Electric Traction & Control
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UNIT – 3

Traction Motors & Their Control

- ***Features of traction motors***
- ***Significance of D.C. series motor as traction motor***
- ***A. C. Traction motors-single phase, Three phase, Linear Induction Motor***
- ***Comparison between different traction motors***
- ***Series-parallel control***
- ***Open circuit, Shunt and bridge transition***
- ***Pulse Width Modulation control of induction motors***
- ***Types of electric braking system.***

Features of traction motors

MECHANICAL FEATURES

ELECTRICAL CHARACTERISTICS

Features of traction motors

- **Mechanical Features**
  - **Robust**
  - **Small Size**
  - **Less Weight**
  - **Totally Enclosed**

Features of traction motors

- **Electrical Characteristics**
  - **High starting torque**
  - **Simple speed control**
  - **Self-relieving property**
  - **Regenerative braking**
  - **Voltage fluctuations withstanding capabilities**
  - **Supply interruption withstanding capabilities**
  - **High overload capacity**
  - **Parallel running**

Electrical Motor

DC Motor

AC Motor

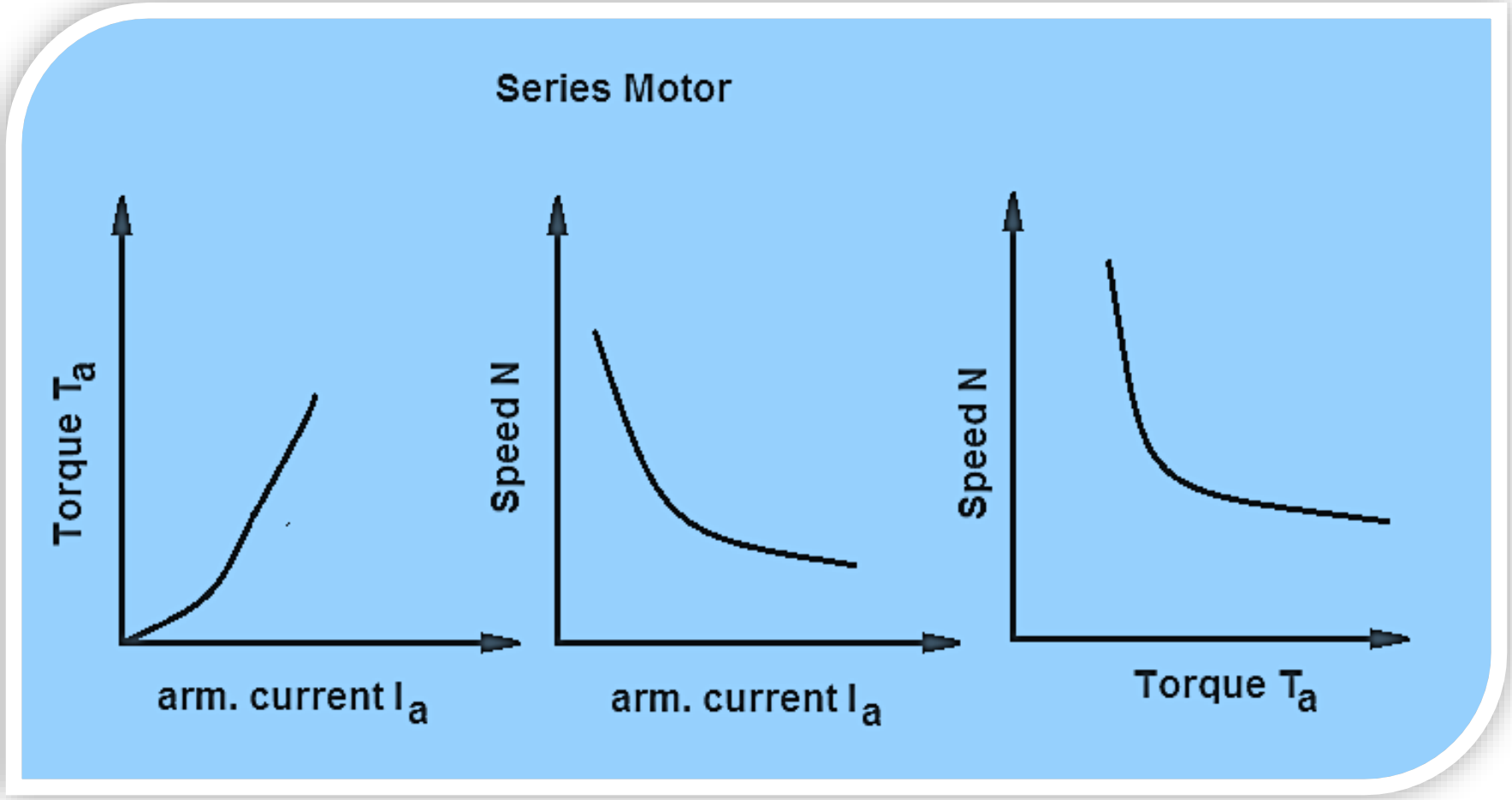
Traction motors

- DC Series Motor
- Induction Motor
- AC Series Motor
- Repulsion Motor
- Linear Induction Motor

