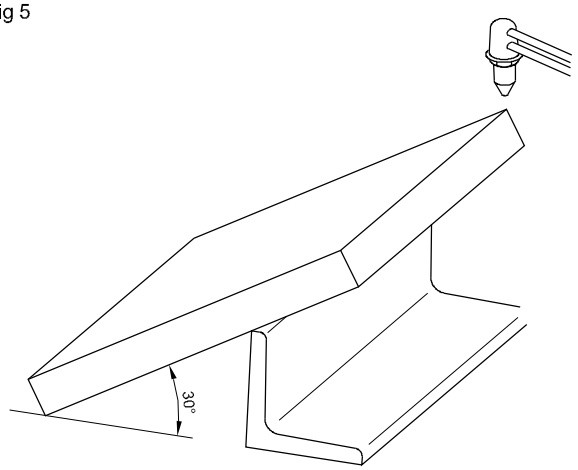
Cutting torch guides: Guides are sometimes used during oxy acetylene cutting.

They can be either a roller guide, double support or spade guide with single support.

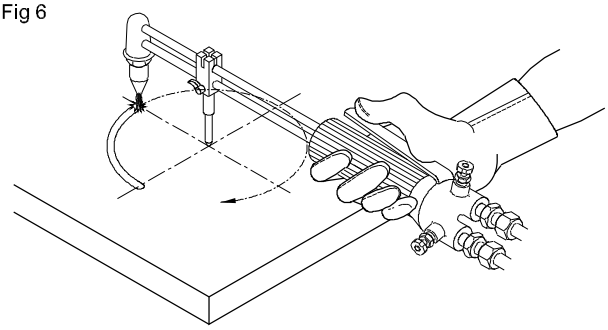
Fig 5



ALTERNATIVE METHOD OF CUTTING
BEVELLED EDGE ON INCLINE

FIN'46015

Fig 6



SMALL CIRCLE CUTTING

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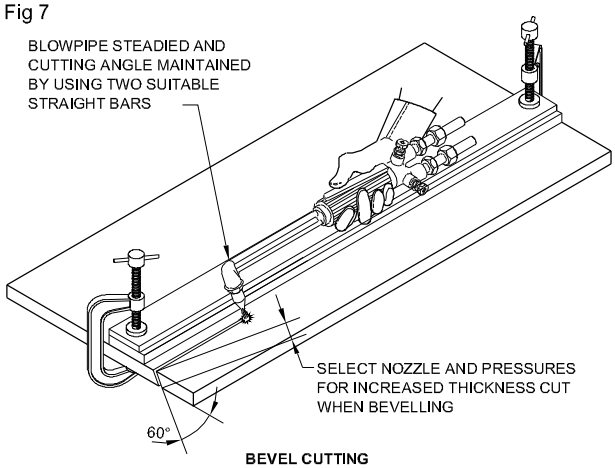
Fig 7



BEVEL CUTTING

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Cutting guides are held onto the nozzle of the cutting torch by tightening a clamp bolt. The clamps, where they are fitted, are adjusted so the inner cones of the preheat flames are approximately 2-3mm above the surface of the metal to be cut. The tip of the cutting nozzle is held at distance of 5-6mm above surface of the plate being cut.

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Oxy-acetylene cutting equipment

Objectives: At the end of this lesson you shall be able to
- **explain the features of the oxy-acetylene cutting equipment, its parts and cutting torch**
- **describe the oxy-acetylene cutting procedure**
- **differentiate between cutting and welding blowpipes.**

Cutting equipment: The oxy-acetylene cutting equipment is similar to the welding equipment, except that instead of using a welding blowpipe, a cutting blowpipe is used. The cutting equipment consists of the following.

– Acetylene gas cylinder

– Oxygen gas cylinder

– Acetylene gas regulator

– Oxygen gas regulator (Heavy cutting requires higher pressure oxygen regulator.)

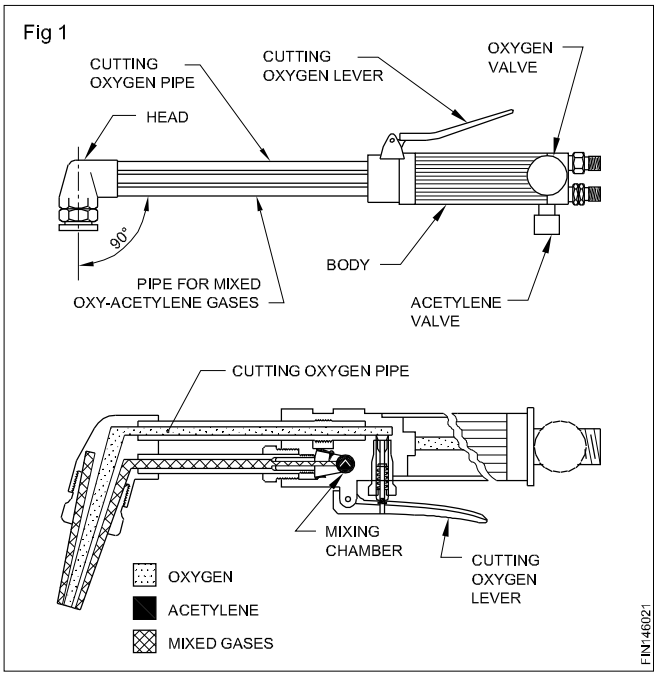
– Rubber hose-pipes for acetylene and oxygen

– Cutting blowpipe

(Cutting accessories i.e. cylinder key, spark lighter, cylinder trolley and other safety appliances are the same as are used for gas welding.)

