

(ELECTRICAL INSTALLATIONS)

Q.1 Write the short notes on:

- (i) Service Mains OR Service line
- (ii) Various types of cables used for Internal wiring
- (iii) fuse units
- (iv) MCB
- (v) MCCB
- (vi) ELCB

Ans → (i) Service Mains OR Service line → The overhead line or cable connecting the suppliers distributing line to the consumer is called service mains or service line.

Service line are two type

- (i) Overhead service line
- (ii) Under ground service-line.

(ii) Various type of cables used for Internal wiring →

According to type of Insulation the cable are

- (1) VIR (Vulcanized Indian Rubber) → conduct wiring
- (2) TRS (Tough Rubber sheathed) → moisture (220-400)V
OR
CTS (cap type sheathed)
- (3) Lead sheathed cable → open area
- (4) PVC (Poly vinyl chloride) → Temperature (250-400)V, (650-1000)V
- (5) weather proof cable → A/c to weather
- (6) flexible cords & cable → Instruments
- (7) XLPE cable - similar to PVC cable → similar to PVC cables
- (8) multi strand cable → Multi-Cables

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(iii) Fuse Units → A fuse unit consists of the metal fuse element link, a set of contact B/W fixed and support body and isolate them.

The various type of fuse unit are:

- (1) Round type fuse unit
- (2) Kit-kit type fuse unit
- (3) Cartridge type fuse unit
- (4) HRC (High rupturing capacity) fuse unit
- (5) Semi-conductor fuse unit

(iv) MCB (miniature circuit breaker) → MCB is mainly used for low energy requirement. It is used 100A current upto 160 A.

Ex Home wiring
Small electronic circuit

(v) MCCB (molded case circuit breaker) → MCCB is mainly used for high energy requirement. It is used for 1000A current upto 2500 A current.

Ex Industrial or Commercial
Electrical motor operator

(vi) ELCB (Earth-Leakage circuit breaker) → It is a device that provide protection against earth leakage. There are two type.

- (1) Current operate type
- (2) Voltage operate type

Q2 Write the short note on the following:

- (1) Types of Batteries
- (2) Characteristics of Lead acid Accumulator
- (3) Nickel metal hydride cells
- (4) Power factor Correction (Improvement)

Ans: (1) Types of Batteries → There are two type of

Batteries

- (1) Primary Battery
- (2) Secondary Battery

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1. Lead Acid Automotive Batteries
 2. Nickel Iron (Edison) Batteries
 3. Nickel cadmium Accumulators
 4. Nickel metal Hydride cells.

(2) Characteristics of Lead Acid Accumulator → There are three important characteristics of Lead Acid Accumulator

- (1) Voltage (2) Capacity (Backup) (3) Efficiency

(i) Voltage → Average emf of cell is approximate 2.0
E.M.F is increase specific gravity increase

(ii) Capacity (Backup) → The ability of an Accumulator to last and provide current is called rated capacity. It is also called Backup (Capacity).

(iii) Efficiency (η_{AH}) → It is the ratio of Ampere hours of discharge to Ampere hours of charge.

$$\% \eta_{AH} = \frac{Ah \text{ of discharge}}{Ah \text{ of charge}} \times 100$$

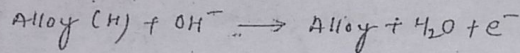
$$\% \eta_{AH} = \frac{I_d \times T_d}{I_c \times T_c} \times 100$$

3) Nickel Metal hydride cell :- Nickel metal hydride cell are small package high power cells. Its construction same as present nickel cadmium cells.

Charging of cells:



Discharging of cells:



4) Power factor correction (Improvement) :- Power factor

Improvement either passive and active circuit. It is used of TOP switch family of three PWM (Pulse width modulation). Power factor correction using 17 component output power 150 watt.

Q3 What is MCCB and How does it differ from MCB? Explain its operating mechanism.

Ans MCCB stands for molded case circuit breaker. MCCB has higher capacity than MCB. MCB is mainly used for low energy requirement just like house wiring or small electronic circuit. But MCCB is used for high energy requirement. It is used for industrial and electrical motor, operator etc.

Operating mechanism of MCCB :- MCCB is based on the principle of all type of thermal magnetic circuit breaker.

When ever a fault occurs, the high current induces a magnetic field inside the breaker. This magnetic induction trips a contact and current is interrupted. MCCB have internal Arc dissipation measure to facilitate interruption.

