
The Inter-American Centre of Investigation and Documentation for Vocational Training (CINTERFOR) is a regional, specialist agency of the International Labour Organisation (ILO).

Established in 1964, CINTERFOR has as its objects the stimulation and co-ordination of the efforts of institutes, organisations and enterprises which are concerned with Vocational Training in Latin America.

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DESCRIPTION OF THE CBC

Field of Occupation of the CBC for Oxy-acetylene welding

The operation and technological sheets contained in this CBC for oxy-acetylene welding are applicable to the preparation of instructional material for teaching workshop practices of the following occupations:

8-72.15 GAS WELDER

Welds metal parts by means of oxy-acetylene or other gas flame:

> Examines parts to be welded to determine best method to use; prepares surfaces of parts to be welded; selects torch nozzle and attaches it to blow pipe; lights torch and adjusts flame by regulating flow of gases; heats parts until they begin to melt and fuses them by applying molten metal from a welding rod; runs flame and welding rod along joint; cleans and smoothes welded parts.
> May mark off parts and flame-cut metal before welding. May specialize in type of metal welded or gas used and be designated accordingly.

It can also be applied in the instructions of multipurpose and specialized operations such as those described as follows:

8-72.10 GAS AND ELECTRIC WELDER IN GENERAL

Welds metal parts by means of oxy-acetylene, other gas flame and electric arc.

> Performs similar tasks to those of *gas welder (8-72.15) and manual electric arc welder (8-72.20).*

8-72.50 MANUAL FLAME CUTTER

Cuts metal by means of oxy-acetylene or other gas flame:

> Fixes appropriate tip into torch nozzle; lights torch and adjusts flame by regulating flow of gases; guides torch along cutting line to melt and remove a narrow strip of the metal, thus cutting the workpiece. May work to drawings and other specifications and mark out cutting lines. May do welding. May specialize in one type of cutting, such as scrap metal cutting, and be designated accordingly.

Operations and technological information

This CBC includes the basic operations that are done in the previously indicated occupations, nevertheless, on preparing manuals for some very specific courses, there may be some operations missing, such as, working with welding machines, which have not been included in this first edition.

In these cases, it is recommended that on drawing up the missing sheets you should observe the preparation standards with the object of maintaining uniformity with the rest of the material.

With respect to the technological information, it is imperative that the complete indexes (VII - General index of technological themes for "General Mechanics" by code) be consulted as many of the subjects are applicable to more than one occupation and consequently may have been included in other CBCs. We may say that the operations are specific to one occupation, while most of the technological information is common to various occupations belonging to a group, in this case that of General Mechanics.

INDEXES

OPERATION SHEETS

I OPERATIONS arranged by reference number. OCCUPATION
OXY-ACETYLENE WELDER

REFERENCE	Name of Operation
01/OW	Preparing oxy-acetylene equipment
02/OW	Welding without filler material
03/OW	Welding with filler material in flat position
04/OW	Horizontal Welding
05/OW	Vertically ascending welding
06/OW	Over-head welding
07/OW	Manual oxycutting

III Corresponding table between OS and TIS directly related.
Tentative distribution of instruction unit.
Occupation: OXY-ACETYLENE WELDER.

	OPERATION SHEETS - OS -	TECHNOLOGICAL INFORMATION SHEETS-TIS-	
Ref.	Name of Operation	Ref.	Title of Subject
01/OW	Preparing oxy-acetylene equipment	229	Equipment for welding with oxy-acetylene (general information)
02/OW	Welding without filler material	230	Welding procedure (oxygas welding)
		231	Gases used in welding (oxygen-acetylene-propane)
		232	Equipment for welding with oxy-acetylene (nozzle welding torch)
		233	Oxy-acetylene flame
03/OW	Welding with filler material in flat position	234	Welding equipment for oxy-acetylene (cylinders, valves, regulators)
04/OW	Horizontal welding	235	Equipment for welding with oxy-acetylene (hose-gas economizer)
05/OW	Vertically ascending welding	--	-----
06/OW	Overhead welding	--	-----
07/OW	Manual oxycutting	236	Manual oxycutting

TECHNOLOGICAL INFORMATION SHEETS OF GENERAL MECHANICS, TO BE RELATED TO ANY OPERATION SHEET ACCORDING TO THE PROGRAMMER's CRITERIA

REF. HIT	TITLE
001	Files
002	Carbon steel (preliminary ideas)
007	Graduated ruler
008	Marking instruments, (ruler, scriber, square)

TECHNOLOGICAL INFORMATION SHEETS OF GENERAL MECHANICS TO BE RELATED TO ANY OPERATION SHEET ACCORDING TO THE PROGRAMMER'S CRITERIA (cont'd.)

Ref. HIT	TITLE
009	Centre punch
010	Spring dividers and jenny (or odd-leg callipers)
012	Non-ferrous metals (pure metals)
013	Hammer and mallet
015	Devices for clamping work (clamps and C.-clamps)
028	Hacksaw
029	Cold chisels
030	Grinders
045	Steel Alloys
058	Tightening tools
060	Screwdrivers
063	Fixing elements (handpress and pressure Pliers
066	Non-ferrous metals (alloys)
207	Protective Equipment (leather clothing)
210	Cleaning accessories (steel brush and chipping hammers)

INDEXES

TECHNOLOGICAL INFORMATION SHEETS

(of the occupation)

V. TECHNOLOGICAL THEME BY REFERENCE NUMBER FOR OXY-ACETYLENE (including code of subjects)

REFE-RENCE	Title of technological subjects	Subject Code
001	Files	3-4.31
002	Carbon Steel (preliminary ideas)	1-2.2
007	Graduated Ruler	2-2.1
008	Marking Instruments (ruler, scriber, square)	5-1.04
009	Centre Punch	5-1.03
010	Spring Dividers and jenny (or odd-leg) callipers	5-1.05
012	Non-ferrous metals (pure metals)	1-3.1
013	Hammer and Mallet	5-1.02
015	Devices for clamping work (clamps and C-clamps	5-2.13
028	Hacksaw	3-4.37
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030	Grinders	3-4.21
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229	Equipment for welding with oxy-acetylene (general information)	3-6.21
230	Welding procedure (oxygas welding)	3-6.23
231	Gases used in welding (oxygen-acetylene-propane)	3-6.22

V TECHNOLOGICAL SUBJECTS BY REFERENCE NUMBER FOR OXYACETYLENE WELDER (Including code of subject) (cont'd).

Reference	Title of Technological Subject	Subject Code
232	Equipment for welding with oxy-acetylene (nozzle - welding torch)	3-6.21
233	Oxy-acetylene flame	3-6.23
234	Equipment for welding with oxy-acetylene (cylinders - valves - regulators)	3-6.21
235	Equipment for welding with oxy-acetylene (hose - gas economizer)	3-6.21
236	Manual oxycutting	3-6.23

FOREWORD

1) The following sheets will be used as a pattern for printing masters or stencils for office offset machines or mimeographs or other types of duplicators. They should be carefully handled so as to prevent damage to the paper of smudging to its surface.

2) It is useful to recheck the sheets before printing the masters so that the weak lines may be retouched with either an ordinary pencil or ink as well as covering the blots and imperfections with "Gouache" (white tempera).

3) Additions that have to be made to the sheets such as local codes can be written on white paper and stuck to their corresponding position. The same procedure is adequate for correcting errors and other mistakes.

OPERATION SHEETS

CBC

OPERATION: PREPARING OXY-ACETYLENE EQUIPMENT | **REF** OS.01/OW | 1/4

Caribbean

This is a basic operation which the welder should correctly master as he will repeat it frequently when doing different jobs of oxy-acetylene welding. It consists of mastering the knowledge dealing with the functioning of the oxy-acetylene equipment so as to render it in working condition.

METHOD OF EXECUTION:

1st Step - *Mount the regulators, thus:-*

SAFETY MEASURE:

THE CYLINDERS SHOULD BE IN A VERTICAL POSITION AND BE SECURED, SO AS TO PREVENT TOPPLING.

a) Remove the cover of the cylinders.

b) Slightly open and close the valve to expel the impurities.

SAFETY MEASURES:

1) BEFORE OPENING THE ACETYLENE CYLINDER, MAKE SURE THAT THERE IS NO EXPOSED FLAME NEARBY.

2) WHEN HANDLING THE CYLINDERS YOUR HANDS SHOULD BE CLEAN OF GREASE AND OIL, AS THESE MAY CAUSE EXPLOSIVE COMBUSTIONS.

c) Connect the regulators to their respective cylinders.

OBSERVATIONS:

1) The connector nut should be tightened with the spanner for the equipment.

2) The dials should remain in such a way that the operator should be able to take the pressure readings with ease.

d) Turn the pressure regulating screw which regulates the flow of gas to the gauge which indicates the working pressure.

SAFETY MEASURE:

WHEN TURNING THE PRESSURE-REGULATING SCREW DO SO IN AN ANTI-CLOCKWISE DIRECTION (fig. 1).

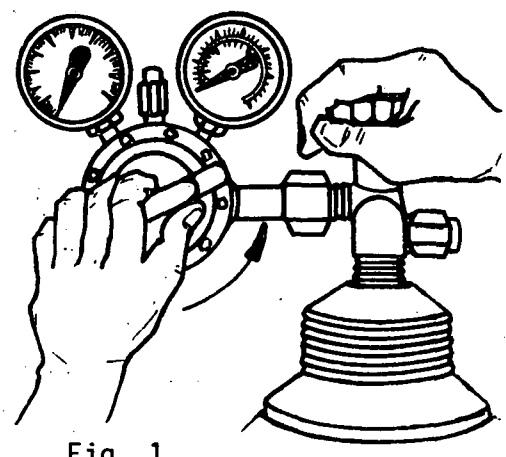


Fig. 1

2nd Step - *Position the hoses, thus:-*

a) Connect the hoses to the regulators (fig. 2).

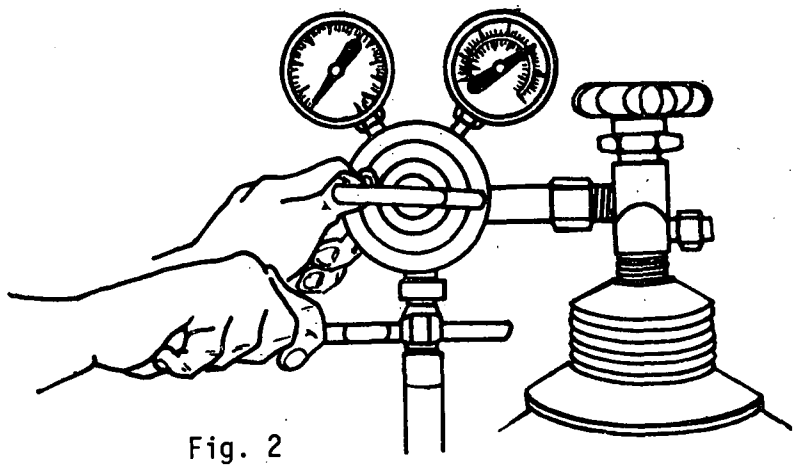


Fig. 2

b) Connect the hoses to the welding torch shank (fig. 3).

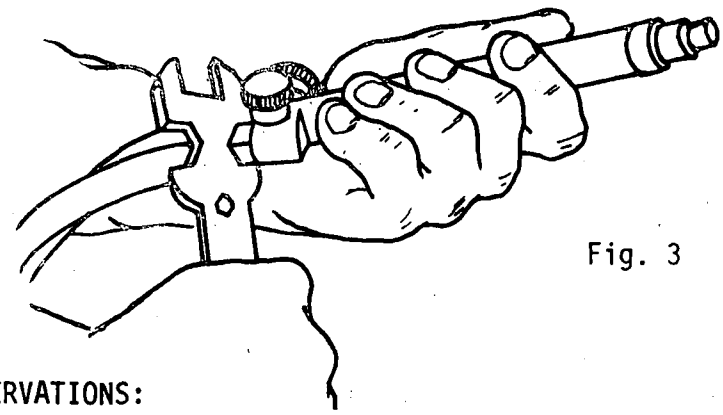


Fig. 3

OBSERVATIONS:

1) The hose that supplies acetylene is red in colour and its connectors have left-handed threads.
2) The hose that supplies oxygen is blue or green in colour and its connectors have right-handed threads.

3rd Step - *Install the nozzle, thus:-*

a) Adjust the nozzle manually.

b) Place the nozzle in the working position (fig. 4).

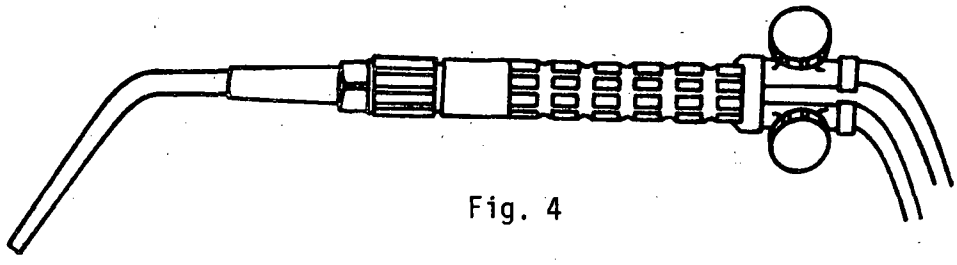


Fig. 4

4th Step - *Regulate the working pressures, thus:-*

a) Open the cylinder valves.

b) Turn the knobs that regulate the oxygen and acetylene.

5th Step - *Ignite the torch, thus:-*

a) Open the acetylene valve in the torch for a ¼ turn.

b) Operate the lighter (fig. 5).

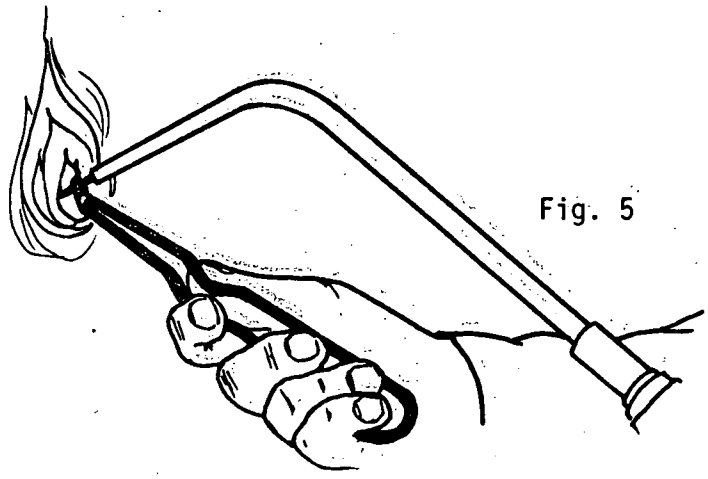


Fig. 5

SAFETY MEASURE:

WHEN THE TORCH IS IGNITED, AIM THE NOZZLE OVER A FREE SECTION AND MANIPULATE THE LIGHTER, WITHOUT PUTTING OUT THE FLAME, SO AS TO PREVENT ACCIDENTS.

c) Slowly open the oxygen valve of the torch until obtaining a well regulated flame, "neutral".

OBSERVATION:

It is important that the welder be able to distinguish between the neutral, oxidizing and carburizing flames (figs. 6, 7, and 8).

Oxidizing Flame

Fig. 7

Neutral Flame

Fig. 6

Carburizing Flame

Fig. 8

6th Step - *Turn off the torch, thus:-*

a) Shut off the acetylene valve in the torch.

b) Shut off the oxygen valve in the torch.

SAFETY MEASURE:

EACH TIME YOU TURN OFF THE TORCH, FIRST SHUT OFF THE ACETYLENE VALVE.

CBC

OPERATION: WELDING WITHOUT FILLER MATERIAL

REF. OS 02/OW | 1/2

Caribbean

This is the operation by which two thin plates are joined with the same material, fusing their edges by means of a flame produced by the combustion of oxygen and acetylene mixed in a welding torch. It is a basic operation to initiate the oxy-acetylene welder into uniform movement with the torch. It is used frequently in sheet-metal work.

METHOD OF EXECUTION:

1st Step - *Prepare the equipment.*

OBSERVATIONS:

1) The tip is selected according to the base metal.
2) Before mounting the tip, ensure that its hole is clean.
3) Use the needle that is suited to the hole of the tip.

2nd Step - *Prepare the material, thus:-*

a) Clean the plates.
b) Even-up the plates.
c) Position the plates for tacking (fig. 1).

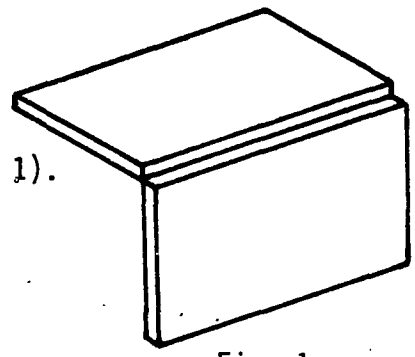


Fig. 1

3rd Step - *Tack, thus:-*

a) Ignite and regulate the torch flame.
b) Put on the welding goggles.

OBSERVATION:

The pressures and tip are selected according to the tables provided by the manufacturers.

SAFETY MEASURE:

FOR WELDING, USE THE GOGGLES WITH THE APPROPRIATE GLASS NUMBER.

c) Bring the cone to a distance of 3mm from the base material (fig. 2).
d) Preheat the area to be tacked.

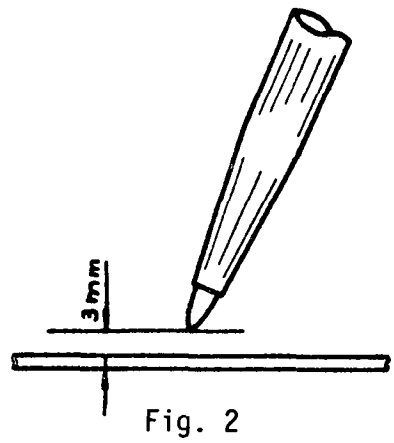


Fig. 2

e) Fuse the edges with a circular movement.

OBSERVATION:
The tacking should be kept at a distance equal to 25 times the thickness of the base material.

SAFETY MEASURE:
TAKE CARE! THE FLAME BACK-FIRE CAN PRODUCE AN EXPLOSION.

4th Step - *Weld, thus:-*

a) Incline the tip through 45° and direct the cone to the centre of the joint (fig. 3).

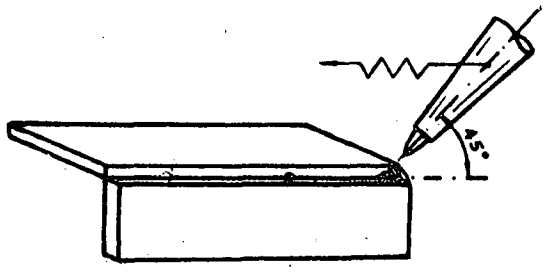


Fig. 3

b) Preheat the base material in the area to be welded.

c) Begin the bead, maintaining the cone at a constant height.

d) Advance the tip while oscillating (fig. 4).

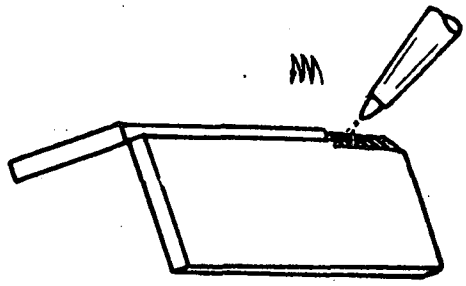


Fig. 4

e) Finish the bead.

f) Turn off the torch.

CBC

OPERATION: WELDING WITH CONTRIBUTING MATERIAL IN A FLAT POSITION

REF. OS 03/OW | 1/2

Caribbean

This type of joint is done in a flat position, with the filler material It allows the welder to make joints in the sheets. It is extensively used in car bodies, ventilation ducts and metal furniture.

METHOD OF EXECUTION:

1st Step - *Prepare equipment.*

OBSERVATION:

Look at table for selection of tips with relation to thickness.

2nd Step - *Prepare material, thus:-*

a) Clean sheets eliminating rust and impurities.

b) Even up the work-piece.

c) Assemble and tack according to fig. 1.

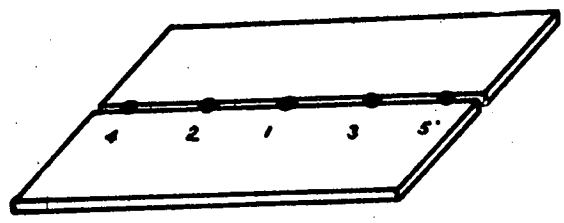


Fig. 1

PRECAUTION:

WEAR THE SAFETY EQUIPMENT.

d) Even up by correcting distortions, after tacking.

e) Start a small bead in the opposite direction to the advance (fig. 2).

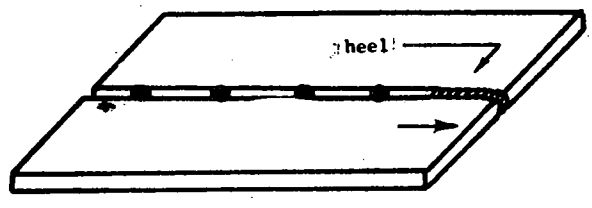


Fig. 2

OBSERVATION:

This small bead is known by the name of a heel.

3rd Step - *Weld the joint, thus:-*

a) Incline tip with regard to the workpiece (fig. 3) and preheat the base metal on starting the bead.

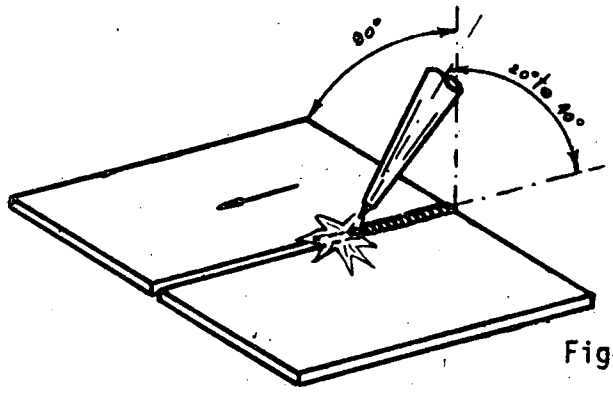


Fig. 3

b) Incline the rod as seen in figure 4.

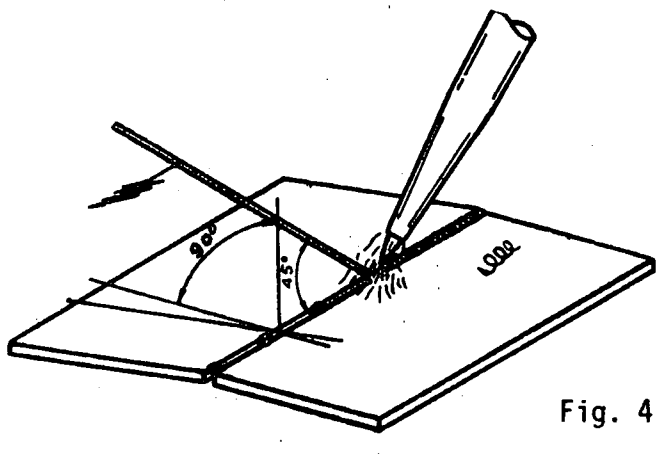


Fig. 4

c) Advance making a semi-circular movement with the tip (fig. 4).

d) Oscillate the filler rod as you advance in a zig-zag manner.

OBSERVATIONS:

1) When oscillating the rod, avoid coming out of the fusing zone.
2) The movements of the tip and the filler rod must be uniform and coordinated between them.

CBC **OPERATION:** HORIZONTAL WELDING | **REF.** OS.04/OW. | 1/1

Caribbean

This type of joint has the purpose of welding parts by means of horizontal deposits on edges without bevel.
Mastering this operation would permit working on parts that cannot be positioned more conveniently.
It is employed frequently in furniture sheet metal work and in making low pressure metallic containers.

METHOD OF EXECUTION:

1st Step - *Prepare the equipment.*

2nd Step - *Prepare the material, thus:-*

a) Clean and even up the sheet.
b) Assemble and tack.
c) Correct distortions.

3rd Step - *Weld the joint, thus:-*

a) Incline the tip and the filler rod (fig. 1).
b) Preheat the beginning of the bead.
c) Distribute the heat on both sides of the joint by means of oscillating movements (fig. 2), drawing back and bringing forward the tip so as to enable a rapid solidification.