The cutting torch (Fig 1): The cutting torch differs from the regular welding blowpipe in most cases; it has an additional lever for the control of the cutting oxygen used to cut the metal. The torch has the oxygen and acetylene control valves to control the oxygen and acetylene gases while preheating the metal.

Fig 1



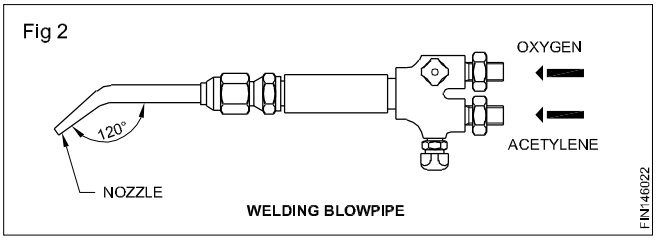
The cutting tip is made with an ORIFICE in the centre surrounded by five smaller holes. The centre opening permits the flow of the cutting oxygen and the smaller holes are for the preheating flame. Usually different tip sizes are provided for cutting metals of different thicknesses.

Oxy-acetylene cutting procedure: Fix a suitable size cutting nozzle in the cutting blowpipe. Ignite the cutting torch the same way as was done in the case of the welding blowpipe. Set the neutral flame for preheating. To start the cut, hold the cutting nozzle at angle 90° with the plate surface, and the inner cone of the heating flame 3 mm above the metal. Preheat the metal to bright red before pressing the cutting oxygen lever. If the cut is proceeding correctly, a shower of sparks will be seen to fall from the underside of the plate. Move the torch steadily on the punched line. If the edge of the cut appears to be too ragged, the torch is being moved too slowly. For a bevel cut, hold the cutting torch at the desired angle and proceed as is done in making a straight line cut. At the end of the cut, release the cutting oxygen lever and close the control valves of the oxygen and acetylene. Clean the cut and inspect.

Difference between cutting blowpipe and welding blowpipe: A cutting blowpipe has two control valves (oxygen and acetylene) to control the preheating flame and one lever type control valve to control the high pressure pure oxygen for making the cut.

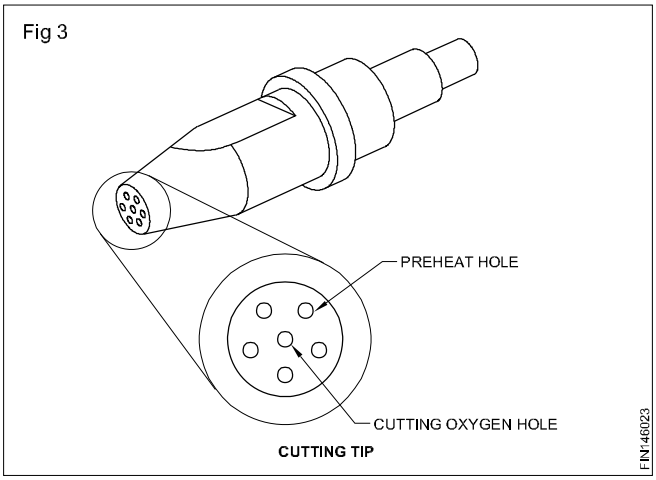
A welding blowpipe has only two control valves to control the heating flame. (Fig 2)

Fig 2



The nozzle of the cutting blowpipe has one hole in the centre for cutting oxygen and a number of holes around the circle for the preheating flame. (Fig 3)

Fig 3



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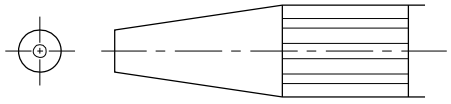
The nozzle of the welding blowpipe has only one hole in the centre for the heating flame. (Fig 4)

Fig 4



WELDING NOZZLE

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The angle of the cutting nozzle with the body is 90°.

The angle of the welding nozzle with the neck is 120°.

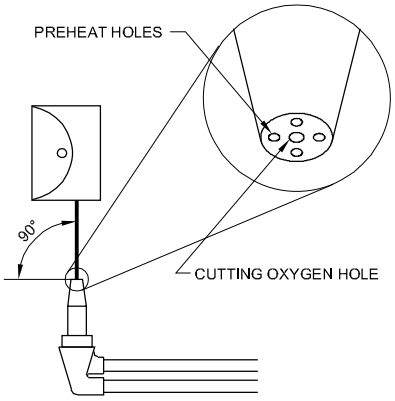
The cutting nozzle size is given by the diameter of the cutting oxygen orifice in mm.

The welding nozzle size is given by the volume of oxy-acetylene mixed gases coming out of the nozzle in cubic meter per hour.

Operating data for cutting mild steel

Cutting nozzle size - mm	Thickness of plate (mm)	Cutting oxygen pressure Kgf/cm^2
0.8	3 - 6	1.0 - 1.4
1.2	6 - 19	1.4 - 2.1
1.6	19 - 100	2.1 - 4.2
2.0	100 - 150	4.2 - 4.6
2.4	150 - 200	4.6 - 4.9
2.8	200 - 250	4.9 - 5.5
3.2	250 - 300	5.5 - 5.6

Fig 5



CLEANING THE HOLES OF CUTTING NOZZLE

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Care and maintenance: The high pressure cutting oxygen lever should be operated only for gas cutting purposes.

