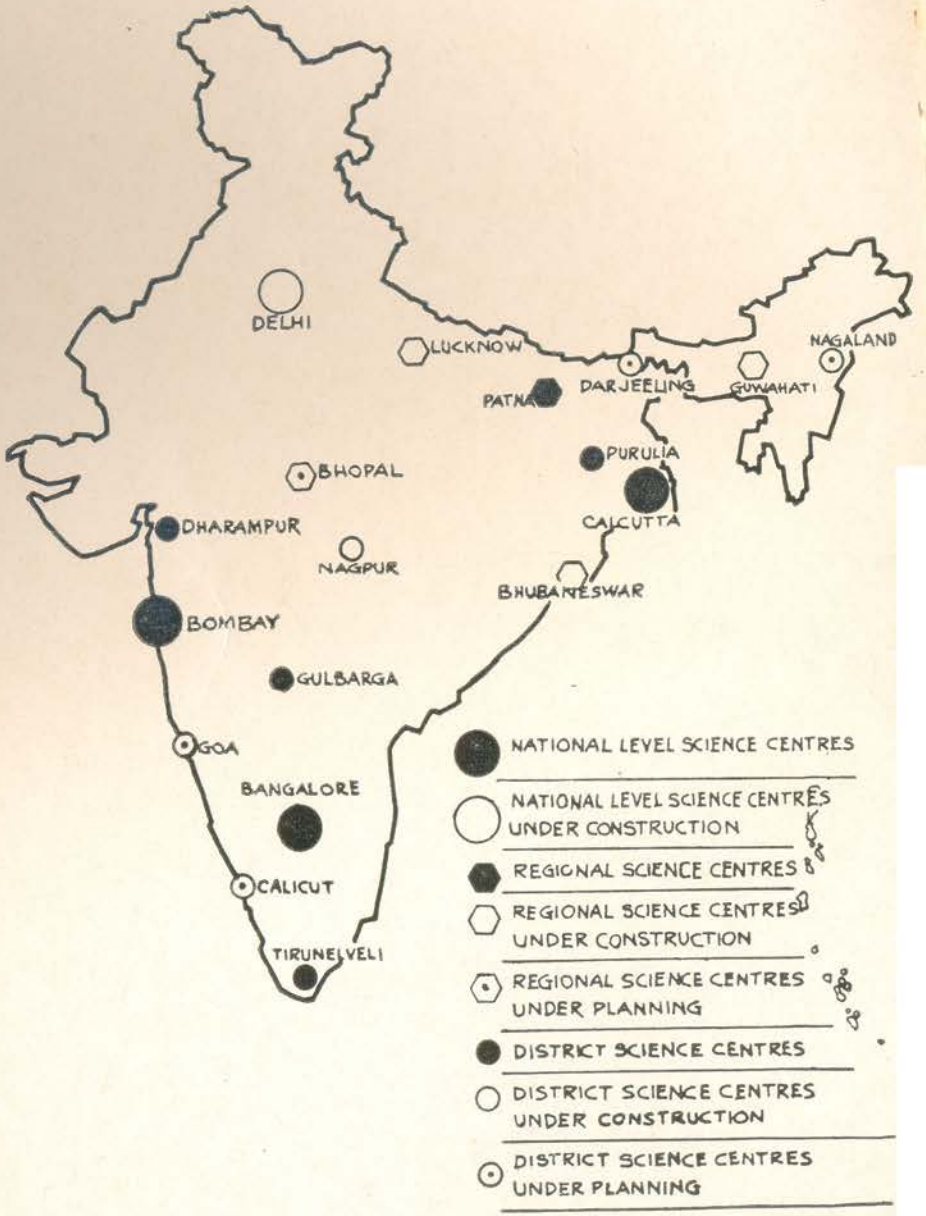
TEACHERS'

TRAINING PROGRAMME

NATIONAL COUNCIL OF SCIENCE MUSEUMS

NCSM NATIONWIDE



TEACHERS' TRAINING PROGRAMME

COURSE—I

NATIONAL COUNCIL OF SCIENCE MUSEUMS
19A, Gurusaday Road, Calcutta-700 019

CONTENTS

INTRODUCTION

Science Museums and Centres under National Council of Science Museums (NCSM) of National, State and District levels, are embedded in the milieu—living and working with the community, among the community. In diverse corners of India are working these Science Centres.

Activity-oriented as these Centres are, direction of their programmes is two-prong ; for children including students, and for adults of the community. For students, there are assorted exhibits on various scientific phenomena, and programmes like science camps and seminars, popular lectures, creative ability centre, sky-watching, telescope-making and so on. Science demonstration lectures bring text book science alive. Teachers' Training Programme greatly contribute in making students more receptive to the messages of science. Women are given training in basic hygiene, nutrition etc. Adults are trained in various vocations and adoption of appropriate technology in their daily life. Not transplanting technology but creating in the people a spirit of self-reliance and resourcefulness is the aim of these grassroot level Centres.

WHY THIS TRAINING?

Science Demonstration Lecture (SDL), Creative Abilities Centre (CAC), and Teachers' Training Programme (TTP)—all are organised by the NCSM with a view to supplement science education in schools.

Science Demonstration Lecture :

Science Demonstration Lecture is conducted in urban and rural schools by experienced staff of NCSM. Lectures are delivered with the help of a series of teaching kits, on selected subjects chosen from school syllabi. Such kits are simple, inexpensive still impressive and can be made by school students under proper supervision.

No costly material, no machine, no special skill

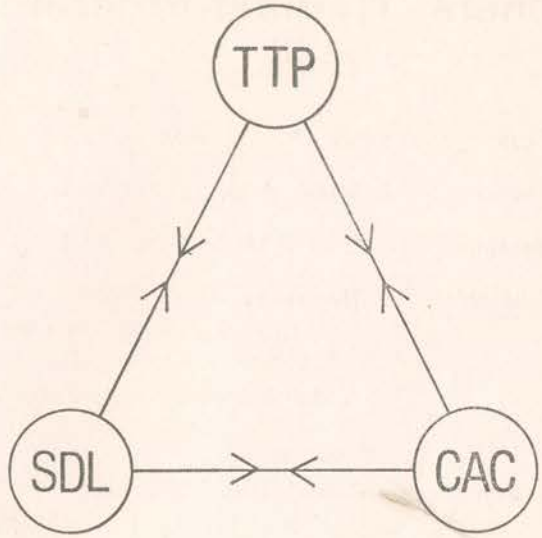
Creative Abilities Centres :

Rural and urban schools are encouraged and helped by NCSM to develop Creative Abilities Centres where students will prepare such teaching kits by working in leisure time and will also persue their science hobbies.

Teachers' Training Programme :

Teachers' Training Programme is organised with a view to train suitable school teachers for running such Creative Abilities Centres in their schools. The introductory course of these programmes introduces the teachers to the use of common tools and fabrication of simple teaching kits and equipment with the help of such simple tools. The advanced course is aimed at developing creative faculties of teachers in evolving new concepts on kits. Both the courses are of two weeks' duration.

Teachers' Training Programme is held at district towns on request from the local District Inspector of Schools or Teachers' Training Colleges. Selection of teachers for training is made by



such authorities from those schools who appear to be enthusiastic in opening a Creative Abilities Centre shortly. Teachers who have conducted such CAC in their schools after receiving the introductory course (TTP-I) are only eligible for undergoing advanced course (TTP-II).

NCSM units bear all expenditure in connection with the materials and tools required for the training. Travelling expenses and daily allowance of the teachers are to be borne either by the respective school authority or by the Education Directorate. The demonstration kits made by the teachers during the training are presented to them for use in their schools. All teachers who have received this training are given certificates by NCSM.

Teachers' Training Programme

COURSE—I

Programme of work (for 12 working days)

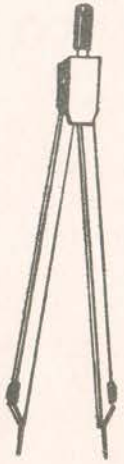
Morning Session		: 10.00 A.M. to 1.00 P.M.
Afternoon Session		: 2.00 P.M. to 5.00 P.M.
1st Day	Morning	: Registration
		Introductory remarks on utilities of the programme
		A demonstration lecture by the NCSM staff
		Discussion
	Afternoon	: Introduction to Tools
		Job No. 1 (Wood work)—Plus Joint
2nd Day	Morning	: Job No.2(Wood work)—Book/Tool Rack
	Afternoon	: Job No. 3 (Soldering Practice)—Carbon Atom
3rd Day	Morning	: Discussion On Electric Lines and Measurements.
	Afternoon	: Job No. 4 (Electric Wiring)—Power Board
4th Day		: Job No. 5—Expansion Due To Heat
5th Day		: Job No. 6—Air Thermometer-cum-Pressure Gauge
6th Day		: Job No. 7—Magnetic Field
7th Day		: Job No. 8—Archimedes' Principle
8th Day		: Job No. 9—Automatic Temperature Control
9th Day		: Job No. 10—Electric Relay
10th Day		: Job No. 11—Electric Meter
11th Day		: Job No. 12—Battery Eliminator
12th Day	Morning	: Job No. 13—Photo Sensitive Circuit
	Afternoon	: Discussions
		Closing ceremony with display of finished jobs.

INTRODUCTION TO TOOLS

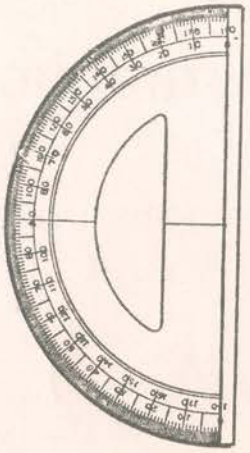
MARKING TOOLS	: Divider 6″, Compass 6″, Set-Squares, Tri-Square, Protractor, Scale 12″, Centre Punch, Foot Rule, Bradawal.
TOOLS FOR WOOD WORK	: Jack Plane 9″ & 6″, Carpenter's Saw, Compass Saw 12″, Firmer Chisel $\frac{3}{4}$″, $\frac{1}{2}$″& $\frac{1}{4}$″, Core Chisel $\frac{1}{2}$″ & $\frac{1}{4}$″, Mortise Chisel, Hand Drill with bits from $\frac{1}{4}$″ to 1/16″, Auger 3/8″, Wooden Mallet, Wood Rasp File 12″, Oil Stone.
TOOLS FOR METAL WORK	: Tin Snip 8″, Hack Saw 12″ with blades, Junior Hack Saw 6″ with blades, Electric Power Drill $\frac{1}{4}$″, Cold Chisel $\frac{1}{2}$″.
TOOLS FOR FITTING WORK	: Bench Vice 2$\frac{1}{2}$″, Ball Pane Hammer $\frac{1}{2}$ lb & $\frac{1}{4}$ lb, Flat Bastard File 10″ & 8″, Round Bastard File 3/8″ & $\frac{1}{4}$″, Triangular File 6″, Rat Tail File 6″, Screw Driver 8″, 6″ & 4″.
ELECTRICAL TOOLS	: Combination Pliers, Long Nose Pliers (insulated) 6″, Flat Nose Pliers 6″, Diagonal Cutting Pliers (insulated) 6″, Knife, Soldering Iron 100W and 25W, Neon Tester, Connector Screw Driver, Simple Multimeter.