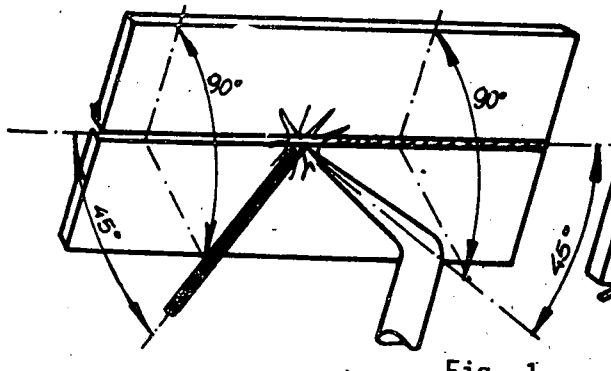


Fig. 1

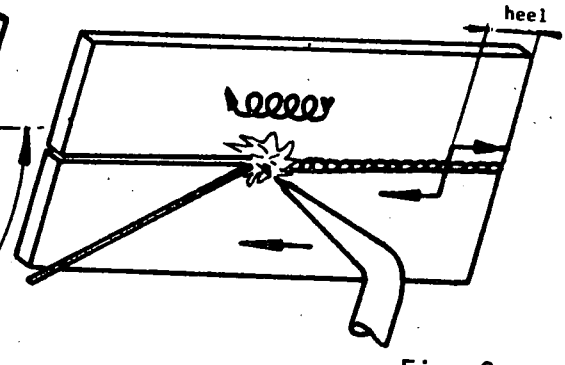


Fig. 2

OBSERVATION:
When joining, proceed to preheat the crater to the fusion temperature before restarting bead.

PRECAUTION:
AVOID THE EXCESSIVE ACCUMULATION OF HEAT IN THE WORK-PIECE TO AVOID THE FALLING OF LIQUID METAL.

d) Finish the joint by back filling the last crater.

CBC

OPERATION: VERTICALLY ASCENDING WELDING

It is the joining of two pieces of material placed in a vertical position by means of oxy-acetylene welding, done upwards, with the aim of obtaining better resistance in the assembling of plates. Its application is extensive in refinery installations, car bodies, storage tanks and sheet metal works.

METHOD OF EXECUTION:

1st Step - *Prepare equipment.*

2nd Step - *Prepare material, thus:-*

a) Clean the sheets to be welded.

b) Even-up the sheets.

c) Place and tack the sheets.

OBSERVATION:

Keep a gap of 2 mm between joints.

d) Correct possible distortions, after tacking.

e) Place the work-piece.

3rd Step - *Weld joints, thus:-*

a) Incline the tip and the filler metal (fig. 1).

b) Oscillate the tip and the filler metal (fig. 2).

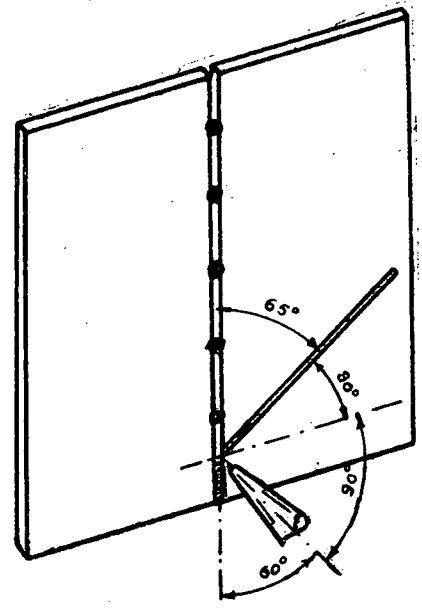


Fig. 1

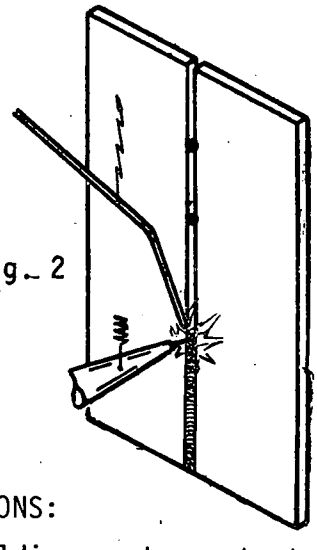


Fig. 2

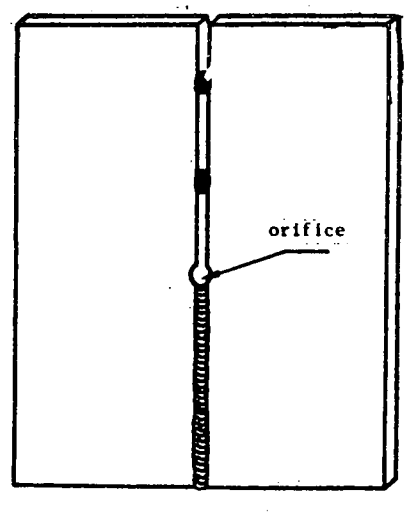


Fig. 3

OBSERVATIONS:

1) The welding must penetrate in such a way that the bead can be seen also from behind.

2) In all the extent of the butt joint an orifice must be kept which will indicate the penetration in the joint (fig. 3).

TECHNICAL VOCABULARY

Ascending - Upward; Uphill

CBC **OPERATION:** OVERHEAD WELDING | **REF.** OS.06/OW | 1/1

Caribbean

This is the joining of two pieces, welded from the under side. This operation presents many difficulties as a uniform fusion should be kept, preventing at the same time, dripping of the molten metal, due to gravity.
Its use is frequent on car bodies and metal furniture.

METHOD OF EXECUTION:

1st Step - *Prepare equipment.*

2nd Step - *Prepare material, thus:-*

a) Clean the sheets.
b) Even-up the sheets.
c) Assemble and tack the work-piece.
d) Correct distortions after tacking.
e) Place the work-piece.

3rd Step - *Weld the joints, thus:-*

a) Incline the tip and the filler rod (fig. 1).
b) Oscillate the tip and rod (fig. 1).

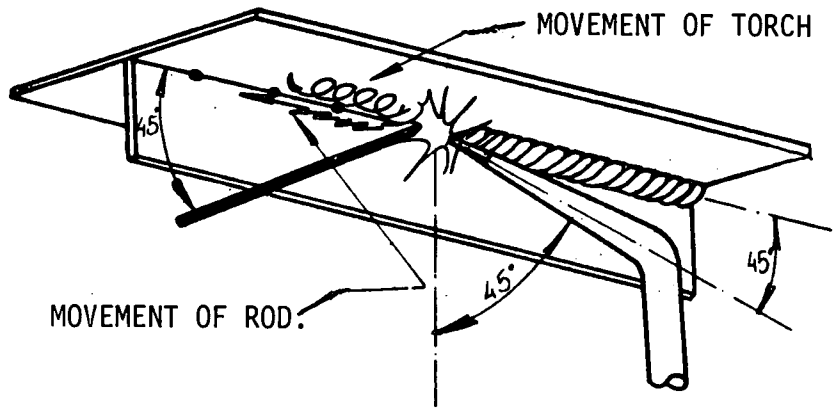


Fig. 1

PRECAUTION:

USE THE PROTECTIVE EQUIPMENT.

CBC

OPERATION: MANUAL OXYCUTTING

REF. OS 07/0W | 1/2

Caribbean

In the metallurgical industry, oxycutting is a much used procedure for cutting common steel by means of the violent combustion of the metal by oxygen; for this, a special torch is used which ensures a flow of additional oxygen at a high pressure.
This torch is called a cutting torch. This said operation is fundamental in the maintenance of machinery and is an indispensable complement in the welder's job.

METHOD OF EXECUTION:

1st Step - *Prepare work-piece, thus:-*

a) Mark the work-piece to be cut.

b) Mark with a centre punch, the contour of the tracing.

c) Place work-piece on the cutting table.

2nd Step - *Prepare equipment, thus:-*

a) Mount the cutting torch.

OBSERVATION

Cutting torches can have nozzles at 90^0 or 75^0.

b) Use a nozzle suitable to the thickness of the material.

OBSERVATION:

The cutting nozzle should be clean; if it is not, use the tip cleaner corresponding to the diameter of the orifices.

c) Regulate the working pressure according to the thickness of the material.

3rd Step - *Ignite the torch, thus:-*

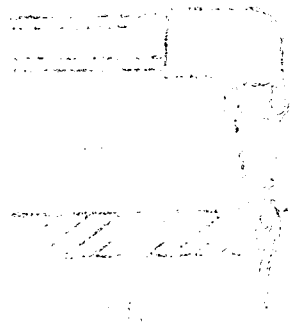
a) Open the acetylene valve.

b) Operate the lighter.

c) Open the oxygen valve until a uniform flame is obtained.

PRECAUTION:

USE THE COMPLETE SAFETY EQUIPMENT.



CBC

TECHNOLOGICAL INFORMATION:

FILES.

This is a manual, high carbon, steel tool, serrated, hardened and tempered (fig. 1). It is used for filing operations.

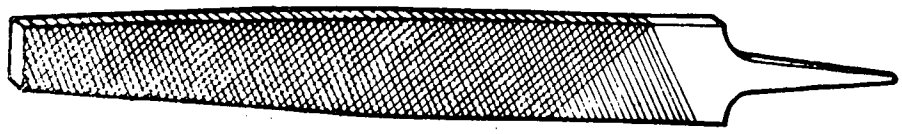


Fig. 1

CLASSIFICATION

Files are classified by their shape, cut and size.

Figures 2 to 9 indicate the most commonly used.

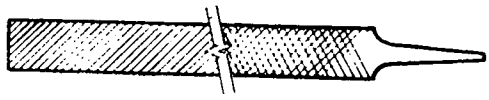


Fig. 2 Flat File

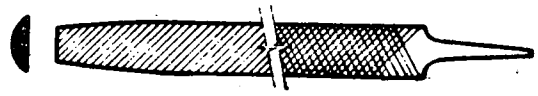


Fig. 6 Half-round File

Fig. 3 Round-edged File

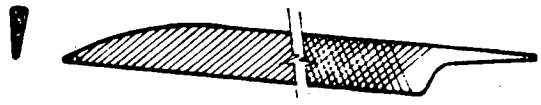


Fig. 7 Knife File

Fig. 4 Square File

Fig. 8 Round File

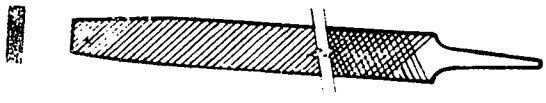


Fig. 5 Flat File with conical point

Fig. 9 Triangular File

TECHNICAL VOCABULARY

Round-edged File - Mill-saw File

Triangular File - Three Square or Three Corner File

CINTERFOR 1st. Edition

Files may be of double or single cut. They are also classified as bastard, smooth and semi-smooth (figs. 10 to 15).

SINGLE CUT

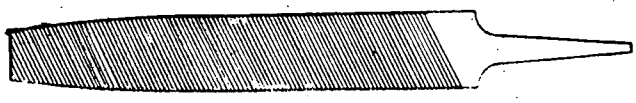


Fig. 10 Smooth File

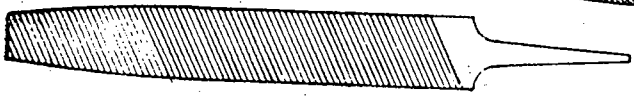


Fig. 11 Semi-smooth File

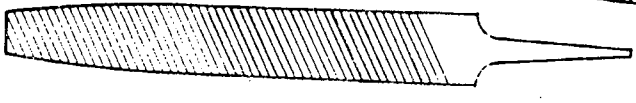


Fig. 12 Bastard File

DOUBLE CUT

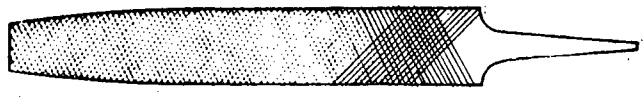


Fig. 13 Smooth File

Fig. 14 Semi-smooth File

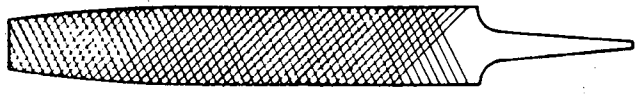


Fig. 15 Bastard File

The most common sizes of file are 100, 150, 200, 250 and 300 mm of body length. (1)

The following table presents the different types of files and their uses.

FILES

CLASSIFICATION	TYPE	APPLICATIONS
WITH REGARD TO SHAPE	FLAT { with conical end / with parallel edges }	Flat Surface Flat internal surfaces which are at right or obtuse angles.
	SQUARE	Flat surfaces at right angles, inner or external grooves.
	ROUND	Concave Surfaces.
	HALF-ROUND	Concave Surfaces.
	TRIANGULAR	Surfaces at an acute angle more than 60 degrees.
	KNIFE	Surfaces at an acute angle less than 60 degrees.
WITH REGARD TO CUTTING	BY ITS INCLINATION { single / double (crossed) }	Non-ferrous metallic materials (aluminium, lead) Ferrous, metallic materials.
	BY THE NUMBER OF TEETH PER CENTIMETRE { Bastards / Semi-smooth / Smooth }	Thick rough dressing Medium rough dressing Finished
SIZE IN mm (LENGTH OF BODY, 1).	100 150 200 250 300	Variable according to the dimensions of the surface to be filed.

CINTERFOR 1st. Edition

CONDITIONS OF USE:

To be safely used and to obtain good results, files must have a handle, be cleaned and in a good cutting condition.

CLEANING:

To clean files a file card must be used and in some cases a soft metal rod (copper or brass) with a flat point.

CARE:

In order to keep the files in good condition, you should:-

1) Avoid knocking.
2) Protect from humidity to avoid corrosion.
3) Avoid contact with one another so that the teeth will not be damaged.

S U M M A R Y:

FILE

- A manual tool for filing
  - is classified with regard to
    - Shape
    - Cutting
    - Size
  - For proper use
    - Good handle
    - Clean
    - Good cutting condition
  - Care
    - Avoid knocking
    - Protect from humidity
    - Avoid contact with one another

CBC

TECHNOLOGICAL INFORMATION:

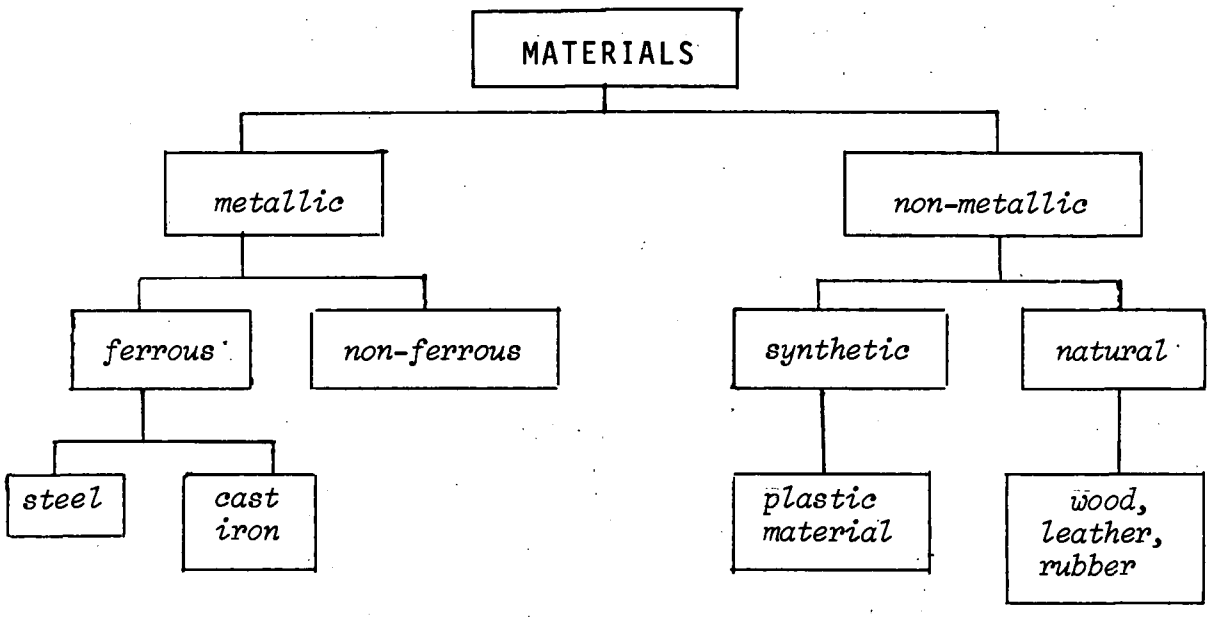
CARBON STEEL (PRELIMINARY IDEAS)

REF TIS. 002 | 1/2

Caribbean

Steel is a *material*

Material Is everything that is used in the making of objects; materials are classified according to the following diagram:-



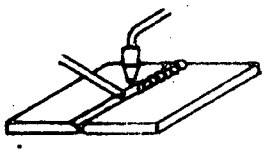
Metals Are materials which possess brilliance, and are generally good conductors of heat and electricity.
Metals can be ferrous or non-ferrous. Ferrous metals are those which contain iron. In this group is steel, which is a metal made up of iron and carbon.

Iron Is a metal found in nature in the form of a mineral.

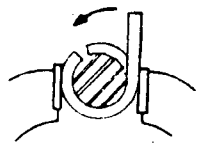
Carbon Is an element also found in nature in large quantities.

The combination of iron and carbon produces *carbon-steel*, where the percentage of carbon varies from 0.05 to 1.5%. This combination is obtained by melting the iron ore jointly with a flux (limestone) in a blast furnace, using coke as fuel.
From this first process pig iron is obtained. It is then taken to other types of furnaces in order to be changed into carbon steel, which has a grey colour.
Steels which contain more than 0.45% carbon can be hardened by a process of heating and rapid cooling. This process is called hardening.
Steels which contain less than 0.45% carbon cannot be tempered, but they can be hard surfaced by means of a treatment called *cementation*.

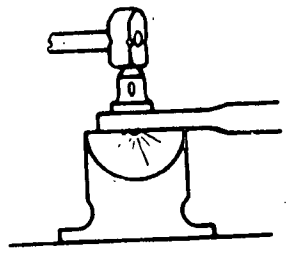
Carbon steel is one of the most important metallic materials used in industry. The majority of the components of machines are made from carbon steel because this material has special mechanical properties. Some of the most important properties are illustrated below:-



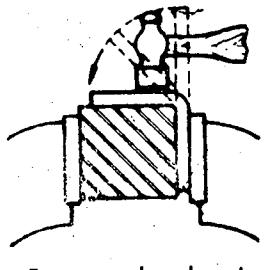
It can be welded.



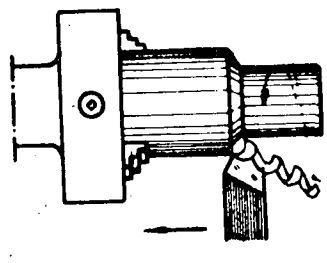
It can be curved.



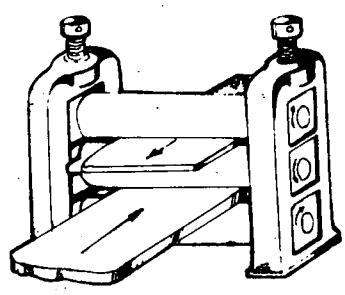
It can be forged.

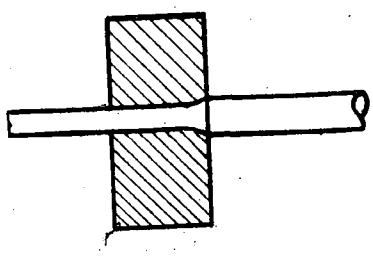


It can be bent.

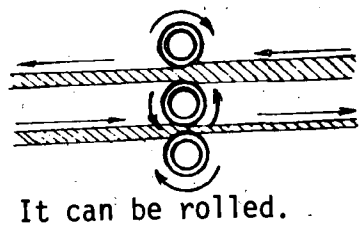


It can be machined.





It can be drawn



It can be rolled.

TECHNICAL VOCABULARY

Cementation - Case Hardening

CBC

TECHNOLOGICAL INFORMATION:

GRADUATED RULER.

This is a graduated steel sheet, generally corrosive resistant. It is used to measure lengths (fig. 1). It is graduated in units of the metric system and/or the English system. It is used for measurements to an accuracy within the smallest graduation of the ruler (fig. 2 and 3).

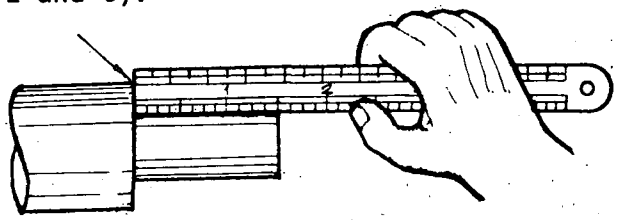


Fig. 2 length measurement with reference face.

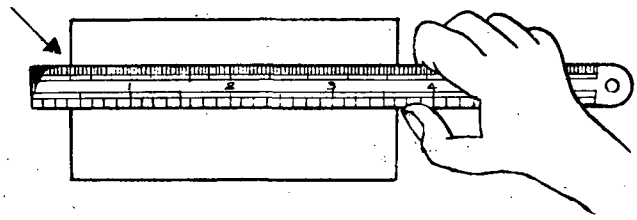


Fig. 3 length measurement without support of reference.

Of variable size, the most common graduated rulers are those of 150mm (6" approximately), and 305mm (12" approximately).

TYPES

Besides the types shown in fig. 1 there are others as shown in figs. 4, 5 and 6.

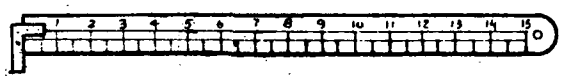


Fig. 4 Graduated ruler with support (end with internal support).

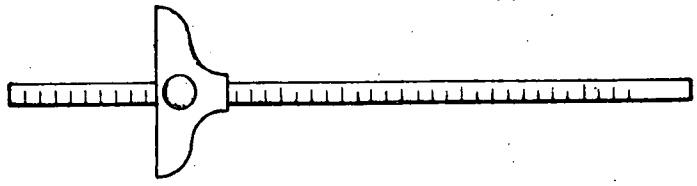
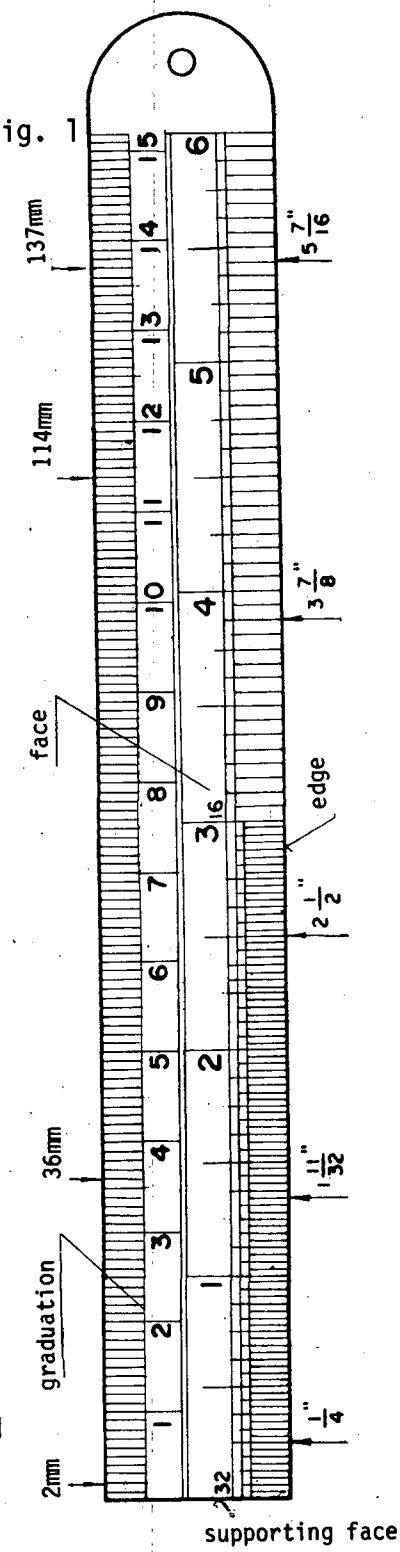


Fig. 5 Depth ruler

Fig. 1



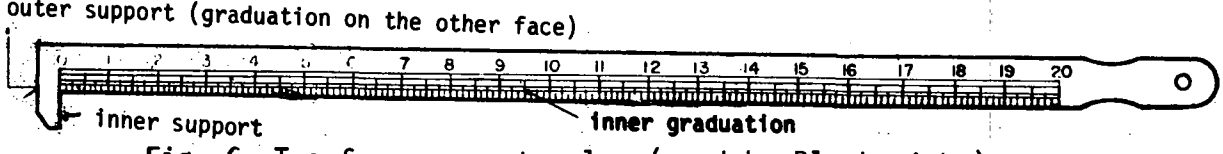


Fig. 6 Two-face support ruler (used by Blacksmiths)

CONDITIONS OF USE:

To ensure accurate measurement, the supporting end of the ruler must be perfectly flat and perpendicular to the edge.

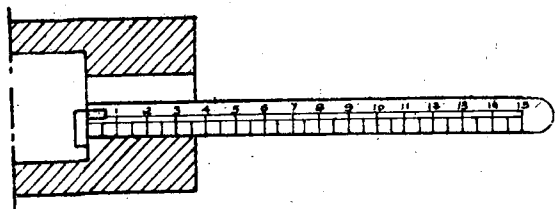


Fig. 7 length measurement with the internal face of reference on the support.

