



Electrical Workshop Practice I (ECEg2073)

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Telegram page
try up to end!!!

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Outline

- 1 General Safety
- 2 Common types of Electrical Hand Tools
- 3 Splicing and Joining
- 4 Termination
- 5 Soldering
- 6 Wiring materials and accessories
- 7 Electrical wiring circuits
- 8 Industrial installation
- 9 Thank You!!!

General Safety

- Safety engineering rules existing in electrical work require that the tools be always maintained in a fit working condition.
- General safeties to be followed are
 - 1 Keep all tools in good repair condition
 - 2 When working with a chisel or cap chisel wears goggles or eye glass to protect the eyes from flying chips;
 - 3 When hacking or cutting parts made of hard or brittle metal with chisels, be sure to use netting (shields, screens, etc.) to protect the surrounding personnel from flying fragments;
 - 4 Bench vices and similar tools must be installed and fixed in such a way that the men using them may stand in a correct and natural working position.

- 1 When soldering, arrange the hot soldering iron so as not to bum the hands and its cords. Never lay switched- on or heated soldering irons on a bench or tables; it may cause a fire to damage the surrounding.
- 2 Premises in which soldering is done must have appropriate ventilation to protect the personnel from the harmful effect of vapor and gases liberated during soldering. Keep the windows opened before starting soldering and brazing.
- 3 When sharpening tools on grinding wheel, be sure to use protective glasses Helmet or goggles to guard the eyes from flying sparks.
- 4 When using an electric arc welding & soldering iron, it is absolutely necessary to put on goggles fitted with protective glass to guard the eyes from the harmful rays of the arc.

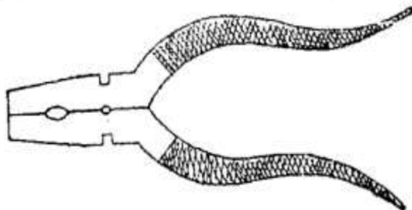
- 1 All high voltage electric insulation strength tests must be carried out in a special fenced-off place. The test stand must have pilot lamp to warn the operating personnel that the high-voltage is switched on.
- 2 Repair of windings of various electrical machines and apparatus involves impregnation.
- 3 Where impregnating work is carried out facilities must be provided to protect the health of the personnel and to prevent fires.
- 4 All operations involved in mixing and dissolving insulation varnishes must be carried in strict conformity with instructions.
- 5 Impregnation shop workers must observe all the requirements of hygiene when handling irritable or caustic solvents.

Common types of Electrical Hand Tools

- Materials used for wiring , splicing and connecting , insulating of electrical installation.

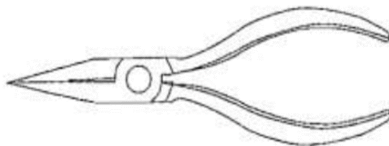
1. CUTTING PLIER:

In electrical tools cutting plier is the most important tool. It is used to cut the cables and to tighten them. The handles of the plier is, wrapped by rubber even to be used in current supply. It is also used to fix or remove screws.



2. LONG NOSE PLIER

It is used to fix and remove screws in narrow gaps. It is widely used while repairing radios and speakers.



3. KNIFE

It is used to remove the insulation in electric cables. The handle of a knife is made up of wood or plastic. Its length is in four or five inches to keep easily in shirt pockets.



4. SCREW DRIVER

It is used to fix and tighten the screws. The point of a screw-driver should be flat to be fixed in the gap in the head of a screw. It is available in different sizes from 4.5 inches to 12 inches. It is named according to its length. Its handle is made up of wood or plastic. Wooden handles are better to be used for long period than plastic handled Screw Driver.



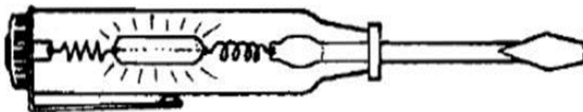
5. CONNECTING SCREW DRIVER

It is also a type of ScrewDriver. Its handle is made of plastic. It is available in small sizes. It is used to fix and tighten screws in joints, and poles. It is of 4.5 or 5 inches.



6. TESTER

It is the essential tool of a electrician. It is also like connecting screw Driver in size.



Its handle is also made up of slots. In its handle a visible pipe like part is fixed in it a neon bulb is fixed with a screw metal and there is a clip in its head. All these parts are connected using a cable. It is used to check current supply in electric circuits. If there is a current supply in the circuit the neon bulb glows.

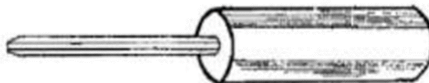
7. POCKER

It has a sharp end. It is used to make holes to fix screws in electric boards.



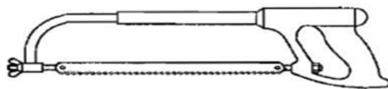
8. JUMPER

It is used to make holes on walls. It is available in 8 SWG or 6SWG sizes. Its handle is made up of iron. By hammering its handle, required holes are made by the sharp points.



9. HACKSAW

It is used to cut PVC or metal pipes and metal frames. The frame of hack saw is made up of Iron and the handle is made up of wood. A clip is fixed in its other end to adjust the length.



10. BALL PANE HAMMER

As its head is round shaped like a ball it is called so. Its head is made up of iron and handle is made up of wood. It is used to fix needles and bend iron rods. It is available in different weights.

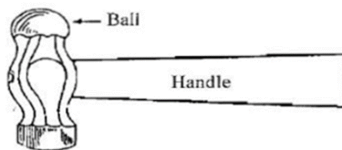
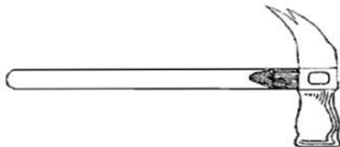


Figure 1

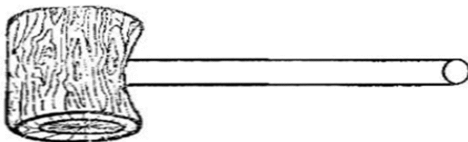
11. CLAWHAMMER

In this type of hammer of end is flat, the other bent and there is a claw in the end. It is used to remove nails and hammering the nails.



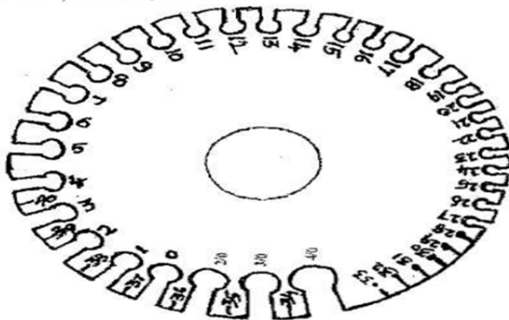
12. MALLET

It is fully made up of wood. It is mostly used for woodet works.



