Experiment No: 8 **Date:**

Aim:

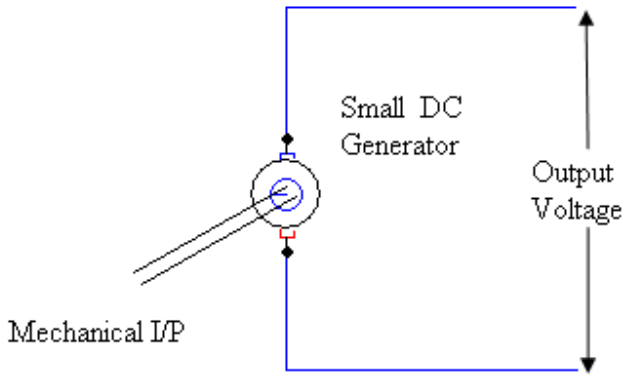
Study of Tachometer

Apparatus:

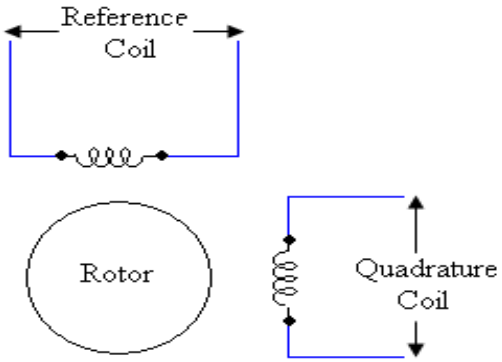
Tachometer, DC motor

Diagram:

DC Tachometer



AC Tachometer



Theory:

Digital tachometers are particularly suitable for the precision measurement and onitoring of all time related quantities, which are able to be converted into a proportional requency using appropriate sensors Time-related quantities include rotational and linear velocity, flow rate and related quantities. The instrument can be programmed to measure absolute values ratio, or proportional difference ,The proportional frequency is generally produced by a magnetic wheel on the shaft, which is scanned by a radial mounted impulse sensor For control applications, a high resolution pick-up can be coupled directly to the motor shaft .

It is electromechanical unit in which o/p is electrical & i/p is speed. Thus it produces voltage proportional to speed. It forms an important element in feedback. Since the o/p angular position derivatives is speed the feedback is derivative in nature. These stabilize the system. The second purpose is to provide speed feedback.

It is of two types.

1) DC tachometer

2) AC tachometer

DC Tachometer:

This is small DC generator driven by motor shaft shoes speed feedback is needed. The field is permanent magnet & rotor is of iron core. The o/p voltage is A.C..The DC generator O/p is proportional to speed.

$$Eb \alpha d\theta /dt$$

$$Eb = K d\theta/dt$$

$$Eb = SK\theta (S)$$

$$E(S)/\theta(S) = SK$$

This is transfer function. See fig. (A), permanent magnet tachometer is efficient compact, reliable but it suffers from high inertia. To reduce inertia use of iron fewer rotors is done on permanent is a short circuited sec. a sine voltage is applied to the reference winding also called as primary winding. The second stator winding when voltage induced is proportional to the speed. The rotor rotates & voltage at the quadrature coil is proportional to speed.

$$E(t) = K \, d\theta / dt$$

Taking Laplace

$$E(s)/ \theta(s) = SK$$

This voltage is ac & in some application may nee to be converted to dc by a demodulator. The typical use of tachometer Comments found in velocity feedback is shown in fig.

Advantages:

1. Brushes m/c, hence no problem of brush friction & brush bounce.
2. Provides speed feedback, hence can be used to measure speed.
3. Reduce electromagnetic noise.
4. Reduce ripple.

Magnet unit R compensated with temp. resistive magnetic shunt. There diverts same part of the pole flux according to temp. variation. This helps in maintain linear relationship between speeds & generate voltage. They are compensated to give linear speed voltage characteristics.

5. Voltage generated do not have undesired phase shift or wave shape.
6. Temp. compensation is easily achieved
7. No zero speed voltage error is present
8. Can be used with high pass filter which reduces servo velocity.
9. Possible to generate high voltage gain on small size.
10. Linear characteristics.

Disadvantages:

1. Wear & tear of brushes at high speed.
2. Commutator sparking gives noise generated voltage.
3. A small ripple is present in the o/p voltage.
4. Require more torque due to brush friction & hysteresis effect.

AC Tachometer:

The construction of ac tachometer is shown in fig. (B) & is quite similar to 2Φ A.C. servomotor. There are two stator winding place in Quadrature with each other. The rotor is short circuited.

A sine rated voltage is applied to ref. winding also called as primary winding. The second winding is placed in Quadrature to ref. winding. When voltage induced is proportional to the speed. The rotor rotates & voltage at the Quadrature coil is proportional to speed.

Calculating digital tachometer using the period measurement method

The digital tachometer implements the period measurement method, with the subsequent calculation of a reciprocal value. Two absolute values, with independent set-up parameters, or their ratio or proportional difference (selectable) can be measured. The measurement is carried out automatically and repetitively, or externally through a contact. In ratio and proportional difference modes, the values used in the calculation are acquired simultaneously, These values are taken at the same point in time, without a delay, whereby a higher accuracy can be attained. In contemporary implementations, the values are taken successively.

Measurement at the same point in time can therefore not be guaranteed. The number of periods measured is selectable. 1 period for a fast reaction time (approx, 40 ms), 10 periods if the drive shaft rotation is uneven. The display update cycle time can be set to 1, 2 or 3 seconds

Conclusion: