UTILIZATION OF ELECTRICAL POWER

Vishal D Devdhar

Lecturer

Government Polytechnic

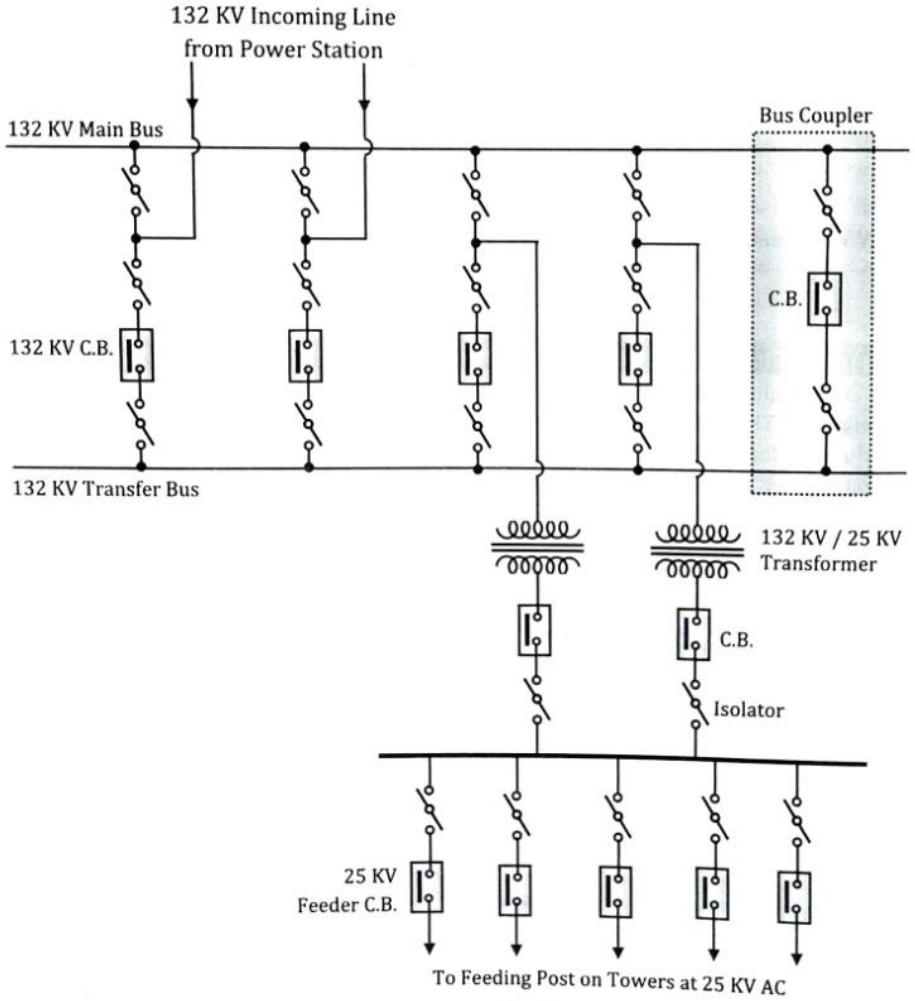
Rajkot

www.vishaldevdhar.org

UNIT-1
ELECTRIC TRACTION SUPPLY SYSTEM

- Single Line Diagram of Traction Substation
- catenary system
- Current collecting equipment
- Coach wiring and lighting devices
- Control and auxiliary equipment
- Braking
- Important features of electric locomotives
- Different types of locomotives
- Power conversion and transmission systems