WIRE GAUGE PLATE

It is of round shape. It is used to measure the width of wires. Its unit is gauge. The wire is put into the hole in the centre of the Gauge to measure its width. Wires are available in gauge of 8 SWG, 12 SWG, 18 SWG.



American Wire Gauge (AWG) to Metric (mm²) Conversion

AWG	MM2	AWG	MM2
30	0.05	6	16
28	0.08	4	25
26	0.14	2	35
24	0.25	1	50
22	0.34	1/0	55
21	0.38	2/0	70
20	0.50	3/0	95
18	0.75	4/0	120
17	1.00	300MCM	150
16	1.50	350MCM	185
14	2.50	500MCM	240
12	4.00	600MCM	300
10	6.00	750MCM	400
8	10.00	1,000MCM	500

AWG to Inches

Diameter in *inches* can be calculated from AWG as

$$d_{in} = 0.005 \, 92^{(36 - n)/39} \quad (1)$$

where

d_{in} = diameter (inches)

n = gauge

AWG to mm

Diameter in *mm* can be calculated from AWG as

$$d_{mm} = 0.127 \, 92^{(36 - n)/39} \quad (1b)$$

where

d_{mm} = diameter (mm)

n = gauge

Figure 2: https://www.engineeringtoolbox.com/awg-wire-gauge-circular-mils-d_819.html

Definition of splicing

- Splicing is connecting or joining two and above wires at one point to make node for distributing electric current or elongated electrical wire as needed.
- : is an electrical connection made by twisting wires together

Advantages of proper splicing

- It makes the installation become mechanically and electrically strong.
- The disadvantage of poor splicing: if the splice is loose, these poorly constructed joints will cause abnormal heating and arcing. if near inflammable material will result in a fire hazard

Types of splices

1 Pig tail splice

- 1 **Single wire pig tail** :It is used for permanent as well as temporary connections in outlet, switch boxes, and other confined space where there is no pull on the wire.

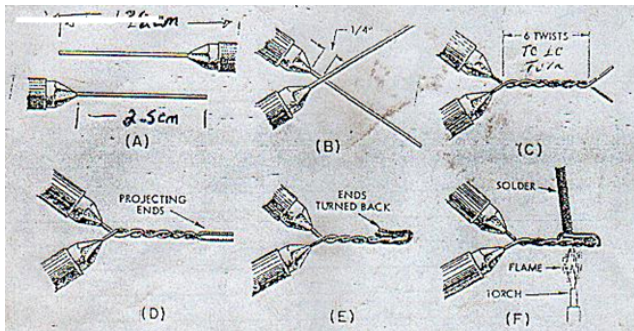


Figure 3: How to make a pig tail splice

- 11 **Bunch splice (pig tail)** is used for joining more than two wires at ceiling-fixture outlets, switch boxes, etc where a number of wires from different parts are brought to one box and splicing together.

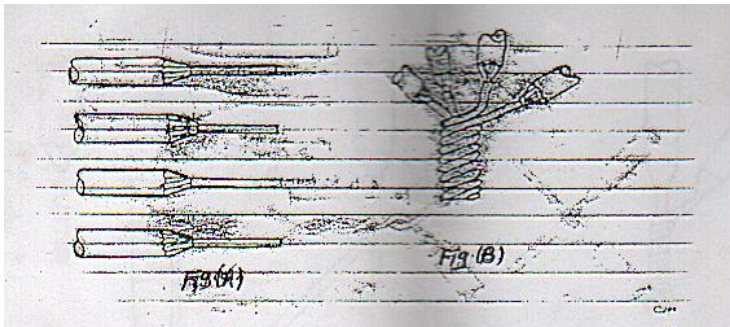


Figure 4: Bunch splice (pig tail)

- iii) **Flexible wire to solid wire splice (pig tail)** This splice is used for joining the solid wires used in permanent wiring together with the flexible conductors used in wiring fixtures and appliances (two wires of different cross section).

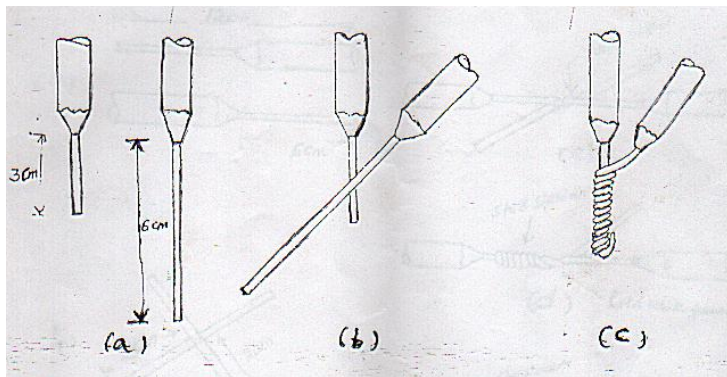


Figure 5: Flexible wire to solid wire splice (pig tail)

- 2 **Western union splice:** Used for extending the length of wires. **Note:** Sometimes the western union splice with greater number of neck turns, greater number of shoulders and no neck turns may be used.

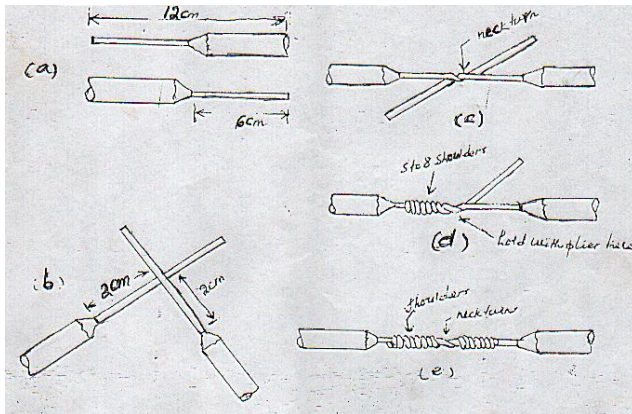


Figure 6: Western union splice

3 Tap (branch) splicing

- A Single branch splice: Used for making a connection anywhere along the length of another wire. It is really one half of a western union splice.

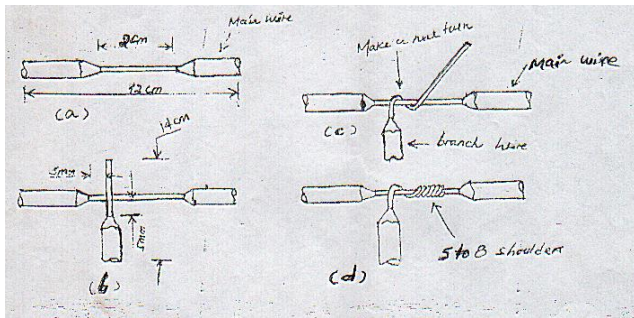


Figure 7: Tap (branch) splicing

- B Double branch splice:** used in where two branch wires, leading in opposite directions, connected to a main wire at one point.