Care should be taken while fitting the nozzle with the torch to avoid wrong thread. Dip the torch after each cutting operation in water to cool the nozzle.

To remove any slag particles or dirt from the nozzle orifice use the correct size nozzle cleaner Fig.5. Use an emery paper if the nozzle tip is damaged to make it sharp and to be at 90^0 with the nozzle axis.

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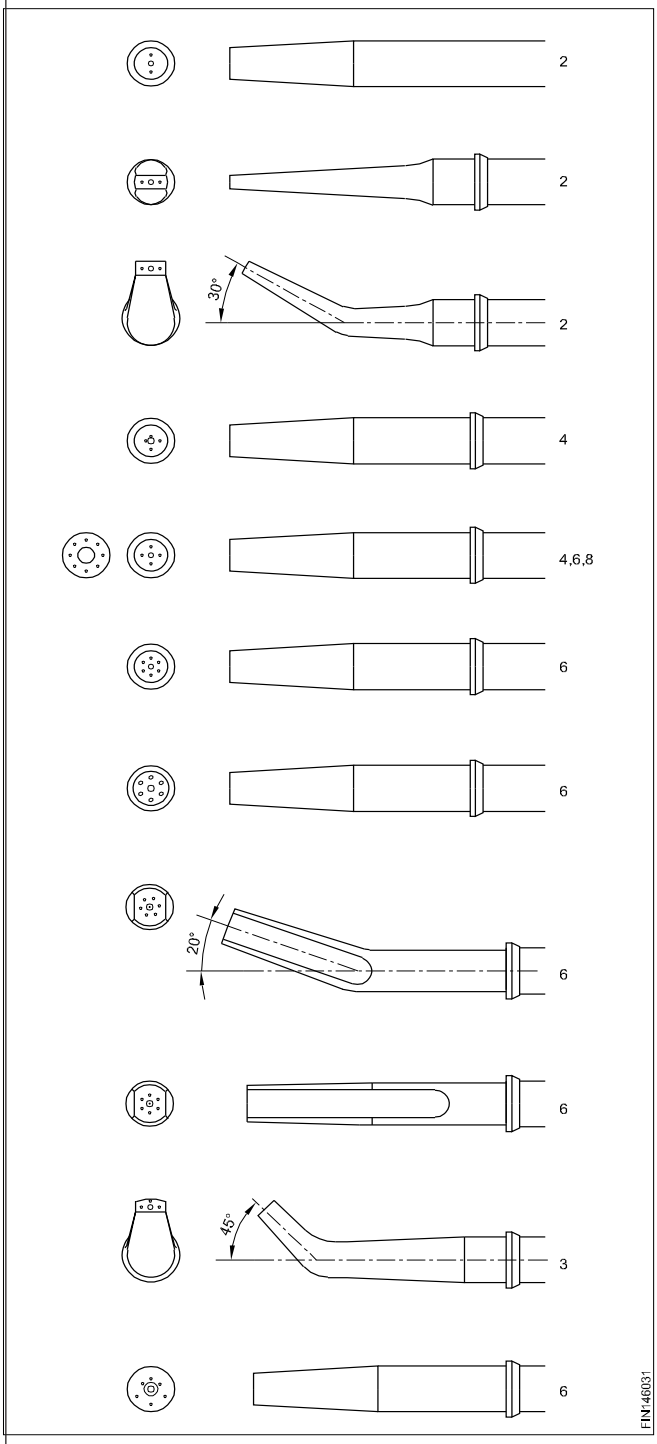
Oxy-acetylene hand cutting - piercing hole and profile cutting

Objectives: At the end of this lesson you shall be able to
- **explain the special types of nozzles for gas cutting and their application**
- **describe the parts of a cutting equipment and their functions**
- **explain troubleshooting and the remedy of the faults in oxygen cutting.**

Table of some common cutting torch tips and their uses

Number of preheat orifices in cutting torch tips	Degree of preheating	Application
	Medium	For straight line or circular cutting of a clean plate.
	Light	For splitting angle iron, trimming plates and sheet metal cutting.
	Light	For hand cutting rivet heads and machine cutting 30 deg. bevels.
	Light	For straight line and shape cutting clean plate.
	Medium	For rusty or painted surfaces.
	Heavy	For cast iron cutting and preparing Vee for cast iron welding .
	Very heavy	For general cutting; also for cutting and stainless steel.
	Medium	For grooving, flame machining, gouging and removing imperfect welds.
	Medium	For grooving, gouging or removing imperfect welds.
	Medium	For machine cutting 45° deg. bevel or hand cutting rivet heads.
	Heavy	Flared cutting orifices provide a large oxygen stream of low velocity for rivet head removal (washing).