SINGLE LINE DIAGRAM 25KV SUBSTATION



CATENARY SYSTEM

- Single Catenary System
- Double Catenary System

SINGLE CATENARY SYSTEM

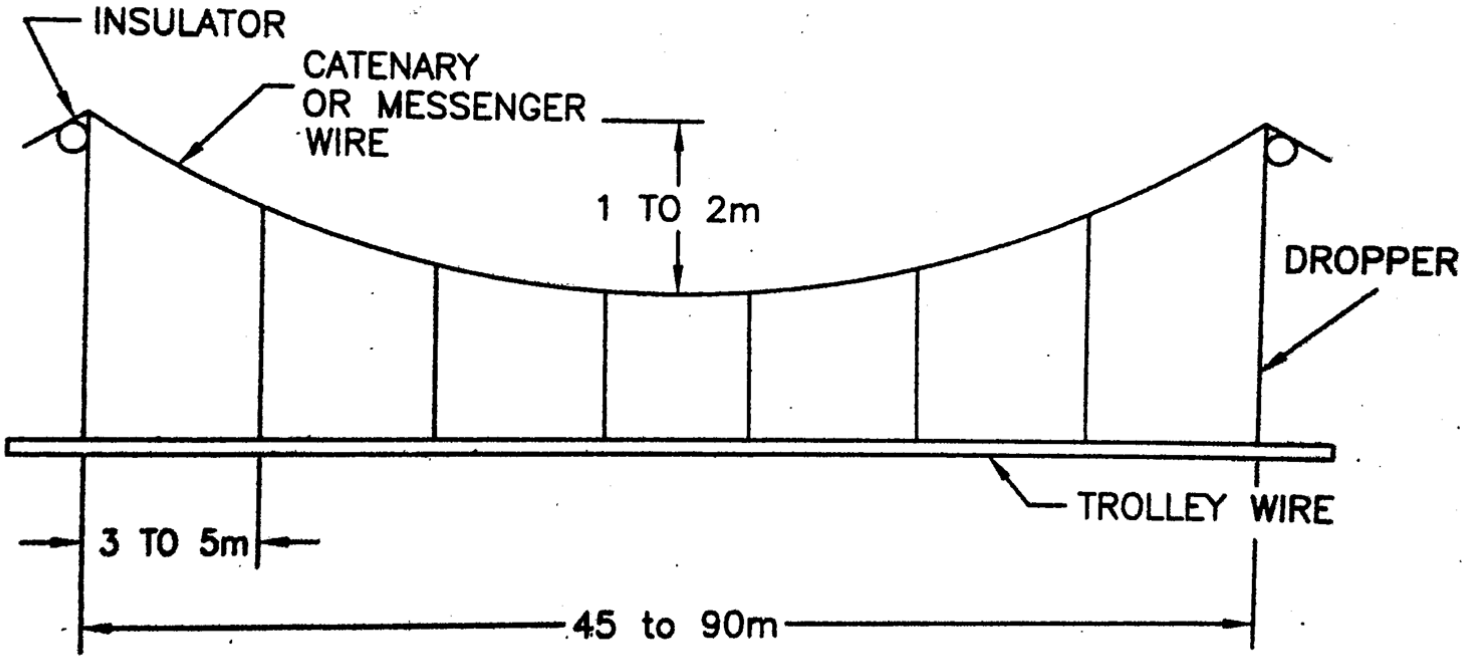


FIG. 4.11 SINGLE CATENARY SYSTEM

DOUBLE (COMPOSITE) CATENARY SYSTEM

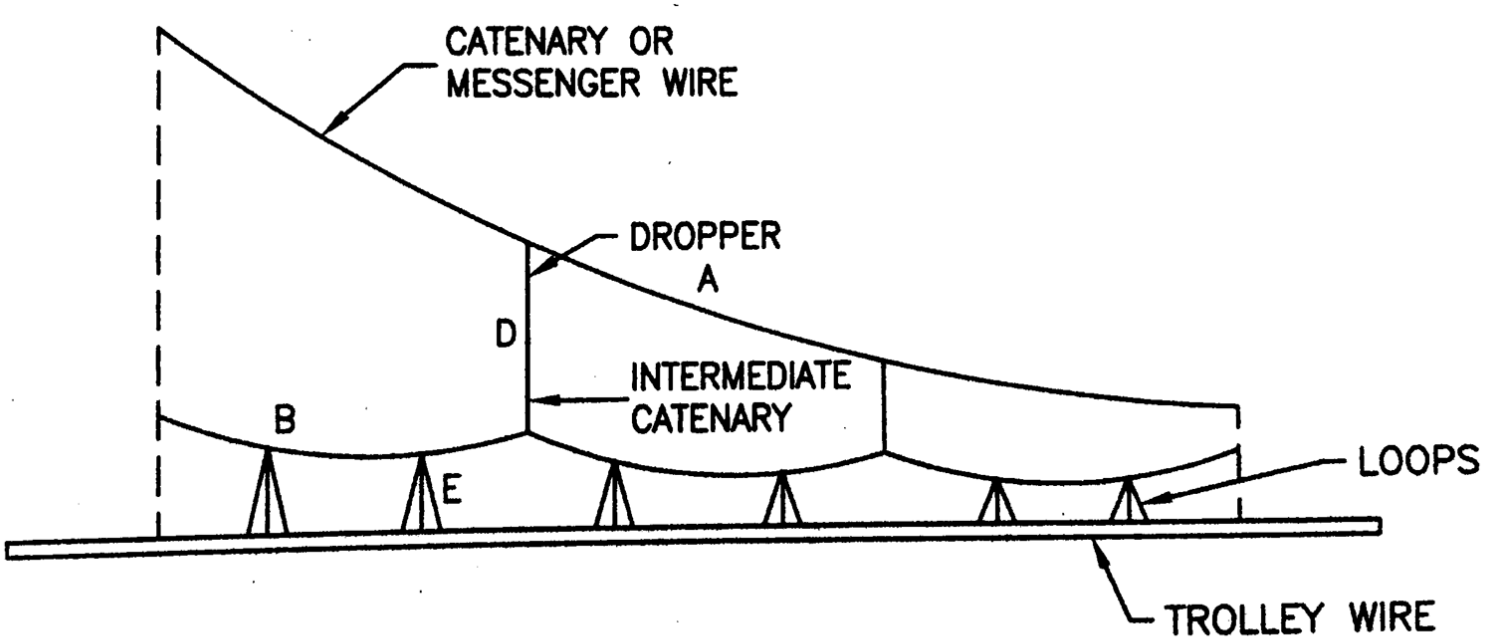


FIG. 4.12 DOUBLE (COMPOUND) CATENARY SYSTEM

SUPPORTING STRUCTURE

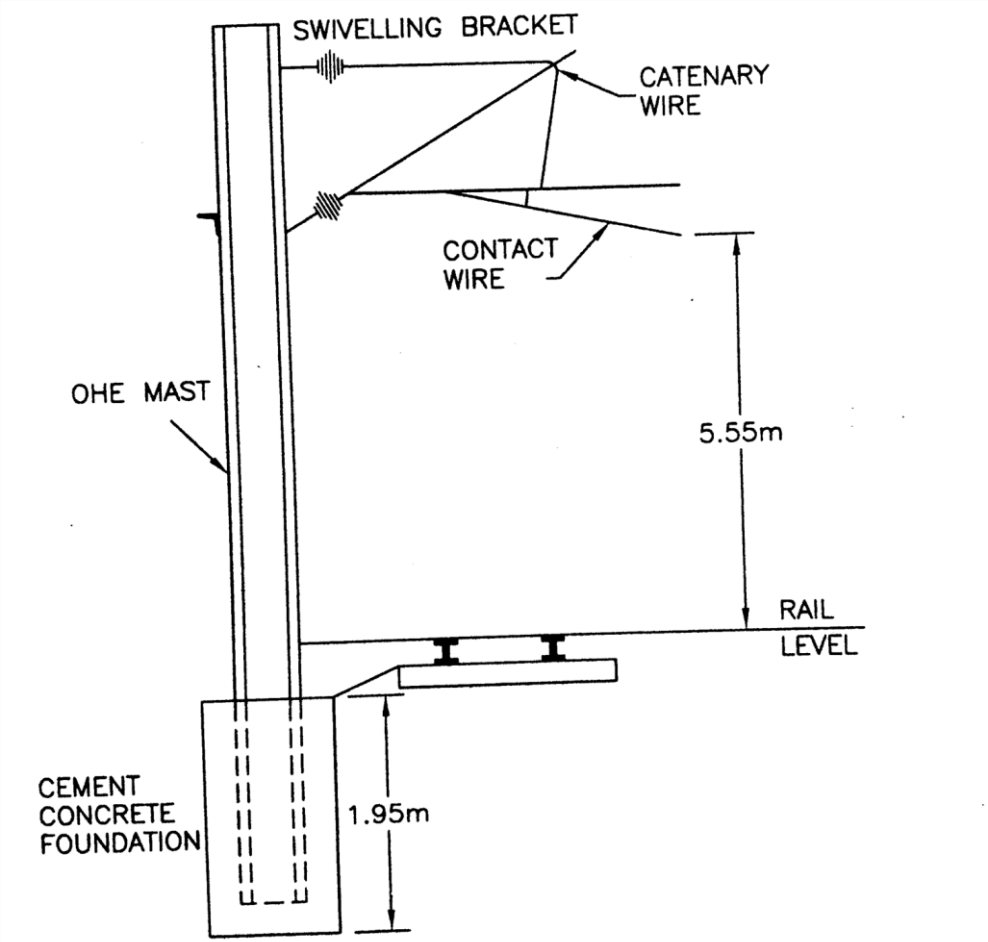


FIG. 4.13 (a) SUPPORTING STRUCTURE OF SINGLE TRACK SYSTEM

SUPPORTING STRUCTURE

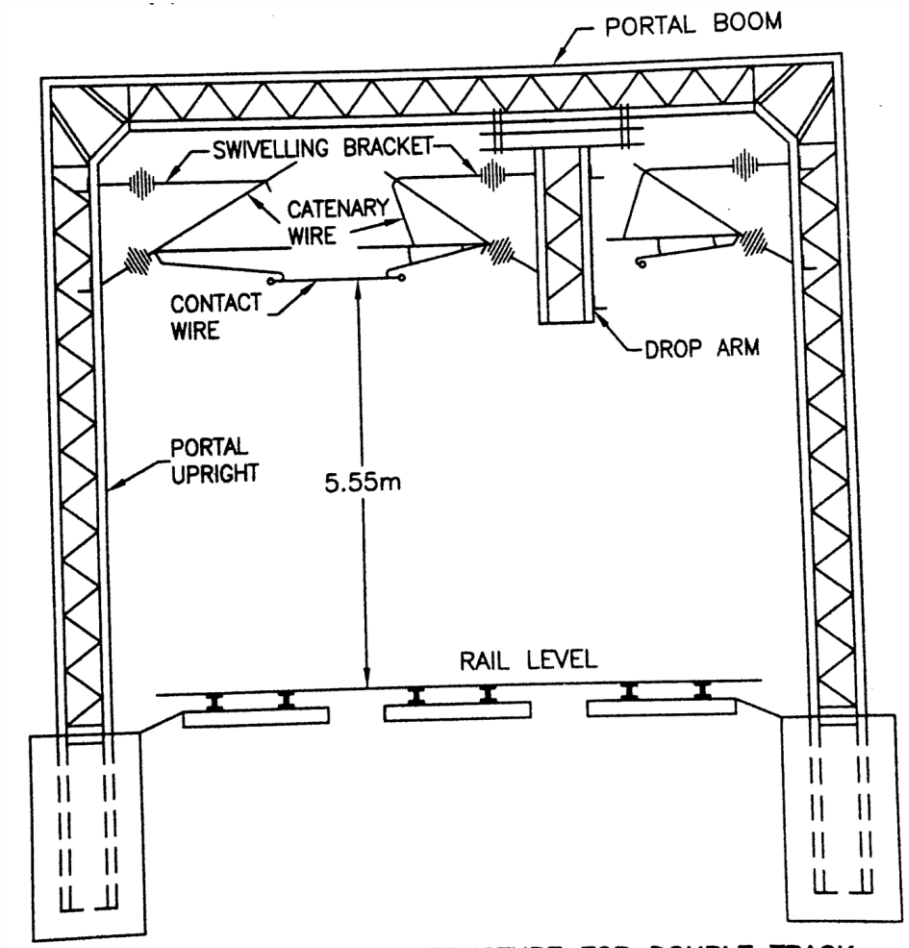


FIG. 4.13 (b) SUPPORTING STRUCTURE FOR DOUBLE TRACK SYSTEM WITH PORTAL AND MAST

SUPPORTING STRUCTURE

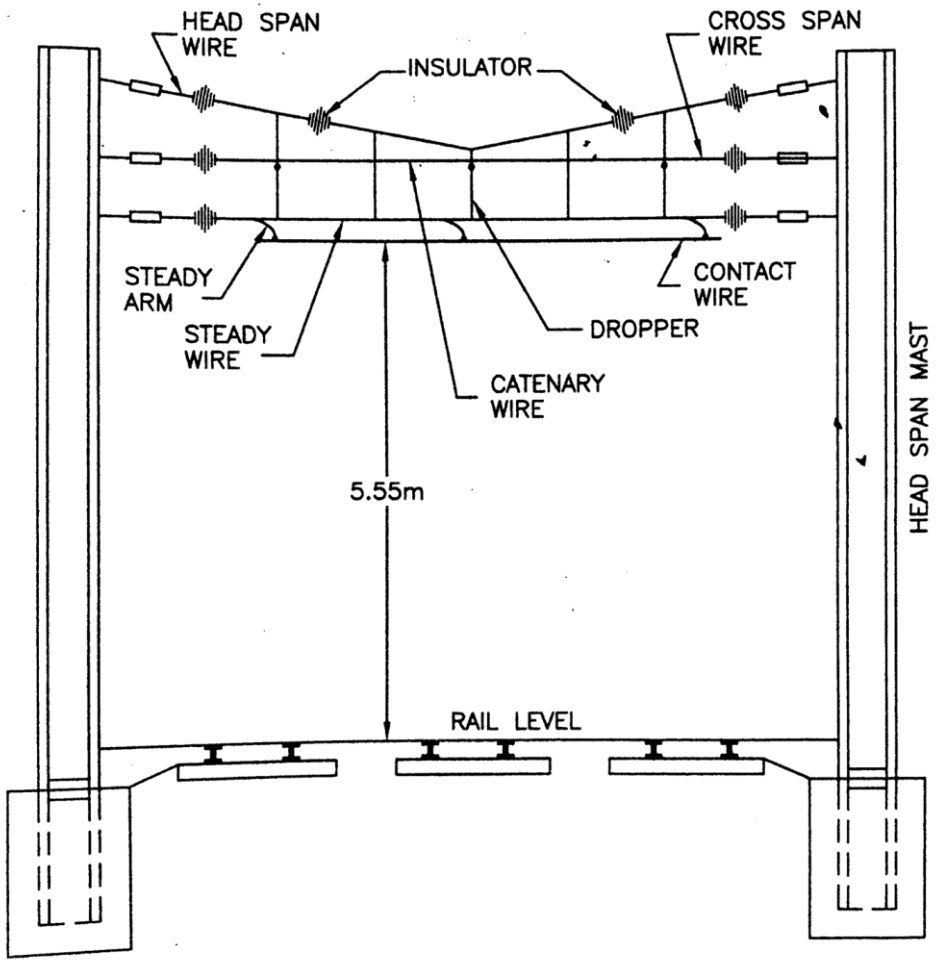
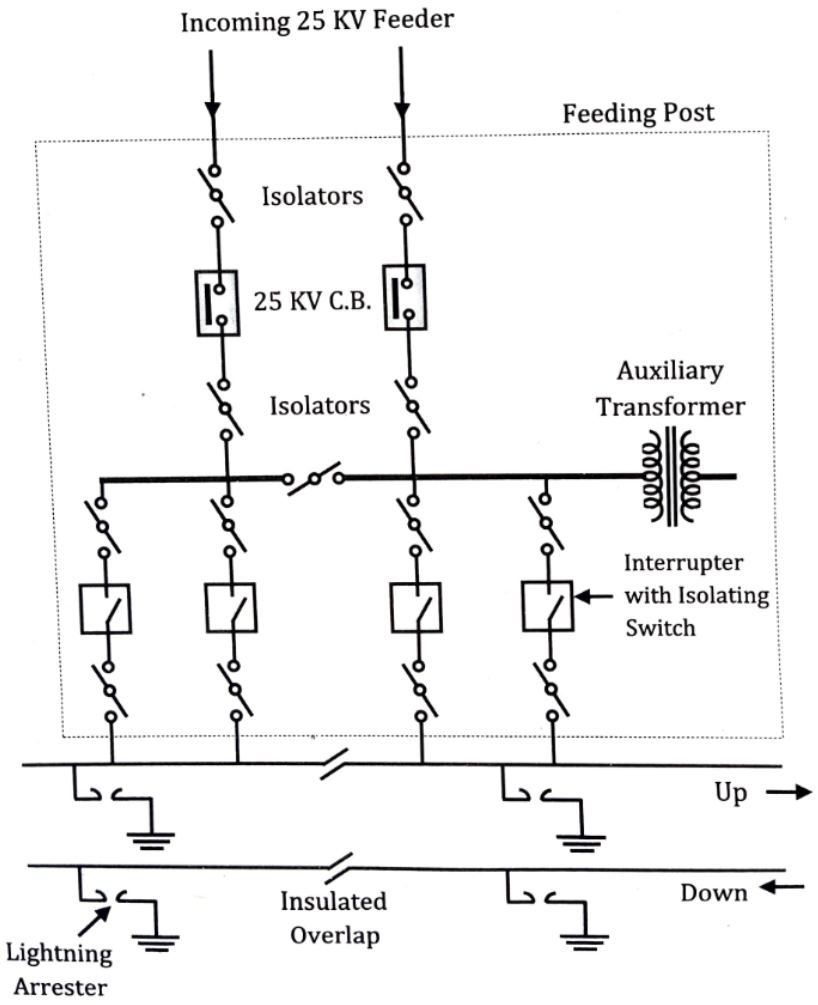


FIG. 4.13 (c) SUPPORTING STRUCTURE FOR DOUBLE TRACK SYSTEM WITHOUT PORTAL

SUPPLY CONTROL POST



NETRA CAR

TRI-NETRA

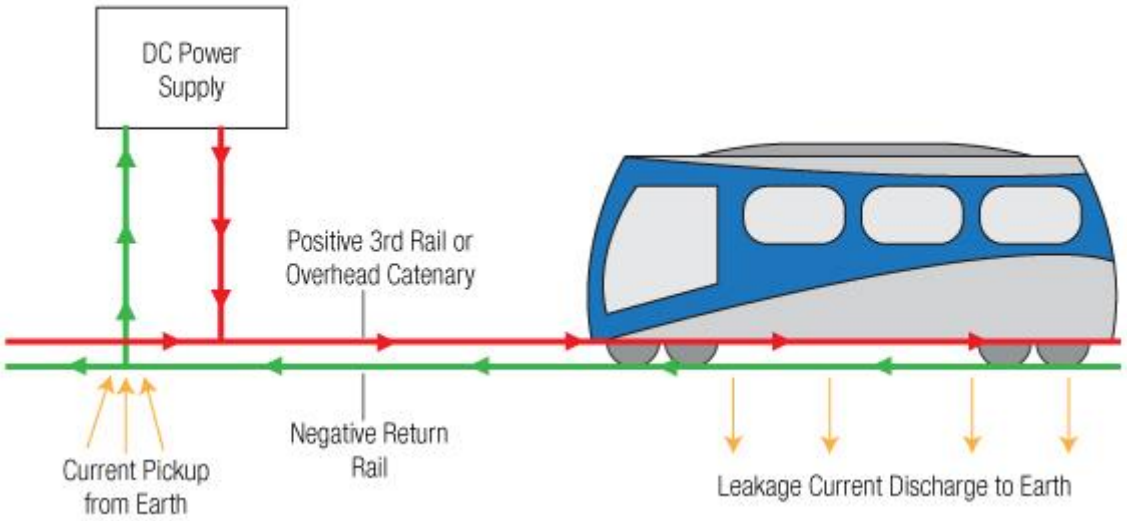
- Terrain Imaging for diesel dRivers INfra-red, Enhanced opTical & Radar Assisted system
- It integrates infrared cameras, enhanced optics, and radar to detect obstacles up to 1 km ahead in fog, rain, or darkness, overlaying real-time images on the driver's display for safer operation.

OHE NETRA

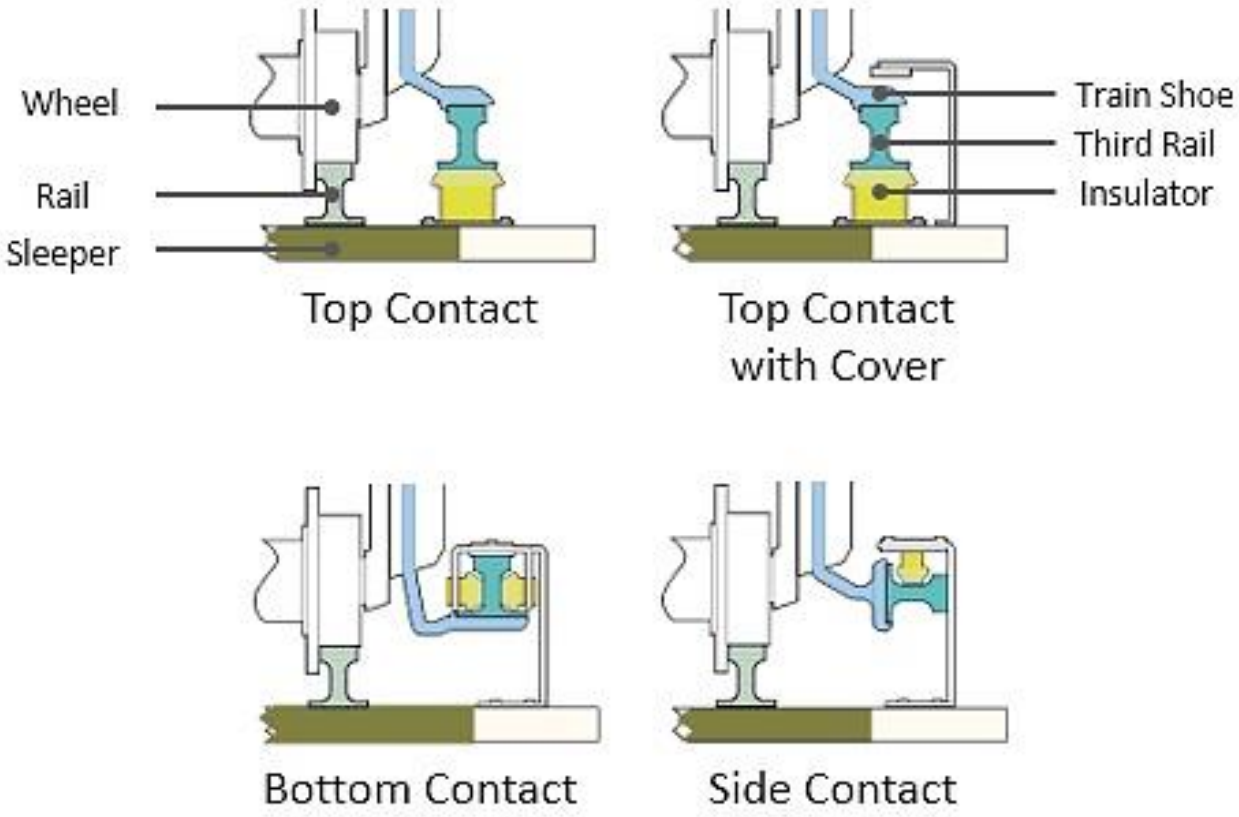
- Overhead Equipment (OHE) recording car for electrification parameter testing (e.g., pantograph-catenary interaction)