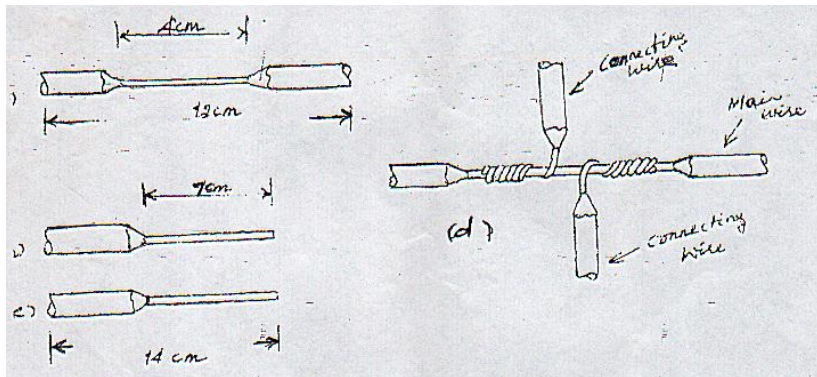


Figure 8: Double branch splice

- 4 **Britannian splice:** Used for joining large non-flexible single core wires. It is commonly applied in distribution system.

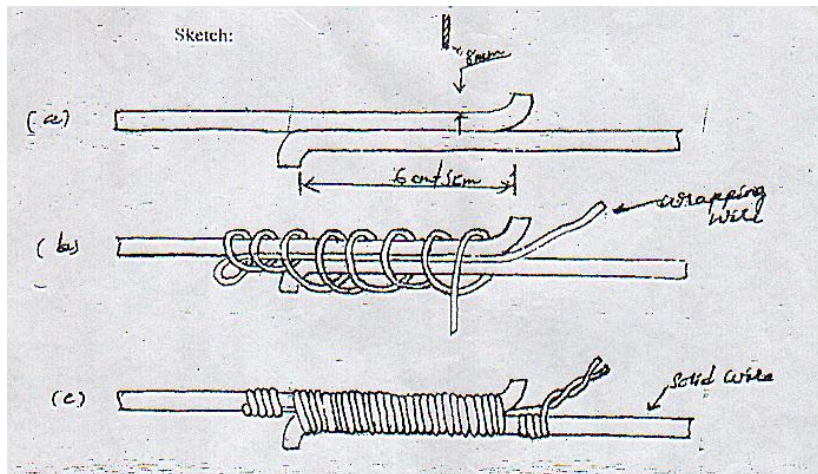


Figure 9: Britannian splice

- 5 **Dove-tail splice:** Used for large non-flexible stranded conductors. Such splice is mostly applied in over head transmission lines.

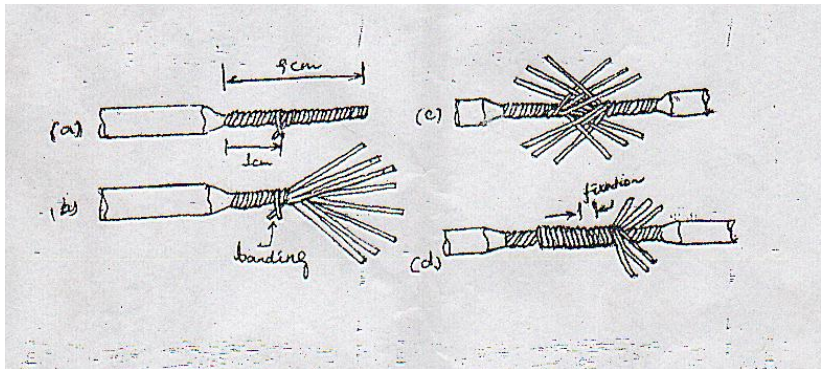


Figure 10: Dove-tail splice

- **TAPPING SPLICES** : An insulation tape is used to cover the splices with (purpose) protective materials, material equivalent in electrical strength to that on the original conductor.

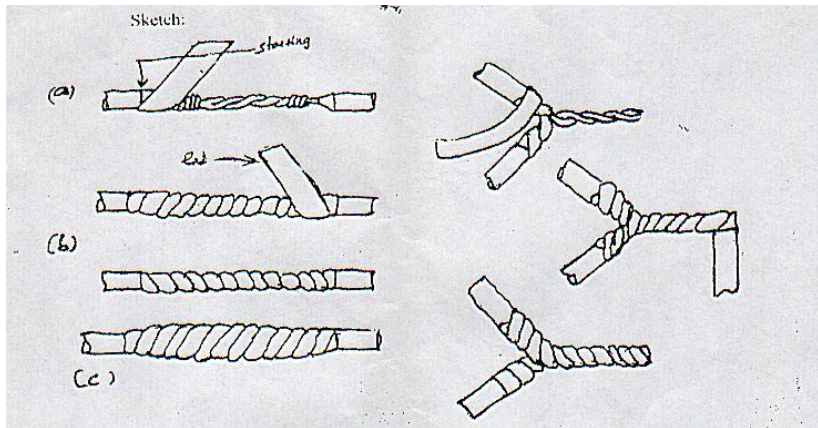


Figure 11: TAPPING SPLICES

Joining wires with connector tubes

- Is used to connect terminal of one wire with another wire it is in the form of Bakelite, porcelain or plastic it also has small screws which are used to make the connection.
- The connector must be able to take all strands of conductors to be joined together .

Definition of termination

- The process of connecting lugs or connectors to the wires as well as the preparation of the wire ends so as to enable them to be connected to the terminals of electrical equipment is called **Termination**.
- Single strand copper wires in sizes up to 10sq.mm and multi-core wires in sizes up to 2.5sq.mm may be connected to the terminals of various instruments and apparatus with out lugs;

- In this case the ends of multi-strand conductors should be welded or tinned while single strand aluminum wires,
- before being connected to the terminal, should be scrapped bright and coated with Vaseline to protect them from oxidizing.
- Heavy cage copper wires and all multi-core aluminum wires should be fitted with special lug.

Types of termination

- 1 **Ring-end termination:** is generally used for terminating small gauge Stranded wires.



Figure 12: Ring-end termination

- 2 **Stub-end termination**

- 3 **Lug-end termination**

- i Crimping type
- ii Soldering type

- Crimping and soldering lugs into the ends of wires, creates Reliable contact of the wires & cables with the terminals of the electrical equipment.

Note:

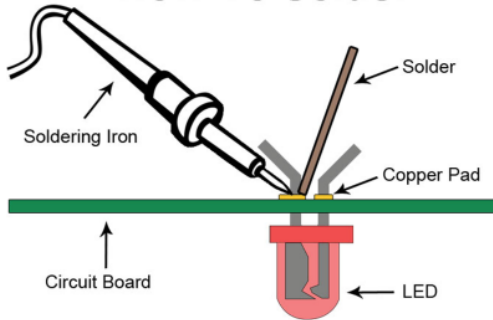
- Single-strand wires with cross-section greater than 10sq.mm are also Terminated by means of lugs, the procedure to be followed being analogous to the one stated above.
- Single as well as multi-strand **Al** wires may also be terminate same manner as **Cu** wires, but the special features of **Al** Wire connections have to take into consideration.



