CONTROL STRUCTURE OF WATER LEVEL CONTROL IN A THERMAL POWER PLANT

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ABSTRACT

The control structure of steam boiler system is one of the most complex systems where required with many control loops and multiple parameters. It is necessary for the controller used for this system to ensure the efficiency of the steam. The paper introduces a control system including two control loops, where an inner flow control loop (with fast response) and an outer level control loop (with slower response) for water level of a Thermal Power Plant.

Keyword : *Steam boiler, Level control, Thermal Power Plant*

1. INTRODUCTION

The study concentrates on a control problem in the combustion chamber and the steam boiler. The combustion chamber is a multiple outputs and inputs system, in which fuel, wind and water supply are its inputs, and the output consists of saturate steam released from the steam tank, an amount of redundant water, smoke and slag from the combustion process. In this case, water is heated in a boiler until it becomes high-temperature steam [1-4]. This steam is then channeled through a turbine, which has many fan-blades attached to a shaft. As the steam moves over the blades, it causes the shaft to spin. This spinning shaft is connected to the rotor of a generator, and the generator produces electrici-ty[5-9]. The steam boiler collects steam then delivers it to the turbine.

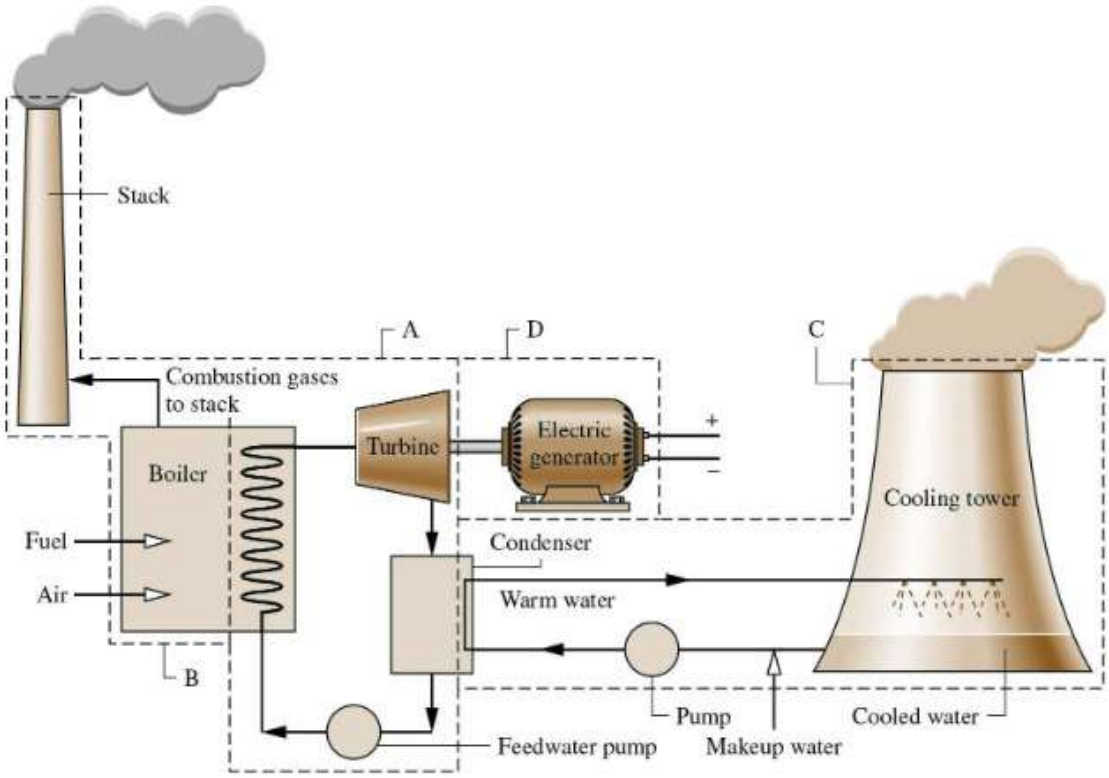

Fig -1 Steam turbine power plant

2. LEVEL CONTROL SYSTEM FOR THE THERMAL POWER PLANT

The process control system of the thermal power plant including objects such as temperature sensors, pressure sensors, level sensors, flow sensors, motors, etc. This process is a multi-input and multi-output system, in which the inputs and outputs are closely related to each other.
The schematic diagram of water level controller is formed as Fig -2.