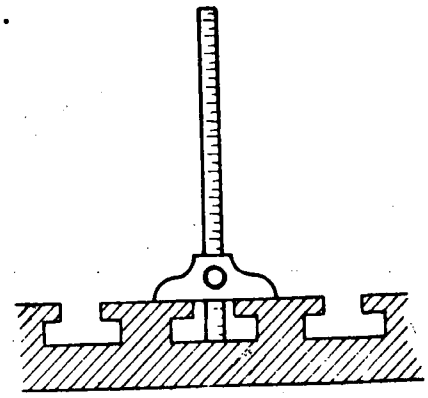


Fig. 8 depth measuring of the slot.

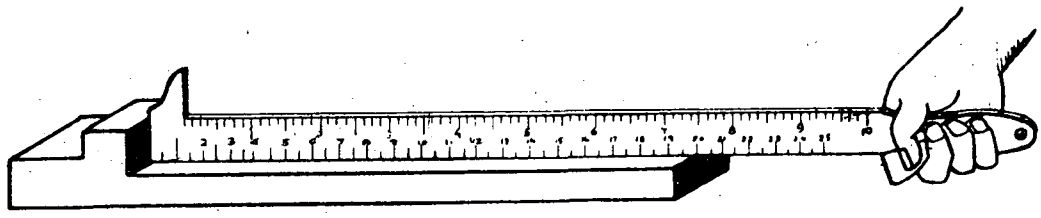


Fig. 9 Measuring from the outer support face.

CARE:

For safeguarding the ruler:

1) Avoid dropping.
2) Avoid bending or twisting it so as to avoid deforming or breaking.
3) Clean it with a rag after use and protect it from corrosion using oil when necessary.

CBC

TECHNOLOGICAL INFORMATION:
MARKING TOOLS. (RULER-SCRIBER-SQUARE)

REF. TIS. 008 | 1/2

Caribbean

These instruments are used only for laying out; that is why they are studied together even though their characteristics are different. They are generally made from carbon steel and the scriber's point is tempered and sharp.

The laying-out ruler has one of its edges bevelled (fig. 1). It is used as a guide for the scriber when tracing straight lines.

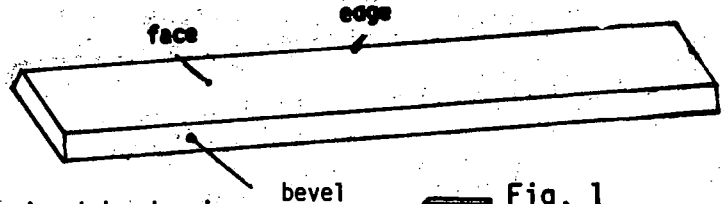


Fig. 1

A square is characterised by having a supporting edge (fig. 2). It acts as a guide for the scriber when tracing perpendicular lines.

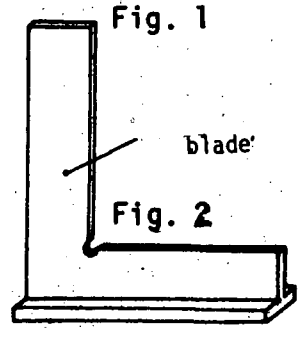


Fig. 2

Fig. 3

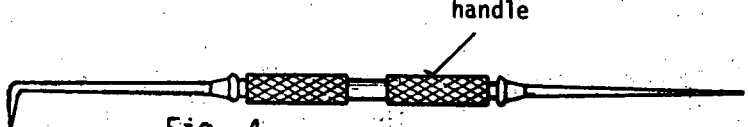


Fig. 4

Scribers generally have a knurled body. They come in different shapes as, for example, those shown in figs. 3 and 4. They are used to mark on materials.

These instruments are manufactured in different sizes. The length of the ruler varies from 150 to 1000mm.
The blade of the square varies from 75 to 2000mm.
The length of the scriber varies from 120 to 150mm.

CARE:

After using them they must be cleaned, lubricated and kept in their proper places, protected against knocking.

OBSERVATION:

When using the scriber it is useful to put a piece of cork or rubber on the end not being used to avoid injury, and to cover the ends to protect them when not in use.

S U M M A R Y

Marking Tool	*ruler*	guide to trace straight lines.
	square	guide to trace perpendicular lines.
	scriber	to mark lines on metal.

Size in millimetres:

ruler	150 to 1000
square	75 to 2000
scriber	120 to 150

CARE:
Clean, lubricate and keep in a proper place to protect against knocks.

CBC

TECHNOLOGICAL INFORMATION:
CENTRE PUNCH.

This is a carbon steel tool with a conical, tempered point, and is generally prismatic (fig. 1) or cylindrically knurled (fig. 2).

It is used to mark points of reference on the work piece and centres on work to be drilled.

Fig. 1

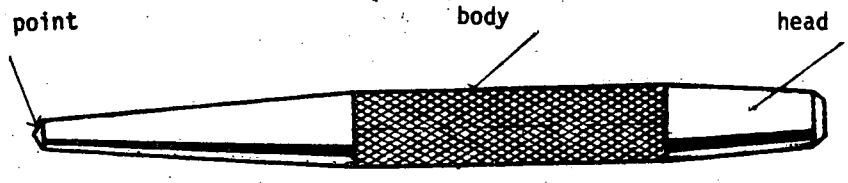


Fig. 2

They are classified by the angle of their points.

By the angle

There are those of 30^0, 60^0, 90^0, 120^0.

The 30^0 ones are used to mark the centre where the tracing compass point rests; the 60^0 ones to mark points of reference (fig. 3)

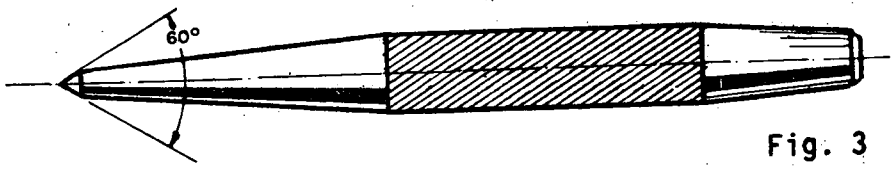


Fig. 3

Those of 90^0 and 120^0 (fig. 4) are used for marking the centre which serves as a guide for centring drills for drilling.

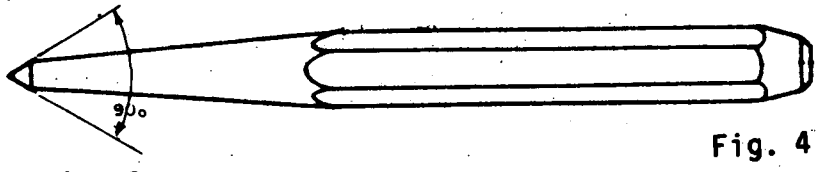


Fig. 4

Its length varies from 100 to 125mm.

Care:

Keep sharp and avoid dropping it.

S U M M A R Y

Centre Punch: A carbon steel tool with a conical, tempered point.

Types

- 30^0 - To mark the supporting centre for a compass.
- 60^0 - To mark places of reference.
- 90^0 and 120^0 - To mark for centring the drills.

Size:- 100 to 125mm

Care

- well sharpened
- avoid dropping

CBC

TECHNOLOGICAL INFORMATION:
SPRING DIVIDERS AND JENNY (OR ODD-LEG) CALLIPERS.

These are carbon steel tools with two legs which open and close at an articulation. The legs may be straight, ending in sharp hardened points (fig. 1), or they may be with one leg straight and another curved (fig. 2).

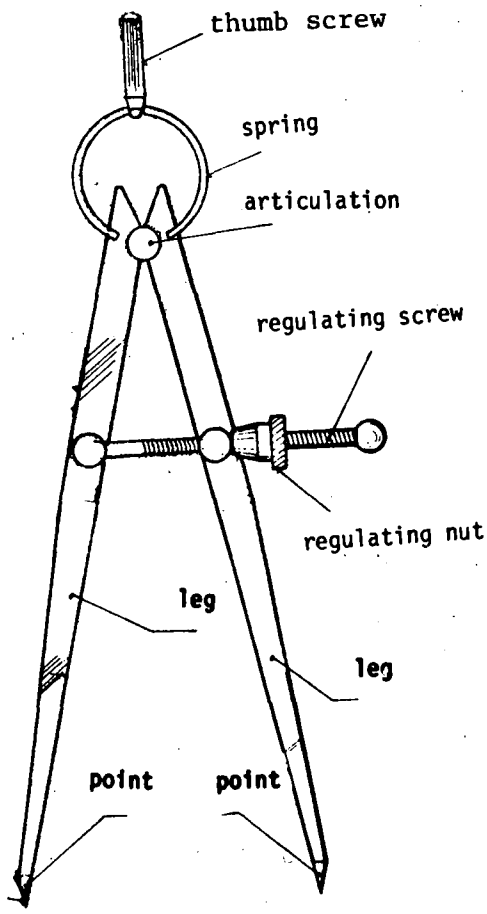


Fig. 1

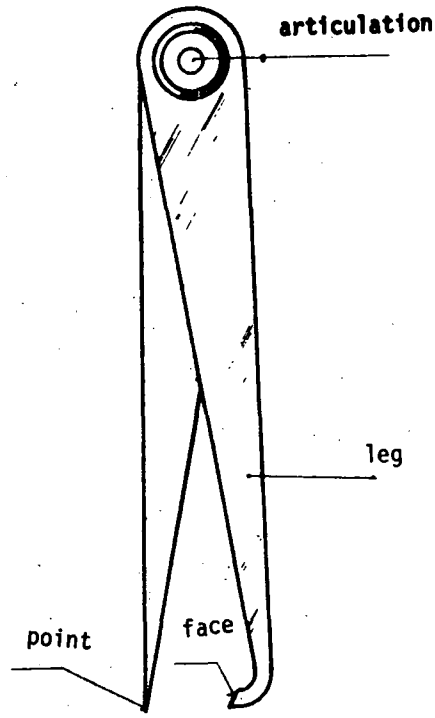


Fig. 2

The compass with straight legs, also called spring dividers, is used to trace circles, arcs and to transfer longitudinal measurements. The one with a curved leg called a jenny calliper or hermaphrodite is used to determine centres or for drawing parallels.
The most common sizes are 100, 150, 200 and 250mm (4", 6", 8", 10" approximately).

CONDITIONS OF USE:

a) The articulation system must be well adjusted;
b) The points must be sharp.

CARE:

a) Protect from knocks and falls;
b) Keep them away from other tools;
c) Clean and lubricate after use;
d) Protect their points with wood or cork.

S U M M A R Y

spring dividers — For tracing arcs; For transferring measurements

Jenny Callipers — To determine centres; To draw parallels

MOST COMMON SIZES :

100, 150, 200 and 250 mm.

CARE:

Well adjusted articulation;
sharp points;
protection against knocks and falls;
protection of points with wood or cork;
cleaning and lubrication.

CBC **TECHNOLOGICAL INFORMATION:**
NON-FERROUS METALS (PURE METALS)

Non-ferrous metals are metallic materials which have no iron content. Among these metals are copper, lead, zinc, tin, aluminium, manganese, magnesium, antimony and their respective alloys.

COPPER Is a non-ferrous metal, red in colour, found in nature in a mineral form.

Properties Copper is a good conductor of heat and electricity. It can be rolled into sheets and drawn or forged. Because of these properties it us used for the manufacturing of cables, vapour pipes, gas lines and sheets.
Its use is fundamental in non-ferrous alloys.
Because copper is very soft, the cutting tools must have polished surfaces to avoid the residue adhering.
For some jobs, this metal can be hardened by means of hammering; it can be softened by means of heating and immediately quenching it in water. Copper can also be used for the coating of some pieces which are submitted to galvanic processes (nickel, chrome and others).

Commercial Forms Copper is made into bars, square, rectangular, round and of other profiles. The rounded ones can be hollow (pipes) or solid (wires and cables). Copper is used most frequently in industry in the form of cables, sheets and rectangular bars of different dimensions.
In manufacturing copper tubing, standard dimensions of the inner diameter and the thickness of the wall are given according to the following table:-

Inner Diameter of the tube (mm)	Thickness of the wall (mm)					
10 to 15	1	1.5	2	-	-	-
20 to 55	1	1.5	2	2.5	-	-
60 to 120	1	1.5	2	2.5	3	4
130 to 140	-	-	-	2.5	3	4
150 to 180	-	-	-	-	3	4

LEAD Is a non-ferrous metallic material, very soft and has a bluish gray colour. It is used for protective clamps, joints, pipes, coating of electric conductors, storage tanks for acids, bushings and alloys with other metals.

Properties Lead can be made into sheets, wires and pipes. Sheets are generally made into 34 different thicknesses; they vary from 0.1 to 12 mm with a width up to 3 m and a length up to 10 m.

Lead is not resistant to wear.

After working with lead it is necessary to wash hands properly, because particles can enter the body causing poison. It is recommended to work in well ventilated places when in contact with vapours or lead dust. Lead can be easily worked, nevertheless, when filing it may present some difficulty because it adheres to the file's cutting surfaces.

ZINC is a bluish white metal, shining when broken, but darkening rapidly on contact with the air.

Properties Zinc is resistant to detergents and to the weather. It reacts to ammonia; therefore it can be cleaned with this liquid.

Zinc is affected by acids and salts. This material is not suitable for storing food which contains salt.

Zinc can be shaped into wire, sheets, bars and pipes: it is used for the construction of canals and ducts (for rainfall), in the coating of steel (galvanized), and in alloys with other metals.

TIN Is a bright metal of light silver colour. It is used to weld storage tanks, steel sheets, tin foil and also in alloys with other metals.

Properties It adheres very well to steel, copper and other similar metals.

It is easily fused and alloyed with other metals, improving their properties.

Tin can be shaped into sheets, bars, pipes and wires.

Pure tin is rarely used to make machine parts because of its low mechanical properties. It is not affected by the weather or acids.

ALUMINIUM Is a non-ferrous material, very soft and light. Its colour is silvery white.

Properties

It is corrosion resistant on contact with air.
It is a good conductor of heat and electricity.
It is easily alloyed with other metals.
It is of low resistance and a low degree of hardness.
It can be machined at high speeds.
It is easily damaged by knocks and scratches.
It can be easily rolled, drawn, stretched, folded, hammered, embossed, pressed and deeply stamped.
Because of the already mentioned properties, aluminium is used for:
Sheet-metal containers;
plates for lining;
embossed work;
stamping and forging;
tubings, electrical conductors;
making alloys with other metals.

MAGNESIUM Is a non-ferrous metallic material. Its colour is silver white.

Properties Pure magnesium cannot be used for constructions. It is good for using as an alloying element. It is very corrosive resistant.
Because of these properties magnesium is used in alloys with other metals and in fire-work displays.

ANTIMONY Is a non-ferrous metallic material, gray in colour, similar to lead.

Properties Pure antimony cannot be used on constructions. It is good for use as an alloying material. It has good mechanical properties.

MANGANESE Is a non-ferrous metallic material, reddish yellow in colour.

Properties Pure manganese cannot be used on metallic constructions.
It is good for alloys.

SUMMARY

METALS	PROPERTIES	APPLICATIONS
COPPER (soft; red colour)	Good conductor of heat and electricity. Can be laminated, drawn and forged. Can be hardened and softened.	Electric cables. Gas and steam pipes. Alloyed with other metals. Coating of work (galvanoplastics).
LEAD (soft; gray blue colour)	Not resistant to scratches. Causes poisoning. Difficult to file.	Clamps. Joints. Pipes. Coating for electric conductors. Storage tanks for acids. Alloys with other metals.
ZINC (bluish white metal; shines on breaking)	Darkens on contact with air. Resistant to detergents and to the weather. Reacts to ammonia. Is affected by acids and salts.	Canals and ducts (gutters) Coating for steel (galvanize). Alloys with other metals.
TIN (bright metal of silver colour)	Adheres well to steel, copper and similar metals. Easily melted and alloyed. Poor mechanical properties. Is not affected by weather or acids.	Welding. Alloyed with other metals.
ALUMINIUM (soft, light; silver white in colour)	Corrosion resistant when in contact with air. Good conductor of heat and electricity. Low mechanical properties and low degree of hardness. Can be machined at high speeds. It can be drawn, rolled, stretched, hammered, embossed, pressed and stamped.	Sheet metal containers. Plates for lining. Embossed work. Stamping. Pipes and conductors. Alloys with other metals.
MAGNESIUM (silver white)	Cannot be used pure for constructions. Very resistant to corrosion.	Alloys with other metals. Fire-works.
ANTIMONY (gray colour similar to lead)	Cannot be used pure for constructions. Good mechanical properties.	Alloys with other metals.
MANGANESE	Cannot be used pure for constructions. Shock resistant.	Alloys with other metals.

CBC

TECHNOLOGICAL INFORMATION:
HAMMER AND MALLET

The HAMMER is a tool of impact, consisting of a carbon steel block with a wooden handle. The part with which the hammering is done is tempered. The hammer is used in the majority of industrial activities, such as: mechanics in general, civil engineering, construction and the like. The hammer is characterized by its shape and weight.

By its shape:

ball-peen hammer (fig. 1).

peen hammers (figs. 2, 3 and 4)

These are the most common types used in mechanic shops.

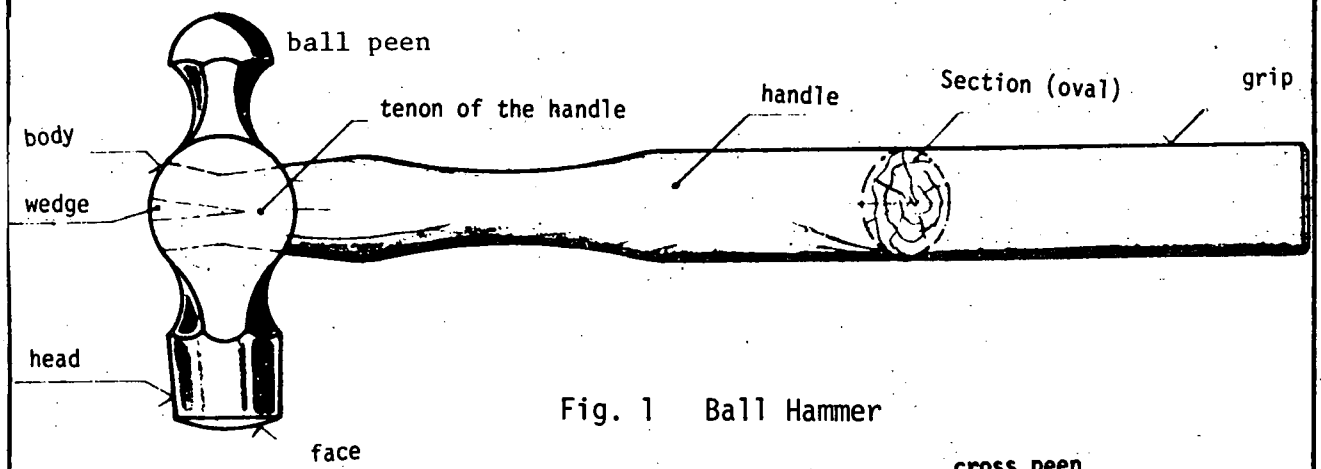


Fig. 1 Ball Hammer

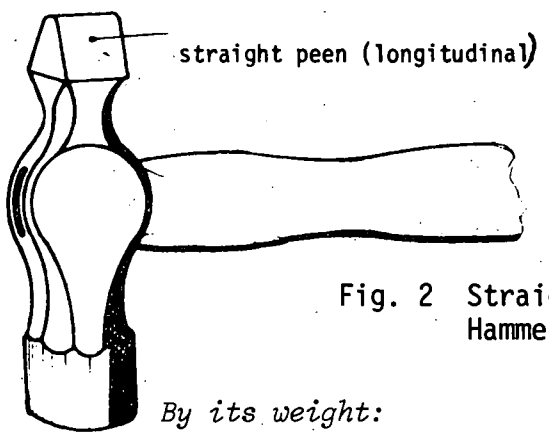


Fig. 2 Straight Peen Hammer

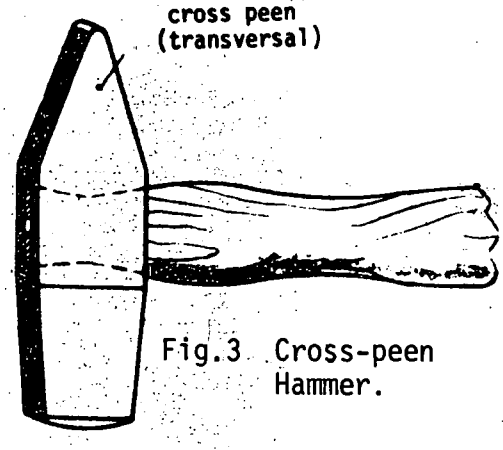


Fig.3 Cross-peen Hammer.

By its weight:

The weight varies between 200 to 1000 grammes.

Conditions of use:

A hammer to be used must have the handle in good condition and well fitted at the wedge.

Care:

Avoid hammering with the handle and do not use it as a lever.

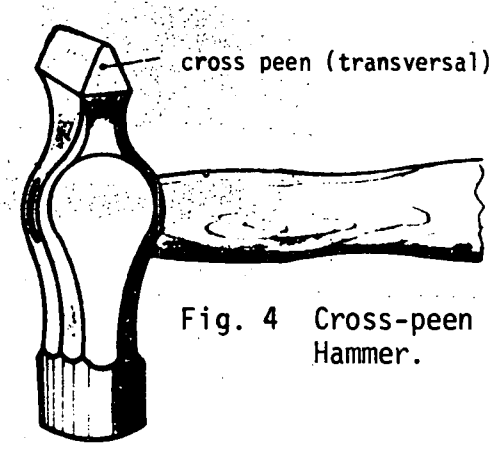


Fig. 4 Cross-peen Hammer.

The MALLET is a tool of impact, made up of a head of wood, aluminium, plastic, copper, lead or leather, and a wooden handle (figs. 5, 6 and 7).

It is used to strike on work or materials whose surfaces must not be deformed by the effects of the blows. Plastic or copper heads can be replaced when worn (fig. 6).

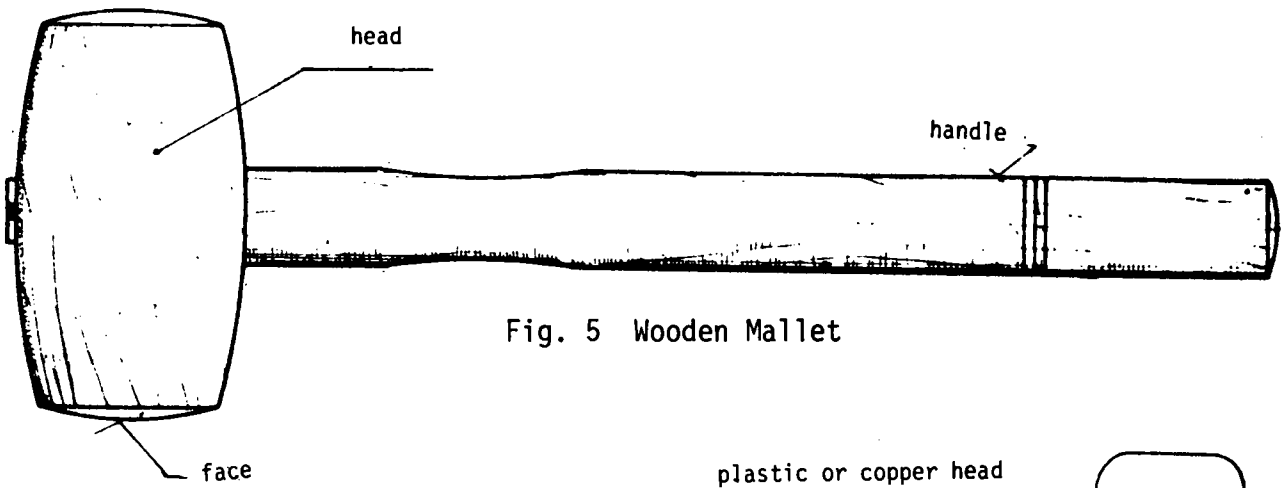


Fig. 5 Wooden Mallet

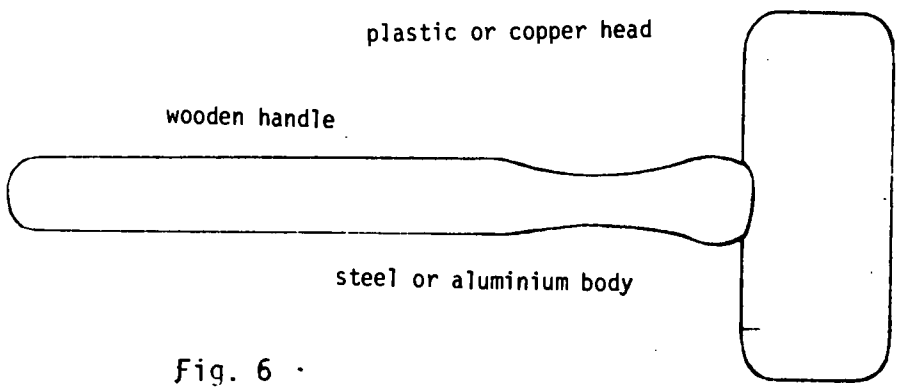


Fig. 6

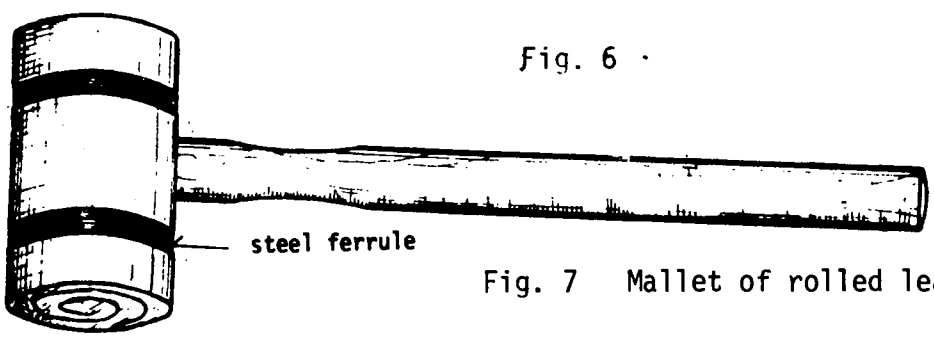


Fig. 7 Mallet of rolled leather

Conditions of use:

a) The mallet head must be well fitted into the handle free from burrs.

b) It must be used only on smooth surfaces.