Definition of Soldering

- Soldering is the process of joining two or more electronic parts together by melting solder around the connection.
- Solder is a metal alloy and when it cools it creates a strong electrical bond between the parts.
- is the process in which two or more metal items are joined together by melting and flowing a filler metal (solder) into the joint.
- The tools like **Soldering lead**, **Soldering Iron**, **Tester**, **Solder Cleaner** and **Clipper** are used in Soldering shop.

How To Solder



[Makerspaces.com/how-to-solder](https://makerspaces.com/how-to-solder)

Step 1 - Heat soldering iron.

Step 2 - Touch soldering iron to copper pad and component lead. Hold for 2-3 seconds.

Step 3 - Add solder to copper pad opposite of the soldering iron. Don't touch solder directly to the iron. Solder should surround pad/lead and be a cone shape.

Step 4 - Wait 1-2 seconds and remove soldering iron.

How To Solder Wires

Now it's time to show you how to solder wires together. For this process, it's recommended to use helping hands or other type of clamp device.

Begin by removing the insulation from the ends of both wires you are soldering together. If the wire is stranded, twist the strands together with your fingers.



Make sure your soldering iron is fully heated and touch the tip to the end of one of the wires. Hold it on the wire for 3-4 seconds.



Keep the iron in place and touch the solder to the wire until it's fully coated. Repeat this process on the other wire.



Hold the two tinned wires on top of each other and touch the soldering iron to both wires. This process should melt the solder and coat both wires evenly.



Remove the soldering iron and wait a few seconds to let the soldered connection cool and harden. Use heat shrink to cover the connection.



Soldering Materials

- A **soldering iron** is a hand tool that plugs into a standard 120v AC outlet and heats up in order to melt solder around electrical connections.
- This is one of the most important tools used in soldering and it can come in a few variations such as pen or gun form.



- For beginners, it's recommended that you use the pen style soldering iron in the 15W to 30W range.
- Most soldering irons have interchangeable tips that can be used for different soldering applications.

- A **soldering station** is a more advanced version of the basic standalone soldering pen.
- If you are going to be doing a lot of soldering, these are great to have as they offer more flexibility and control.
- The main benefit of a soldering station is the ability to precisely adjust the temperature of the soldering iron which is great for a range of projects.
- These stations can also create a safer workspace as some include advanced temperature sensors, alert settings and even password protection for safety



Wire and cable

- The term **wire** and **cable** are used more or less synonymously in house wiring .
- bare conductors, whether single or stranded together are termed as Wire .
- Conductors covered with insulation are termed as cables.
- The necessary requirements of cable are that it should conduct electricity efficiently, cheaply and safely .
- This should neither be small so as to have a large internal voltage drop nor be too large so as to cost too much.
- Its insulation should be such as to prevent leakage of current in unwanted direction and thus to minimize risk of fire and shock.

A Cable consists of three parts

- ➊ **The conductor or core** :- the metal Wire or strand of Wires carrying the current.
- ➋ **The insulation or dielectric** :- a covering of insulating material to avoid leakage current from the conductor.
- ➌ **The protective covering** :- for protection of insulation from mechanical damage.

Conductor Materials Used in Cables

- Copper and Aluminum are the materials used as conductors
 - Copper:- Though Silver is the best conductor but due to its higher cost it is hardly used any where.
 - The next best conductor is, copper. It is cheaper comparatively
 - It is mechanically strong, hard, extremely tough, durable and ductile.
 - It is highly resistive to corrosion, Oxidation and pitting.

- **Aluminum:** is frequently used in place of copper for bare electric cables used for long distance power distribution.
- The electrical conductivity of aluminum is about 60% of that of copper (2.87×10^{-8} ohm-m at 20 °C) .
- so for the same resistance for a given length, the aluminum required be 1.61 times that of copper in volume and 1.26 times of that of copper in diameter.
- The only application of aluminum cables for wiring in buildings is for a continuous bus bar system of distribution, used sometimes in blocks of flats or office buildings for rising mains and sub-mains of larger sectional area.

Insulating Materials

The insulation material used in electric cable must possess following properties:

- i High resistivity
- ii High flexibility
- iii Non- inflammability
- iv High resistivity to moisture, acids or alkalies qualities.

So the type of insulating material used depends upon the service for which the cable is required.

The various types of insulating materials used in cables are :-

- i) **Rubber:** Rubber may be natural or synthetic. Its relative permittivity is between 2 and 3 and its dielectric strength is 30KV/mm.

Though it possesses high insulating qualities, it absorbs moisture readily, softens when heated to a temperature of 60 °C to 70 °C, swells under the action of mineral oils and ages when exposed to light. Hence pure rubber cannot be used as insulating material.

ii) **PVC:** Polyvinyl chloride is a man made thermo- plastic which is tough, Incombustible and chemically un reactive.

- Its chief drawback is that it softens at temperatures above 80°C . It does not deteriorate with age
- PVC insulated cables are usually employed for low and medium voltage domestic and industrial lights and power installations

iii) **Vulcanized India Rubber.** It is prepared by mixing India rubber with Minerals such as sulphur, zinc red lead, etc.

- The copper conductors used in this cable are tinned to protect them from corrosive action of rubber on copper.
- The use of VIR cables is limited to low voltage distribution and internal wiring as paper insulated cables have largely superseded them.

- iv. **Impregnated Paper.** It is quite cheap, has low capacitance, high dielectric Strength (30KV/mm) and high insulation resistivity(10 Mohm-cm) .
- The main advantage of paper insulated cables is that a cable of given size can be worked out at a higher current density than a VIR cable

Types of cables used in internal wiring

❖ The wires employed for internal wiring of buildings may be divided into different groups according to:-

- ✓ The type of conductor
 - ✓ The number of cores
 - ✓ The voltage grading and
 - ✓ the type of insulation used.
- According to the **number of cores**, the cables may be divided into the classes known as:- **single core**, **twin core**, **twin core with ECC** (earth continuity conductor) cables etc.
 - According to voltage grading the cables may be divided into two classes:

Conduit Accessories and Fittings

❖ Conduit Couplers:

✓ Conduit is available in lengths from 3m to 5m and for straight runs of greater length, Couplers are used to join two lengths of conduit.

❖ Bends, Elbows and Tees:

✓ In general conduit fittings include bends, elbows and tees.

✓ Bends are usually used for change in direction of conduit. these should never be sharp. The minimum allowable radius of curvature is 2.5 times the outside diameter of the conduit.