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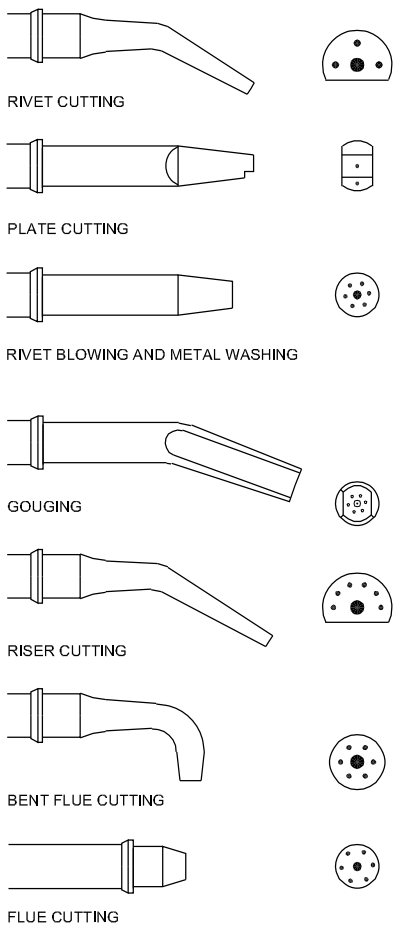
Special purpose nozzle: For profile cutting, different types of nozzles are used for cutting metals in different shapes.

Nozzles used for cutting profiles are shown in Fig 1.

Fig 2



SPECIAL TYPES OF NOZZLES USED FOR GAS CUTTING

Cutting torch: Fig 2 Oxygen and fuel gas are mixed and then the gas is carried to the tip of the orifice to form 'preheat' flames. If oxygen is carried directly to the tip it oxidises the metal and blows it away to form the cut.

Method of piercing a hole: Hold the cutting blowpipe at right angles on the point where the hole is to be made. The point will be brightened. Release the cutting oxygen slowly. Raise the torch, tilt the nozzle slightly to the left and right directions so that the sparks may not foul the nozzle. Thus the hole may be pierced.

For cutting of the profile hold the blowpipe head in such a way that the oxygen stream is directed by the correct tilting of the blowpipe. It is obvious that the angle between the nozzle and the plate must remain constant and this poses the greatest difficulty for the beginners.

Position of the preheating flame as related to the plate surface is very important.

Fig 3

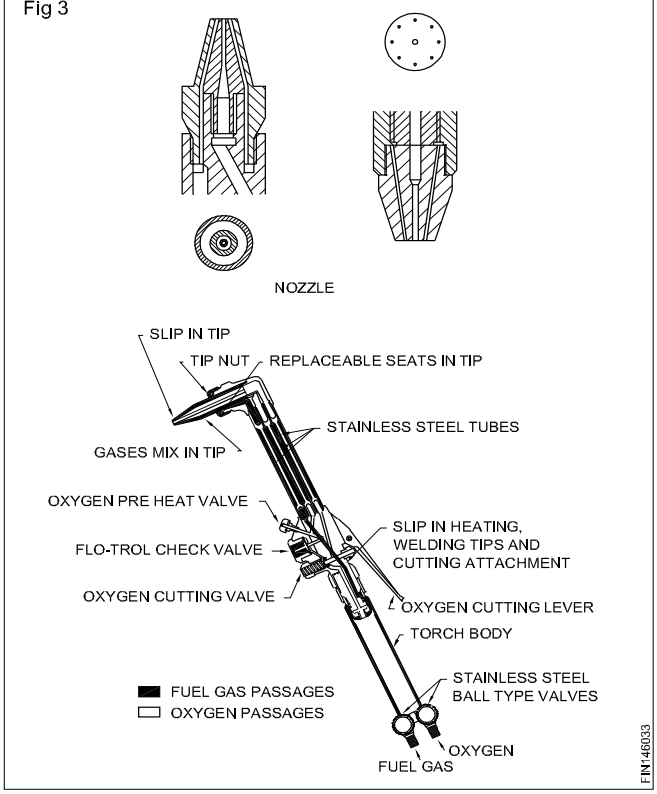
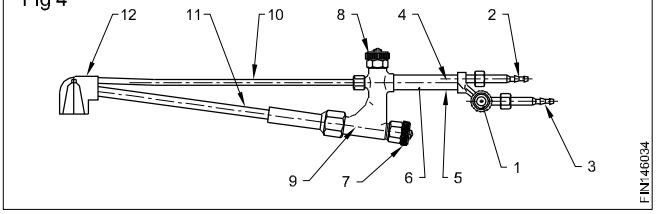


Fig 4



Names and functions of the parts of a cutting torch (Fig 3 and Table 1)

Table 1

No.	Name	Function
1	Acetylene gas valve	To adjust the flow rate of acetylene gas.
2	Oxygen hose joint	To connect with the oxygen hose.
3	Acetylene gas hose joint	To connect with the acetylene gas hose.
4	Oxygen conduit	To lead oxygen.
5	Acetylene gas conduit	To lead acetylene gas.
6	Grip	To hold the torch.
7	Preheating oxygen valve	To adjust the preheating flame.
8	Cutting oxygen valve	To adjust the cutting oxygen flow rate.
9	Injector	To mix the acetylene gas with oxygen.
10	Cutting oxygen conduit	To lead the cutting oxygen.
11	Mixed gas conduit	To lead the mixture of acetylene gas and oxygen.
12	Torch head	To attach the nozzle.