TECHNICAL VOCABULARY

- Mallet of Rolled Leather — Hide-faced Mallet; raw-hide mallet

CBC

TECHNOLOGICAL INFORMATION:
DEVICES FOR CLAMPING WORK
(CLAMPS AND C-CLAMPS)

These are carbon steel or cast steel elements. They are used for fixing workpieces on tables, or plates of machinery.

Characteristics of clamping devices:- Clamping devices are generally made of carbon steel or cast steel with a central slot to accommodate a screw which complements the clamp in fixing the workpieces. Figures 1, 2 and 3 show the most common types of clamps.

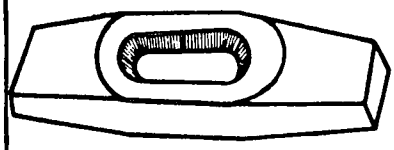


Fig. 1

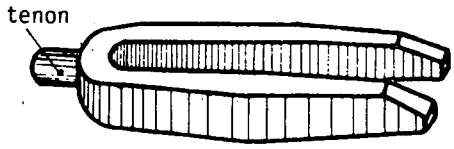


Fig. 2

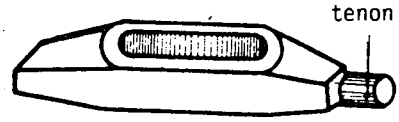


Fig. 3

The clamp is only for fixing the workpieces on to the table or machine accessories.

Types and characteristics of 'C' and 'U' clamps:- 'C' and 'U' clamps are characterized by having a screw which is tightened manually, and are used as auxiliary elements for holding workpieces (figs. 4 and 5).

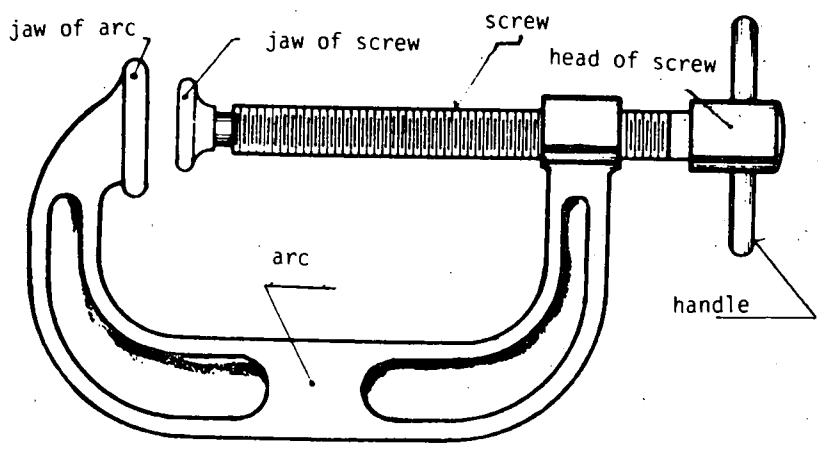


Fig. 4

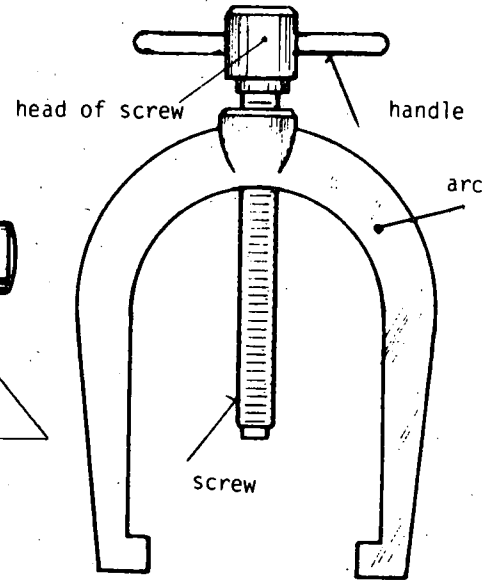


Fig. 5

These types of clamps are manufactured of cast steel. The 'C' clamps besides holding workpieces on the table are also used for holding together many pieces of material on which the same operation is going to be done.

There are clamps which are operated by two screws; these are called parallel clamps (fig. 6).
The proper handling of the two screws keeps the faces of the two jaws parallel thus producing a better grip.

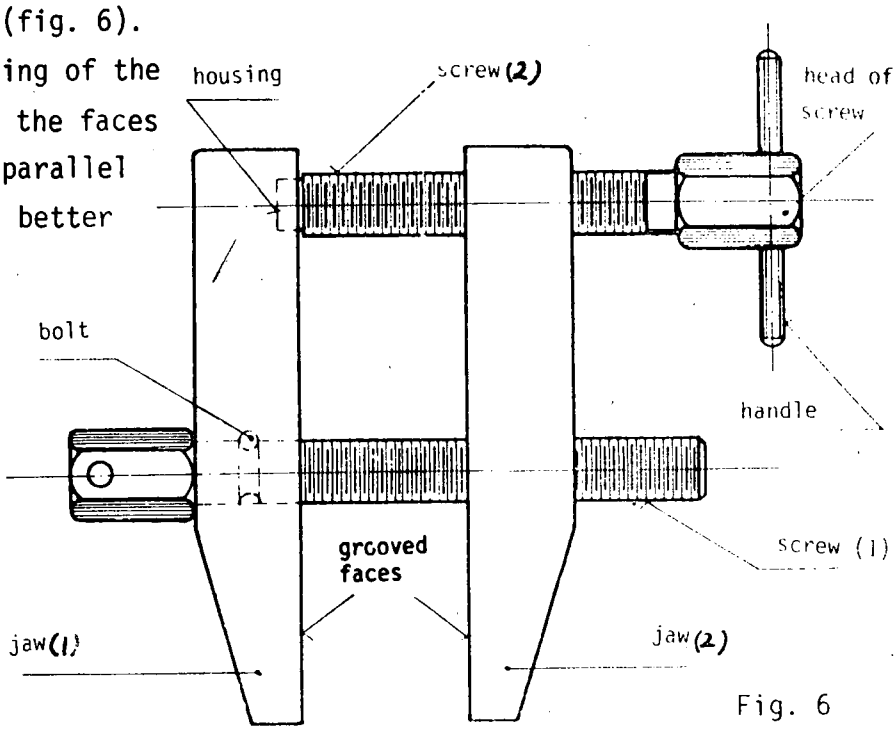


Fig. 6

Conditions of use: The screw threads of the clamp must be cleaned and lubricated. The tightening surfaces must be without burrs.

Care:

The tightening must be done manually and must not be done in excess. After use it must be cleaned and kept in a suitable place to protect it against knocks.

CBC

TECHNOLOGICAL INFORMATION:

HACKSAW

REF. TIS. 028 | 1/2

Caribbean

It is a manual tool consisting of a steel arch on which a saw is mounted (blades may be of high speed or carbon steels indented and tempered). The blade has perforations at its ends for fixing on to the arch by means of pins placed at the supports. The frame has a fixed support, and an adjustable one which is cylindrical and threaded, carrying a butterfly nut to tighten the blade (fig. 1).

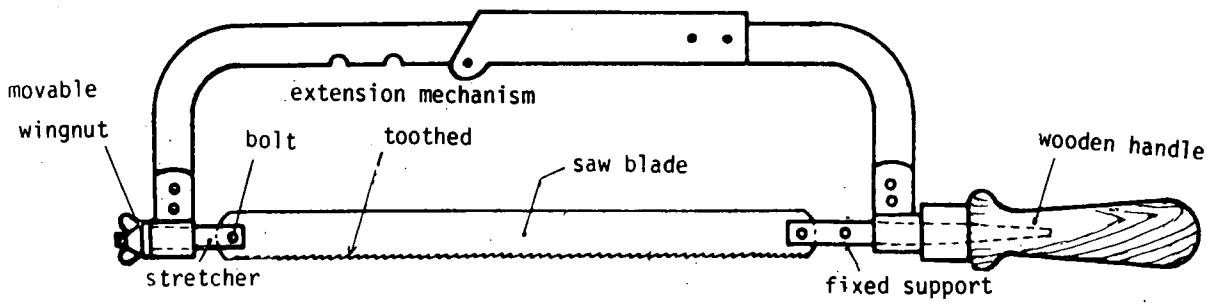


Fig. 1

The hacksaw is used to cut materials and to make or begin grooves.

Characteristics and Structure:

The arch of the saw is characteristic because it can be regulated and adjusted according to the length of the blade.
It has a screw with a wing nut which tightens the saw blade. For its manipulation it is equipped with a handle made of wood, plastic or fibre.
The blade is characterized by : Its length, which commonly measures 8", 10" or 12" from centre to centre of the holes; by the width, which is generally of ½"; by the number of teeth per inch, which is generally of 18, 24 or 32t/1" (fig. 2).

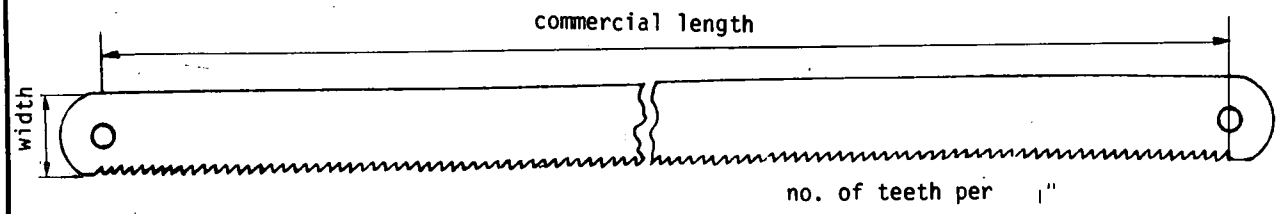


Fig. 2

The saw has set teeth, which are lateral displacements of the teeth in an alternated manner as shown in fig. 3 to 7.

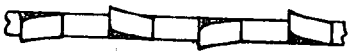


Fig. 3

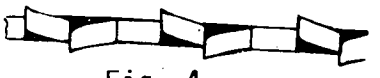


Fig. 4

Fig. 5

Fig. 6

Choosing of blade:

The blade is chosen according to:
1- The thickness of the material which must not be less than two pitches of the teeth (fig. 8).
2- The type of material, choosing those of a small pitch (p) for hard materials.

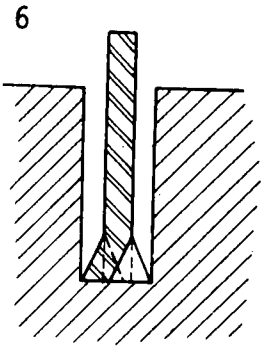


Fig. 7

Conditions of use:
The tension of the blade must be given only by hand; a wrench must not be used.
When the work is finished the blade must be loosened.

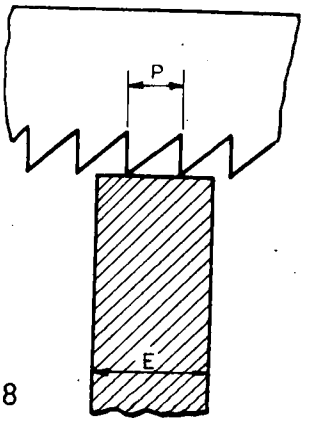


Fig. 8

S U M M A R Y

Saw | *arch* - carbon steel
tempered, toothed blade - high speed steel or carbon steel.
handle - wood, plastic or fibre.

Characteristics:
Length - width - number of teeth per inch

Selection: According to the thickness of the material (more than 2 pitches of the teeth); according to the type of the material (large number of teeth for hard materials).

CBC

TECHNOLOGICAL INFORMATION:

COLD CHISELS

They are cutting tools with bodies made of steel with a circular, rectangular, hexagonal or octagonal section. It has a forged end with a wedge-like tip (figs. 1, 2 and 3) tempered and conveniently sharpened, the other end being bevelled or rounded called the head.

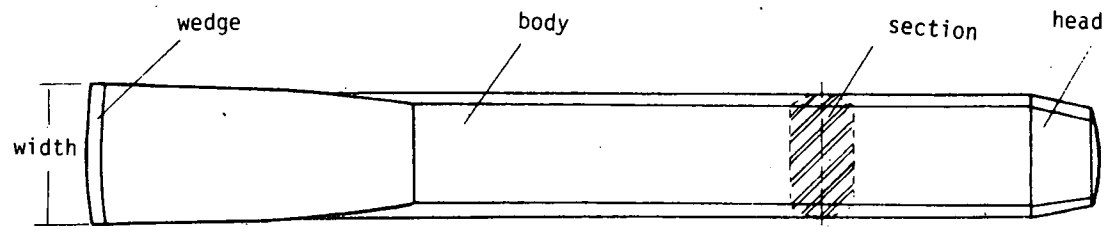


Fig. 1 Flat Cold Chisel

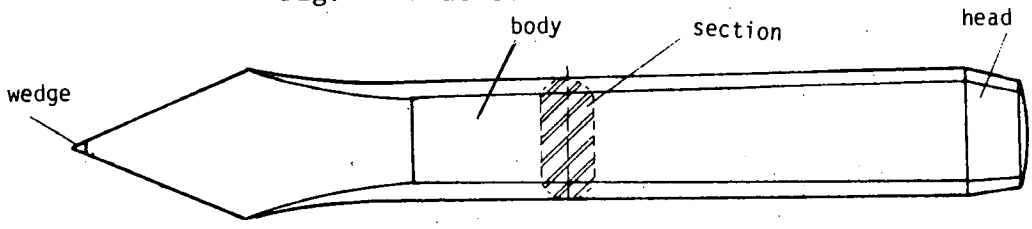


Fig. 2 Cross-cut Cold Chisel (front view)

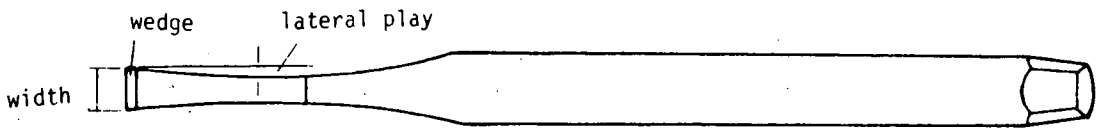


Fig. 3 Cross-cut Cold Chisel (side view)

The bevel of the wedge can be symmetrical (fig. 4) or assymetric (fig. 5). Cold chisels are used to cut sheets (fig. 6) to take off excess material (fig. 7) to open grooves (fig. 8), The most common sizes are between 150 and 180 mm in length.

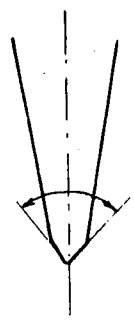


Fig. 4

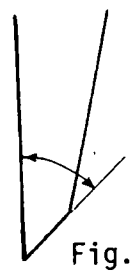
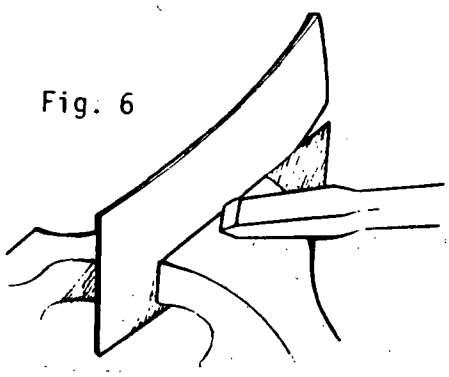


Fig. 5

The cutting edge must be slightly convex (fig. 9) and the wedge angle (b) shown in fig. 10 varies with the material to be worked.

Fig. 6



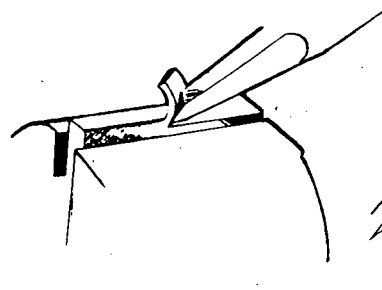


Fig. 7

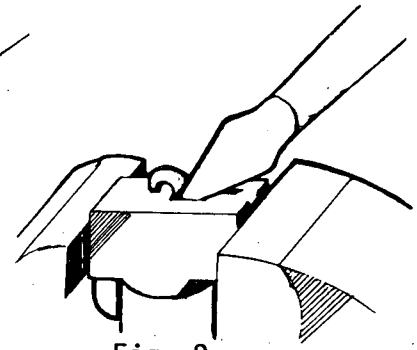


Fig. 8

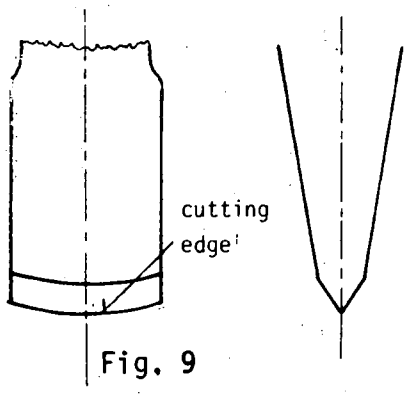


Fig. 9

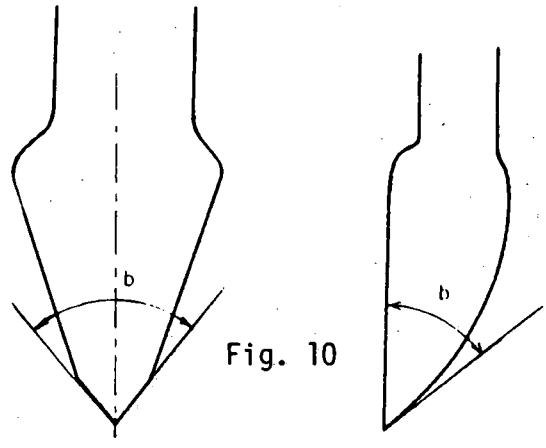


Fig. 10

The head of these tools is chamfered and tempered in order to avoid the formation of burrs. This temper must be softer than the one of the wedge so that the part which gets the blows does not fragment.

Figs. 11 and 12 show another type of cold chisel.

Wedge Angles (b)

Wedge	Material
50°	Copper
60°	Mild steel
65°	Hard steel
70°	Cast iron and hard cast bronze

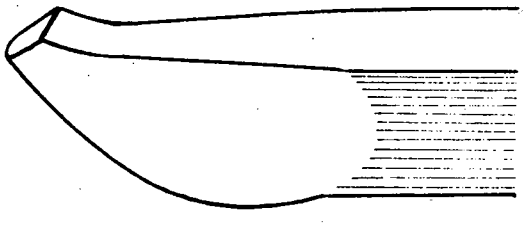


Fig. 11

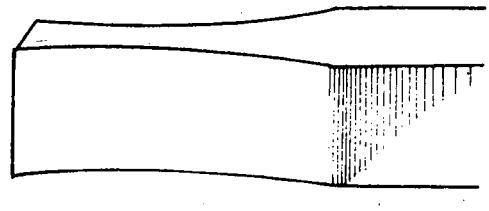


Fig. 12

Conditions of use:

For good cutting, this tool must have a proper angle on the wedge and it must be well tempered and sharp.

S U M M A R Y

Cold Chisels:

Are cutting tools made of steel.

Are used for cutting sheets, opening grooves and taking off excess material.

Their length varies between 150 and 180 mm.

Their wedge angles vary according to the material to be cut.

The cutting edge must be convex.

They must have their heads slightly tempered to avoid burrs and fragmentation.

The wedge must be tempered and sharp to cut properly.

CBC **TECHNOLOGICAL INFORMATION:** GRINDERS | **REF.** TIS.030 | 1/4

Caribbean

These are machines in which the operator grinds work, principally, in the sharpening of tools.

CONSTITUTION

It is composed, generally of an electric motor, on the ends of which are attached two emery stones: one, made of coarse grain, serves to trim the work and the other, of fine grain, for finishing tool edges.

USUAL TYPES

Pedestal Grinder (fig. 1).

It is used in common rough-cutting and in the sharpening of manual and machine tools in general. The power of the standard electric motor is 1 H.P., with 1450 to 1750 RPM.

OBSERVATION

There are pedestal grinders with 4 H.P. motor power. They are used principally for coarse hewing and for trimming castings.

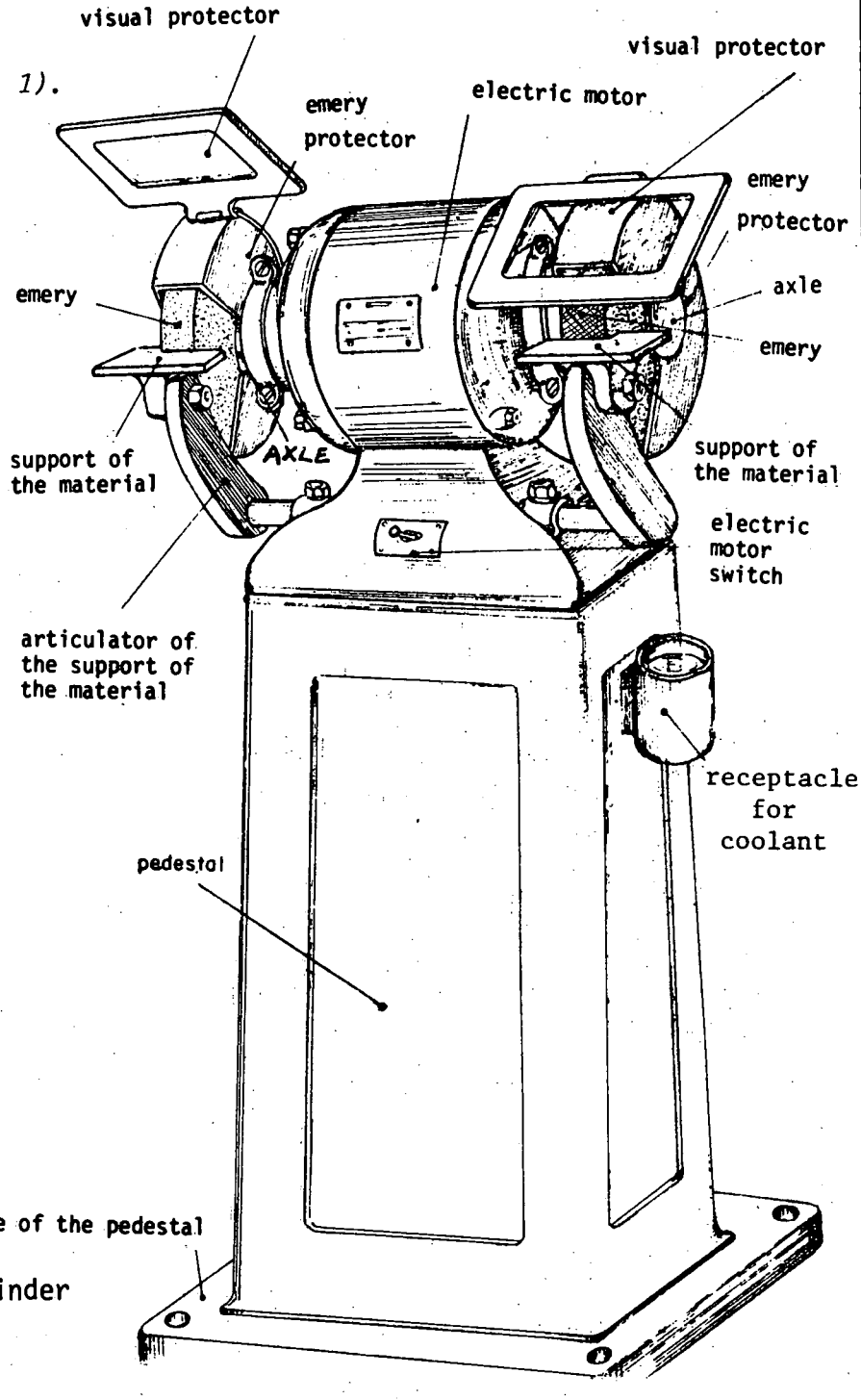


Fig. 1 Pedestal Grinder

Parts of the pedestal grinder

a) *Pedestal* - A grey cast iron structure which serves as a support and enables the fastening of the electric motor.

b) *Electric Motor* - which rotates the emery stone.

c) *Stone Protector* - It accumulates the particles loosened from the emery or, when it breaks, prevents the pieces from causing accidents.

d) *Work Support* - It may be fastened at an appropriate angle, the important thing is to maintain, as the diameter of the stone diminishes, some clearance (from 1 - 2 mm) so as to prevent small parts from getting in between the stone and the support.

e) *Visual Protector* - Indicated in Fig. 1. It is the most practical for work in general.

f) *Coolant Container* - Used to cool the tools made of tempered steel, preventing the heat produced by the friction between the tool and the emery stone from reducing the resistance of the cutting edge, in case they are annealed.