✓ Solid elbows and tees should be used only at the end of the conduit run(e.g. close behind a light fitting or accessory). The detachable lid provided in inspection type tees and elbows facilitate **pulling of cables**.

❖ Conduit Boxes:

✓ Conduit boxes are used in surface conduit wiring as well as concealed conduit wiring.

✓ The conduit boxes are of different designs.

Lighting Accessories And Fittings

- **Switches**

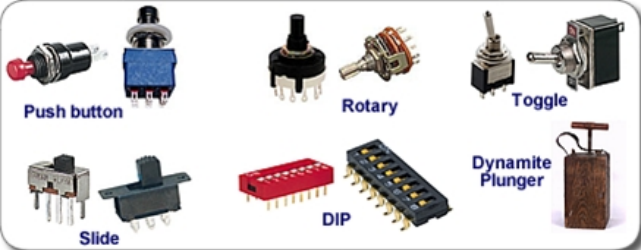
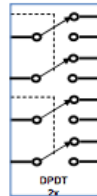
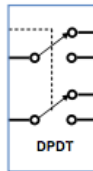
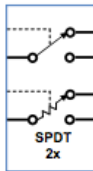
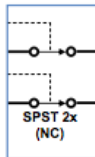
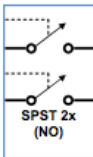
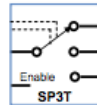
- ❖ the most familiar switch is that used to **control lighting circuits**.

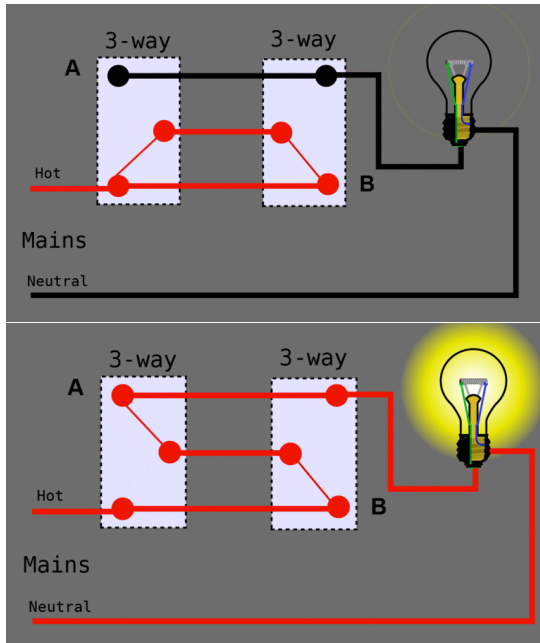
Most are rated at 5/6A, but rating at 15A are also available.

- ❖ Three types of switches are available;

- single pole
- two-way and
- four-way(intermediate), each for the control of a practical circuit arrangement.

Switches Configuration by Function



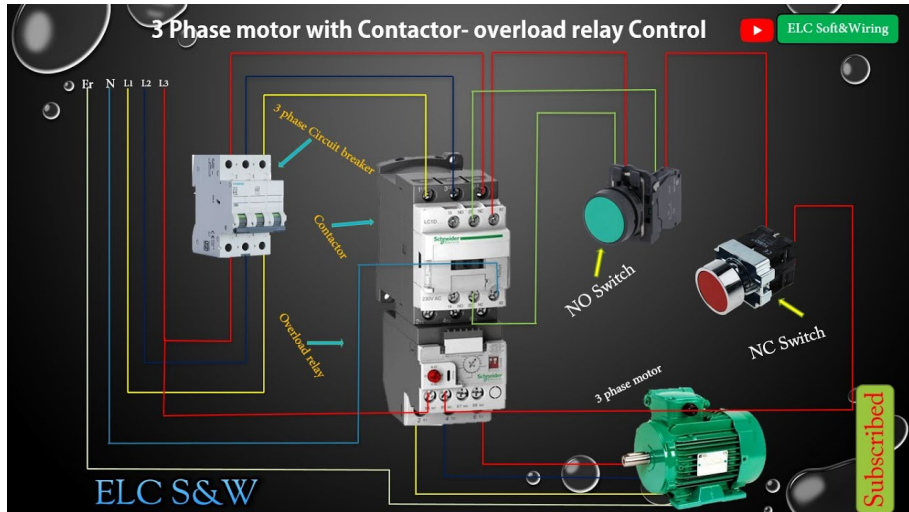


Protection device

- A fuse element consists essentially of a piece of copper or tin-lead alloy wire which will melt when carrying a predetermined current.
- This element with contacts, carrier, and base is called a fuse.
- It is placed in series with the circuit to be protected, and automatically breaks the circuit when overloaded.
- In general, the regulations regarding fuses require that fuses shall be accessible, and shall be fitted either on the front of a switch-board or in protecting cases.
- In most cases of installation work, the fuses are fitted in a distribution board.

Circuit Breakers

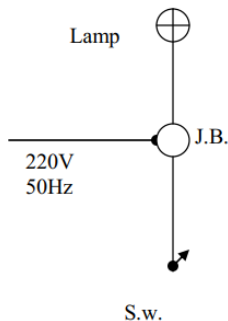
- ❖ It is a device designed to open and close a circuit by non- automatic means, and to **open the circuit automatically on a predetermined** over –current without injury to itself when properly applied within its rating.
- ❖ So a circuit breaker is combination device composed of a manual switch and an over-current device.
- ❖ A circuit breaker has several advantages over any type of fuse.
 - a) in the event of a fault or overload, all the poles are simultaneously disconnected from the supply.
 - b) overload and time-lags are capable of adjustment within limits.
 - c) the circuit can be closed again quickly onto the fault safely.



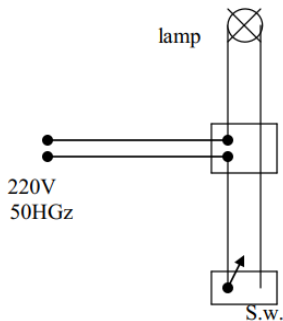
Laboratory Jobs

Laboratory Job.1

- One lamp controlled by a single pole, single throw switch. N.B as we equipped with low voltage power supply we will be working on 220V, 50Hz.