MARKING TOOLS

COMPASS

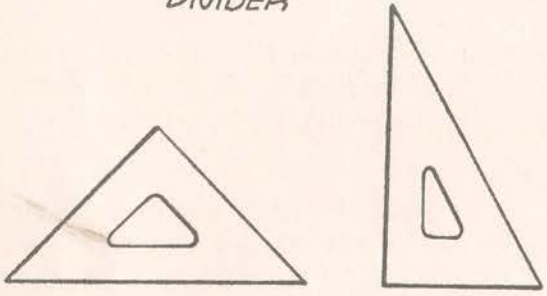


DIVIDER

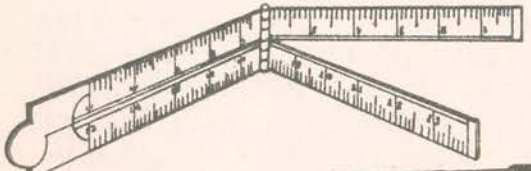


PROTRACTOR

12" SCALE

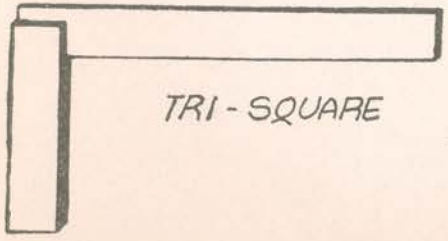


SET SQUARE



FOOT RULE

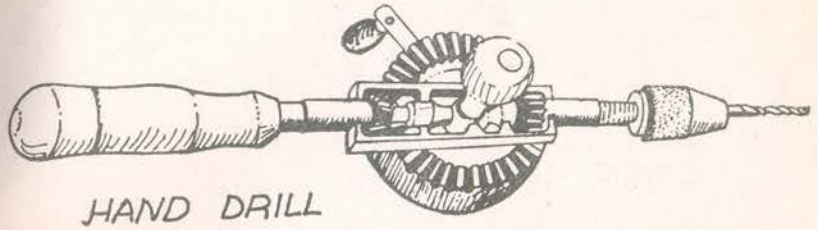
BRADAWL



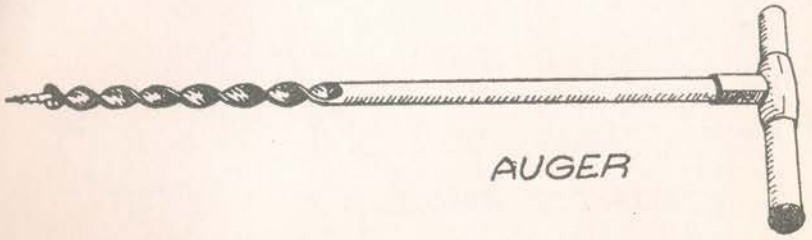
TRI - SQUARE

CENTRE PUNCH

TOOLS FOR WOOD WORK

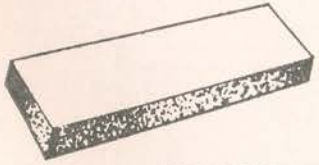


HAND DRILL

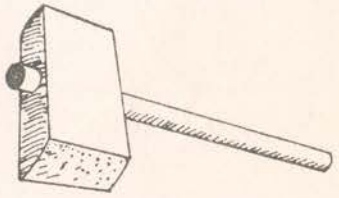


AUGER

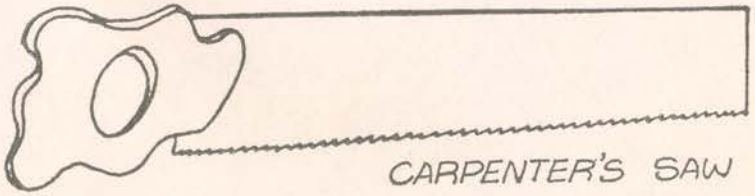
FIRMER CHISEL



OIL STONE

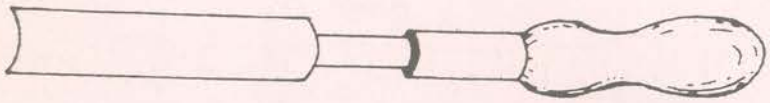


WOODEN MALLET



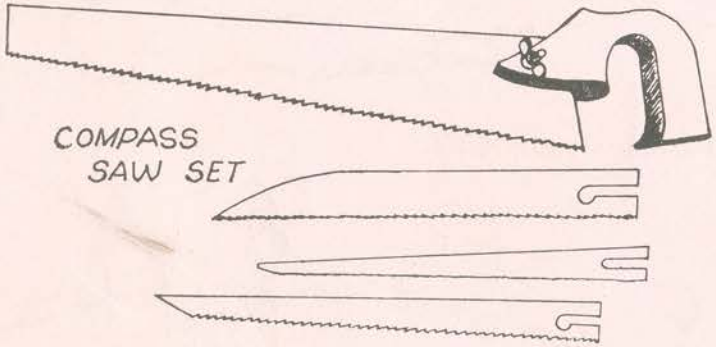
CARPENTER'S SAW

WOOD RASP

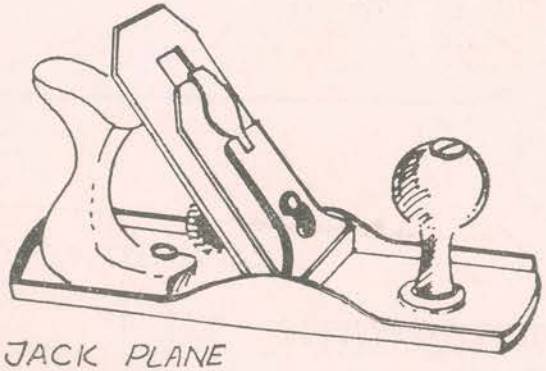


CORE CHISEL

MORTISE CHISEL



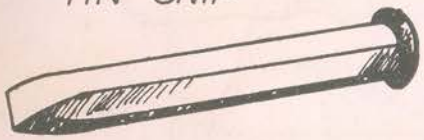
COMPASS SAW SET



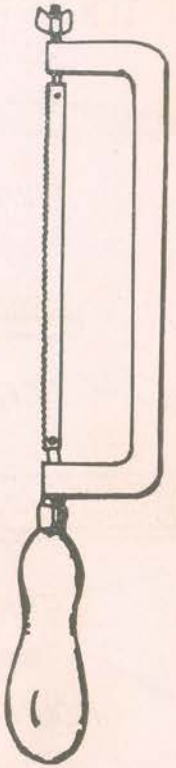
JACK PLANE

TOOLS FOR METAL WORK

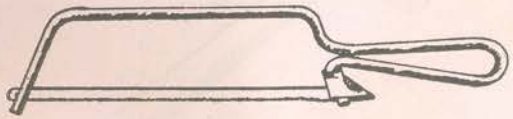
TIN SNIP



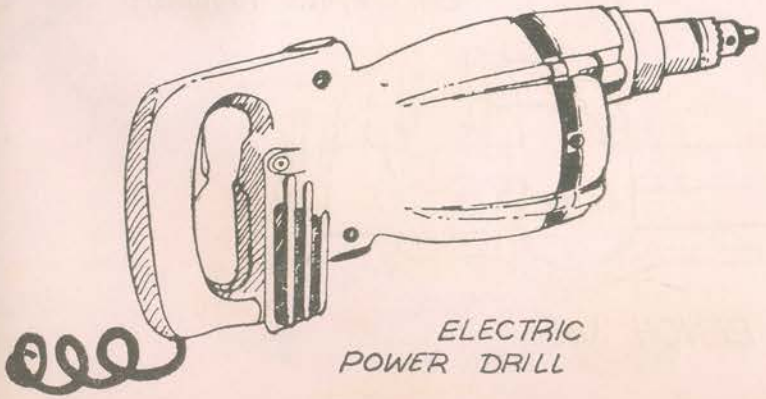
COLD CHISEL



HACK SAW (Size 12")

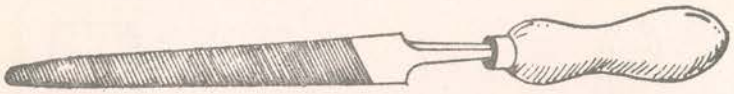


JUNIOR HACK SAW

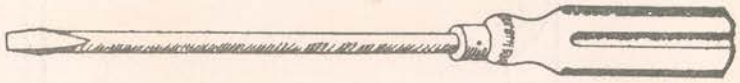


ELECTRIC POWER DRILL

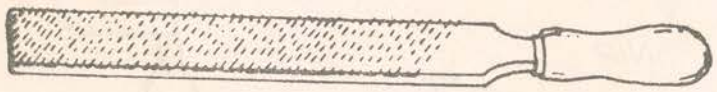
TOOLS FOR FITTING WORK



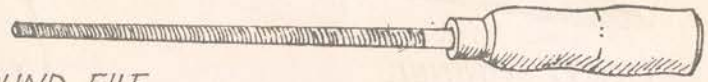
TRIANGULAR FILE



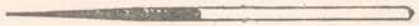
SCREW DRIVER



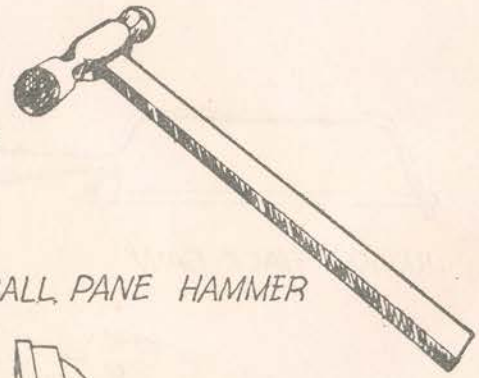
FLAT FILE



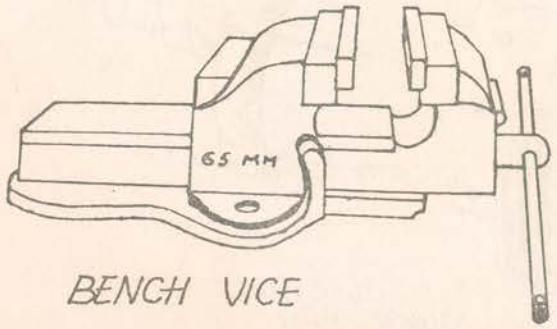
ROUND FILE



RAT TAIL FILE



BALL PANE HAMMER



BENCH VICE

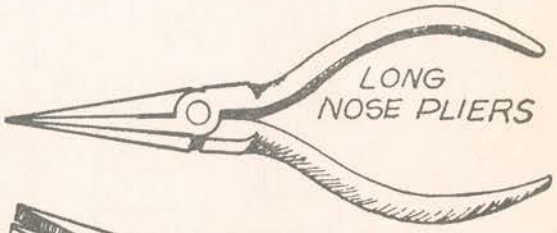
ELECTRICAL TOOLS

COMBINATION PLIERS

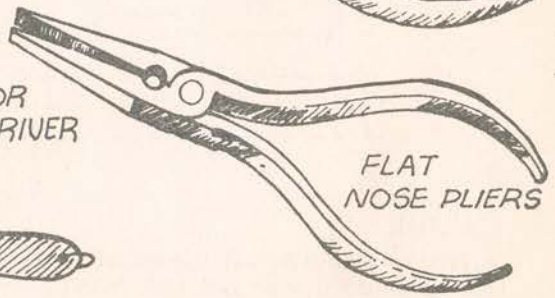
SOLDERING IRON

CONNECTOR SCREW DRIVER

NEON TESTER



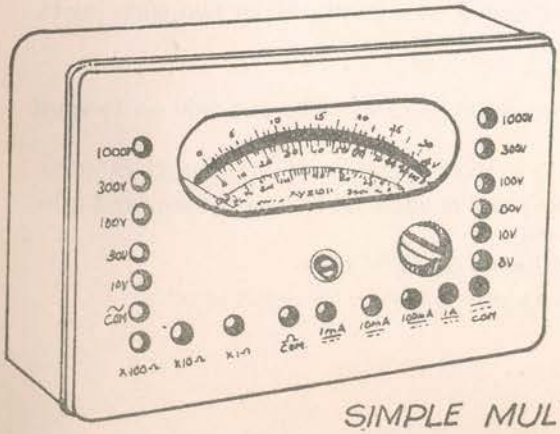
LONG NOSE PLIERS



FLAT NOSE PLIERS

KNIFE

DIAGONAL CUTTING PLIERS

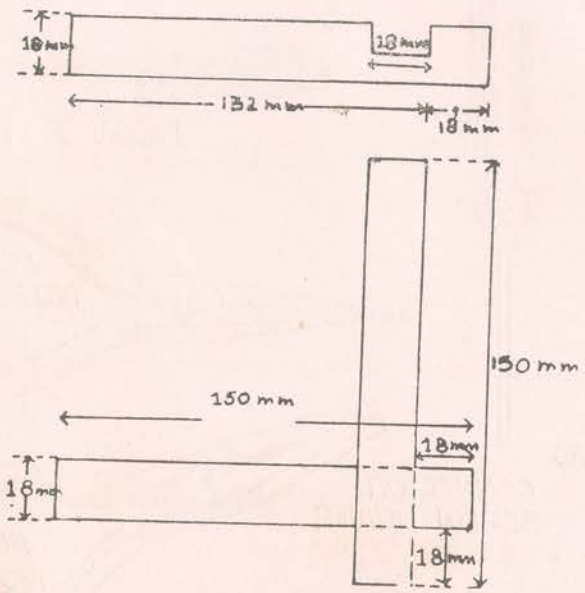


SIMPLE MULTIMETER

JOB NO. 1 : PLUS JOINT

TOOLS :

Jack Plane, Carpenter's Saw, Flat Chisel, Coarse Flat File, Tri-Square & Hammer.



SCHEDULE :

Prepare four wooden pieces of size 18 mm×18 mm×150 mm. Use Carpenter's saw and jack plane.

Cut a notch on each piece as shown in the sketch by saw and chisel and smooth it by flat file.

Make two pieces and form a plus joint. Make two such joints.

