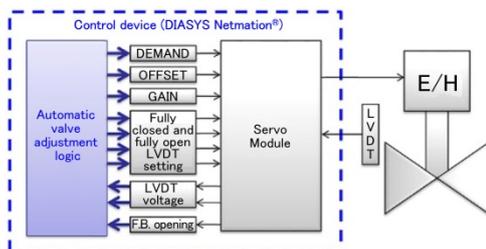


Servo Valve Automatic Adjustment (Automatic Adjustment System for High-Pressure Electric Hydraulic Control Valve)



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Control valves using high-pressure electric hydraulic (EH) oil and a servo valve are used as fuel control valves for gas turbines, as well as for steam control valves for steam turbines in power plants. Due to the recent adoption of the linear variable differential transmitter (LVDT), which is an accurate and durable position sensor, for the servo valve, these control valves have a complicated mechanism and many adjustment items unlike pneumatic control valves, etc., so high-level skills are required for their various settings and sensitivity adjustments. The product presented in this report uses learning circuits, etc., to program such expertise and techniques and has made it possible to automatically and quickly achieve results equal to or better than those of adjustment by engineers with high-level skills.

1. Adjustment of Electric Hydraulic Control Valve

The adjustment of the servo valve is made by changing various settings on the control device. Specifically, this adjustment includes the adjustment of the LVDT voltage value at the fully closed and fully open position of the control valve, OFFSET adjustment that adjusts the relationship between the command value and the actual opening (feedback) value and GAIN adjustment that adjusts the operating speed and operating behavior of the valve. These settings are not irrelevant and need to be balanced as a whole and optimally adjusted.

Especially in terms of GAIN adjustment, in order to adjust the GAIN value to an optimum value with which the control valve operates smoothly to the target value, it is necessary to check and set the dynamic characteristics (behavior) of the control valve with an oscilloscope, etc., so expertise and techniques, including judgment ability, are required.

2. Features of servo valve automatic adjustment

Electric Hydraulic Control Valve automatic adjustment is a system that automatically adjusts various setting adjustments such as LVDT voltage value adjustment, OFFSET adjustment, GAIN adjustment, etc., which were previously made manually by engineers based on their expertise. Just by pushing a single button on the dedicated controller, the control valve automatically opens and closes to sense its state and behavior, automatically making adjustments. In addition, GAIN adjustment, which was previously made with an oscilloscope, etc., is performed automatically by memorizing the behavior of the control valve at each GAIN value so that an optimum value is obtained. This system was realized based on DIASYS Netmation[®], a control device that we produce.

With this system, the working time for adjustment can be reduced, adjustments can be made regardless of who is making them and the adjustment accuracy can be improved. Automatic adjustment completes adjustments that previously required expertise and as much as one hour of work by an engineer in about 20 minutes. Since adjustment is made automatically, this system enables the simultaneous adjustment of multiple control valves, which can lead to a significant reduction in adjustment time. After automatic adjustment, all that is required is confirmation of static characteristics (data collection in step increments of 25%, etc.) in a manner similar to pneumatic control valves, so there is no need for expertise and this work can be carried out regardless of the worker. In addition, because there is no variation caused by the feeling of the

engineer since adjustment is made automatically, the finishing accuracy is also improved. **Figure 1** shows an accuracy scatter diagram of the adjustment results made by 6 engineers and the 6-time adjustment results made by automatic adjustment, for 5 types of control valves. This indicates the variation was reduced in the case of automatic adjustment.

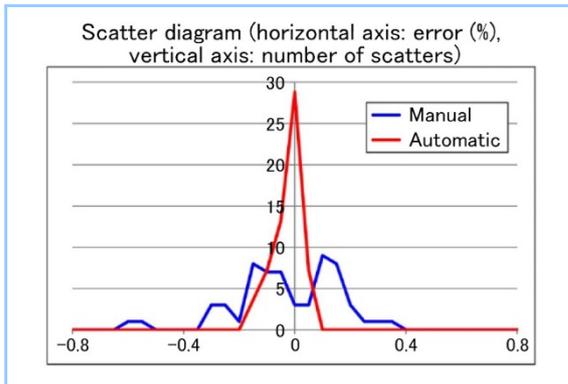


Figure 1 Scatter diagram

3. Output function of dynamic characteristic test record

As a result of automatic adjustment, the record of behavior in the dynamic characteristics test sampled every 50 msec is automatically output and can be easily graphed using a dedicated tool. The operating time of the control valve and the excess amount (overshoot amount) of the control value (actual opening) with respect to the control target value (command) are also automatically calculated.

Figure 2 below is a sample graph output.

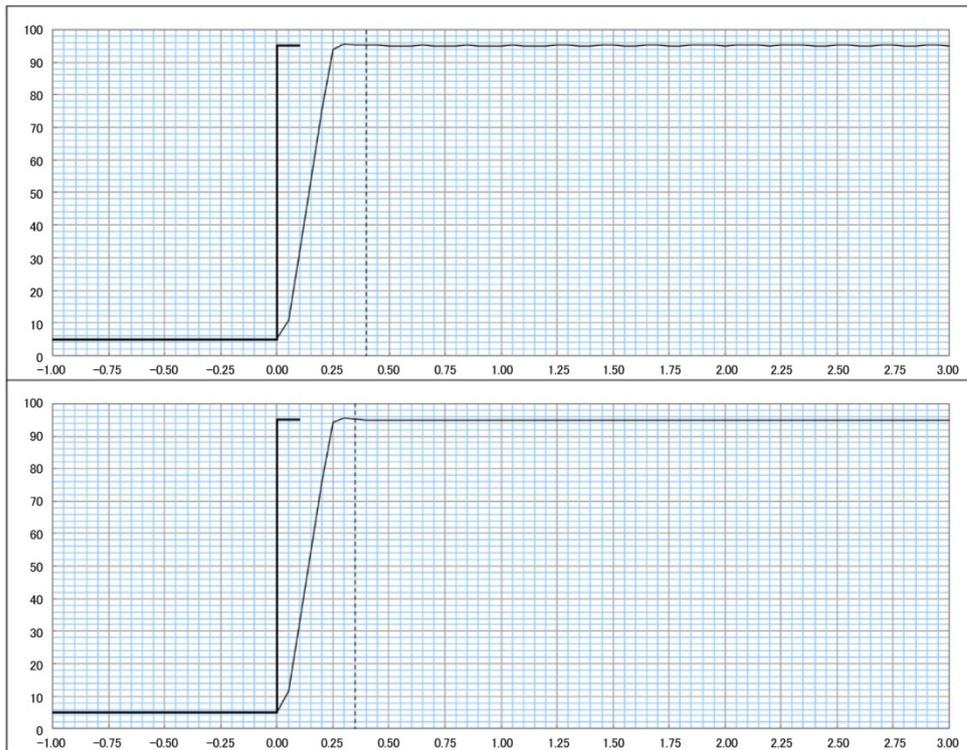


Figure 2 Graph of dynamic characteristic test results

4. Future development

The application of this system is being promoted mainly in newly constructed plants. We have also been working on the expansion of future application destinations and functions of this system, including at plants that have already been delivered and are in operation.