Ward Leonard Method of Speed Control

The Ward Leonard method is a reliable and well-established electrical control system for precisely regulating the speed of DC motors. Developed in the early 20th century, it's still used in various industries demanding high-precision speed control.

Concept:

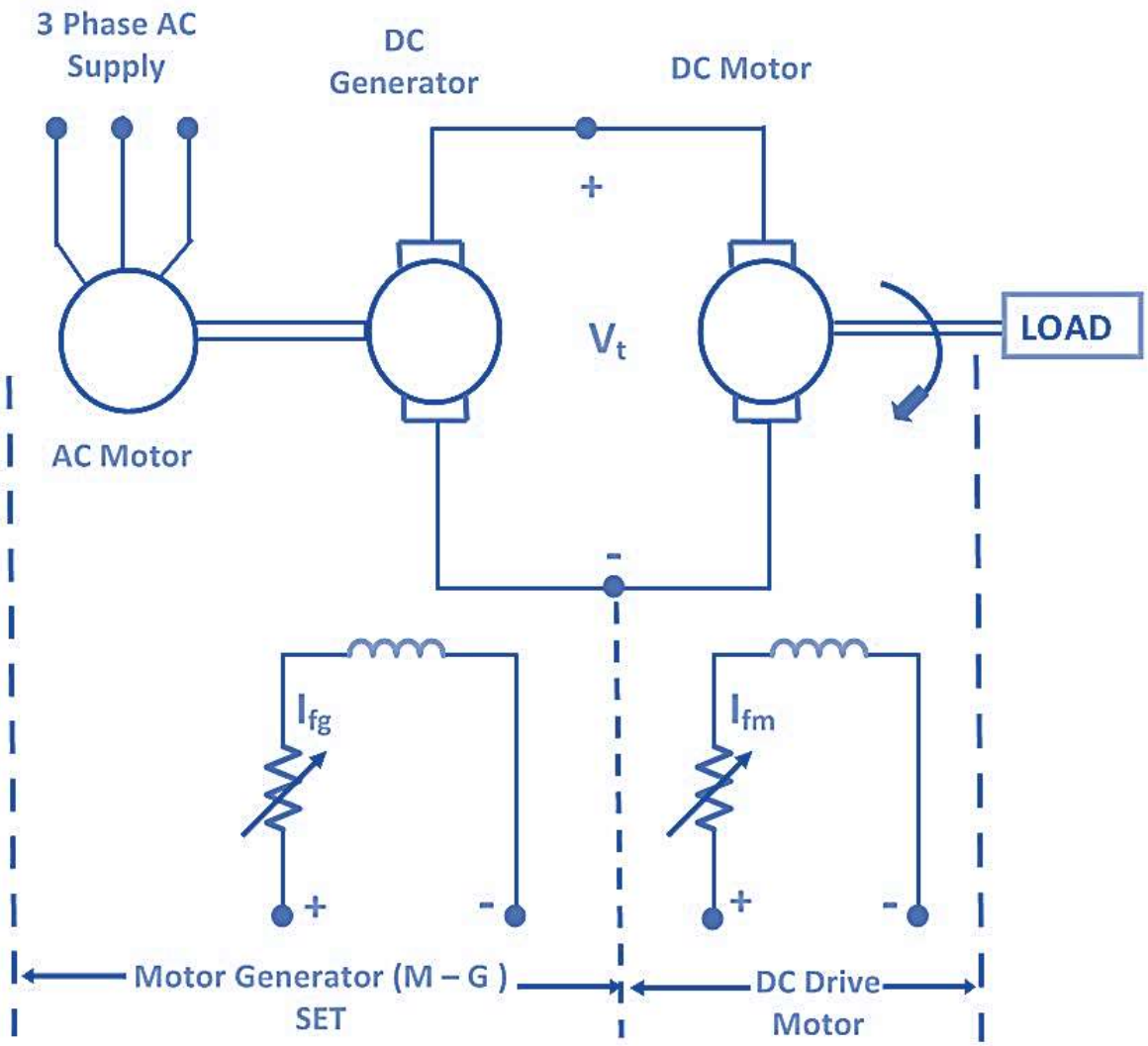
This method relies on a motor-generator set to control the voltage supplied to the DC motor whose speed needs to be adjusted. Here's a breakdown of the system:

- **Motor-Generator Set (M-G Set):** This is the core of the Ward Leonard system. It comprises two separate machines:
  - **Driving Motor (M2):** This can be an AC motor (induction or synchronous) powered by an AC supply. It runs at a relatively constant speed.
  - **DC Generator (G):** This generator is directly coupled to the driving motor (M2) and generates DC voltage. The field current of this generator is adjustable, allowing control over its output voltage.
- **Main DC Motor (M1):** This is the motor whose speed needs to be controlled. Its field circuit is usually fixed to a constant value.

Speed Control Mechanism:

1. By adjusting the field current of the DC generator (G), you can vary its output voltage.
2. This varied DC voltage from the generator is directly fed to the armature of the main DC motor (M1).
3. Since the speed of a DC motor is directly proportional to the applied voltage, changing the generator's voltage controls the speed of the main motor (M1).

Diagram:



In the diagram:

- M1 - Main DC motor (motor to be controlled)
- M2 - Driving motor (AC motor)
- G - DC Generator
- Vg - Supply voltage to driving motor (M2)
- Vgf - Field current control for generator (G)
- Vmt - Voltage output from generator (G)
- Ia - Armature current of main motor (M1)

Advantages of Ward Leonard Method:

- **Precise Speed Control:** Offers a wide range of speed control with high accuracy due to the variable voltage control of the DC motor.

- **Reversible Operation:** The direction of the main motor (M1) can be reversed by reversing the current through its armature.
- **Regenerative Braking:** The system can be configured for regenerative braking, where the kinetic energy of the motor is converted back into electrical energy and fed back to the AC supply.

Disadvantages of Ward Leonard Method:

- **Complex and Bulky:** The system requires additional equipment (M-G set) compared to simpler control methods.
- **Lower Efficiency:** Due to energy losses in the motor-generator set, the overall system efficiency is lower.
- **High Maintenance:** The M-G set requires regular maintenance due to the presence of rotating machinery.

Applications:

While largely replaced by solid-state drives in recent times, the Ward Leonard method is still used in applications requiring very precise speed control and high power handling capabilities, such as:

- Steel mills
- Paper mills
- Mining equipment (hoists, winders)
- Electric trains
- Large elevators