Bench Grinder (fig. 2).

It is fastened to the bench and its electric motor has ¼ to ½ H.P. power with 1450 to 2800 R.P.M.

It is used for finishing and resharpening the cutting edge of the tools. In Fig. 3 we have a bench grinder for sharpening metallic-carbide tools.

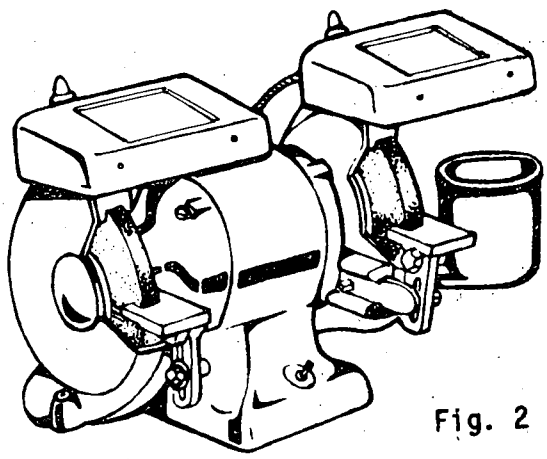


Fig. 2

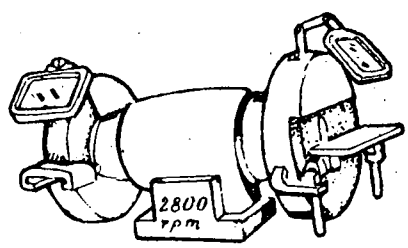


Fig. 3

CONDITIONS FOR USE

Grinders and other related machines are the ones that cause most accidents. To avoid this, it is recommended that these points be observed:

a - When the emery stone is mounted on the motor axle, the revolutions indicated on the stone should co-incide with or be a little greater than that of the motor;
b - On fastening the emery stone, the hole should be exact and be perpendicular to the flat face;
c - The curved surface of the stone should remain concentric with the motor axle. If this is not the case, on turning on the motor, vibrations and undulations would be experienced by the work.

In order to dress the grinding wheels, various types of special dressers are used:
a - Dressers with tempered steel cutters, with angular shaped grooves (star-faced, fig. 4 or undulated fig. 5); Fig. 6 shows the correct position for the dresser to even off the surface of the grinding-wheel..

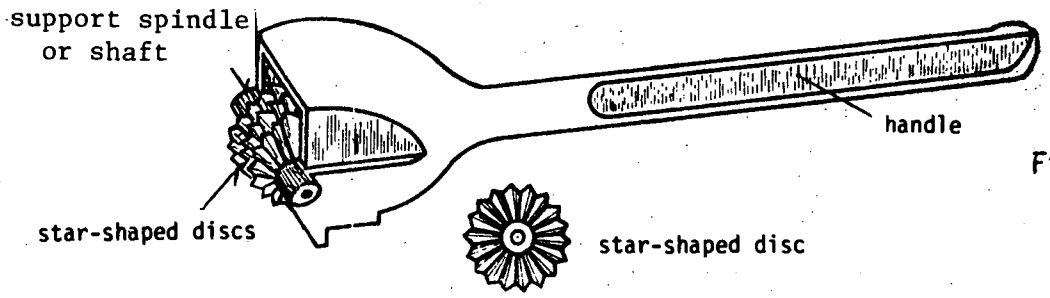


Fig. 4

Fig. 5

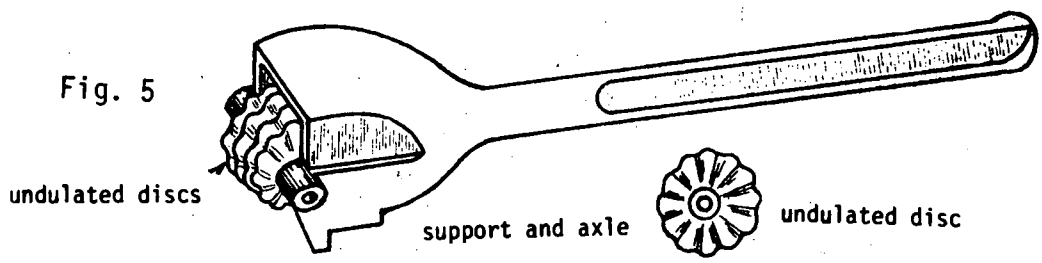
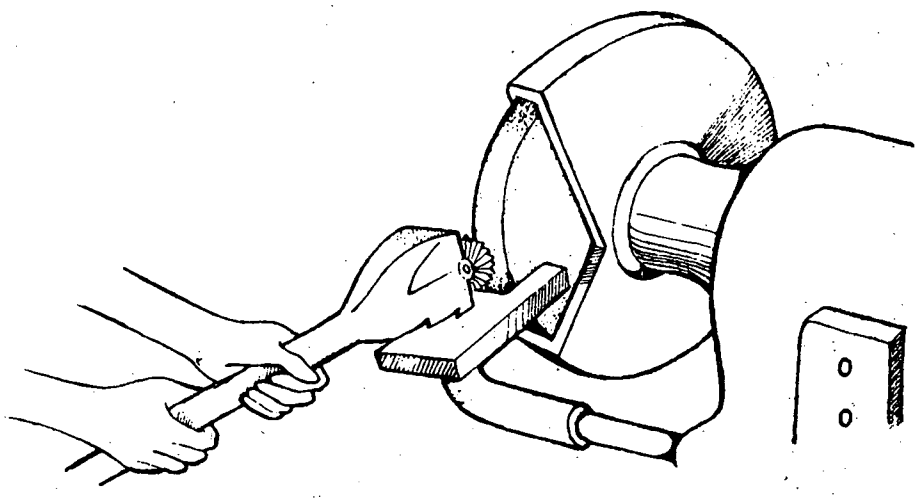


Fig. 6



b - abrasive rod dresser (fig. 7.

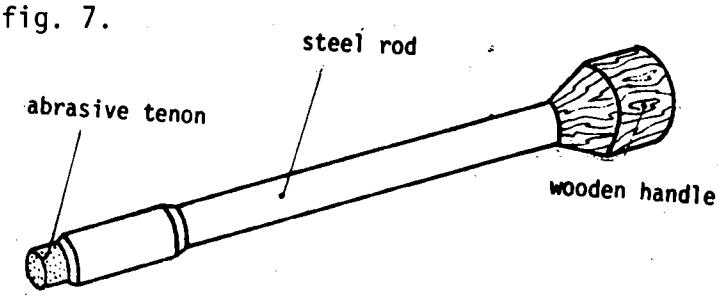


Fig. 7

c - emery wheel dresser with a diamond tip (fig. 8). It is often used in the dressing the wheels on the grinding machine. It is also used in fine grain emery stones of the bench grinders. Figs. 9, and 10, demonstrate the correct position for machining the diameter of the emery stone. The cuts should be very fine and the size of the diamond should always be greater than the grain of the crushed emery stone so as to prevent it from being rooted out from the support.

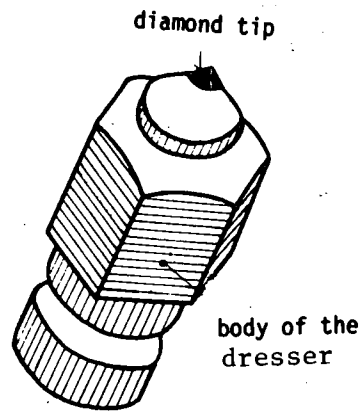


Fig. 8

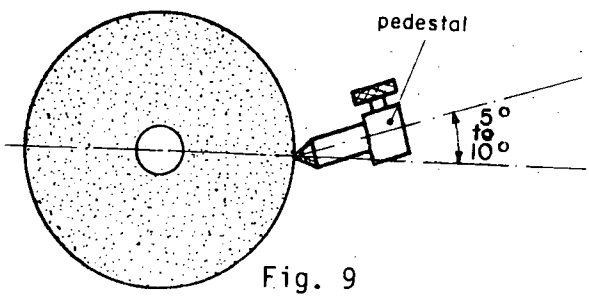


Fig. 9

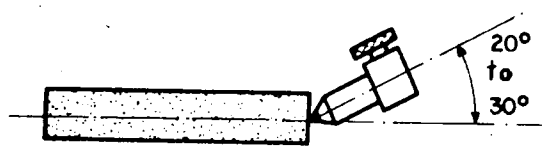


Fig. 10

These are ferrous elements made by the fusion of steel with other elements such as:

Nickel (Ni)
Chromium (Cr)
Manganese (Mn)
Tungsten (W)
Molybdenum (Mo)
Vanadium (Va)
Silicon (Si)
Cobalt (Co)
Aluminium (Al)

Steel alloys are used to manufacture parts and tools which depending on their use, require in their composition the presence of one or several of the above mentioned elements. The resulting alloy receives the name of the element or elements, as the case may be, that compose it. Each one of these elements gives the following properties to the steel.

NICKEL (Ni)

This is one of the first metals to be used successfully in rendering certain qualities to steel. Nickel increases its resistance and toughness, raises its limit of elasticity, makes it a good conductor and increases its resistance to corrosion. Nickel steel contains 2 to 5% Ni and 0.1 to 0.5% carbon. The percentages 12 to 21% Ni and 0.1% carbon produce stainless steels which are very hard and resistant.

CHROMIUM (Cr)

It also renders to the steel high resistance, hardness, high elasticity limit and good resistance to corrosion.
Chromium steel contains 0.5 to 2% chromium and 0.1 to 1.5% C.
The special chromium-steel (stainless type) contains 11 to 17% Chromium.

MANGANESE (Mn)

Steels with 1.5 to 5% manganese are brittle. Manganese, nevertheless, when added in correct quantities, increases the resistance of steel to wear and shock, maintaining its ductilty.

Manganese steel usually contains 11 to 14% Mn and 0.8 to 1.5% carbon.

TUNGSTEN (W)

It is generally added to steels with other elements. Tungsten increases hardness, the breaking point, limit of elasticity and resistance to heat.
Steels with 3 to 18% W and 0.2 to 1.5% C are very resistant.

MOLYBDENUM (Mo)

Its effect on steel is similar to that of tungsten. It is used generally, added to chromium, to produce chrome-molybdenum steel of great stress, especially under repeated stress.

VANADIUM (Va)

It improves, in steels, the resistance to tension, without loss in ductility, and elevates the limits of elasticity and fatigue. Chrome-vanadium steels generally contain, 0.5 to 1.5% Cr. 0.15 to 3% Va and 0.13 to 1.1% C.

SILICON (Si)

Increases the elasticity and resistance of steels. Silicon steels contain 1 to 2% Si and 0.1 to 0.4% C. Silicon has the property of insulating or suppressing magnetism.

COBALT (Co)

It favourably influences the magnetic properties of steels. Besides, cobalt associated with tungsten increases the resistance of steels to heat.

ALUMINIUM (Al)

It deoxidizes steel. In the thermo-chemical treatment process called nitriding, it is confined with nitrogen to aid in forming a very hard superficial layer.

TYPE OF STEEL ALLOY	PERCENTAGE OF ADDITION	CHARACTERISTICS OF THE STEEL	INDUSTRIAL USE
NICKEL STEELS	1 to 10% Ni	Good resistance to breakage and shock when tempered and annealed.	Automobile parts Machine tool parts
	10 to 20% Ni	Good resistance to tension. Very hard Temperable in air jets.	Boat armour - axles Brake rods - projectiles
	20 to 50% Ni	Stainless Resistant to breakage Electrically resistant	Thermal motor valves Electrical resistors Knives - measuring instruments
CHROMIUM STEEL	Up to 6% Cr.	Good resistance to breakage. Hard. Not resistant to shock	Bearings. Tools. Projectiles. Armour
	11 to 17% Cr.	Stainless	Measuring devices and instruments. Knives.
	20 to 30% Cr.	Rust resistant	For internal combustion engines. Gauges - moulds.
CHROMIUM NICKEL STEEL	0.5 to 1.5% Cr. 1.5 to 5% Ni.	Great resistance and hardness. Very resistant to shock, torsion and bending.	Crankshaft - gears Axles - High speed motor parts - connecting rods.
	8 to 25% Cr. 18 to 25% Ni	Stainless. Resistant to the effect of heat, Resistant to corrosion by chemical elements.	Oven doors - retorts. Lines for salt water and gas, pump shafts, valves - turbines.
MANGANESE	7 to 20% Mn.	Extreme hardness. Great resistance to shock and wear.	Jaw crushers - valve rods in general. Needles. Rail crossings and curves. Dragline outfit parts.

TYPE OF STEEL ALLOY	PERCENTAGE OF ADDITION	CHARACTERISTIC OF THE STEEL	INDUSTRIAL USE
SILICON STEEL	1 to 3% Si	Resistance to breakage High unit of elasticity. Property of suppressing magnetism.	Springs - electric machine armature sheets. Electrical bobbins.
SILICON MANGANESE STEEL	1% Si 1% Mn	Great resistance to breakage. High limit of elasticity.	Various springs. Vehicle springs. Automobiles.
TUNGSTEN STEEL	1 to 9%	Hardness - resistance to breakage - Resistant to heat from abrasion. Magnetic properties.	High-speed cutting tools Moulds Manufacture of magnets.
MOLYBDENUM STEELS AND VANADIUM STEELS		Hardness - resistance to breakage. Resistant to heat from abrasion.	Simple molybdenum and vanadium steels are not common. They are compounded with other elements.
COBALT STEEL	(Co)	Magnetic properties Hardness - resistance to breakage. High resistance to abrasion.	Permanent magnets. Armature sheets. Simple, Cobalt steel is not common.
HIGH-SPEED STEEL	8 to 20% W 1 to 5% Va Up to 8% Mo 3 to 4% Cr.	Exceptional hardness. Resistance to cutting, even with the hot tool due to high speed. The high-speed steel tool, can machine very hard manganese steel.	All types of cutting tools for high-speeds. Rolling mill cylinders. Moulds Gauges Punches
ALUMINIUM CHROMIUM STEEL	0.85 to 1.20% Al 0.9 to 1.8% Cr.	Facilitates great superficial hardness through nitriding treatment. (Thermo-chemical)	Internal combustion motor parts. Crankshafts. Axles. Gauges for measuring fixed dimensions.

CBC **TECHNOLOGICAL INFORMATION:** TIGHTENING TOOLS | **REF.** TIS.058 | 1/2

Caribbean

These are tools generally made of wrought and tempered steel. The material commonly used is vanadium steels or (extra hard) chrome steel.
They are used to tighten or loosen nuts or screws manually. They are characterized by their types and shapes. They are of various sizes having their handles (or levers) in proportion to their openings.

GENERAL CLASSIFICATION

Spanner with single set opening.
Spanner with set socket.
Spanner with adjustable opening.
"Allen or "unbrako" spanner.
Radial or bolt spanner.

Spanner with single set opening. There are two types: with one opening (fig. 1) and with two openings (fig. 2).

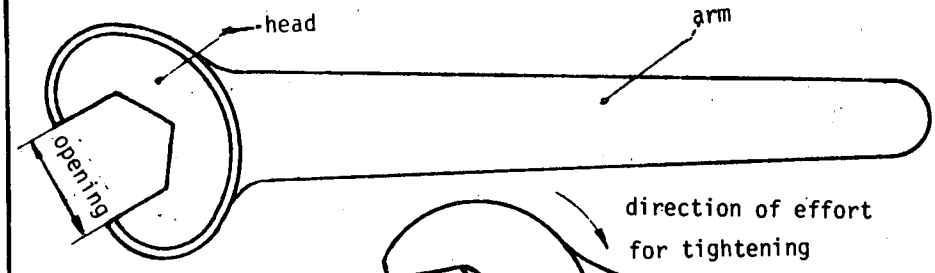


Fig. 1

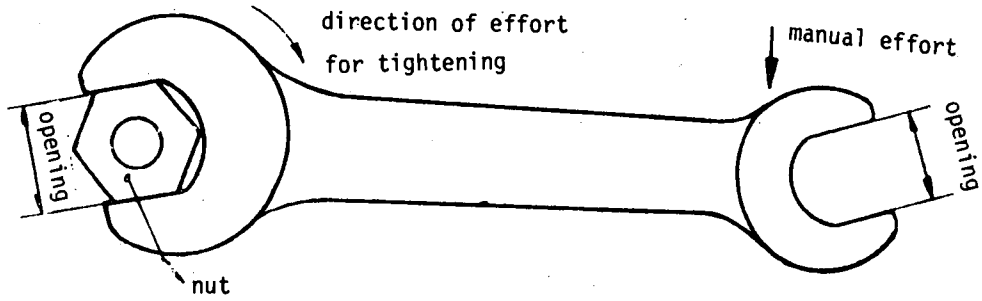


Fig. 2

Spanner with fixed opening: these are of various types and shapes (figs. 3, 4 and 5).

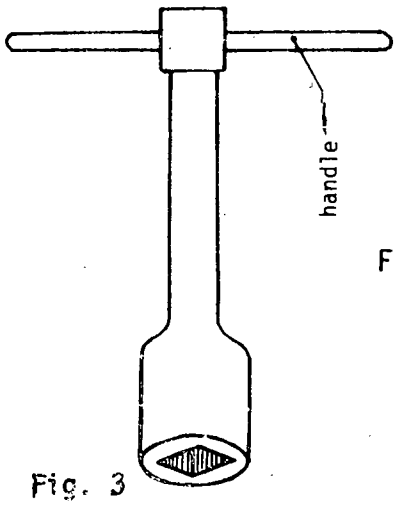


Fig. 3

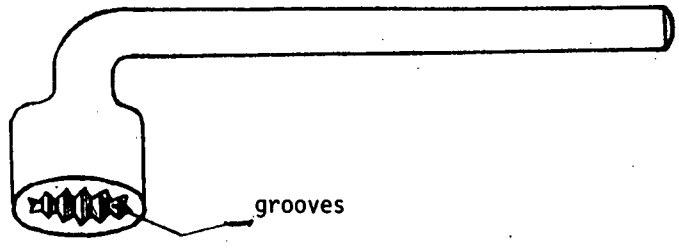


Fig. 4

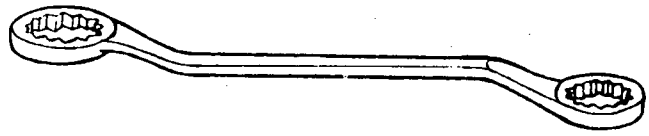


Fig. 5

Spanner with adjustable opening is the one which allows the moveable jaws to open and close by means of a regulating screw or nut. There are two types : an adjustable end wrench (figs. 6, 7 and 8) and a pipe wrench (fig. 9).

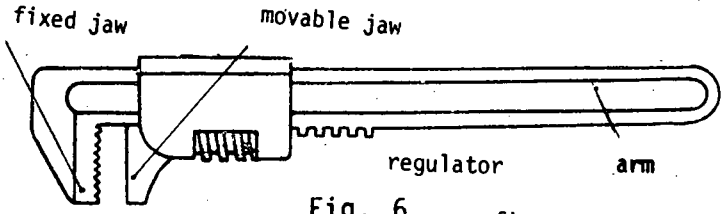


Fig. 6

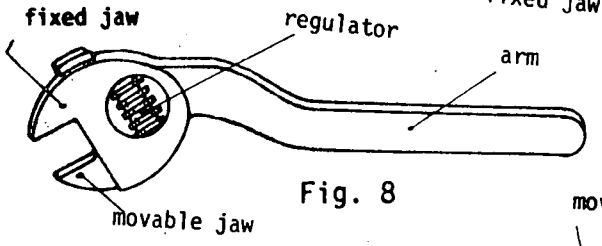


Fig. 8

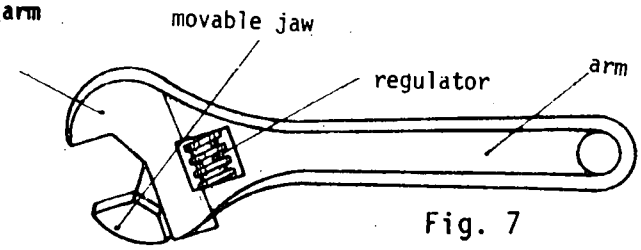


Fig. 7

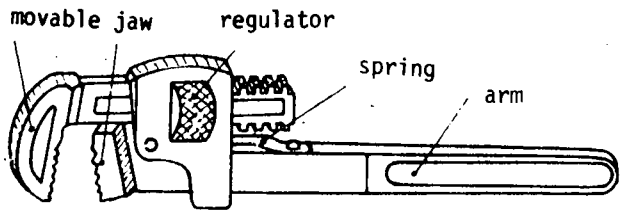


Fig. 9

Spanner for hexagonal adjusting (allen). This is used for screws whose heads have a hexagonal cavity. This type of spanner is generally obtained in sets of six or seven spanners (fig. 10).

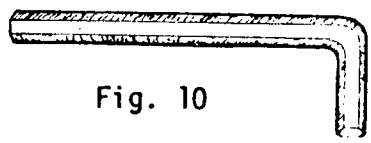


Fig. 10

Axial and radial and inlaid spanners are used on the grooves of generally cylindrical work pieces which may have internal or external threading (figs. 11, 12 and 13).

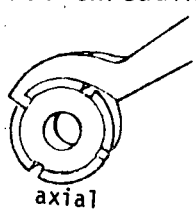


Fig. 11

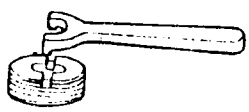


Fig. 12

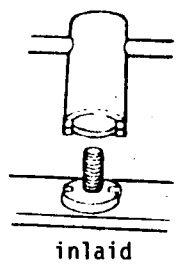


Fig. 13

CONDITIONS OF USE

Tightening spanners must fit tightly on the screws or nuts, thus avoiding damage to both.

CARE

Avoid knocking with the spanners.

Clean them after use.

Keep them in their case or appropriate panels.

CBC

TECHNOLOGICAL INFORMATION: SCREWDRIVERS

The screwdriver is a tool to turn screws, with a carbon steel cylindrical body. One of its ends is forged in the shape of a wedge and the other end in the shape of a prismatic dowel or is cylindrically grooved, on which a wooden or plastic handle is placed (fig. 1 and 2).

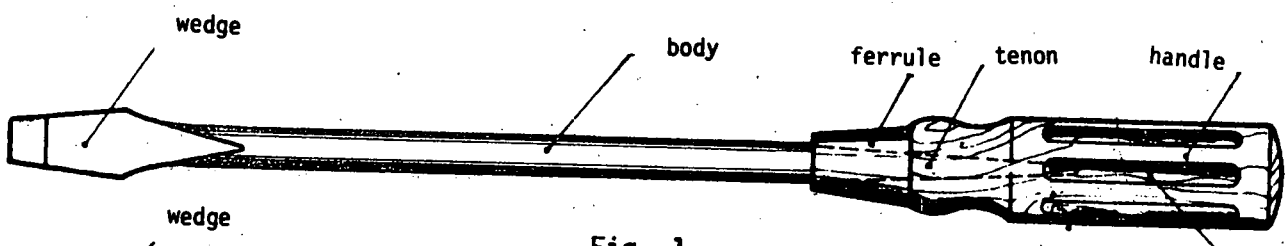


Fig. 1

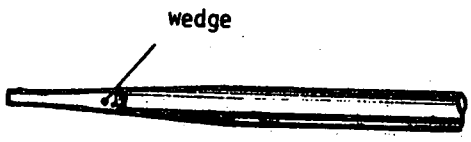


Fig. 2

USE

This type of screwdriver is used to tighten or loosen screws which have a grooved head, allowing the screwdriver to enter, to tighten or loosen by turning it (figs. 3, 4 and 5).