CURRENT COLLECTING EQUIPMENT

- Conductor rail system
- Overhead current collection system

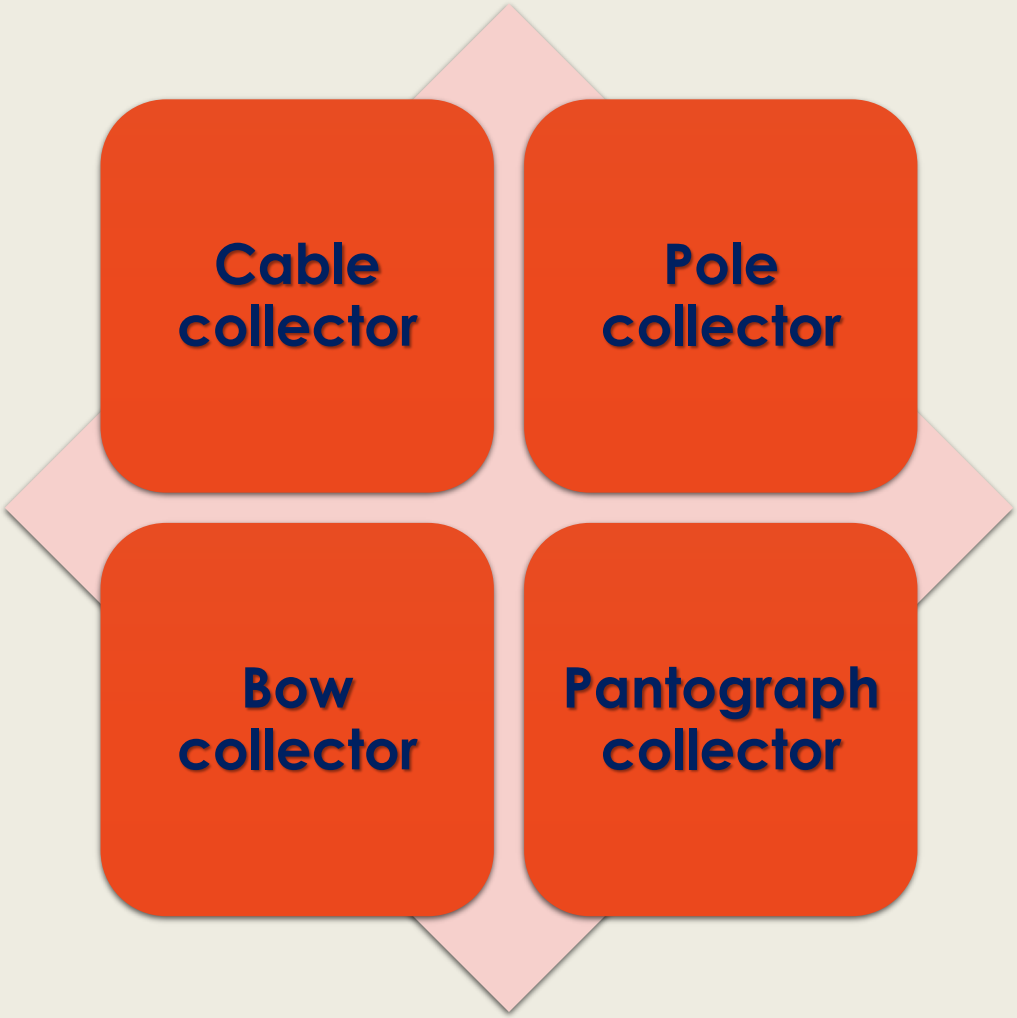


CONDUCTOR RAIL SYSTEM

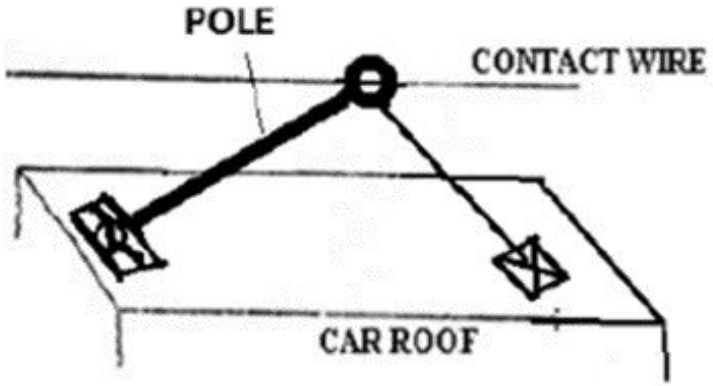


CONDUCTOR RAIL SYSTEM

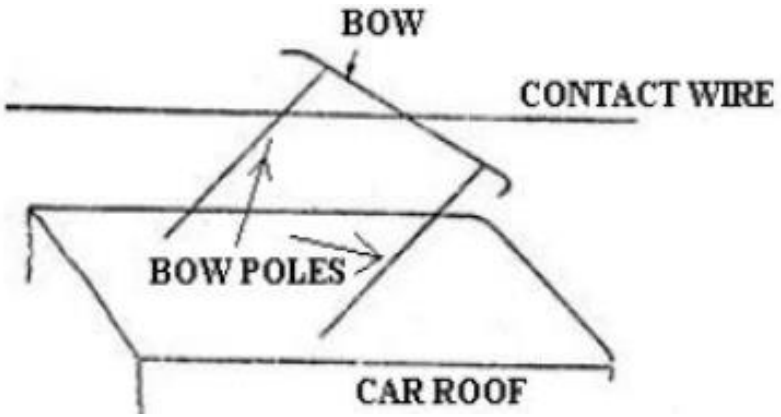
Overhead Current Collection System



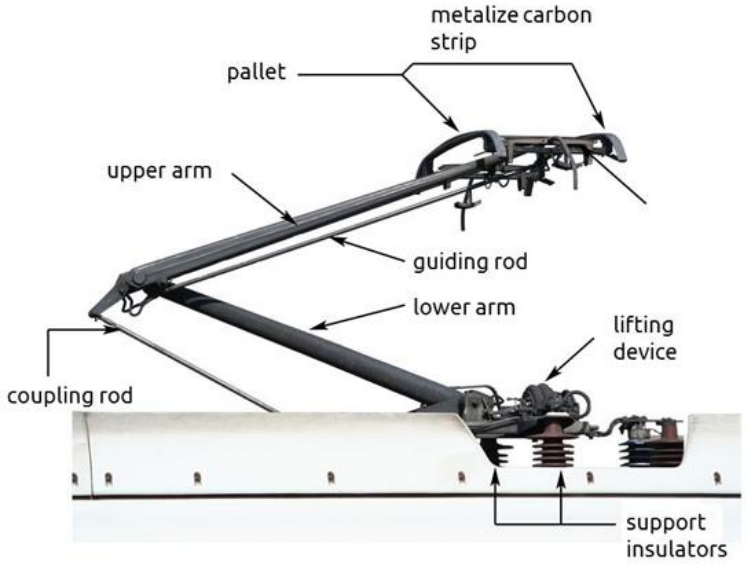
Cable collector



Pole collector



Bow collector



Pantograph collector


NIEDERFLUR

Coach Wiring & lighting devices

Lighting Devices

- Various Lighting Devices

Coach Wiring System

- Single Battery
- Double Battery

Coach Wiring & lighting devices

Dynamo(DC Generator)

- Totally enclosed
- Same polarity with direction of rotation
- Constant voltage at varying speed

Battery Sets

Battery Changeover Switch

Magnetic Light Switch

Auto cut in – cut out switch

Rosenberg Generator

- **Totally enclosed**
- **Same polarity with direction of rotation**
- **Constant voltage at varying speed**

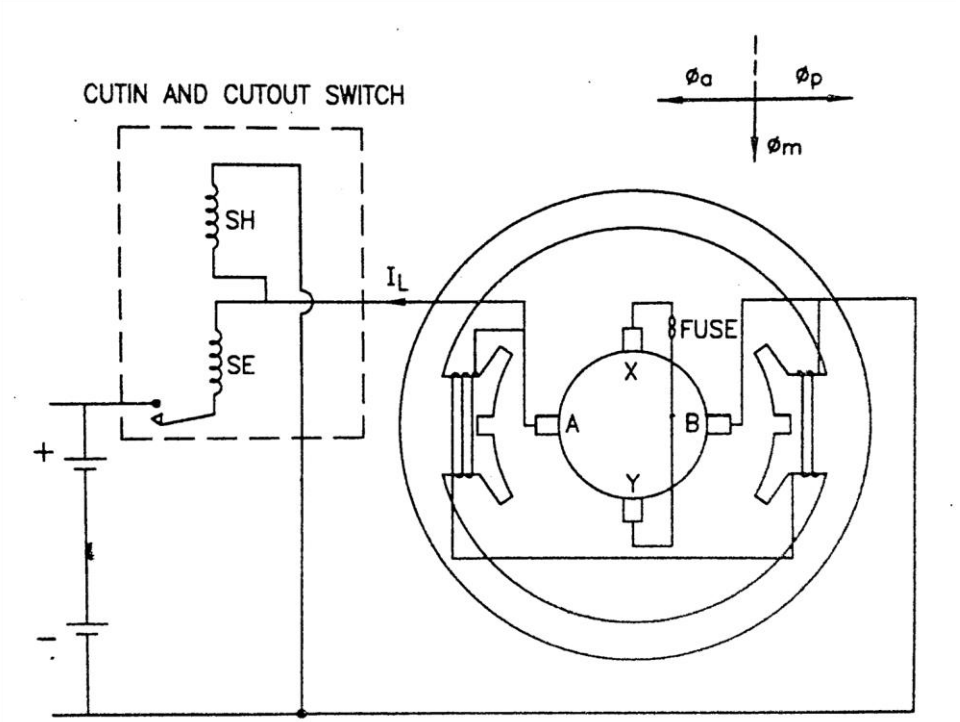
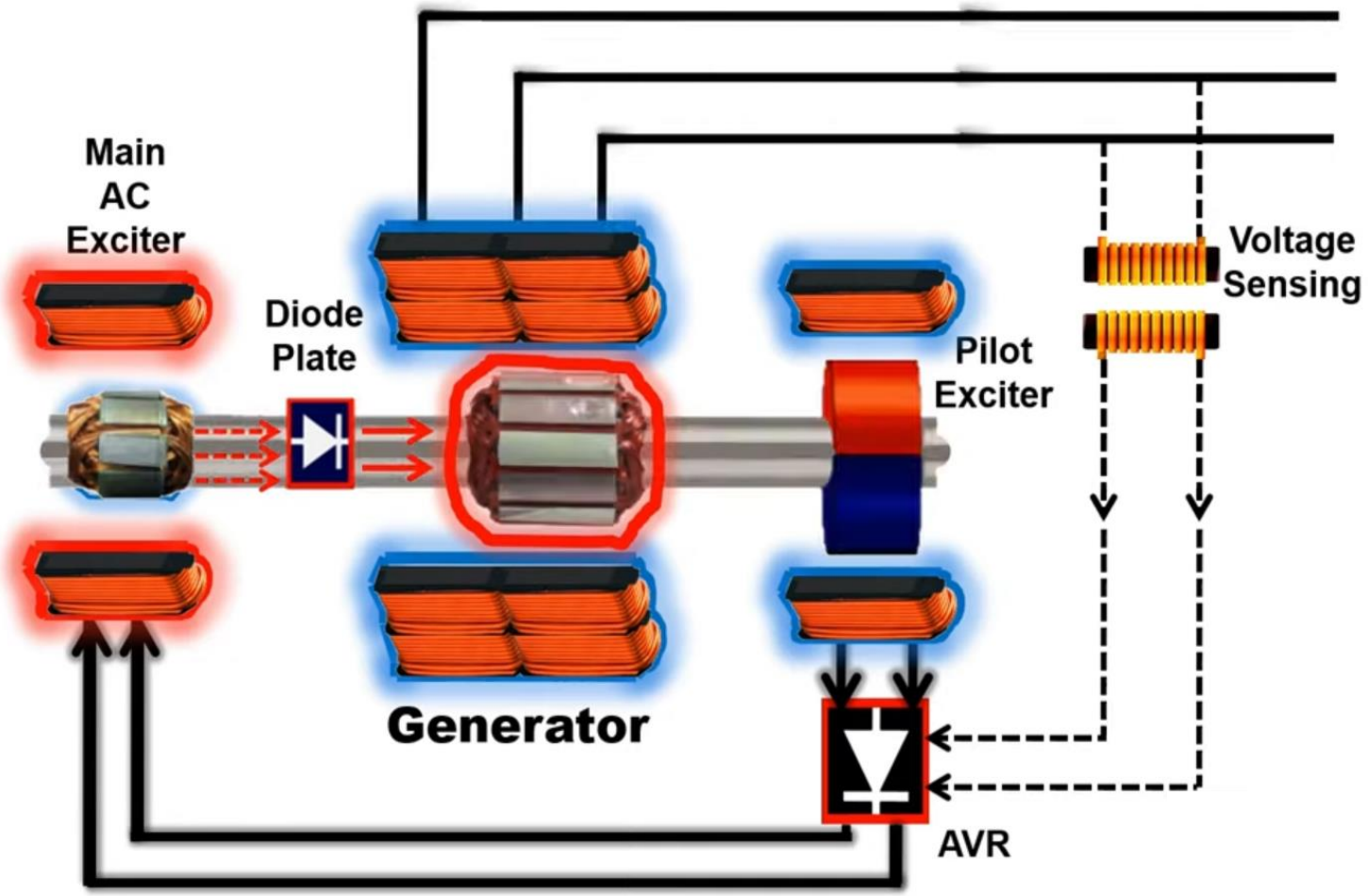


FIG. 4.14 ROSENBERG GENERATOR

BRUSHLESS ALTERNATOR

The three phase AC voltage is provided to the external circuit or loads



Battery Change Over Switch

- Speed< 20km/hr
  - Both battery supply load
- Speed>20km/hr
  - One battery share load parallel with dynamo
  - Other battery is put on charge