Single line representation diagram



Wiring diagram (multi line representation)

(Fig. 1. Lay out diagram & Wiring diagram)

- Two lamps connected in series controlled by a single pole, single throw switch

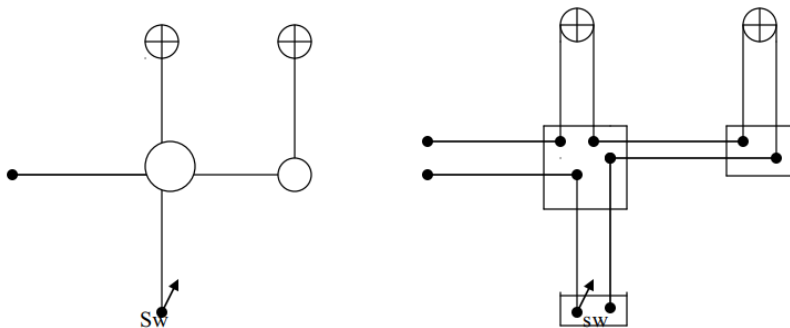


Figure 15: Lay-out & Wiring diagram

- Two lamps connected in parallel controlled by single pole, single throw switch

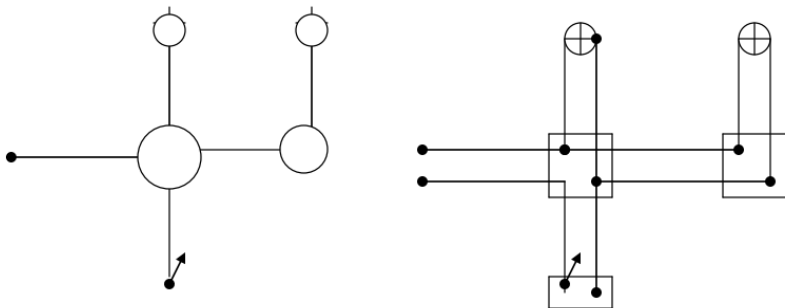


Figure 16: Lay out & Wiring diagram

● Bed room lighting

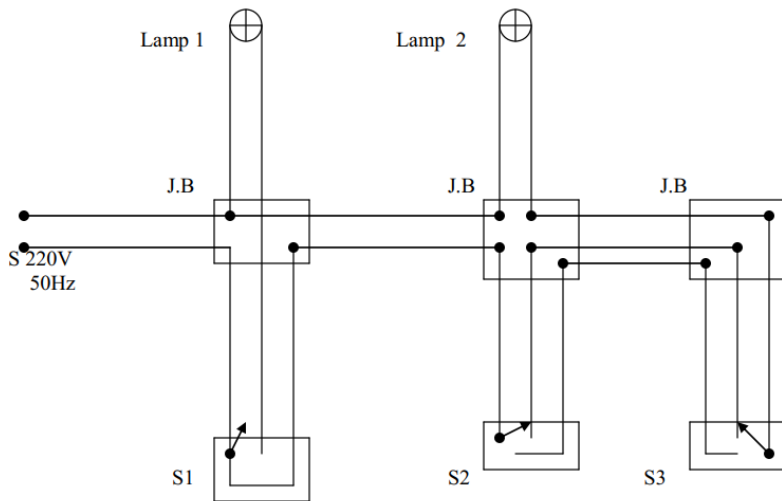


Figure 17: Wiring Diagram For Bed Room Lighting

- Two lamps controlled from three different places by means of two, two-switches and by an intermediate switch

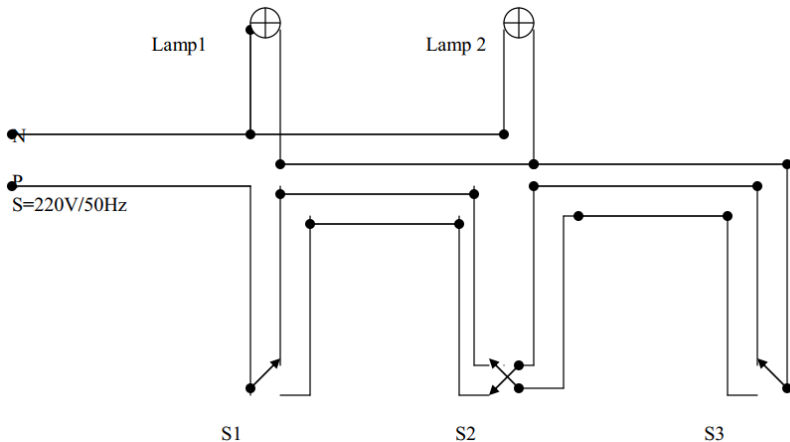
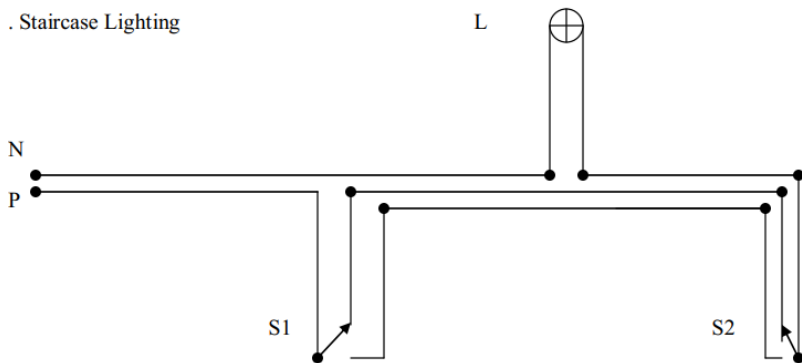


Figure 18

● Staircase Lighting

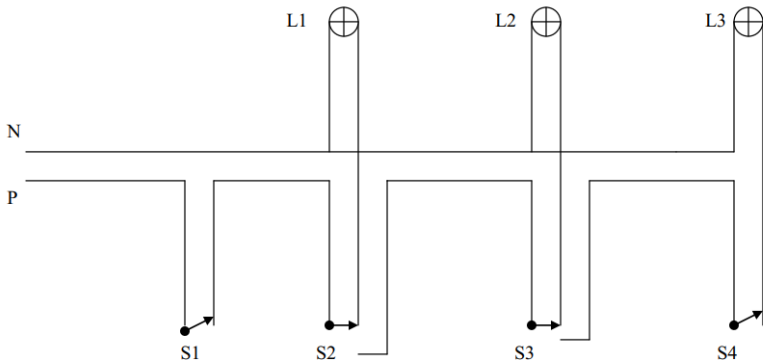
. Staircase Lighting



Wiring Diagram for Staircase Lighting

Figure 19: Staircase Lighting

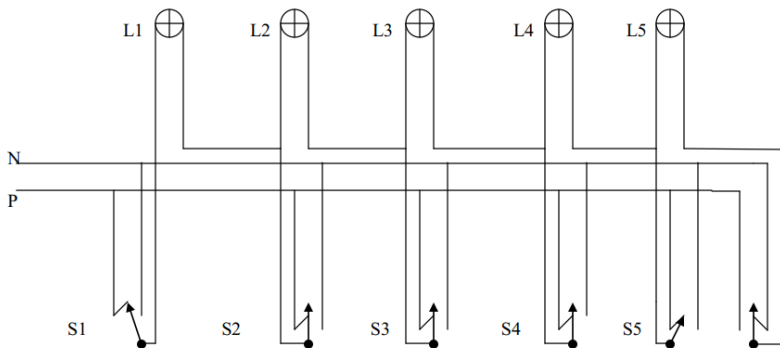
Corridor Lighting



Wiring diagram for corridor lighting

Figure 20: Corridor Lighting

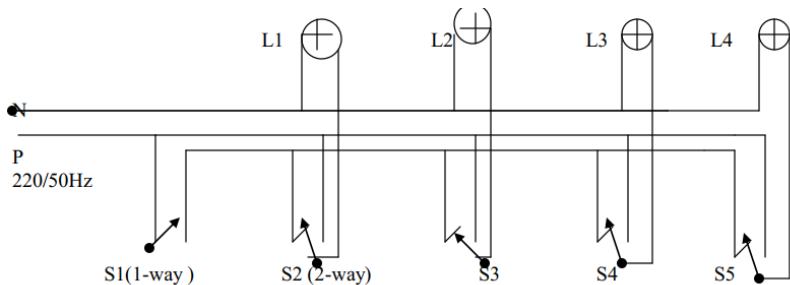
- Staircase Lighting Sequentially operation one after an other, that means if the first lamp OFF, at the same time the next lamp will turn ON. This system used for long distant staircase lighting.