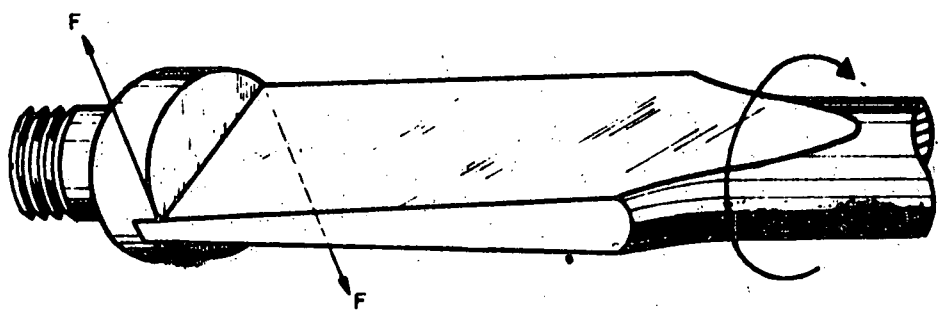


Fig. 3

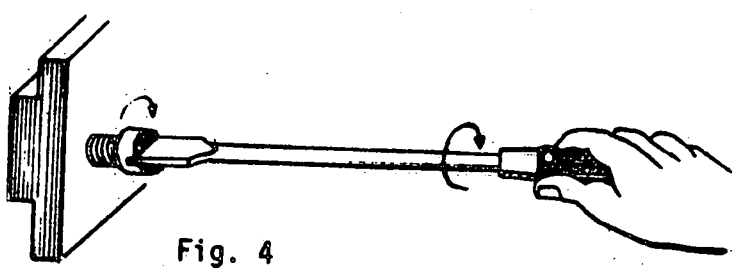


Fig. 4

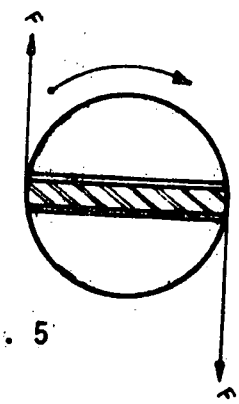


Fig. 5

CHARACTERISTICS

The screwdriver must have its wedge tempered and annealed. The end of the wedge must have parallel faces in order to allow the proper adjustment on to the groove of the screw (fig. 5).

The handle must be grooved longitudinally to allow a firmer grip. The lengths of screwdrivers vary between 100 and 300 mm (4" and 12").

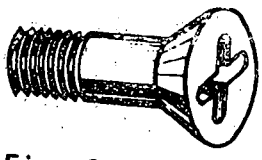


Fig. 6

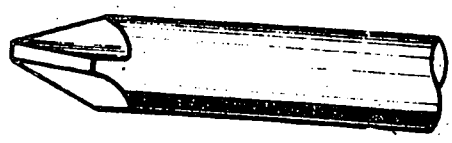


Fig. 7

This measurement is taken on the length of the body.

The shape and dimensions of the wedges are proportional to the diameter of the body of the screwdriver.

For screws with a cross groove (fig. 6) a screwdriver with a cross shaped wedge is used. It is called "PHILLIPS" (fig. 7).

CONDITIONS FOR USE

The handle must be fixed onto the body of the screwdriver in order to avoid it slipping.

CARE

Keep the screwdriver in a suitable place.

CBC **TECHNOLOGICAL INFORMATION:** HOLDING DEVICES (HAND PRESS AND PRESSURE PLIERS)

These are manual tools, made of forged steel or cast iron. They are formed with two hardened and grooved jaws, joined and articulated by means of an axle. To close or open the jaws, a screw with a wing nut is used; for others a lever is used (figs. 1 and 2).

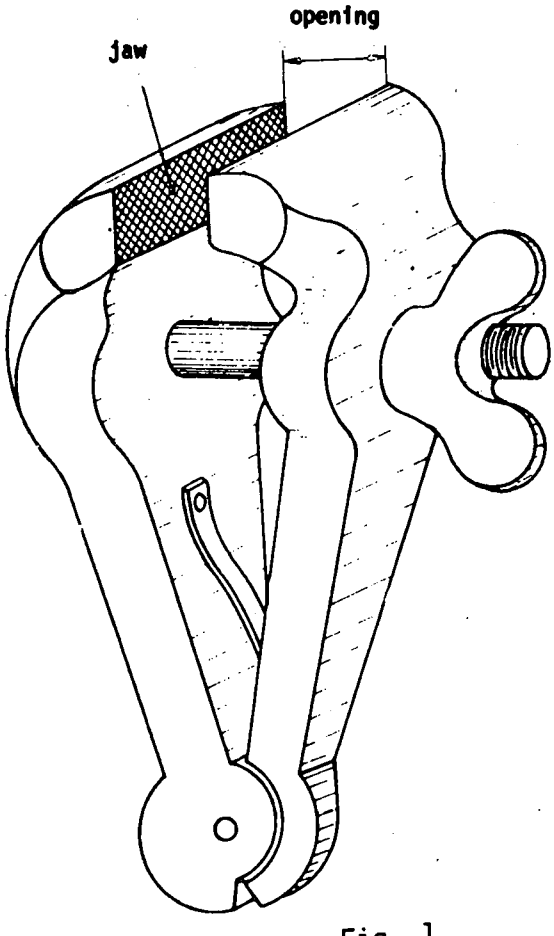


Fig. 1

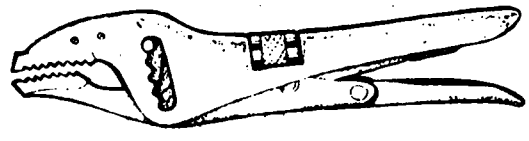


Fig. 2

Fig. 2 Pressure Pliers (or vice-grip pliers)

These tools are frequently used to hold workpieces to be machined, when because of their characteristics, they cannot be held with any other tool.

CONSTRUCTION

Hand Press

It is made of forged steel or cast iron. Its jaws have crossed or or single-grooves for a better gripping of the workpieces. The length of the hand press is from 100 to 150 mm.

The jaws are in proportion to the length of the hand press.

This is made with a spring between the jaws for it to remain opened.

Pressure Pliers

It is generally made of a special steel.

CINTERFOR 1st. Edition

Its jaws are grooved and tempered.
It is found on the market with the measurements of 8" and 10".
The pressure pliers have a screw to regulate the opening of the jaws.

The screw and the wing-nut must have perfect threads.
The articulations and the spring must be in good working condition.

The hand pliers and the pressure pliers must be cleaned and oiled after use. Keep them in a suitable place.

BRASS is an alloy of copper and zinc with a minimum of 50% of copper. Its colour is yellowish, and approaches that of copper according to the proportion of this metal.

Colour of Brass according to the percentage of copper

Copper % Percentage	60	60 to 63	67 to 72	80 to 85	90	More than 90
Colour	Golden yellow	Reddish yellow	Greenish yellow	Light red	Golden red	Copper colour

Applications - hinges, electric material, radiators, screws, bushings, hardware and other applications.

Properties - Brass can be rolled and drawn, cold or hot, transforming it into sheets, wires, bars and other sections. The cold rolled and cold drawn increase approximately 1.8 times the resistance and hardness; that is why brass can be made in different degrees of hardness; soft, semi-hard and hard.

Brass is more resistant than copper. The semi-hard is 1.2 times more resistant than the soft brass and the hard brass is 1.4 times harder than the soft one. Brass is melted easily; therefore it is used in the making of welding rods.

BRONZE - Is an alloy of copper, tin and other metals, such as: lead, zinc and others, where the minimum percentage of copper is 60%.

Applications - high pressure valves, nuts for the main screws of machines, cog wheels, worm screws, bushings and other applications.

Properties - In comparison with copper, bronzes have a higher resistance and are easier to melt. They have according to their alloys, good characteristics of sliding and a good electrical conductivity. They are resistant to corrosion and wear.

Classification - By their composition bronzes are classified as:-

tin bronze;
aluminium bronze;
manganese bronze;
lead bronze;
zinc bronze;
phosphorus bronze.

a) *Tin Bronze* - is a copper and tin alloy, the tin proportion varies from 4 to 20%.
The colour varies from golden red to yellowish red.
Properties - It is hard, corrosion resistant.
Applications - Because of its easy melting and its resistance to wearing by friction, it is used for bush bearings and valve parts. It is easily machined. It is used for naval construction, because of its anti-corrosive properties and its resistance.
b)*Aluminium Bronze* - is an alloy with a content of 4 to 9% aluminium. Its colour is similar to brass.
Properties - It is very resistant to corrosion and wear, its melting presents difficulties; however, it can be worked well hot or cold. By rolling and drawing, sheets, plates, screw-threads and pipes can be obtained for chemical industry.
Application - Because of its good qualities relative to friction and resistance to wear, it is used in the making of bushings, worm screws and cog wheels.
c) *Manganese Bronze* - is a manganese alloy in which copper predominates. Its colour varies from yellow to grey. Manganese is a metal which is not used pure but in alloys with other metals.
Properties - It has good conditions of hardness and it does not alter with sea water or detergents. It is heat resistant.
Applications - It is used in electronics, as wire for resistors and parts in contact with steam and sea water.
d) *Lead Bronze* - is an alloy which has 25% lead.
The colour of this bronze is like that of copper.
Properties - it presents good qualities of sliding. Its resistance is not considerable and it is self-lubricating.
Applications - Because of its quality as a self-lubricant, it is used in the making of bushings for friction bearings.
e) *Zinc Bronze (reddish)* - is a copper, tin and zinc alloy, in which copper is predominant. Its colour is pink-yellow.
Properties -It is corrosion and wear resistant, melts well and can be easily machined.

Applications - Because of its resistance to high pressure and being anti-corrosive, it is used for valves, clamps for pipes, sliding bushings, and machine parts, where the quality of this bronze is needed.

f) *Phosphorus Bronze* - is an alloy of copper, tin and a quantity of phosphorus (material in the form of mineral from the group of metalloids).

Properties - It is wear resistant and anti-corrosive.

Applications - It is used for the making of bushings for sliding bearings, helical gears and for naval construction parts.

ANTI-FRICTION METAL

Is an alloy of tin, antimony and copper with percentages of 5% copper, 85% tin and 10% antimony.

Properties - It is an anti-friction metal, and wear resistant.

Applications - bushings for correcting rods, for automotive engines and bushings for sliding bearings.

TECHNICAL VOCABULARY

Anti-friction Metal - Bearing Metal

CBC

TECHNOLOGICAL INFORMATION:
PROTECTIVE EQUIPMENT
(LEATHER CLOTHING)

REF. TIS.207

Caribbean

This is composed of elements made of leather and they are used by the welder to protect himself from the heat and radiation produced by the electric arc. This equipment is composed of gloves, apron, jackets, sleeves and leggings.

GLOVES:

Made of leather or asbestos, and their shape varies as can be seen in figures 1 and 2. The asbestos gloves are used only for jobs of a high temperature. Avoid handling very hot workpieces with the gloves, because they lose their shape and flexibility.

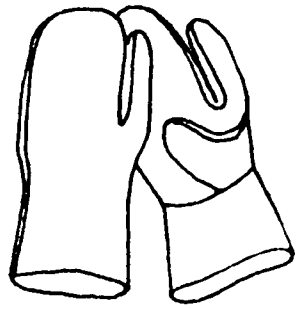


Fig. 1

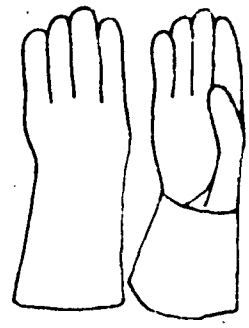


Fig. 2

APRON:

It is of a common shape (fig. 3) or with leg protectors (fig. 4). Its objective is to protect the front part of the body and legs up to the knees.

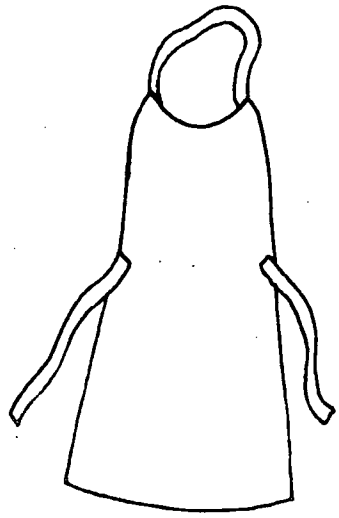


Fig. 3

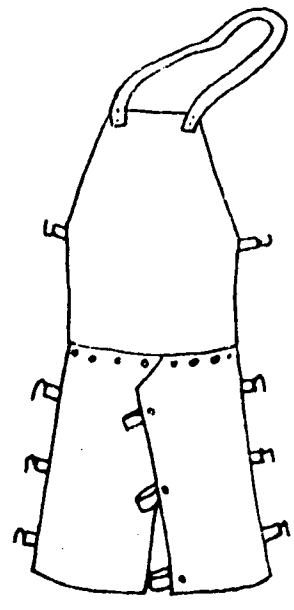


Fig. 4

JACKET:

Its shape can be seen in figure 5. It is used to specially protect the arms and part of the chest. It is used frequently when welding is done in a vertical, horizontal or overhead position.

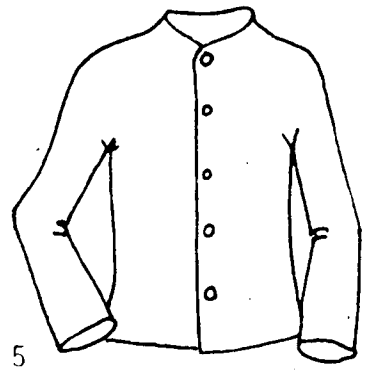


Fig. 5

SLEEVES:

This garment is meant only to protect the arms of the welder (fig. 6). It is mostly used for welding which is done at a work-bench and in a flat position.

There are other types of sleeves in the shape of a vest which also cover part of the chest (fig. 7).

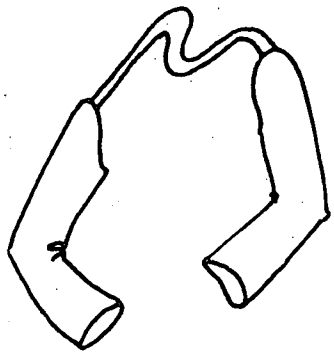


Fig. 6

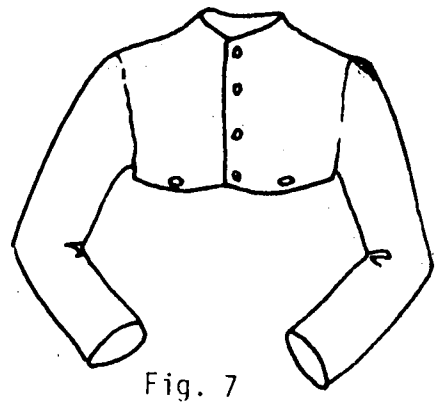


Fig. 7

LEGGINGS:

These are used to protect part of the legs and the welder's feet (fig. 8). The leggings can be replaced by high, plain boots (fig. 9) with a steel tip.

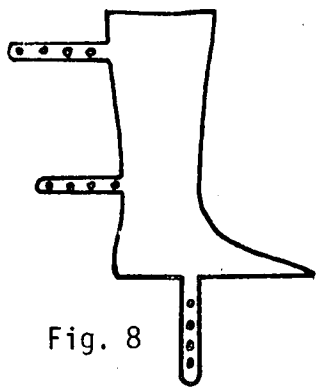


Fig. 8

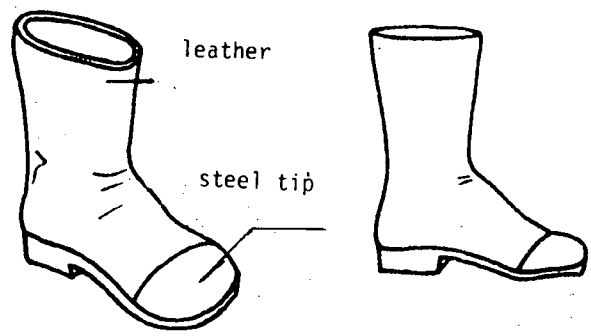


Fig. 9

CHARACTERISTICS:

They are of cured leather, flexible, light weight, treated with lead salt to avoid radiation from the electric arc.

CARE:

It is important to keep these elements in good working condition, free from tears and with their fastenings in good condition. They must be kept clean and dry to ensure a good insulation.

CBC

TECHNOLOGICAL INFORMATION:
CLEANING ACCESSORIES
(STEEL BRUSH - CHIPPING HAMMER)

These are suitable tools for cleaning workpieces before and after welding is done.
They are studied jointly even though they have different characteristics.

WIRE BRUSH:

This is made of steel wires and a wooden handle by which it is held (fig. 1).

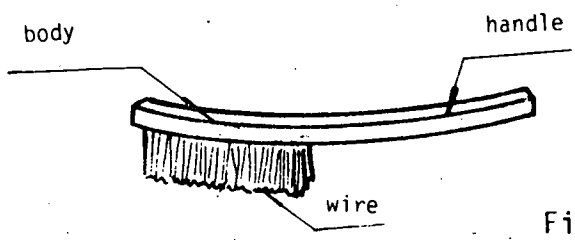


Fig. 1

CHIPPING HAMMER:

It is made with a handle which can be of wood as shown in figure 2 or made of steel as in figures 3, 4 and 5.

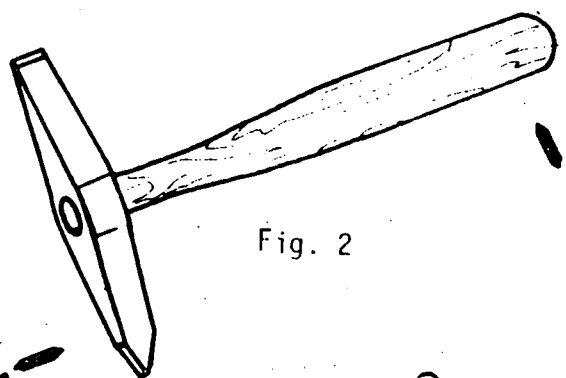


Fig. 2

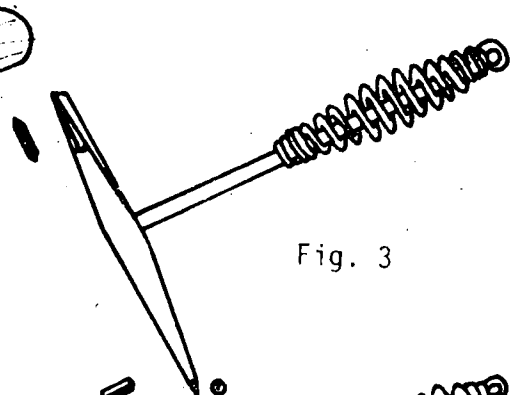


Fig. 3

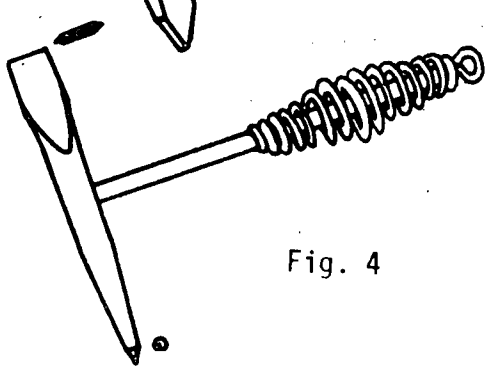


Fig. 4

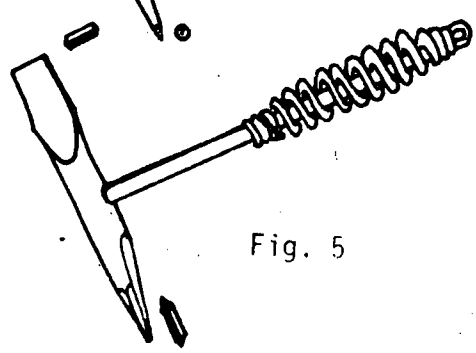


Fig. 5

Its body is long; one of its ends has a point and the other has the shape of a chisel. The chipping hammer has its end hardened and pointed.
There are other types of chipping hammers combined with the wire brush as shown in figure 6.

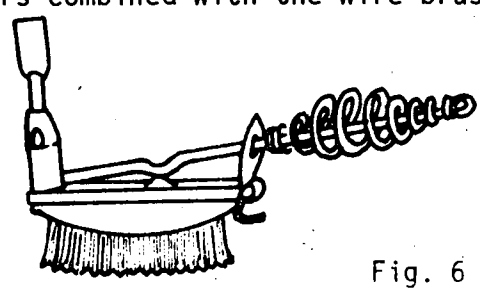


Fig. 6

TECHNOLOGICAL INFORMATION:
EQUIPMENT FOR WELDING WITH OXYACETYLENE
(GENERAL INFORMATION)

This is the unit of elements which, when grouped, allows the passage of gases (oxygen–acetylene) up to a blow torch, in whose interior the mixture is produced. This in contact with a spark causes combustion which is necessary in the oxyacetylene welding process.

Structure
This equipment is formed by the following accessories (fig. 1):

1) Oxygen Cylinder
2) Acetylene Cylinder
3) Valves
4) Oxygen Regulator
5) Acetylene Regulator
6) Hoses
7) Blow Torch
8) Nozzle
9) Carriages

OBSERVATION:
There is equipment provided with an acetylene generator for local use in small workshops, which is very economical.

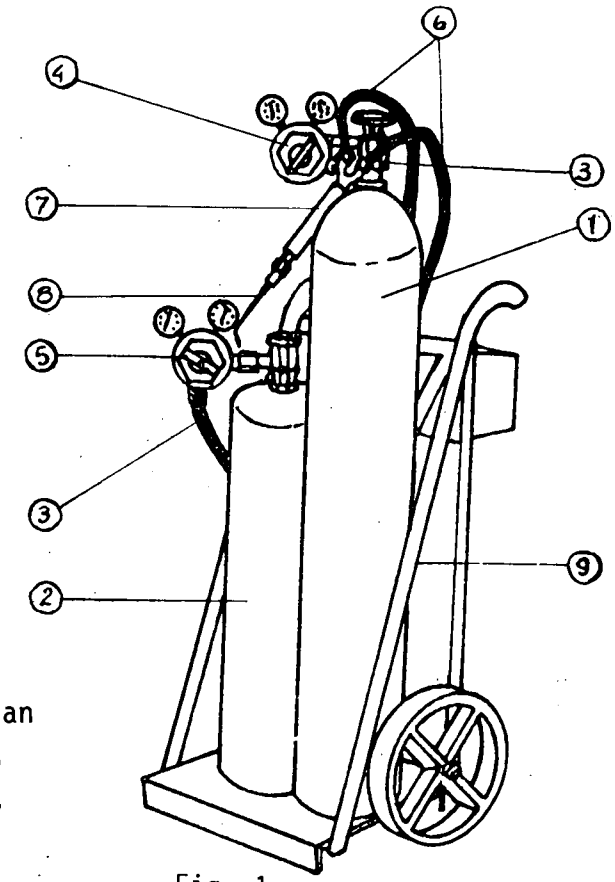


Fig. 1

Advantages
Mobile equipment is easy to transport. With this equipment and with an additional device, the cutting of ferrous metals is made easy. It makes it easy to heat workpieces in difficult places.

Conditions of use
It must be used by persons who know its functioning perfectly. It must have the best possible safety conditions, and should be complete in all its parts.

Maintenance
It is important that each time this equipment is used:

- It must be totally disconnected.
- The accessories must be cleaned with dry rags (hoses, torches, regulators).
- The nozzles must be cleaned with a tip cleaner corresponding to the orifice.

Care
When manipulating this equipment, avoid its contact with grease or oil in order to avoid explosive combustion.

This is a procedure which makes it possible to join metals, using heat produced by combustion from the oxy-acetylene or oxy-propane gases. In this procedure it is possible to weld with or without filler material.

I OXY-ACETYLENE PROCEDURE

TYPES

There are three types, depending on the working pressure of the acetylene.

High Pressure

When the acetylene is used at a pressure which varies between 0.3 and 0.5 kg/cm^2

Medium Pressure

When the acetylene is used at a pressure which varies between 0.1 and 0.3 kg/cm^2

Low Pressure

When the acetylene is maintained at a common pressure, not taking into consideration the losses from the valves and hoses. Practically, this has no application in industry.

From the combination of oxygen and acetylene a flame reaching 3200°C is obtained which makes it possible to weld ferrous and non-ferrous work-pieces. Using a special torch facilitates the cutting of ferrous metals of great thickness.

Advantages

1 - By means of this combustion, a high temperature flame is obtained.
2 - It welds ferrous and non-ferrous materials.

Disadvantages

1 - It is a more expensive process than oxy-propane.
2 - It produces distortions because of the great concentration of heat, and this is the reason why it is not recommended for certain kinds of jobs.
3 - Welding of thick work-pieces is uneconomical.