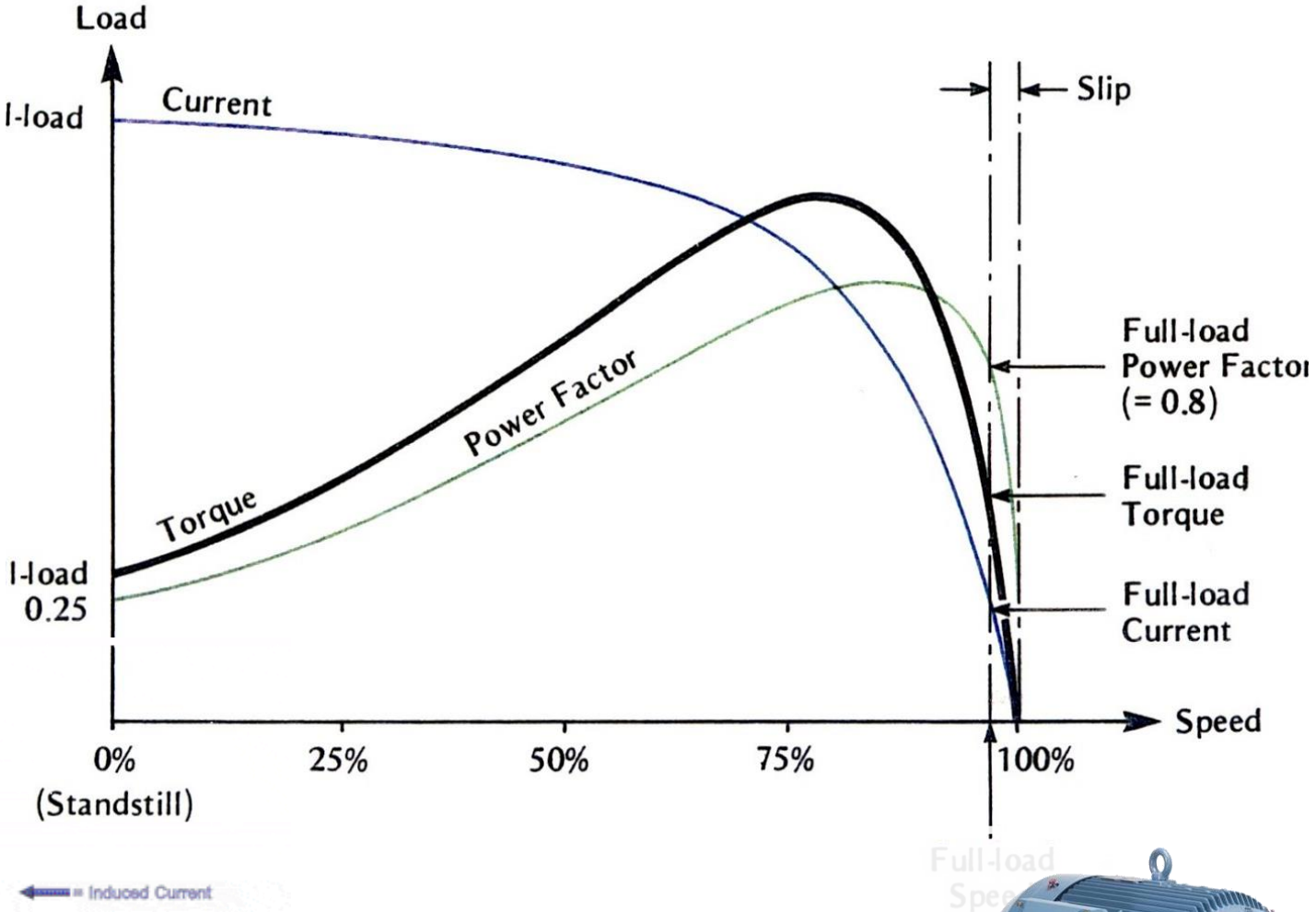
DC Series Motor

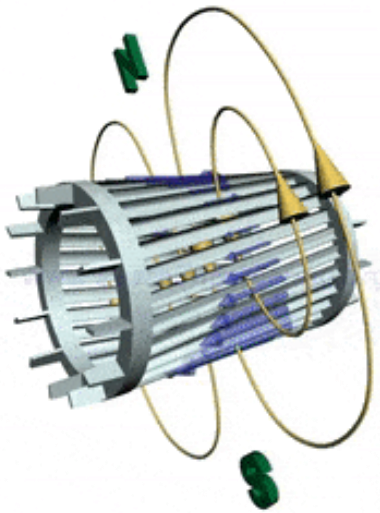
- **Significance of DC Series Motor as traction motor**
  - High starting torque
  - Simple speed control
  - Good commutation
  - Self-relieving property
  - Voltage fluctuations withstanding capabilities
  - High overload capacity
  - Parallel running
  - Simple & robust construction

DC Series Motor



Induction Motor





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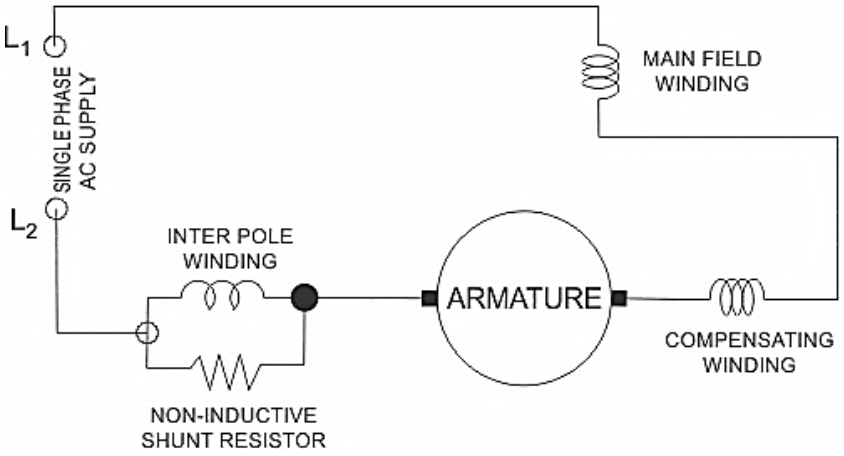
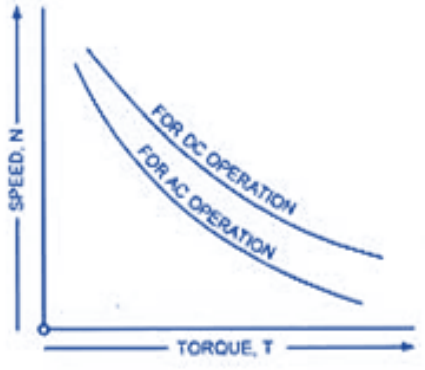
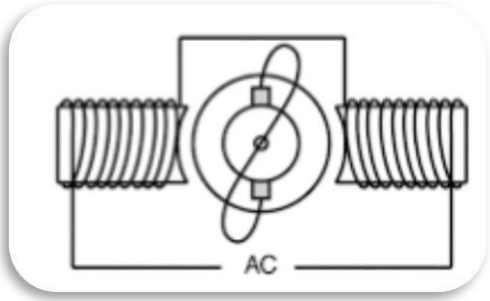
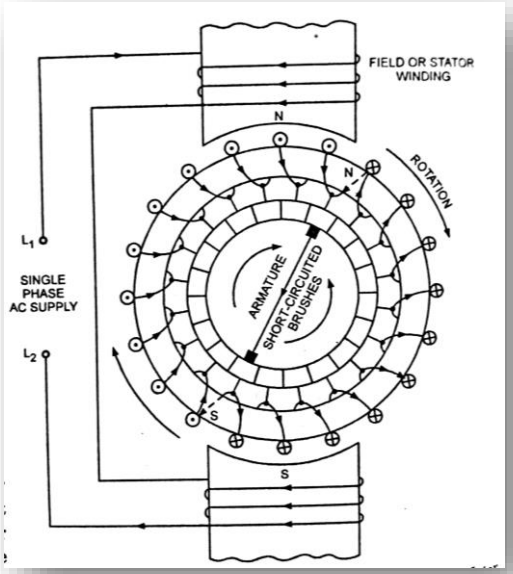


