Tachogenerator

- The word Tachogenerator comes from Greek word ‘TACHO’.
- In Greek, Tacho means speed. Generator means an instrument which generate power.
- Tachogenerator, is a device which is used for measuring the speed of a shaft and converting into a voltage so that it can be measured.
- In other words, it converts angular velocity into voltage.

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Uses

- They are used to measure the speeds of electric motors, engines, and the equipment they power: conveyor belts, machine tools, mixers, fans, etc.

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Types of Tachogenerator

- DC Tachogenerator - A DC Tachogenerator is a small DC generator, which generate electrical voltage corresponding to the speed of rotating machine.
- AC Tachogenerator - The AC tachogenerator is a small brushless alternator with a rotating multi-pole permanent magnet. The output voltage is again measured by a voltmeter although the varying frequency will affect the accuracy of this instrument.

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DC Tachogenerator

- A DC Tachogenerator is a small DC generator, which has to generate electrical voltage corresponding to the speed of rotating machine.
- The produced voltage is dynamically-induced EMF.
- When the conductor is in motion and the field is in stationary an EMF is induced in the conductor and this type of EMF is called Dynamically-induced EMF.

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Continued

- The requirement of dynamically-induced EMF is to establish necessary flux in field system.
- A system of conductors is required so that a relative motion between the flux and conductor create rate of change of flux linkage and generate the DC voltage.
- The field system may be in the form of electromagnet or permanent magnet, and it is the stationary part of the DC Tachogenerator.

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Operating Principle

- The operating principle of DC tachogenerator is same as that of DC generator and is based on the principle of Faraday's Law of Electromagnetic Induction.
- According to the law, when an conductor move in a magnetic field it cuts the magnetic lines of force, due to which an EMF is induced in the conductor.
- The magnitude of induced EMF depends upon the rate of change of magnetic flux linkage with the conductor.

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Schematic Diagram

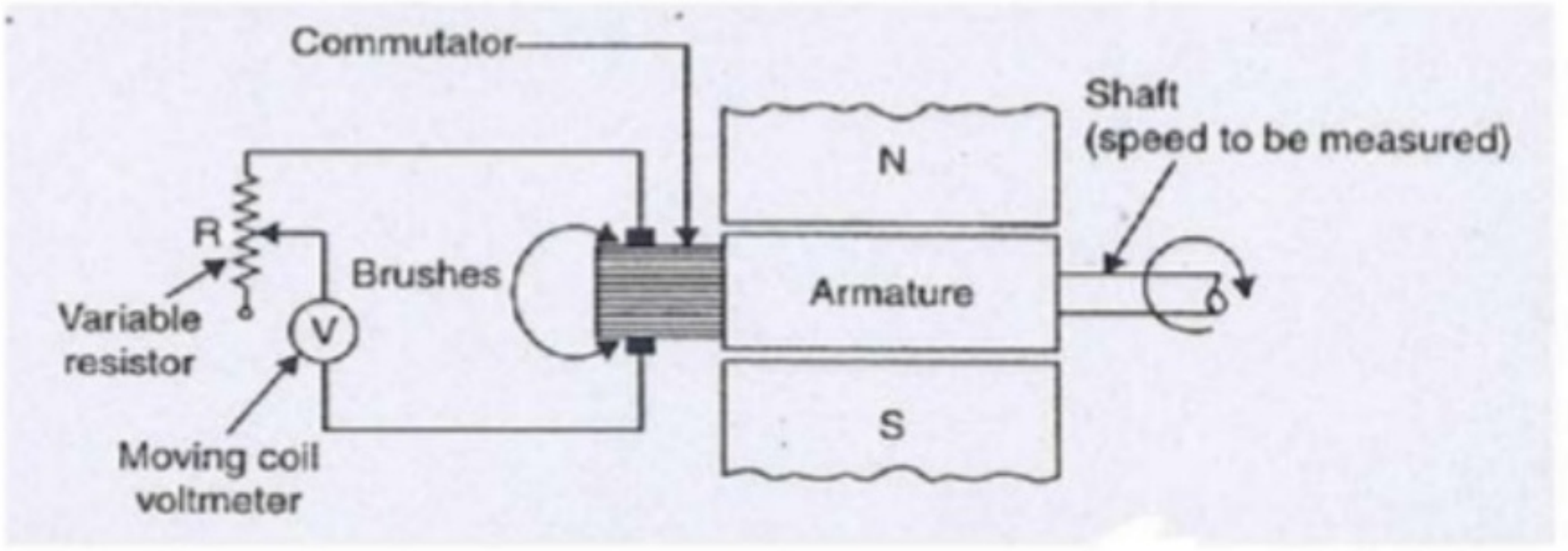

Figure 1: Schematic diagram of DC Tachogenerator

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Working Principle

The armature of the DC tachogenerator is kept in the permanent magnetic field.

The armature of the tachogenerator is coupled to the machine whose speed is to be measured.

When the shaft of the machine revolves, the armature of the tachogenerator revolves in the magnetic field producing EMF which is proportional to the product of the flux and speed to be measured.

As the field of the Permanent magnet is fixed, the EMF generated is proportional to the speed directly.

The generated EMF is measured using moving coil voltmeter with uniform scale calibrated in speed directly.