II OXYGEN-PROPANE PROCESS

According to the pressure developed by the propane, the low pressure process is generally used; employing the combustion of these gases, soft metals can be welded.

Using a cutting torch and the combination of these gases, a flame which reaches approximately 2700°c is obtained.

Advantage

The cost of propane is cheaper than acetylene.

Disadvantages

1 - The cutting is slower than that in the combination of oxy-acetylene.
2 - Only soft metals can be welded.

CBC

TECHNOLOGICAL INFORMATION: GASES USED FOR WELDING (OXYGEN - ACETYLENE - PROPANE)

These are chemical elements used to produce combustion for oxy-gas welding procedures; it is the reason why they are studied together even though they have different characteristics.

OXYGEN

Is a combustible, odourless, tasteless, colourless gas; it is used to maintain or intensify combustion. It is found in the atmosphere in a proportion of 21%.

FUNCTION

It allows the cutting of metals, because of the oxidation it produces. When mixed with acetylene a flame which reaches to a temperature of approximately 3200°C is obtained, making it possible to weld workpieces.
For the welder's use it is normally put in cylinders. The oxygen mixed with propane reaches to a temperature of 2780°C; this makes it possible to weld soft metals (tin, silver).

PRECAUTION

In contact with oils and grease it is inflammable.

ACETYLENE

It is a colourless, combustible gas of a characteristic odour; it is obtained by the chemical reaction from the mixture of calcium carbide and water. Calcium carbide is a chemical compound which looks like stone; it is produced by the fusion of lime and coke in an electric oven.

PREPARATION OF ACETYLENE AND EQUIPMENT

The industrial manufacture of acetylene is done in generators, made according to various systems and capacities of carbide load. According to the pressure at which the acetylene is obtained, the generators are called high or low pressure. The high pressure generators, like the most common low pressure ones are of the type of *carbide to water* (fig. 1). The carbide is placed in a container located on top of a tank whose interior has a certain level of water; by means of a mechanical device the carbide falls into the tank.

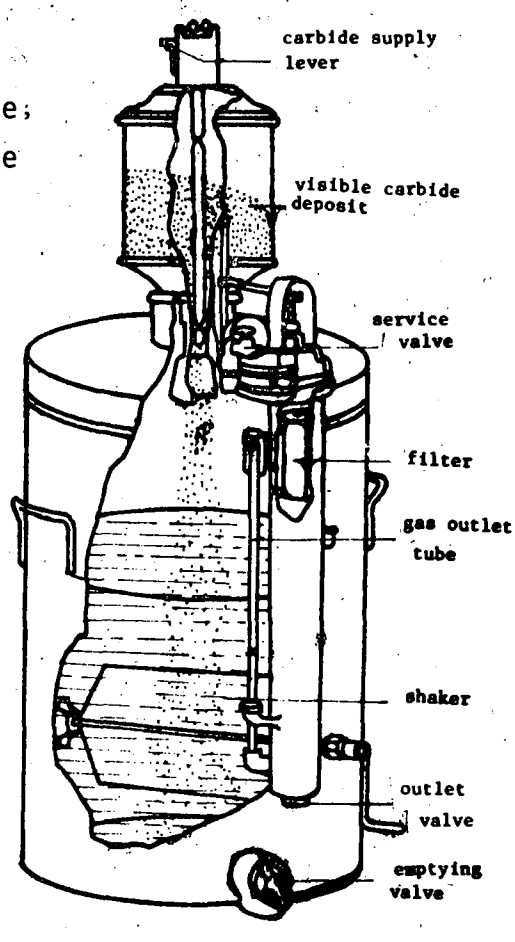


Fig. 1

As the carbide makes contact with the water, the acetylene is produced in the form of a gas, which is deposited in the upper part of the generator. When the acetylene is taken out from the generator, which from a filter passes to the hoses, automatically a feeding device opens the valve at the bottom of the carbide container. In this way a fresh quantity of acetylene is generated and when in the interior of the generator, the acetylene reaches to a certain pressure, the feeding device closes the valve at the bottom of the container, thus cutting off the carbide supply. There are also other types of generators: "water to carbide" and "contact system".

ADVANTAGES AND DISADVANTAGES

Acetylene is easy to obtain, economical, making it possible to use it for cutting and rapid heating of metals. It has the disadvantage of being toxic.

CONDITIONS OF USE

Acetylene cannot be compressed as other gases to high pressures because of the risk of explosions. For this reason it is put in a steel cylinder whose interior is full of a porous mass, which is saturated with acetone, which has the property of dissolving great quantities of acetylene, avoiding cavities where free gas at a high pressure could remain.

The cylinders (fig. 2) are closed with a safety valve and a fusible plug which will jump out if the gas goes over a given pressure.

CAUTION:

1) During welding, the acetylene cylinders must *remain in a vertical position.*

2) Protect the acetylene cylinder *from any direct flame.*

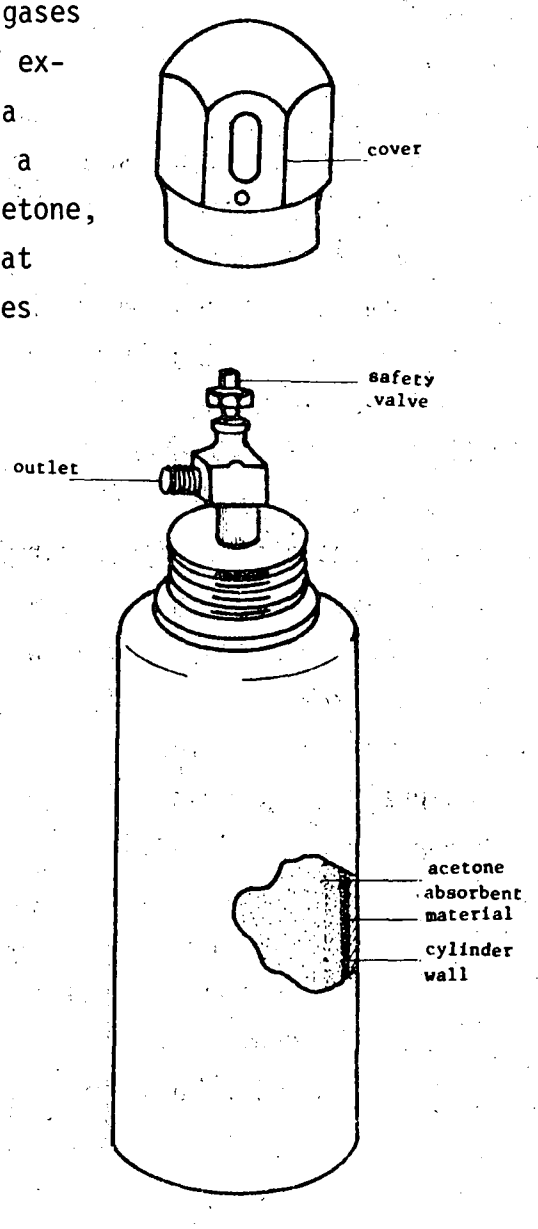


Fig. 2

CBC

TECHNOLOGICAL INFORMATION:
GASES USED FOR WELDING
(OXYGEN - ACETYLENE - PROPANE)

PROPANE

Is a combustible gas obtained from the derivation of hydrocarbons, generally used for the cutting of ferrous metals. It is also used for welding of low fusion metals such as furnaces for fusions and heat treatments.

CHARACTERISTICS

It reaches to a temperature of 2780°C, it liquefies at approximately 44.5°C diminishing its volume. It has a characteristic odour.

ADVANTAGES

This gas when mixed with oxygen produces a flame which makes it possible to cut metals; it is more economical in relation to other gases and being lighter it is easy to transport.

DISADVANTAGES

Its application in industry for welding is limited.

PRODUCTION

It is obtained from the separation of the hydrocarbons of crude oil. After being separated, the hydrocarbons are submitted to a distillation process, in which from various steps of cooling and heating the mixture of those products derived from the gas is separated. After that they are fractioned to obtain independently, gasoline, butane gas and propane gas.
Later, the propane gas so obtained, is put in cylindrical or spherical containers of different sizes.

CONDITIONS FOR USE

The purity of the gas and the safety of its storage are required conditions of propane.

PRECAUTIONS:

It is a toxic gas, inflammable; therefore its inhaling must be avoided and it must be kept away from excessive heat.

CBC

TECHNOLOGICAL INFORMATION:
WELDING EQUIPMENT FOR OXY-ACETYLENE
(NOZZLE - WELDING TORCH)

WELDING NOZZLE

Accessories for equipment which allow the exit of the welding flame. Generally made of copper, also made of monel; they are of different sizes depending mainly on the size of the outlet orifice of the nozzle. According to the orifice it is possible to regulate the working pressure which is in a close relation with the base metal (table 1).

THICKNESS OF MATERIAL IN MM	NO. OF NOZZLE	PRESSURE OF OXYGEN IN ATM. APPROX.	PRESSURE OF ACETYLENE IN KG/cm^2	DIAMETER OF NOZZLE ORIFICE IN MM	OXYGEN CONSUMPTION LITRES/HOUR
0.5-1	1	1	0.2	0.74	100
1-1.5	2	1	0.2	0.93	150
1.5-2	3	1.5	0.25	1.20	225
2-3	4	2	0.3	1.4	300
3-4	5	2.5	0.4	1.6	400
4-5	6	3	0.45	1.8	500
5-7	7	3	0.48	2.1	650
7-11	8	3.5	0.5	2.3	800
11-15	9	4	0.52	2.5	900

Various aspects must be taken into consideration in order to choose a suitable nozzle for welding.

TYPES OF NOZZLES

There are two types of nozzles for general use in oxy-acetylene: *Interchangeable nozzles* are the ones which can be put on the gas mixer by means of a thread (fig. 1), and *fixed nozzles* are those in which the mixer and the nozzle are one unit (fig. 2).

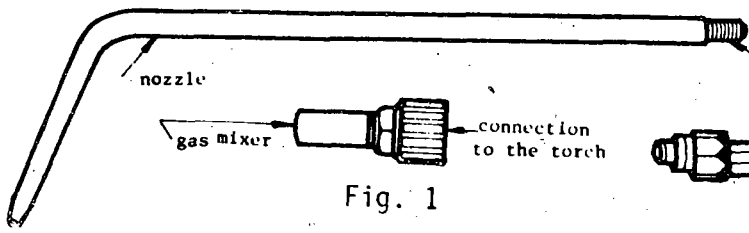


Fig. 1

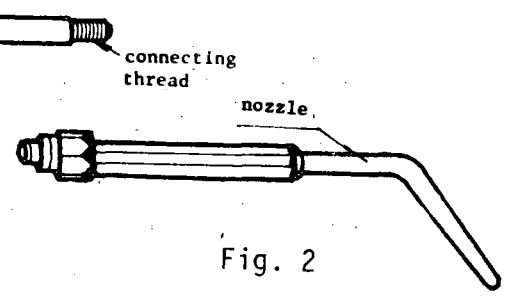


Fig. 2

OBSERVATION

When cleaning the nozzle orifice, use the appropriate tip cleaner.

WELDING TORCH

Is the part of the oxy-acetylene equipment which allows the complete mixture of the gases and at the same time makes it possible to keep the proportion of the flame during the operation, correct and invariable.
The gas mixture must come out through the nozzle of the torch with a flow velocity which depends on the required pressure for welding. The flow velocity must be greater than the combustion rate of the used gas to avoid back firing of the flame.

The welding torch must be light weight and easy to handle in order to avoid fatigue.

TYPES

There are two types of welding torches, low and high pressure.

Low pressure torch: (fig. 3) is that which is designed to use the acetylene

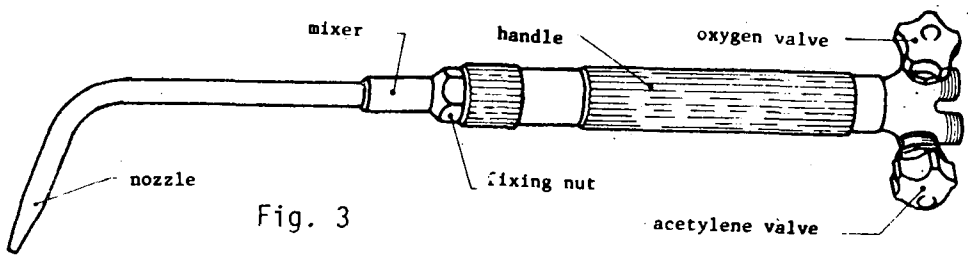


Fig. 3

directly, at a pressure slightly higher than that of the atmosphere. In this type of torch the acetylene cannot reach to it, in the required quantity for welding and has to be sucked in by the oxygen, by means of an injector in the torch, as seen in figure 4. The oxygen drags the needed quantity of acetylene and both gases completely mixed, come out the torch with enough pressure for combustion to take place.

OBSERVATION:

With this torch medium pressure welds can be done.

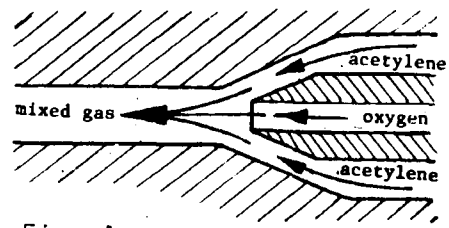


Fig. 4

High pressure torch: (fig. 5) is that welding torch where the flame composition does not change so easily, because the gases enter at approximately the same pressure.

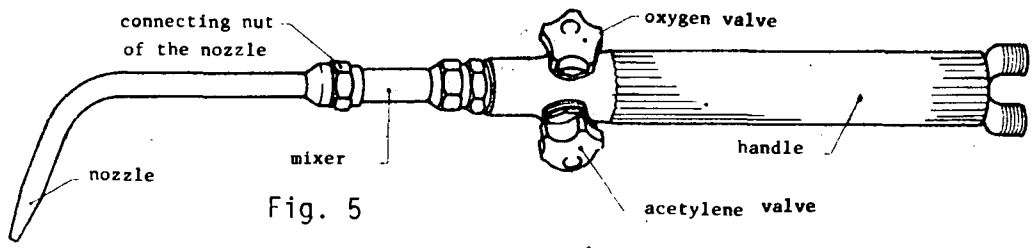


Fig. 5

In this type of torch when a different type of gas consumption is needed, changing the nozzle is sufficient. Keeping the same injector and mixer, however, an equal pressure for both gases is obtained when the proper nozzle is used.

OBSERVATION:

If an equal gas pressure is wished for the two gases, it is necessary to use a high pressure torch in which the nozzle and/or the injector to vary the consumption can be exchanged, since the consumption will be constant when the elements are not changed.

CBC

TECHNOLOGICAL INFORMATION:
OXY-ACETYLENE FLAME

Is the heat source for fusion welding with gas. The flame is the result of the combustion of oxygen and acetylene in a torch. It is used to make soft and hard welds, by varying the proportion of the mixture of the gases.

OBSERVATION:
The temperature reached with the acetylene flame is 3200°C at the tip of the cone.

TYPES

To make the welding job easier, three types of flame have been established:
neutral flame;
oxidizing flame;
carburizing flame.

Neutral or normal flame (fig. 1)

Is the one in which the correct proportion of the mixture is established, which is the most advisable to maintain the properties of the material. This flame is used for welding pieces of the following materials: cast iron, malleable steel, soft steel, bronze, stainless steel, steel with 12% chrome, steel with chrome-nickel, copper, tin, aluminium and its alloys, magnesium and its alloys.

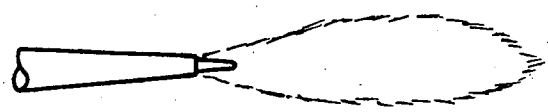


Fig. 1

OBSERVATIONS:
1) In the welding of soft metals (silver, tin, antimony) the flame will be soft neutral.
2) The neutral flame can be soft neutral or hard neutral.

Oxidizing flame (fig. 2)

In the mixture for this type of flame, the oxygen proportion is more than that of acetylene, obtaining a smaller cone or brilliant cone.

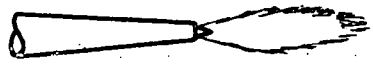


Fig. 2

This flame is used for welding tin, with a great percentage of zinc and bronze alloys.

OBSERVATION:

If the oxygen proportion is exceeded, a flame like the one seen in figure 3 will be obtained. In this flame the cone could disappear at its centre when a flowing stream of oxygen occurs.

It is a very oxidizing flame which can be used in cutting of soft steels and steels of very little carbon content up to 3 mm in thickness.

Fig. 3

Carburizing Flame

Is the one where the acetylene proportion is more than the oxygen as seen in figure 4.

Fig. 4

It is used to do welding on the following metals: carbon steel, wrought steel and its alloys, forged aluminium and special steels.

CYLINDERS

Are two special containers to store oxy-acetylene welding gases. One of oxygen (fig. 1) and another of acetylene (fig. 2).

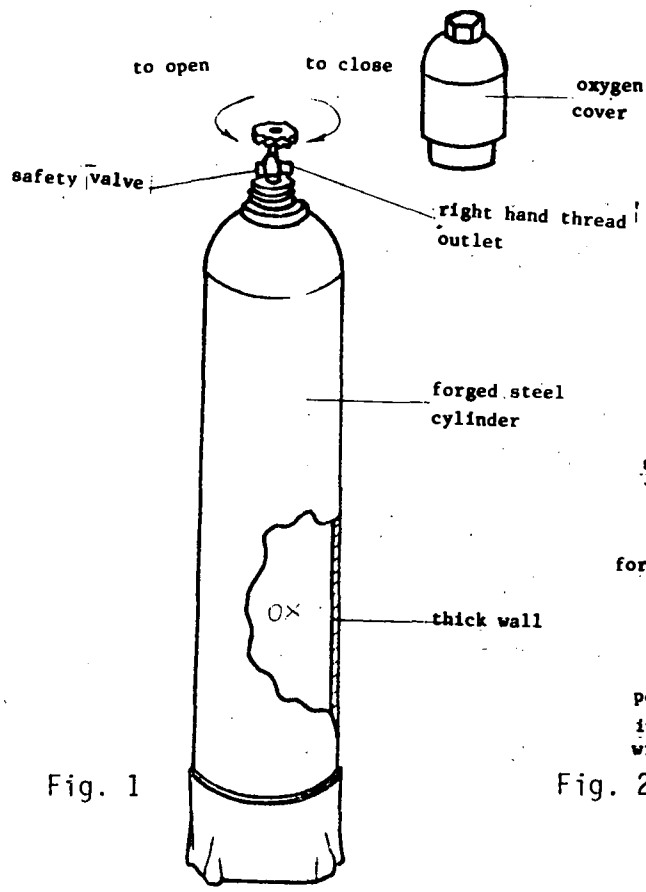


Fig. 1

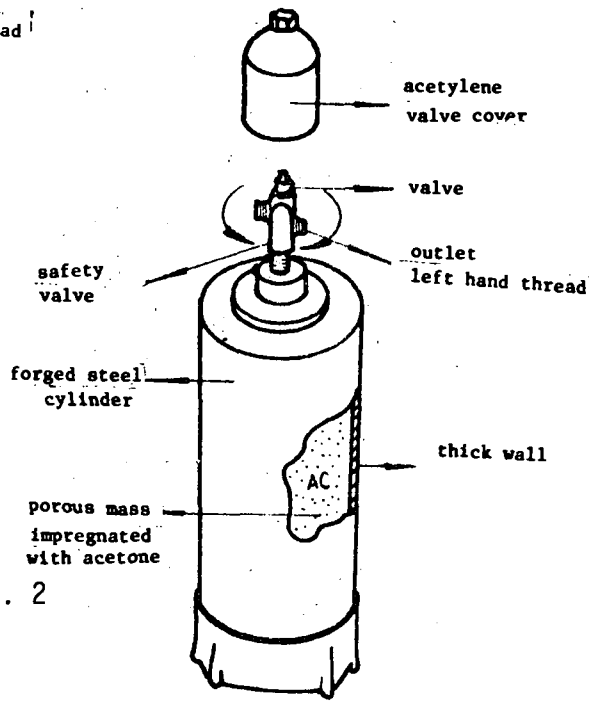


Fig. 2

Cylinder for oxygen

It is a long steel container without seams. The neck of the cylinder is narrower; it is reinforced and has an inner threading in which the locking valve is placed. The outer threading of the neck is used for placing the protective cover of the valve. The bottom part is flat for securing it in the working place.

Cylinders for Acetylene

They are made of steel (without seams).

Because of the tendency of acetylene to explode, as a safety measure, the storage and transportation of this gas in containers under high pressure, is not recommended.

Nevertheless, to make possible the use of these cylinders it is necessary to dissolve the acetylene in acetone, a combustible transparent liquid, and in this way the acetylene is dissolved (liquid gas). In order to avoid danger when compressing the liquified gas, the cylinder is charged with a porous mass of asbestos fibre, pieces of charcoal and kapok.

The porosity of this mass allows absorption of the acetone; then the acetylene slowly introduced is uniformly dissolved into the acetone and distributes itself in the cylinder.

Cylinders are provided with a safety valve, which permits the outlet of gas in case of overheating of the cylinder. This valve is usually placed at the foot of the cylinder.

OBSERVATION:

The oxygen cylinder as well as the acetylene cylinder, must be handled with precaution and be protected against heat radiation of any sort.

PRECAUTION:

WHEN IT IS NECESSARY TO MOVE THE CYLINDERS, THEY MUST BE PROVIDED WITH THE PROTECTIVE COVER OF THE VALVE AND KNOCKS SHOULD BE AVOIDED.

VALVES

These are devices made generally of bronze which permit the entry and outlet of gases (fig. 3).

In the valve for the oxygen and acetylene the thread is from right to left (normal threads).

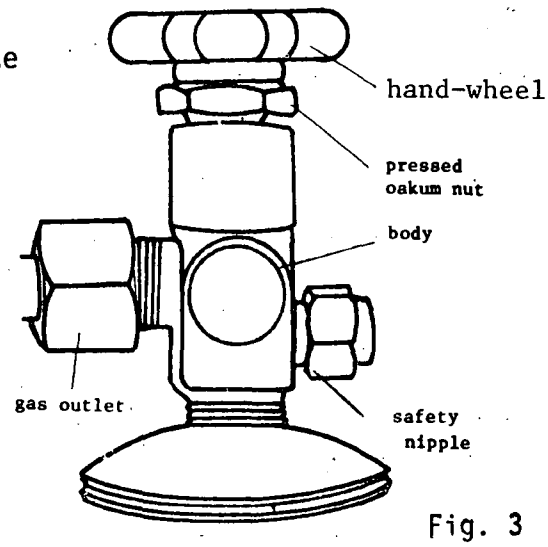


Fig. 3

Safety Valves

These are special devices placed in the regulator and in the gas dispensers. They have functions of letting gas escape in case of a pressure surge or in the case of flame back-firing.

Safety valves in the regulator

They have as their aim, protecting the equipment in the event of pressure surge, letting gas escape. These valves, like the regulators are made of bronze.

Safety valves on the gas dispenser

Are devices on the gas generator which have the aim of protecting the equipment and the welder in the case of a possible accident, caused by back-firing. There are hydraulic valves and dry valves, the most common being the hydraulic ones of high and medium pressure.

Valves of medium pressure (fig. 4)

This type of valve is used in generators or in dissolved acetylene installations. These are open receptacles with a safety pipe with connection to the outside.

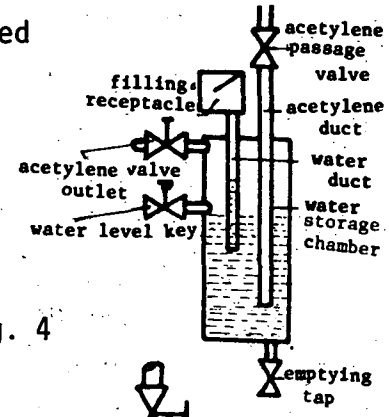


Fig. 4

High pressure valves for acetylene

These are bodies of seamless steel which can resist high pressure, which can be produced by the back firing of flames (fig. 5). The safety offered by these valves depends on the correct level of water which acts as the seal. That is why it is necessary to ensure the water level before starting the job, and each time a back pressure is produced by the back-firing of flame. The level can be checked by opening the water tap.

FUNCTION

If a flame back-fires, the storage chamber increases its pressure, automatically causing the valve to close, making it impossible for the acetylene to flow into the chamber.

