CONTROL SYSTEMS

A control system is an arrangement of physical components connected or related in such a manner as to command, direct, or regulate itself or another system, or is that means by which any quantity of interest in a system is maintained or altered in accordance with a desired manner.

Any control system consists of three essential components namely input, system and out put. The input is the stimulus or excitation applied to a system from an external energy source. A system is the arrangement of physical components and output is the actual response obtained from the system. The control system may be one of the following type.

1) man made
2) natural and / or biological and
3) hybrid consisting of man made and natural or biological.

Examples:

1) An electric switch is man made control system, controlling flow of electricity.
   input : flipping the switch on/off
   system : electric switch
   output : flow or no flow of current
2) Pointing a finger at an object is a biological control system.
   input : direction of the object with respect to some direction
   system : consists of eyes, arm, hand, finger and brain of a man
   output : actual pointed direction with respect to same direction
3) Man driving an automobile is a hybrid system.
   input : direction or lane
   system : drivers hand, eyes, brain and vehicle
   output : heading of the automobile.

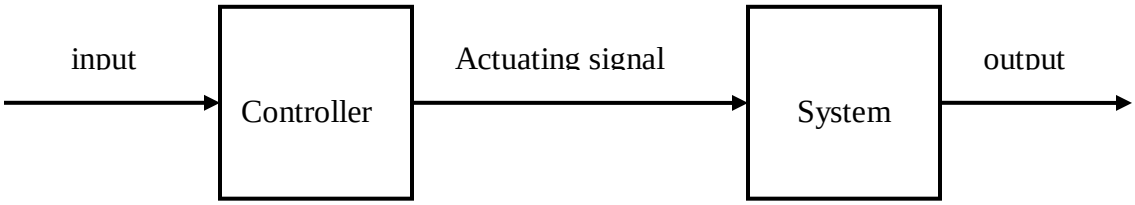
Classification of Control Systems

Control systems are classified into two general categories based upon the control action which is responsible to activate the system to produce the output viz.

1) Open loop control system in which the control action is independent of the out put.

2) Closed loop control system in which the control action is some how dependent upon the output and are generally called as feedback control systems.

Open Loop System is a system in which control action is independent of output. To each reference input there is a corresponding output which depends upon the system and its operating conditions. The accuracy of the system depends on the calibration of the system. In the presence of noise or disturbances open loop control will not perform satisfactorily.



EXAMPLE - 1 Rotational Generator

The input to rotational generator is the speed of the prime mover (e.g steam turbine) in r.p.m. Assuming the generator is on no load the output may be induced voltage at the output terminals.

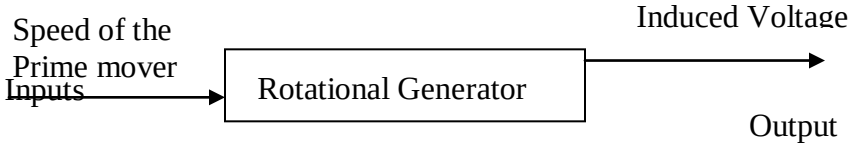


Fig 1-2 Rotational Generator

EXAMPLE – 2 Washing machine

Most (but not all) washing machines are operated in the following manner. After the clothes to be washed have been put into the machine, the soap or detergent, bleach and water are entered in proper amounts as specified by the manufacturer. The washing time is then set on a timer and the washer is energized. When the cycle is completed, the machine shuts itself off. In this example washing time forms input and cleanliness of the clothes is identified as output.

Fig 1-3 Washing Machine

EXAMPLE – 3 WATER TANK LEVEL CONTROL

To understand the concept further it is useful to consider an example let it be desired to maintain the actual water level 'c ' in the tank as close as possible to a desired level ' r '. The desired level will be called the system input, and the actual level the controlled variable or system output. Water flows from the tank via a valve V_o , and enters the tank from a supply via a control valve V_c. The control valve is adjustable manually.

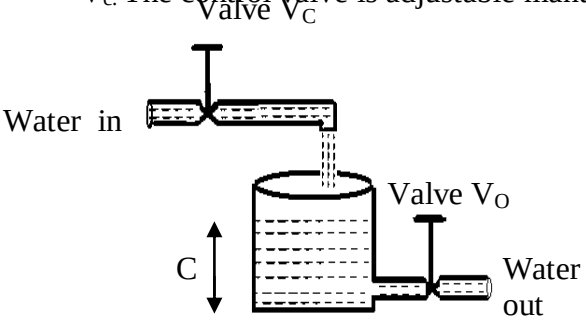


Fig –1.4 a) Water level control

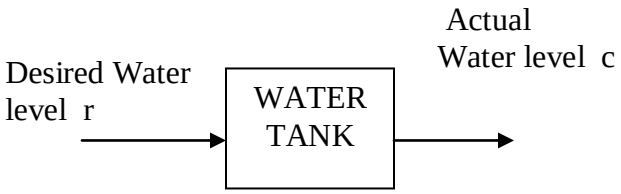


Fig 1-4 b) Open loop control

A closed loop control system is one in which the control action depends on the output. In closed loop control system the actuating error signal, which is the difference between the input signal and the feed back signal (out put signal or its function) is fed to the controller.

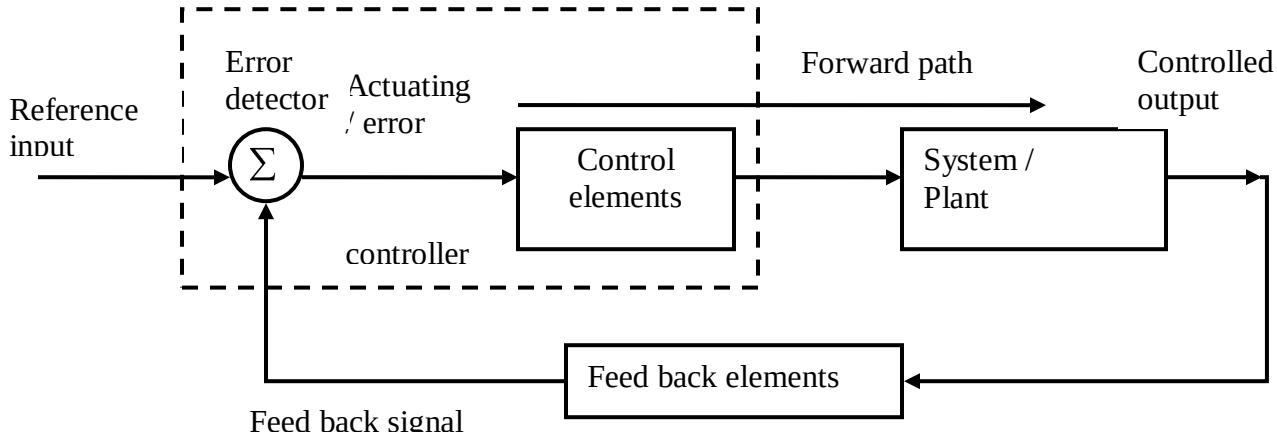


Fig –1.5: Closed loop control system

EXAMPLE – 1 – THERMAL SYSTEM

To illustrate the concept of closed loop control system, consider the thermal system shown in fig-6 Here human being acts as a controller. He wants to maintain the temperature of the hot water at a given value r^o C. the thermometer installed in the hot water outlet measures the actual temperature C^0 C. This temperature is the output of the system. If the operator watches the thermometer and finds that the temperature is higher than the desired value, then he reduce the amount of steam supply in order to lower the temperature. It is quite possible that that if the temperature becomes lower than the desired value it becomes necessary to increase the amount of steam supply. This control action is based on closed loop operation which involves human being, hand muscle, eyes, thermometer such a system may be called manual feed back system.

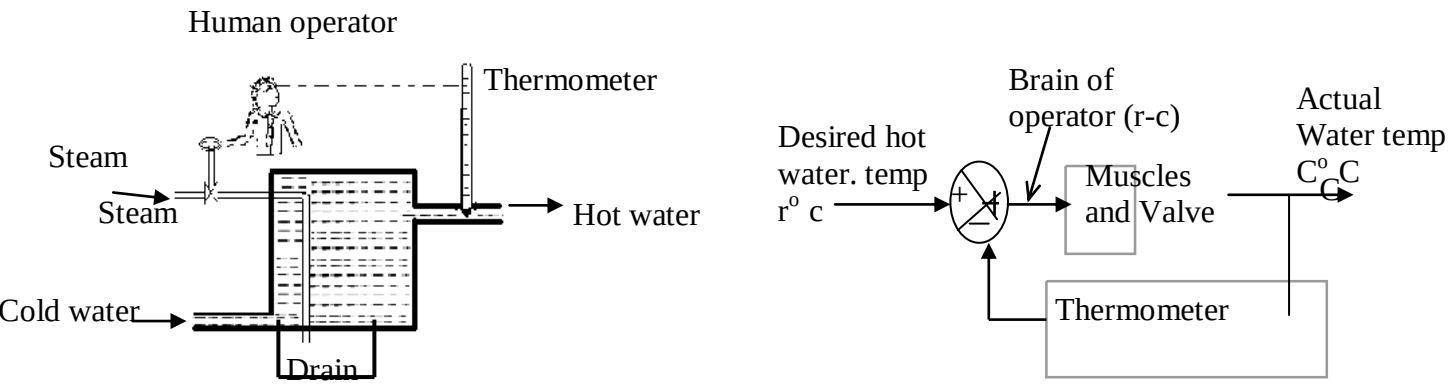


Fig 1-6 a) Manual feedback thermal system b) Block diagram

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