AC Series Motor with Interpoles and compensating Windings



AC Series Motor



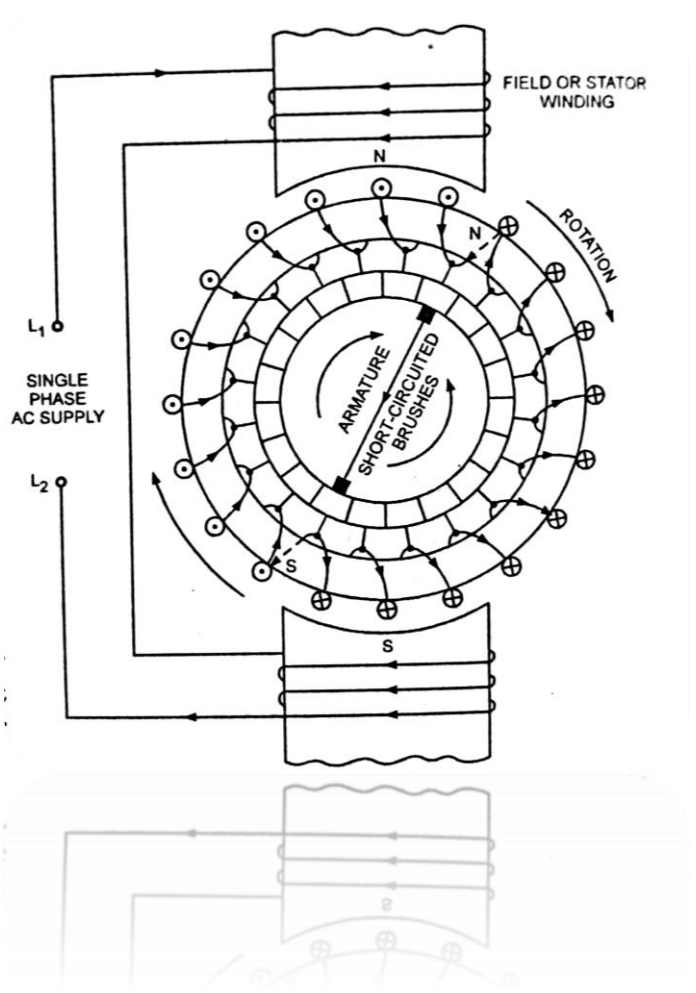


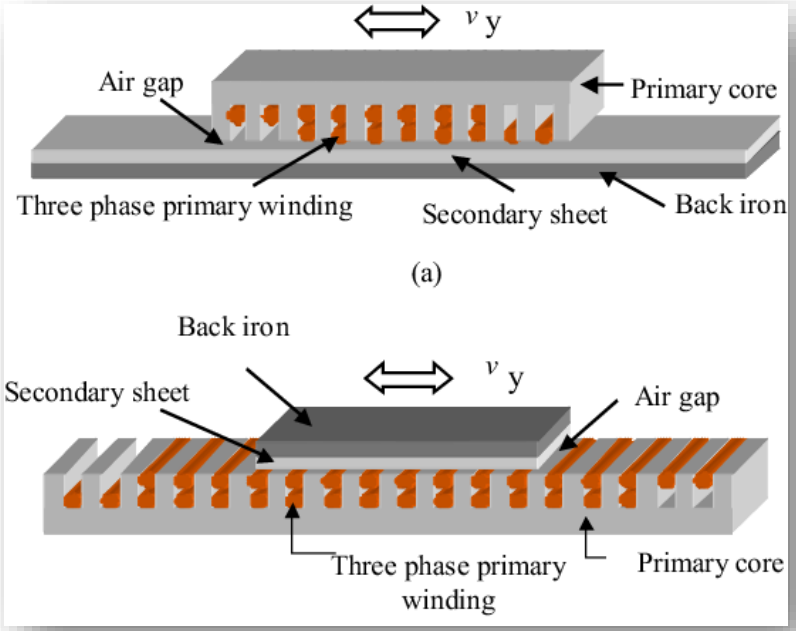
Repulsion Motor

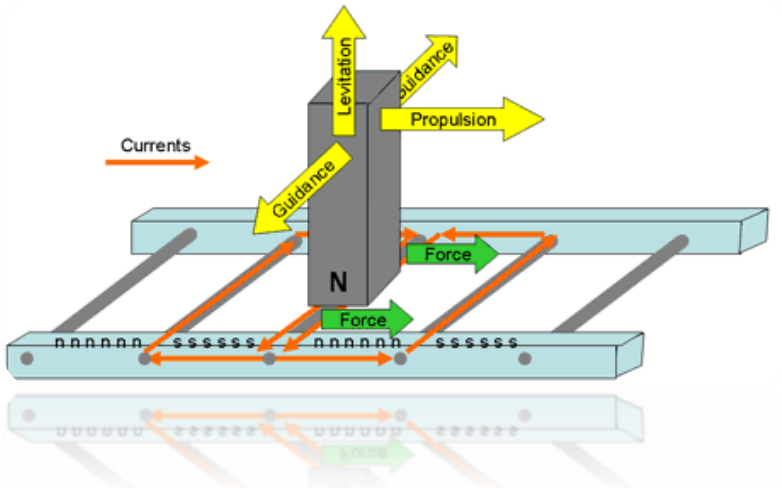
- Construction is similar to AC series motor
- Armature is short circuited and not connected to source
- Direction of rotation can be changed by changing brush position

Repulsion Motor

- **Advantages**
  - High starting torque
  - Speed reversal is possible
  - Speed control is available
- **Disadvantages**
  - Low power factor
  - High speed variation with load variation
  - Sparking at brushes
  - High cost







Magnetic Levitation

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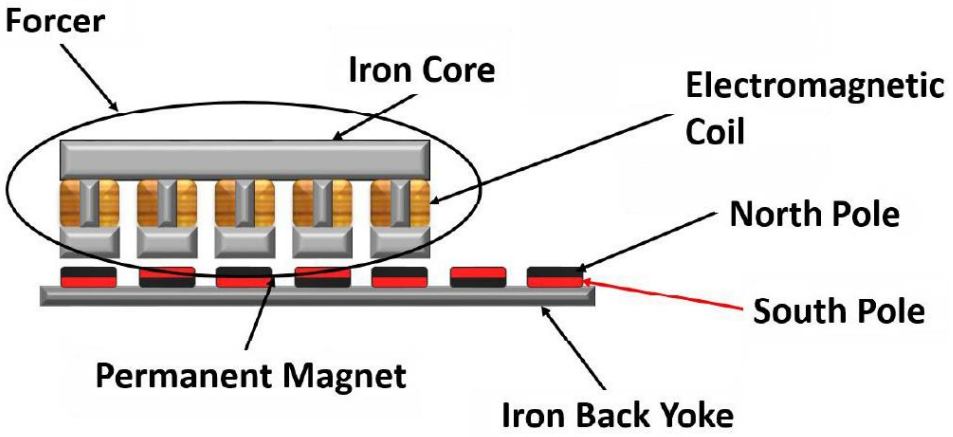
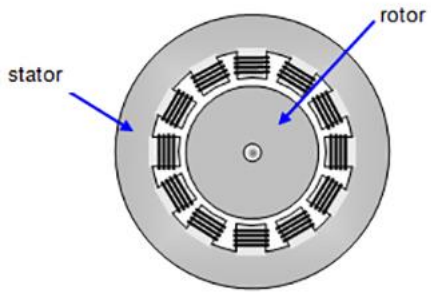
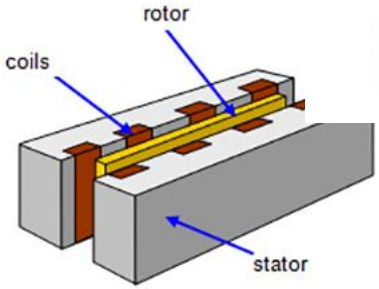
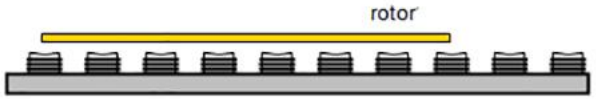