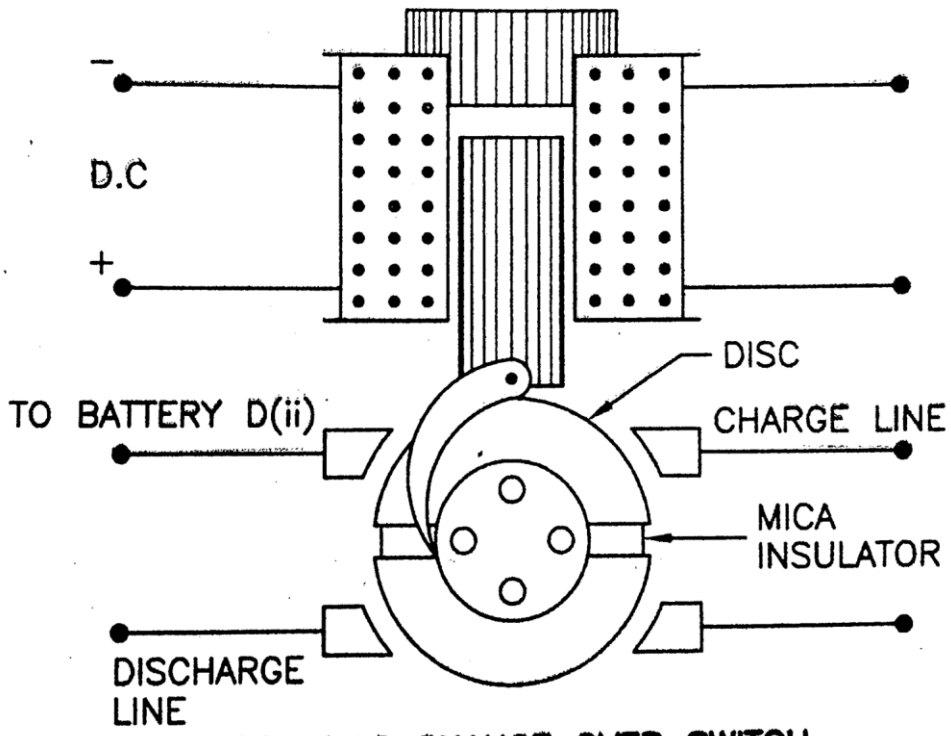


FIG. 4.18 CHANGE OVER SWITCH

AUTO CUT IN – CUT OUT SWITCH

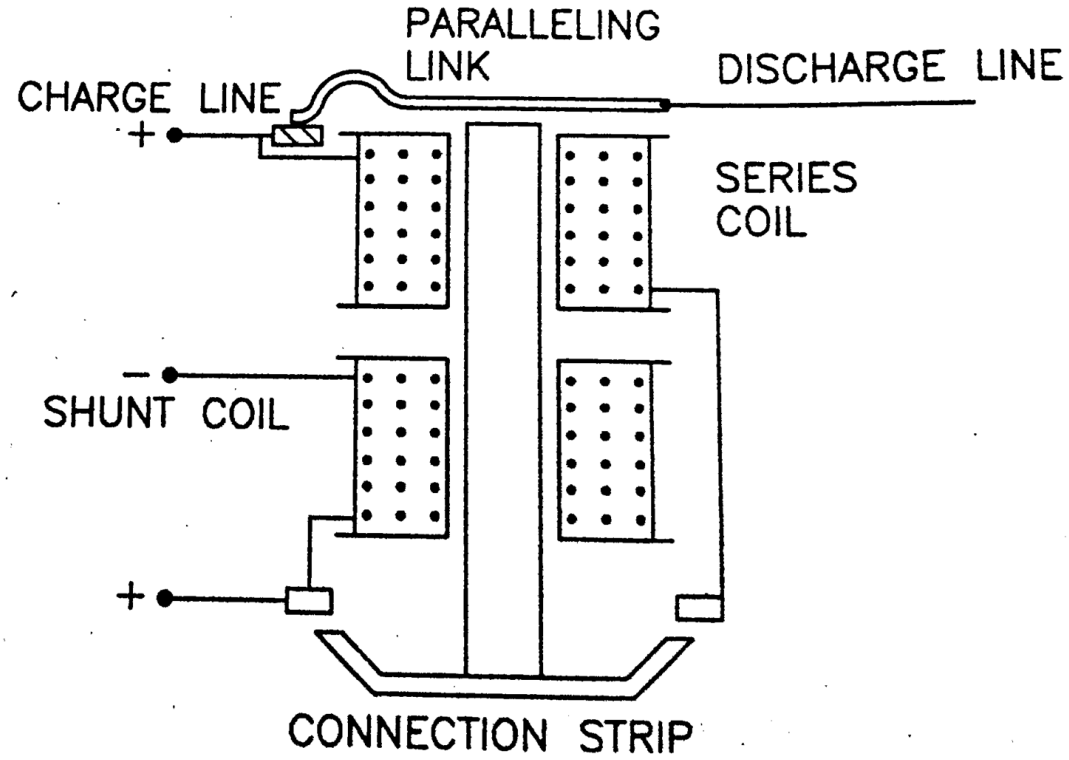


FIG. 4.17 AUTO CUT IN–AUTO CUT OUT SWITCH

Magnetic Light Switch

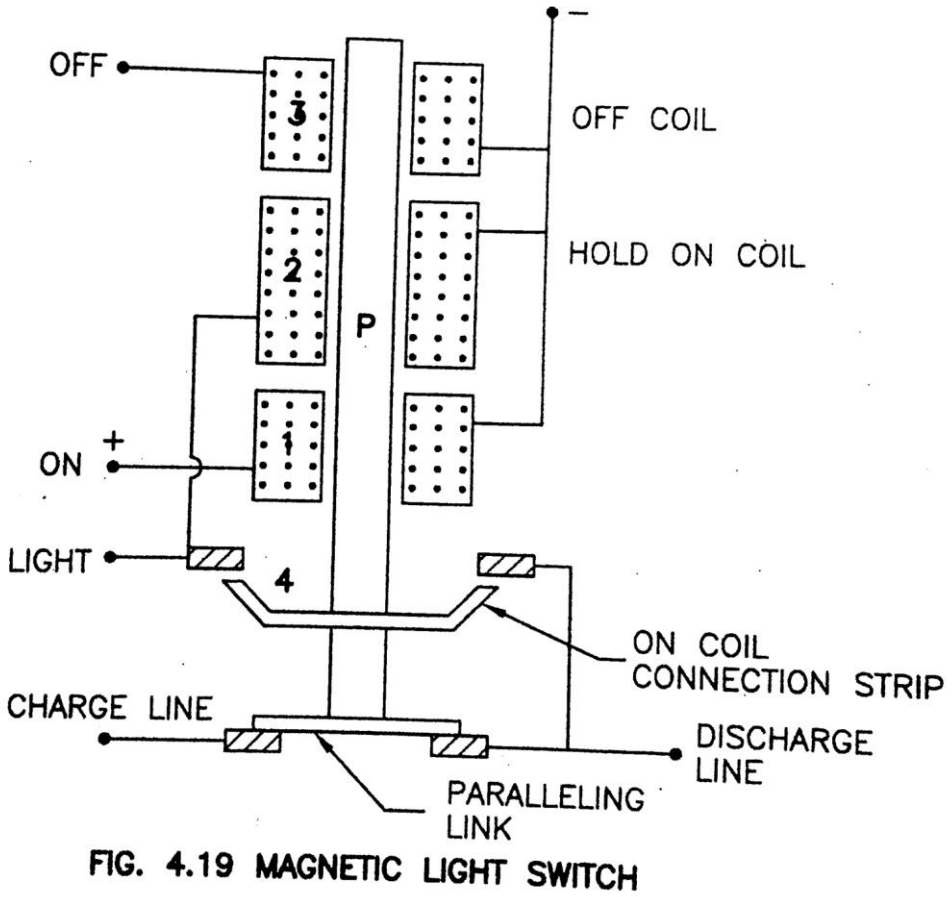


FIG. 4.19 MAGNETIC LIGHT SWITCH

Coach Wiring

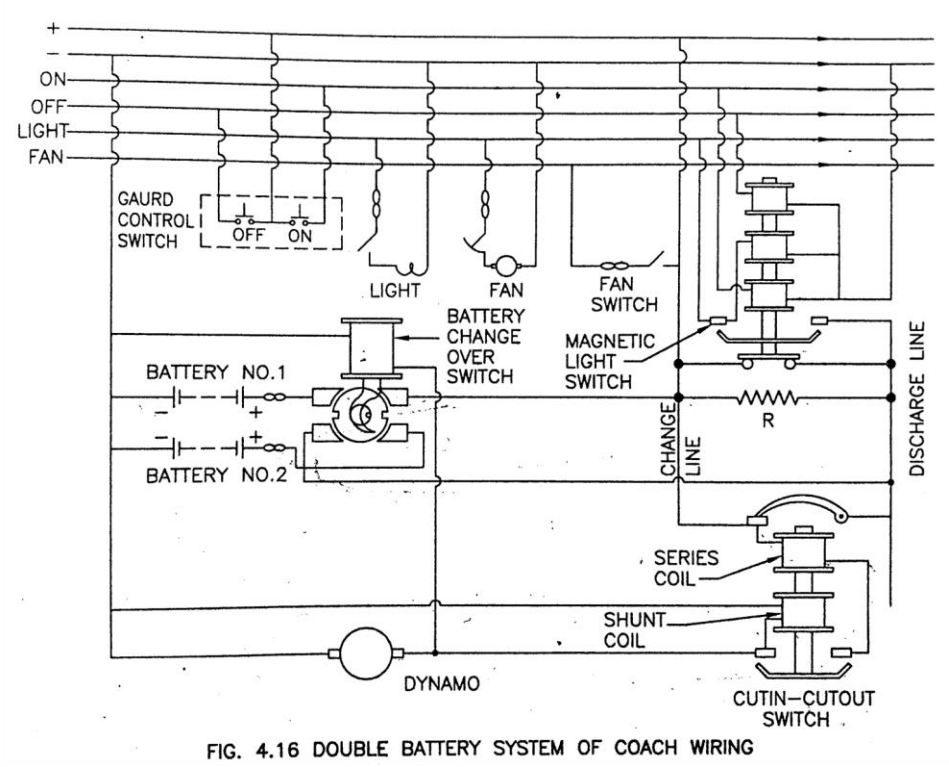


FIG. 4.16 DOUBLE BATTERY SYSTEM OF COACH WIRING

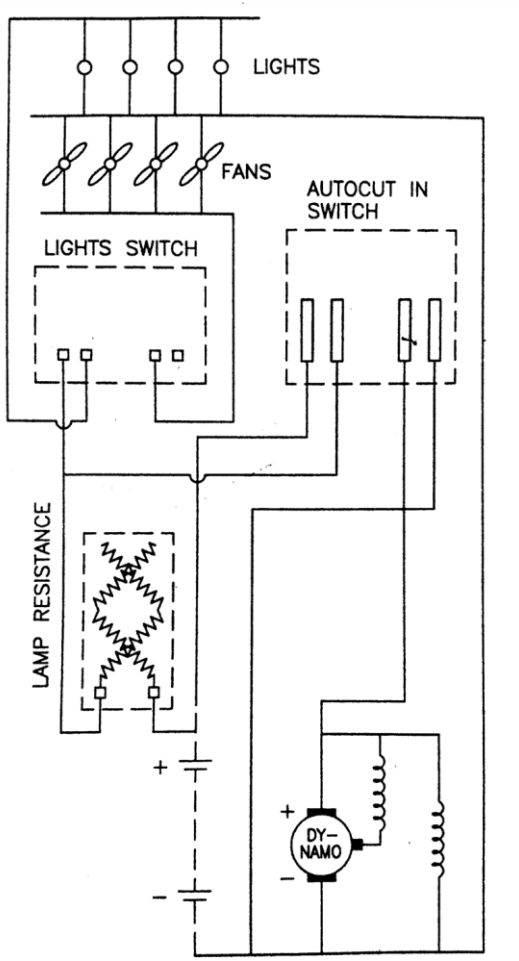


FIG. 4.15 SINGLE BATTERY SYSTEM

Lamp Resistance

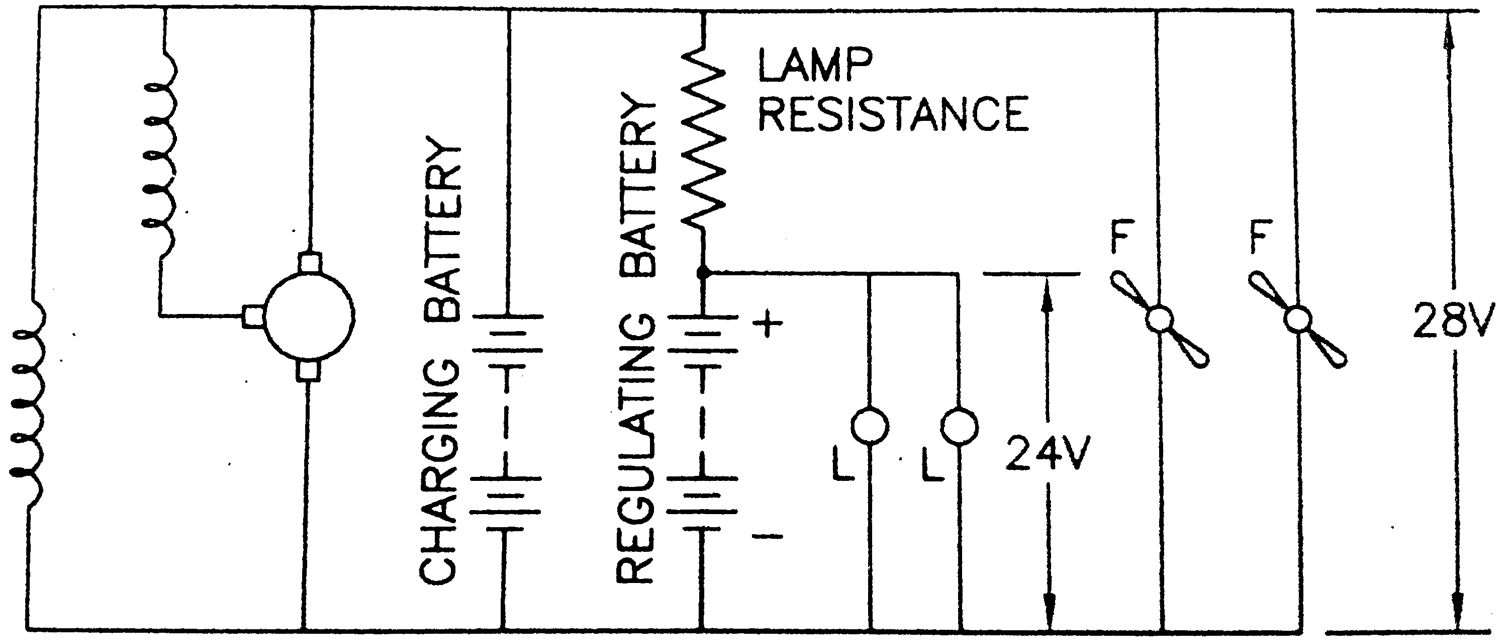
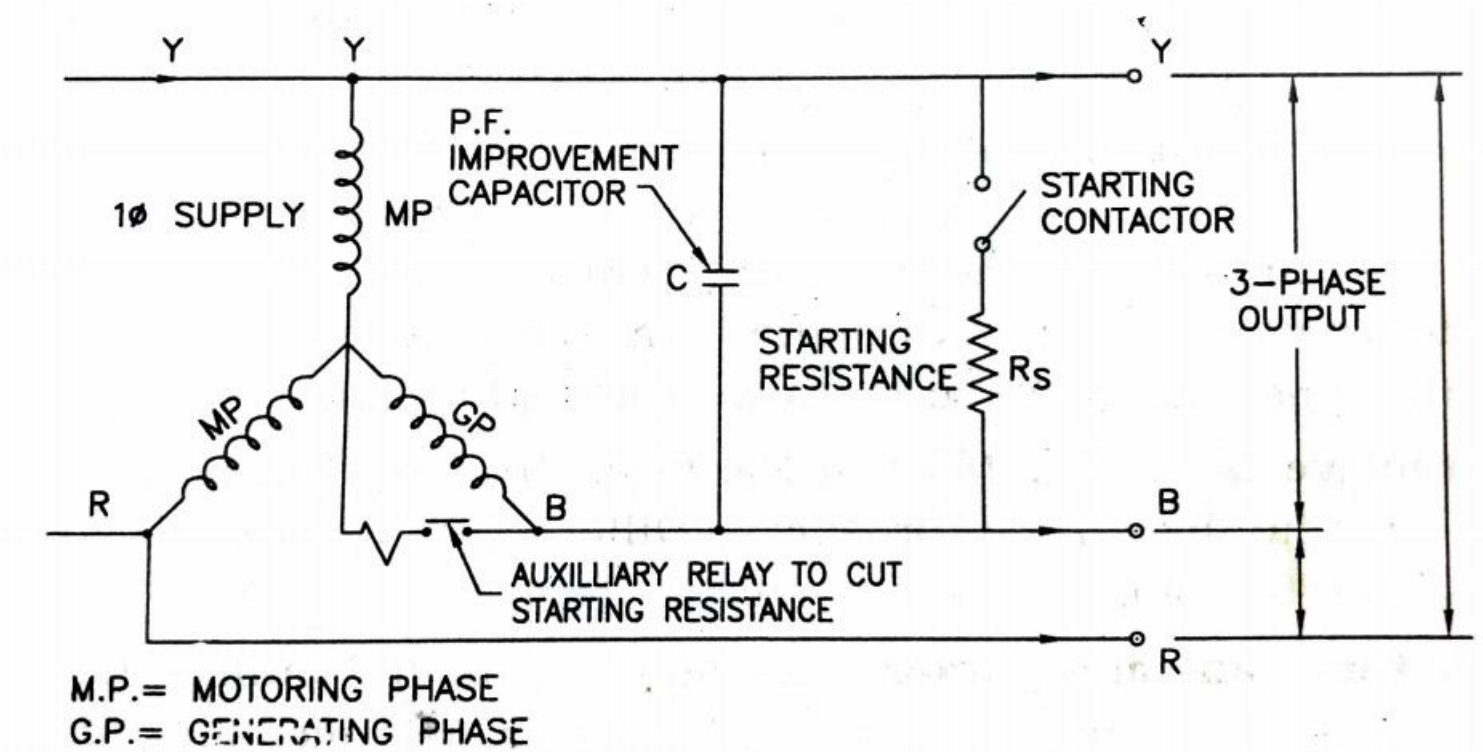
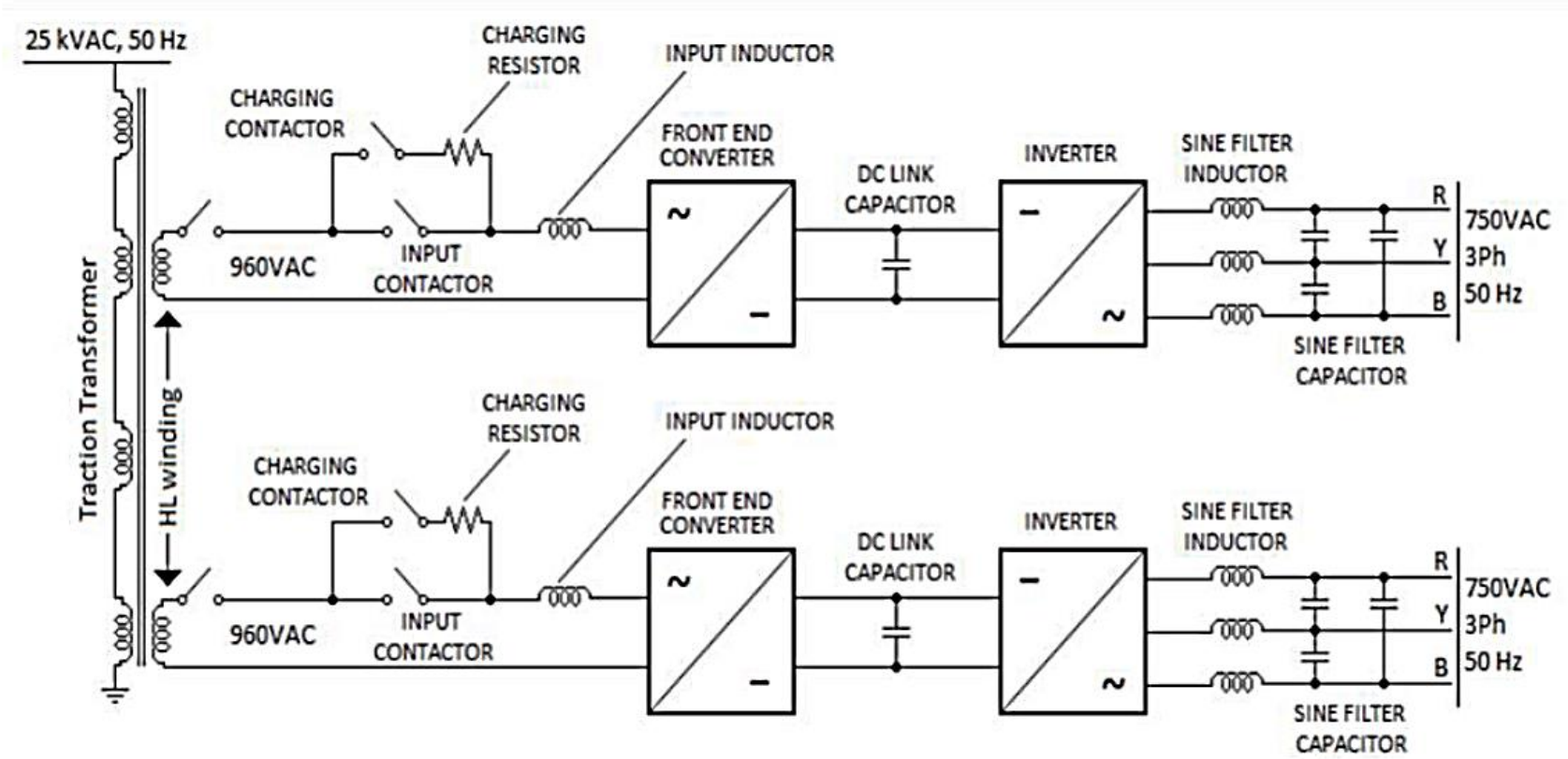


FIG. 4.21 LAMP RESISTANCE

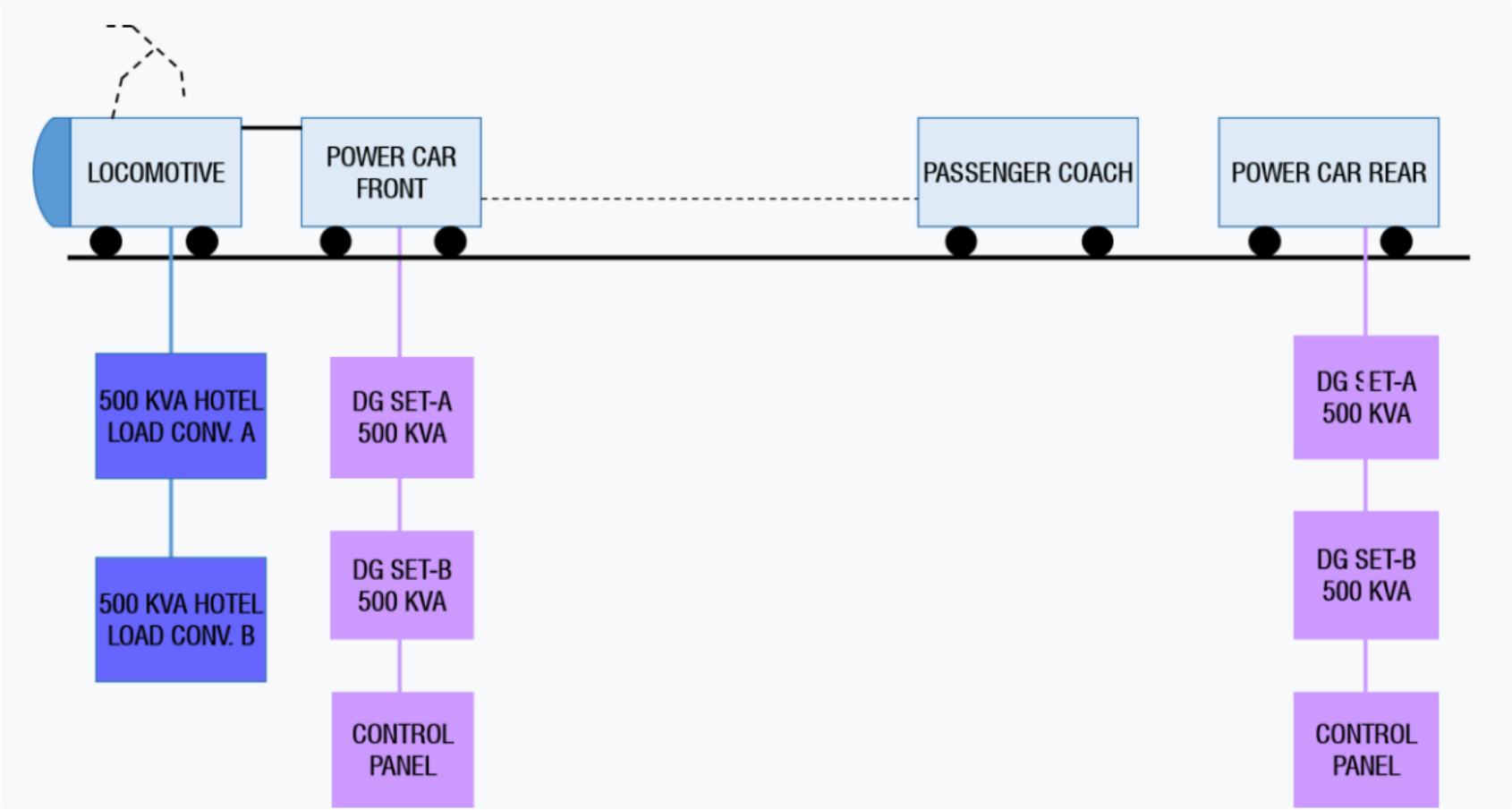


ARNO CONVERTER

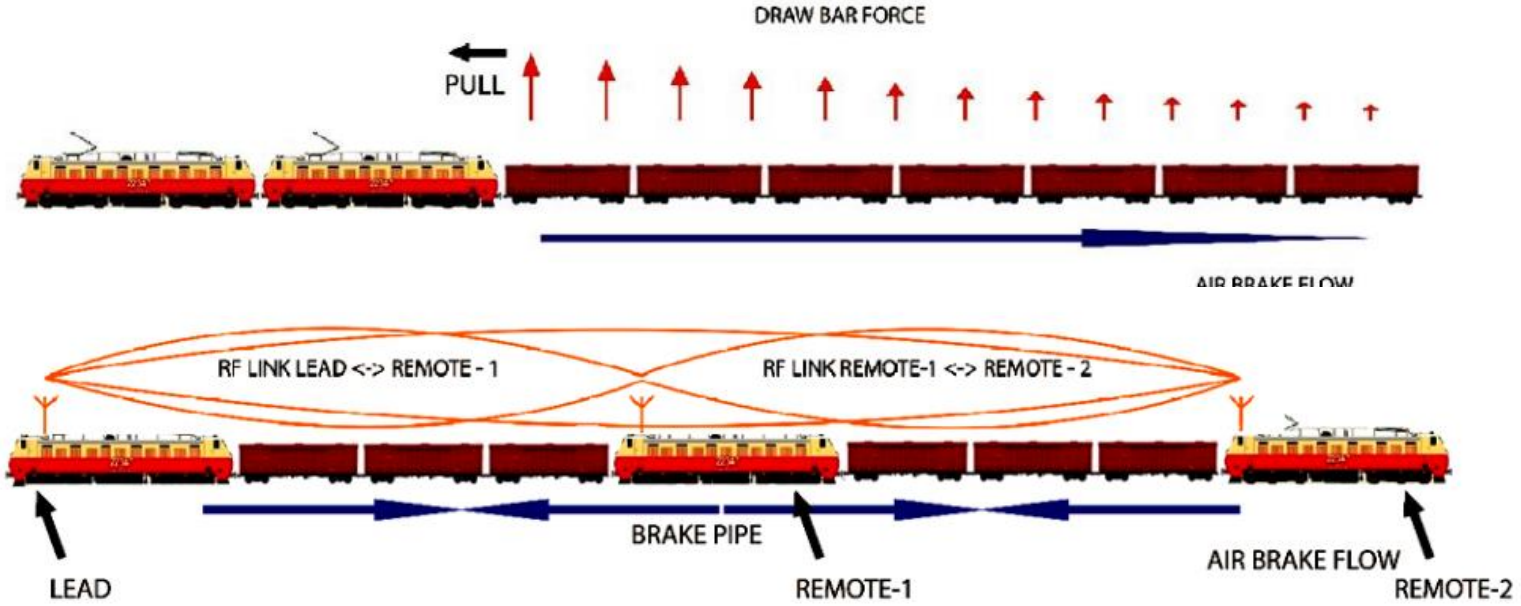
Hotel Load Converter



HEAD-ON GENERATION (HOG) SUPPLY FLOW



Distributed Power Wireless Control System (DPWCS)



