Design of interactive control system for industrial boiler

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Abstract

With the rapid development of modern industry, industrial boiler control system can improve the thermal efficiency of boilers, which has great application value for saving coal consumption. With the PLC of Siemens S7-200 system as the control core of hardware, the design of man-machine interface of industrial boiler process interactive control system is completed by Kingview software. The interactive control system of industrial boiler based on configuration software realizes real-time query of object attribute information and simulation operation of process flow. The system can effectively improve the efficiency of industrial boiler work, and provide technical support and decision support for optimizing and improving process.

Keywords

Industrial boiler;Programmable controller;Configuration software;Interactive control.

1. Introduction

With the continuous development of science and technology, programmable logic controller has been widely used in various control fields. [1] Industrial boilers are very important thermal power equipment. The operation efficiency of the boiler can be improved by automatic control of PLC. and reduce the discharge of pollutants, reduce the enormous waste of energy. Industrial boiler control system can greatly improve the efficiency of industrial boiler system by monitoring and managing the lower PLC through industrial computer.

Configuration technology is a new software development technology rising in the field of industrial automation. By using the tools in the configuration software package, the required application software can be developed through hardware configuration, data configuration, picture configuration and so on. It has the functions of remote monitoring, data acquisition, data analysis, process control and so on. PLC has the advantages of two simple development, long development cycle, strong versatility and high reliability. This paper adopts Siemens PLC and Kingview software to realize automatic control and status monitoring of boiler industrial process.

2. Design of Industrial Boiler Control System Based on PLC

2.1 I/O Allocation of PLC for Industrial Boilers.

The control system mainly includes peripheral control program section, internal circulation temperature program section, blower control program section, analog to digital conversion section and digital analog control section. The input and output points of the system include boiler pressure, boiler temperature, internal circulating temperature, boiler water level, blower frequency and internal circulating pump frequency unit. The specific I / O distribution is shown in Table 1.

Table 1 I/O Distribution Diagram

Drawing mark	PLC address	Functional nnotation
SA1	I0.1	Manual control switch for coal feeding
SA2	I0.2	Manual control switch for discharging coal cinder
SA3	I0.3	Manual control switch for guiding wind
……	……	……
KM1	Q0.0	Control of coal supply KM1
KM2	Q0.1	Discharge cinder control
KM2	Q0.2	Induced draft fan control KM3
……	……	……