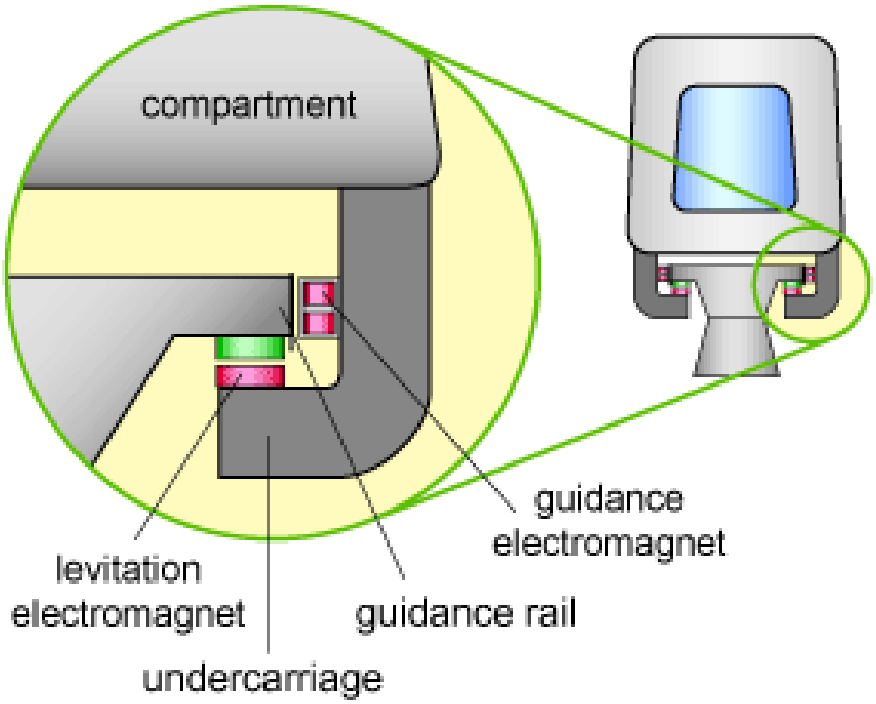






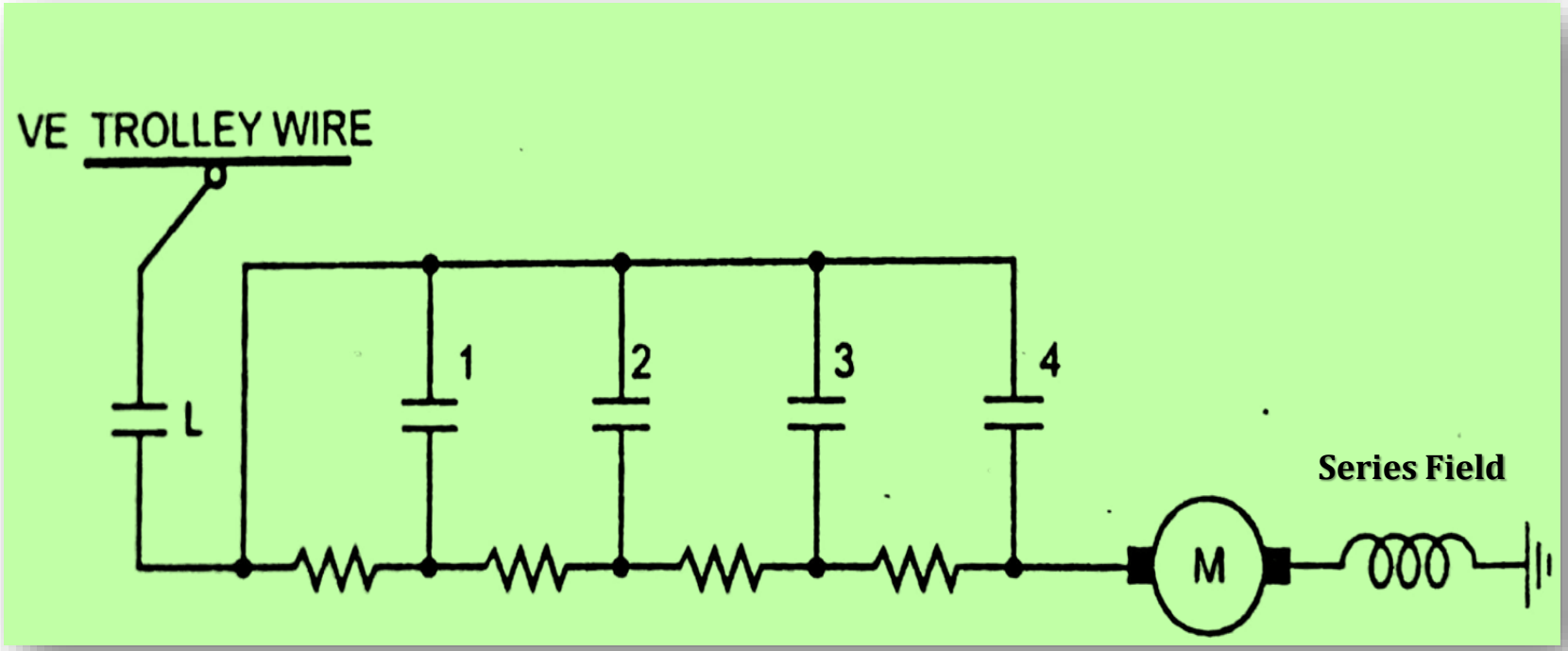
Linear Induction Motor

Linear Induction Motor



Speed Control of DC Traction Motor

- Rheostatic Control
- Series Parallel Control
- Field Control
- Motor-Generator Locomotive Control
- Diesel Electric Locomotive Control



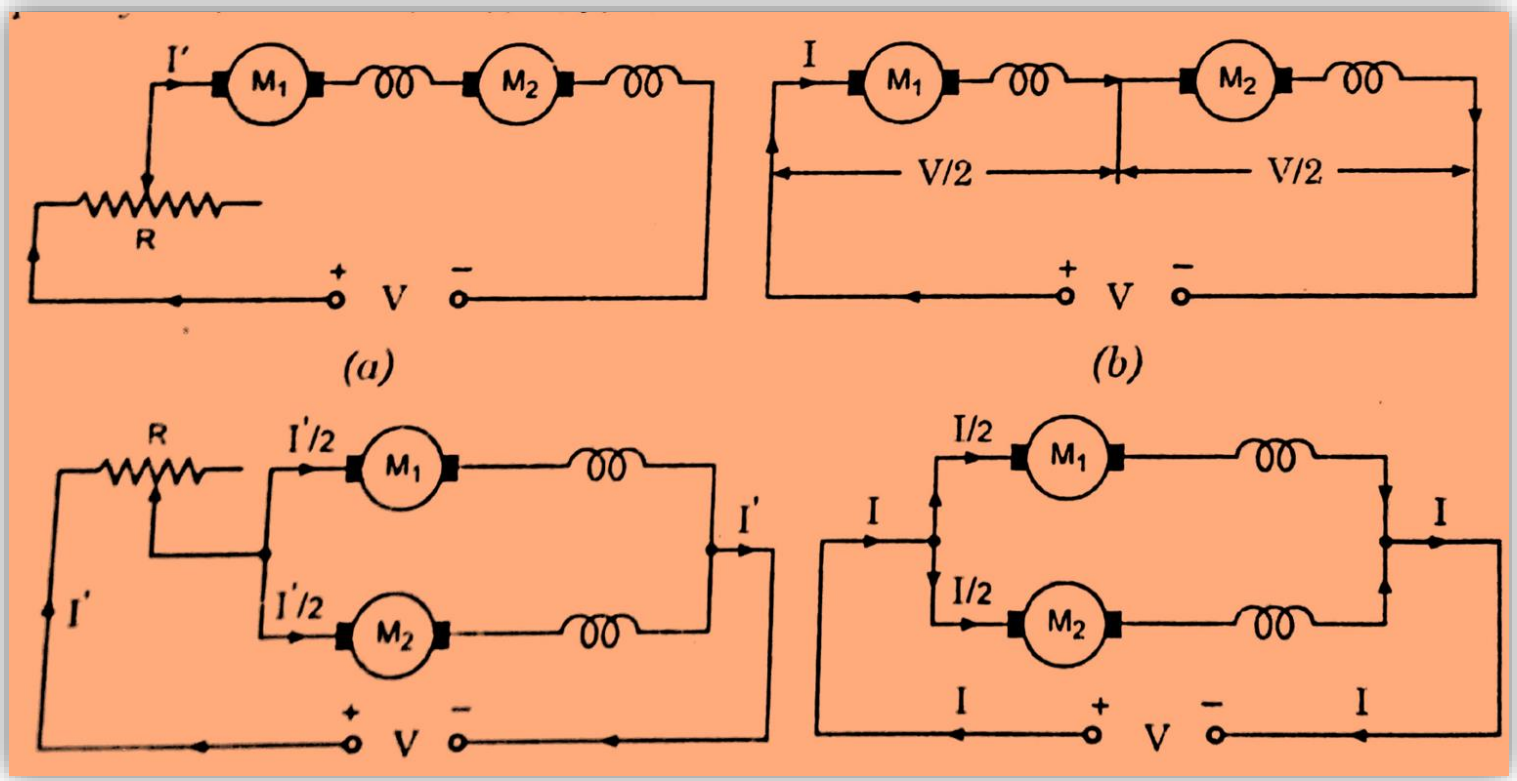
DC Series Motor

Rheostatic Control

Speed Control of DC Traction Motor

Series Parallel Control

Speed Control of DC Traction Motor



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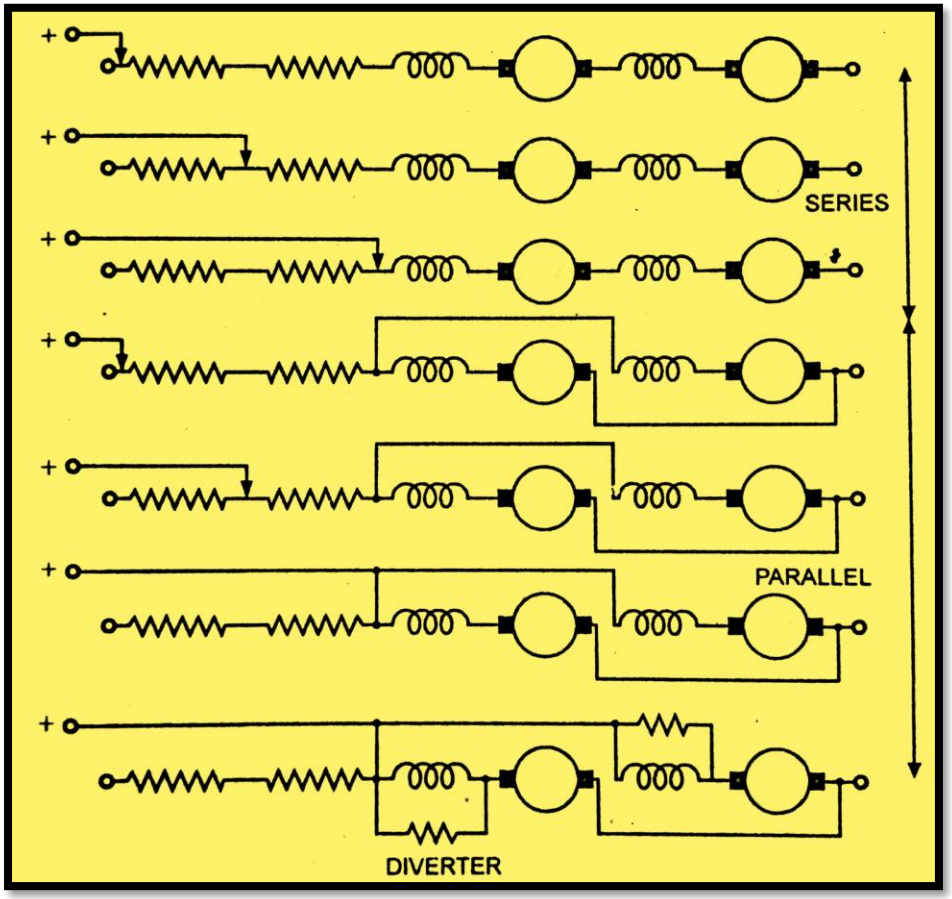
$$N \propto \frac{E_b}{\varphi}$$