Metadyne

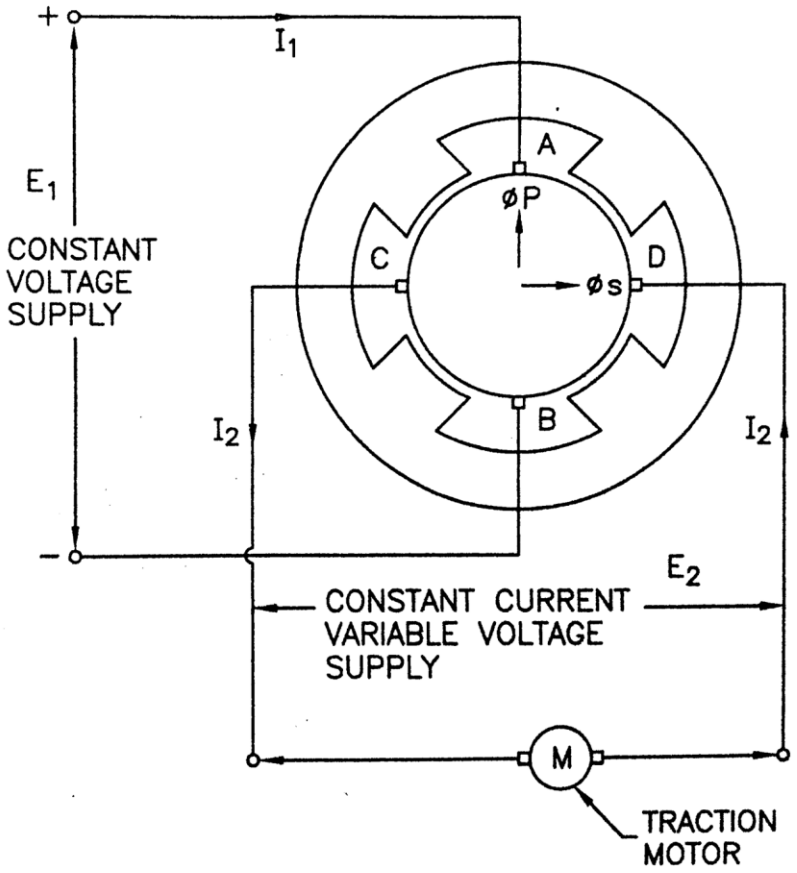


FIG. 8.22 (a) METADYNE PRINCIPLE

Metadyne Control

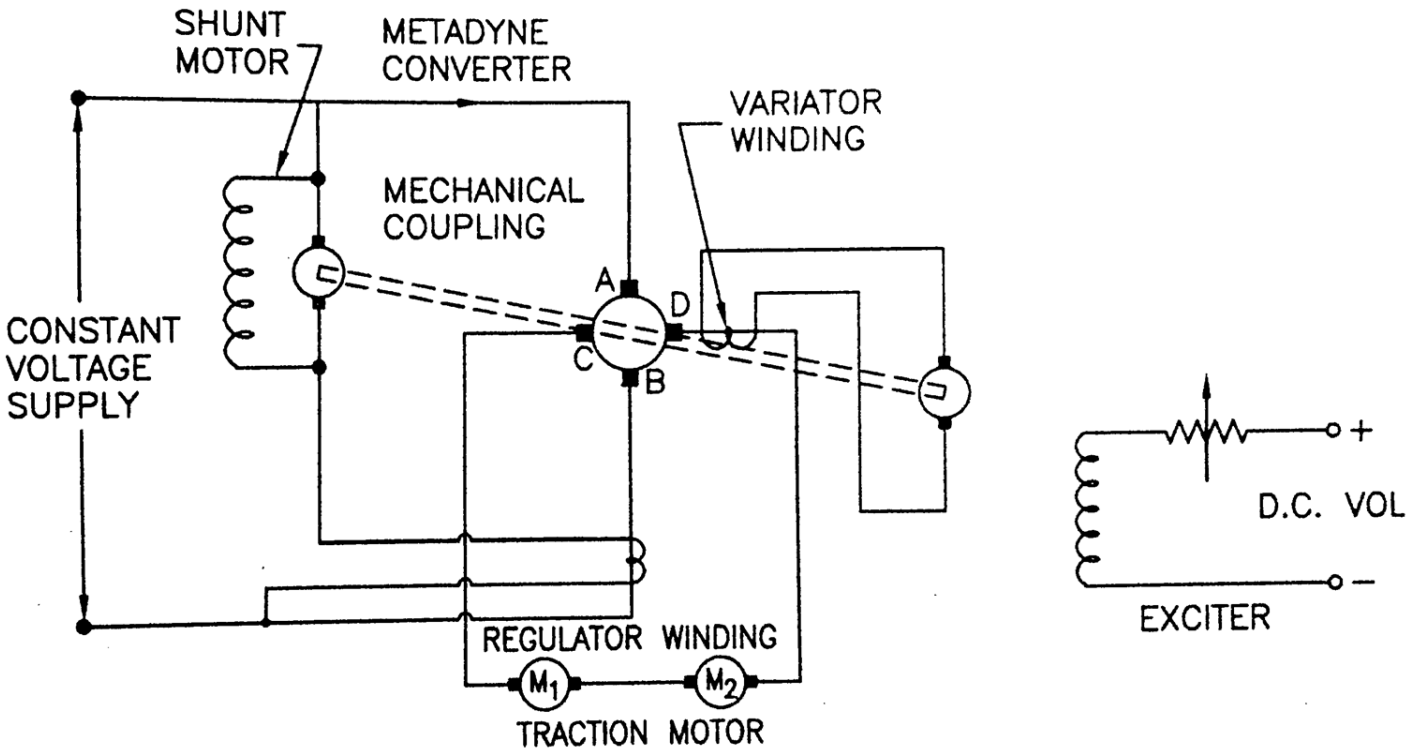


FIG. 8.22 (b) SCHEMATIC DIAGRAM OF CONTROL OF TRACTION MOTORS BY METADYNE CONTROL METHOD

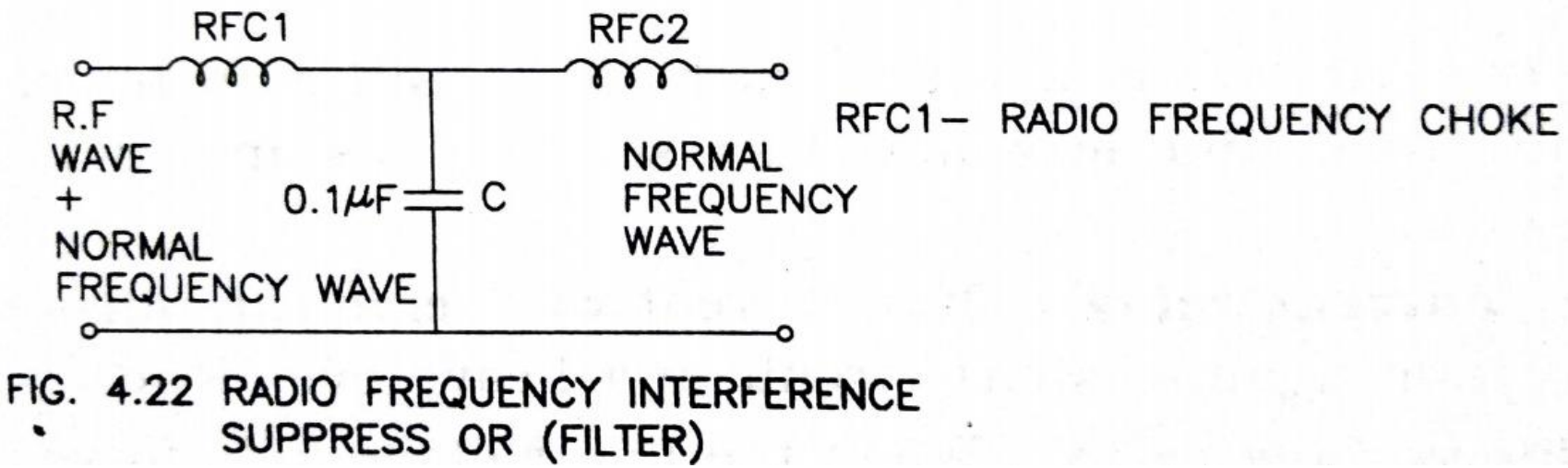


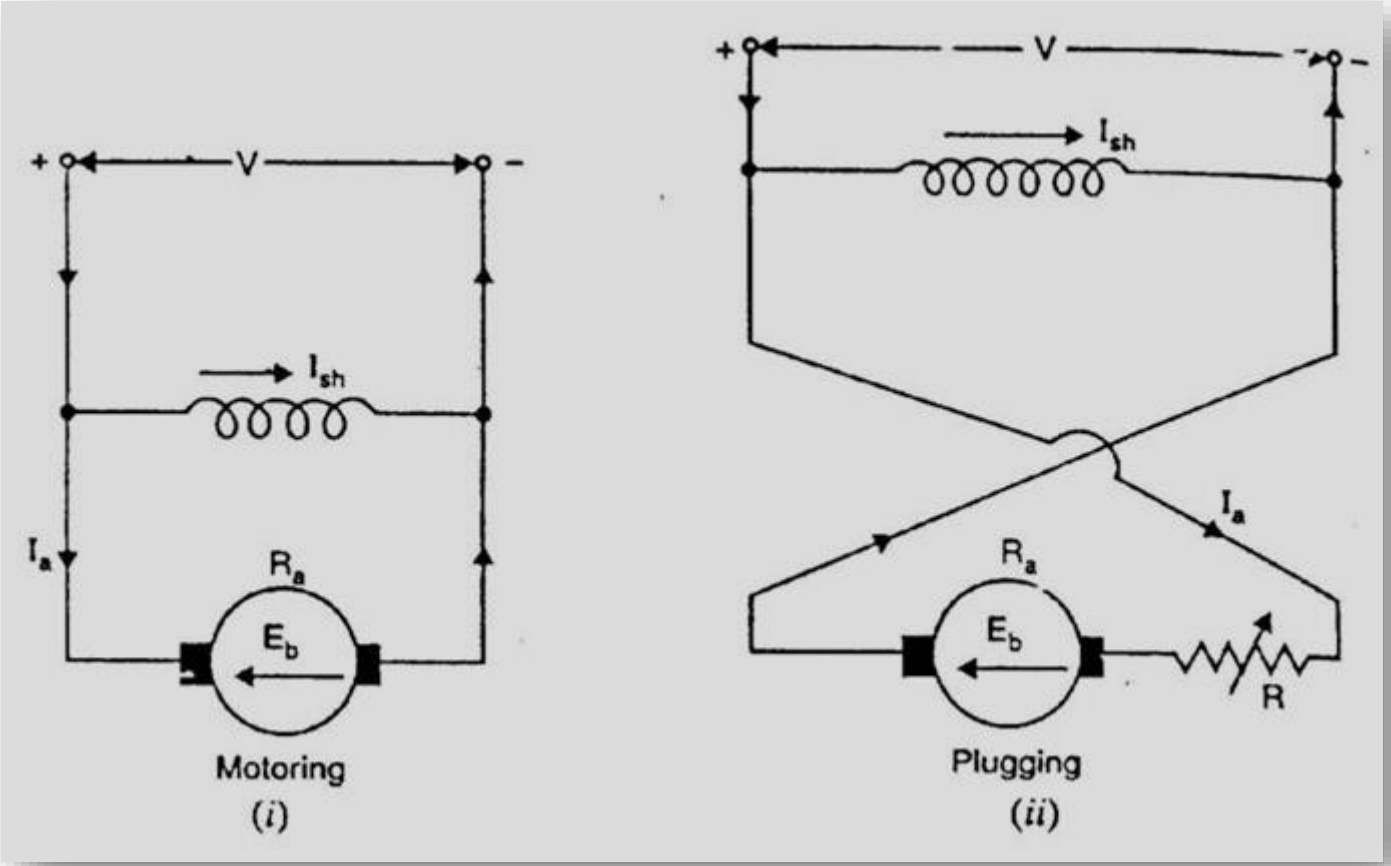
FIG. 4.22 RADIO FREQUENCY INTERFERENCE SUPPRESS OR (FILTER)

Radio Interference Suppression

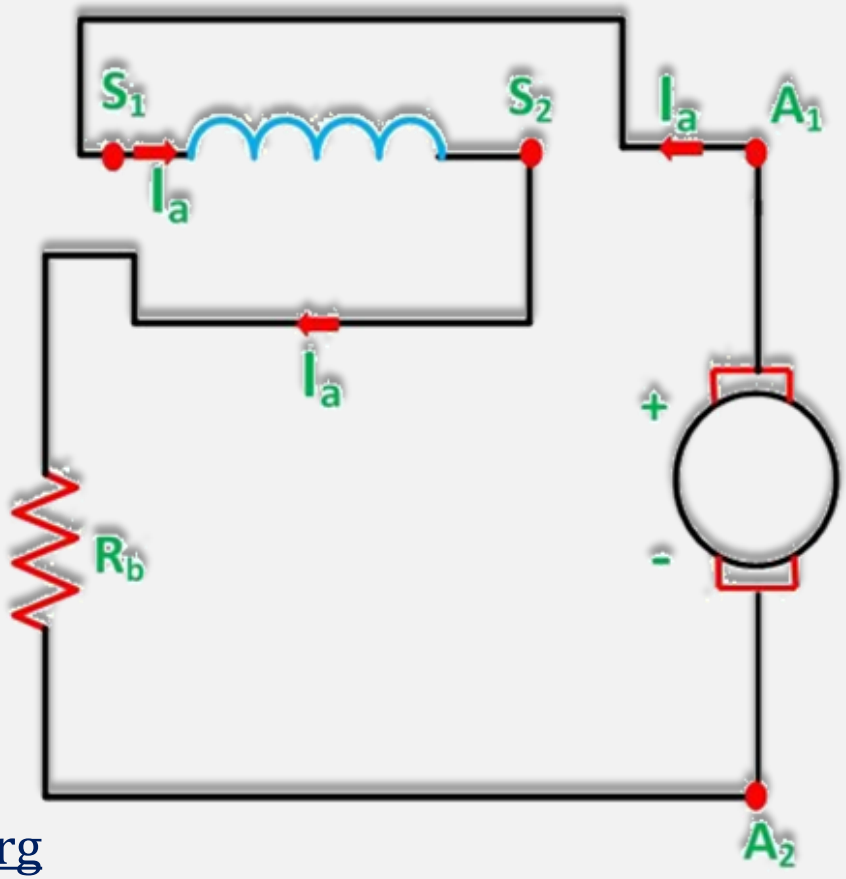
Braking

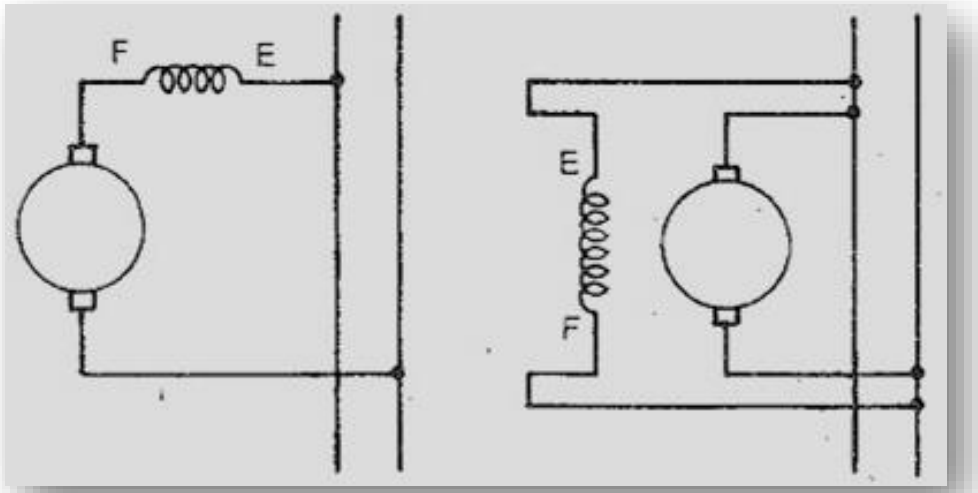
- Plugging/ Reverse Current
- Rheostatic Braking / Dynamic Braking
- Regenerative Braking

Plugging (Reverse Current)



Rheostatic Braking / Dynamic Braking





Regenerative Braking

IMPORTANT FEATURES OF LOCOMOTIVES

- Self contained
- Easy Speed Control
- High Acceleration
- Smooth Retardation
- Less weight
- High Efficiency
- Long Life

Classification of Locomotives

Self Contained Locomotive

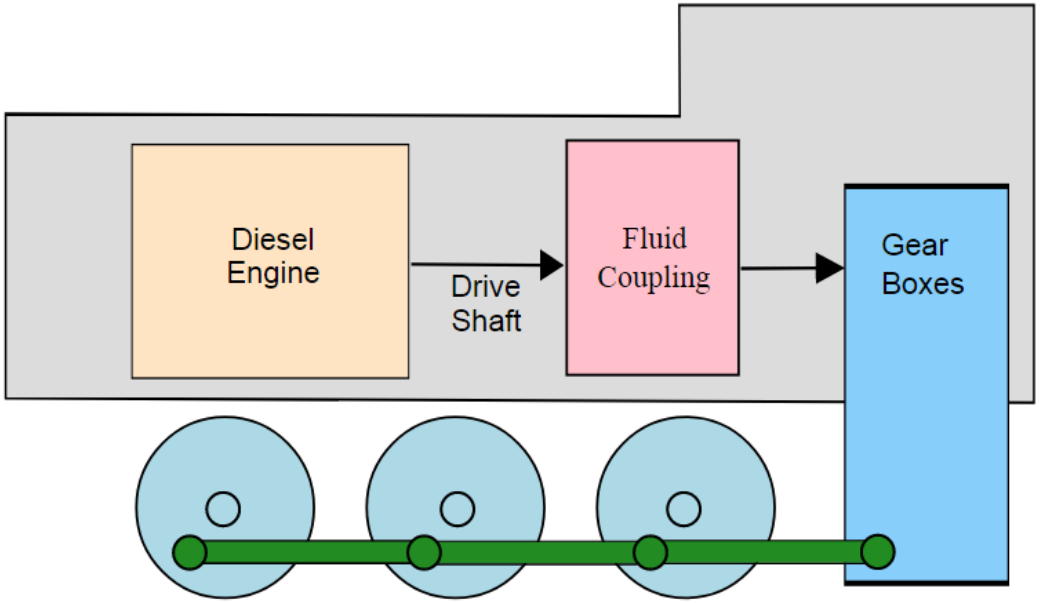
- Diesel
- Steam
- Battery
- Diesel Electric

Locomotive obtaining energy from external source

- DC
- AC
- Dual (AC&DC)

Self contained locomotive

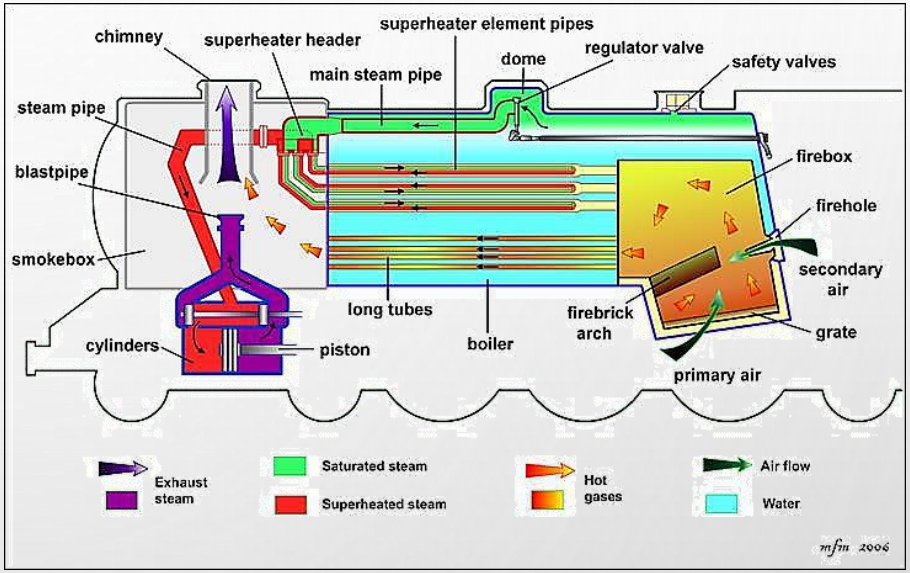
Diesel Locomotive



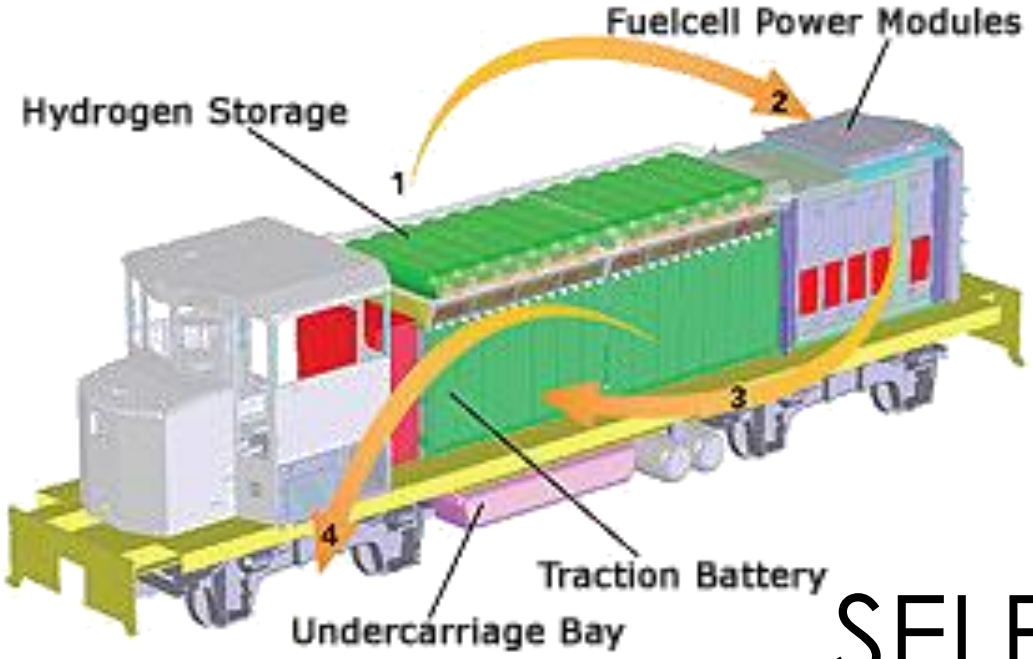
SCHEMATIC DIAGRAM OF A DIESEL MECHANICAL LOCOMOTIVE