2.2 Process Flow of Industrial Boiler.

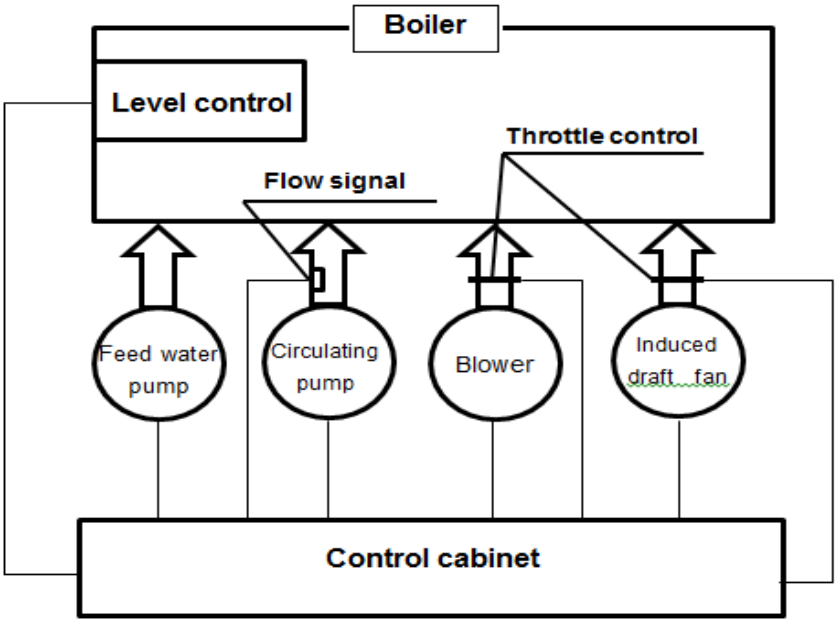

Fig. 1 The block diagram of boiler control system

When the system detects that the start-up conditions meet, the boiler automatically ignites. The block diagram of boiler control system is shown in Fig.1. The main contents include fan-water pump start-up, flap opening to the maximum pre-sweep, the establishment of wind pressure detection, pre-sweep end and wind pressure establishment. During the preignition process, close the small damper and turn on the ignition transformer to ignite the boiler in advance. A few seconds later, light oil solenoid valve is lit. At the same time, the fuel solenoid valve is opened to make the fuel head work. The flame detector detects the transfer. After the flame is detected, the fuel changes from light oil to heavy oil. At this point, the fuel will be burned with low flame to reheat the furnace. After a period of time, the ignition timing control process ends and the steam pressure is automatically controlled. The duration of pre-sweeping air is 60s (0-60s), the delay time of pre-ignition is 3S (67-70s), the light oil solenoid valve and light oil pump are powered off at 86s, and then the boiler is heated automatically. The time sequence is 95s, and the ignition process ends. The fluctuation of fuel supply and the change of steam load are the main external factors that affect steam pressure. Simple control schemes can be used to control the steam pressure by adjusting the amount of fuel in the case of small fuel fluctuations or low economic requirements. Because the fuel quantity of this control mode changes with the steam load, it is regarded as the initiative and the air supply as the follower. In order to meet the requirements of combustion adequacy and economy, if the steam load suddenly decreases and the pressure increases, the fuel consumption can be reduced first and then the air consumption can be reduced by using the low value selector, thus avoiding the waste of fuel. In

addition, if the load of steam increases and the pressure decreases, the high value selector can be used to increase the air supply first, and then increase the amount of fuel, so that the combustion is more fully.

3. Design and Implementation of Monitoring System Based on Kingview

Kingview 6.55 can be used in the PLC virtual experiment platform to monitor the dynamic process of the experiment through computer animation, which makes it intuitive, flexible and participatory. Configuration software is a graphical object-oriented, window-based engineering tool used to control the design, configuration and implementation of control strategies in processor control execution environment and application control environment, which is used for hardware configurations such as networks, I/O modules, controllers, field devices, and program configurations for all continuous, logical, motor-controlled, sequential and advanced control functions. Dynamic display can be generated quickly by mouse click configuration. The system also provides a graphics library containing general facilities of the factory, such as containers, pipes, valves, tanks, motors, etc. to help users further speed up graphics design. In addition, for some similar pictures that are used in many places, the configuration time can be reduced by using the function of template pictures, and the function of graphical pictures can be significantly enhanced by using scripting programs. For example, high-speed animation, tooltips, control station functions can be completed through script programs. According to the needs of the project, the login interface, parameter setting interface and operation interface are mainly set up. The control interface design of boiler control system is shown in Fig. 2.