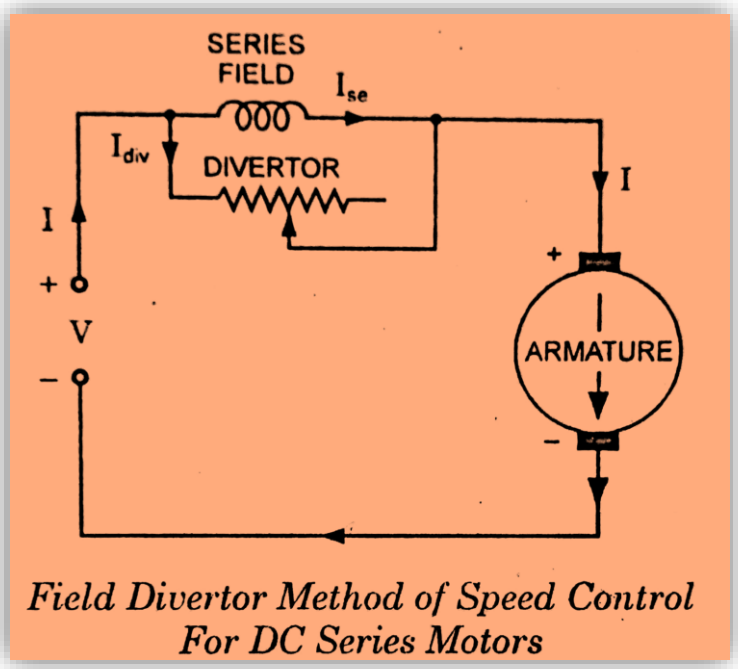


Speed Control of DC Traction Motor

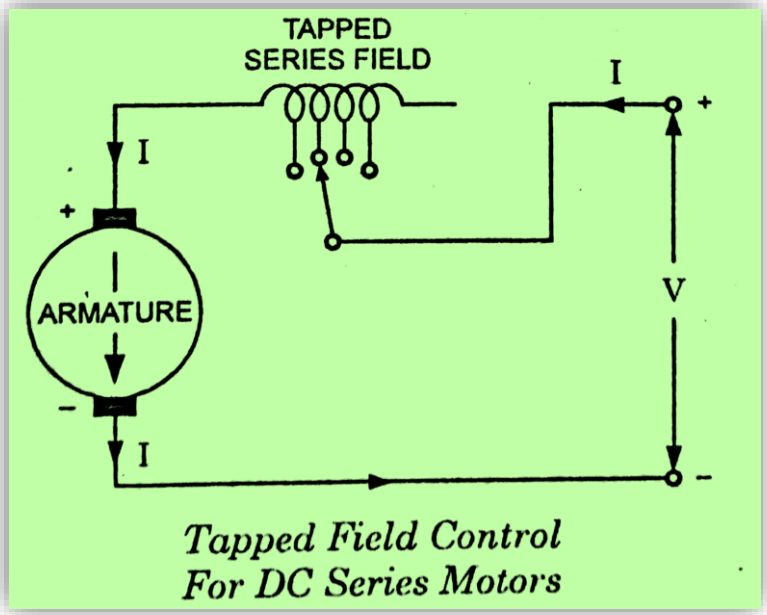
Combination of Series Parallel & Resistance Control