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Continued

- The series resistance is used to limit the current under output short circuit condition.
- The polarity of output voltage indicates the direction of rotation.
- The commutator collects current from armature conductors and converts internally induced AC EMF into DC (unidirectional) EMF.
- The brushes are used to collect current from commutator and make it available to external circuitry of the DC tachogenerator.

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EMF Equation

$$E = \frac{\emptyset PN}{60} \times \frac{Z}{a}$$

Where,

E= Generated voltage in volts

Ø= Flux per pole in webers

P= Number of poles

N= Speed in revolutions per minutes (RPM)

Z= Number of conductors in the armature winding

a= Numbers of parallel paths in the armature winding

= 2 for wave winding

= P for lap winding

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Advantages

- Waveform and phase shift problems are absent.
- There is no transformer action firing residual voltage at zero speed.
- With smaller size higher sensitivity of 10-20V/1000rpm is possible.
- Temperature compensation is simple.

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Disadvantages

- At higher speed brush vibration problem is troublesome.
- Arcing at brush commutator contact due to brush wear make it unsuitable for explosive condition.

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AC Tachometers

- The AC tachogenerator is a small brushless alternator with a rotating multi-pole permanent magnet. The output voltage is again measured by a voltmeter although the varying frequency will affect the accuracy of this instrument.

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Construction

It consists of:

- Permanent Magnet
- Coil (Stator)
- Rectifier Bridge
- Moving Coil (MC) Voltmeter

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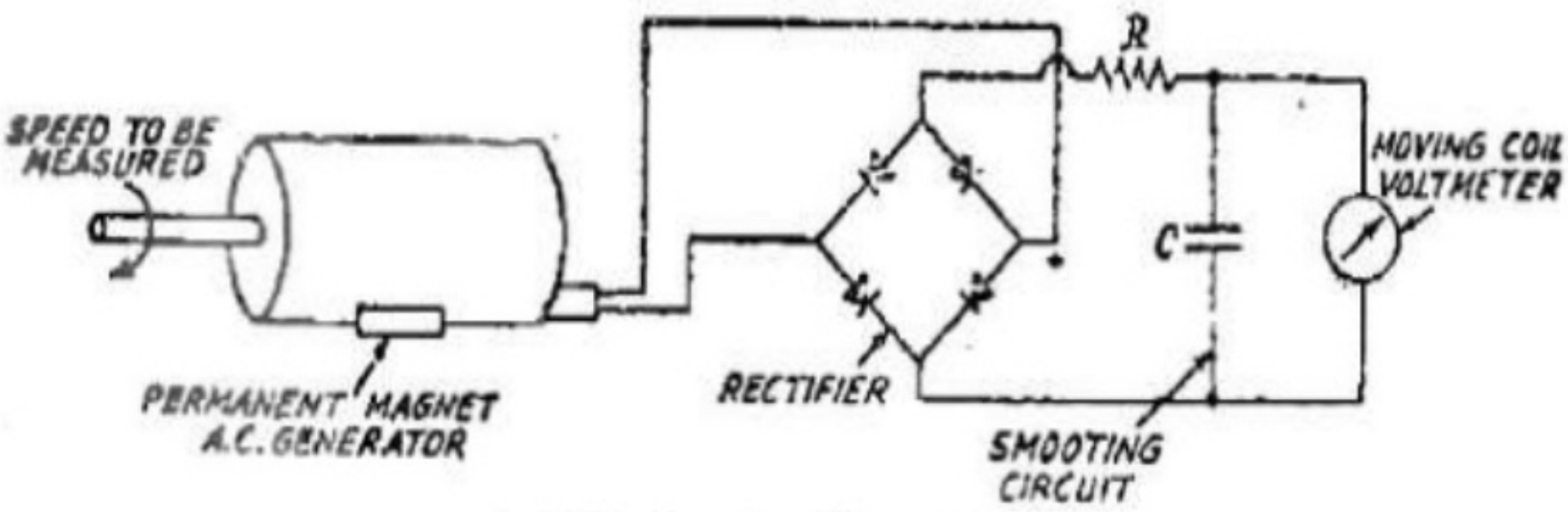
Schematic Diagram



A.C. Tachometer Generator.

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Working

- In AC tachogenerator, the armature is provided with an AC winding, either single phase or three phase windings.
- When the rotor is stationary and primary winding excited by an AC input voltage, the induced voltage in secondary is zero. Due to relative position of two winding being placed at 90^0 to each other.

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Continued

- As the rotor rotates, a voltage is induced in the secondary winding whose magnitude is proportional to the rotor speed.
- The emf induced in quadrature coil is directly proportional to the rotor speed and is in phase with applied voltage to the reference coil.

$$V_t = K_t \phi\,(t)$$

Advantages

- Ripples are reduced as compared to DC tachometer.
- No problem of brush friction and brush bounce.

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Disadvantages

- It measures the speed only in one direction.
- Rectification required.
- Difficult to maintain.

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Differences

AC Tachogenerator	DC Tachogenerator
It is use to measure speed only in one direction only.	It is use to measure speed in both direction.
Need of rectifier to convert AC output into DC.	Output is in DC form therefore no need of rectifier.
Ripples are reduced.	Small ripples are appearing at output.
No problem of brush friction and brush bounce.	Problem of wear and tear brushes at high speed.
Maintenance is difficult.	Easy to maintenance.

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