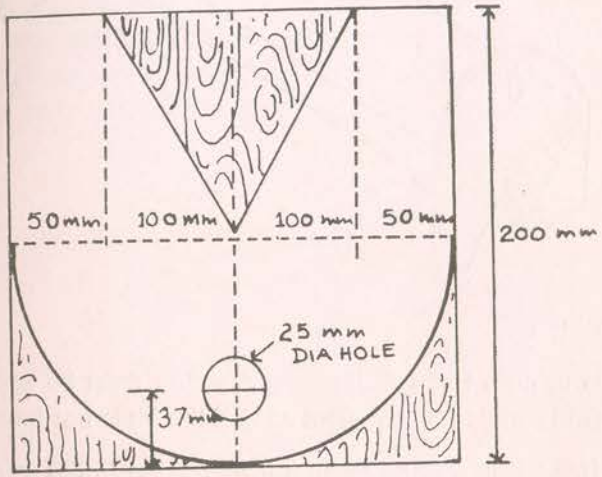
REMEMBER :

* Jack Plane, Carpenter's Saw and Flat File cut only on forward strokes.
* Do not use such cutting tools on pieces of wood stuck by nails.
* Learn how the cutting tool is adjusted in a Jack Plane and how it can be sharpened.
* Learn the use of different types of files.
* Learn how to fix two pieces of wood by wood screws.

Job No. 2 : MAKING A BOOK/TOOL RACK

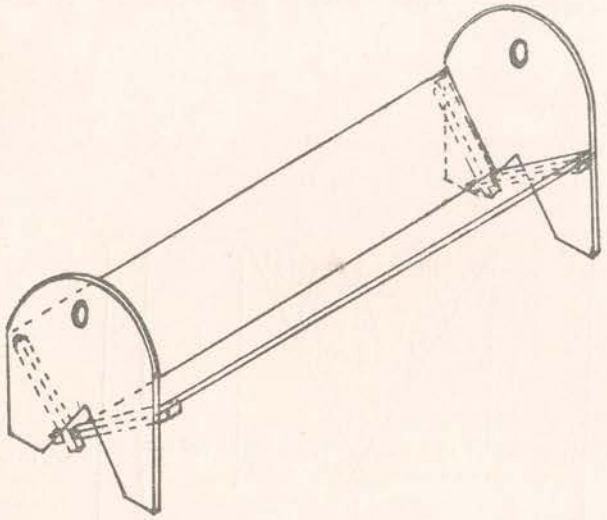
TOOLS :

Carpenter's Saw, Tri-Square, Coarse Flat File, Compass, Hand Drill with $\frac{1}{4}$" bit, Round File $\frac{1}{2}$", Triangular File $\frac{1}{2}$".



SCHEDULE :

Prepare two square sheets of 20 mm side. Remove the shaded portions and file smoothly. Use the two joints of job no.1 together with these two sheets and make a book/tool rack as per sketch.



REMEMBER :

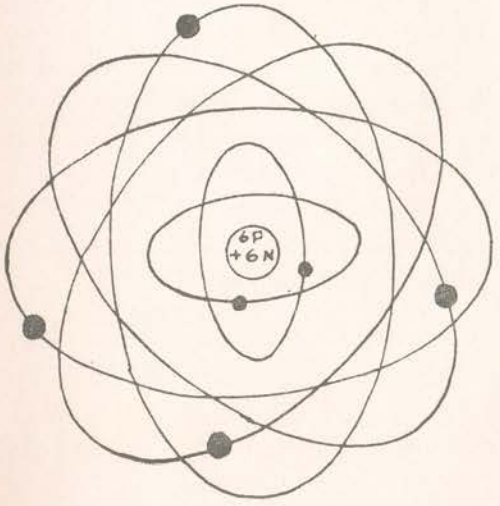
- While using a Hand Drill proper pressure must be applied and the Drill should be held erect so that the bit is not broken.
- The Hand Drill may be taken out by turning in the same direction and not in the reverse direction.

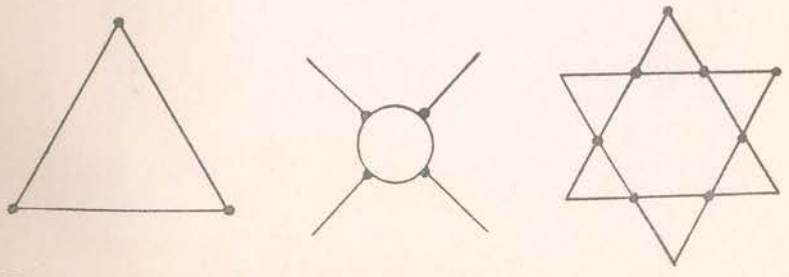
Job No. 3 : SOLDERING PRACTICE—CARBON ATOM

Practice soldering to form geometric patterns out of 18 SWG copper wire.

SCHEDULE :

Prepare a model of a carbon atom which has six protons and six neutrons in the nucleus and six electrons on outer orbits (overall diameter—225mm). Use different coloured beads for protons, neutrons and electrons. Make the circular orbit by GI wire suitably soldered to hold in position.





SOLDERING IRON :

Soldering Irons can generally be used on 230 volts A.C./ D. C. both and may have different wattage ranging from 6W to

500 W. For transistors and small electronic components 6W—25W iron is suitable. For general work 65W or 100W would be better. Irons of 250W and 500W are required in heavy metal work. A soldering iron has a heating coil inside and the general defect is that either the coil is cut at one or more points due to wear and tear or the leading cord is disconnected somewhere or the soldering bit starts scaling.

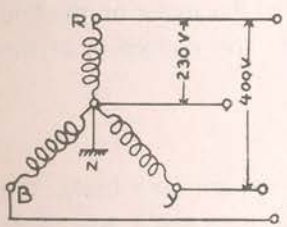
DISCUSSION ON ELECTRICAL LINES AND MEASUREMENTS

SUPPLY LINES :

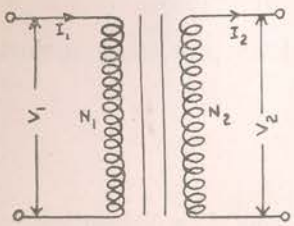
1. The domestic supply is 230 volts, 50 Hertz, alternating (A.C.) and rarely in some places 230 volts D.C.

2. The generated voltage at the power station is usually 11,000 volts. It is transformed to higher voltage e.g. 33,000 or 132,000 volts and carried by means of transmission lines to the consumers. The voltage is lowered by a stepdown transformer again.

3. The domestic supply comes from 400 volts 3 phase star system. Any two terminals of the star give 400 volts while any one terminal with the central earthed line gives 230 volts. This earthed line is dead and all three terminals are live, and careless handling of these live terminals may prove fatal.



4. A. C. supply voltage can be raised or lowered according to necessity by means of transformer. A common transformer has two separate coils, wound on a common magnetic core. A. C. voltage on one side induces a voltage on the other side in proportion to the turns ratio. The current and voltage relation with respect to the turns ratio is given as :



$$\frac{V_1}{V_2} = \frac{I_2}{I_1} = \frac{N_1}{N_2}$$

The more the turns, the more is the voltage and less the current.

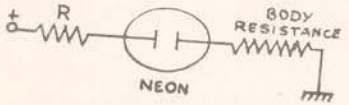
REMEMBER :

Do not work on any electric line with wet hands, or on wet floors. Sit on a dry wooden chair while working.

TESTING OF LINES :

1. Use of Neon Tester: Touch the Neon Tester on the line. If the Tester glows, the line is live. Learn the function of the Tester.

2. Use of a Test Lamp : Touch one terminal of the Test Lamp on the line and the other terminal on an earth point. If the lamp glows, the line is live.



3. Use of a Voltmeter : Touch one terminal of the meter on the line and the other terminal on an earthed point. The deflection of the meter needle will show the voltage.

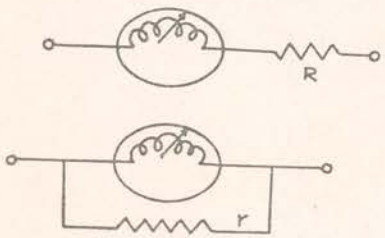
ELECTRIC SHOCK AND PROTECTION :

1. If any high potential difference is appllied on your body, the resulting current through the body paralyses nerves and other systems and ultimately causes death.

2. To avoid electric shock it is necessary to ensure that the circuit is not completed through your body or at least the current flowing through your body is restricted to a safe value.

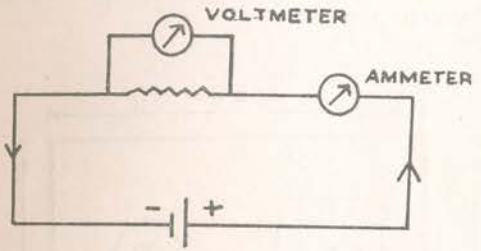
3. An isolating transformer may be used for protection against shock.