Wiring diagram for staircase lighting circuit with 6 two-way switches.

Figure 21

● Master “ON” Circuits

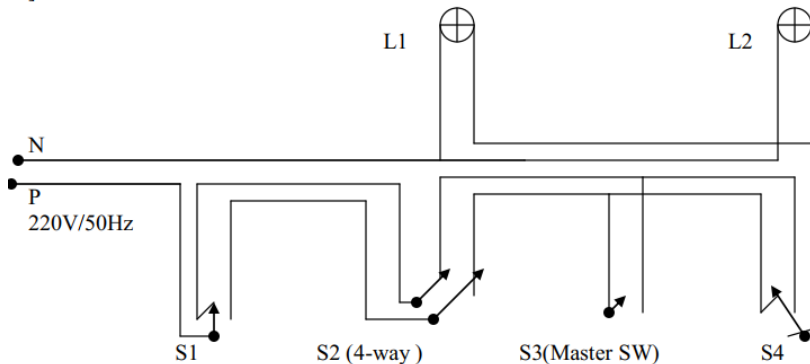


Complete :-Wiring diagram for master “ON” circuit with three two-way switches and one Single –way switch.

Requirement: To switch on the lamps and to prevent any body switching them OFF with individual switches.

Figure 22

● Master “ON” for corridor lighting



Wiring diagram for a master ON circuit

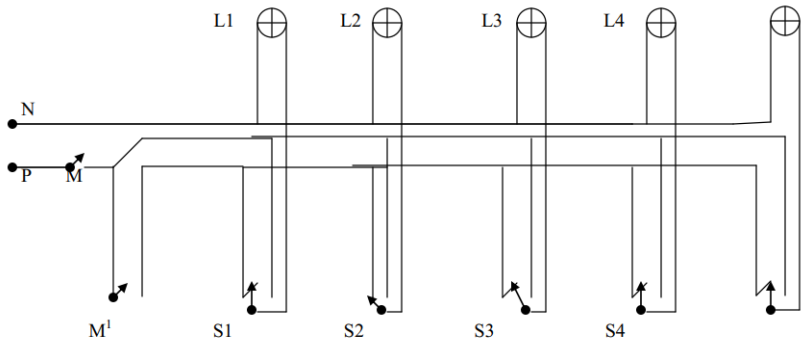
Requirement: When the master switch is switched “ON” the lamps remain lighted independent of the position of all switches.

Figure 23

Variable Master Control

- The variable master control are those master switches which work both as “master on” and “master off”.
- The five lamps are controlled independently by their switches while single-way switch M & M1 as a variable master controls.
- When M is in off position no light will light, thus working as “master off” control.
- If M & M1 switched “ON” then all lamps can be controlled independently.
- **Requirement:** Used to control either master on or master off.
- **Master OFF:** To put off the lamps irrespective of the position of the individual switches and to prevent any body switching on lamps

Variable Master Control



Wiring diagram for variable master control circuit

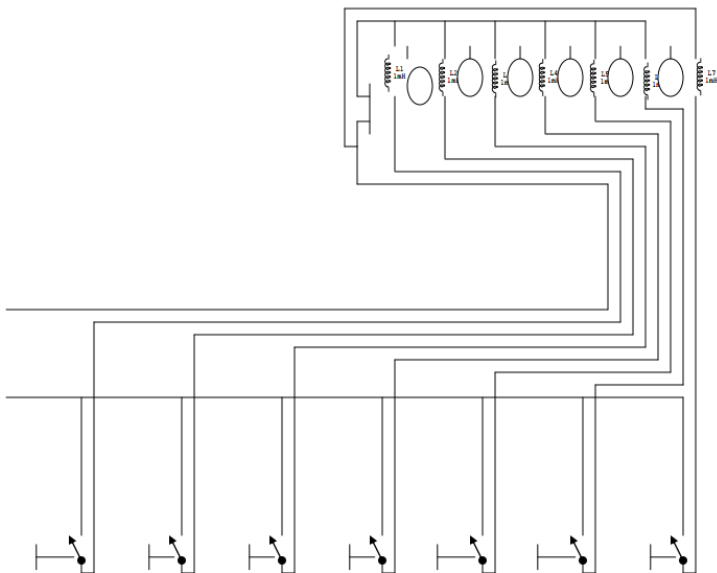
Figure 24

Annunciator Circuit

- A bell circuit is often arranged so that the bell can be operated from any one of two or more positions.
- In these circumstances it is necessary to install an indicator to show which push button has been pressed.
- The bell gives an audible signal and the indicator flag a visual signal at some central point.
- Indicating that a service is required, or an emergency has arisen at a particular push position.

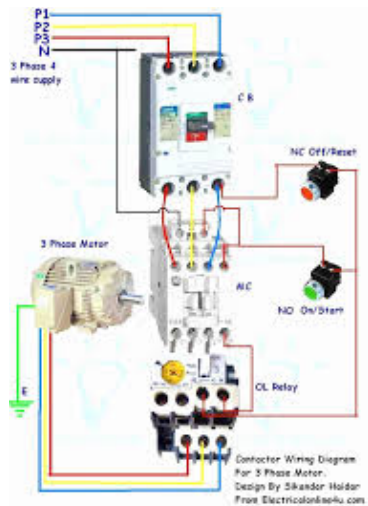
- Assume this type of circuit is used in hospitals. Individual pushes are available at each bed and the bell indicator board is situated in the ward supervisor's office.
- Large fire alarm system also uses indicator boards to indicate the zone or part of the building where the call was initiated.
- Complete the wiring diagram shown below and construct the installation on the wiring board.

● Annunciator Circuit



Starting of ac motors

- Motor control was a simple problem when motors were used to drive a common line shaft to which several machines were connected.
- It was simply necessary to start and stop the motor a few times a day.
- However, with individual drive, the motor is now almost an integral part of the machine and it is necessary to design the motor controller to fit the needs of the machine to which it is connected.



