TACHOGENERATOR

A tachogenerator is a sensor, which transforms a mechanical angular velocity into a proportionate voltage signal. It is coupled mechanically to the shaft, the angular speed of which is to be measured, through gears or V-belts. For the output voltage to be proportional to the angular speed, the magnetic flux of the tachogenerator must be constant. There are two types of tachogenerators:

1. dc tachogenerator
2. ac tachogenerator

DC tachogenerator A dc tachogenerator may have either a separately excited field winding or a permanent magnet. In separately excited tachogenerators (Fig. 1) the field winding core is maintained at saturation so that a small change in field current does not affect the air gap flux. The second type of dc tachogenerators are more in use as these tachogenerators do not require a separate supply to excite the field winding.

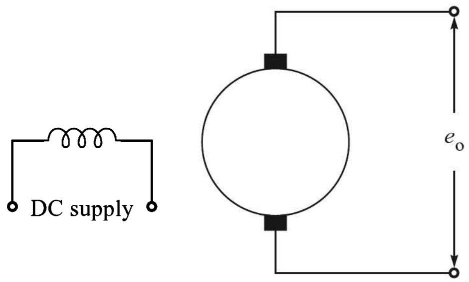

Fig. 1 Separately excited dc tachogenerator.

Number of poles of the tachogenerator is more than two. The stability of the output voltage increases with the number of poles. Sometimes, low pass filters are used to minimise the high frequency noise in the output voltage. Silver-tip metal brushes are used to reduce the brush drop. In ideal condition the generated voltage is given by

$$e_o = K\omega(t)$$

where $\omega(t)$ is the angular velocity and K is the tachogenerator constant. The transfer function of the tachogenerator is given by

$$T(s) = E_o(s)/\Omega(s)$$

AC tachogenerator AC tachogenerators are similar to a two phase induction motor as far as construction is concerned. The rotor is of drag cup type, for which there are two clear advantages: (i) low moment of inertia as the rotor is light and (ii) output voltage is free from slot ripples. The schematic diagram of an ac tachogenerator is shown in Fig. 2. One winding, called reference winding, is excited by an ac supply. The second winding, called control winding, is the output winding. The reference winding excitation produces an alternating field which produces a transformer emf, e_t. The rotor may be considered as a short-circuited winding. So, a current flows in it due to e_t. The flux Φ_d due to this current is along the direct axis as shown in Fig. 3(a). When the tachogenerator is rotating at an angular speed ω_r, a rotational emf, e_s is induced in the rotor and the flux, Φ_q, produced by e_s, acts along the quadrature axis as shown in Fig. 3 (b). The direct axis flux Φ_d does not induce any emf in the control winding as it is displaced by 90° in space from the reference field. However, the quadrature axis flux Φ_q induces a transformer emf, e_o, in the control winding. As Φ_q is proportional to the speed, so the output emf e_o is also proportional to the speed.

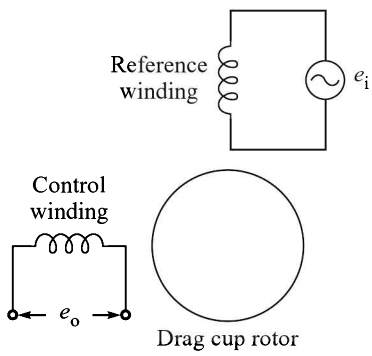

Fig. 2 Schematic diagram of ac tachogenerator.

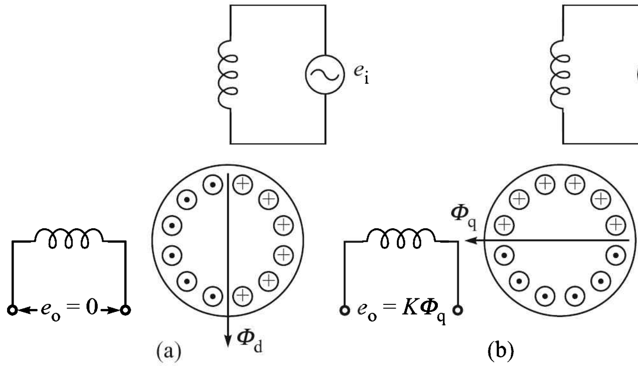

Fig. 3 : (a) Production of direct axis field; (b) production of quadrature axis flux.

The output emf is given by

$$e_o = K'\omega_r$$

and transfer function is given by

$$T(s) = E_o(s)/\Omega(s)$$

A typical high accuracy ac tachogenerator is excited by a 115 V, 400 Hz supply and has a sensitivity of 2.8×10^{-3} volt per r.p.m. Most commercial ac tachogenerators are designed for the use in ac servomechanism operating at 50 Hz or 400 Hz. A special ac tachogenerator with alnico permanent magnet rotor with many poles are designed to avoid the supply in the reference winding. It has only one winding.