Q4 Describe the various types of wire or cables usually used in internal wiring of building.

Ans Types of wire and cables :- The internal wiring of building may be divided into different.

- (1) Conductor
- (2) Number of core used
- (3) Voltage grading
- (4) Types of Insulation used

(1) Conductor

- 1. Copper conductor cable
- 2. Aluminium conductor cable

(2) Number of core used

- 1. Single core cable
- 2. Twin core cable
- 3. Three core cable
- 4. ECC (Earth Continuity Conductor)
- 5. Double core cable

(3) Voltage grading

- 1. 250 / 440 volts cable
- 2. 650 / 1100 volts cable

(4) Type of Insulation used

- 1. VIR (Vulcanized Indian Rubber)
- 2. TRS (Tough Rubber sheathed) or
CTS (Car tyre sheathed)
- 3. Lead sheathed cable
- 4. PVC (Poly vinyl chloride)
- 5. Weather proof cable
- 6. Flexible leads & cable
- 7. XLPE cable
- 8. Multi strand cable

Q5 Draw the wiring diagram, schematic diagram, single line diagram, one light, one ceiling fan with Regulator and 5A 3 Pin plug point each controlled by individual switches.

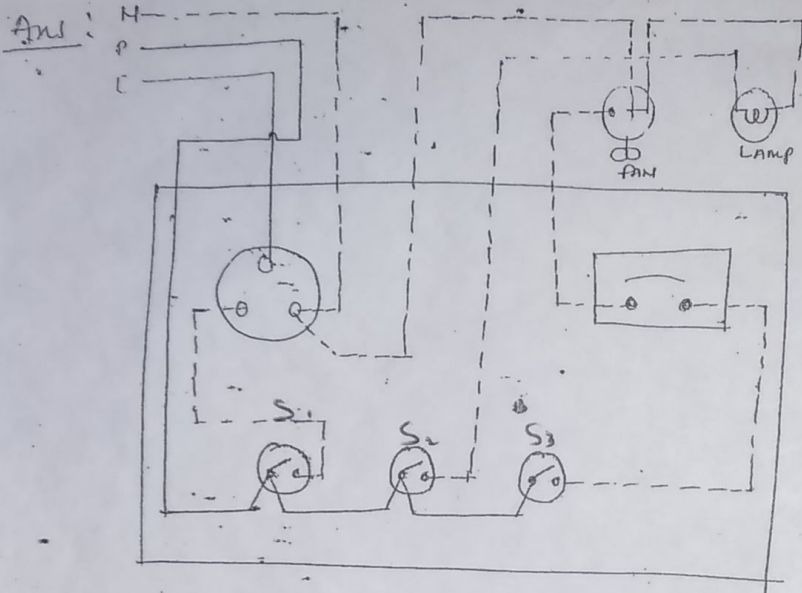


Fig. One Lamp, one fan & one socket outlet controlled by individual switches.

Q6 What is switch fuse unit? Describe any switch fuse unit with neat diagram.

Ans: Fuse Unit → A fuse unit consists of the metal fuse element link, a set of contact b/w fixed and support body and isolate them.

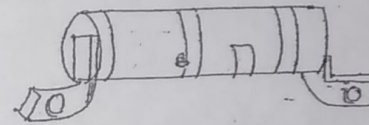
The various type of fuse unit are

- (1) Round type fuse unit
- (2) Kit-kat type fuse unit
- (3) Cartridge type fuse unit
- (4) HRC (High rupturing capacity) fuse unit
- (5) Semi-conductor fuse unit.

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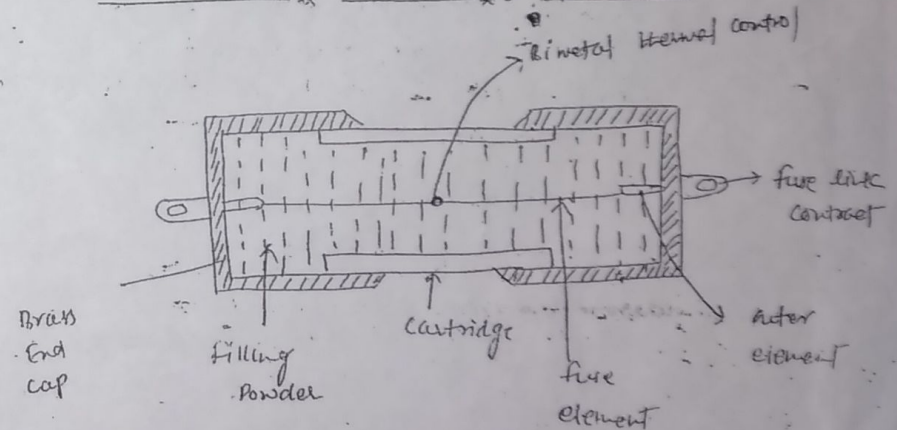
(1) Round type fuse unit → This type of fuse unit consists of Porcelain or Bakelite box and two separated terminals for holding the fuse wire b/w them. This type of fuse is not in common use because of some disadvantages. (1) one of terminal always energized for replacement of fuse either the worker will touch line wire and open the main switch.