- The following components will be used
 - **Contactors**



Figure 26: Contactor

- Contactor is an electrically controlled switch (relay) used for switching a power circuit.
- A contactor is activated by a control input which is a lower voltage / current than that which the contactor is switching.

● Overload Relays



Figure 27: overload relay

- An "Over current Relay" is a type of protective relay.
- In a typical application the over current relay is used for over current protection, connected to a current transformer and calibrated to operate at or above a specific current level.

- **Aux. Contacts**



Figure 28: Aux. Contacts

- Auxiliary contacts of a switching device are contacts in addition to the main circuit contacts and operate with the movement of the latter.

- **Push button**



Normally Open Pushbutton



Normally Closed Pushbutton

Figure 29: Push buttons

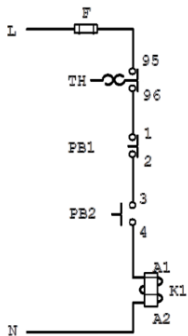
- It used to start and stop the controlling circuit. If the Push button is green color it is normally open used to start the motor and otherwise the color red it is Normally Closed used for stop the motor.
- **Timer**: is a switching device by give time delay in a circuit.

Full voltage DOL starter of 3 phase induction motor

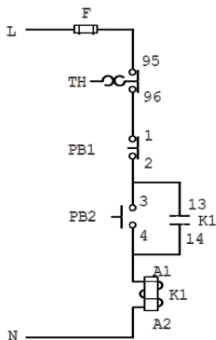
- This method of starting is ideal as long as the peak starting current is accepted and the initial starting torque of peak starting of the motor is adequate to state the machine .
- The starting current peak is 4 to 8 times the rated current this high starting current may be damage the circuits and motor windings so not recommended for high capacity motors above 5kw.
- Torque during starting is always higher than the rated torque for the modern motors.

- It reaches about reaches maximum when the motor reaches about 80% of its speed and at this speed the current is considerably reduced.
- This use for small capacity squirrel cage motors for directly connecting them to the 3 phase ac supply.
- And starting torque in this method is about 1.5 times the normal torque.
- Therefore this method is not recommended if smooth starting is the requirement of the loads

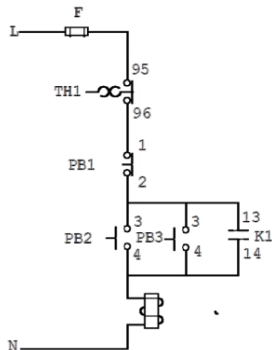
Controlling circuits



INCHING MODE



SELF HOLD MODE



TO DIFFERANT POSTION

Figure 30: Controlling circuits by DOL starter

- **Principle operation of circuit:** - when we press PB1 K1 is energized the motor start run and press PB1 K1 is de energized the is stop rotate.

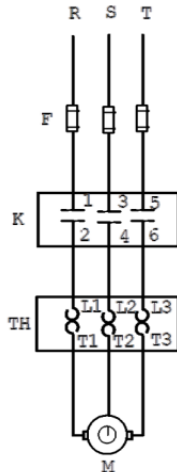


Figure 31: Power circuit

Full voltage forward reversing 3-phase induction motor

- These circuits used only for change the direction rotation of the motor.

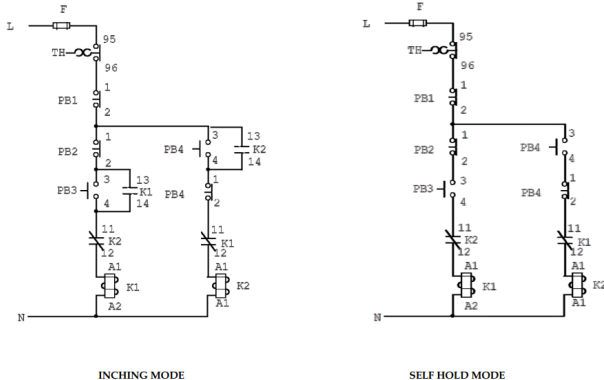


Figure 32: motor rotation in forward and reverse direction

- **Principle operation** :- when we press BP 3 k1 is energized and k2 is open by means of normally closed 11,12 k1 the motor rotate clock wise direction and if we need the motor anti clock wise direction press BP 4 then the motor start rotate at opposite direction from the privies.

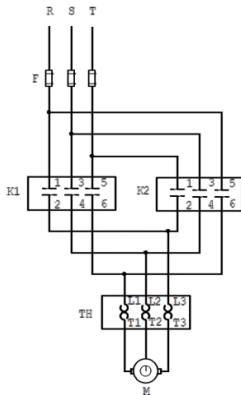


Figure 33: motor rotation in forward and reverse direction power circuit

Star-Delta Star/Delta 3 phase induction motors

- This form of reduced voltage starter is suitable for those 3 phase squirrel cage motors in which all the six terminals of the stator winding are brought out.
- For the purpose of starting the motor windings are connected in star and the motor is energized with 58% of the full voltage to each of the winding and maintained at this voltage for a predetermined time.
- Then it is de energized and the reconnected with winding in delta with full line voltage across each line.

- The reduced voltage - 58% of the rated voltage is constant during the first step of starting.
- The torque which is reduced by a ratio of the square of the voltage is equal to one third of the torque furnished by directly started motor and the current in the supply line is reduced by directly started motor and the current in the supply line is reduced by the same amount.
- This starting used for above 55kw motors.

● Power and Controlling circuit

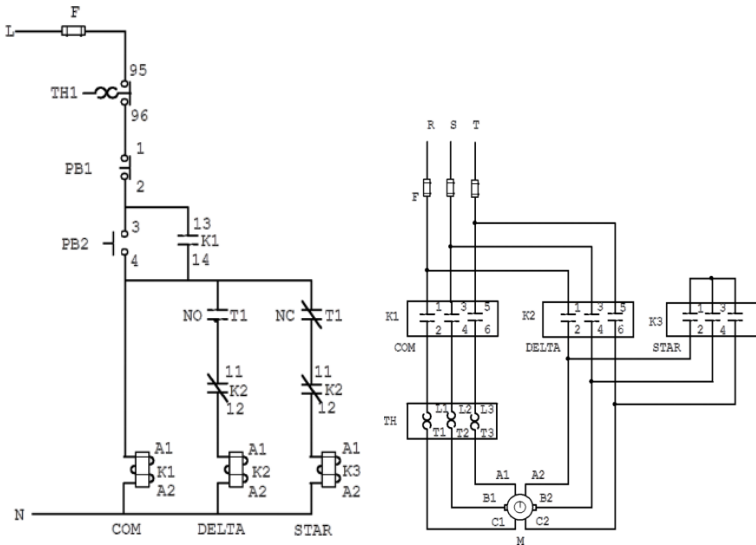


Figure 34: power and controlling circuit

Thank You!!!