SELF CONTAINED LOCOMOTIVE

- STEAM LOCOMOTIVE



www.vishaldevdhar.org

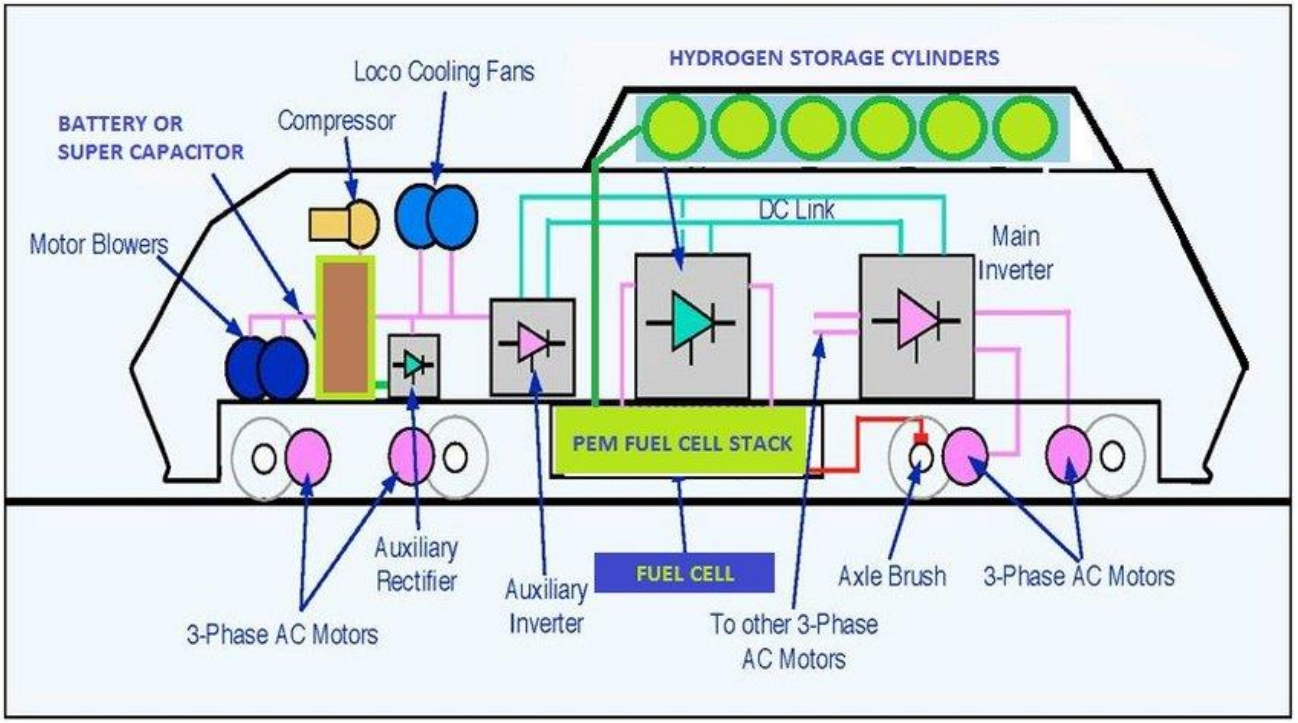


SELF CONTAINED LOCOMOTIVE

Battery Locomotive

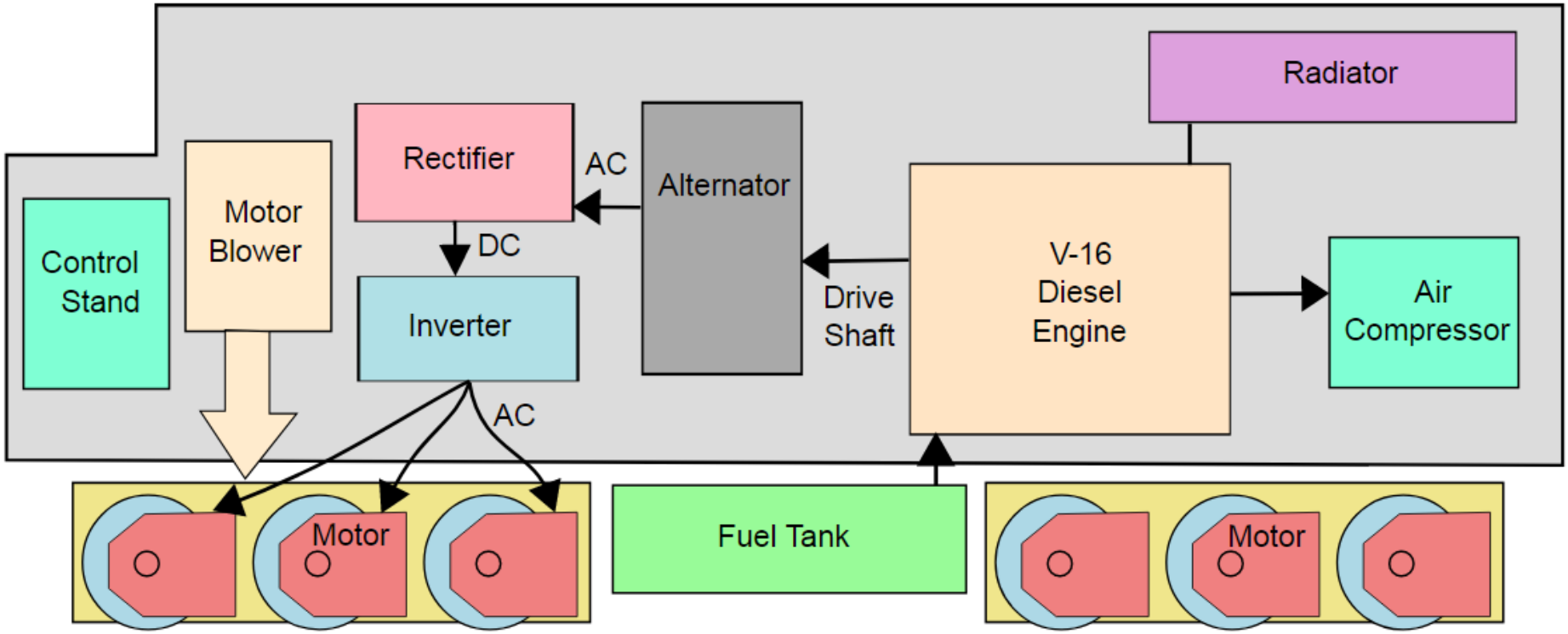
www.vishaldevdhar.org

SELF CONTAINED LOCOMOTIVE
Battery Locomotive



SELF CONTAINED LOCOMOTIVE

Diesel-Electric Locomotive



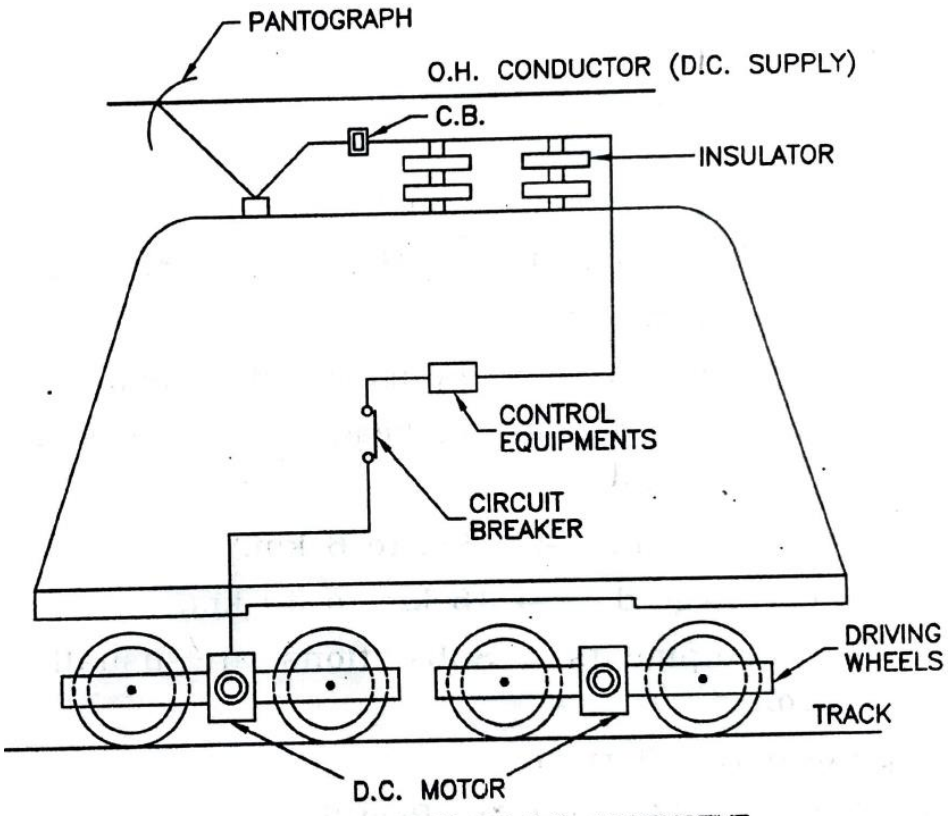
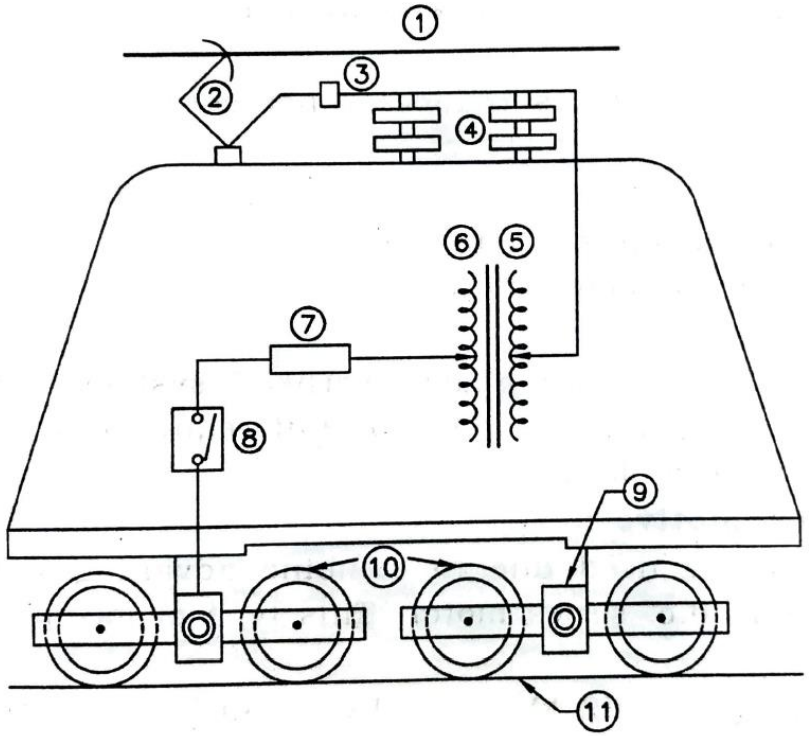


FIG. 5.2 BLOCK DIAGRAM OF D.C. LOCOMOTIVE

EXTERNAL SOURCE LOCOMOTIVES

DC Locomotive

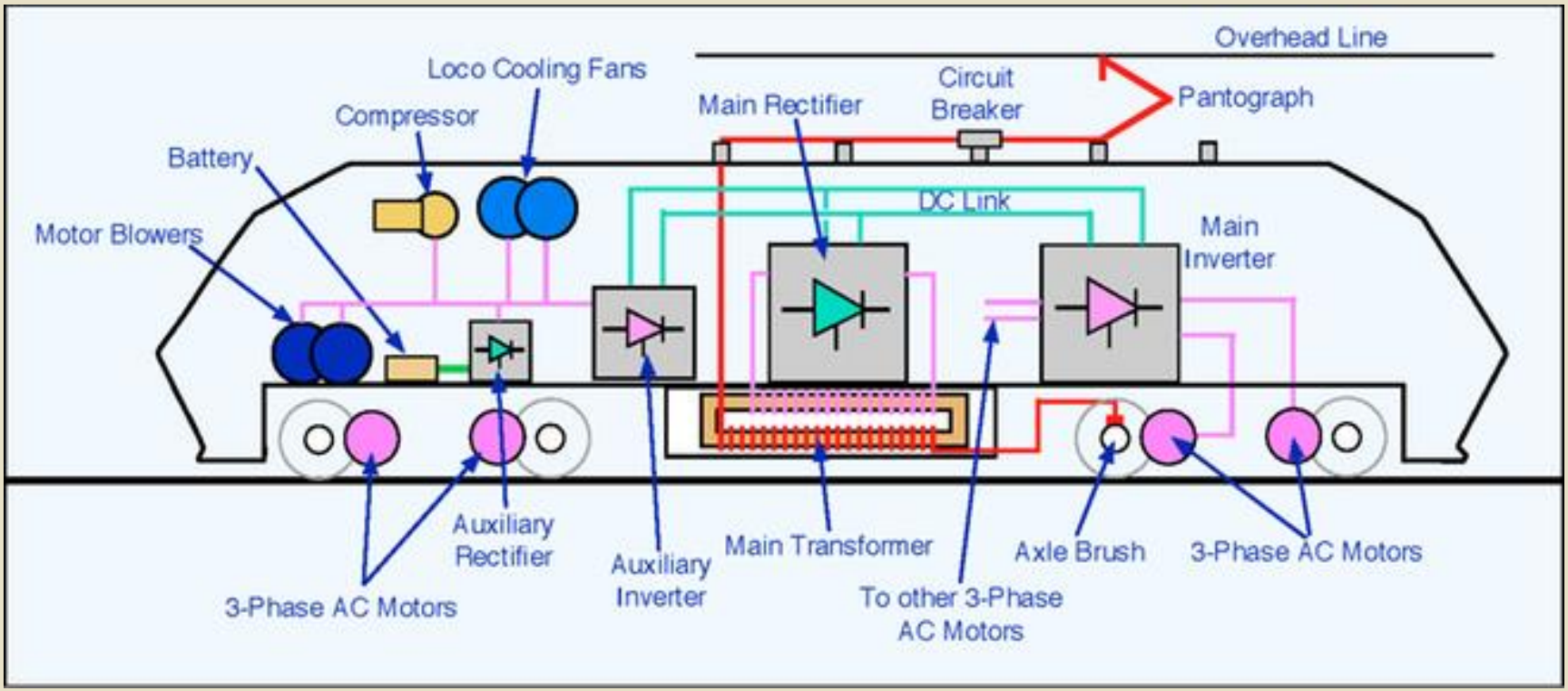


1. OVERHEAD CONDUCTOR
2. PANTOGRAPH
3. CIRCUIT BREAKER
4. INSULATOR
5. TAP CHANGER
6. TRANSFORMER
7. CONRTOL EQUIPMENT
8. STARTING & SPEED REGULATOR
9. A.C. SERIES MOTOR
10. DRIVING WHEEL
11. RAIL TRACK