Field Control

Speed Control of DC Traction Motor



Field Divertor Method of Speed Control For DC Series Motors



Tapped Field Control For DC Series Motors

1

Open-Circuit Transition

2

Shunt Transition

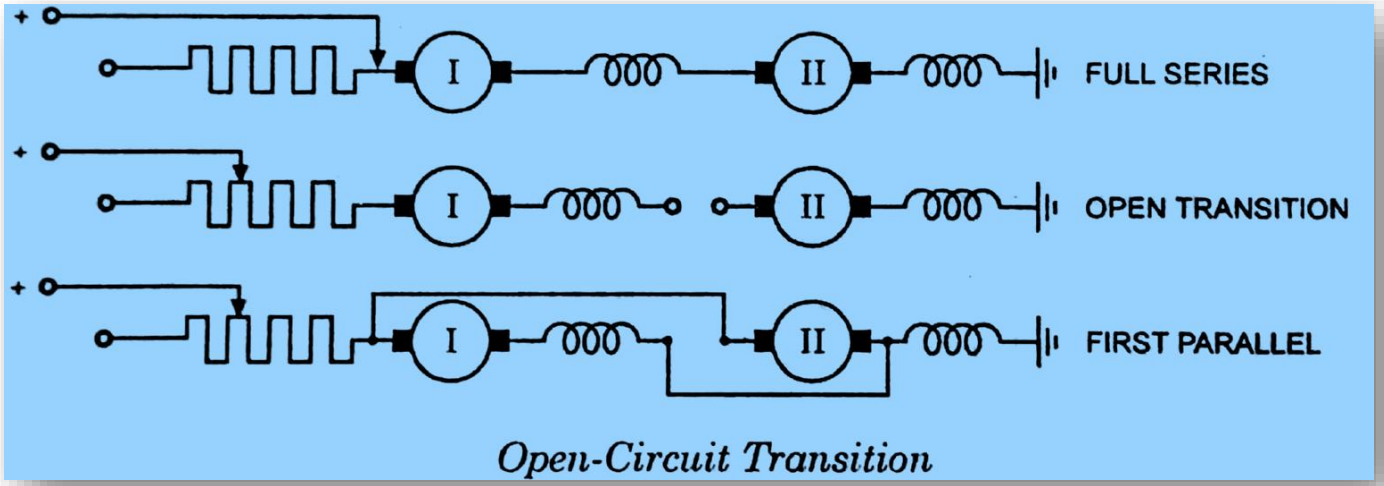
3

Bridge Transition

Transition Methods

Transition Methods

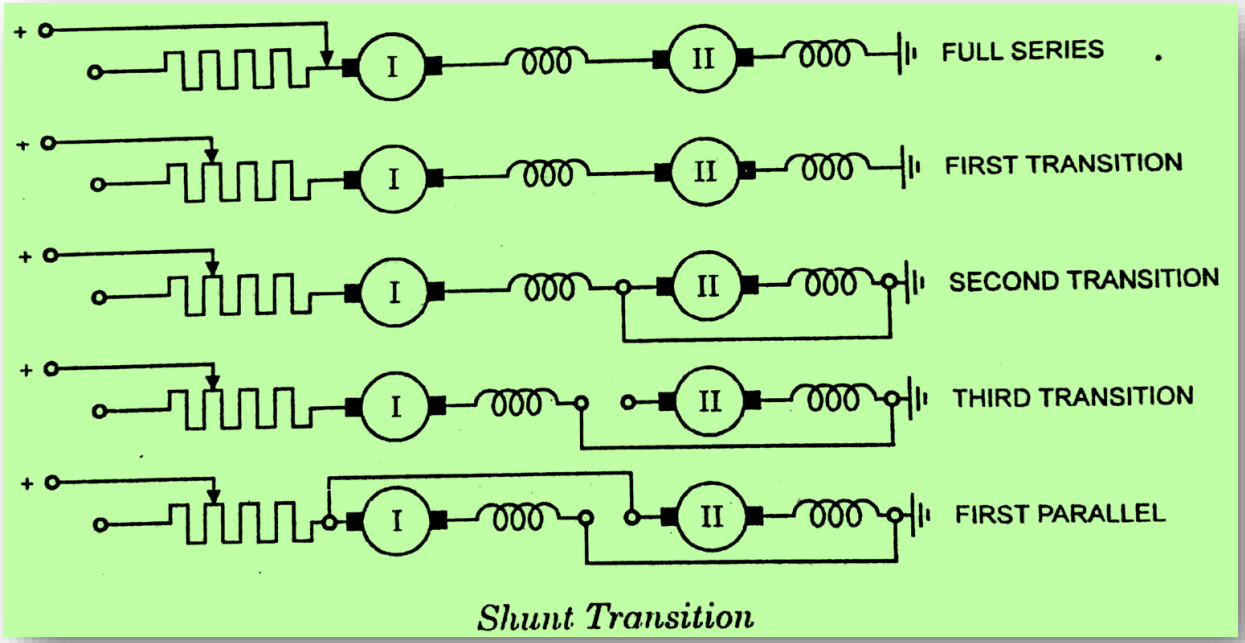
Open Circuit Transition



Open-Circuit Transition

Transition Methods

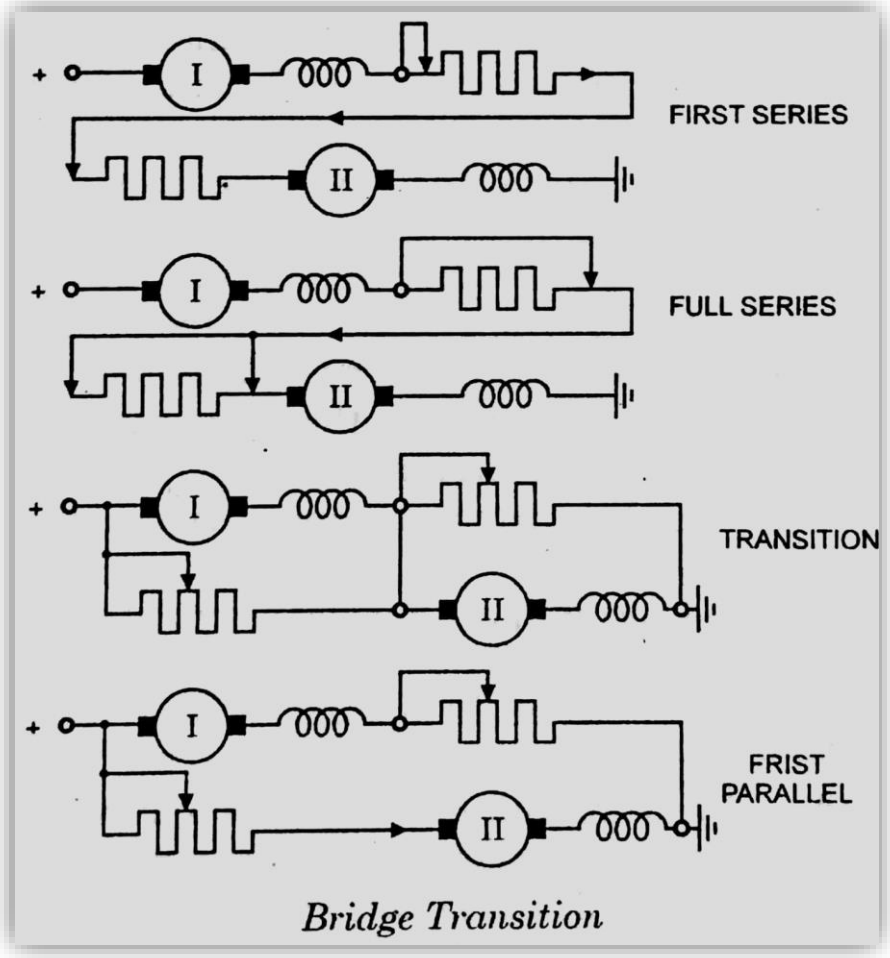
Shunt Transition



Shunt Transition

