

VELOCITY SENSORS:

A velocity sensor is a device used to measure the speed of motion of an object. Velocity refers to how fast an object moves and sometimes also includes the direction of movement. In engineering systems, velocity sensors measure linear velocity (straight motion) or angular velocity (rotational motion). Velocity sensors are widely used in robotics, automation systems, industrial machines, vehicles, and smart systems to monitor and control motion. The measurement of velocity helps systems maintain accuracy, stability, and proper operation. Velocity is usually measured in meters per second (m/s) for linear motion or revolutions per minute (RPM) for rotational motion.

Principle of Velocity Sensor:

The working principle of a velocity sensor is based on detecting **motion and converting it into an electrical signal** that is proportional to the speed of the moving object. Many velocity sensors operate based on **electromagnetic induction** or **optical detection**. When a rotating or moving object passes through a sensor, it creates changes in **magnetic field, light intensity, or electrical signals**. These changes are processed by electronic circuits to determine the velocity. For example, in electromagnetic velocity sensors, the voltage produced is proportional to the rotational speed according to **Faraday's law of electromagnetic induction**.

Schematic Diagram :

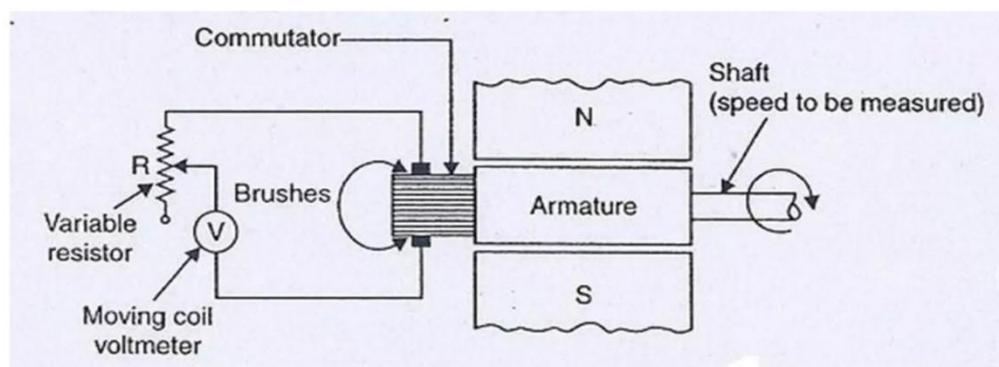


Figure 1: Schematic diagram of DC Tachogenerator

Construction of Velocity Sensor (Tachogenerator):

A typical velocity sensor consists of the following parts:

1. Shaft

The shaft is connected to the rotating machine whose velocity is to be measured.

2. Armature Coil

The armature is a coil that rotates within a magnetic field and produces voltage when it rotates.

3. Permanent Magnet / Field Magnet

It produces a magnetic field inside the sensor.

4. Commutator and Brushes

These components collect the generated voltage from the rotating armature.

5. Output Terminals

The generated voltage is taken from the terminals and sent to the control system.

Working of Velocity Sensor:

The working of a velocity sensor can be explained in the following steps:

1. The **shaft of the machine** is connected to the velocity sensor.
2. When the machine rotates, the **shaft of the tachogenerator also rotates**.
3. The **armature coil rotates inside the magnetic field** produced by the permanent magnet.
4. Due to the rotation, the conductor **cuts the magnetic flux**.
5. According to **Faraday's law**, an **induced voltage is produced** in the armature coil.
6. The generated voltage is **directly proportional to the rotational speed**.
7. This voltage is measured and used to determine the **velocity of the rotating object**.

Thus, the velocity sensor converts **mechanical motion into an electrical signal**.

Types of Velocity Sensors

1. Tachogenerator

A tachogenerator is an electrical generator that produces voltage proportional to rotational speed. It is commonly used in **motor speed control systems and feedback control systems**.

2. Optical Encoder

Optical encoders use **light and rotating discs with slots** to detect motion. As the disc rotates, pulses are generated. The number of pulses per second determines the velocity.

3. Magnetic Velocity Sensor

These sensors detect motion using **magnetic fields**. When a metallic object moves near the sensor, the magnetic field changes and produces electrical signals.

4. Laser Doppler Velocity Sensor

These sensors use the **Doppler effect of laser light** to measure velocity. They are highly accurate and used in **research and scientific measurements**.

Advantages of Velocity Sensors

- High accuracy in speed measurement
- Fast response to motion changes
- Reliable for feedback control systems
- Easy integration with electronic control systems
- Suitable for industrial automation

Disadvantages of Velocity Sensors

- Some sensors are expensive
- Sensitive to environmental conditions
- Require proper calibration
- Mechanical wear may occur in some sensors

A **velocity sensor** is an important device used to measure the **speed of motion of an object**. It converts mechanical motion into an electrical signal that can be used for monitoring and control. Sensors such as **tachogenerators, optical encoders, magnetic sensors, and laser Doppler sensors** are widely used in modern

systems. Because of their ability to provide accurate speed measurement, velocity sensors play a vital role in **robotics, industrial automation, vehicles, and smart technologies.**