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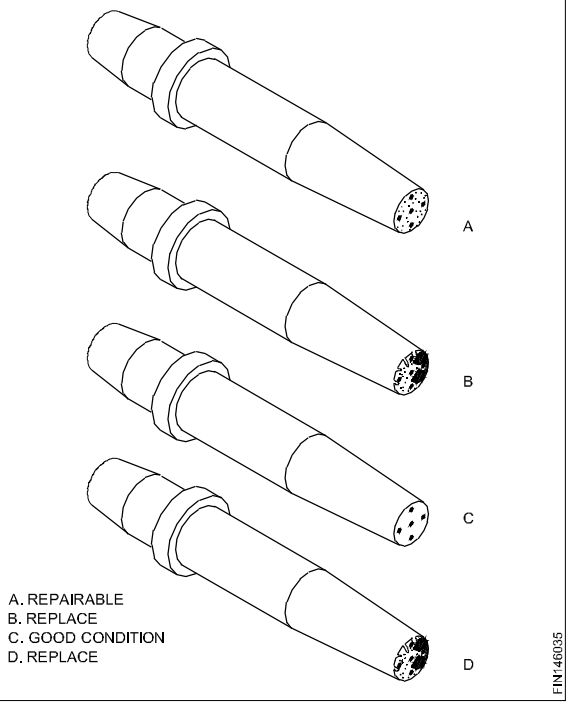
Troubleshooting

Object	Trouble	Part to be checked	Method	Remedy	
Torch		Hose joint	Soap water or water	Tighten further or replace.	At the beginning of the work.
	Gas leakage	Valve & regulator	Soap water or water	Replace the torch.	At the beginning of the work.
		Cutting tip attaching part	Soap water or water	Tighten further or replace.	At the beginning of the work.
	Suction of Acetylene	Injector	Plug the fuel gas hose mouth with your finger.	Replace.	Periodical check for the low pressure torch.
	Preheating flame shape		Neutral flame by visual inspection	Clean or replace.	At the beginning of the work or at random.
	Cutting oxygen flow		Visible gas flow by visual inspection	Clean or replace.	At the beginning of the work or at random.

Care and maintenance: The cutting oxygen orifice should be cleaned at regular intervals by using different size wire of nozzle cleaner. (Fig 4)

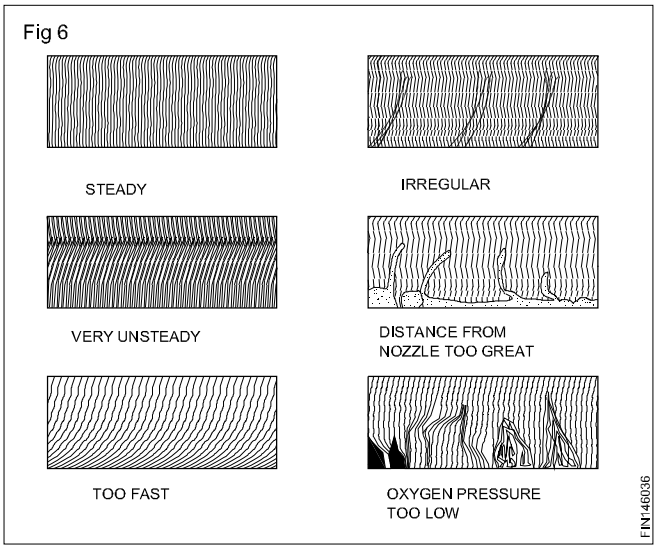
Fig 5



Characteristics of analysis of cutting: This analysis has been made on referring to the cutting face and the formation of cut in this surface.

This can be analysed as shown in the figure . (Fig 5)

Fig 6



Safety in gas cutting process

Objectives: At the end of this lesson you shall be able to
- **describe the safety precautions to be followed for handling gas cutting equipment**
- **explain the safety precautions to be followed by the operator**
- **state the safety required during gas cutting operation.**

Equipment safety: Safety precautions for gas cutting equipment are the same as those adopted in the case of gas welding equipment.

Safety for the operator (Fig 1)

Always use safety apparel for the:

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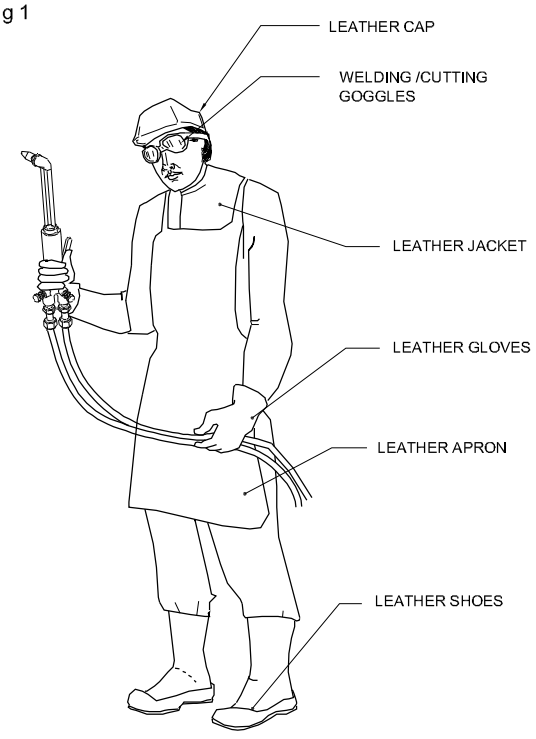
Fig 1



WEAR PROTECTIVE CLOTHING

– protection of your eyes
– protection from burns
– protection of clothing
– prevention of inhaling burnt gases.

Goggles, gloves and other protective clothing must be worn.

Safety during operation: Keep the work area free from flammable materials.

Ensure that the combustible material is atleast 3 metres away from the cutting operation area.

In case the flammable material is difficult to remove, suitable fire resisting guards/partitions must be provided.

Protect yourself and others from the flying sparks.

Ensure that the metal being cut is properly supported and balanced so that it will not fall on the feet of the operator or on the hoses.