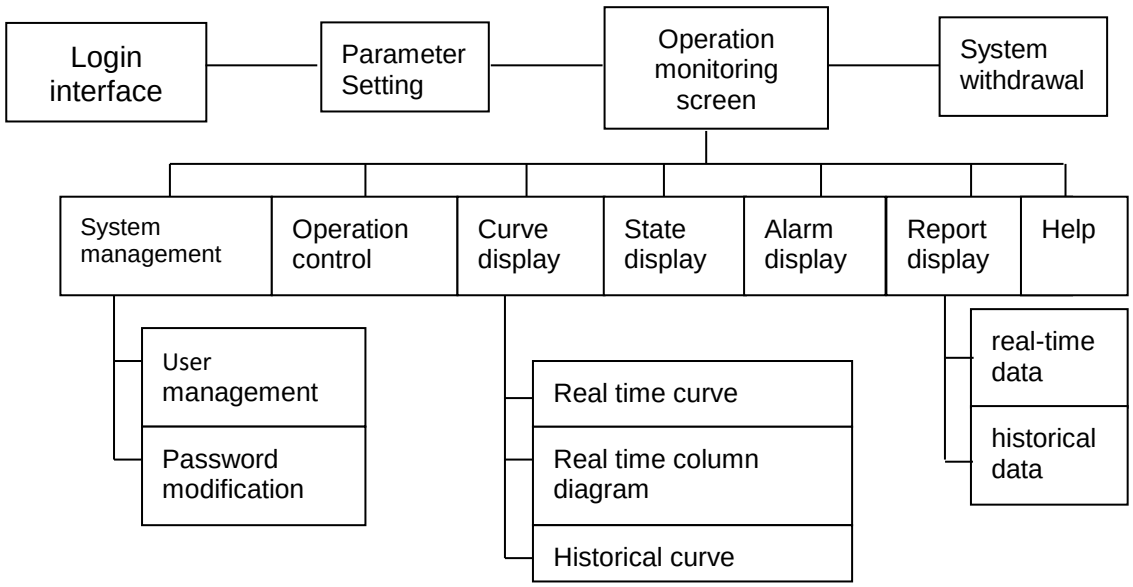

Fig. 2 The control interface design of boiler control system

4. Comunication setup and Implementation

The upper computer is equipped with Kingview 6.55 and Siemens PLC programming software V4.0 STEP 7 MicroWIN SP9. The lower computer adopts Siemens S7-200 PLC. The communication module is the communication bridge between PLC and PC virtual equipment. The information exchange is completed by RS-232 serial communication. [2] Configuration software communicates through serial port number COM1 and PLC, and monitor the state of all the memory, controller and I / O interface of PLC, and transfer them to the computer in the form of variable values for use and processing by the upper computer.

RS-232C is a standardized interface announced by the Electronic Industry Association (EIA) in 1962. It adopts bit-by-bit serial mode, and the baud rate is set at 19200 bps, 9600 bps, 4800 bps, 2400 bps,

1200 bps, 600 bps, 300 bps, etc. It is simple and convenient to use directly on occasions where the communication distance is close and the baud rate is not very high. In the industrial boiler interactive control system, because of the close communication distance and the low baud rate requirement, the communication port of Siemens series is RS-232C. Therefore, the communication between configuration software and PLC adopts serial communication mode, and the interface adopts RS-232C. The wiring diagram of the 9 core RS232C interface between PC and SIEMENS PLC is shown in Fig.3.

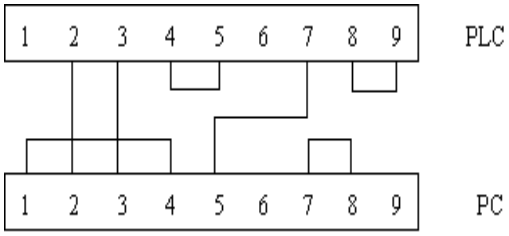

Fig. 3 Wiring diagram of 9 cores RS232C between PC and PLC

In serial communication, asynchronous communication is adopted. In asynchronous serial communication, each character data sent and received is composed of four parts in sequence: starting bit, data bit, parity bit, stop bit. If both sides can receive and transmit data normally, they must have the same data sending and receiving regulations, that is, baud rate, start bit, data bit, parity check bit, stop bit and so on must be strictly the same [3-4]. Through PLC programming software to read PLC communication parameters: baud rate 19200b/s, 8-bit data bit, 1-bit stop bit, odd check, station number and PLC module consistent, PLC programming software provides communication parameters for Kingview software. In the Kingview Project Manager, the communication settings are made by the configuration software. It should be noted that the device address should be consistent with the address set in the PLC communication parameter settings program to complete the configuration of PLC equipment, so as to realize the normal communication between COM port and PLC equipment.

5. Comunication setup and Implementation

In the boiler process control, because of the huge control system involved, the control loop involved, the control scheme is more complex, and there are more control channels involved in the boiler drum water level control, boiler combustion process control, superheated steam temperature control and other schemes, the system parameter setting and monitoring are rather tedious, and the reliability is low, which is not conducive to operation. In this paper, Siemens PLC control is used to make the control process easy to operate and monitor, so that the control system as far as possible to meet the control requirements. The use of decentralized control, centralized management, system screen monitoring alarm function is to ensure the safety and economy of production. The unified database is more convenient to achieve enterprise production optimization, and improve economic efficiency.

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