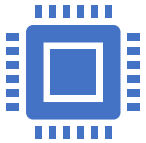
Transition Methods

Bridge Transition



Controllers

Drum Type Controller

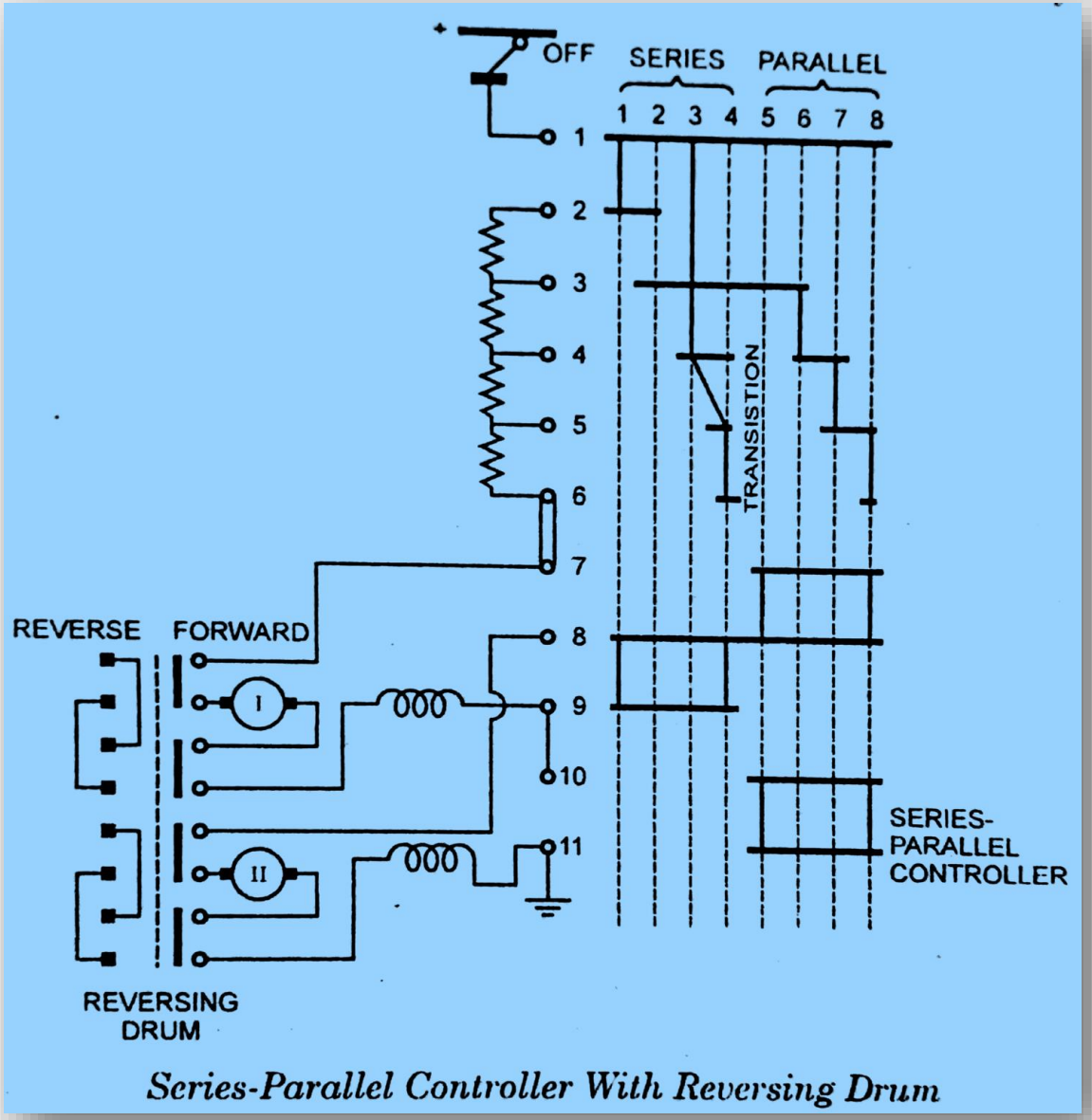


Contactor Type Controller

Multiple Unit Control

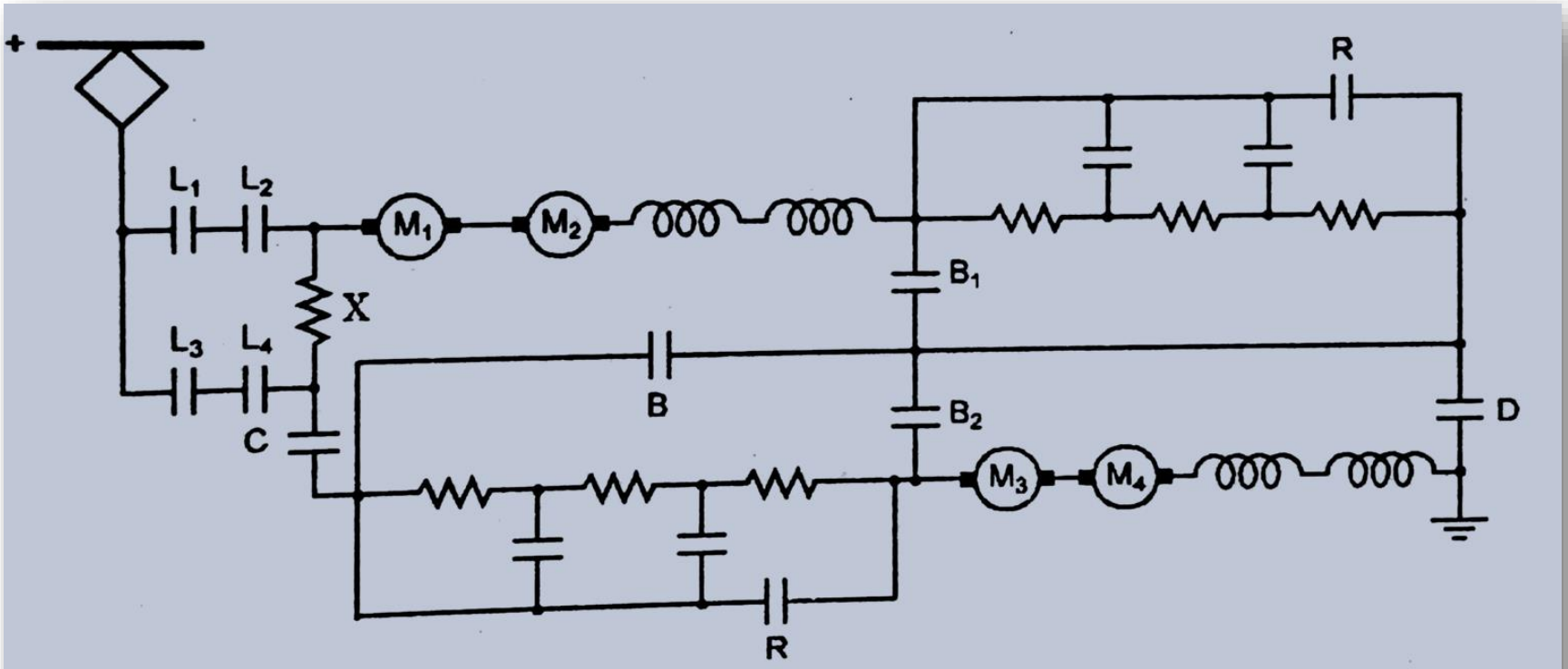
Controller

Drum Type Controller

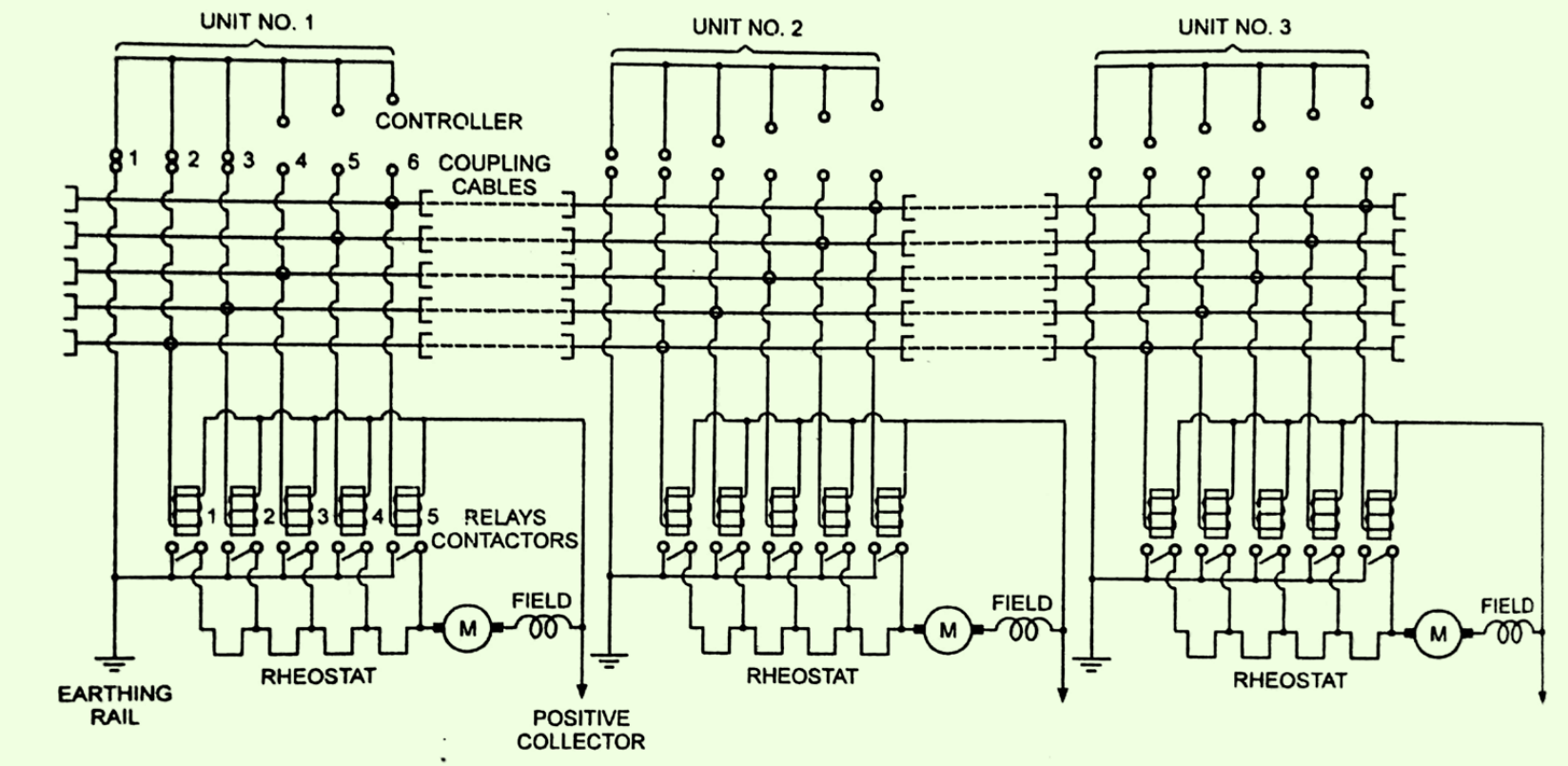


Series-Parallel Controller With Reversing Drum

Controller
Contactor Type Controller



Power Diagram of 1,500 V DC Train Equipment (Bridge Transition)
Fig. 13.12



Multiple Unit Control