Keep the space clear underneath the cutting job so as to allow the slag to run freely, and the cutting parts to fall safely.

Be careful about flying hot metal and sparks while starting a cut. Containers which hold combustible substances should not be taken directly for cutting or welding. (Fig 2) Wash the containers with carbon tetrachloride and caustic soda before welding or cutting and fill them with water before repairing.

Keep fire-fighting equipment handy and ready.

Fig 2

Common faults in gas cutting

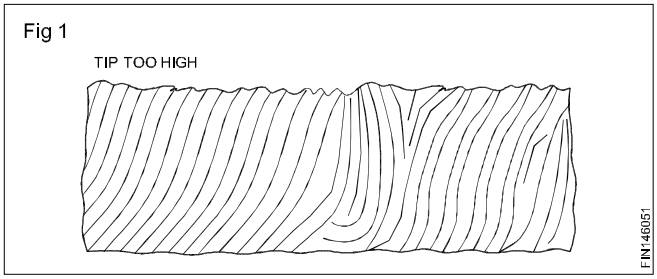
Objectives: At the end of this lesson you shall be able to
- **explain the common faults in cutting**
- **describe the causes and remedies**
- **explain the method of good gas cutting.**

Common faults in cutting

(Fig 1) The tip is too high off the steel. The top edge is heated or rounded, the cut face is not smooth, and often the face is slightly bevelled where preheat effectiveness is partially lost due to the tip being held so high. The cutting speed must be reduced because of the danger of losing the cut.

(Fig 2) Extremely slow cutting speed. Pressure marks on the cut face indicate too much oxygen for the cutting conditions. Either the tip is to big, the cutting oxygen pressure is too high, or the speed is too slow as shown by

Fig 1



the rounded or beaded top edge. On reducing the cutting oxygen volume to the correct proportions for the thickness of the cut, the pressure marks will recede toward the bottom edge until they finally disappear.

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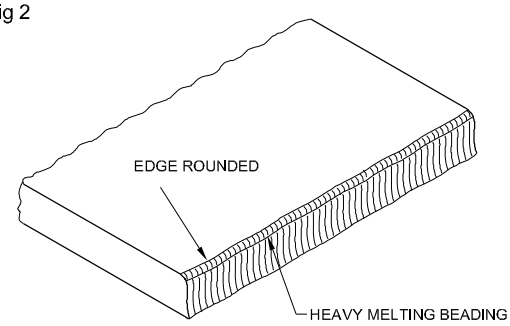
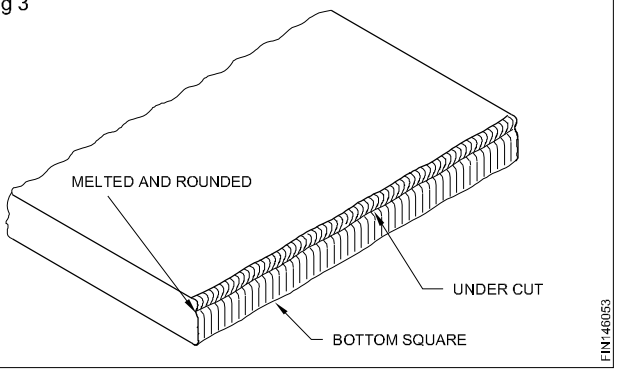
Fig 2



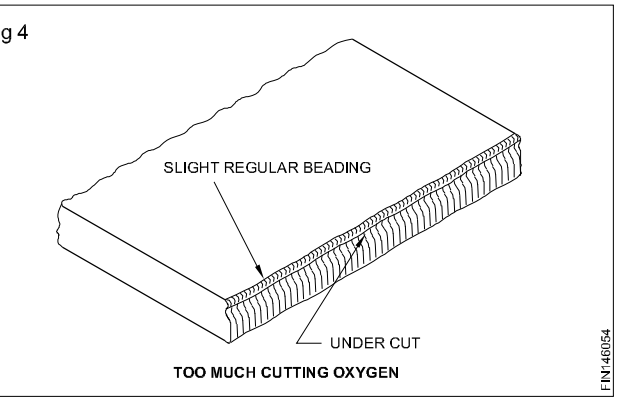
(Fig 3) Tip too close to the steel. The cut shows grooves and deep drag lines, caused by an unstable cutting action. Part of the preheat cones burned inside the kerf, where normal gas expansion affected the oxygen cutting stream.

Fig 3



(Fig 4) Too much cutting oxygen. The cut shows pressure marks caused by too much cutting oxygen. When more oxygen is supplied than can be consumed in oxidation, the remainder flows around the slags, creating gouges or pressure marks.

Fig 4



(Fig 5) Too much preheating. The cut shows a rounded top edge caused by too much preheat. Excess preheating does not increase the cutting speed, it only wastes gases.

(Fig 6) Poor quality bevel cut. The most common fault is gouging, caused by either excessive speed or inadequate preheat flames. Another fault is a rounded top edge caused by too much preheat, indicating excessive gas consumption.

(Fig 7) Slightly too fast a cutting speed. The drag lines on this cut incline backwards, but a 'drop cut' is still attained. The top edge is good; the cut face is smooth and slag-free. This quality is satisfactory for most production work.

