School of Electrical, Electronics and Communication Engineering

Course Code : MPSE2502 Course Name: Power System Dynamics and Stability

UNIT IV

Isochronous Governor

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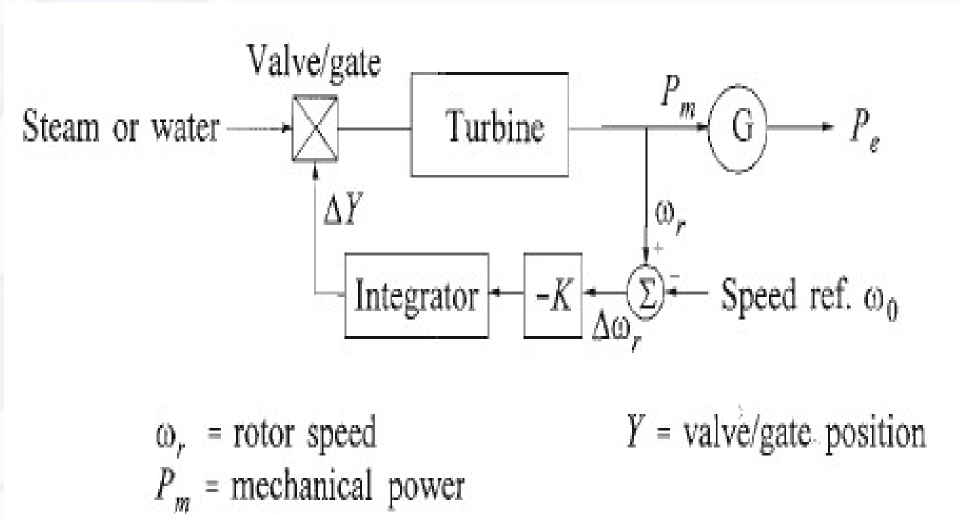
Contents

INTRODUCTION

- The word "isochronous" means constant speed. An isochronous governor adjusts the turbine valve/gate to bring the frequency back to the nominal or scheduled value.
- The measured rotor speed is compared with reference speed w_0.
- The error signal (equal to speed deviation) is amplifier and integrated to produce a control signal AY which actuates the main steam supply valves in the case of a steam turbine or gates in the case of a hydraulic turbine.
- Because of the reset action of this integral controller, AY will reach e new steady state only when the speed error A, is zero.
- Figure shows the time response of a generating unit, with an isochronous governor, when subjected to an increase in load.



Schematic diagram of an Isochronous governor

- The increase in P_e causes the frequency to decay at a rate determined by the inertia of rotor. As the speed drops, the turbine mechanical power begins to increase.
- This causes a reduction in the rate of decrease of speed, and then an increase in speed when the turbine power is in excess of the load power.
- The speed will ultimately return to its reference value and the steady-state turbine power increases by an amount equal to the additional load.
- An isochronous governor works when a generator is supplying an isolated load or when only one generator in a multi generator system is required to respond to changes in load.