(2) Cartridge type fuse → It essentially consists of an insulating container of cylindrical or tube shape & sealed with metallic cap known as cartridge fuse.



There are various type of material used as filler like sand, calcium carbonate, Quartz etc. This type of fuse is available upto 660V & 800A current.

(3) High Rupturing Capacity (HRC) fuse →



As a very heavy generating capacity of the modern Power Station, heavy current flows into the fault & fuse clearing the fault would be required. HRC fuse commonly used. It is capacity 500 MVA upto 66 KV & above.

The most advantages are

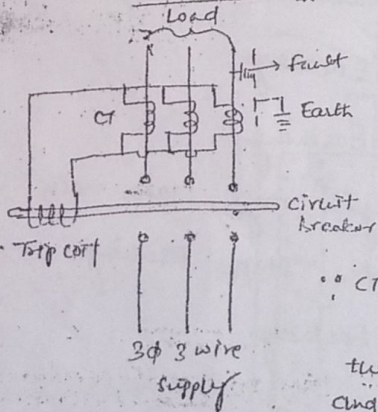
- (i) No maintenance is required.
- (ii) The operation is quick & sure.
- (iii) They are cheaper as other types of circuit.
- (iv) It is used clearing high as well as low current.

Q7 What is ELCB? Draw their circuit diagram and explain their working.

Ans: Earth-Leakage Circuit Breaker (ELCB) → It is a device that provide protection against earth leakage. There are two type ELCB.

- (1) Current operated type ELCB
- (2) Voltage operated type ELCB

(1) Current operated type ELCB → Current operated earth

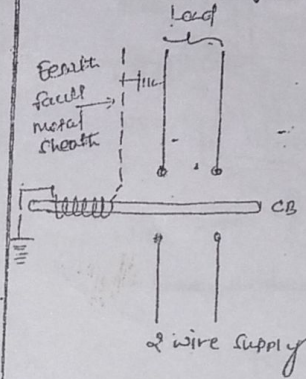


Leakage circuit breaker is used when the product of the operating current in Amperes and the earth loop impedance in ohm does not exceed 40 A. Here CB is used.

In normal condition when there is no earth leakage the Algebraic sum of all the current in three wire of CT is zero and no current flow through the trip coil.

In case any earth leakage the current are unbalanced and trip coil is energized and thus trip the circuit breaker.

(2) Voltage operated type ELCB → Voltage operated earth



Leakage CB is suitable for use when the earth loop impedance exceed the value to the fuse or excess current in the CB.

When the voltage b/w the ECC (Earth Continuity Conductor) and earth electrode rise to a sufficient value the trip carry the current and trip to the CB.

Q8 What is MCB (miniature circuit breaker)? Explain its function and working with neat diagram.

Ans: Miniature circuit breaker (MCB) → It is a device that provide protection to the wiring against over current and short circuit fault.

Working: → "A short circuit the increase current energized the solenoid, operating the plunger to strike the trip and released of the latch mechanism."

Miniature circuit breaker (MCB) are available current rating 0.5, 1, 2, 2.5, 3, 4, 5, 6, 7.5, 10, 16, 20, 25, 32, 35, 40, 63, 100, 125, 160 A. The voltage rating 240/415 V upto 220 V DC. Application: → It is used to protection equipment AC, computer & Refrigerator etc.

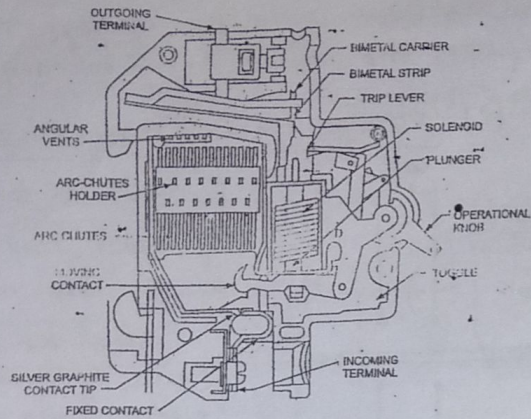


Fig. (1) Miniature Circuit Breaker (Courtesy Havells)

Qx9: What is Earthing? Explain the Purpose of Earthing.

Ans: Earthing: → The Earthing of electrical Equipment taking the equipment to zero potential & avoid the shock to the operator under fault condition.

Purpose of Earthing: → The Earthing is Provided

- (1) To avoid electric shock to the human being.
- (2) To avoid risk of fire due to earth leakage current.
- (3) To protect all the m/c.
- (4) To main line voltage constant.

Qx10: Explain Advantage of Earthing of Grounded neutral supply.

Ans: The following advantage are:

- (1) It is very easy for Earth fault protection.
- (2) Spikes include the lighting & switching on voltage.

(3) Let stresses on Insulation, if there is Earth fault else where.

Qx11: Explain the Necessity of Earthing?

Ans: Necessity of Earthing → the resistance of the windings and the frame is say (R_i) called Insulation resistance and (R_{body}) be the resistance of a person who happens to touch the machine.

$$I_{body} = \frac{V}{R_i + R_{body} + R_E}$$

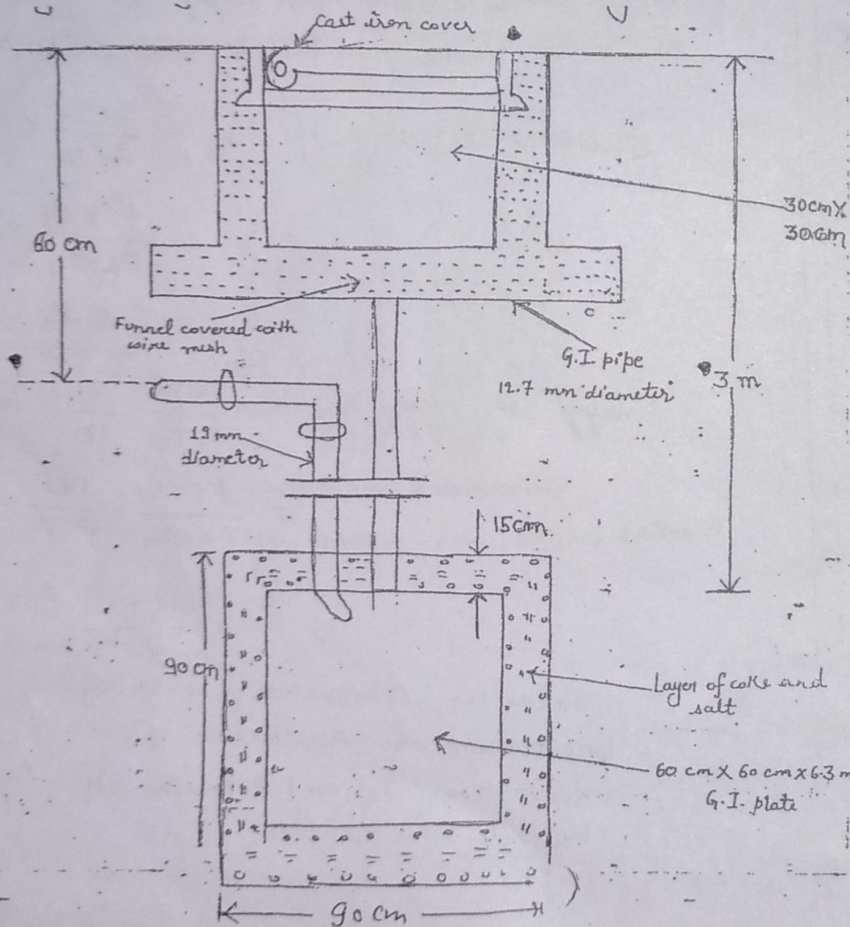
Qx12: Explain various method of Earthing and Explain plate & Pipe Earthing. Discuss the Merits & Demerits.