Fig 5

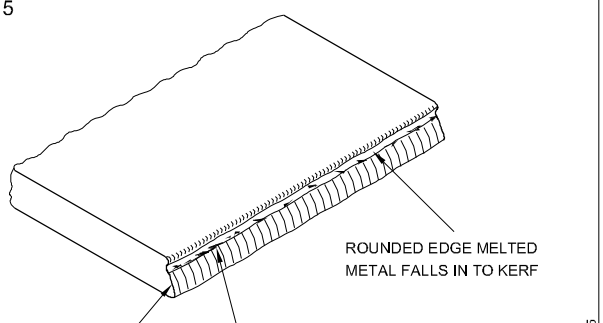


Fig 6

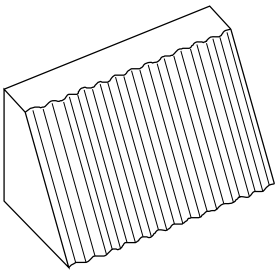
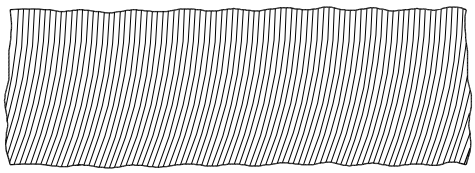
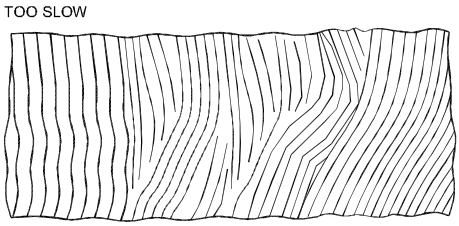


Fig 7



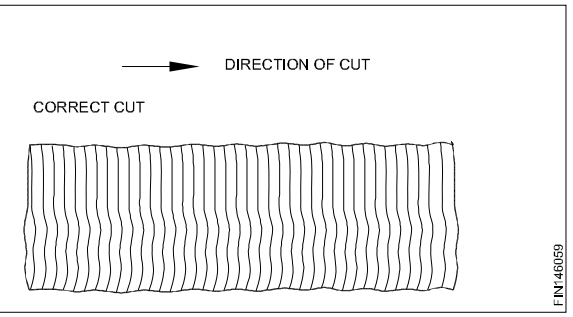
(Fig 8) Slightly too slow a cutting speed. The cut is of high quality although there is some surface roughness caused by the vertical drag line. The top edge is usually slightly beaded. This quality is generally acceptable, but faster speeds are more desirable because the labour cost for this cut is too high.

Fig 8



In a good cut, the edges are square, and the lines of cut are vertical. (Fig 9)

Fig 9



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Gas cutting machines (oxy-acetylene)

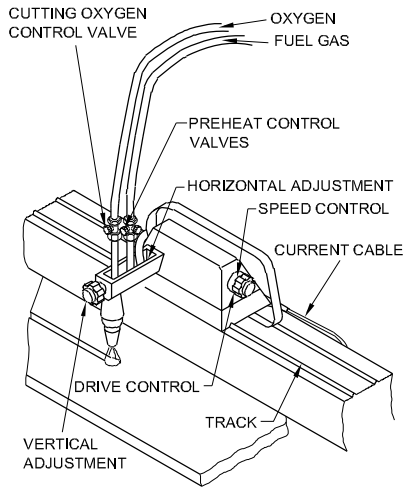
Objective : At the end of this lesson you shall be able to
- **identify the different types of gas cutting machines.**

Straight line and circle cutting machines

These machines are used for regular, straight and circle cutting.

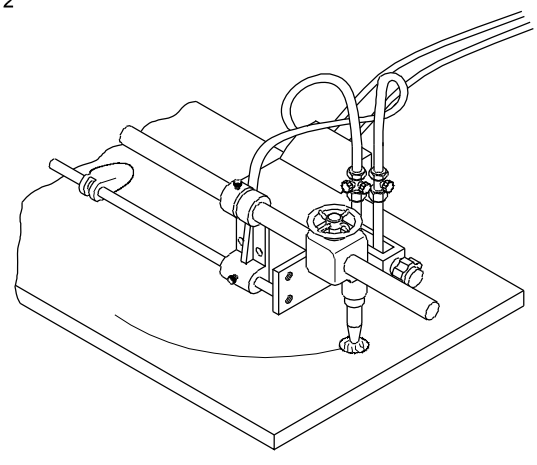
Straight line cutting (Fig 1)

Fig 1



Large circle cutting (Fig 2)

Fig 2



Small circle cutting (Fig 3)

Profile cutting machines

These are used to cut any shape required for fabrication.

A profile cutting machine with magnetic roller for single cutting head is shown in Fig 4.