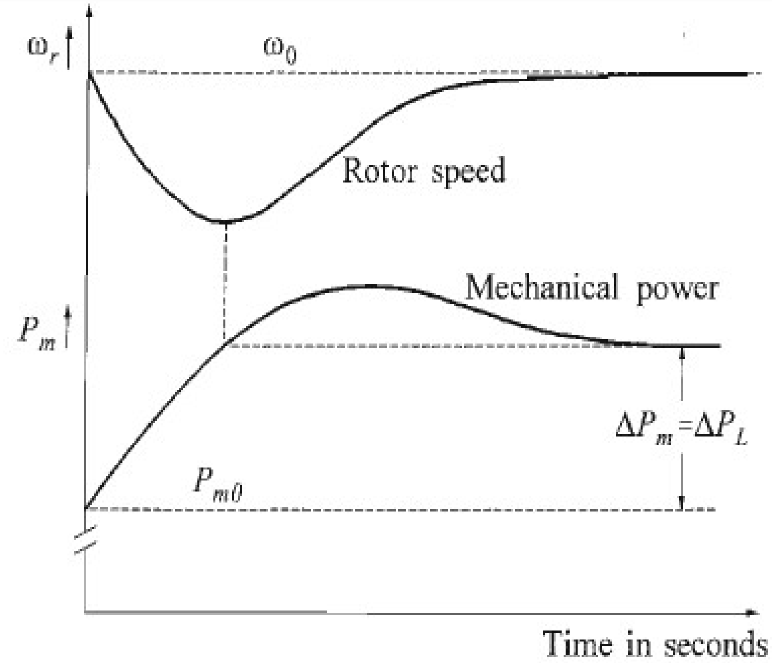


Fig. shows Response of generating units with Isochronous governor

Governor with speed-droop characteristic –

- The isochronous governor cannot be used when there are two or more units connected to the same system since each generator would have to have precisely the same speed setting.
- Otherwise, they would fight each other, each trying to control system frequency to its own setting.
- For stable load division between two or more units operating in parallel, the governors are provided with a characteristic so that the speed drops as the load is increased.
- The speed-droop or regulation characteristic may be obtained by adding a steady-state feedback loop around the integrator as shown in Figure.
- The Transfer function of the governor reduces to the form as shown in Fig. where governor is characterized as proportional controller with the gain (1/R).

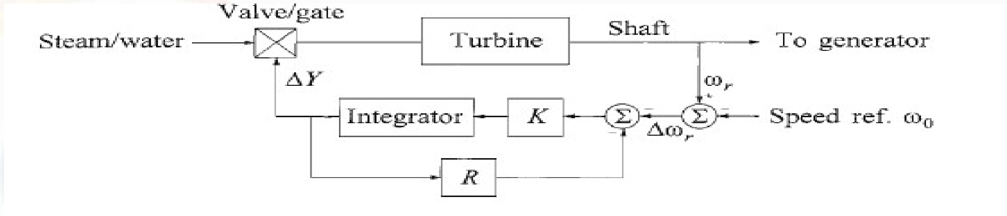
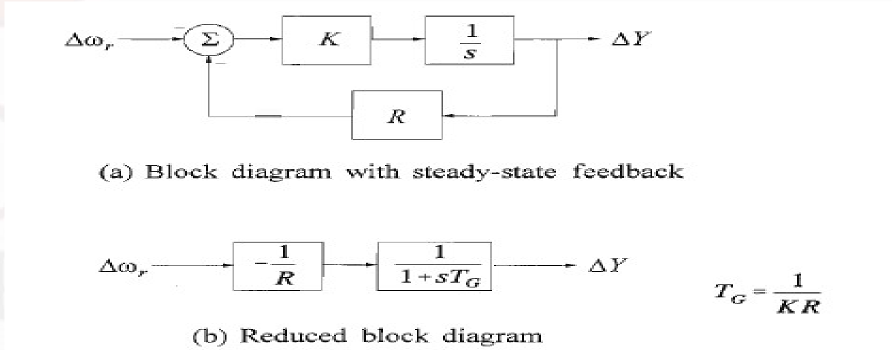


Fig. shows Governor with steady state feedback



(a) Block diagram with steady-state feedback

(b) Reduced block diagram

Percent speed regulation or droop:

The value of R determines the steady-state speed versus load characteristic of the generating unit as shown in Fig.The ratio of speed deviation (40) or frequency deviation (A) to change in valve/gate position (AY or power output (AP) is equal to R. The parameter R is referred to as speed regulation or droop. It can be expressed in percent as-

$$\text{Percent } R = \frac{\text{percent speed or frequency change}}{\text{percent power output change}} \times 100$$

$$= \left(\frac{\omega_{NL} - \omega_{FL}}{\omega_0} \right) \times 100$$

where

ω_{NL} = steady-state speed at no load
ω_{FL} = steady-state speed at full load
ω_0 = nominal or rated speed