Ans: The various method of Earthing are:

- (1) Plate Earthing
- (2) Pipe Earthing
- (3) Earthing through water main
- (4) Horizontal strip Earthing
- (5) Rod Earthing

(1) Plate Earthing → The copper plate size is $60\text{ cm} \times 60\text{ cm} \times 3.18\text{ mm}$ while G.I. plate size is not less than $60\text{ cm} \times 60\text{ cm} \times 6.3\text{ mm}$. The G.I. plate are commonly used. Now-a-days the plate is embedded 3 meter (10 feet) into ground.

The Earth wire is drawn through G.I. pipe of 19 mm diameter about 60 cm below the ground. The Earthing efficiency increase with increase the plate area and depth of embedding. If the Resistivity of the soil is high.



(2) Pipe Earthing: In this method of Earthing a G.I. pipe of 38 mm diameter and ^{2.75} meter (7 feet) length is embedded vertically into the ground. This pipe act as an Earth electrode. The depth depends on the condition of the soil.

The pit area around the pipe is filled with salt and coal mixture for improving the condition of the soil and earthing efficiency.

According to the Indian standard, the pipe should be placed at a depth of 4.75 m.

Advantage → The advantage of pipe earthing over the plate earthing. The Earth lead used must be G.I. wire of sufficient cross-sectional area to carry fault current safely. It should not be less than of copper conductor of 12.97 mm^2 cross sectional area.

Disadvantage → Pipe earthing is that the embedded pipe length has to be increased sufficiently in case the soil specific resistivity is high order.

The increase the excavation work and hence increased cost. In ordinary soil condition the range of the earth resistance should be 2 to 5 ohm.

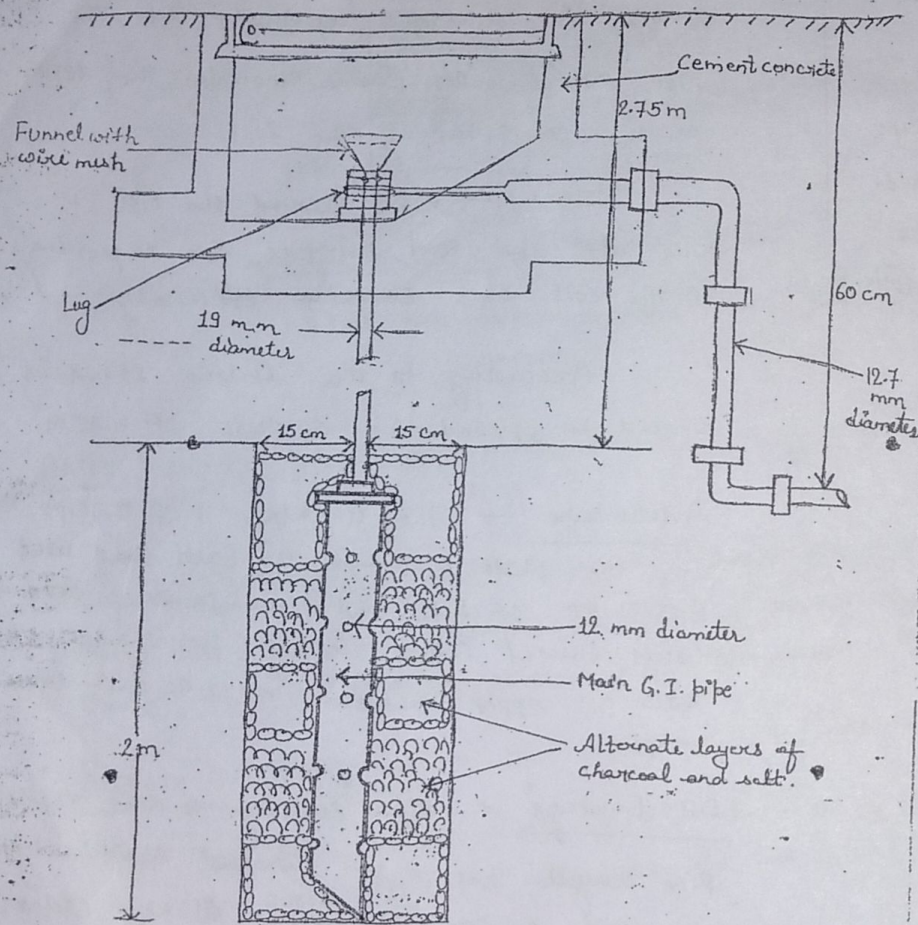


fig: Pipe earthing

Qx: A battery has taken a charging current of 5.2 A for 24 hours at a voltage of 2.25 V, while discharging it gave a current of 4.5 A for 24 hours at an average voltage of 1.05 V. Calculate the quantity efficiency and the energy efficiency of the battery.