Fig 3

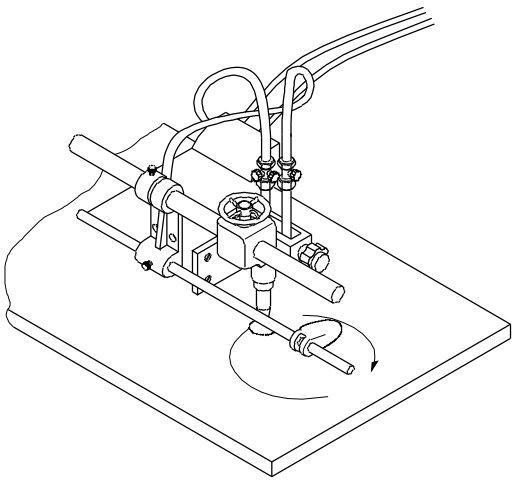
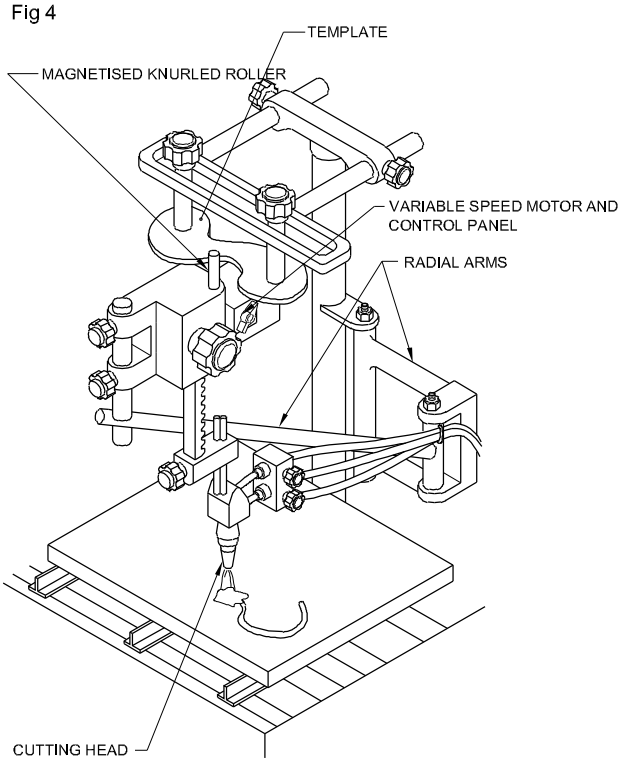


Fig 4



It is also called as radial arm cutting machine.

A profile cutting machine with a magnetic roller for multi-cutting heads is shown in Fig 5.

It is also called as cross-carriage cutting machine.

Profile cutting machines are also available with an electronic control and scanning head.

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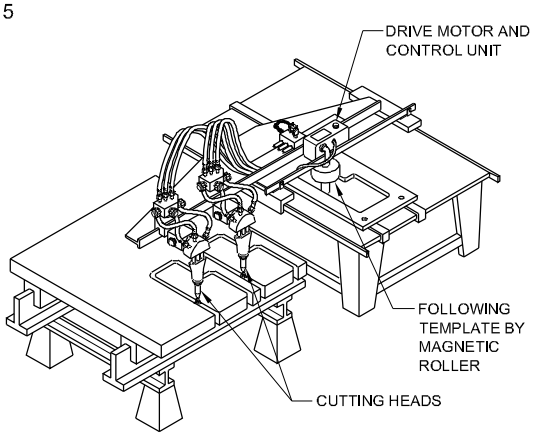
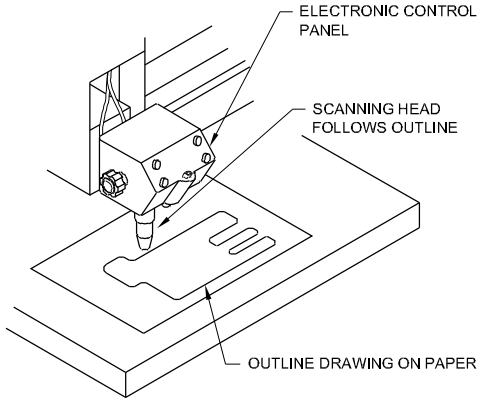
Fig 5



Electronic control replaces the magnetic roller system and template. (Fig 6)

Fig 6



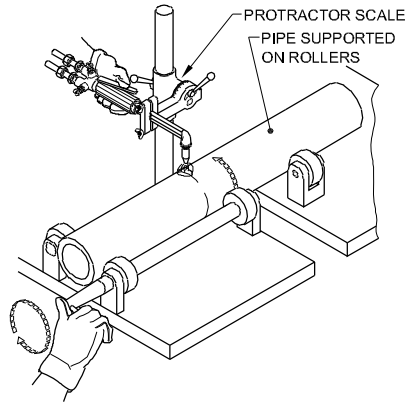
AUTOMATIC SCANNER FOLLOWING OUTLINE DRAWING ON PAPER

Pipe cutting machines

These are used for circumferential cutting or beveling of pipes.

A simple pipe cutting arrangement using a hand cutting blowpipe is shown in Fig 7.

Fig 7

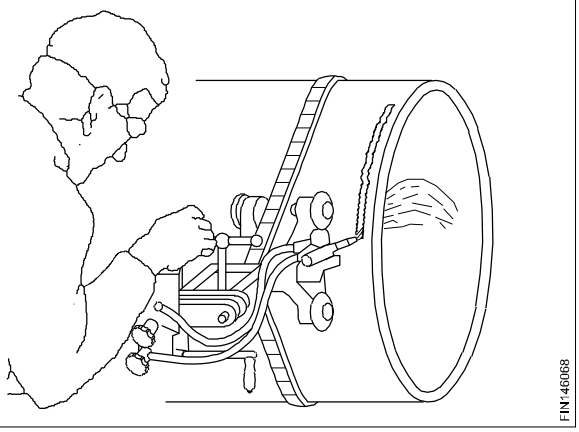


SIMPLE PIPE CUTTING ARRANGEMENT

The pipe is rotated by hand.

The pipe cutting machine with manual control shown in Fig 8 is rotated by hand around the pipe.

Fig 8



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