Controller
Multiple Unit Control

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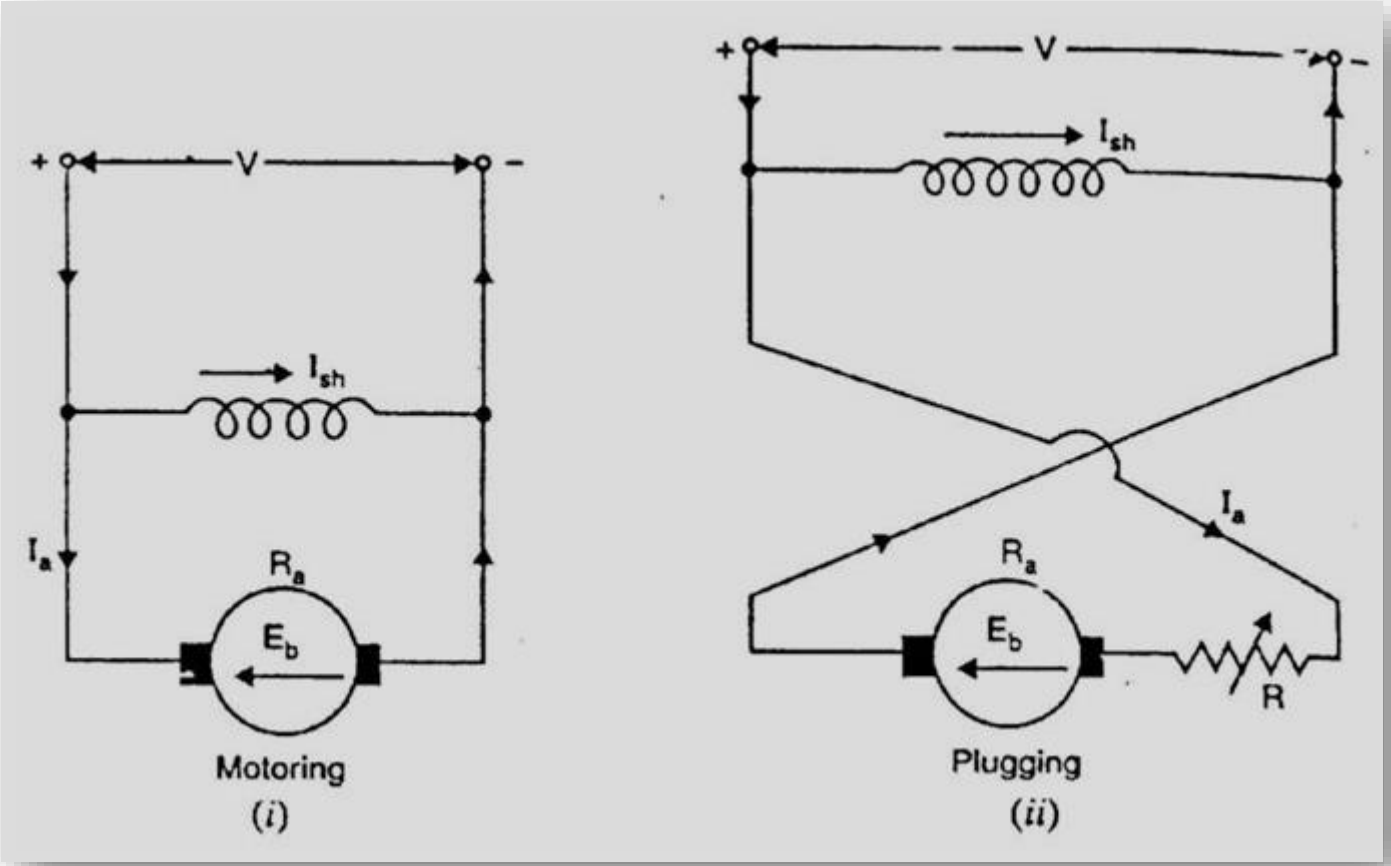
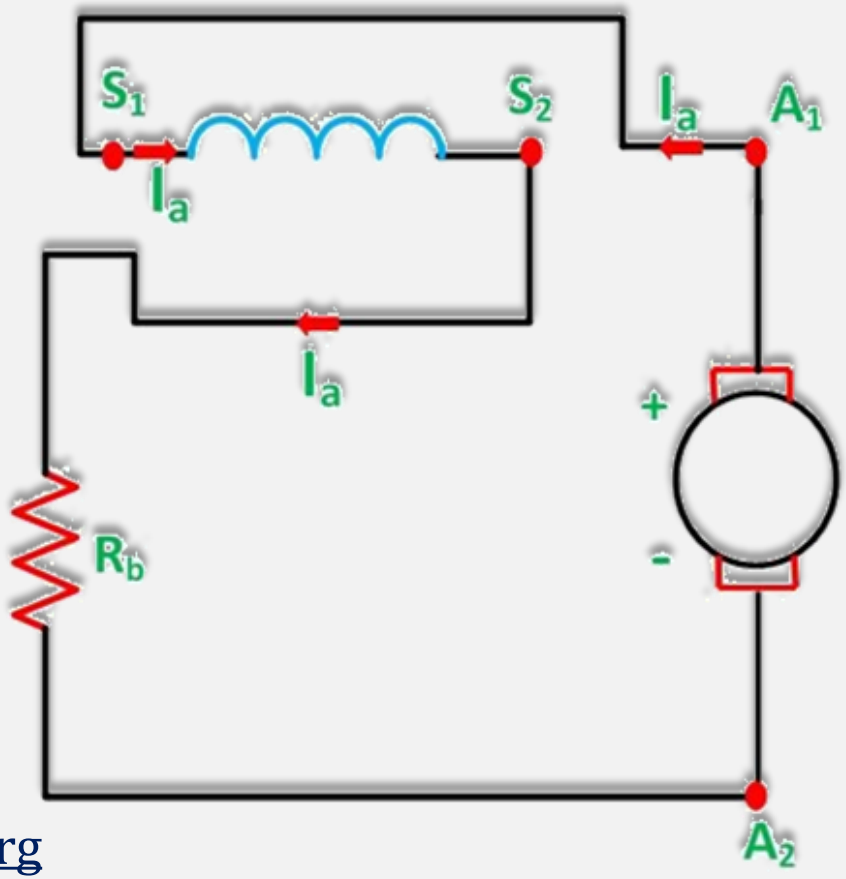
Braking

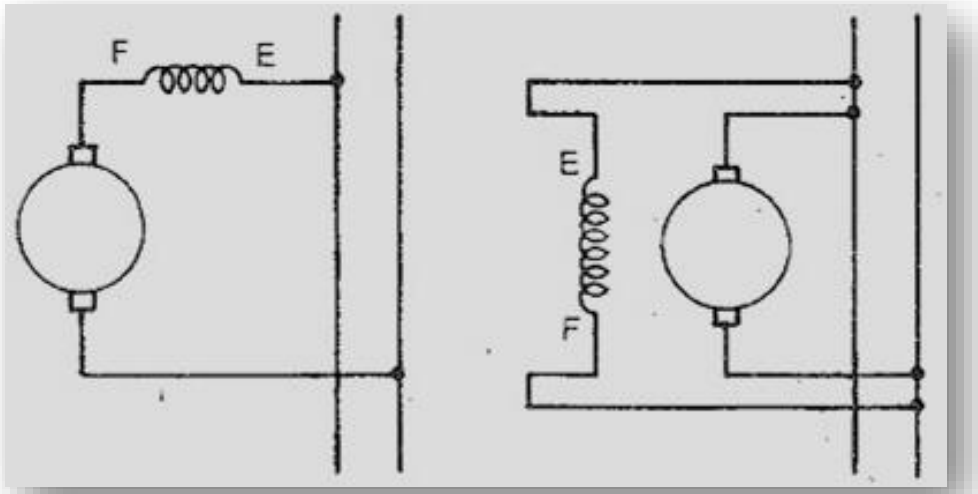
- Plugging/ Reverse Current
- Rheostatic Braking / Dynamic Braking
- Regenerative Braking

Plugging (Reverse Current)



Rheostatic Braking / Dynamic Braking





Regenerative Braking

References

Utilization of Electric Power & Electric Traction

by

J. B. Gupta.


Thank
You