FIG. 5.3 BLOCK DIAGRAM OF SINGLE PHASE A.C. LOCOMOTIVE

EXTERNAL SOURCE LOCOMOTIVES

AC Locomotive



External source locomotives

AC Locomotive

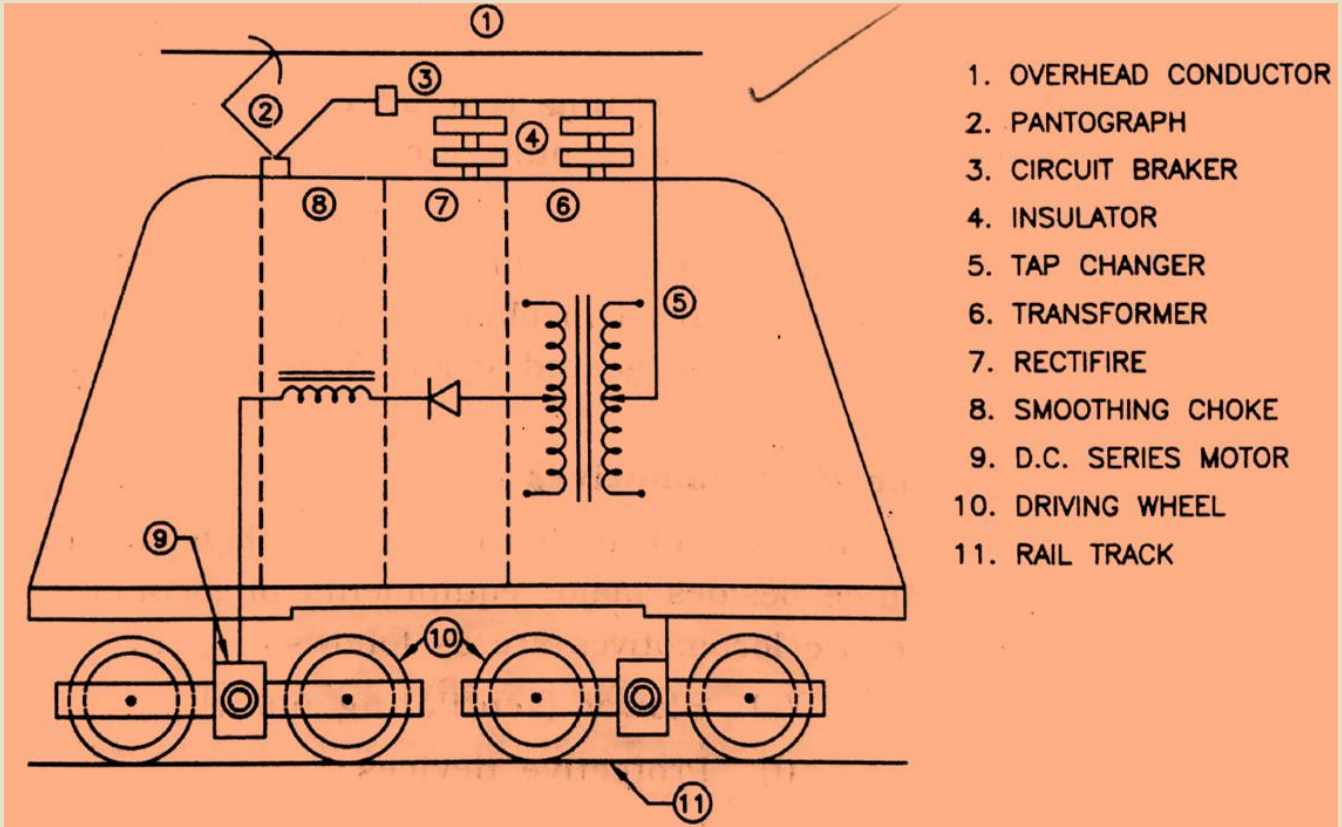


FIG. 5.4 POWER CIRCUIT DIAGRAM OF SINGLE PHASE A.C. LOCOMOTIVE

External source locomotives

AC-DC Locomotive

Types of locomotives

Sr. No.	First Letter (Gauge)	Second Letter (Motive Power)	Third Letter (Job Type)
1	W – Broad gauge (wide)	D – Diesel	G – Goods
2	Y – Metre gauge (yard)	C – DC electric (DC overhead line)	P – Passenger
3	Z – Narrow gauge (2.5 Foot)	A – AC electric (AC overhead line)	M – Mixed (goods and passenger)
4	N – Narrow (toy) gauge (2 Foot)	CA – DC and AC (AC or DC overhead line)	S – Shunting (switching)
5		B – Battery (rare)	U – Multiple unit (electric or diesel)
6			R – Railcar

TYPES OF LOCOMOTIVES

Diesel

- WDM – Wide diesel mixed
- WDP – Wide diesel passenger
- WDG – Wide diesel goods
- WDS – Wide diesel shunter
- WCDS – Wide converted diesel shunter

DC Electric

- WCM - Wide DC mixed
- WCP – Wide DC passenger
- WCG – Wide DC goods

TYPES OF LOCOMOTIVES

AC electric

- WAM – Wide AC mixed
- WAP – Wide AC passenger
- WAG – Wide AC goods

Dual (AC and DC)

- WCAM - Wide DC/AC mixed
- WCAP – Wide DC/AC passenger
- WCAG – Wide DC/AC goods

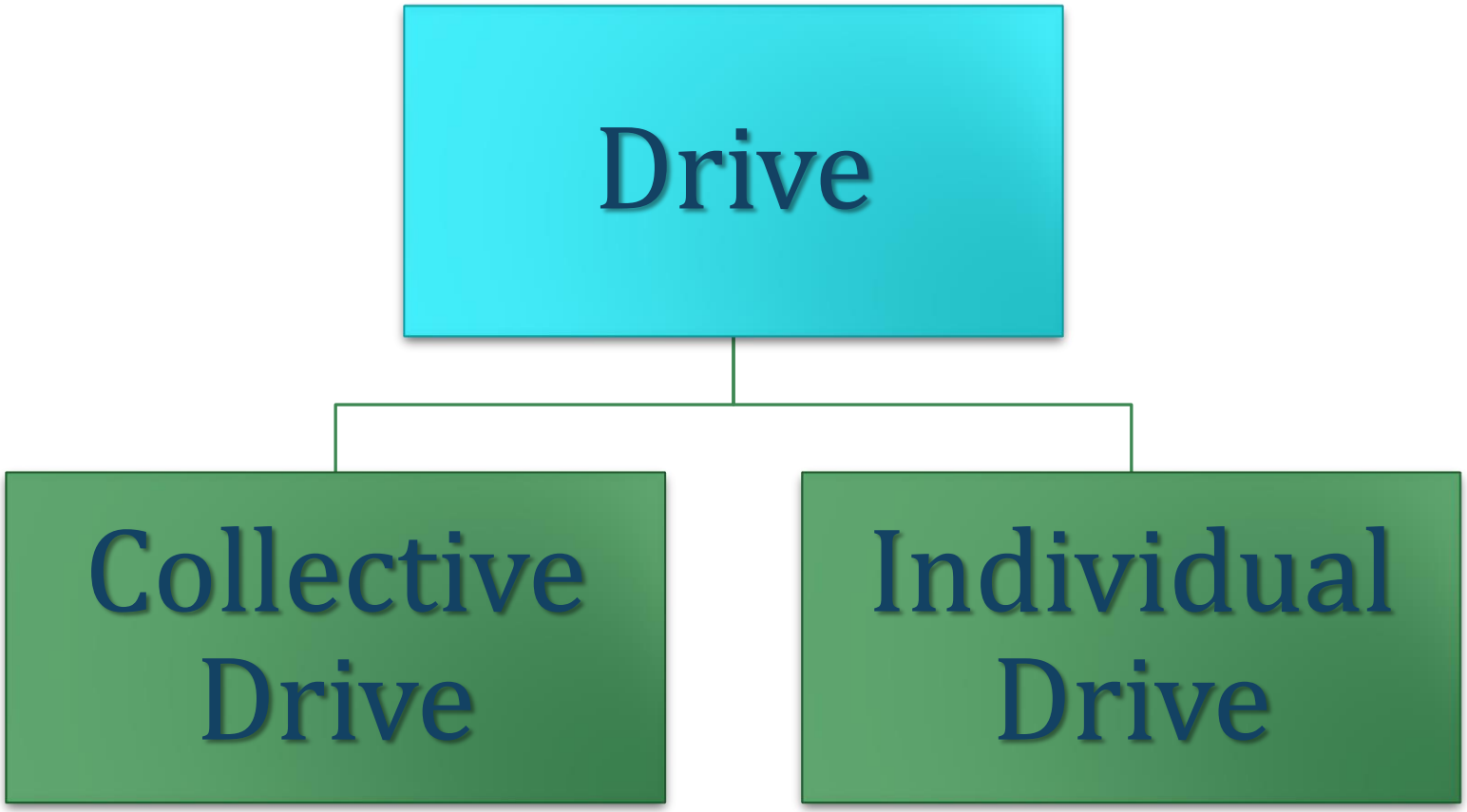
ELECTRIC LOCOMOTIVES


3246
3246
3246

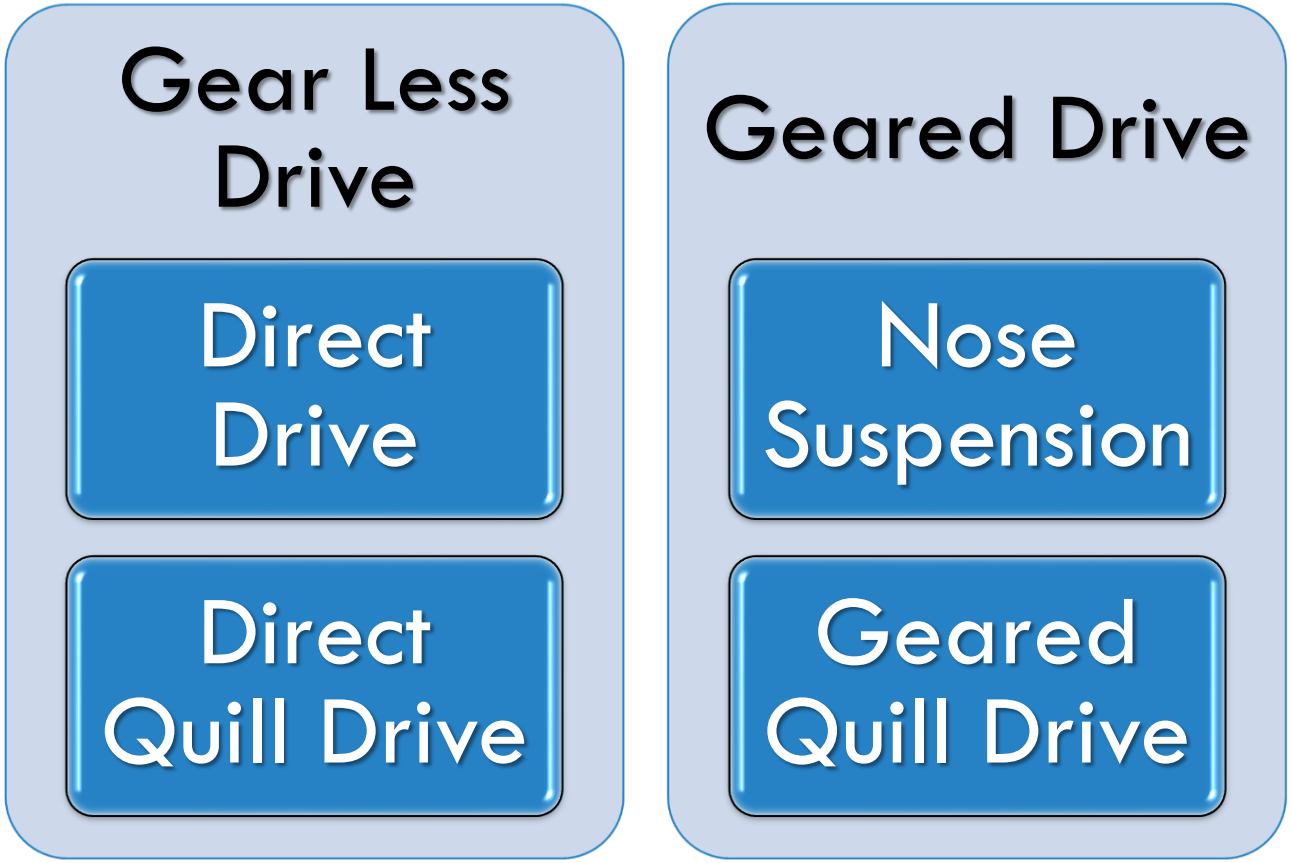

5824
CANADIAN
PACIFIC
5824
C


ДР1А-161

POWER TRANSMISSION – MECHANICAL DRIVES



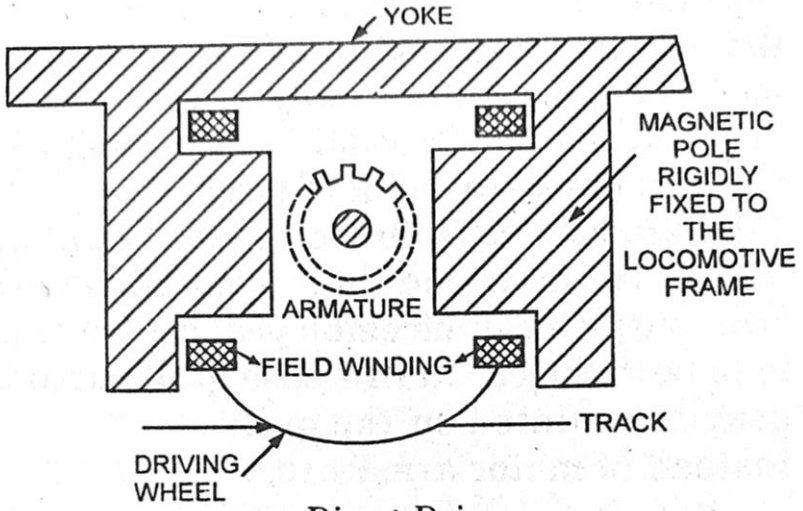
INDIVIDUAL DRIVE



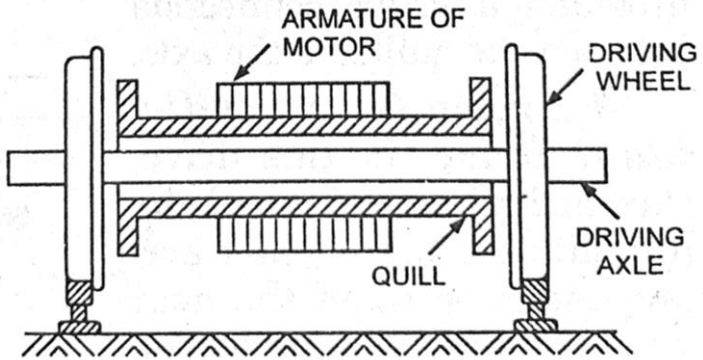
INDIVIDUAL DRIVE

Gear Less Drive

- Direct Drive
- Direct Quill Drive



Direct Drive

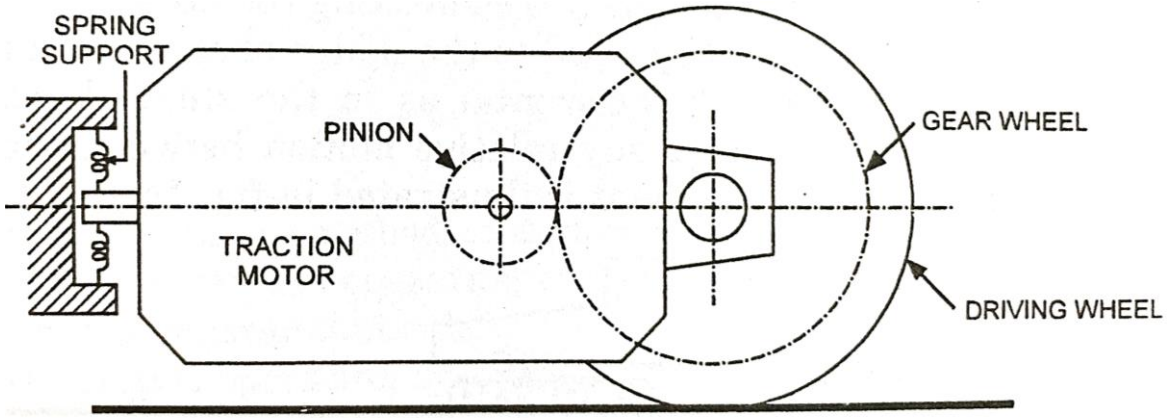


Direct Quill Drive

INDIVIDUAL DRIVE

Geared Drive

- Nose Suspension
- Geared Quill Drive



Nose-Suspension Geared Drive

www.vishaldevdhar.org