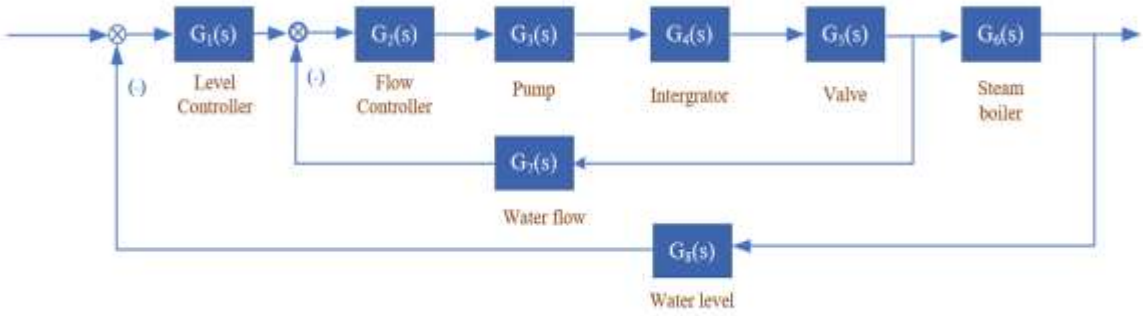

Fig -2 The schematic diagram of level controller

The transfer functions of elements in the block diagram are written as follows:
G_3 denotes the transfer function of water supply system.

$$G_3(s) = \frac{k_3}{T_1 T_2 s^2 + T_2 s + 1} \tag{1}$$

Because the input signal of the valve is the angular velocity, while the output signal of the power transmission is the speed, an integration block is added with the transfer function G_4:

$$G_4(s) = \frac{k_4}{s} \tag{2}$$

Next, in the valve, the input signal is the angular velocity, whereas water flow plays output role. And, the relationship between the output signal and the input signal of the valve is a first-order inertial equation has the form of G_5:

$$G_5(s) = \frac{k_5}{T_5 s + 1} \tag{3}$$

In the steam boiler, the water flow is the input element. The water is transferred into steam. The output signal is the steam flow. The relationship between the output signal and the input signal is a first-order inertial equation with delay is determined by G_6

$$G_6(s) = \frac{k_6}{T_6 s + 1} e^{-\tau s} \tag{4}$$

The input signal of the G_7 sensor is the water flow, while the its output signal is the DC current, so the transfer function of the G_7 flow sensor is:

$$G_7(s) = k_7 = \frac{\Delta I_{\max}}{\Delta Q_{\max}} \tag{5}$$

Similarly, the input signal of the G_8 level sensor:

$$G_8(s) = k_8 = \frac{\Delta I_{\max}}{\Delta H_{\max}} \tag{6}$$

The aim of the level and flow control system in the steam boiler is to preserve water level and the water supply flow to the boiler. are shown in Fig -3.

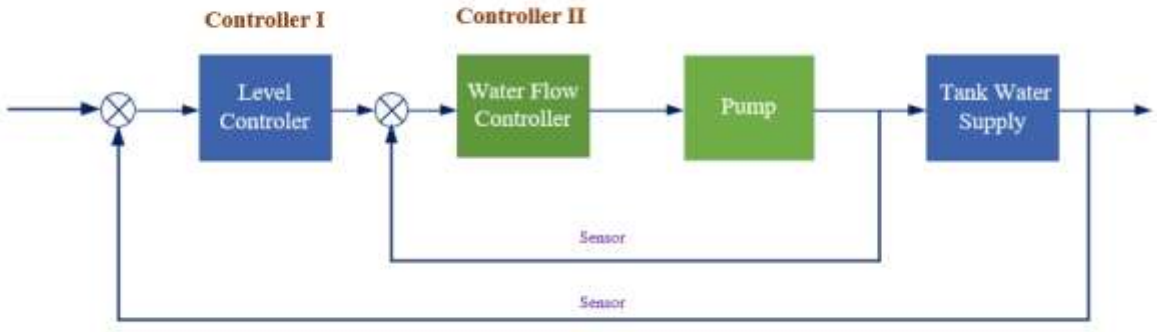

Fig -3: The cascade control structure diagram

In order to meet the heating requirement of the steam boiler, the flow of water supply must be kept stable to ensure sufficient water to the heater. To stabilize the water flow, the pump speed named Pumb in Fig -3 need to be controlled according to the reference flow.

3. CONCLUSIONS

The primary purpose of this paper is to develop a two-loop control structure to keep the water level steam boiler in a thermal power plant stable. The following study will implement control design methods for the above system with the proposed control structure.

4. ACKNOWLEDGEMENT

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