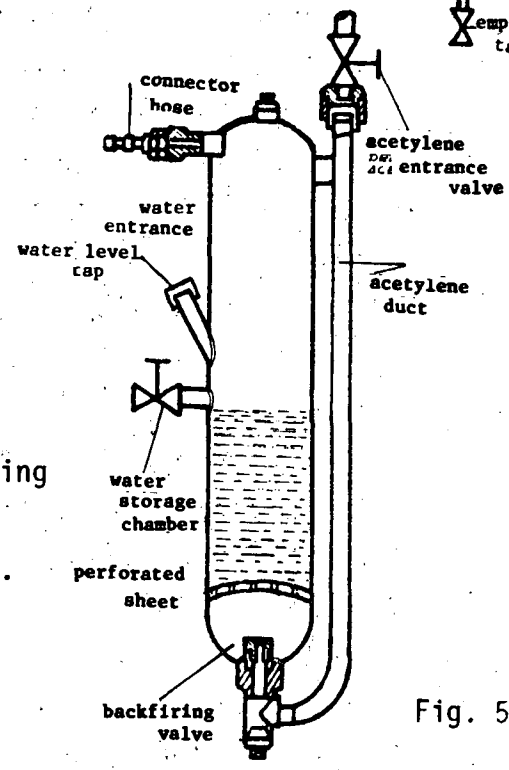


Fig. 5

OBSERVATION:

The flame goes out on the surface of the water.

Dry valves (check valves)

This type of valve (fig. 6) works by gravity and it only allows the gas to flow in one direction.

FUNCTION

The gas pressure lifts the gate when it goes the direction indicated by the arrow and it closes it in the other direction.

OBSERVATION:

The valve must be cleaned periodically.

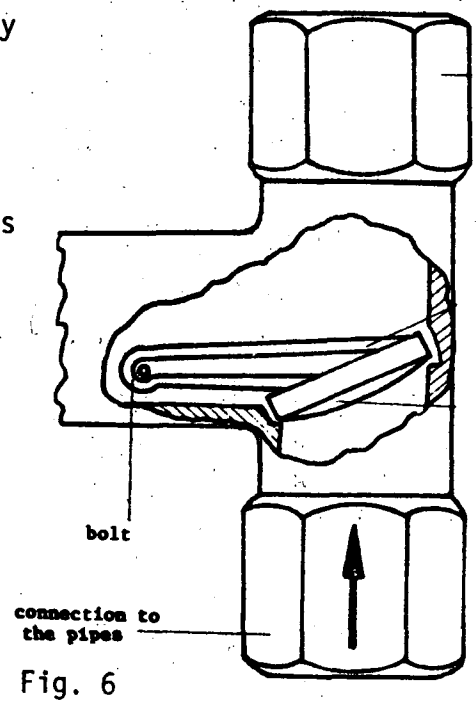


Fig. 6

PRESSURE REGULATORS (FIG. 7)

These are accessories which permit the reduction of the high and variable pressure of the tank to an adequate working pressure for welding and the maintenance of this pressure constantly during the process.

The high pressure gauge indicates the gas content in the cylinder.

The low pressure gauge indicates the needed pressure for work which will be regulated according to the nozzle to be used and the base material.

The safety valve permits the outlet of gas in case of a pressure surge.

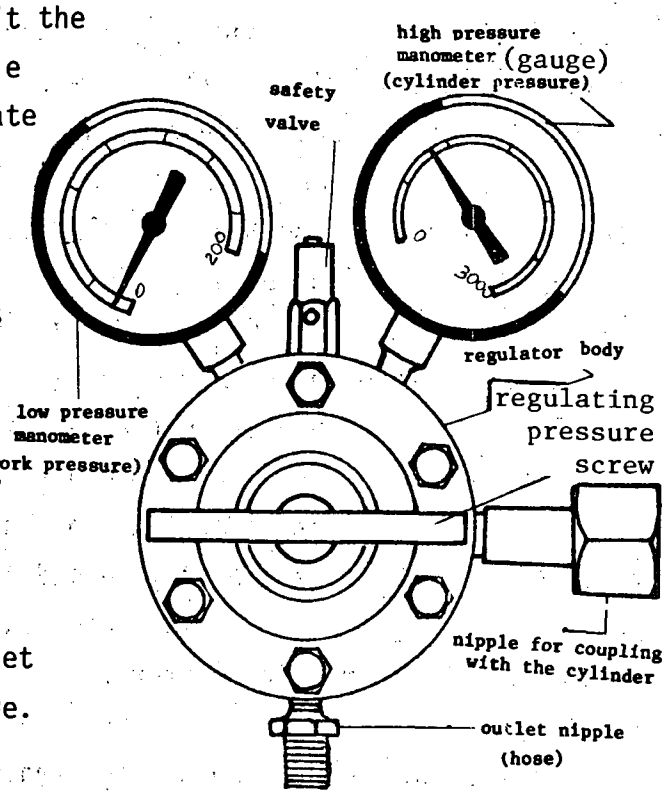


Fig. 7

Adjusting screw

It is used to graduate the working pressure. As it is rotated clockwise, the pressure rises in the low pressure gauge; if it is rotated in the reverse the pressure for work will go down.

Body of the regulator

Is a cylindrical box made of bronze, which encloses the inner unit which can be seen in figure 8. This box must be hermetically sealed.

1- Handwheel
2- Graduating spring
3- Regulator body
4- Diaphragm
5- Outlet nozzle
6- Compression spring
7- Regulating valve
8- Compensating valve
10) Adjusting screw

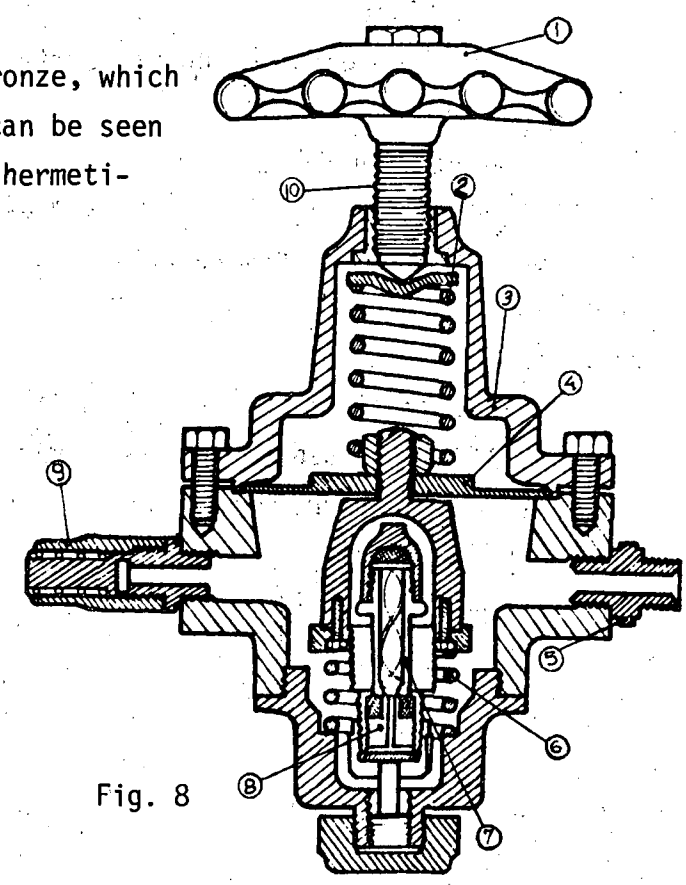


Fig. 8

CBC

TECHNOLOGICAL INFORMATION:
EQUIPMENT FOR WELDING WITH OXY-ACETYLENE
(HOSES - GAS ECONOMIZER)

THE HOSES

Are flexible ducts (fig. 1), which allow the passage of gases, while operating the oxy-acetylene equipment, commonly called hoses. In the oxy-acetylene equipment there are two hoses - the oxygen and the acetylene.

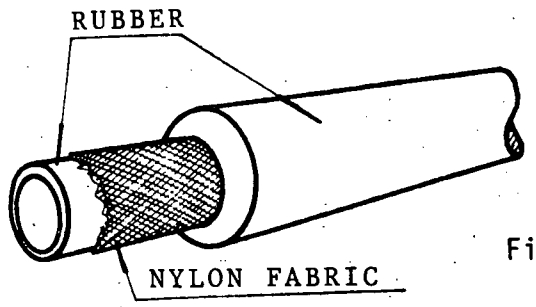


Fig. 1

OXYGEN HOSES

Must be most resistant to wear and to temperature changes.

The characteristic colours for the oxygen hose are blue, green or black.

These hoses must withstand a pressure test of 40 atm, the diameter inside is 4, 6 or 9 mm.

ACETYLENE HOSES

The characteristic colour for these hoses is red and the test pressure is 20 atm; they are made with different diameters, 4, 6 or 9 mm; commonly used are those of 6 mm for oxygen and acetylene; for economic reasons, the 9 mm is no longer used although it was used in the past in exceptional cases; also other diameters are used.

CONSTITUTION

The recommended material for the making of the hose is natural or synthetic rubber with an inner fabric reinforcement; there are hoses which for protection against wear and external damage, are covered with a wire mesh and asbestos.

FASTENING OF THE HOSES

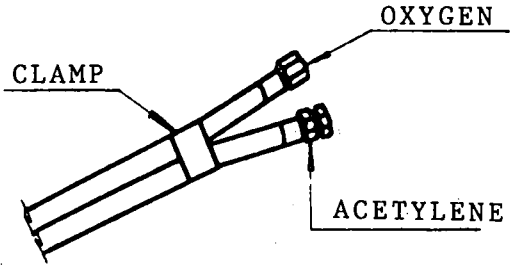
In order to fasten the hose to the connectors, special small clamps whose size is according to the size of the hose are used.

These clamps are tightened by means of a bolt and nuts. In order to prevent the hose from getting loose the clamps are provided with overlaps.

OBSERVATION:

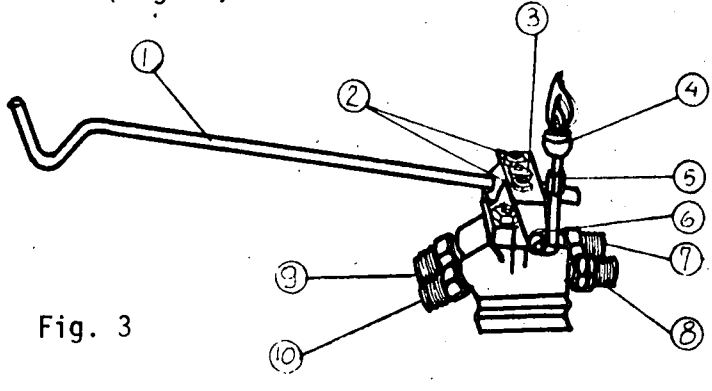
In the case of hoses which are side by side (oxygen-acetylene) use clamps to avoid separation (fig. 2).

Fig. 2



THE GAS ECONOMIZER (Fig. 3).

Fig. 3



1 Valve lever for gases	6 Pivot screw
2 Adjusting screws	7 Acetylene intake
3 Adjusting screw	8 Oxygen intake
4 Pilot flame	9 Acetylene outlet
5 Nut	10 Oxygen outlet

A component device of the equipment which allows extinguishing of the flame, without turning the valves of the torch, saving thus oxygen and acetylene.

On pressing down the control lever of the gases, the valves, set in the body of the economizer, automatically close, thus putting out the flame on the torch. As the torch is raised from the valve lever, it rises by the action of a spring, allowing the gases to flow to the torch; a flame constantly maintained as a pilot is used for lighting the torch, re-starting the work with the original flame.

CBC

TECHNOLOGICAL INFORMATION:

MANUAL OXY-CUTTING

The procedure used in industry for cutting soft steel into pieces of great thickness and different shapes, based on the principle of ferrous oxidation, is known as manual oxy-cutting.

It has great application in the preparation of the workpieces for the making and assembling of welded structures.

There are two procedures for cutting, taking into consideration the combustible gases used: *Propane and acetylene.*

EQUIPMENT USED

The equipment used for oxy-cutting is similar to the one used in the oxy-acetylene welding process, with the exception of the torch, cutting nozzle and accessories.

CUTTING TORCH

Implement which gives a means of mixing oxygen with propane or acetylene in the correct proportions, producing a flame of high temperature. It also has an additional duct for the oxygen, which at high pressure, makes possible the cutting of metal.

The torch for cutting can be of two types: *the one attached to a welding handle* (fig. 1) and *the fixed cutting torch (fig. 2).*

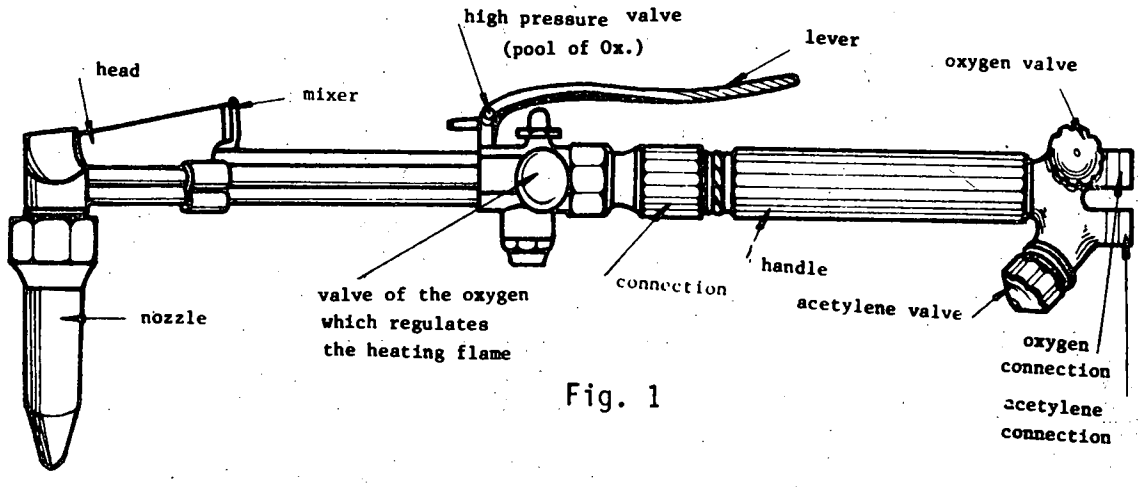


Fig. 1

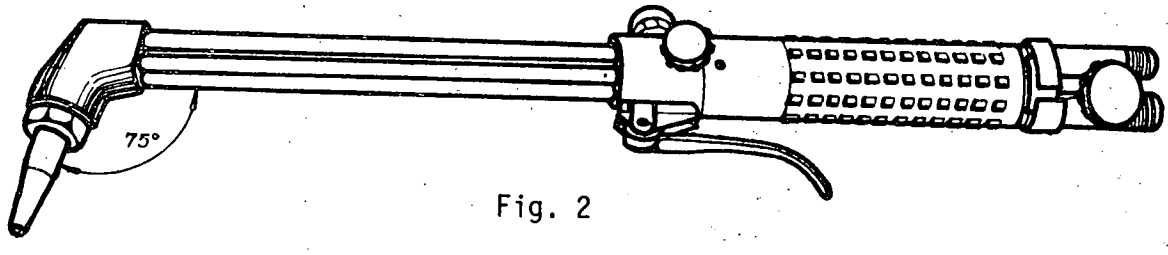


Fig. 2

The first one is used only for cutting with acetylene and the set torch is used for propane as well as for acetylene. In both cases, the inclination between the nozzle and the head can be of 75^0 and 90^0.

CUTTING NOZZLE

Element which when attached to the head of the torch, allows the making of a hot flame, able to heat the metal to be cut. It also permits the passage of a jet of oxygen, of high pressure for cutting.

There are nozzles for cutting with acetylene (fig. 3), as well as nozzles for the cutting with propane which are made of two pieces (fig. 4).

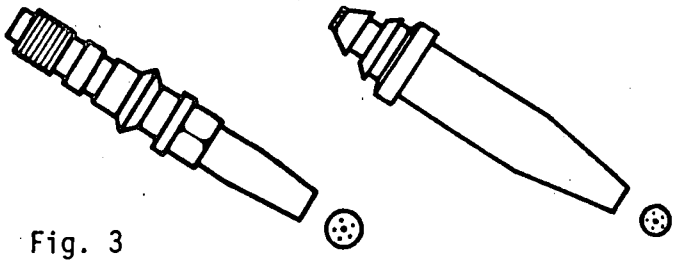


Fig. 3

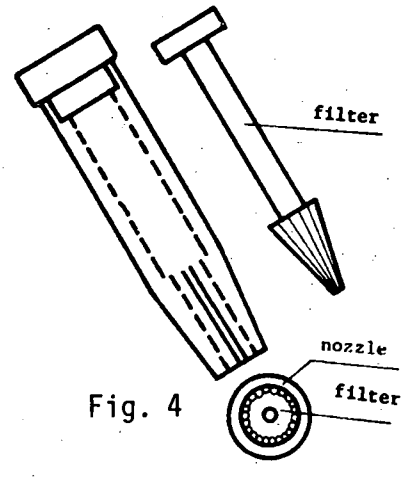


Fig. 4

In order to select the nozzle, one must take into consideration the thickness of the material to be cut, for which the following table is used:

TABLE FOR SELECTION OF NOZZLE

THICKNESS OF METAL IN mm (INCHES)	OXYGEN PRESSURE kg/cm^2 lbs/ins.	ACETYLENE PRESSURE kg/cm^2 lbs/ins.	PROPANE PRESSURE kg/cm^2 lbs/ins.	NUMBER AND BRAND OF NOZZLE			
				TOCHWELD	HARRIS	OXWELD	AIRCO
3.17 (1/8)	2.46 (35)	0.14 (2)	0.14 (2)	68	00		
4.76-9.52 (3/16-3/8)	1.75-2.24 (25-32)	0.21-0-.35 (3-5)	0.21-0.35 (3-5)	62	00-0	3	0-1
12.70-22.22 (1/2-7/8)	2.10-3.51 (30-50)	0.21-0.35 (3-5)	0.21-0.42 (3-6)	56	1	4	1-2
25.40-38.10 (1-1 1/2)	2.46-3.51 (35-50)	0.21-0.42 (3-6)	0.28-0.56 (4-8)	53	1	6	2
50.80 (2)	3.16 (45)	0.35 (5)	0.56 (8)	51	2	8	3
76.20 (3)	2.81 (40)	0.42 (6)	0.56 (8)	46	3	8	4-5
101.60-152.40 (4-6)	2.81-3.86 (40-55)	0.42-0.56 (6-8)	0.42-0.63 (6-9)	42	3-4	8	5-6
177.80-203.20 (7-8)	3.51-3.86 (50-55)	0.42-0.56 (6-8)	0.42-0.63 (6-9)	35		10	
228.60-304.80 (9-12)	3.86-4.92 (55-70)	0.56-0.70 (8-10)	0.49-0.70 (7-10)			12	
330.20-406.40 (13-16)	5.62-6.32 (80-90)	0.70-0.84 (10-12)	0.49-0.70 (7-10)	25			

OBSERVATION:

This table is subject to the specifications of the manufacturer; only common models of nozzles have been taken which have their equivalents in other makes not given. The cleaning of the nozzle is done with tip cleaners suitable to their orifices (fig. 5).

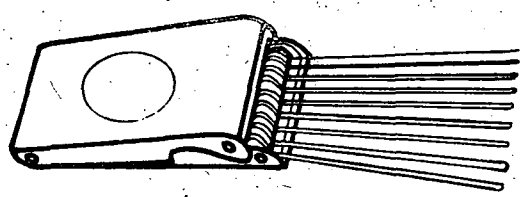


Fig. 5

ACCESSORIES

The normal Oxy-cut requires accessories in order to better the conditions of the cut, among which can be mentioned the carriage (fig. 6) and the cutting compass (fig. 7).

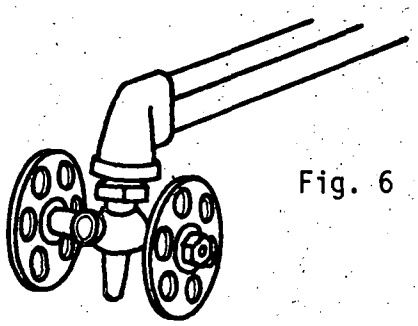


Fig. 6

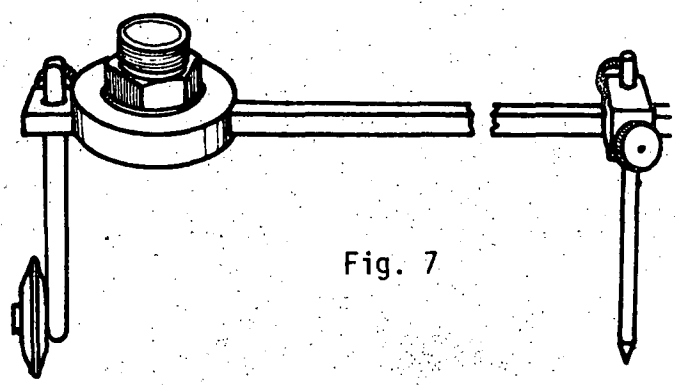


Fig. 7

The *carriage* is a graduated accessory which keeps the nozzle of the torch at a uniform height above the material to be cut. It has metallic wheels which facilitate displacement of the torch along its cutting path.

The carriage can be used alone or with guides in order to maintain a straight cut, as shown in fig. 8.

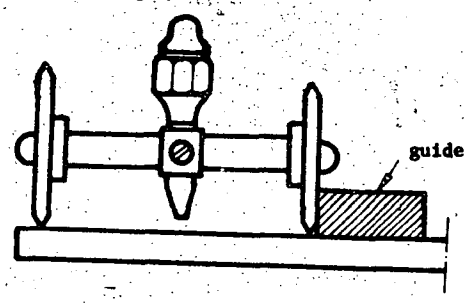


Fig. 8

The *cutting compass* is an implement which can be adjusted to the torch in the same way as the carriage. It is used to cut circles and semi-circles as indicated in fig. 9.

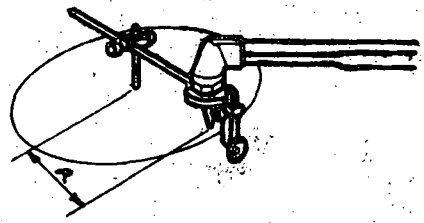


Fig. 9

APPLICATIONS:

1) The oxycut has extensive application in parts which require bevelling; its preparation can be in a V or X with different inclinations.
2) The oxycut can be mechanised; for this, semi-automatic cutting machines are used (figs. 10 and 11).

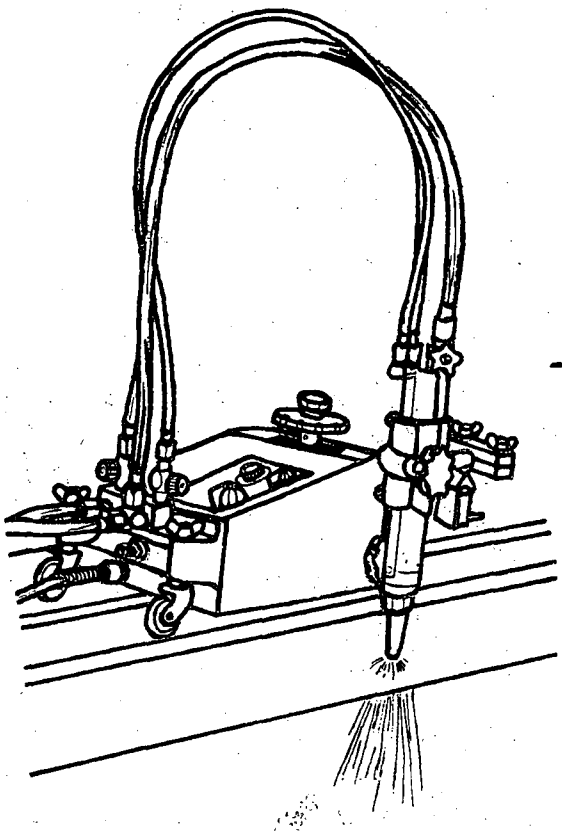


Fig. 10

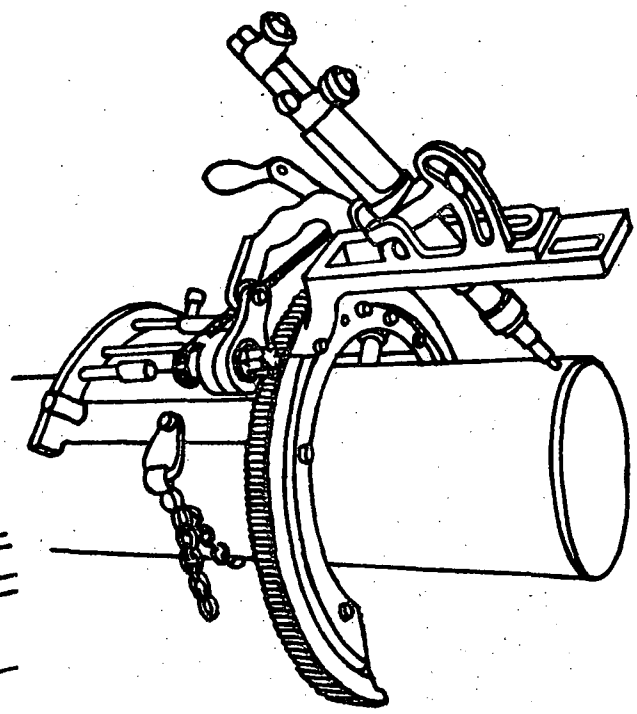


Fig. 11