USE OF METERS :



1. A Voltmeter is a Galvanometer with high resistance (R) in series. A Voltmeter should be connected across a line where the voltage is to be measured.

2. An Ammeter is a Galvanometer with low resistance (r) in parallel (shunt). An Ammeter should always be connected in series in a circuit and never across two points where a voltage exists. Many people burn out their meters by just putting it across a battery or supply lines.

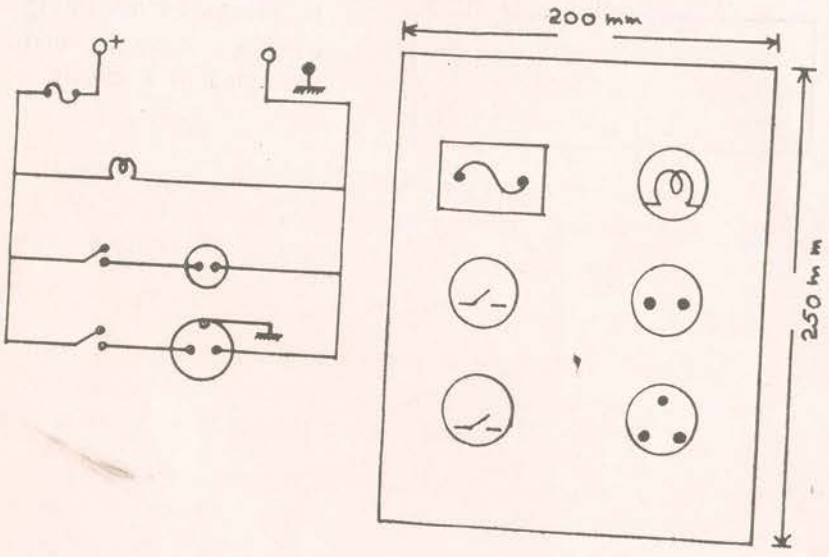


3. Learn the use of a Multimeter for measuring voltage, current and resistance in a circuit.

Job No. 4 : WIRING A LABORATORY POWER BOARD

MATERIALS :

A Double Board, one Kit-Kat Fuse (5 Amp.), one Batten Holder, two Tumbler Switches (5 Amp.), one Two-Pin Plug Base (5 Amp.), one Three-Pin Plug Base (5 Amp.), one 40 Watt Lamp, one Three-Pin Plug Top and connecting wires.



SCHEDULE :

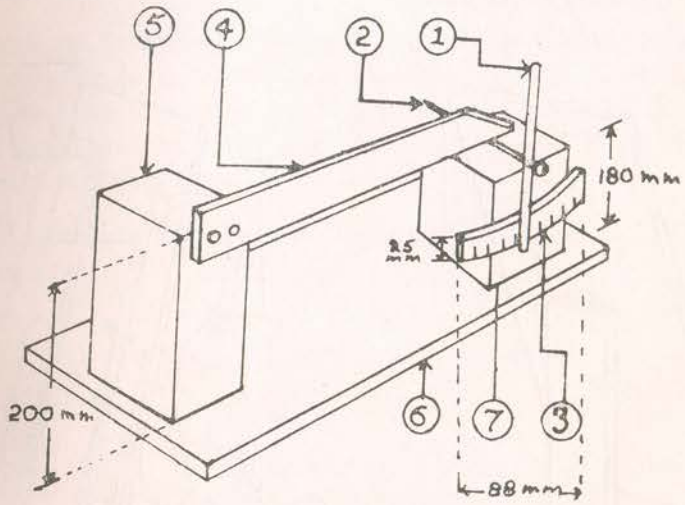
Make a Double Board of size 250 mm × 200 mm and ensure the connections in the following manner :

* the 3-pin plug base is to be controlled by a tumbler switch.
* the 2-pin plug base is to be controlled by a tumbler switch.
* the lamp holder is to be connected direct on the line.
* a fuse is to be inserted in the proper place on the line.
* the 3-pin plug top is to be connected by means of a suitable connecting cable.

Job No. 5 : EXPANSION OF SOLID BY HEAT

MATERIALS :

Aluminium Strip (350 mm × 25 mm × 3 mm), Wooden Block (50 mm × 25 mm × 150 mm), Wooden Block (50 mm × 25 mm × 130 mm), Plywood Board (450 mm × 200 mm × 6 mm), Cardboard, Wood Screws, Drinking Straw and Paper Pin.



SCHEDULE :

Cut the Wooden Blocks as shown in (5) and (7) in the sketch. Fix two Blocks on the base made of plywood (6). Fix Aluminium Strip (4) by Wood Screws as shown in the sketch. Insert the pin (2) through the centre of the Straw (1) and place it between the free end of the Aluminium Strip (4) and the top surface of the Wooden Block (7); this acts as an indicator. Fix the Cardboard Scale (3) of size (88 mm × 25 mm) having 34 equal division marks.

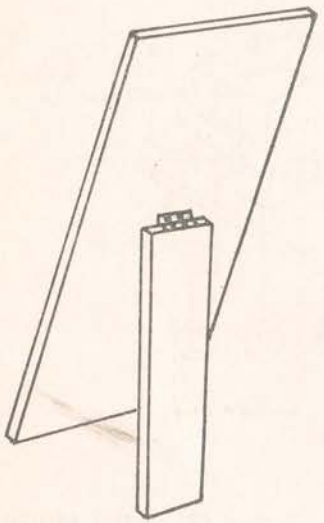
EXPERIMENT :

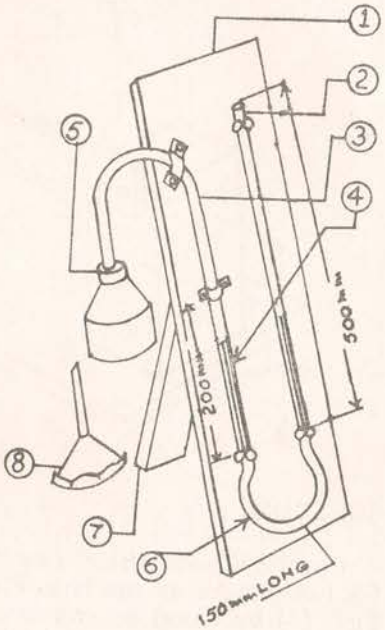
Heat the Aluminium Strip somewhere near its fixed end by the flame of a candle. The small increase in length of the Strip will cause the Pin to rotate which in turn rotates the Straw. The angular displacement of the Straw can indicate the linear expansion of the Aluminium Strip, if the scale is properly calibrated.

Job No. 6 : AIR THERMOMETER CUM PRESSURE GAUGE

MATERIALS :

Plywood Board (450 mm × 200 mm × 6 mm), Glass Tubing (700 mm × 6 mm dia), Brass Hinges, Rubber Tubing (700 mm × 6 mm dia), Polythene Funnel (small size); Balloons (large size); Kerosene Lamp Can.





SCHEDULE :

Fix the Wooden Leg (7) at the middle of the back of Plywood Board (1) by a hinge and screws. This is for keeping the Board erect. Cut the Glass Tubing into portions (2) and (4) and secure their positions on the Plywood Board by link-clips. Connect the lower ends of (2) and (4) which are in the same level by a 150 mm long Rubber Tubing (6). Fill the Tube with a coloured liquid. Connect one end of a long Rubber Tube (3) to the free end of (4) and the other end to the Kerosene Lamp Can (5). The Kerosene

Lamp Can will act as the Bulb of the thermometer. A scale may be placed in between the tubes (2) & (4) which may be properly calibrated.

For a pressure gauge the Kerosene Lamp Can may be replaced by a funnel with a piece of stretched balloon tied on its mouth.

EXPERIMENT :

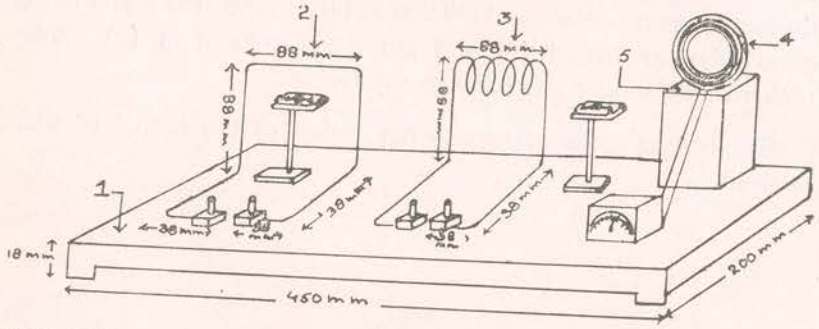
Place the Kerosene Lamp Can in bath of hot liquid the temperature of which is to be measured. Due to heat the air inside the Kerosene Lamp Can expands which in turn pushes the liquid in the glass tube downward (4) and the liquid column in (2) moves upward indicating a rise in temperature.