Ans:

Charging Current $I_c = 5.2 \text{ A}$
 Charging mean voltage $V_c = 2.25 \text{ V}$
 Charging Period $T_c = 24 \text{ Hours}$
 Discharging current $I_d = 4.5 \text{ A}$
 Discharging mean voltage $V_d = 1.05 \text{ V}$
 Discharging Period $T_d = 24 \text{ Hours}$

$$\begin{aligned} \text{Quantity efficiency } \% \eta_{QH} &= \frac{I_d T_d}{I_c T_c} \times 100 \\ &= \frac{4.5 \times 24}{5.2 \times 24} \times 100 \\ &= 86.54 \% \text{ Ans} \end{aligned}$$

$$\begin{aligned} \text{Energy efficiency } \eta_{WH} &= \frac{I_d T_d}{I_c T_c} \times \frac{V_d}{V_c} \times 100 \\ &= \frac{4.5 \times 24}{5.2 \times 24} \times \frac{1.05}{2.25} \times 100 \\ &= 71.15 \% \text{ Ans} \end{aligned}$$

Qx: Give the construction, characteristics, Advantage, Disadvantage & Application of

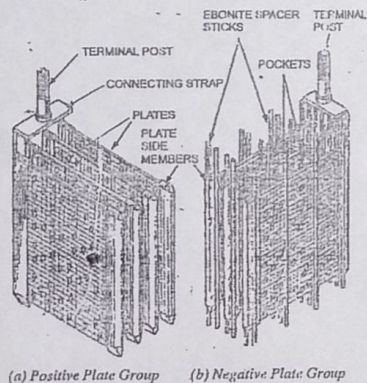
- (i) Nickel-Iron (Edison) Batteries
- (ii) Lead Acid
- (iii) Nickel-cadmium cell

Ans. (1) Nickel-Iron (Edison) Batteries :-

Active material :- The +ve plate consist of $Ni(OH)_2$ or (NiO_2) about 17% of Graphite is added to increase the conductivity and about 2% added Barium hydroxide.

The -ve plate consist of FeO & $Fe(OH)_2$ and small amount of Nickel sulphate and ferrous sulphide about 20% of KOH & more added (NiO_2)

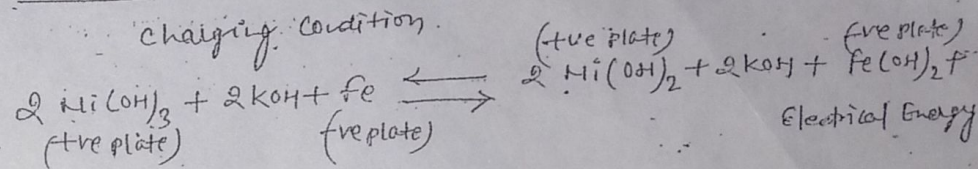
Construction :- The vessel containing the electrolyte & electrode is made of nickel plate with welded lid the -ve plate is one more than +ve plate. plate same polarity with their pocket fitted.



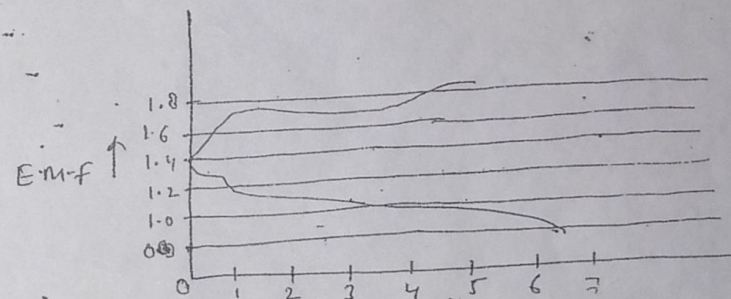
(a) Positive Plate Group (b) Negative Plate Group

Fig. Nickel-Iron (Edison) Batteries.

Operation :-



Electrical characteristics :-



Charge & Discharge Hour

Advantage :-

- (1) They have a long service life.
- (2) They have rugged construction.
- (3) They need little maintenance.

Disadvantage :-

- (1) High Initial Cost
- (2) High Internal resistance
- (3) Lower EMF
- (4) Low operating efficiency

Application :-

- (1) Industrial trucks
- (2) Mine locomotive
- (3) Railway.