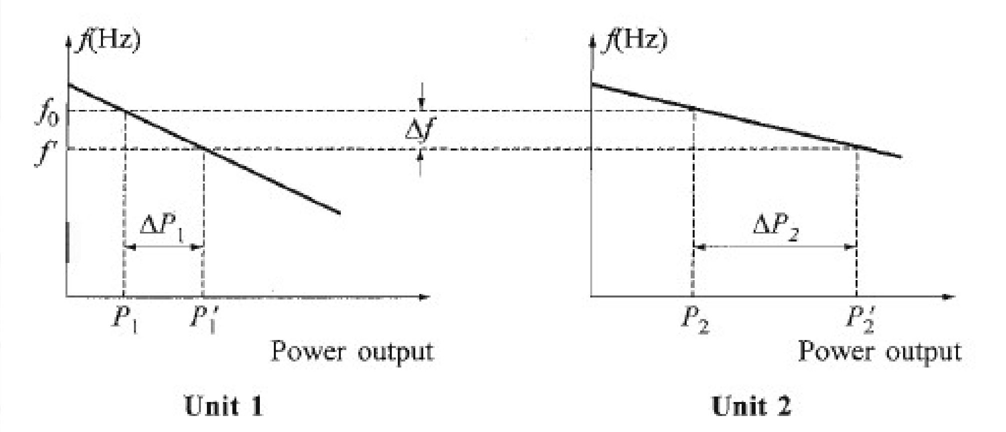
Load sharing by parallel units-

- If two or more generators with droop in governor characteristics are connected to a power system, there will be a unique frequency at which they will share a load change.
- Consider two units with droop characteristics as shown in Fig. They are initially at nominal frequency f_o with outputs P_1 and P_2.
- When a load increase ΔP_L causes the units to slow down, the governors increase output until they reach a new common operating frequency f'.
- The amount of load picked up by each unit depends on the droop characteristic:

$$\Delta P_1 = P_1' + P_1 = \Delta f / R_1$$
$$\Delta P_2 = P_2' + P_2 = \Delta f / R_2$$

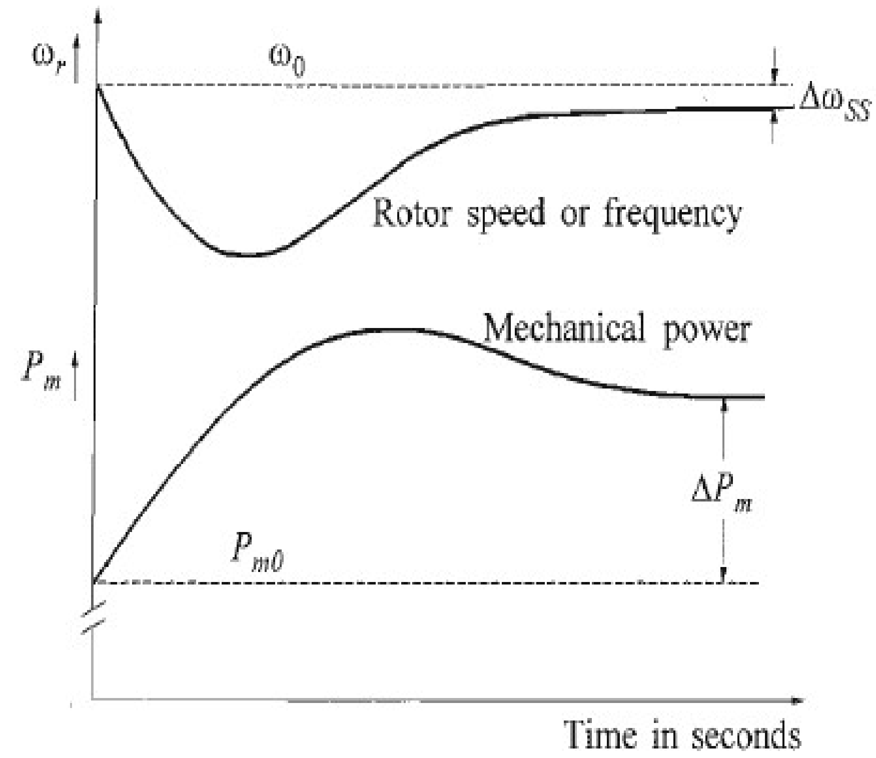
$$\Delta P_1 / \Delta P_2 = R_2 / R_1$$

- If the percentage of regulation of the units are nearly equal, the change in the outputs of each unit will be nearly in proportion to its rating.



Time response-

- Fig. shows the time response of a generating unit, with a speed-droop governor, when subjected to an increase in load.
- Because of the droop characteristic, the increase in power output is accompanied by a steady-state speed or frequency deviation



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