For reading pressure expose the mouth of the funnel to such pressure.

Job No. 7 : MAGNETIC FIELD

MATERIALS :

Super Enamel Copper Wire 16 and 36 SWG, Bar Magnet, Safety Razor Blade, Carpet Needle, Press Button, Eraser, Centre-Zero Ammeter (10-0-10 MA), Torch Cell (2 nos.), 6 mm Ply Board; Wooden Batten (18 mm × 12 mm), Wooden Block (50 mm × 25 mm × 100 mm); Wood Screws and Iron Nails, Machine Screws and Nuts.



SCHEDULE :

Cut a 450 mm × 200 mm × 6 mm plyboard and fix two 18 mm × 12 mm ×200 mm wooden battens by nails (1). Bend 16 SWG copper wire of suitable length (2). Prepare a solenoid having 10 nos. of circular turns each of diameter 18 mm with 16 SWG Copper wire (3). Fix them by brass machine screws and nuts as shown. Use 36 SWG copper wire to make a 30 mm diameter coil of 100 turns (4) and mount it on a wooden block of size 50 mm × 25 mm × 100 mm by link clips which is fixed on the wooden base by wood screws from the bottom. To prepare a magnetic needle magnetise the safety razor blade with the help of the bar magnet by single touch method. Fix the magnetised blade between the two parts of a press button by pressing at its centre hole. Make the carpet needle stand erect by pushing its threading end through the eraser. Pivot the magnetised razor blade assembly by placing the bottom dent of the press button on the pointed end of the erect needle.

EXPERIMENT :

(a) Electric current flowing through a straight wire produces a circular magnetic field around itself. Connect the two torch cells in series across the ends of the straight wire (2) and place the magnetic needle below or above the straight wire, its axis being parallel to the wire and perform the experiment.

(b) A solenoid behaves as a bar magnet when electric current flows through it. Connect the two ends of the solenoid (3) to the terminals of the two torch cells in series and find out the magnetic polarities developed at the two ends of the solenoid with the help of the magnetic needle.

Repeat the experiments (a) and (b) by reversing the battery connection.

(c) Electric current is induced in a coil when magnetic flux changes through it. Perform this experiment by connecting the ends of the coil to the terminals of the Ameter and moving the bar magnet to and fro near the coil with one of its poles facing the coil.

Repeat the experiment using the other pole of the magnet.

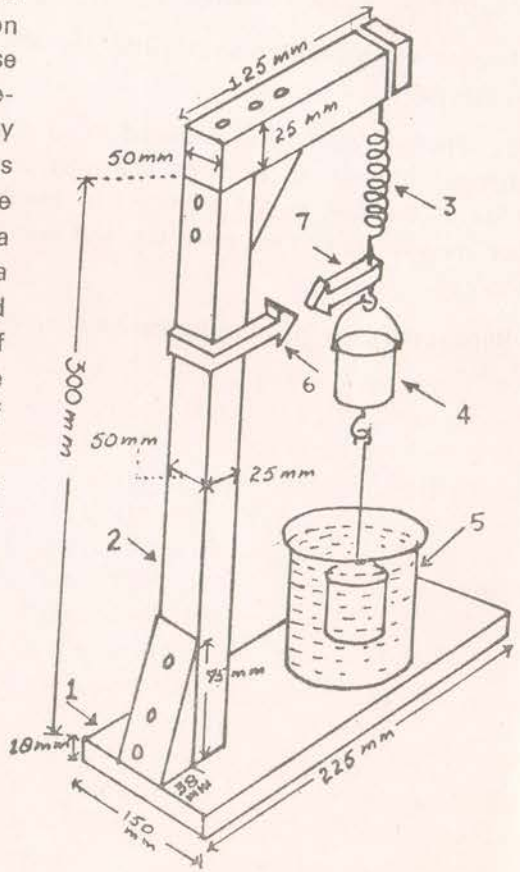
Job No. 8 : ARCHIMEDES' PRINCIPLE

MATERIALS :

Wooden Block (50 mm × 25 mm × 300 mm), Ply Board 6mm, Wooden Block (50 mm × 25 mm × 125 mm), Wooden Batten (18 mm × 12 mm), Aluminium Rod—40 mm long and 25 mm dia, G.I. Sheet 32 SWG, Spring Steel wire No. 22; Glass Beaker, Wood Screws and Iron Nails, G. I. Wire 28 SWG.

SCHEDULE :

Cut 225 mm × 150 mm × 6 mm Ply board and fix two 18 mm × 12 mm × 150 mm Wooden Battens by Iron Nails. This is the base (1) of the device. Prepare the Stand (2) by the Wooden Blocks as shown and fix it on the base by nails; Make a 50 mm × 10 mm dia spring (3) with end hooks with the help of the spring wire. Make a Hollow Can (4) of length 25 mm by bending the G. I. sheet of appropriate size over the solid Aluminium Rod (5) of size 25 mm × 25 mm dia and soldering joints. Make hanging hooks with G.I. wire, make pointers (6, 7) with the help of G. I. strip and set up the device as shown.



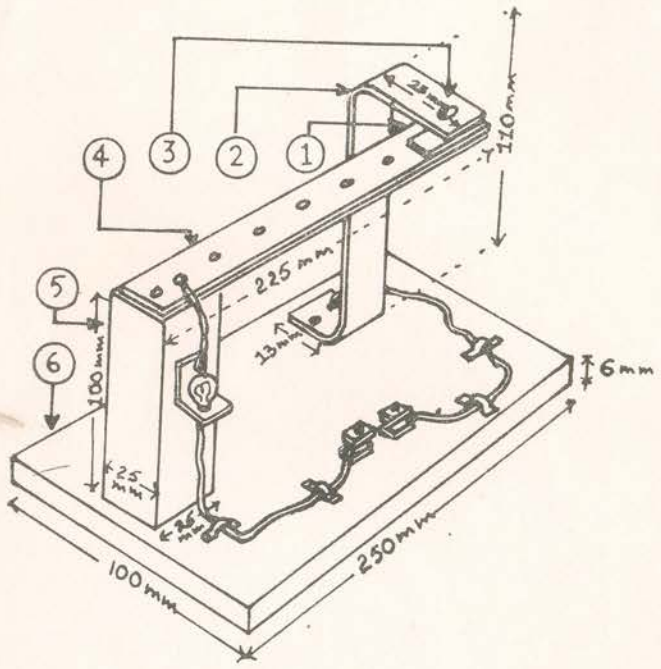
EXPERIMENT :

Adjust the pointer (6) to coincide with the spring pointer (7) when the solid aluminium rod hangs in air. Immerse the rod fully in water contained in the beaker and note the upward movement of the pointer (7) indicating apparent loss of weight. Pour water in the hollow cylinder to see when pointer (6) again coincides with the pointer (7). What is your inference ?

Job No. 9 : AUTOMATIC TEMPERATURE CONTROL

MATERIALS :

Wooden Block (25 mm × 25 mm × 100 mm), G. I. Strip (225 mm × 10 mm—24 SWG—2 nos), Brass Strip (225 mm × 10 mm—24 SWG), Lamp 6 volt, Lamp Holder, Plywood Board (250 mm × 100 mm × 6 mm), Aluminium Rivets; Brass Machine Screws (18 mm × 3 mm dia), Nuts, Link Clips, Wood Screws, Connecting Wire.



SCHEDULE :

The G. I. and brass strips are rivetted together to form a bimetal using five aluminium rivets. The bimetallic combination (4) is fixed at the one end on the top of the wooden block (5) by screws in such a way that the G. I. strip remains on the top of the brass strip. The wooden block (5) is fixed on the plywood board (6) as

per sketch. With the other G. I. strip a bracket (2) is made and is fixed on the board so that its top end is a little bit above the free end of the bimetal strip. At the top end of the bracket contact (3) is made by a brass machine screw with nut. Electrical connection is done as shown in the sketch.

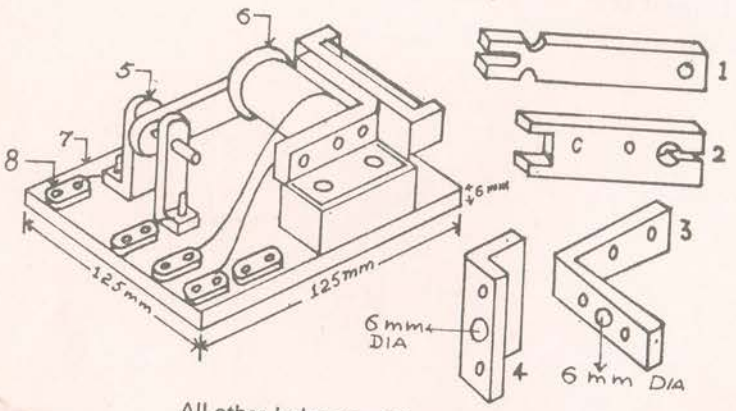
EXPERIMENT :

Heat the bimetal strip by a match stick. It will bend up and make contact with the contact above. The lamp will glow. When the bimetal strip cools down the circuit is broken and lamp extinguishes.

Job No. 10 : ELECTRIC RELAY

MATERIALS :

Roofing bolts (75 mm × 6 mm dia) and nuts, G. I. Sheet of 18 and 22 SWG, Plywood Board (125 mm × 125 mm × 6 mm), Wooden Block (50 mm × 25 mm × 50 mm), Super Enamel Copper wire 36 SWG, Bakelite/Perspex disc 25 mm dia (2 nos), Insulating paper, Aluminium Rivets, Brass Machine Screws and Nuts, Rubber Band.



All other holes are of 3 mm dia

SCHEDULE :

Make a 70 mm × 12 mm strip (1) from 22 SWG G. I. sheet and fix a rivet at the long end. Make a 57 mm × 12 mm strip (2) from 22 SWG G. I. sheet and bend it sharply at 20 mm from one end. Make a 83 mm × 12 mm strip (3) from 18 SWG G. I. sheet and bend it at right angle at its middle and make a 6 mm hole at the centre of one of its sides. Cut a 50 mm × 50 mm strip (4) from 18 SWG G. I. sheet and bend it at right angle at its middle. Cut slots and drill holes in all strips as per sketch before bending. Make a coil format of size 37 mm × 6 mm dia around the roofing bolt and fix two bakelite discs at two ends (6). Wind about 3000 turns of 36 SWG wire using a hand drill and neatly bring out two terminals on the bakelite discs. Now assemble the parts over the plywood

board (7) as shown. Make two contact brackets (5) of 12 mm width from 22 SWG GI strip and fix two brass screws for contact and mount these contacts as shown. All connections should be brought to 20 mm × 10 mm terminal strips (8) made of 22 SWG G. I. sheet and fixed on board by round head brass screws. Complete all electrical connections and fix a rubber band between the armature strip (1) and the armature bracket (2).

Adjust armature tension so that the relay works at minimum 4.5V D.C. It draws about 28 mA current and is suitable for use in some Transistor Control Circuit.

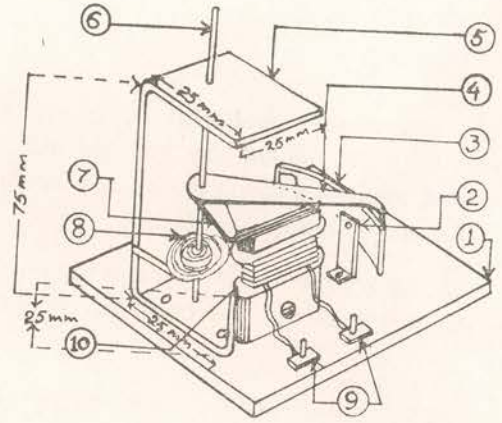
REMEMBER

* The voltage and current controlled by contacts are entirely independent of those applied on the coil. As such a small current flowing through a sensitive coil can regulate fairly high current and voltage through contacts.
* For handling large currents the contacts should be sturdy. For handling large voltage the contacts should be properly insulated.
* Connect appropriate condenser across the pair of contacts if you notice sparks.
* Relays are extensively used for automatic switching.

Job No. 11 : ELECTRIC METER

MATERIALS :

G. I. Sheet 24 SWG, Soft Iron Strips (50 mm × 25 mm —6 Nos), Super Enamel Copper Wire 38 SWG, Knitting Needle (8.7 mm long), Standard Hair Spring for Table Clock (18 mm dia), Aluminium Sheet (75 mm × 100 mm—24 SWG); Aluminium Foil (100 mm × 12 mm).



SCHEDULE :

Fix the G. I. bracket (5) on the board (1) by screws. Make the electromagnet (10) by winding 300 turns of copper wire around the soft iron pieces placed one above the other. Fix it to the G. I. bracket by machine screw and nut. Fix aluminium pointer made of aluminium foil, armature made of G. I. strip and hair spring to respective positions on the needle as per sketch. The needle should be placed vertically with its pointed end resting on a dent and the top end passing through a hole in the bracket. The hair spring is kept under tension by soldering its free end to the vertical portion of the bracket. When no current is flowing through the coil (10) the armature is little far from the electromagnet while the pointer reads zero.

EXPERIMENT :

The scale may be calibrated by connecting known currents. It will then be ready for measuring any unknown current.

REMEMBER

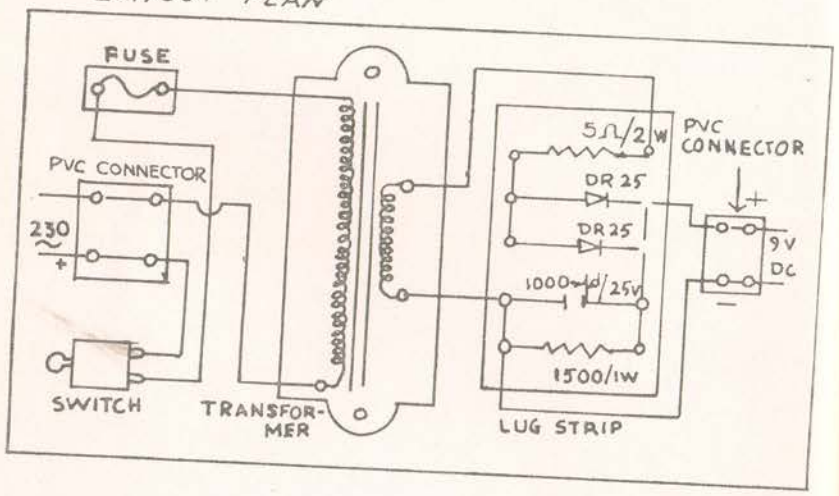
* The meter works only on D.C.
* Maximum voltage to be sent is 6 volts.
* Maximum current to be read is 200 mA.

Job No. 12 : BATTERY ELIMINATOR

MATERIALS :

Transformer 230 V/9 V, 500 mA, SPST switch, Cartridge Fuse 300 mA with holder, Diode DR 25 (2 Nos.), Electrolytic Condenser, 1000 mfd/25V, Carbon Resistor 150 ohms/1 watt, Wire-wound resistor 5 ohms/2 watt, Plyboard (150 mm × 100 mm × 6 mm), lug strip 5 way, PVC connector 2 way (2 Nos.), Wooden Batten (37 mm × 12 mm × 100 mm—2 Nos), Wood screws, Connecting wires; Iron nails.

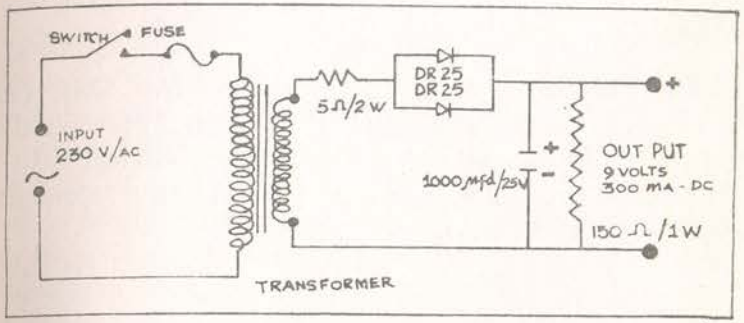
LAYOUT PLAN



SCHEDULE :

Fix two wooden battens at the two ends of the plyboard by nails. On this wooden base fix transformer, switch, fuse holder, connectors and lug strip as shown in the layout plan. Use pins on the lug strip for connecting components. Complete wiring and soldering as shown in the circuit diagram. Solder the diodes by a 25 watt iron as quickly as possible. Check the circuit and connect power. Measure output voltage by a multimeter.

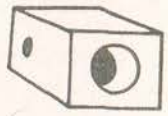
CIRCUIT DIAGRAM



REMEMBER

* Use 25 watt soldering iron to avoid overheating of diodes.
* Check polarities of diodes and electrolytic condenser before connection; otherwise you may burn them.
* Check for dry solder or wrong connection before giving power.
* Use heat sinks for diodes for continuous operation with more than 100 mA current.
* Never short circuit the output terminals.

Use this eliminator for transistor circuits or other operation requiring 9 volt D.C. and drawing not more than 300 mA current.



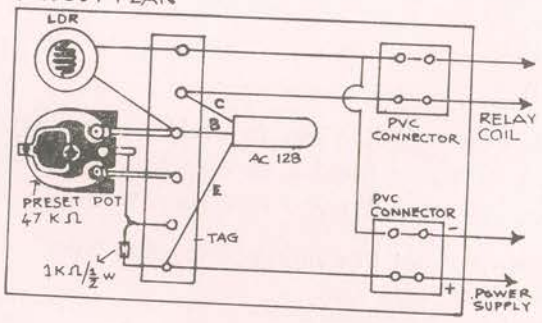
HEAT SINK

Job No. 13 : PHOTO SENSITIVE CIRCUIT

MATERIALS :

Relay (6V—9V, 300 Ω), LDR, Transistor (AC 128), Preset Pot (47 KΩ), Carbon resistor (1 KΩ/½ watt), Plywood Board (100 mm × 100 mm × 6 mm), Wooden batten (18 mm × 12 mm × 100 mm—2 Nos.), PVC connector (2 Nos.), Nails, Connecting wires; Tag strip (5 way).

LAYOUT PLAN



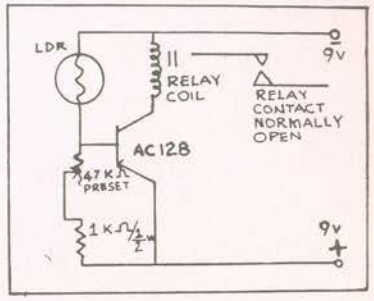
SCHEDULE :

Prepare a wooden base with plywood board and wooden battens. Fix the PVC connector and the tag strip. Connect the LDR, preset pot, carbon resistor and transistor as shown in the layout plan by soldering. Solder the transistor and the LDR at the end by a 25 watt soldering iron as quickly as possible. Complete wiring as shown in the diagram. Check the connection with the help of the circuit diagram. Connect the relay (Job No. 10) and apply power from the 9 volt battery eliminator (Job No. 12).

OPERATION :

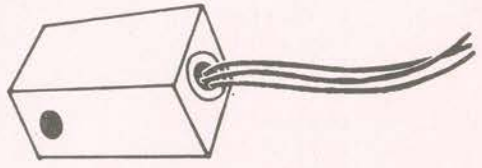
With no light falling on the LDR, the relay will not be energized since the circuit does not conduct current through the relay coil. When light falls on the LDR, its resistance decreases, as a result circuit conducts current through the relay coil. The relay is now energized and its normally open contacts close thereby operating the load connected across it.

CIRCUIT DIAGRAM



USE :

May be used for variety of control purposes, viz. Burglar Alarm, Smoke Detector, Automatic Counter or Sorter, Light Sensor etc. Suitable indicators e.g. Counter, Motor, Lamp etc., may be connected through the relay contacts. For continuous operation use a heat sink for the transistor.



Heat Sink

LIST OF BOOKS

Sl. No.	Author	Title	Publisher
1.	D. P. Roychoudhury	*Amrao Hote Pari*	Swakshar Limited 11B, Chowringhee Terrace, Calcutta-700016.
2.	G. C. Bhattacharjee	*Kare Dekho*	Bangiya Bijnan Parishad 294/2/1 A. P. C. Road, Calcutta-700 009,
3.	D. N. Biswas	*Kishore Bijnani*	Jignasa 133A, Rashbehari Avenue, Calcutta-700 029.
4.	Andre	Harmless Scientific Experiments for Boys	W. Foulsham & Co. Ltd. London.
5.	Kneitel & Brown	101 Easy Audio Projects	D. B. Taraporevala Sons & Co. Pvt. Ltd. 210, Dr. Dadabhai Naoroji Rd Bombay-400 001.
6.	L. Buckwalter	Electronic Games & Toys You Can Build	W. Foulsham & Co. Ltd., London.
7.	Kneitel & Brown	49 Easy Entertainment And Science Projects	—do—
8.	L. Buckwalter	Fascinating Easy-to-Build Electronic Games	—do—
9.	A. D. Bulman	Experiments And Models For Young Physicists	John Murray (Publishers) Ltd., 50 Albemarle St., London.
10.	R. R. Hopwood	Science Model-Making	—do—
11.	E. M. Noll	Science Projects in Electricity	W. Foulsham & Co. Ltd., London.
12.	F. G. Rayer	The Pegasus Book of Electrical Experiments	Dobson Books Ltd., 80, Kensington Church St., London.
13.	F. G. Rayer	The Pegasus Book of Electronic Experiments	—do—
14.	J. P. Shields	Projects in Basic Magnetism	W. Foulsham & Co. Ltd., London.
15.	Deryk T. Kelly	School Science & Technology-I Application of Science	The English Universities Press Ltd. St. Paul's House, Warwick Lane, London.
16.	Charles Windley	Teaching & Learning with Magic	Acropolis Book Ltd. Washington D. C. 20009, USA.
17.		Source Book of Science Teaching	UNESCO Orient Longman & Co., Calcutta.
18.		The Book of Popular Science (monthly magazine)	Grolier, Canada.
19.		Popular Mechanics (monthly magazine)	Hearst Corporation 959 Eighth Avenue, New York, NY 10019 U S A.
20.		Science Today (monthly magazine)	The Times of India Press Dr. D. N. Road, Bombay-400001.
21.		Sachitra Bijnan Kosh (Pictorial Encyclopaedia)	Jatiya Sanskrit Parishad 16/3, Gariahat Road, Calcutta-700 019.
22.		Science Reporter (monthly magazine)	Publication and Information Directorate (CSIR), Hillside Road, New Delhi-110 012.
23.		Science Age (monthly magazine)	Nehru Centre Annie Besant Road, Bombay-400 018.

WHAT WILL YOU DO AFTER RECEIVING THIS TRAINING ?

* Go back to your school with the demonstration kits you made during the training programme and use them in your class. Convince the authorities about the utility of such kits in introducing a new system of teaching.

* Start a Creative Abilities Centre (CAC) in a room in your school with not more than 20 students working in groups in leisure time. NCSM will help you by providing a master plan with all details.

* Get some demonstration kits made by your students in CAC and set up a demonstration lecture unit on any subject as outlined by NCSM. Use this unit in your class.

* Guide your students in pursuing their hobbies and develop their creative talents. Consult the designs and information supplied by NCSM and make new instruments, models, and kits.

* Organise annual science exhibition in your school and actively participate in science fairs organised by NCSM in your district and at state level.

* Ask NCSM to help you all the time.

CAN YOU ENTHUSE YOUR STUDENTS TO TAKE UP INVESTIGATIVE PROJECTS ?

* Conduct different tests for detecting adulteration in food and other consumer products.

* Test acidity or alkalinity of soil and advise farmers accordingly.

* Estimate Nicotine and tar content of different brands of cigarettes.

* Test water samples from different areas and investigate into the cause of pollution.

* Conduct a survey on food habits in your locality and check for nutrition value in average intake.

* Set up a simple weather station in your schools and try to forecast weather.

SET UP A CREATIVE ABILITIES CENTRE

* Build up a Creative Abilities Centre (CAC) in your school where your students will work in off time and pursue their hobbies in science.

* In CAC your students can develop their creative talents or build up their own laboratory by making teaching kits.

* The membership of CAC may be restricted to about 20 students of senior classes (say from classes VIII to XI) at present. Suitable tests may be devised to select candidates when there are many applicants.

* CAC can be located in various schools or in other organisations dedicated to science-propagation.

* Science Museums and Centres under the NCSM will act as a link among all such CACs and will provide necessary technical advice and guidance in setting up such CACs in different places and in running such centres subsequently. NCSM will supply design of projects, list of tools, books and other informative materials.

* Overall responsibility including financial implications of CAC shall rest with the school authorities and the day to day work may be looked after by a properly trained teachers engaged in the school.

* Such teachers who will be running your CAC may be properly trained in the Teachers' Training Programme by the Museum/ Centre.

Designed and Published by National Council of Science Museums, 19A, Gurusaday Road, Calcutta-700 019 and printed at Rae & Co. (P) Ltd., 5A, Madge Lane, Calcutta-700 016.

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TEACHERS'

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